QUANTITATIVE MARKET RISK DISCLOSURE, BOND DEFAULT RISK AND THE COST OF DEBT: WHY VALUE AT RISK?

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[Δ] This paper is based, in part, on my dissertation completed at the University of Illinois at Urbana-Champaign. I wish to thank my committee members, Rashad Abdel-khalik, Anil Bera, Dennis Chambers, and Dave Ziebart for their invaluable comments. I am also grateful to Paul Beck, Donal Byard, Mark DeFond, George Pennacchi, Sara Reiter, Bill Ruland, Catherine Schrand, Joe Weintrop and seminar participants at Baruch College – CUNY, Santa Clara University, SUNY at Binghamton, the University of Illinois at Urbana-Champaign, the University of Southern California, and Vanderbilt University for helpful comments. All remaining errors are my own.

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ABSTRACT: This paper investigates the association of SEC-mandated quantitative market risk disclosure (SEC 1997) with bond default risk and firms' costs of issuing new debt. I examine such an association by partitioning the sample firms based on their current hedging performance. The results indicate that the first quantitative market risk disclosure is associated with bond default risk and cost of issuing debt differently, depending on the success in hedging. After controlling for other market risk factors, default risk and cost of debt both increase for speculative and/or ineffective hedging firms, but decrease for effective hedging firms. The results are robust to alternative measures of hedging and speculation. These findings highlight the importance of reporting the effectiveness of a firm's hedging strategy, as required under SFAS No. 133. The analyses also show that the reduction in bond default risk and cost of debt is observed more frequently with the value at risk format than with sensitivity analysis.

Keywords: *Market risk disclosure, cost of debt, hedging, value-at-risk.*

Data Availability: *Data are available from the sources identified in the paper.*

I. INTRODUCTION

Recently, the American Accounting Association and the Securities and Exchange Commission (SEC) have both called for an assessment of the usefulness of information provided by the quantitative market risk disclosures[1] mandated by the SEC's Financial Reporting Release No. 48 (henceforth, the SEC Release) (AAA 1999, 25-26). While critics argue that the difficulties in reliably measuring exposures to possible future outcomes may overshadow the usefulness of the quantitative market risk disclosures,[2] several studies have found evidence that these disclosures assist investors in evaluating firms' market risk (see, for example, Jorion 2002). Despite the documented usefulness of quantitative market risk disclosures, there is little direct evidence about the effect of these disclosures on firms' costs of capital. A reduction in a firm's cost of capital should; however, motivate financial statement preparers to voluntarily expand their market risk disclosures (Barth 1998).

This paper investigates the association between the mandated quantitative market risk disclosures and bond default risk and firms' costs of issuing new debt. Unlike previous market risk disclosure studies, I examine the usefulness of the quantitative market risk disclosures in the following ways: First, I study the association between these disclosures and bond market risk measures. Second, I identify the conditions where

[1]The SEC defines market risk as the risk of loss from adverse changes in market rates and prices, such as interest rates, foreign currency exchange rates, commodity prices, and similar market rate or price changes (e.g., equity prices). In reporting quantitative market risk, firms can choose one or more of the following alternatives: (1) tabular presentation (presenting sufficient information on fair value and contract terms of derivative portfolios), (2) sensitivity analysis (describing the potential gains or losses in derivative portfolios from some hypothetical adverse market movements) or (3) value at risk (henceforth, VaR, representing a summary statistical measure of potential loss in derivative portfolios from adverse market movement in related prices with a specified likelihood of occurrence during a specified period of time). See the SEC Release (1997) for a complete description of the quantitative market risk disclosure requirements.
[2] For example, the AICPA argues that sensitivity measures depend heavily on the assumptions, making a certified audit difficult (AICPA 1998).

firms' costs of debt are more likely to be associated with an increase of risk disclosures by partitioning the sample firms based on their current hedging performance. Third, I investigate the variation in the association between these disclosures and both firms' default risk and costs of debt across different risk disclosure formats.

An investigation of the relation between disclosure and cost of capital is in line with Verrecchia's point that this relation "should be of fundamental interest to accounting researchers in that it provides an economic basis for evaluating the costs and benefits of accounting information" (Verrecchia 1999, 272). Theoretical research suggests that a higher disclosure level leads to a lower cost of capital (Klein and Bawa 1976; Barry and Brown 1985; Diamond and Verrecchia 1991). However, extant empirical evidence on this issue has been mixed, and one cited reason for the mixed results is the difficulty of estimating cost of equity capital directly (Leuz and Verrecchia 2000). In contrast to this, bond market risk measures, such as bond ratings and bond risk premiums, have the advantage of being directly observable. Thus they facilitate a direct test on the relation between risk disclosures and the cost of debt capital.

Quantitative market risk disclosures provide forward-looking information that is more likely to help investors' and creditors' capital allocation decisions when there is high uncertainty about a firm's value and future returns. Such high uncertainty may exist when companies use derivatives to speculate or when they do not effectively hedge market risks. Identifying the importance of hedging and hedging effectiveness is particularly relevant to the requirements under Statement of Financial Accounting Standards (SFAS) No. 133, *Accounting for Derivative Instruments and Hedging Activities* (FASB 1998). Under this statement, companies that elect to apply hedge accounting are required to, at the inception of the hedge, identify the method to assess the effectiveness of the hedging derivatives and the approach to determine the ineffective part of the hedge. If disclosing firms' hedging performance could aid investors and creditors to evaluate firms' risk exposures, then SFAS No. 133 may encourage economically sound risk management practices.

To assess how firms' hedging performance affects the relation between risk disclosure and the cost of debt capital, I subdivide my sample firms and separate the successful hedging firms from the unsuccessful hedging firms and the speculative firms by using, among other proxies, changes in the disclosure firms' stock return volatility over the two-year pre-disclosure period. I then document whether these firms' new bond default risk and costs of issuing new debt change, relative to a control sample, around the first report of its quantitative market risk, controlling for other determinants of bond default risk and the cost of debt.

The results indicate that, taking the disclosure firms as a whole, quantitative market risk disclosures are not significantly associated with a company's cost of debt capital. However, bond default risk and cost of debt increase for speculative firms and decrease for effective hedging firms. To the extent that these results depend on the adequacy of the empirical proxy for hedging and speculation, these findings suggest that firms' current risk management strategy, hedging vs. non-hedging, and its effectiveness are important in understanding the relation between risk disclosures and the cost of debt capital. Thus, this paper extends the stream of literature on the relation between disclosure and the cost of capital (Botosan 1997; Sengupta 1998; Botosan and Plumlee 2002) by providing evidence that the relation between risk disclosures and the cost of debt capital differs depending on a firm's current risk management performance. In addition, this paper introduces Moody's cumulative average bond default rate as a proxy for bond default risk, thus avoiding the use of categorical bond ratings data to measure (continuous) bond default risk commonly employed in prior research (Reiter 1990).

I also find that the value at risk (VaR) disclosure is associated with a significantly more favorable (or less unfavorable) impact on a company's cost of debt capital compared to the sensitivity analysis disclosure.[3] However, firms using VaR disclosure format are generally larger, and have lower total risk compared to the firms that disclose using sensitivity analysis. It is possible that these systematic differences are related to firms' disclosure format decisions *and* to the observed differential impact on their costs of debt capital across the two disclosure formats, making it difficult to conclude that the disclosure format *causes* such differences.

The next section discusses the research hypotheses. Sample selection procedure and research design are presented in Section III. Section IV reports the empirical results and additional analyses. Section V summarizes and concludes this study.

II. HYPOTHESES DEVELOPMENT

Quantitative Market Risk Disclosure and the Cost of Debt Capital

If the bond market is informationally efficient, *prospective* information contained in the quantitative risk disclosures should assist bond market participants to evaluate the level of market risk to which a firm is exposed, resulting in a reduced compensation for

[3] Tabular disclosure is not considered because it does not directly state the likely impact of change in market rates or/and prices on fair values, earnings or cash flows of derivative portfolios. In addition, Roulstone (1999) reports that the tabular format is the least popular among the SEC registrants. Thornton

their estimation uncertainty regarding the "true" parameters of a firm's returns. The first hypothesis tests that after a company's quantitative market risk is disclosed, such a reduction in creditors' estimation uncertainty will take place, and a lower risk premium will be charged by creditors.

A large body of accounting literature discusses the theoretical implications of the relation between public disclosure and the cost of capital. Some researchers examine the reduction of non-diversifiable estimation risk associated with investors' assessments of the parameters of an asset's return or payoff distribution resulting from an expanded disclosure (see, e.g., Klein and Bawa 1976). Others focus on the reduction in the adverse-selection component of the bid-ask spread (Amihud and Mendelson 1986) or increased demand for securities trade (Diamond and Verrecchia 1991) after information is disclosed. Ball and Brown (1969) even argue that the existence of information is an absolute, but not relative, risk-reducing phenomenon. All these studies suggest that improved disclosure is related to a lower cost of capital. Consequently, firms that have established a reputation for high quality disclosures will be charged a relatively lower risk premium (Healy and Palepu 1995; Welker 1995; Botosan 1997; and Sengupta 1998).

