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Fair Value Accounting for Liabilities and Own Credit Risk

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ABSTRACT: We find that equity returns associated with credit risk changes are attenuated by the debt value effect of the credit risk changes, as Merton (1974) predicts. We find that the relation between credit risk changes and equity returns is significantly less negative for firms with more debt—controlling for asset value changes, credit risk increases (decreases) are associated with equity value increases (decreases). This result obtains across credit risk levels. The relation is associated with changes in both expected cash flows and systematic risk, as reflected in analyst earnings forecasts and equity cost of capital. By inverting the Merton (1974) model, we provide descriptive evidence that if unrecognized debt value changes were recognized in income, but not unrecognized asset value changes, most credit upgrade (downgrade) firms would recognize lower (higher) income. These potentially counterintuitive income effects primarily are attributable to incomplete recognition of contemporaneous asset value changes. However, for a substantial majority of downgrade firms we find that recognized asset write-downs exceed unrecognized gains from debt value decreases. This mitigates concerns that income effects from recognizing changes in debt values would be anomalous for such firms.

Keywords: *fair value accounting; income recognition; debt; credit risk.*

Data Availability: *Data are available from public sources indicated in the text.*

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I. INTRODUCTION

This study tests whether equity value changes associated with credit risk changes are attenuated by debt value changes associated with the credit risk changes, as Merton (1974) predicts.[1] Prior research finds that increases in credit risk are associated with decreases in equity value. However, this research does not address whether the equity value change results from a single effect or is the net of two countervailing effects—a direct effect arising from change in asset value and an indirect effect arising from change in debt value. We find that increases (decreases) in equity value are associated with decreases (increases) in debt value arising from increases (decreases) in credit risk, after controlling for the direct effect on equity value of the credit risk change. Recognition in net income of changes in values of liabilities, particularly those arising from changes in credit risk, is a controversy presently facing accounting standard setters. Thus, we provide descriptive evidence on the effects on firms' net income of recognizing presently unrecognized changes in debt value. Because fair value accounting for liabilities would apply to all firms, we conduct our tests on a broad sample of primarily solvent firms.

Credit risk changes arise from unanticipated asset value changes or asset risk changes. Merton (1974) shows that equity value changes associated with credit risk changes comprise potentially countervailing direct and indirect effects. The direct effect is the one-to-one relation between asset value and equity value that exists in the absence of debt. The indirect effect is the debt value change associated with a change in asset value or asset risk. The indirect effect associated with asset value change is the portion of the asset value change absorbed by debt holders; the indirect effect associated with asset risk change is the wealth transfer between equity holders and debt holders arising from a change in asset risk.[2] The direct and indirect effects are potentially countervailing because equity value equals asset value minus debt value. The indirect effect on equity value associated with credit risk changes is the primary focus of our study.

Understanding how credit risk changes affect the values of debt and equity is relevant to the debate about using fair value accounting for liabilities. The conceptual frameworks of the Financial Accounting Standards Board (FASB) and the International Accounting Standards Board (IASB) provide for income recognition of gains and losses arising from changes in the recognized amount of debt. Thus, if debt is recognized at fair value, then the indirect effect would result in recognizing gains (losses) associated with decreases (increases) in the fair value of debt. This is counterintuitive to some and has generated controversy relating to financial reporting for liabilities. Also, assets and liabilities are accounted for using different conventions. To the extent that recognized decreases in debt value are not offset by recognized decreases in asset value, firms with increases in credit risk could recognize net gains. Some view this as anomalous, and concern about recognizing such gains is the primary reason the European Commission endorsed International Accounting Standard (IAS) No. 39 (IASB 2003) for use by European firms only after deleting

[1] We use the term credit risk to describe factors that determine the risk premium on debt. Because we assume contractual debt cash flows do not change prior to maturity, debt value decreases result from credit risk increases. The terms credit risk, default risk, firm risk, and total risk often are used interchangeably in the studies we cite. These terms largely are consistent with our usage of the term credit risk. One exception is that default risk is sometimes more narrowly construed, i.e., although firms with no outstanding debt can have credit risk, only firms with outstanding debt have default risk (see, e.g., Dhaliwal et al. 1991 and footnote 16).

[2] Throughout, the term asset risk refers to unsystematic risk. Unanticipated changes in systematic asset risk change asset value, which is reflected in the direct effect.

the option for firms to use fair value accounting for financial liabilities. The European Commission did not delete the corresponding option for financial assets.

To address our research question, our tests focus on the relation between annual equity returns and changes in debt value. Our proxy for change in debt value is the interaction between credit risk change and the amount of the firm's debt. Our proxy for credit risk change is change in estimated credit rating because credit ratings reflect credit rating agencies' assessments of credit risk; higher credit ratings reflect higher risk. Our proxy for the amount of debt is book value of debt, scaled by total assets. Based on Merton (1974), we predict a positive relation between equity returns and the interaction between credit risk change and the amount of debt. That is, we predict that the relation between equity returns and credit risk change is less negative for firms with more debt. Our tests include controls for credit risk change, leverage, earnings, and change in earnings. We expect equity returns are negatively related to credit risk change and positively related to earnings and changes in earnings. We do not predict the sign of the relation with leverage.

Consistent with predictions, we find that the relation between equity returns and credit risk changes is significantly less negative for firms with more debt. Because of potential nonlinearities associated with the direction of credit risk change, we also estimate the relation separately for firms with credit downgrades and upgrades. We find that downgrade firms have significantly negative equity returns. Consistent with our primary findings, we also find that equity returns are significantly less negative for firms with more debt. As predicted, we find the opposite for upgrade firms, i.e., although their equity returns are significantly positive, the returns are significantly less positive for firms with more debt. Because of potential nonlinearities in the relation associated with level of credit risk, we also permit the relation to differ depending on whether the upgrade or downgrade is within investment grade, between investment grade and non-investment grade, or within non-investment grade. Consistent with our primary findings, we find that the relation between equity returns credit risk changes is significantly attenuated for firms with more debt, except for firms downgraded within investment grade and firms upgraded to investment grade.

To investigate the robustness of our findings, we conduct several additional analyses. In particular, as an alternative proxy for debt value change we use the effect on the firm's debt value of the change in market interest rate associated with the firm's credit risk change. To calculate this proxy, we use debt maturity information disclosed in the firm's financial statement footnotes. Consistent with our primary findings, we find that the gain or loss arising from the debt value change is significantly positively associated with equity returns. Also, because credit risk changes reflect asset risk changes and asset value changes, we estimate our primary equation after replacing change in credit risk with change in equity cost of capital and change in analyst earnings forecasts. Change in equity cost of capital is a proxy for change in systematic risk; change in analyst earnings forecasts is a proxy for change in expected asset cash flows. The findings indicate that our primary results are attributable to both change in systematic risk and change in asset cash flows. In particular, we find that change in equity cost of capital and change in analyst earnings forecasts each interacted with debt attenuate the relation between returns and change in equity cost of capital and change in analyst earnings forecasts.

Establishing that changes in debt value arising from changes in credit risk are associated with changes in equity value indicates that such debt value changes are a component of firms' economic income. Because meeting the objective of financial reporting requires faithful representation of firms' liabilities and economic performance (IASB 2006), our results indicate that debt value changes are candidates for inclusion in firms' accounting income. To investigate concerns about the accounting recognition of such changes, we provide descriptive evidence on the effects on firms' reported net income of recognizing changes in debt fair values. We do this by inverting the Merton (1974) model to obtain estimates of firms' asset value and debt value. Because the estimates likely contain estimation error, this evidence should be interpreted with caution.

The evidence reveals that if all unrecognized changes in debt and asset values were recognized, then upgrade firms would report higher net income and downgrade firms would report lower net income than they currently recognize. This is consistent with firms' unrecognized asset value changes exceeding their unrecognized debt value changes. As one would expect, the evidence reveals that if only unrecognized changes in debt value were recognized, then upgrade firms would recognize lower net income and downgrade firms would recognize higher net income. However, the evidence also reveals that for downgrade firms, recognized asset write-downs are larger, on average, than unrecognized gains from decreases in debt value. This evidence mitigates the concern that debt value decreases would exceed recognized contemporaneous asset value decreases. However, this is not true for all downgrade firms, which suggests some concern about anomalous income effects is not unwarranted.

The paper proceeds as follows. Section II elaborates on the study's background, motivation, and related research. Section III describes the basis for our prediction and the research design. Section IV presents the primary findings, and Section V presents results from additional analyses. Section VI presents results relating to effects on reported net income of using fair value accounting for debt, and Section VII offers concluding remarks.

II. BACKGROUND, MOTIVATION, AND RELATED RESEARCH

Risk, Debt Values, and Equity Values

A large finance literature focuses on explaining debt values, particularly the relation between debt value and credit risk. In this literature, debt valuation models typically are based on Merton's (1974) insight that equity can be viewed as a call option on the value of underlying assets with a strike price equal to the face amount of debt (see, e.g., Duffee 1996, 1998; Duffie and Singleton 1999; Huang and Huang 2003; see Bohn 2000 for a review of this literature). The debt valuation models establish a negative relation between credit risk and debt value. This relation also applies to post-contracting changes in credit risk, because debt value changes when the market interest rate commensurate with the new level of credit risk differs from the rate determined at the inception of the debt. Strong (1990) empirically investigates debt value changes associated with credit risk changes as measured by bond rating changes for a sample of 190 firms in 1983. Strong (1990) seeks to distinguish debt value changes associated with credit risk changes from those associated with market risk changes, and finds that both explain debt value changes. However, this literature does not link debt value changes and equity value changes.

Holthausen and Leftwich (1986), Hand et al. (1992), and Goh and Ederington (1993), among others, investigate equity value changes associated with bond rating change announcements. These studies generally find that debt and equity values decrease with bond rating downgrades. Such findings indicate that downgrade announcements convey net negative information to both debt and equity markets, and are consistent with an association between credit risk increases and net negative equity value effects.[3] Consistent with these findings and with Galai and Masulis (1976) and Bowman (1979), Vassalou and Xing (2004) show that a large portion of default risk is systematic and, thus, priced in equity value. These studies generally do not find significantly positive announcement equity returns for upgrades. Prior literature explains that this likely occurs because bond rating upgrades occur with a lag and, thus, equity prices reflect the information on which the upgrade is based prior to the rating change announcement (Pinches and Singleton 1978). Regardless, these studies do not attempt to distinguish the two countervailing effects on equity value associated with credit risk changes that we document.

Other studies examine how the level of default risk affects the response of equity value to unexpected earnings. In particular, Dhaliwal and Reynolds (1994) find that earnings response coefficients (ERCs) are negatively related to the level of default risk. Dhaliwal et al. (1991; hereafter, DLF) test the empirical implications of Dhaliwal and Reynolds (1994) by using the 15-year average of leverage as a proxy for default risk. For a sample of 56 firms with high leverage and 56 firms with low leverage, DLF find low leverage firms have higher ERCs. DLF confirm this inference by finding that 48 firms with zero leverage have even higher ERCs. However, neither Dhaliwal and Reynolds (1994) nor DLF examine the effects of change in default risk or the effects on equity value of debt value changes associated with credit risk changes.