Merton (1974) provides the direct theoretical support for the empirical relationship between the level of market risk, the uncertainty level of market risk and bond risk premiums. Given continuous trading and a flat term-structure of interest rates, Merton demonstrates that the bond risk premium is positively related to the variance of the return on firm value and the ratio of expected future payments on the bond to the value of the firm. His analysis implies that a lender's estimate of a bond issuer's default

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and Welker (2002) argue that tabular disclosure does not necessarily convey new or more precise information about firms' market risk.

risk--and therefore the risk premium required on the bond--changes with the level of uncertainty about a firm’s market risk exposure as well as the level of a firm’s market risk that affect a firm’s variance of return, along with other variables which indicate certain provisions of the indenture and firm-specific financial conditions.

While it is difficult to predict the direction of disclosure-induced market risk changes for any particular firm, analyses in Klein and Bawa (1976), Diamond and Verrecchia (1991) and other aforementioned studies indicate that, on average, investors will perceive the disclosure firms to be less risky because of the reduced uncertainty about the implications for firm value of changes in market rate/price, and thus the reduced uncertainty about the variance of returns for these firms. On the other hand, changes in firms’ derivative investment policies also influence the relative level of market risk of firms affected by the quantitative risk disclosure requirements. Facing stringent quantitative market risk disclosure rules, management is more likely to take on less risky derivative projects. Therefore, disclosures of a company's reduced-risk-taking derivative activities are likely to be associated with a reduction in the firm's perceived default risk.

The above arguments express the view of a reduced uncertainty regarding asset returns as a result of expanded disclosure. Such a reduction can occur either directly, through an improvement in the transparency of a firm's potential market risk, or indirectly, through a reduction in a firm’s incentives to take risk, thus lending support to the following hypothesis:

H_{1a}: The change in a firm's quantitative market risk disclosure (the first disclosure of quantitative market risk) is associated with a reduction of a firm's bond default risk.

H_{1b}: The change in a firm's quantitative market risk disclosure (the first disclosure of quantitative market risk) is associated with a reduction of a firm's cost of issuing debt.

Quantitative Market Risk Disclosure Format and the Cost of Debt Capital

Hypothesis 1 investigates the impact of aggregate quantitative market risk disclosures. Since the SEC Release allows companies to choose different quantitative disclosure formats, I also examine whether sensitivity analysis and VaR formats are associated with companies' bond default risk and costs of debt capital differently.

It is possible that information from the two different disclosure formats reflects different aspects of a firm's market risk exposures. Sensitivity analysis describes the magnitude, and sometimes the direction[4] of a firm’s market risk exposure to future possible exchange or interest rate changes. For example, IBM’s sensitivity analysis in its 1997 annual report indicates that if interest rates decrease by 10% from their levels at December 31, 1997, the fair market value of IBM’s financial instruments will decrease by $369 million. On the other hand, if interest rates increase by 10% from their levels at December 31, 1997, the fair market value of IBM’s financial instruments will be increased by $341 million. Similarly, the company’s foreign currency exposure indicates that a 10% change of all the foreign currency exchange rates against U.S. dollar from their levels at December 31, 1997 will lead to a $809 million decrease or a $981 million increase in the fair value of the company’s financial instruments.

However, IBM discloses only the aggregated interest rate exposures across all maturities and aggregated currency exposures across all foreign currencies. In making

[4] Firms often use phrases like “an adverse change in…” or “a change in…” to avoid releasing information on the direction of their risk exposures in their sensitivity analysis disclosures.

these sensitivity analysis disclosures, a firm has to assume the same percentage change in the prices of all foreign currencies or commodities. Since a ten percent change in the U.S. dollar/yen exchange rate is much more likely than a ten percent change in the U.S. dollar/Indian rupee, combining the gain or loss resulting from a ten percent change in the U.S. dollar/yen with that resulting from a hypothetical ten percent change in the U.S. dollar/Indian rupee yields an aggregated number that is too hypothetical to interpret.

The aggregated sensitivity numbers dampen the informativeness of the sensitivity analysis in terms of reducing the uncertainty of creditors' assessment of firm value. In spite of this, disclosing the proprietary information about the direction of a firm's market risk exposure may be undesirable for companies that face existing or prospective competitors, thus resulting in a possible adverse effect on a firm's perceived default risk and cost of debt.

Compared with sensitivity analysis, VaR expresses the potential loss in future earnings, fair value or cash flows from market movements in interest and exchange rates over a selected period of time, and with a selected likelihood of occurrence. A VaR disclosure is aimed at making the following statement: "We are *X%* sure that we will not lose more than *V* dollars in the next *N* days." The variable *V* is VaR. The calculation of VaR depends on the underlying assumptions about the probability distribution of the sensitivity of earnings, cash flow, and fair value to changes in market factors and two parameters: *X*, the confidence level, and *N*, the time period. Subject to the simplifying assumptions in calculating VaR, the information contained in VaR is concise and easily comprehensible.

For example, the Dow Chemical Co. 1997 disclosure indicates that at December

31, 1997, Dow is 95% sure that it will not lose more than $12 million as a result of its foreign currency exposures, $23 million from its interest rate exposures, and $3 million as a result of its equity exposures in the next one day period. Dow also indicates that the VaR methodology used in the disclosure is the variance/covariance statistical model.

Combined with knowledge of the likely changes in market rates or prices over the past year, investors can infer from the disclosed one-day loss the magnitude of the market risk exposure that Dow Chemical Co. is facing. Unlike sensitivity analysis that assumes independent movement in interest rate, exchange rate, or commodity price, the estimation of VaR incorporates both the variability and co-movement of the underlying interest rates, currency exchange rates, and commodity prices. For example, the variance-covariance matrix of the distribution of changes in the underlying market factors must be estimated in calculating VaR under the variance/covariance approach used by Dow. From this perspective, information provided by VaR portrays a more realistic situation of a firm's market risk exposures.[5]

However, the high aggregation of firm risk contained in a VaR disclosure conceals the direction of a firm's market risk exposure, reducing not only its informativeness for investors, but also the ability of competitors to infer the underlying risk management strategies that this company is taking.

Taken together, sensitivity analysis and VaR measure market risk differently and communicate different aspects of a firm's market risk exposure, thus they are expected to be associated with differential impacts on a company's bond default risk and cost of debt capital. This is summarized in Hypothesis 2 (stated in alternative form):

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[5] VaR's popularity among many different types of organizations has led proponents to believe that it will replace or at least complement other techniques such as asset/liability management and stress testing

H_{2a}: VaR disclosure is associated with a differential effect on bond default risk than sensitivity analysis disclosure.

H_{2b}: VaR disclosure is associated with a differential effect on the cost of issuing debt than sensitivity analysis disclosure.

III. RESEARCH DESIGN

Sample Selection

My initial sample consists of non-financial firms[6] that first reported sensitivity analysis and VaR market risk disclosures in their 1997, 1998 or 1999 10-K filings to the SEC. The SEC Release was implemented in two stages. During the first stage, banks and thrifts along with any other company whose market capitalization exceeded $2.5 billion on January 28, 1997 were required to comply with the SEC Release after June 15, 1997. Smaller firms had to implement the disclosure rules under the SEC Release after June 15, 1998. Accordingly, the sample is collected through searching the Compact Disclosure database from June 1997 to December 1999.[7]

A sample of 436 firms is obtained. Among them, 291 firms disclose using sensitivity analysis, 112 firms use VaR disclosure, and the remaining 33 firms disclose using both, as summarized in Table 1. Among the sample firms, the most commonly

(Marshall and Siegel 1997).

[6] Financial service firms are excluded since they are required to provide similar disclosures prior to the SEC Release and studies have been done to examine them (e.g., Schrand, 1997).

[7] I conduct a keyword search for every month from June 1997 to December 1999. The management discussion and analysis (MD&A) section as well as the footnotes to the annual reports are searched using the terms *derivative(s) instrument(s), market risk, value at risk, value-at-risk, var, sensitivity analysis*.

disclosed market risk is interest rate exposure (44.90%) and foreign currency exchange exposure (37.48%), and 29.58 percent of the disclosure firms are from the electric and gas industry.

Insert Table 1

Each firm is then cross-referenced against new bond issues[8] published in Moody's Bond Survey (Mergent Bond Record after 1999) in the years 1998-2000. If a firm has multiple new issues in a given year, only the first after-disclosure issue of that year is included. The yields 111 new bond issues with available bond ratings and bond yield data from Moody's and available accounting information from Compustat. After discarding firms that lack new bond information in the pre-disclosure period, firms that have missing daily returns data from 1999 CRSP, bonds issued by companies that disclose using both sensitivity analysis and VaR (for the format test), issues that have non-December-end fiscal years,[9] the final sample in testing hypothesis 1 on the association between risk disclosure and bond default risk and cost of debt consists of 59 disclosure firms.

The control sample used in testing hypothesis 1 is selected from those that issued a new bond both before and after the sample period but did not make a quantitative market risk disclosure in their 10-K filings. I delete financial institutions, firms lacking necessary Compustat and CRSP data, and firms that have no-December-ended fiscal

[8] Focusing on new bond issues is due to the fact that information on bond risk premium and default risk for new debt issues is current and easily available. While this reduces the sample size, problems with seasoned debt, such as ratings are not up-dated timely, infrequent trading with these bonds, etc., can be avoided.
[9] The purpose of deleting firms that have non-December-ended fiscal years is to make sure that stock return volatility changes for both the disclosure firms and the control firms are measured over identical two-year periods.

years, resulting in a final control sample of 58 firms.[10] Table 2 summarizes the sample selection procedure.

Insert Table 2

Dependent Variables

Bond default risk Previous studies have used bond ratings as a proxy for bond default risk (see, for example, Abdel-khalik et al. 1978). The problem with this is that ratings are categorical rather than continuous and ratings do not reflect an interval scale (Reiter 1990). To overcome this problem, I use Moody's statistical measures of the average cumulative default rates for each of its rating categories to proxy bond default risk (*DSK*). These average cumulative default rates are collected from Moody's "Statistical Tables of Default Rates and Recovery Estimates" published in 1999. They are calculated by Moody's default rate model based on the historical bond default information from 1983 to 1999. Since most of the sample bonds (more than 90%) have maturities of more than eight years, the average cumulative default rates for each rating categories after the eighth year are used.[11]

Cost of debt capital I use the yield to maturity of a new issue in year *t* over the daily average of the constant maturity yield on a U.S. Treasury bond of comparable maturity on the same issuance date[12] to proxy the cost of debt (*COD).*[13] Information on the

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[8] I check each control firm with the Compact Disclosure Database by the keywords of their company names and the terms *market risk, value at risk, sensitivity analysis,* and *tabular,* and find no matches. I then further read through the MD&A and footnotes of their annual reports, and find no quantitative market risk disclosures in their 10-K filings.

[11] I also use the average cumulative default rates for each of Moody's rating categories after the third and the fifth year and similar results are obtained.

[10] Pair matching using individual corporate bond is difficult because it is hard to find appropriate matches (Reiter 1990). Using the Treasury yield series overcomes this problem.

[11] Another measure of the cost of debt could be the total interest cost of the firm, after deducting underwriter discount. However, prior research on the relation between disclosure and the cost of debt has not found a material difference using this alternative measure (Sengupta 1998).

constant maturity yield on U.S. Treasury bonds to match the new issues is obtained from the DataStream Database. I match each industrial bond with the nearest maturity Treasury Bond available.

Testing Variables

Disclosure variable In testing hypothesis 1 on the association between market risk disclosure and cost of debt, I use a dummy variable (*DISC)* whose value is one for each disclosure firm and zero for the control firms.[14]

Format variable The *FORMAT* variable is used to separate the firms that made sensitivity analysis disclosures from those that made VaR disclosures. *FORMAT* equals one for VaR disclosure, and zero for sensitivity analysis disclosure.

Other Bond Risk Determinants

In addition to the use of a control sample, I also select a set of control variables that affect bond default risk (*DSK*) and cost of debt (*COD*) but are unrelated to the market risk disclosures. These variables indicate issuer-related information, issue characteristics and issue-related macroeconomic conditions that suggested by prior literature (Abdel-khalik et al. 1978; Reiter 1990; Sengupta 1998):

DE = Book value of long-term debt over total stockholder's equity value at the end of year *t*. Higher *DE* means higher leverage, and higher *DSK* and *COD*.

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[12] I choose not to use an inverse Mills ratio from a probit regression on the disclosure and the control firms to correct the self-selection bias of derivative usage because (1) the control sample contains firms that use derivatives but their derivatives positions are immaterial. Some companies even mention they use derivatives but don't disclose quantitative market risk for unknown reasons; deleting control firms that do not use derivatives reduces the sample size, and (2) the inclusion of other control variables, such as firm size, profitability, leverage, interest burden, book-to-market ratio (in sensitivity analysis) will reduce the self-selection bias.

PM = Profit margin of a firm, computed as net income before extraordinary items divided by net sales of year *t*. It is expected to be negatively related to *DSK* and *COD*.
TIER = Time interest earned ratio, equals the sum of income before extraordinary items and interest expense, divided by interest expense of year *t*. It is predicted to be negatively associated with *DSK* and *COD*.

LSIZE = Log of total market value of equity at the end of year *t*. Larger firms are expected to have lower *DSK* and *COD*.[15]

LMATU = Log of years to maturity. Longer maturity results in higher interest rate exposure. Hence, it is expected to be positively related to *DSK* and *COD*.

LISIZE = Log of issue size. The larger the size of the bond issued, the more frequently the bond is expected to be traded. *LISIZE* measures bond marketability, which is negatively related to bond default risk.

CALL = 1 for a callable bond, and 0 otherwise. Callable bond exposes bondholders to interest risk, which yields high *DSK* and *COD*.

CON = 1 for a convertible bond, and 0 otherwise. Other things being equal, a convertible bond results in lower *DSK* and *COD*.

SUB = 1 for a subordinate bond and 0 otherwise. Subordinate status is expected to be correlated with higher *DSK* and *COD*.

RPERM = Average yield on Moody's Aaa bonds for the month of issue less average yield on 30-year U.S. Treasury bond for the month of issue. This variable controls the time series variation of risk premiums over the business cycle, which has a positive association with cost of debt.

Econometric Specifications

The following cross-sectional regressions are performed to test hypothesis 1 on the association between the first quantitative market risk disclosure and changes in bond default risk and cost of debt from the pre-disclosure to the post-disclosure period:

$$\Delta DSK_i = \alpha + \beta_1 DISC_i + \beta_2 \Delta DE_i + \beta_3 \Delta PM_i + \beta_4 \Delta TIER_i + \beta_5 \Delta LSIZE_i + \beta_6 \Delta LMATU_i$$
$$+ \beta_7 \Delta LISIZE_i + \beta_8 \Delta CON_i + \beta_9 \Delta SUB_i + \beta_{10} \Delta CALL_i + \beta_{11} INDUSTRY_i$$

[13] I also use log of firm total assets at the end of year *t* to proxy firm size, similar results are obtained.

$$+b_{12}YEAR_i + e_i \quad (1)$$

$$DCOD_i = g + h_1DISC_i + h_2DDE_i + h_3DPM_i + h_4DTIER_i + h_5DLSIZE_i$$
$$+ h_6DLMATU_i + h_7DLISIZE_i + h_8DCON_i + h_9DSUB_i + h_{10}DCALL_i$$
$$+ h_{11}DRPERM_i + h_{12}INDUSTRY_i + h_{13}YEAR_i + m_i \quad (2)$$

where D = The relative change from the pre-disclosure to the post-disclosure period. For example, $DCOD_i = \frac{COD_{it+1} - COD_{it}}{COD_{it}}$. *DSUB (DCON, DCALL)* is a dummy variable which takes on the value of one if a new bond issued before disclosure *is not* a subordinate (convertible, callable) bond and the new bond issued after disclosure *is* subordinate (convertible, callable). It equals zero otherwise.[16] *INDUSTRY* is a vector of indicator variables for the industry groups identified in Panel C of Table 1. *YEAR* is a vector of indicator variables for 1997, 1998 and 1999.

I estimate the following two equations on the new bonds issued by the sample disclosure firms in year *t+1*, where *t* is the first year of disclosure, to examine the potential differential impact on bond default risk and cost of debt between the sensitivity analysis and the VaR disclosures:

$$DSK_{it+1} = a + b_1FORMAT_{it} + b_2DE_{it} + b_3PM_{it} + b_4TIER_{it} + b_5LSIZE_{it} +$$
$$b_6LMATU_{it+1} + b_7LISIZE_{it+1} + b_8CON_{it+1} + b_9SUB_{it+1} + b_{10}CALL_{it+1}$$
$$+ b_{11}INDUSTRY_{it} + b_{12}YEAR_{it} + e_{it+1} \quad (3)$$

$$COD_{it+1} = g + h_1FORMAT_{it} + h_2DE_{it} + h_3PM_{it} + h_4TIER_{it} + h_5LSIZE_{it} +$$
$$h_6LMATU_{it+1} + h_7LISIZE_{it+1} + h_8CON_{it+1} + h_9SUB_{it+1} + h_{10}CALL_{it+1} +$$

[14] I drop the dummy variables that equal ones if a new bond issued before disclosure *is* a subordinate (convertible, callable) bond and the new bond issued after disclosure *is not* subordinate (convertible, callable) and equal zeros otherwise, since they don't significantly explain the changes in bond default risk and cost of debt (except for changes in bond convertibility) and they reduce degrees of freedom. The signs

$$\eta_{11}RPERM_{it+1} + \eta_{12}INDUSTRY_{it} + \eta_{13}YEAR_{it} + \mu_{it+1} \quad (4)$$

Estimating equations (3) and (4) tests not only whether different disclosure formats have differential impacts on bond default risk and cost of debt, but also whether such differential impacts are beyond the information provided by other control variables.