Only a few studies attempt to link debt value changes associated with credit risk changes to equity value changes. Kliger and Sarig (2000; hereafter, KS) examine changes in stock and bond prices incident to Moody's 1982 adoption of finer bond rating partitions. KS find significant decreases in debt value for firms with implied downgrades, but do not find consistently significant increases for firms with implied upgrades. The significance of equity value changes in each bond rating change group depends on the specification; KS find no positive equity returns for downgrade firms when basing expected returns on a market model. Hand et al. (1990; hereafter, HHS) investigate whether bond holders gain at the expense of stock holders when firms defease debt in substance, but not legally, for a sample of 80 defeasances by 68 firms from 1981 to 1987. For a subsample of these firms with announcement data, HHS find significantly positive bond returns and significantly negative stock returns at the defeasance announcement. However, the negative correlation between the bond returns and stock returns is weak. After also investigating motivations for the defeasances, HHS conclude that the negative stock returns are more likely attributable to information effects than to increases in debt values. These studies provide suggestive results. However, the uniqueness of the settings and small sample sizes limit generalizability of their inferences. Also, the studies do not attempt to distinguish the countervailing effect on equity value of debt value changes associated with credit risk

[3] Goh and Ederington (1993; hereafter, GE) find no significantly negative equity returns for bond rating downgrades associated with change in leverage. GE predict positive equity returns to these announcements because such downgrades should be associated with a wealth transfer from debt holders to equity holders. Finding no significant announcement equity returns could be because such downgrades do not reflect information that affects equity values or the return window does not span the date that the information was impounded in share prices. Our use of annual returns windows mitigates the possibility of failure to capture the effect on equity returns of credit risk changes. Also, see Ederington and Yawitz (1987) for a review of earlier studies in this literature. Relatedly, Ederington and Goh (1998) find that analysts decrease earnings forecasts following downgrades and attribute this finding to information transfer from debt rating agencies to equity analysts.

changes.[4] Thus, the empirical validity of Merton's (1974) predictions of equity value increases associated with debt value decreases remains largely unexplored.

Accounting for Debt

Currently, financial accounting standards require that liabilities are initially measured at cost, which typically equals their value at the time, and subsequently measured at cost or amortized cost. Long-term debt, in particular, is initially measured at the face value of the debt adjusted for issue premium or discount, and subsequently measured at amortized cost. Interest expense is based on the rate of interest implicit in the debt issuance price. This rate reflects the debt's market rate of interest, including the effect of the firm's credit risk, when it is issued. Fair value accounting for debt would initially measure debt at the same amount. However, fair value accounting would subsequently measure debt at fair value, with changes in fair value recognized in income. Thus, the recognized amount of debt and its interest expense would reflect a current market interest rate, including the effect of the firm's current credit risk (Barth and Landsman 1995). The promised stream of cash flows associated with the debt is the same regardless of the accounting. The primary differences are in the timing of recognition of the associated cash flows, as is true of all accruals, and their characterization as principal, interest, or gains and losses.

Fair value measurement of liabilities, particularly long-term debt, is a controversy currently facing standard setters. The FASB has identified fair value as the most relevant measurement basis for financial instruments and has indicated that measuring all financial instruments at fair value is one of its long-term goals (FASB 1999). Fair value is permitted in U.S. and international standards for many financial assets, e.g., Statement of Financial Accounting Standards (SFAS) No. 133 and IAS No. 39. However, using fair value accounting for liabilities is not widespread. SFAS No. 133 and IAS No. 39 require fair value accounting for derivative liabilities, but require or permit firms to measure at amortized cost other liabilities, including long-term debt. Those who agree with the FASB's goal believe measuring liabilities at fair value is consistent with measuring assets at fair value. The FASB's goal also is consistent with income and its volatility better reflecting market and other risks when firms measure financial assets and liabilities at fair value (see, e.g., Barth et al. 1995; Hodder et al. 2006).

However, others find recognizing changes in debt value disturbing. They are particularly concerned about the financial reporting implications of recognizing changes in debt value arising from changes in the firm's own credit risk. For example, the European Central Bank called the recognition of gains associated with increases in credit risk "counterintuitive" (European Central Bank 2001), and the European Commission's endorsement of IAS No. 39 for use by European firms eliminated the fair value option for financial liabilities. The main issue of concern is that net income will not reflect changes in net asset value if debt value decreases are recognized but all concurrent asset value decreases are not. For example, if some intangible assets are not recognized, then troubled firms could report positive net

[4] Another stream of research links debt value and equity value by simulating the potential magnitude of agency costs arising from risk-taking incentives identified in Merton (1974), e.g., Parrino and Weisbach (1999; hereafter, PW). Analytical models and simulations such as those in PW suggest agency costs can be substantial. However, PW construct simulated debt values based on the Merton (1974) model. Thus, PW cannot test the model's predictions. Empirically, Odders-White and Ready (2006; hereafter, OR) find that firms with higher credit risk have higher adverse selection equity spread components, suggesting agency costs are priced in equity value as well as in debt value. However, OR do not test the relation between debt value changes and equity value changes associated with increases in credit risk.

income because of debt value decreases in periods in which they experience equity value decreases.[5]

Lipe (2002) demonstrates how accounting ratios might convey misleading positive signals when a firm approaching bankruptcy uses fair value to measure liabilities. Lipe (2002) concludes that debt value changes attributable to credit risk changes should not be recognized. However, the misleading financial statement effects of Lipe's (2002) example primarily derive from incomplete recognition of assets and asset value changes, not from recognizing debt value changes.

Although there is a substantial literature addressing the value relevance of fair values for equity prices and returns, few studies examine fair values of liabilities in industries other than banking and insurance. Banking industry studies consistently demonstrate the value relevance of asset fair values and, to a lesser extent, deposit liabilities and long-term debt fair values. For example, Barth et al. (1996; hereafter, BBL) find that unrealized gains and losses on long-term debt estimated from disclosures in bank financial statements are significantly associated with the difference between equity market value and equity book value, although not in all model specifications and years. BBL find no significant association between changes in unrecognized gains and losses on long-term debt and changes in the difference between equity market value and equity book value. Eccher et al. (1996) and Nelson (1996) find no association between equity value and disclosed long-term debt fair value. For a sample of nonfinancial firms, Simko (1999) finds that disclosed liability fair values are associated with equity values, but not consistently across industries and years.

Barth, Landsman, and Rendleman (1998 hereafter, BLR) estimate debt values for a sample of nonfinancial firms and investigate the financial statement effects of fair value accounting for debt. BLR find that financial statement amounts based on fair value are potentially relevant to investors because financial statement amounts would be substantially different from those currently recognized. However, none of these studies investigates the effects of changes in credit risk on the values of the firm's debt and equity.

III. BASIS FOR PREDICTION AND RESEARCH DESIGN

Based on Merton (1974), equity value, E, can be expressed as:

$$E = A\mathrm{N}(d_1) - Ke^{-rT}\mathrm{N}(d_2) \tag{1}$$

where A is asset value, K is contractual debt payments, e is the exponential function, r is the risk-free rate of return, T is duration of the debt, N is the cumulative standard normal distribution, $d_1 = \dfrac{\ln(A/K) + (r + \sigma^2/2)^T}{\sigma\sqrt{T}}$, $d_2 = d_1 - \sigma\sqrt{T}$, and σ is standard deviation of

[5] When credit risk decreases, asset value increases often are not recognized. Yet, if debt is measured at fair value, debt value increases would be recognized as losses. When credit risk increases, the opposite occurs. Recognized assets may be written down. However, not all assets are recognized and asset write-downs may not be complete or timely. Even in the absence of a change in asset value, there could be a wealth transfer from debt holders to equity holders when asset risk changes. Although such wealth transfers are consistent with Merton's (1974) theory, they are viewed by some as anomalous. This is because recognizing in net income the effects of such wealth transfers would result in recognizing a gain (loss) from decreases (increases) in debt value associated with increases (decreases) in risk. Our descriptive evidence in Section VI suggests that for most firms the "anomaly" associated with unrecognized asset value changes dominates that associated with only wealth transfers. Income effects associated with credit risk increases are more troublesome to regulators than those associated with credit risk decreases.

asset returns. $N(d_1)$ reflects the probability that asset value will exceed the contractual debt payments when they become due.

To isolate the indirect effect that is the focus of our study, we restate Equation (1) as follows.

$$E = A - Ke^{-rT}\{L\,(1 - N(d_1)) + N(d_2)\} \tag{2}$$

where $L = A/Ke^{-rT}$. As does Merton (1974), Equation (2) states equity value, E, as asset value, A, minus debt value, $D = Ke^{-rT}\{L\,(1 - N(d_1)) + N(d_2)\}$. Equation (2) reveals that $D = A$ when asset value is expected to be less than the present value of the contractual debt payments, and equals the present value of the contractual debt payments otherwise.

Our interest is in the relation between equity value changes and debt value changes arising from credit risk changes. Credit risk changes derive primarily from unanticipated changes in asset value or asset risk.[6] Thus, we restate Equation (2) in change form, which, holding constant the amount of debt, Ke^{-rT}, results in Equation (3) where Δ denotes change.

$$\Delta E = \Delta A - Ke^{-rT}\Delta\{L\,(1 - N(d_1)) + N(d_2)\}. \tag{3}$$

Equation (3) reveals ΔA as the direct equity value effect of an asset value change. This is the one-to-one mapping between asset value and equity value that exists in the absence of debt. Equation (3) also reveals that when the firm has debt, asset value change and asset risk change affect debt value, which results in the indirect equity value effect. This is the asset value change absorbed by debt holders and the debt value effect associated with asset risk change. Debt value changes when asset value changes even for solvent firms. Because priority of debt over equity at liquidation of the firm does not imply debt holders have a priority claim on asset value before liquidation, debt holders participate in asset value changes, even when asset value exceeds the amount of the debt.

The relation between changes in asset value and asset risk and change in debt value is complex. For asset value changes, $\partial D/\partial A > 0$. Because equity value cannot be negative, $\partial E/\partial A$ is net positive. However, Equation (3) makes clear that $\partial E/\partial A$ has two components, the positive direct effect, and the negative indirect effect stemming from $\partial D/\partial A$. For asset risk changes, $\partial D/\partial \sigma < 0$. There is no direct equity value effect of change in unsystematic risk. However, because equity value equals asset value minus debt value, asset risk increases (decreases) result in equity value increases (decreases) associated with debt value decreases (increases), even when asset value is unchanged. That is, $\partial D/\partial \sigma < 0$ means that $\partial E/\partial \sigma > 0$.