Exploring the Effect of Hedging

Prior research on the relation between disclosure and the cost of capital focuses just on the disclosure effect. I argue that the underlying market conditions surrounding the disclosed items also impact the disclosure's effect on the cost of capital. With respect to the quantitative market risk disclosures, their associations with companies' costs of debt capital are expected to be different depending on whether firms' derivative programs result in high or low market risks. Sengupta (1998) shows that when there is high uncertainty about firm value, bond market participants tend to rely more heavily on companies' disclosures to assess firms' default risk. Therefore, forward-looking quantitative market risk disclosures are expected to be more useful when firms' derivative programs result in high market risk. This occurs when firms use derivatives to take on additional risks (speculate) (Jensen and Meckling 1976) or when they do not successfully hedge risks using derivatives (Bodnar, Hayt and Marston 1996). Since incentives to manage risk differ across hedging and speculative firms, and the effectiveness of hedging strategies varies across companies, the association between quantitative market risk disclosure and firms' default risk and the cost of issuing debt is expected to be different across both the successful and unsuccessful hedging firms as

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and significance of other variables are not affected by the exclusion of these variables.

well as the speculative firms.

To assess this, I divide the sample into two subsamples: hedging firms and speculative firms. Previous studies have used notional amounts of derivatives positions (Barton 2001) or a hedge ratio measured within a particular industry (Pincus and Rajgopal 2002) to proxy for hedging.[17] I choose not to use these measures because: (1) notional amounts only roughly measure the exposure from derivatives (Hentschel and Kothari 2001), (2) notional amounts cannot indicate the *relation* between the exposure of the derivatives and the exposure of the underlyings, and thus it cannot distinguish hedging and speculation, and (3) the disclosed quantitative market risk amounts are incomparable across firms/industries (Hodder et al. 2001), making it difficult to construct measures of hedging effectiveness using these quantitative disclosures. Following Guay (1999), I use total firm risk change from derivative usage to measure firms' hedging effectiveness (*DRISK*). As in Guay (1999), I measure total firm risk change as change in stock return volatility, calculated by the change in the annualized standard deviation of daily stock returns over the two-year period prior to the first disclosure year. The argument in support of this empirical proxy is that risk management theory has, in general, addressed hedging/speculation in terms of changes in aggregate firm risk/return volatility (e.g., see Smith and Stulz 1985; Hentschel and Kothari 2001).[18] Since

[17] Other studies have relied on survey data or annual financial statements where firms identify themselves as hedgers. One problem with this is that these firms could potentially use derivatives and other financial instruments for speculation and not for hedging (Mian 1996).

[18] Using changes in total firm risk to measure the effectiveness of hedging introduces noise because derivatives are only one component of firms' risk management tools. When firms use other tools to manage total firm risk (e.g., business operations), the empirical tests may understate the role of derivative hedging effectiveness in affecting the association between derivative market risk disclosures and bond default risk. For example, the speculative sample may potentially be biased toward firms that are ineffective in other ways of risk management, hence reducing the likelihood that derivative risk disclosures will have an impact on bond default risk and cost of debt. Similarly, the hedging sample will also likely

unsuccessful hedging firms and speculative firms are associated with a potentially different post-hedging market risk position than the successful hedging firms, I classify the first two into the same group as the speculative subsample. Therefore, if the change in total firm risk (*DRISK*) is *greater than* zero,[19] the firm is classified into the speculative sample (*SPE*). Otherwise, it is put into the hedging sample (*HEG*). Such a specification allows me to investigate the interactions of risk, risk disclosure, and the cost of debt capital.

I use the following cross-sectional regressions to assess the effect of hedging and speculation on the relation between risk disclosures and bond default risk and cost of debt:

$$DDSK_i = a + b_1 DH_i + b_2 DS_i + b_3 NDH_i + b_4 DDE_i + b_5 DPM_i + b_6 DTIER_i + b_7 DLSIZE_i + b_8 DLMATU_i + b_9 DLISIZE_i + b_{10} DCON_i + b_{11} DSUB_i + b_{12} DCALL_i + b_{13} INDUSTRY_i + b_{14} YEAR_i + e_i \qquad (5)$$

$$DCOD_i = g + h_1 DH_i + h_2 DS_i + h_3 NDH_i + h_4 DDE_i + h_5 DPM_i + h_6 DTIER_i + h_7 DLSIZE_i + h_8 DLMATU_i + h_9 DLISIZE_i + h_{10} DCON_i + h_{11} DSUB_i + h_{12} DCALL_i + h_{13} DRPERM_i + h_{14} INDUSTRY_i + h_{15} YEAR_i + m_i \qquad (6)$$

where variables *DH, DS and NDH* stand for firms that disclose and hedge, firms that disclose and speculate, and firms that hedge but do not disclose, respectively.

contain firms that are effective in other risk management tools, and this may also reduce the power of the tests.

[19] Two firms out of the sample have experienced no changes in their stock return volatility over the two-year pre-disclosure period. Deleting the two firms does not affect the regression results.

IV. EMPIRICAL RESULTS

Descriptive Statistics

Descriptive statistics for the variables used in testing the association between quantitative market risk disclosure and bond default risk and cost of debt are presented in Table 4 and 5. For ease of reference, variable definitions are summarized in Table 3.

Insert Table 3 and 4

Table 4 presents means, medians, and standard deviations for the variables of the firms in the *HEG* and the *SPE* sub-samples. The mean and median of the percentage change in cost of debt (*COD*) and bond default risk (*DSK*) are significantly smaller among the *HEG* firms than among the *SPE* firms. The classification variable for the *HEG* and *SPE* firms, *DRISK*, is significantly different, with averages of –0.002 in the *HEG* sample and 0.004 in the *SPE* sample. This is consistent with the evidence in Guay (1999) that hedging firms experience decreases in stock return volatility associated with their derivative programs. Changes in firm size are larger for the *HEG* firms than for the *SPE* firms, supporting the idea that there are economies of scale in hedging (Nance et al. 1993; Mian 1996). Other control variables are not significantly different (except for changes in bond maturity), suggesting that there is no systematic difference in terms of changes in bond issue characteristics, in bond issuers' financial conditions, and in the macroeconomic conditions around bond issuance periods across the *HEG* and the *SPE* sub-samples.

Insert Table 5

Tests on mean and median differences of the variables for the disclosure and control firms across the *HEG* and *SPE* sub-samples are reported in Table 5. Such tests provide univariate evidence about the interaction between risk, risk disclosure, and the cost of debt capital. For the *HEG* sample, disclosure firms have a significantly smaller increase in *COD*, a larger but insignificant decrease in *DSK* compared to the control firms. In the *SPE* sample, disclosure firms have a significantly larger increase in both *COD* and *DSK* from the pre- to the post-disclosure period. Without controlling for other variables, the evidence suggests that disclosure on increased market risk exposures (the *SPE* disclosure firms) is associated with an increase in the cost of debt capital, while disclosure on decreased market risk exposures (the *HEG* disclosure firms) is associated with a reduction in the cost of debt capital, compared with the non-disclosure firms.

Regression Results

Table 6 reports the results from OLS regression of the change in bond default risk and cost of debt on the disclosure indicator variable (*DISC*) and on the control variables (equations (1) and (2)). The third column of Table 6 provides the regression results for the bond default risk equation. As can be seen from the table, changes in bond default risk are not significantly affected by market risk disclosure. The sign of the coefficient on the *DISC* variable is positive, indicating that overall, such disclosures affect firms' bond default risk unfavorably. The positive relation between the *DISC* variable and changes in bond default risk is somewhat surprising given that the research hypothesis and theory have suggested that a greater level of disclosure is associated with a lower cost of debt capital.[20]

The results also indicate that changes in firms' debt-to-equity ratios and profit

[20] This is also consistent with the fact that very few firms have voluntarily made these quantitative market risk disclosures under SFAS No. 119, where these disclosures are encouraged (Bushee 1997).

margins are related to changes in bond default risk in the expected directions. Other variables such as changes in the subordinate status and convertibility of the bond and changes in bond maturity also significantly explain the change in bond default risk with predicted signs.