Thus, Merton (1974) predicts that equity value changes associated with credit risk changes can be characterized into potentially countervailing direct and indirect effects. Our research question leads us to focus on testing the prediction that the decrease (increase) in equity value associated with an increase (decrease) in credit risk is mitigated by debt. We test the prediction because, as with any model, the Merton (1974) model is based on assumptions that may not hold empirically. For example, the model does not consider the effects of institutional features such as market inefficiencies or debt covenants, either of which could limit equity value increases associated with debt value decreases. Also, Merton

[6] Change in credit risk also can arise from change in the amount of debt. Equation (4) below assumes the amount of debt does not change during the year. However, see footnote 8 for findings relating to alternative measures of debt.

(1974) shows that the indirect effect decreases as solvency increases, raising the possibility that the effect is negligible for most firms. We test the importance of the indirect effect for a broad sample of primarily solvent firms. Failure to find that the indirect effect is important would call into question the substance of the accounting controversy over recognizing the effect in net income.

Research Design: Returns and Credit Risk Changes

Our empirical specification of Equation (3) is Equation (4):

$$RET_t = \beta_0 + \beta_1 \Delta CR_t + \beta_2 \Delta CR_t \times DBTA_t + \beta_3 DBTA_t + \beta_4 EPS_t + \beta_5 \Delta EPS_t + \beta_6 NEG_t + \beta_7 NEG_t \times EPS_t + \beta_8 NEG_t \times \Delta EPS_t + \varepsilon_{4t}. \quad (4)$$

RET is annual size-adjusted stock return, inclusive of dividends; it corresponds to ΔE in Equation (3). t denotes year; we omit firm subscripts. For our research question, the key variable in Equation (4) is $\Delta CR \times DBTA$, where *CR* is credit risk and *DBTA* is the debt-to-assets ratio. It is our proxy for change in debt value associated with change in credit risk. Thus, estimating its coefficient permits us to test our predictions relating to the indirect equity value effect. We predict β_2 is positive.

Change in credit risk reflects change in asset value and change in asset risk. Both alter the distribution of expected debt payments, resulting in debt value changes. Thus, we use change in credit risk to capture $\Delta\{L(1 - N(d_1)) + N(d_2)\}$ in Equation (3). Our proxy for change in credit risk is ΔCR, where *CR* is a categorical variable that ranges from 1 denoting low risk to 4 denoting high risk; ΔCR is positive (negative) when credit risk increases (decreases). The Appendix explains how we follow prior research to estimate *CR* based on the relation between accounting variables and credit ratings for firms with such ratings. These variables are total assets, return on assets, ratio of debt to total assets, and indicators for whether a firm pays dividends, has subordinated debt, or has negative net income. We use credit ratings because they reflect the credit agency's assessment of credit risk, where that assessment is based on publicly available and private information (Jorion et al. 2005). Using *CR* permits us to expand our sample beyond firms with credit ratings, thereby enhancing the generalizability of our inferences. Also, as Section II notes, credit ratings, especially upgrades, are revised with a lag (e.g., Pinches and Singleton 1978), which adds noise when actual credit rating changes are used as proxies for changes in credit risk.[7]

Our proxy for the amount of debt in Equation (3), i.e., the present value of the contractual debt payment, Ke^{-rT}, is book value of debt. Book value of debt is not a perfect proxy, however, because the payments are discounted at the firm's borrowing rate when the debt was issued, rather than the current risk-free rate. *DBTA* is the end-of-year ratio of book value of debt to book value of total assets. We deflate book value of debt by total

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[7] Our inferences are unaffected by the use of alternative measures of credit risk change, including change in actual credit rating. See Table 6 and footnote 21. Hillegeist et al. (2004; hereafter, HKCL) estimate probability of default using asset value and asset risk estimates obtained from inverting the Merton (1974) model. Because HKCL use stock prices as inputs, the HKCL probability of default estimates are endogenous in Equation (4). Thus, we do not use them in our tests. In Section VI, we present findings from estimating a relation analogous to Equation (4) using asset value and asset risk estimates obtained from the Merton (1974) model. Our inferences from that specification are the same as those we obtain from Equation (4).

assets to control for cross-sectional size differences in Equation (4) and because doing so results in a variable that ranges from 0 to 1, which facilitates interpretation of its coefficient.[8]

We also include ΔCR in Equation (4). We expect ΔCR primarily to be a proxy for change in asset value, ΔA. Thus, based on Equation (3) and prior research (e.g., Holthausen and Leftwich 1986), we predict β_1 is negative. However, because ΔCR reflects asset value and asset risk changes related to debt, it likely is an incomplete and noisy proxy for asset value changes related to equity. For this reason, and to facilitate comparison with the extensive accounting literature examining the relation between returns and earnings, Equation (4) includes *EPS*, earnings per share before extraordinary items deflated by beginning-of-year stock price, and ΔEPS. Because *EPS* is earnings after interest expense, both of these variables are proxies for change in asset value related to equity. We predict β_4 and β_5 are positive. We also include *NEG*, $NEG \times EPS$, and $NEG \times \Delta EPS$, where *NEG* is an indicator variable that equals 1 if *EPS* is negative, and 0 otherwise, to permit the relation between returns and earnings to differ for firms with negative earnings (Hayn 1995; Barth, Beaver, and Landsman 1998).[9] We predict β_6, β_7, and β_8 are negative. We include *DBTA* in Equation (4) because we interact it with ΔCR.[10] We do not predict the sign of its coefficient, β_3.[11]

We estimate Equation (4) pooling all firms with year and industry fixed effects, defining industries following Barth, Beaver, and Landsman (1998). To mitigate the effects of influential observations, we estimate Equation (4) using Huber-M estimation, which minimizes a less rapidly increasing function of the regression residuals than OLS.[12]

Because d_1 is a logarithmic function of asset value, *A*, the Merton (1974) model predicts that the sensitivity of debt value, *D*, to change in asset value decreases as asset value increases, i.e., as credit risk decreases. Therefore, we also estimate Equation (4) separately for firms with credit risk upgrades and downgrades. To permit further potential nonlinearities associated with level of credit risk, we partition firms based on whether the upgrade or downgrade is within investment grade, between investment grade and non-investment grade, or within non-investment grade.[13]

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8 None of our inferences is affected if we instead deflate book value of debt by lagged market value of equity or number of shares outstanding, or use in place of $DBTA_t$ the ratio of total liabilities to total assets, the ratio of debt and capitalized leases to total assets, $DBTA_{t-1}$, or the ratio of lagged market value of debt to lagged market value of assets that we estimate in Section VI. Our inferences also are unaffected if we include $\Delta DBTA$ in our estimating equations.

9 Untabulated findings reveal that our inferences are unaffected if we exclude the five earnings variables. The coefficient on ΔCR is -0.24 (t = -40.08), the coefficient on $\Delta CR \times DBTA$ is 0.21 (t = 10.43), and the coefficient on *DBTA* is -0.15 (t = -15.41).

10 We use only accounting-based explanatory variables in Equation (4) to avoid endogeneity associated with changes in market values. In Section VI, as a sensitivity check, we estimate a version of Equation (4) using market value estimates. See also footnote 7.

11 Returns may be correlated with change in debt. However, change in *DBTA* is reflected in ΔCR through Equation (A1). Also, untabulated statistics reveal that changes in *DBTA* are close to zero for most firms—the upper (lower) decile of $\Delta DBTA$ is 0.10 (-0.07). Inferences from an untabulated estimation of Equation (4) eliminating observations with the highest and lowest 1 percent of $\Delta DBTA$ are the same as those from the estimation we tabulate.

12 All of our inferences are unaffected if we use OLS estimation. We also obtain similar inferences if we base our test statistics on standard errors that are clustered by firm, which controls for heteroscedasticity and intertemporal firm-specific dependence in regression residuals.

13 This approach effectively controls for beginning-of-year credit risk, as well as clientele effects. Nonetheless, in untabulated analyses, we include CR_{t-1} as an additional explanatory variable in our estimation equations. None of our inferences is affected.

IV. DATA AND FINDINGS FOR RELATION BETWEEN CHANGES IN RISK AND EQUITY RETURNS

Data and Sample

Fair value accounting for liabilities would apply to all firms, regardless of financial condition. Thus, we construct our sample to comprise a broad cross-section of primarily solvent firms. In particular, we begin with all firms with available data on Compustat for 1986–2003.[14] We eliminate firms in the utilities, financial services, and real estate industries because their capital structures markedly differ from those of other firms. To mitigate the effects of outliers, we eliminate firms for which the absolute value of EPS_t, EPS_{t-1}, or ΔEPS_t is greater than 1.5 (Easton and Harris 1991) and firms with *RET* in the extreme top and bottom percentiles of the observations (Kothari and Zimmerman 1995; Collins et al. 1997; Fama and French 1998; Barth et al. 1999; among others). To mitigate undue effects of very small firms, we also eliminate firms with total assets or sales less than $10 million, or share price less than $1.[15] The final sample comprises 49,081 firm-year observations, of which 11,399 have credit ratings. Data limitations reduce the sample size for some analyses.

We obtain stock market data from CRSP, analyst forecast data from I/B/E/S, bond covenant data from the Fixed Income Securities Database, interest rate data from The Federal Reserve, and all other data from Compustat. The credit ratings on Compustat are Standard & Poor's Issuer Credit Rating.[16] *RET* is each firm's size-adjusted annual buy-and-hold return, computed as the firm's compounded monthly fiscal year return minus the corresponding compounded size decile return associated with the firm's market value of equity at the beginning of the year.[17]

Descriptive Statistics

Table 1 presents descriptive statistics for the variables in Equation (4). Panel A presents distributional statistics, Panel B presents correlations between the variables, and Panel C presents the industry composition of the sample. Panel A reveals that the mean of *RET* is −0.01, which is close to zero as expected. The median is somewhat more negative, −0.07, which indicates skewness in returns similar to that observed for all firms on CRSP during

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[14] The sample period begins in 1986 because Compustat does not include credit ratings before 1985 and two years are necessary to calculate change in credit risk.

[15] Our inferences are unaffected if we include all firms in our tests.

[16] Prior to September 1, 1998, the S&P rating is the firm's senior debt rating, which is an assessment of the creditworthiness of the firm's long-term debt that is not subordinate to any other long-term debt. Typically, the rating is for the firm's most senior debt issue. If a firm does not have senior debt, it is an implied senior rating. Beginning September 1, 1998, S&P credit ratings reflect the firm's overall creditworthiness; our inferences are the same before and after September 1, 1998. S&P does not require the rated firm to have debt outstanding. Of the 11,399 observations for 1,851 firms in our sample with S&P credit ratings, 67 observations for 45 firms have no debt. Thus, we do not restrict our expanded sample to firms with debt outstanding. Of the 37,682 observations for which we estimate credit risk, 6,339 have zero debt. Our credit risk estimation procedure is applicable to firms with zero debt—four of the six variables in Equation (A1) in the Appendix do not require the firm to have debt. Also, our inferences are unaffected by (1) eliminating firms with zero debt, (2) permitting the coefficients in Equation (A1) to vary for zero debt firms, and (3) placing all zero debt firms into the lowest *DBTA* portfolio in the ranked *DBTA* specification. Our inferences also are unchanged when we eliminate observations with negative equity book value.