Insert Table 6

The fourth column of Table 6 reports the OLS estimation results on the cost of debt equation. Similar to the default risk equation, the coefficient on *DISC* is positive, but insignificant. Other variables, such as changes in bond subordinate status, in bond call provision and in bond maturity have significant explanatory power for changes in the cost of debt capital around the sample period with the expected signs. Changes in firm leverage (*DDE*), in profit margins (*DPM)*, and in interest earned ratio (*DTIER)* are also significant. This is consistent with prior findings that greater leverage, lower profit margins and lower interest earned ratio will lead to a higher cost of debt (Reiter 1990).

In sum, the results suggest that, for the sample as a whole, the disclosure of quantitative market risk is not significantly associated with changes in companies' bond default risk and cost of debt capital. This might be subject to several interpretations. First, the market risk disclosure information may be too complicated for the bond market to process. Second, the information may have already been released to the market prior to the disclosure regulation becoming effective. Third, due to the institutional features of the bond market,[21] new information such as market risk disclosures may not be immediately reflected in bond market risk measures, and finally the effects of disclosure among the sub-sample firms may have cancelled out with each other.

Insert Table 7

Table 7 reports the results of estimating changes in bond default risk and cost of debt on the disclosure variable and on the control variables after partitioning the sample firms into hedging and speculative sub-samples (equations (5) and (6)). The third column provides the regression results for the bond default risk equation, and the fourth column reports the results for the cost of debt equation. As can be seen from both regression results, changes in bond default risk and cost of debt are significantly associated with the market risk disclosures when firms' current hedging performances are considered. The disclosure and hedge variable (*DH*) is significantly negative in both equations, suggesting that quantitative market risk disclosure is associated with a favorable effect on firms' bond default risk and the cost of debt capital when firms effectively hedge their market risk. Similarly, the coefficient on the disclosure and speculating variable (*DS*) is persistently significantly positive across the two equations, indicating that such disclosures affect firms' bond default risk and cost of debt unfavorably if firms use derivatives to speculate or simply do not effectively hedge their risk exposures to adverse market movements. Table 7 also shows that for the non-disclosure firms, effective hedging does not significantly affect a firm's bond default risk and cost of issuing new debt. These findings are consistent with the view that firms that use derivatives effectively (ineffectively) and for (not for) sound economic reasons will benefit (not benefit) from providing investors with quantitative information about the risks in their derivative activities (Barth 1998).

Results in Table 7 also suggest that changes in bond subordinate status and

[21] Most of the bond trades take place on the OTC market among institutional investors. Bond trades among exchange-listed issues account for only a small amount of the total bond trading volume, and these bonds

maturity, changes in firm leverage variable, and changes in profitability variable are significant in explaining changes in bond default risk and the cost of debt capital around the sample period with expected signs, consistent with findings in prior studies.

Similar to the results reported in Table 6, the positive relations between the *DS* variable and changes in bond default risk and cost of debt are at odds with the research hypothesis and theory, which suggests that a greater level of disclosure is associated with a lower cost of debt capital.

One possible explanation for the positive relation between disclosure and cost of capital is that increased public disclosure results in a lower cost for investors' private information acquisition activities, which reduces investors' liquid needs. This in turn translates into a less liquid market and a higher cost of capital (Barth et al. 1999). Another explanation is that mandatory disclosure can increase expected trading profits for the insiders, thereby making the noninsiders worse off by widening their trading bid-ask spread (Fishman and Hagerty 1995). Furthermore, the presence of higher uncertainty due to bad risk management or speculative risk taking behavior increases the potential influences of such identified adverse effects on market liquidity (Cordella and Yeyati 1998; Zhang 2000).

Such an unfavorable effect may also occur due to investors' misperceptions about the level of uncertainty of a company's asset returns. Numerous studies support the idea that managers have strong incentives to manipulate or simply withhold unfavorable information from the market (Gordon 1962; Benston 1973), which lowers the perceived level of uncertainties for these firms. Compliance with a disclosure regulation such as the SEC Release forces companies to reveal risks that previously may have been obscured,

are exchanged among individual investors.

manipulated, or even withheld, resulting in an upward revision in investors' expectations about the uncertainty levels of these firms, and raising the expected excess returns for future investments (Jorgensen and Kirschenheiter 2002).

Sensitivity Analysis

If misclassification exists between the hedging and the speculating sample, the predictive power of the empirical model may be small. In fact, the insignificance of the coefficients on the hedge but no disclosure (*NDH*) variable and on other control variables in the OLS estimations in Table 7 may be due to the use of changes in stock return volatility as a crude measure to identify hedging and speculative firms.[22] In order to test the robustness of my results to the definition of hedging used, I experiment with some other measures of hedging effectiveness.

Merton (1971) indicates that the volatility of a firm's operations determines the price of risky bonds. One way of capturing a firm's riskiness of operations is implied asset volatility, which is calculated by multiplying a firm's equity return volatility at time *t* by its ratio of market value of equity to total assets at time *t*. I redo the analyses, classifying firms by increases or decreases in their implied asset volatility over the two-year pre-disclosure period. This classification process yields 31 hedging firms and 86 speculative firms. The results are qualitatively the same as the results based on the previous classification of hedging.

[22] The existence of multicollinearity in the explanatory variables may potentially contribute to the insignificant results. To assess this, I examine the VIF (variance inflation factor) for each variable. The VIF for the *NDH* variable in estimating equations (5) and (6) is 2.587 and 2.166, respectively. It is greater than three for four other explanatory variables in each regression, which indicates a potential multicollinearity problem. To address this, I delete the four independent variables that have the largest VIFs in equations (5) and (6) and rerun the regression. The *NDH* variable is not significant at conventional levels. The adjusted

I also reclassify firms by changes in their Book-to-Market ratios and Price-to-Earnings ratios over the sample period based on the findings of Fama and French (1992). In each case, the *DS* variable is significantly positive at the 10% level in estimating bond default risk and the cost of debt capital. The *DH* variable is mostly significant in estimating bond default risk and cost of debt, which suggests that the results are robust to the hedging/speculating classification variable.[23] Finally, I add changes in Book-to-Market ratio in the regressions to control for firms' growth opportunities that may affect firms' derivative usage. The inclusion of this variable doesn't affect the signs and significance of the *DS, DH,* and *NDH* variables.

Quantitative Market Risk Disclosure Format and a Firm's Bond Default Risk and the Cost of Issuing New Debt

For comparison purposes, bond default risk (*DSK*) is also measured by a categorical variable that captures Moody's bond ratings. DSK_{it} is coded into 1 through 6 to represent the ratings of Aaa, Aa, A, Baa, Ba, and B for a particular individual bond over time *t*. Accordingly, equation (3) of examining the differential impact between sensitivity analysis and VaR disclosures on bond default risk is estimated using both OLS and ordered logistic regression procedures. The regression results are reported in the third and fourth columns of Table 8, and are qualitatively the same under both estimation methods.[24] The adjusted R^2 of the OLS estimation is 80.76%. The likelihood ratio test

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R^2s are only marginally increased compared with the regression results when all the independent variables are included. Therefore, multicollinearity does not seem to be a serious problem in this study.

[23] I also rank the *DRISK* variable across the sample firms and classify the firms into hedging and speculative based on below and above-median *DRISK*, and the results are qualitatively the same.

[24] A few studies comparing the performance of the linear probability model and the probit model show that the conceptually superior probit performs no better than the simplistic linear probability model in terms of

for the logit model is 96.029, and is significant, indicating that the model predicts bond default risk reasonably well. The disclosure format indicator variable (*FORMAT*) is significantly negative under both estimation methods. Its coefficient estimator is –0.030 in the logit regression, which implies that using the VaR disclosure format can increase the probability that a company's bond ratings will be upgraded by 3% relative to using sensitivity analysis disclosure.

Insert Table 8

The results of regressing cost of debt on the format variable and on the control variables are reported in the fifth column of Table 8. The adjusted R^2 of this model is 47.69%, which is comparable with prior studies (Sengupta 1998). The coefficient on *FORMAT* is significantly negative at -0.042, indicating that disclosure using the VaR format of market risk can save a company up to 4.2% of its effective interest cost compared with disclosing using the sensitivity analysis format. Taken together, the results indicate that VaR disclosure of quantitative market risk is associated with a more favorable (or a less unfavorable) effect on bond default risk and cost of debt compared with the sensitivity analysis disclosure.

Since the SEC Release gives companies a lot of flexibility in terms of the format they can choose to make quantitative market risk disclosures, a firm's choice on the format of these disclosures is largely discretionary in nature. As a result, the analyses reported in Table 8 may suffer from a self-selection bias. To address this problem, I provide summary statistics on the relative size, leverage, and other market risk factors about the VaR and the sensitivity analysis disclosure firms in Table 9.

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rating predictions, especially when a small sample (around 100) of new debt issues is used (Kaplan and Urwitz 1979; Noreen 1988).