[17] Consistent with Fama and French (1992) and Jegadeesh (1992), our inferences are unaffected by using beta-adjusted returns. However, using beta-adjusted returns noticeably reduces our sample size. We use annual returns for our tests because there is no basis on which to identify shorter return windows for sample firms without announced credit rating changes. Even for firms with such announcements, using annual returns mitigates the potential for mis-specifying when share prices reflect the change in economic fundamentals associated with the credit rating change (Pinches and Singleton 1978; Dichev and Piotroski 2001), mis-specifying market expectations at the announcement date, and confounding our inferences with information effects associated with the announcement.

TABLE 1
Descriptive Statistics
(n = 49,081)

Panel A: Distributional Statistics

Variable	Mean	Median	Std. Dev.
RET	−0.01	−0.07	0.54
Δ*CR*	0.01	0.00	0.44
DBTA	0.21	0.18	0.20
EPS	0.02	0.05	0.18
Δ*EPS*	0.01	0.01	0.19
NEG	0.26		

Panel B: Pearson (above the Diagonal) and Spearman (below the Diagonal) Correlations

	RET	Δ*CR*	*DBTA*	*EPS*	Δ*EPS*	*NEG*
RET		−0.20	−0.07	0.27	0.25	−0.25
Δ*CR*	−0.21		0.08	−0.21	−0.28	0.26
DBTA	−0.06	0.07		−0.13	−0.05	0.12
EPS	0.43	−0.26	−0.03		0.52	−0.65
Δ*EPS*	0.39	−0.37	−0.04	0.50		−0.29
NEG	−0.32	0.26	0.07	−0.76	−0.38	

Panel C: Industry Composition of Sample

Industry	SIC Codes	n	Percent
Mining and construction	1000–1999, except 1300–1399	1,266	2.58
Food	2000–2111	1,531	3.12
Textiles, printing, and publishing	2200–2799	3,871	7.89
Chemicals	2800–2824, and 2840–2899	1,618	3.30
Pharmaceuticals	2830–2836	1,600	3.26
Extractive industries	2900–2999, and 1300–1399	2,199	4.48
Durable manufacturers	3000–3999, except 3570–3579, 3670–3679	14,610	29.77
Computers	7370–7379, 3570–3579, and 3670–3679	7,039	14.34
Transportation	4000–4899	3,107	6.33
Retail	5000–5999	7,172	14.61
Services	7000–8999, except 7370–7379	5,068	10.32
		49,081	100.00

All correlations in Panel B are significantly different from 0. Sample of 7,561 Compustat firms from 1986–2003.
Variable Definitions:
RET = size-adjusted annual stock return, including dividends (from CRSP);
CR = credit risk group (1 = highest to 4 = lowest);
DBTA = ratio of debt (Compustat #9 + #44) to total assets (#6);
EPS = earnings per share before extraordinary items (#18/shares outstanding from CRSP), deflated by beginning of year stock price;
NEG = indicator for negative *EPS*; and
Δ = annual change.

the same time period. Panel A also reveals that sample firms have positive mean and median *EPS* and Δ*EPS*. Although the median credit risk change, Δ*CR*, is zero, the mean is positive, which indicates that, on average, credit risk increases. Table 1, Panel A, also reveals that mean *DBTA* is 21 percent and 26 percent of the sample firms have negative *EPS*.

Panel B of Table 1 reveals that *RET* is negatively correlated with ΔCR (Pearson correlation is −0.20 and Spearman correlation is −0.21), which is consistent with prior research and with ΔCR reflecting changes in asset value. As expected based on prior research, *RET* is positively correlated with *EPS* and ΔEPS. *RET* is negatively correlated with *DBTA*. Other correlations in Panel B also are consistent with expectations. For example, the correlations between *EPS* and ΔEPS are positive, and those between ΔCR and *EPS* and ΔEPS are negative. The negative correlation between ΔCR and *EPS* (ΔEPS) is consistent with a positive association between asset value changes and *EPS* (ΔEPS), which is consistent with earnings and credit risk change reflecting some common components of asset value change. ΔCR and *DBTA* are positively correlated, which is consistent with downgrade firms having more debt. *NEG* is negatively correlated with *RET*, *EPS*, and ΔEPS, and positively correlated with ΔCR and *DBTA*. All correlations are significantly different from zero.[18] However, we base our inferences on the Equation (4) multivariate relation.

Table 1, Panel C, reveals that the industries most highly represented in the sample are Durable Manufacturers (29.77 percent), Retail (14.61 percent), and Computers (14.34 percent). These percentages reflect the industry composition of the Compustat population. Untabulated statistics reveal that the industry composition of firms with credit ratings is similar to that in Panel C.

Primary Findings

Table 2 presents regression summary statistics from estimating Equation (4). It reveals, as predicted, that the relation between change in credit risk and equity returns is less negative for firms with more debt. In particular, the first set of columns in Panel A reveals that the coefficient on $\Delta CR \times DBTA$ is significantly positive (coef. = 0.19, t = 10.24). That is, the indirect equity value effect associated with a change in credit risk is significant. Also as predicted, the coefficient on ΔCR is significantly negative (coef. = −0.11, t = −19.56), those on *EPS* and ΔEPS are significantly positive (coefs. = 1.89 and 0.43, t = 72.11 and 26.03), and those on *NEG*, $NEG \times EPS$, and $NEG \times \Delta EPS$ are significantly negative (coefs. = −0.12, −1.80, and −0.28, t = −23.43, −57.10, and −13.19). Panel A also reveals that the coefficient on *DBTA* is significantly negative (coef. = −0.07, t = −7.82).

To compare the magnitudes of the direct and indirect effects, the second set of columns in Panel A presents summary statistics from estimating a version of Equation (4) using a ranked *DBTA* variable. The ranked *DBTA* variable is the decile rank of *DBTA*, scaled to be between 0 and 1. Specifically, we place firms into portfolios 0 to 9 with portfolio 9 comprising firms with the largest *DBTA*, and divide these portfolio ranks by 9. This permits us to interpret β_1 as the magnitude of the relation between change in credit risk and equity returns for firms with the lowest *DBTA*. The sum of β_1 and β_2 is the magnitude for firms with the highest *DBTA*.

Results of the rank regression in the second set of columns in Table 2, Panel A are consistent with predictions and the results in the first set of columns. Most importantly, the coefficient on $\Delta CR \times DBTA$ is positive, 0.12, and significantly different from zero (t = 9.75). This finding indicates that changes in debt value associated with changes in credit risk are significantly negatively associated with equity value. The sum of β_1 and β_2, −0.13

[18] We use the term significance to denote statistical significance at less than the 0.05 level based on a one-sided test when we have signed predictions and a two-sided test otherwise.

TABLE 2
Regression of Returns on Debt Interacted with Credit Risk Change
(n = 49,081)

$$RET_t = \beta_0 + \beta_1 \Delta CR_t + \beta_2 \Delta CR_t \times DBTA_t + \beta_3 DBTA_t + \beta_4 EPS_t + \beta_5 \Delta EPS_t + \beta_6 NEG_t + \beta_7 NEG_t \times EPS_t + \beta_8 NEG_t \times \Delta EPS_t + \varepsilon_{4t}$$

Panel A: Pooled Credit Risk Effects

	Pred.	Coef.	t-statistic	*DBTA* Ranks Coef.	*DBTA* Ranks t-statistic
ΔCR	−	−0.11	−19.56	−0.13	−18.02
$\Delta CR \times DBTA$	+	0.19	10.24	0.12	9.75
DBTA	?	−0.07	−7.82	−0.04	−7.32
EPS	+	1.89	72.11	1.90	72.25
ΔEPS	+	0.43	26.03	0.43	26.02
NEG	−	−0.12	−23.43	−0.12	−23.59
$NEG \times EPS$	−	−1.80	−57.10	−1.80	−57.12
$NEG \times \Delta EPS$	−	−0.28	−13.19	−0.29	−13.31
Adj. R^2		0.17		0.17	

Panel B: Separate Effects for Downgrades and Upgrades

	Pred.	Coef.	t-statistic	Coef.	t-statistic
$DN \times \Delta CR$	−	−0.09	−10.90		
$DN^{INV} \times \Delta CR$	−			−0.01	−0.19
$DN^{ACR} \times \Delta CR$	−			−0.04	−3.52
$DN^{NINV} \times \Delta CR$	−			−0.13	−12.13
$DN \times \Delta CR \times DBTA$	+	0.17	7.53		
$DN^{INV} \times \Delta CR \times DBTA$	+			0.04	0.37
$DN^{ACR} \times \Delta CR \times DBTA$	+			0.15	4.88
$DN^{NINV} \times \Delta CR \times DBTA$	+			0.19	5.64
$UP \times \Delta CR$	−	−0.13	−15.42		
$UP^{INV} \times \Delta CR$	−			−0.11	−3.93
$UP^{ACR} \times \Delta CR$	−			−0.10	−7.09
$UP^{NINV} \times \Delta CR$	−			−0.16	−14.83
$UP \times \Delta CR \times DBTA$	+	0.18	4.95		
$UP^{INV} \times \Delta CR \times DBTA$	+			0.27	2.18
$UP^{ACR} \times \Delta CR \times DBTA$	+			0.09	1.39
$UP^{NINV} \times \Delta CR \times DBTA$	+			0.21	4.70
DBTA	?	−0.07	−7.11	−0.07	−7.17
EPS	+	1.89	72.17	1.90	72.59
ΔEPS	+	0.42	25.40	0.42	25.20
NEG	−	−0.13	−23.67	−0.12	−22.88
$NEG \times EPS$	−	−1.81	−57.36	−1.82	−57.65
$NEG \times \Delta EPS$	−	−0.27	−12.27	−0.27	−12.44
Adj. R^2		0.17		0.17	

(*continued on next page*)

TABLE 2 (continued)

Huber M-estimates are presented, with year and industry fixed effects untabulated. Sample of 7,561 Compustat firms from 1986–2003. See Table 1 for industry composition.

Variable Definitions:

RET = size-adjusted annual stock return, including dividends (from CRSP);
CR = credit risk group (1 = highest to 4 = lowest);
DBTA = ratio of debt (Compustat #9 + #44) to total assets (#6);
DBTA ranks = decile rank of *DBTA*, scaled between 0 and 1;
EPS = earnings per share before extraordinary items (#18/shares outstanding from CRSP), deflated by beginning of year stock price;
NEG = indicator for negative net income before extraordinary items;
DN (*UP*) = indicator for credit downgrade (upgrade);
DN^{INV} (UP^{INV}) = indicator for credit downgrade (upgrade) within investment grade;
DN^{NINV} (UP^{NINV}) = indicator for credit downgrade (upgrade) within non-investment grade;
DN^{ACR} (UP^{ACR}) = indicator for credit downgrade (upgrade) across grades; and
Δ = annual change.