Insert Table 9

The results in Table 9 are consistent with VaR disclosure firms being generally larger, and having lower equity risk than the sensitivity analysis disclosure firms. The average size of the log of market value of equity for the VaR firms is 9.135, compared to 8.637 of the sensitivity analysis firms, and the difference is significant at the 10% level. The average total firm risk for VaR firms is 0.018 and 0.021 for the sensitivity analysis firms, and the difference is statistically significant at the 10% level. These findings indicate that firms that disclose in a VaR format are different along the size and equity risk dimensions from the firms that use a sensitivity analysis format. To test the robustness of my results to the equity risk factor, I rerun the analysis in Table 9 controlling for the total risk variable. The coefficient on the *FORMAT* variable is negative and significant in both the bond default risk and the cost of debt estimations. The total risk variable is significantly positive in the logit model bond default risk equation and is insignificant in other regression models. The analyses support that the format of disclosure still makes a difference even after the equity risk factor is controlled.

V. CONCLUSIONS

In this study, I examine whether companies' bond default risk and costs of debt capital are associated with the expanded risk disclosures mandated by the SEC 1997 Release. This study utilizes the unique research setting where the first disclosures of quantitative market risk for non-financial firms are available upon the adoption of the SEC Release.

The results indicate that quantitative market risk disclosures are not significantly associated with a company's bond default risk and its cost of debt capital for the sample as a whole, however, bond default risk and the cost of debt capital increase for the ineffective hedging and speculative firms and decrease for the effective hedging firms. I also find a significantly more favorable (or less unfavorable) impact on a company's bond default risk and the cost of debt capital with the VaR disclosure format compared to the sensitivity analysis disclosure, even after controlling for the fact that firms using VaR disclosure format are generally larger and with lower total risk compared to those that disclose using sensitivity analysis.

However, the instability of firms' debt financing policies makes it difficult to conduct analyses on new issues across different testing periods, and ultimately makes it difficult to establish causality with such an association test.[25] Finally, due to the lack of comparability of the reported market risk numbers across firms, this study does not use the quantitative risk information in market risk disclosures. If the disclosed quantitative information such as VaR in fair value or sensitivity analysis in fair value is in fact heavily priced in bond default risk and risk premium, the results of this study understate the role of quantitative market risk disclosures. Subject to these caveats, this paper makes a contribution to prior literature by identifying the contexts where disclosures will be more useful to market participants. In this study, I find derivative market risk disclosures are associated with changes in bond market risk measures by partitioning firms on their current hedging performance argued to potentially affect the usefulness of market risk disclosures. The specification used in this paper is also applicable to other contexts that

[25] To overcome this problem, I also examine risk premium changes on seasoned bonds of the affected companies prior to, during, and subsequent to the market risk disclosures (Guo 2002). The evidence is generally consistent with a change in average bond risk premium caused by quantitative market risk disclosures, especially for the speculative firms.

examine the relation between disclosure and the cost of capital. Finally, given that little accounting research to date is available to help practitioners and academics measure the underlying risk and uncertainty of financial derivatives, this paper hopes to motivate further research into the current trend toward developing and understanding risk disclosures as an important step to improving financial reporting.

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TABLE 1: Summary Distribution of the Initial Sample[a]

	1997	1998	1999	Total	Percentage
Panel A: Distribution by Format of Disclosure					
Sensitivity Analysis	89	175	27	291	66.74%
VaR	70	35	7	112	25.69%
Both	17	12	4	33	7.57%
Total	176	222	38	436	100%
Panel B: Distribution by Type of Instrument					
Interest Rate	142	153	26	321	44.90%
Foreign Exchange	126	127	15	268	37.48%
Commodity	60	56	10	126	17.62%
Total	328	336	51	715[b]	100%
Panel C: Distribution by Type of Business					
Electric & Gas (49)	80	48	1	129	29.58%
Chemical (28)	19	12	3	34	7.80%
Machinery (35)	11	18	5	34	7.80%
Communication (48)	13	18	2	33	7.57%
Electronic Equip.(36)	6	15	4	25	5.73%
Business Service (73)	8	13	3	24	5.51%
Instruments (38)	7	11	3	21	4.82%
Others	32	87	17	136	31.19%
Total	176	222	38	436	100%

a. The initial sample is collected by searching the Compact Disclosure Database from June 1997 to December 1999.

b. Since some firms report more than one type of derivative instrument, the total number of disclosure firms is greater than that in Panel A.

TABLE 2: Sample Selection Criteria for Firms Issuing New Bonds

Panel A: Disclosure Firms

Firms with sensitivity analysis and value-at risk disclosure (June 1997-December 1999)	436
<u>*Less*</u>	
Missing matching new bond issue after the disclosure	(306)
Missing information on Compustat	(19)
Disclosure with both VaR and Sensitivity Analysis	(5)
With non-December-end fiscal years	(4)
Final Sample in the Format Test	102
<u>*Less*</u>	
Missing matching new bond issue prior to the disclosure year	(39)
Missing information on CRSP	(8)
Final Sample in the Change Test	59[b]

Panel B: Control Firms

Control firms identified from Moody's Bond Survey	168
<u>*Less*</u>	
Financial institutions	(72)
Missing Compustat and CRSP information	(34)
With non-December-end fiscal years	(4)
Final Control Sample in the Change Test	58
Final Total Sample in the Change Test	117

a. Four firms that report both VaR and sensitivity analysis and have new bonds both before and after disclosure are added back to the sample.

TABLE 3: Variable Definitions

Variable	Definition
DSK*	Average cumulative default rate for Moody's bong ratings
COD	Bond yield to maturity minus daily average of the constant maturity yield on U.S. Treasury bond of comparable maturity on the issuance date
RISK	Annualized standard deviation of daily stock returns
DE	The book value of long-term debt over total stockholder's equity value at the end of year t
PM	Profit margin of a firm, represented by net income before extraordinary items divided by net sales of year *t*
TIER	Time interest earned ratio, calculated by the sum of income before extraordinary items and interest expense, divided by interest expense of year *t*
LSIZE	Log of total market value of equity at the end of year *t* (in millions of dollars)
LMATU	Log of years to maturity
LISIZE	Log of issue size (in millions of dollars.)
CALL	Indicator variable set equal to 1 for callable bonds and 0 otherwise
CON	Indicator variable set equal to 1 for convertible bonds and 0 otherwise
SUB	Indicator variable set equal to 1 for subordinate bonds and 0 otherwise
RPERM	Average yield on Moody's Aaa bonds for the month of issue less average yield on 30-year U.S. Treasury bonds for the month of issue
DISC	Dummy variable set equal to 1 for disclosure firms and 0 for non-disclosure firms
INDUSTRY	Vector of indicator variables for each of the industry group in Panel C of Table 1
YEAR	Vector of indicator variables for 1997, 1998, 1999

* Percentage change in these variables from year *t* to year *t+1* is represented by adding a "Δ" to that variable. *DSUB (DCON, DCALL)* is a dummy variable which takes on the value of one if a new bond issued before disclosure is not a subordinate (convertible, callable) bond while the new bond issued after disclosure is subordinate (convertible, callable), it equals zero otherwise.

TABLE 4: Descriptive Statistics for the Hedging (HEG) and the Speculative (SPE) Sub-samples

Variables[a]		HEG[b]	SPE[b]	Difference	*P*-value
ΔCOD	Mean	0.681	1.147	-0.466	0.100[c]*
	Median	0.441	0.946	-0.505	0.104[d]
	Std. Dev.	0.623	1.356		
ΔDSK	Mean	-0.039	0.220	-0.259	0.027**
	Median	-0.045	0.131	-0.176	0.061*
	Std. Dev.	0.199	0.331		
ΔDE	Mean	0.157	1.398	-1.241	0.342
	Median	0.137	1.285	-1.147	0.178
	Std. Dev.	0.387	12.636		
ΔPM	Mean	-0.319	-1.530	1.211	0.158
	Median	-0.234	-0.137	-0.097	0.349
	Std. Dev.	0.587	8.216		
ΔTIER	Mean	-0.200	-0.292	0.092	0.437
	Median	-0.128	-0.040	-0.088	0.164
	Std. Dev.	0.434	2.520		
ΔLMATU	Mean	0.026	0.228	-0.202	0.007***
	Median	0	0.238	-0.238	0.008***
	Std. Dev.	0.308	0.337		
ΔLISIZE	Mean	0.015	-0.122	0.137	0.316
	Median	0.014	0.042	-0.029	0.163
	Std. Dev.	0.103	1.304		
ΔLSIZE	Mean	0.037	0.022	0.015	0.185
	Median	0.031	0.012	0.018	0.058*
	Std. Dev.	0.047	0.052		
ΔRPERM	Mean	0.362	0.491	-0.129	0.189
	Median	0.289	0.403	-0.113	0.198
	Std. Dev.	0.283	0.830		
ΔRISK	Mean	-0.002	0.004	-0.006	<0.000***
	Median	-0.001	0.004	-0.005	<0.000***
	Std. Dev.	0.002	0.003		
No. of Observations		22	95	-73	

*, **, *** denotes significance at or below the 0.10, 0.05, 0.01 level, respectively, based on a two-tailed test of significance.

a. See variable definitions in Table 3.

b. The *HEG* sample consists of firms of which annualized standard deviation of daily stock returns does not increase from year *t-2* to *t-1*, where *t* is the year of their first reports of quantitative market risk disclosure. The *SPE* sample consists of firms of which annualized standard deviation of daily stock returns increases from year *t-2* to *t-1*, where *t* is the year of their first reports of quantitative market risk disclosure.

c. Numbers are *p*-values (two-tailed) for mean differences *t*-test.

d. Numbers are *p*-values (two-tailed) for Wilcoxon Signed Rank test for median difference.