+ 0.12, is not significantly different from zero (t = −0.70). This finding indicates that for the highest debt firms, the increase in equity value associated with a decrease in debt value, i.e., the indirect effect, essentially offsets the decrease in equity value associated with a decrease in asset value, i.e., the direct effect. Our lowest *DBTA* decile firms have zero debt. Thus, finding that β_1 is significantly negative (t = −18.02) indicates that for zero debt firms an increase in credit risk is associated with a decrease in equity value, which reflects the direct effect on equity value of change in credit risk.

Our primary findings are based on pooled estimates of Equation (4). Although Equation (4) includes year and industry fixed effects, the relations could exhibit differences across years and industries other than mean effects. However, untabulated findings reveal that this is not the case. Separate-year estimation yields positive coefficients on $\Delta CR \times DBTA$ in all 18 years, and a cross-year Z-statistic of 12.35.[19] Separate-industry estimation yields coefficients on $\Delta CR \times DBTA$ that are positive in all 11 industries; the cross-industry Z-statistic is 3.74. All other results are consistent with those in Table 2.

The first set of columns in Table 2, Panel B, relates to estimating Equation (4) permitting the coefficients on ΔCR and $\Delta CR \times DBTA$ to vary with the sign of the credit risk change. Consistent with the findings in Panel A, the Panel B findings reveal that ΔCR is significantly negatively related to *RET* for credit downgrades, $DN \times \Delta CR$, and upgrades, $UP \times \Delta CR$ (coef. = −0.09; t = −10.90 for downgrades; coef. = −0.13; t = −15.42 for upgrades). Thus, downgrade (upgrade) firms have significantly negative (positive) incremental returns. More importantly for our research question, the findings also reveal that the relation between credit downgrades (upgrades) and returns is less negative (positive) for firms with more debt. The coefficient on $\Delta CR \times DBTA$ is significantly positive for firms with credit downgrades, $DN \times \Delta CR \times DBTA$, and upgrades, $UP \times \Delta CR \times DBTA$, (coef. = 0.17; t = 7.53 for downgrades; coef. = 0.18; t = 4.95 for upgrades). Untabulated findings based on the ranked *DBTA* specification reveal the same inferences.[20]

[19] Z = (mean t)/(std. deviation t/$\sqrt{N-1}$), where *N* is the number of years (industries) and *t* is the t-statistic on the estimated coefficient for each year (industry) (see White 1980; Bernard 1987).

[20] That the tabulated coefficient for downgrade firms, 0.17, is smaller than that for upgrade firms, 0.18, appears inconsistent with predictions from Merton (1974). However, findings from an untabulated ranked *DBTA* specification, which permits comparison of coefficient magnitudes, reveal that the coefficient for downgrade firms, 0.11, is larger than that for upgrade firms, 0.10.

Findings from estimating Equation (4) partitioning firms based on the type of credit risk change are in the second set of columns in Table 2, Panel B. As the Appendix notes, credit rating groups 1, 2, 3, and 4 are analogous to firms with ratings of AAA to A−, BBB+ to BBB−, BB+ to BB−, and B+ to D, respectively. The first two groups comprise investment grade ratings; the second two comprise non-investment grade. In Table 2, Panel B, $DN^{INV} = 1$ for firms downgraded from the highest credit group, $CR = 1$, to the second highest, $CR = 2$, and 0 otherwise. Thus, firms with $DN^{INV} = 1$ are downgraded within investment grade. $DN^{ACR} = 1$ for firms downgraded from group 1 or 2 to group 3 or 4, and 0 otherwise. Thus, firms with $DN^{ACR} = 1$ are downgraded from investment grade to non-investment grade. $DN^{NINV} = 1$ for firms downgraded from group 3 to group 4, and 0 otherwise. Thus, firms with $DN^{NINV} = 1$ are downgraded within non-investment grade. UP^{INV}, UP^{ACR}, and UP^{NINV} are analogously defined. $UP^{INV} = 1$ for firms upgraded within investment grade, $UP^{ACR} = 1$ for firms upgraded from non-investment grade to investment grade, and $UP^{NINV} = 1$ for firms upgraded within non-investment grade.

The findings reveal that our inferences extend to almost all levels of credit risk. The coefficients on $\Delta CR \times DBTA$ interacted with DN^{ACR}, DN^{NINV}, UP^{INV}, and UP^{NINV} are significantly positive, as predicted (t-statistics range from 2.18 to 5.64). The coefficients on $DN^{INV} \times \Delta CR \times DBTA$ and $UP^{ACR} \times \Delta CR \times DBTA$ are positive, as predicted, but not significantly so (t = 0.37 and 1.39). These findings indicate that for all levels of credit risk changes, except downgrades within investment grade and upgrades to investment grade, equity value changes are significantly associated with debt value changes.[21]

V. ADDITIONAL ANALYSES

Estimates of Change in Debt Value Based on Change in Interest Rates

The findings in Table 2 reveal that the relation between returns and credit risk changes depends on the amount of debt. To provide additional evidence on whether the effect we document in Table 2 is attributable to change in debt value rather than to other effects, we calculate the gain or loss arising from the change in each firm's debt value attributable to a change in the firm's credit risk. We calculate the gain or loss using Equation (5) and then evaluate the relation between it and equity return:

$$GL\_ACC = \sum_{t=1}^{5} - DEBTt \times \left[\frac{1}{(1 + R_{end})^t} - \frac{1}{(1 - R_{beg})^t}\right] - DEBT6^{+} \times \left[\frac{1}{(1 + R_{end})^{10}} - \frac{1}{(1 + R_{beg})^{10}}\right]. \quad (5)$$

DEBTt is debt maturing in each of the next five years and $DEBT6^{+}$ is debt maturing in six years and beyond. We multiply $DEBT6^{+}$ by factors taken to the 10th power because we assume that any debt not maturing in the next five years matures in ten years.[22] We obtain debt maturities from financial statement footnotes. The terms in brackets capture the interest rate change related to the firm's change in credit risk. To construct these terms, we use the

[21] When we limit the sample to firms without credit ratings, our inferences are unaffected. When we use actual credit ratings for firms that have them and *CR* for firms without them, our inferences are unaffected, except that the coefficient on $DN^{INV} \times \Delta CR \times DBTA$ is significantly positive as predicted (t = 1.79), and the coefficient on $UP^{INV} \times \Delta CR \times DBTA$ is not significantly different from zero (t = 0.78).

[22] Lack of data precludes us from making a more refined estimate. However, we alternatively assumed debt matures in six years or 20 years, with no change in our inferences. These findings suggest it is unlikely that our inferences are affected by the maturity assumption.

average historical interest rate over our sample period associated with each credit risk category.[23] R_{beg} (R_{end}) is the average historical interest rate associated with the firm's credit risk, *CR*, at the beginning (end) of the year. Thus, R_{beg} differs from R_{end} only if the firm's credit risk changed during the year. Using the average rate avoids confounding temporal effects and helps insulate *GL_ACC* from effects associated with changes in market interest rates between the beginning and end of the year.

For comparison, we calculate the debt gain or loss implied by the parameters estimated in Equation (4). The market-implied gain or loss on debt, *GL_MKT*, is $0.19 \times \Delta CR \times DBTA$. We use 0.19 because it is the estimate of β_2 in Table 2, Panel A. *GL_ACC* and *GL_MKT* are per share, deflated by beginning of year stock price. The reduced sample size of 28,837 observations for this test reflects lack of yearly debt payment data and elimination of firms with *GL_ACC* or *GL_MKT* in the extreme top and bottom percentiles of observations, which mitigates the effect of outliers on our inferences. Table 3, Panel A, reveals that the means (standard deviations) of *GL_ACC* and *GL_MKT* are 0.00 and 0.00 (0.01 and 0.01). Panel B reveals that *GL_ACC* and *GL_MKT* are significantly positively correlated; the Pearson (Spearman) correlation is 0.81 (0.99). Correlations between *GL_ACC* and *RET* are similar to those between *GL_MKT* and *RET*.

Table 3, Panel C, presents regression summary statistics from Equation (4) with *GL_ACC* instead of $\Delta CR \times DBTA$. Inferences are the same as those we obtain from Table 2. In particular, the gain or loss on debt associated with changes in credit risk attenuates the equity gain or loss reflected in ΔCR. The coefficient on *GL_ACC* is 2.41, with a t-statistic of 7.82. All other results are similar to those in Table 2.[24]

EPS Interacted with DBTA

Equation (4) includes *EPS* and ΔEPS as proxies for change in asset value associated with change in equity value. However, change in asset value reflected in earnings could also be associated with change in debt value. Thus, we estimate Equation (6), which allows the relation between earnings and equity returns to depend on the amount of debt.

$$\begin{aligned} RET_t = {} & \beta_0 + \beta_1 \Delta CR_t + \beta_2 \Delta CR_t \times DBTA_t + \beta_{2a} EPS'_t \times DBTA_t \\ & + \beta_{2b} \Delta EPS'_t \times DBTA_t + \beta_3 DBTA_t + \beta_4 EPS'_t + \beta_5 \Delta EPS'_t \\ & + \beta_6 NEG'_t + \beta_7 NEG'_t \times EPS'_t + \beta_8 NEG'_t \times \Delta EPS'_t + \varepsilon_{6t}. \end{aligned} \tag{6}$$

EPS' is earnings per share before interest expense and extraordinary items deflated by beginning-of-year stock price, and $NEG' = 1$ if *EPS'* is negative, and 0 otherwise. Consistent with Equation (4), we predict β_{2a} and β_{2b} are negative. In this section we interpret ΔCR, *EPS'*, and $\Delta EPS'$ as alternative proxies for change in asset value associated with change in debt value, and test for the joint explanatory power of β_2, β_{2a}, and β_{2b}.

Estimating Equation (6) allows us to relate our findings to those of Dhaliwal et al. (1991; hereafter, DLF). DLF estimate the relation between annual return and change in

[23] We obtain historical interest rates for the Moody's equivalent of the highest and second-highest credit risk groups from http://www.federalreserve.com. We estimate interest rates of the lowest credit risk group by adding a risk premium of 5 percent, which is the approximate spread between lower investment grade and junk bond rates during our sample period. We estimate interest rates for the remaining group by averaging those of the second-highest and lowest credit risk groups.

[24] In the spirit of Table 2, Panel B, we also estimate Equation (5) permitting different coefficients on gains and losses. Untabulated findings reveal that the coefficient on gains is significantly larger than that on losses (t = 3.36).

TABLE 3
Regression Relating Debt Gain/Loss to Returns
(n = 28,837)

Panel A: Descriptive Statistics for Regression Variables

Variable	Mean	Median	Std. Dev.
RET	−0.01	−0.07	0.53
GL_ACC	0.00	0.00	0.01
GL_MKT	0.00	0.00	0.01

Panel B: Pearson (above the Diagonal) and Spearman (below the Diagonal) Correlations

	RET	*GL_ACC*	*GL_MKT*
RET		−0.11	−0.10
GL_ACC	−0.19		0.81
GL_MKT	−0.19	0.99	

Panel C: Regression Summary Statistics from:

$$RET_t = \beta_0 + \beta_1 \Delta CR_t + \beta_2 GL\_ACC_t + \beta_3 DBTA_t + \beta_4 EPS_t + \beta_5 \Delta EPS_t + \beta_6 NEG_t + \beta_7 NEG_t \times EPS_t + \beta_8 NEG_t \times \Delta EPS_t + \varepsilon_t$$

	Pred.	Coef.	t-statistic
ΔCR	−	−0.11	−14.26
GL_ACC	+	2.41	7.82
DBTA	?	−0.09	−7.91
EPS	+	1.88	54.90
ΔEPS	+	0.50	22.89
NEG	−	−0.12	−17.26
NEG × EPS	−	−1.82	−44.22
NEG × ΔEPS	−	−0.31	−10.90
Adj. R^2		0.17	

All correlations in Panel B are significantly different from 0. Huber M-estimates are presented in Panel C, with year and industry fixed effects untabulated. Sample of 5,623 Compustat firms from 1986–2003.

$$GL\_ACC = \sum_{t=1}^{5} - DEBTt \times \left[\frac{1}{(1 + R_{end})^t} - \frac{1}{(1 + R_{beg})^t}\right] - DEBT6^+ \times \left[\frac{1}{(1 + R_{end})^{10}} - \frac{1}{(1 + R_{beg})^{10}}\right],$$

deflated by $shares_t \times price_{t-1}$,

where:

R = interest rate associated with the firm's credit risk group, averaged over 1986 to 2003;
$DEBTt$ = debt maturing in each of the next one to five years (Compustat #44, #91–#94); and
$DEBT6^+$ = debt maturing in six years and beyond (#9 less the sum of #91–#94).

$$GL\_MKT = \beta \times \Delta CR \times DBTA$$

where:

β = 0.19 from Table 2, Panel A;
RET = size-adjusted annual stock return, including dividends (from CRSP);
CR = credit risk group (1 = highest to 4 = lowest);
DBTA = ratio of debt (#9 + #44) to total assets (#6);
EPS = earnings per share before extraordinary items (#18/shares outstanding from CRSP), deflated by beginning of year stock price;
NEG = indicator for negative net income before extraordinary items; and
Δ = annual change.

earnings, permitting the coefficient on change in earnings, i.e., the earnings response coefficient, to vary with leverage. DLF focus on change in earnings before interest expense so that the earnings change captures asset value change related to debt and equity. DLF interpret change in earnings as unexpected earnings and leverage as a proxy for default risk. DLF predict the earnings response coefficient is smaller for high leverage firms.[25] DLF reason that if earnings provides information about the value of the firm, then the response of equity value to unexpected earnings will be affected by default risk because more of the change in asset value accrues to debt holders for firms closer to default. The first term on the right-hand side of Equation (1) captures this notion in that $\Delta E = \Delta A \, N(d_1)$, where d_1 is a function of leverage.

Table 4 presents the regression summary statistics from Equation (6). It reveals that the coefficients on $\Delta CR \times DBTA$, $EPS' \times DBTA$, and $\Delta EPS' \times DBTA$ are all significantly different from zero (t = 8.07, −23.21, and 3.91), although the coefficient on $\Delta EPS' \times DBTA$

TABLE 4
Regression Allowing Earnings Response to Vary with Debt
(n = 46,025)

$$RET_t = \beta_0 + \beta_1 \Delta CR_t + \beta_2 \Delta CR_t \times DBTA_t + \beta_{2a} EPS'_t \times DBTA_t + \beta_{2b} \Delta EPS'_t \times DBTA_t + \beta_3 DBTA_t + \beta_4 EPS'_t + \beta_5 \Delta EPS'_t + \beta_6 NEG'_t + \beta_7 NEG'_t \times EPS'_t + \beta_8 NEG'_t \times \Delta EPS'_t + \varepsilon_{6t}$$

				DBTA Ranks	
	Pred.	**Coef.**	**t-statistic**	**Coef.**	**t-statistic**
ΔCR	−	−0.12	−20.04	−0.12	−15.59
$\Delta CR \times DBTA$	+	0.16	8.07	0.07	5.40
$EPS' \times DBTA$	−	−0.80	−23.21	−0.69	−20.40
$\Delta EPS' \times DBTA$	−	0.16	3.91	0.13	4.05
$DBTA$	?	−0.22	−22.52	−0.11	−16.99
EPS'	+	0.93	41.55	1.11	35.41
$\Delta EPS'$	+	0.33	16.47	0.30	11.43
NEG'	−	−0.19	−31.12	−0.19	−31.55
$NEG' \times EPS'$	−	−0.62	−21.29	−0.62	−21.00
$NEG' \times \Delta EPS'$	−	−0.27	−12.15	−0.26	−11.54
Adj. R^2		0.15		0.14	

Huber M-estimates are presented, with year and industry fixed effects untabulated. Sample of 7,561 Compustat firms from 1986–2003. See Table 1 for industry composition.

Variable Definitions:
RET = size-adjusted annual stock return, including dividends (from CRSP);
CR = credit risk group (1 = highest to 4 = lowest);
DBTA = ratio of debt (Compustat #9 + #44) to total assets (#6);
DBTA ranks = decile rank of *DBTA*, scaled between 0 and 1;
EPS′ = earnings per share before interest expense and extraordinary items [(#18 + #15)/shares outstanding from CRSP], deflated by beginning of year stock price;
NEG′ = indicator for negative *EPS′*; and
Δ = annual change.

[25] DLF also include proxies for risk and earnings persistence. In Equation (6), ΔCR reflects risk; permitting the coefficients on EPS' and $\Delta EPS'$ to vary with NEG' allows for different persistence of positive and negative earnings.

does not have the predicted sign.[26] An untabulated F-test confirms the joint significance of the variables.[27] Untabulated separate-year and separate-industry estimations reveal coefficients on $\Delta CR \times DBTA$, $EPS' \times DBTA$, and $\Delta EPS' \times DBTA$ that are consistent with predictions in 18, 18, and 10 of 18 years, and in 11, 9, and 6 of 11 industries. The untabulated estimations also reveal Z-statistics that confirm the significance of the coefficient estimates on $\Delta CR \times DBTA$ and $EPS' \times DBTA$, and that all other findings are consistent with those in Table 4.[28]

The finding in Table 4 relating to $\Delta CR \times DBTA$ is consistent with that in Table 2, and reveals that our inferences are robust to including additional proxies for change in asset value associated with change in debt value. Although an untabulated estimation reveals that in a rank version of Equation (6) $\beta_1 + \beta_2$, which equals -0.05, is significantly negative ($t = -3.32$), this sum does not incorporate the incremental effects associated with EPS' and $\Delta EPS'$. The Table 4 findings also reveal that the effect we document is incremental to that documented in DLF. In particular, after controlling for $\Delta EPS' \times DBTA$, the coefficients on $\Delta CR \times DBTA$ and $EPS' \times DBTA$ are significantly positive and negative, respectively.

Separating Change in Risk and Change in Asset Value

Among other effects, change in credit risk reflects change in asset value. Change in asset value arises from change in expected systematic asset risk, change in expected asset cash flows, or both. In this section, we attempt to separately investigate these components of change in credit risk to determine whether our primary findings relate to both of these components or only one. In particular, we estimate Equation (7) in which we replace change in credit risk, ΔCR, with change in equity cost of capital, ΔECC, and change in analyst earnings forecasts, ΔAF:

$$\begin{aligned} RET_t = {} & \beta_0 + \beta_1 \Delta ECC_t + \beta_2 \Delta ECC_t \times DBTA_t + \beta_3 \Delta AF_t + \beta_4 \Delta AF_t \times DBTA_t \\ & + \beta_5 DBTA_t + \beta_6 EPS_t + \beta_7 \Delta EPS_t + \beta_8 NEG_t + \beta_9 NEG_t \times EPS_t \\ & + \beta_{10} NEG_t \times \Delta EPS_t + \varepsilon_{7t}. \end{aligned} \tag{7}$$

We use ECC as our proxy for expected systematic asset risk because systematic equity risk is systematic asset risk after taking account of leverage. Thus, the interaction of $DBTA$ and ΔECC in Equation (7) will be significantly positive if equity returns associated with increases in expected systematic asset risk are more positive for firms with more debt. We use AF as our proxy for expected asset cash flows because asset value changes arising from changes in expected cash flows will be reflected in future earnings, which are the object of analyst forecasts.

We estimate ECC following Claus and Thomas (2001), Gebhardt et al. (2001), Gode and Mohanram (2003), and Easton (2004). Each study's estimate is based on the residual income model, after specifying a relation between equity cost of capital, equity market

[26] Untabulated findings reveal that the coefficient on $\Delta EPS' \times DBTA$ is significantly negative (-0.28, $t = -7.32$) when $EPS' \times DBTA$ is excluded from the estimating equation.

[27] Because interest expense is pretax, we implicitly assume the effective tax rate is zero. Untabulated findings reveal similar inferences when we assume either a tax rate of 35 percent or an estimate of each firm's effective tax rate, i.e., income tax expense divided by pretax income.

[28] Using EPS in Equation (6) in place of EPS' does not affect inferences relating to $\Delta CR \times DBTA$ or $EPS' \times DBTA$. However, consistent with DLF's use of $\Delta EPS'$, it affects inferences relating to $\Delta EPS' \times DBTA$. Its coefficient is significantly different from zero with an unpredicted sign (insignificantly different from zero) in the pooled (year-by-year) estimation.

value, equity book value, and forecasted earnings and dividends. We use the assumptions in Dhaliwal et al. (2005). Following Dhaliwal et al. (2005) and Hail and Leuz (2006), *ECC* is the mean of these four cost of equity estimates. To mitigate the effects of error in estimating *ECC*, we eliminate observations for which $ECC < 0$ percent or $ECC > 50$ percent. *AF* is the consensus, i.e., median, one-year-ahead forecast of annual earnings per share in June of year t, minus the consensus two-year-ahead forecast of annual earnings per share in June of year $t-1$, scaled by stock price in June of year $t-1$. We exclude observations in the extreme top and bottom percentiles of the *AF* distribution. The reduced sample size of 22,769 observations for this analysis primarily reflects lack of analyst forecast data and our data trimming procedures.

Table 5 presents the findings. Panel A presents descriptive statistics and reveals that the mean and median ΔECC are -0.00. The mean (median) ΔAF is -0.02 (-0.01), which is consistent with analysts "walking down" their forecasts over time (Richardson et al. 2004). The distributional statistics for the other variables are similar to those in Table 1, Panel A. Table 5, Panel B, reveals that *RET* is negatively (positively) correlated with ΔECC (ΔAF), which is consistent with equity value decreases being correlated with systematic risk increases (expected cash flow decreases). Panel B also reveals that ΔECC (ΔAF) is significantly positively (negatively) correlated with ΔCR. Because increases in equity cost of capital and decreases in expected earnings are associated with increases in credit risk, these correlations support our use of ΔECC and ΔAF as proxies for the two components of ΔCR.