TABLE 5: Descriptive Statistics for the HEG, the SPE Sub-samples by Disclosure and Non-disclosure of Quantitative Market Risk

Variables[a]		HEG[b]				SPE[b]			
		DISC[c]	NO DISC[c]	Difference	*P*-value	DISC[c]	NO DISC[c]	Difference	*P*-value
ΔCOD	Mean	0.445	0.917	-0.472	0.077*	1.422	0.878	0.544	0.049[d]**
	Median	0.570	0.892	-0.322	0.074*	1.131	0.840	0.291	0.034[e]*
	Std. Dev.	0.651	0.594			1.354	1.357		
ΔDSK	Mean	-0.069	-0.009	-0.060	0.461	0.276	0.157	0.071	0.079*
	Median	-0.052	-0.004	-0.048	0.566	0.219	0.083	0.136	0.058*
	Std. Dev.	0.192	0.205			0.329	0.333		
ΔDE	Mean	0.000	0.313	-0.313	0.069*	2.325	0.490	1.835	0.404
	Median	0.000	0.331	-0.331	0.008***	0.155	0.001	0.154	0.036**
	Std. Dev.	0.061	0.510			14.948	1.016		
ΔPM	Mean	-0.295	-0.342	0.047	0.856	-2.086	-0.962	-1.124	0.505
	Median	-0.004	-0.345	0.341	0.237	-0.225	-0.036	-0.189	0.292
	Std. Dev.	0.342	0.779			10.861	4.093		
ΔTIER	Mean	-0.093	-0.308	0.215	0.256	0.097	-0.672	0.768	0.137
	Median	0.009	-0.458	0.467	0.131	0.084	-0.011	-0.095	0.177
	Std. Dev.	0.480	0.375			1.016	3.375		
ΔLMATU	Mean	0.015	0.038	-0.023	0.719	0.347	0.109	0.238	0.088*
	Median	0.000	0.000	-0.000	0.676	0.477	0.176	0.301	0.072*
	Std. Dev.	0.251	0.360			0.428	0.211		
ΔLISIZE	Mean	0.032	-0.003	0.035	0.432	0.058	0.299	-0.241	0.182
	Median	0.029	0.000	0.029	0.551	0.042	0.041	-0.001	0.794
	Std. Dev.	0.117	0.088			0.165	1.820		
ΔLSIZE	Mean	0.056	0.017	0.039	0.045**	0.032	0.013	0.019	0.072*
	Median	0.046	0.016	0.003	0.088*	0.038	0.021	0.017	0.039**
	Std. Dev.	0.051	0.032			0.057	0.045		
ΔRPERM	Mean	0.305	0.418	-0.113	0.360	0.647	0.338	0.309	0.098*
	Median	0.288	0.350	-0.063	0.793	0.493	0.344	0.149	0.101
	Std. Dev.	0.095	0.390			1.132	0.200		
ΔRISK	Mean	-0.002	-0.001	-0.001	0.704	0.005	0.004	0.001	0.579
	Median	-0.001	-0.002	0.001	0.792	0.004	0.004	0.001	0.574
	Std. Dev.	0.002	0.002			0.003	0.003		
No. of Observations		11	11	0		47	48	-1	

*, **, *** denotes significance at or below the 0.10, 0.05, 0.01 level, respectively, based on a two-tailed test of significance.

a. See variable definitions in Table 3.

b. The *HEG* sample consists of firms of which annualized standard deviation of daily stock returns does not increase from year *t-2* to *t-1*, where *t* is the year of their first reports of quantitative market risk disclosure. The *SPE* sample consists of firms of which annualized standard deviation of daily stock returns increases from year *t-2* to *t-1*, where *t* is the year of their first reports of quantitative market risk disclosure.

c. DISC represents the disclosure firm. NO DISC represents the control firm.

d. Numbers are *p*-values (two-tailed) for mean difference *t*-test.

e. Numbers are *p*-values (two-tailed) for Wilcoxon Signed Rank test for median difference.

TABLE 6: Regression Results of Change in Quantitative Market Risk Disclosure on Firms' Bond Default Risk and Costs of Debt Capital

Model (1): $\Delta DSK_i = \alpha + \beta_1 DISC_i + \beta_2 \Delta DE_i + \beta_3 \Delta PM_i + \beta_4 \Delta TIER_i + \beta_5 \Delta LSIZE_i + \beta_6 \Delta LMATU_i + \beta_7 \Delta LISIZE_i + \beta_8 \Delta CON_i + \beta_9 \Delta SUB_i + \beta_{10} \Delta CALL_i + \beta_{11} INDUSTRY_i + \beta_{12} YEAR_i + \varepsilon_i$

Model (2): $\Delta COD_i = \gamma + \eta_1 DISC_i + \eta_2 \Delta DE_i + \eta_3 \Delta PM_i + \eta_4 \Delta TIER_i + \eta_5 \Delta LSIZE_i + \eta_6 \Delta LMATU_i + \eta_7 \Delta LISIZE_i + \eta_8 \Delta CON_i + \eta_9 \Delta SUB_i + \eta_{10} \Delta CALL_i + \eta_{11} \Delta RPERM_i + \eta_{12} INDUSTRY_i + \eta_{13} YEAR_i + \mu_i$

Variable[a]	Predicted Sign	Model 1	Model 2
DISC	-	0.136	0.426
		(0.195)	(0.241)
ΔDE	+	0.056	0.621
		(0.034)**	(0.059)*
ΔPM	-	-0.003	-0.030
		(0.074)*	(0.071)*
ΔTIER	-	-0.021	-0.102
		(0.148)	(0.096)*
ΔLSIZE	-	-0.623	1.062
		(0.316)	(0.619)
ΔLMATU	+	1.108	1.521
		(0.000)***	(0.064)*
ΔLISIZE	-	0.027	0.499
		(0.207)	(0.318)
ΔCON	-	-1.591	-5.187
		(0.000)***	(0.149)
ΔSUB	+	2.367	7.133
		(0.000)***	(0.034)**
ΔCALL	+	0.046	1.170
		(0.236)	(0.038)**
ΔRPERM	+		0.092
			(0.155)
No. of Observations		117	117
Adjusted R^2 in %		46.19%	19.00%

*, **, *** denotes significance at or below the 0.10, 0.05, 0.01 level, respectively, based on a one-tailed test of significance. Numbers in parentheses are *p*-values (calculated using White's (1980) robust standard errors).

a. See variable definitions in Table 3.

TABLE 7: Regression Results of Change in Quantitative Market Risk Disclosure on Firms' Bond Default Risk and Costs of Debt Capital – Exploring the Effect of Hedging

Model (1): $\Delta DSK_i = \alpha + \beta_1 DH_i + \beta_2 DS_i + \beta_3 NDH_i + \beta_4 \Delta DE_i + \beta_5 \Delta PM_i + \beta_6 \Delta TIER_i + \beta_7 \Delta LSIZE_i + \beta_8 \Delta LMATU_i + \beta_9 \Delta LISIZE_i + \beta_{10} \Delta CON_i + \beta_{11} \Delta SUB_i + \beta_{12} \Delta CALL_i + \beta_{13} INDUSTRY_i + \beta_{14} YEAR_i + \varepsilon_i$

Model (2): $\Delta COD_i = \gamma + \eta_1 DH_i + \eta_2 DS_i + \eta_3 NDH_i + \eta_4 \Delta DE_i + \eta_5 \Delta PM_i + \eta_6 \Delta TIER_i + \eta_7 \Delta LSIZE_i + \eta_8 \Delta LMATU_i + \eta_9 \Delta LISIZE_i + \eta_{10} \Delta CON_i + \eta_{11} \Delta SUB_i + \eta_{12} \Delta CALL_i + \eta_{13} \Delta RPERM_i + \eta_{14} INDUSTRY_i + \eta_{15} YEAR_i + \mu_i$