Panel C of Table 5 presents two sets of regression summary statistics from Equation (7). The first set is based on estimating Equation (7) directly. The findings from this set reveal, as expected, that ΔECC (ΔAF) is significantly negatively (positively) related to returns (t = -32.04 (10.46)). More importantly for our research question, the findings reveal that the relation is significantly less negative (positive) for firms with more debt. The coefficient on $\Delta ECC \times DBTA$ is significantly positive (t = 5.36) and that on $\Delta AF \times DBTA$ is significantly negative (t = -6.81). All other inferences are the same as those we obtain from Table 2. Untabulated summary statistics based on a *DBTA* rank regression reveal similar inferences. These findings indicate that our Table 2 findings are attributable to changes in expected systematic asset risk, as captured by ΔECC, as well as changes in expected asset cash flows, as captured by ΔAF.

The second set of findings in Panel C of Table 5 is based on estimating Equation (7) using a two-stage approach. Recall that our construction of *ECC* uses equity returns as an input. Thus, it is possible that the relation between *RET* and $\Delta ECC \times DBTA$ or ΔECC in Equation (7) stems from our construction of *ECC*, not from any economic relation. To obtain an estimate of ΔECC that does not depend on *RET*, we re-estimate Equation (7) replacing ΔECC with the predicted value from Equation (8):

$$\begin{aligned}\Delta ECC_t = {} & \beta_0 + \beta_1 \Delta CR_t + \beta_2 \Delta CR_t \times DBTA_t + \beta_3 DBTA_t + \beta_4 EPS_t \\ & + \beta_5 \Delta EPS_t + \beta_6 NEG_t + \beta_7 NEG_t \times EPS_t + \beta_8 NEG_t \times \Delta EPS_t \\ & + \beta_9 \Delta r_{f,t} + \varepsilon_{8t}. \end{aligned} \quad (8)$$

The explanatory variables in Equation (8) comprise all of those in Equation (7), which likely are related to *RET* but not to the true error in Equation (7), and the change in the risk-free interest rate, Δr_f. r_f is the annual one-year Treasury rate published on http://www.federalreserve.gov. Because the t-statistics from the second-stage estimation do not

TABLE 5
Regressions Relating Returns to Cost of Capital Changes and Analyst Earnings Forecast Revisions
(n = 22,769)

Panel A: Distributional Statistics for Regression Variables

Variable	Mean	Median	Std. Dev.
RET	−0.01	−0.05	0.49
ΔCR	0.02	0.00	0.46
ΔECC	−0.00	−0.00	0.03
ΔAF	−0.02	−0.01	0.03
DBTA	0.20	0.18	0.17
EPS	0.04	0.05	0.12
ΔEPS	0.00	0.01	0.12
NEG	0.18		

Panel B: Pearson (above the Diagonal) Spearman (below the Diagonal) Correlations

	RET	*ΔCR*	*ΔECC*	*ΔAF*	*DBTA*	*EPS*	*ΔEPS*	*NEG*
RET		−0.23	−0.31	0.16	−0.07	0.25	0.25	−0.23
ΔCR	−0.24		0.15	−0.16	0.09	−0.26	−0.34	0.32
ΔECC	−0.33	0.15		−0.07	0.04	−0.14	−0.15	0.14
ΔAF	0.22	−0.17	−0.09		−0.10	0.41	0.15	−0.45
DBTA	−0.05	0.08	0.03	−0.10		−0.07	−0.06	0.08
EPS	0.40	−0.27	−0.17	0.38	0.04		0.55	−0.64
ΔEPS	0.41	−0.41	−0.23	0.28	−0.03	0.52		−0.32
NEG	−0.28	0.32	0.12	−0.38	0.04	−0.66	−0.38	

Panel C: Regression Summary Statistics from:

$$RET_t = \beta_0 + \beta_1 \Delta ECC_t + \beta_2 \Delta ECC_t \times DBTA_t + \beta_3 \Delta AF_t + \beta_4 \Delta AF_t \times DBTA_t + \beta_5 DBTA_t + \beta_6 EPS_t + \beta_7 \Delta EPS_t + \beta_8 NEG_t + \beta_9 NEG_t \times EPS_t + \beta_{10} NEG_t \times \Delta EPS_t + \varepsilon_{7t}$$

				Two-Stage		
	Pred.	Coef.	t-statistic	Coef.	t-statistic	Bootstrapped t-statistic
ΔECC	−	−4.09	−32.04	−16.75	−15.27	−8.96
ΔECC × *DBTA*	+	2.40	5.36	5.30	2.94	2.05
ΔAF	+	1.21	10.46	1.05	8.72	6.28
ΔAF × *DBTA*	−	−2.58	−6.81	−2.03	−5.13	−4.07
DBTA	?	−0.13	−8.09	−0.06	−3.59	−2.57
EPS	+	1.80	38.49	1.66	29.05	8.70
ΔEPS	+	0.80	24.37	0.40	8.10	3.40
NEG	−	−0.11	−14.28	−0.03	−2.53	−1.35
NEG × *EPS*	−	−1.78	−29.91	−1.63	−23.85	−8.38
NEG × *ΔEPS*	−	−0.62	−14.15	−0.45	−9.43	−3.59
Adj. R^2		0.20		0.17		

(*continued on next page*)

TABLE 5 (continued)

Panel D: Regression Summary Statistics from:

$$\Delta ECC_t = \beta_0 + \beta_1 \Delta CR_t + \beta_2 \Delta CR_t \times DBTA_t + \beta_3 DBTA_t + \beta_4 EPS_t + \beta_5 \Delta EPS_t + \beta_6 NEG_t + \beta_7 NEG_t \times EPS_t + \beta_8 NEG_t \times \Delta EPS_t + \beta_9 \Delta r_{f,t} + \varepsilon_{8t}$$

	Pred.	Coef.	t-statistic
ΔCR	+	0.01	10.56
$\Delta CR \times DBTA$	−	−0.01	−2.77
$DBTA$	?	0.01	4.06
EPS	−	−0.03	−7.93
ΔEPS	−	−0.03	−10.05
NEG	+	0.00	7.74
$NEG \times EPS$	+	0.02	5.53
$NEG \times \Delta EPS$	+	0.01	3.37
Δr_f	+	0.61	30.03
Adj. R^2		0.08	

All correlations in Panel B are significantly different from 0. Huber M-estimates are presented in Panel C, with year and industry fixed effects untabulated. In the two-stage estimation in Panel C, ΔECC is the predicted value from the Panel D regression. Bootstrapped t-statistics are based on the standard deviations of the coefficient estimates from 1,000 iterations of the two-stage analysis each based on 3,000 randomly selected sample firms, with replacement. Sample of 4,357 Compustat firms from 1986–2003.

Variable Definitions:
- *RET* = size-adjusted annual stock return, including dividends (from CRSP);
- *ECC* = the mean of the equity cost of capital estimates from the Gebhardt et al. (2001), Claus and Thomas (2001), Gode and Mohanram (2003), and Easton (2004) models; we calculate equity cost of capital at the end of June for each year;
- *CR* = credit risk group (1 = highest to 4 = lowest);
- *AF* = revision in analysts' consensus (median) earnings per share forecast, from June of prior year to June of current year (from I/B/E/S summary file), deflated by price;
- *DBTA* = ratio of debt (Compustat #9 + #44) to total assets (#6);
- *EPS* = earnings per share before extraordinary items (#18/shares outstanding from CRSP), deflated by beginning of year stock price;
- r_f = annual one-year Treasury rate; and
- Δ = annual change.

reflect estimation error in the first-stage estimation, they likely are overstated. Thus, we also report bootstrapped t-statistics. Bootstrapped t-statistics are based on the standard deviations of coefficient estimates from 1,000 iterations of the two-stage analysis.[29] Inferences from the second set of findings in Panel C, which relate to the two-stage estimation, are the same as those from the first. Most importantly, the coefficient on $\Delta ECC \times DBTA$ is significantly positive (t = 2.94, bootstrapped t = 2.05) and that on $\Delta AF \times DBTA$ is significantly negative (t = −5.13, bootstrapped t = −4.07).

Panel D of Table 5 presents regression summary statistics from Equation (8), i.e., the first stage of the two-stage estimation in Panel C. The findings in Panel D are as expected. In particular, they confirm that ΔECC is significantly positively associated with ΔCR after controlling for leverage, earnings, change in earnings, and change in the risk-free interest

[29] We estimate the two-stage regression for each of 1,000 samples of 3,000 firms randomly selected with replacement from our sample firms. The bootstrapped standard error for each t-statistic is the standard deviation of each coefficient estimate across the 1,000 estimations.

rate (t = 10.56). The significantly negative coefficient on $\Delta CR \times DBTA$ confirms that debt attenuates this relation (t = −2.77). The significantly positive coefficient on *DBTA* indicates that leverage is positively related to equity cost of capital (t = 4.06). The remaining coefficients are consistent with expectations based on how we construct ΔECC. In particular, the significantly negative (positive) coefficients on *EPS* and ΔEPS (NEG, $NEG \times EPS$, and $\Delta NEG \times EPS$) indicate that positive earnings are associated with decreases in expected equity cost of capital (t = −7.93 and −10.05; t = 7.74, 5.53, and 3.37); and the significantly positive coefficient on Δr_f indicates that increases in expected equity cost of capital are positively associated with increases in market interest rates.

Debt Covenants

Debt holders may protect the value of their debt from increases in credit risk by including covenants in debt contracts. Some covenants are designed to prevent the firm from rising above a particular level of credit risk; others are designed to minimize costs to debt holders associated with a credit risk increase. Thus, covenants can mitigate the effects of credit risk increases on debt value and, thus, on equity value (Core and Schrand 1999). To investigate this possibility, we estimate Equation (4) including ΔSP and $\Delta SP \times DBTA$ interacted with an indicator variable, *COV*, which equals 1 if more than one-half of the firm's debt issues have covenants, and 0 otherwise. The mean of *COV* for our sample is 0.53. Because *COV* is available only for firms with credit ratings, we use S&P credit ratings, *SP*, in this analysis as our proxy for credit risk. This results in a substantially smaller sample than in our primary analysis. We predict a negative coefficient on $\Delta SP \times DBTA \times COV$. We do not predict the sign of the coefficient on $\Delta SP \times COV$. Table 6 presents the findings. As predicted, $\Delta SP \times DBTA \times COV$'s coefficient is significantly negative (t = −1.93). This indicates that equity holders do not benefit as much from the presence of debt when covenants in debt contracts protect debt holders from participating in losses associated with increases in credit risk.[30]

VI. INCOME EFFECTS OF RECOGNIZING CHANGES IN DEBT VALUES

Estimating Asset and Debt Values and Asset Volatility

Merton (1974) provides a mechanism for decomposing equity value into the values of assets and liabilities. This permits us to provide descriptive evidence on the net income effects of recognizing changes in debt values. Specifically, given observed equity value and historical stock volatility, we invert the Merton (1974) model to obtain estimates of asset value and its volatility. We use these estimates to estimate debt value.