Variable[a]	Predicted Sign	Model 1	Model 2
DH[b]	-	-0.467	-0.639
		(0.057)*	(0.093)*
DS[b]	-	0.223	1.014
		(0.041)**	(0.048)**
NDH[b]	?	-0.238	0.132
		(0.256)	(0.419)
ΔDE	+	0.051	0.606
		(0.057)*	(0.026)**
ΔPM	-	-0.005	-0.034
		(0.072)*	(0.067)*
ΔTIER	-	-0.022	0.096
		(0.213)	(0.204)
ΔLSIZE	-	-1.009	-5.649
		(0.411)	(0.613)
ΔLMATU	+	1.293	3.934
		(0.000)***	(0.048)**
ΔLISIZE	-	0.028	0.501
		(0.591)	(0.317)
ΔCON	-	-1.523	-5.389
		(0.000)***	(0.103)
ΔSUB	+	2.264	7.595
		(0.000)***	(0.026)**
ΔCALL	+	0.016	1.732
		(0.359)	(0.372)
ΔRPERM	+		0.174
			(0.128)
No. of Observations		117	117
Adjusted R^2 in %		50.03%	17.98%

*, **, *** denotes significance at or below the 0.10, 0.05, 0.01 level, respectively, based on a one-tailed test of significance where sign is predicted, two-tailed otherwise. Numbers in parentheses are *p*-values (calculated using White's (1980) robust standard errors).

a. See variable definitions in Table 3.

b. *DH, DS* and *NDH* are dummy variables that represent sample firms that disclose market risk and hedge, firms that disclose market risk and speculate, and firms that hedge but don't disclose market risk, respectively. Hedge firms are firms of which annualized standard deviation of daily stock returns does not increase from year *t-2* to *t-1*, where *t* is the year of their first reports of quantitative market risk disclosure. Speculative firms are firms of which annualized standard deviation of daily stock returns increases from year *t-2* to *t-1*, where *t* is the year of their first reports of quantitative market risk disclosure.

TABLE 8: Regression Results of the Format of Disclosing Quantitative Market Risk on Bond Default Risk and the Cost of Debt Capital

Model (1): $DSK_{it+1} = \boldsymbol{a} + \boldsymbol{b}_1 FORMAT_{it} + \boldsymbol{b}_2 DE_{it} + \boldsymbol{b}_3 PM_{it} + \boldsymbol{b}_4 TIER_{it} + \boldsymbol{b}_5 LSIZE_{it} + \boldsymbol{b}_6 LMATU_{it+1} + \boldsymbol{b}_7 LISIZE_{it+1} + \boldsymbol{b}_8 CON_{it+1} + \boldsymbol{b}_9 SUB_{it+1} + \boldsymbol{b}_{10} CALL_{it+1} + \boldsymbol{b}_{11} INDUSTRY_{it} + \boldsymbol{b}_{12} YEAR_{it} + \boldsymbol{e}_{it+1}$

Model (2): $COD_{it+1} = \boldsymbol{g} + + \boldsymbol{h}_1 FORMAT_{it} + \boldsymbol{h}_2 DE_{it} + \boldsymbol{h}_3 PM_{it} + \boldsymbol{h}_4 TIER_{it} + \boldsymbol{h}_5 LSIZE_{it} + \boldsymbol{h}_6 LMATU_{it+1} + \boldsymbol{h}_7 LISIZE_{it+1} + \boldsymbol{h}_8 CON_{it+1} + \boldsymbol{h}_9 SUB_{it+1} + \boldsymbol{h}_{10} CALL_{it+1} + \boldsymbol{h}_{11} RPERM_{it+1} + \boldsymbol{h}_{12} INDUSTRY_{it} + \boldsymbol{h}_{13} YEAR_{it} + u_{it+1}$

Variable[a]	Predicted Sign	Model (1)		Model (2)
		OLS[b]	Ordered Logit[c]	
FORMAT[d]	?	-0.017 (0.052)[e]*	-0.030 (0.036)[f]**	-0.042 (0.069)*
DE	+	0.010 (0.054)*	-0.299 (0.157)	0.134 (0.054)*
PM	-	-0.117 (0.004)***	-4.673 (0.069)*	-0.156 (0.063)*
TIER	-	-0.002 (0.107)	-0.007 (0.185)	-0.144 (0.147)
LSIZE	-	-0.015 (0.026)**	-1.528 (0.000)***	-0.078 (0.002)***
LMATU	+	0.017 (0.279)	0.561 (0.068)*	0.398 (0.058)*
LISIZE	-	0.004 (0.138)	-1.017 (0.037)**	-0.066 (0.295)
CON	-	-0.190 (0.025)**	-1.459 (0.029)**	-1.579 (0.087)*
SUB	+	0.085 (0.000)***	2.792 (0.004)***	0.458 (0.067)*
CALL	+	0.215 (0.235)	0.539 (0.555)	2.989 (0.157)
RPERM	+			6.353 (0.033)**
No. of Observations		102	102	102
Adjusted R^2 in %		80.76%		47.69%
Likelihood Ratio Test			96.029 (<0.0001)***	

*, **, *** denotes significance at or below the 0.10, 0.05, 0.01 level, respectively, based on a one-tailed test of significance where sign is predicted, two-tailed otherwise. Numbers in parentheses are *p*-values (calculated using White's (1980) robust standard errors).

a. See variable definitions in Table 3.

b. *DSK* is measured by the average cumulative default risk rate for each Moody's bond rating categories.

c. *DSK* is measured by an ordinal indicator variable for each Moody's bond rating categories.

d. FORMAT equals one if the disclosure is in VaR format, it equals zero if it is a sensitivity analysis disclosure.

e. Numbers in parentheses are *p*-values for the t-test (calculated using White's (1980) robust standard errors).

f. Numbers in parentheses are *p*-values for the χ^2-test

TABLE 9: Descriptive Statistics for the Firms of Different Formats of Disclosures

Variables[a]		VAR[b]	SEN[b]	Difference	P-value
COD	Mean	1.665	2.282	-0.617	0.037[c]**
	Median	1.390	2.125	-0.735	0.058[d]*
	Std. Dev.	1.207	1.439		
DSK[e]	Mean	3.231	4	-0.769	0.001***
	Median	3	4	-1	0.001***
	Std. Dev.	0.931	1.224		
DSK[f]	Mean	0.036	0.140	-0.104	0.003***
	Median	0.010	0.092	-0.082	0.026**
	Std. Dev.	0.077	0.156		
DE	Mean	1.121	1.191	-0.070	0.771
	Median	0.713	1.018	-0.305	0.534
	Std. Dev.	0.940	1.420		
PM	Mean	0.044	0.010	0.034	0.434
	Median	0.049	0.053	-0.004	0.313
	Std. Dev.	0.077	0.311		
TIER	Mean	4.925	3.752	1.173	0.320
	Median	2.441	2.967	0.526	0.781
	Std. Dev.	6.183	5.219		
LSIZE	Mean	9.135	8.637	0.498	0.069*
	Median	9.449	8.706	0.743	0.065*
	Std. Dev.	1.398	1.284		
LSIZE*	Mean	9.217	8.729	0.488	0.038**
	Median	9.240	8.894	0.346	0.087*
	Std. Dev.	1.117	1.177		
BM	Mean	0.372	0.353	0.019	0.732
	Median	0.311	0.314	-0.003	0.392
	Std. Dev.	0.202	0.409		
PE	Mean	22.768	24.709	-1.941	0.813
	Median	17.337	22.343	-5.006	0.512
	Std. Dev.	36.335	48.189		
Total Risk	Mean	0.018	0.021	-0.003	0.065*
	Median	0.017	0.020	-0.003	0.014**
	Std. Dev.	0.008	0.012		
Equity Beta	Mean	0.850	0.989	-0.139	0.256
	Median	0.910	1.026	-0.116	0.173
	Std. Dev.	0.462	0.537		
No. of Observations		43	59	16	

*, **, *** denotes significance at or below the 0.10, 0.05, 0.01 level, respectively, based on a two-tailed test of significance. LSIZE* is log of firm total assets at the end of year *t*. BM is firm's book-to-market ratio (book value of assets/market value of assets). PE is firm's price-to-earnings ratio (fiscal year end price per share divided by earnings per share at year *t*). Total risk is calculated as the average of annualized standard deviation of daily stock return over year *t-2* to *t-1*. Equity betas are calculated by fitting the market model over the 60-month period prior to the disclosure. To be included, a firm must have at least 24 months of nonmissing returns data. CRSP value-weighted market portfolio is used to proxy the market return. The number of observations used in calculating total risk and equity beta is 42 for *VAR* firms and 57 for *SEN* firms.

a. See variable definitions in Table 3.

b. The *VAR* sample consists of firms that have made VaR market risk disclosure in year *t*. The *SEN* sample consists of firms that have made sensitivity analysis market risk disclosure in year *t*.

c. Numbers are *p*-values (two-tailed) for mean difference *t*-test.

d. Numbers are *p*-values (two-tailed) for Wilcoxon Signed Rank test of median difference.

e. *DSK* is measured by an ordinal indicator variable for each Moody's bond rating categories.

f. *DSK* is measured by the average cumulative default risk rate for each Moody's bond rating categories.