Our estimation procedure generally follows Hillegeist et al. (2004; hereafter, HKCL). Equity value is fiscal year-end share price times the number of shares outstanding. Following HKCL, we estimate equity volatility using daily stock returns and require at least 80 percent of the returns to be non-missing in the estimation period. We differ from HKCL in that we estimate the remaining term of the debt rather than assuming it equals one year. Compustat provides the amount of debt due in each of the next five years. Thus, we calculate the weighted average remaining term of the firm's debt by summing the percentage of total debt outstanding in each maturity category times the number of years in that category. Consistent with how we estimate *GL_ACC* in Section V, we assume that the

[30] Untabulated statistics reveal that *COV* and *DBTA* are significantly positively correlated, although the correlation is small, 0.09. To control for this, in an untabulated analysis we use *COV** in place of *COV*, where *COV** is the residual from a regression of *COV* on *DBTA*. Our inferences relating to covenants are unaffected.

TABLE 6
Regression Allowing Relation to Vary with Debt Covenants
(n = 11,399)

$$RET_t = \beta_0 + \beta_1 \Delta SP_t + \beta_2 \Delta SP_t \times COV_t + \beta_3 \Delta SP_t \times DBTA_t + \beta_4 \Delta SP_t \times DBTA_t \times COV_t + \beta_5 COV_t + \beta_6 DBTA_t + \beta_7 EPS_t + \beta_8 \Delta EPS_t + \beta_9 NEG_t + \beta_{10} NEG_t \times EPS_t + \beta_{11} NEG_t \times \Delta EPS_t + \varepsilon_t$$

	Pred.	Coef.	t-statistic
ΔSP	−	−0.11	−4.99
$\Delta SP \times COV$	?	0.00	0.07
$\Delta SP \times DBTA$	+	0.13	2.88
$\Delta SP \times DBTA \times COV$	−	−0.15	−1.93
COV	?	0.00	0.73
$DBTA$	?	−0.12	−7.15
EPS	+	0.95	19.13
ΔEPS	+	0.45	14.65
NEG	−	−0.11	−11.18
$NEG \times EPS$	−	−0.80	−13.59
$NEG \times \Delta EPS$	−	−0.25	−6.08
Adj. R^2		0.16	

Huber M-estimates are presented, with year and industry fixed effects untabulated. Sample of 1,851 Compustat firms from 1986–2003.

Variable Definitions:
RET = size-adjusted annual stock return, including dividends (from CRSP);
SP = S&P credit rating (Compustat #280) (1 = highest to 4 = lowest);
DBTA = ratio of debt (#9 + #44) to total assets (#6);
EPS = earnings per share before extraordinary items (#18/shares outstanding from CRSP), deflated by beginning of year stock price;
NEG = indicator for negative net income before extraordinary items;
COV = indicator whether at least half of the outstanding debt issues have covenants (from Fixed Income Securities Database); and
Δ = annual change.

firm's remaining long-term debt is due in the 10th year. The Merton (1974) model assumes zero-coupon debt. Thus, if there are amounts due before maturity, we increase the amounts due by the amount of net interest paid in year *t*, as reported in the statement of cash flows. We also differ from HKCL in that we focus on debt rather than total liabilities and we include in assets all other liabilities. We define fair value of debt as the estimated value of the firm's assets minus the market value of equity.

For the risk-free rate, we use the annual one-year Treasury rate as in Equation (8). To mitigate effects of estimation errors, we eliminate the top and bottom percentiles of observations of each variable, except for the remaining term of the debt, the risk-free interest rate, and *DBTA*. These data requirements result in a sample of 19,118 observations. The decrease in sample size from Table 3, which also requires yearly debt maturity data, primarily results from missing net interest paid or stock return volatility data and our data trimming procedures.

Panel A of Table 7 presents descriptive statistics for inputs to and outputs from the Merton (1974) model. The mean (median) ratio of market value of equity, *MVE*, to book

TABLE 7
Descriptive Statistics using Merton Model Estimates
(n = 19,118)

Panel A: Distributional Statistics for Merton Model Estimation Inputs and Outputs

Variable	Mean	Median	Std. Dev.
MVE/BVE	2.09	1.65	1.67
MVA/BVA	1.74	1.43	1.11
MVD/BVD	1.20	1.11	0.56
Term remaining on debt	4.67	5.00	1.96
Risk-free interest rate	0.05	0.05	0.02
σ_E	0.49	0.44	0.23
σ_V	0.38	0.33	0.20
ΔMVA	0.00	0.01	0.96
$DBTA$	0.24	0.22	0.17

Panel B: Regression Summary Statistics from:

$$RET_t = \beta_0 + \beta_1 \Delta MVA_t + \beta_2 MVA_t \times DBTA_t + \beta_3 \Delta\sigma_{V_t} + \beta_4 \Delta\sigma_{V_t} \times DBTA_t + \beta_5 DBTA_t + \varepsilon_t$$

	Pred.	Coef.	t-statistic
ΔMVA	+	0.34	71.10
$\Delta MVA \times DBTA$	−	−0.37	−27.67
$\Delta\sigma_V$	0/−	0.03	1.01
$\Delta\sigma_V \times DBTA$	+	0.37	3.56
$DBTA$	?	−0.34	−22.12
Adj. R^2		0.22	

Huber M-estimates are presented, with year and industry fixed effects untabulated. Sample of 3,994 Compustat firms from 1986–2003.

Variable Definitions:
RET = size-adjusted annual stock return, including dividends (from CRSP);
MVE = market value of equity (from CRSP);
BVE = book value of equity (Compustat #60);
MVA = market value of assets estimated using the Merton (1974) model; $MVD = MVA - MVE$, BVA = book value of assets (#6) − book value of liabilities other than debt (#181 − #9 − #44);
BVD = book value of debt (#9 + #44);
σ_E = volatility of equity values estimated using monthly stock returns (from CRSP) over a period equal to the term remaining on debt;
σ_V = volatility of asset values estimated using the Merton (1974) model;
$DBTA$ = ratio of debt (#9 + #44) to total assets (#6); and
Δ = annual change.

ΔMVA is deflated by MVE_{t-1}.

value of equity, BVE, is 2.09 (1.65), which is consistent with sample firms having unrecognized net assets. The average remaining maturity of debt is 4.67 years, the average risk-free interest rate over the sample period is 5 percent, and the average volatility of equity returns is 49 percent. Consistent with leverage increasing equity volatility, our calculated asset volatility, σ_V, is 38 percent. The mean (median) ratio of market value to book value of assets, MVA/BVA, is 1.74 (1.43). The mean (median) ratio of market value to book value of debt, MVD/BVD, is 1.20 (1.11). Untabulated statistics confirm that our sample comprises primarily solvent firms. In particular, asset value is less than the book value of debt for only 1.4 percent of the sample firms.

Internal Validity Check of Model Estimates

Before turning to descriptive evidence on the income effect of recognizing changes in debt values, we investigate the internal validity of our model estimates. We do this by estimating a version of Equation (4) in which we include change in asset value and change in asset volatility, both estimated using the Merton model, in lieu of credit risk change and earnings. Recall that Equation (4) includes credit risk change as a proxy for changes in asset value and asset risk. Thus, in this specification, we interact both with *DBTA*. If the model is validly implemented, the presence of debt should attenuate the equity value effects of changes in asset value and asset risk.[31]

Table 7, Panel B, presents the findings, which are consistent with our primary results. It reveals that equity returns are significantly positively associated with change in asset value, ΔMVA, (t = 71.10). Consistent with ΔMVA reflecting change in systematic risk, the coefficient on $\Delta\sigma_V$ is not significantly different from zero after controlling for ΔMVA (t = 1.01). More importantly for our research question, consistent with Merton (1974) and the Table 2 findings, the association between equity returns and increases in asset value (asset risk) is less (more) positive when the firm has more debt. In particular, the coefficient (t-statistic) on $\Delta MVA \times DBTA$ is −0.37 (−27.67) and that on $\Delta\sigma_V \times DBTA$ is 0.37 (3.56).

Descriptive Evidence on Income Effects

Table 8 presents descriptive statistics relating to the effect on net income of recognizing presently unrecognized change in debt value, ΔUD. Because of estimation error likely in ΔUD and ΔUA, change in unrecognized assets, these statistics should be interpreted with caution. Nonetheless, they indicate the potential effect on net income of recognizing changes in debt value. Table 8 presents statistics separately for firms with credit downgrades, upgrades, and no change in credit standing based on ΔCR. *NI* is net income as reported by the firms. All variables are deflated by beginning of year *MVE*.

Turning first to downgrade firms, Table 8, Panel A, reveals that, on average, these firms have negative *NI* in year *t*. They have positive *NI* in year $t-1$ and, thus, a negative change in *NI* from year $t-1$ to year *t*. The means (medians) of NI_t, NI_{t-1}, and ΔNI are −0.05, 0.06, and −0.12 (−0.02, 0.06, and −0.08), respectively. Table 8 also reveals that downgrade firms have negative mean (median) changes in unrecognized debt value, ΔUD, −0.01 (−0.00) and unrecognized asset value, ΔUA, −0.13 (−0.14). The net change in unrecognized asset and liability values, $\Delta UA - \Delta UD$, also is negative, with a mean (median) of −0.12 (−0.13). These statistics all are consistent with downgrade firms experiencing a decline in economic fundamentals between year $t-1$ and year *t*.

Negative ΔUD statistics for downgrade firms indicate that net income would have been higher had they recognized ΔUD. Untabulated statistics reveal both the mean and median ΔUD are significantly different from zero. $NI - \Delta UD$ is what net income would have been had unrecognized change in debt value been recognized. For downgrade firms, Table 8, Panel A, reveals that the mean (median) $NI - \Delta UD$ is −0.04 (−0.01). Thus, on average, downgrade firms would have negative net income even if unrecognized debt value were recognized.

[31] We view this as an internal validity check because stock price and its volatility are model inputs. Thus, the dependent variable is used indirectly to estimate the explanatory variables.

TABLE 8
Descriptive Statistics using Merton Model Estimates, Separately for Upgrades and Downgrades
(n = 19,118)

Panel A: Distributional Statistics by Change in Credit Risk

	Downgrades (n = 1,719)			Upgrades (n = 1,626)			No Change (n = 15,773)		
	Mean	Median	Std. Dev.	Mean	Median	Std. Dev.	Mean	Median	Std. Dev.
NI_t	−0.05	−0.02	0.16	0.10	0.08	0.08	0.04	0.06	0.11
NI_{t-1}	0.06	0.06	0.08	0.00	0.04	0.13	0.04	0.06	0.10
ΔNI_t	−0.12	−0.08	0.15	0.10	0.05	0.14	0.00	0.01	0.10
ΔUD_t	−0.01	−0.00	0.20	0.02	0.00	0.19	0.01	0.00	0.21
ΔUA_t	−0.13	−0.14	0.56	0.14	0.10	0.77	−0.02	−0.02	0.60
$\Delta UA_t - \Delta UD_t$	−0.12	−0.13	0.50	0.12	0.08	0.74	−0.02	−0.03	0.55
$NI_t - \Delta UD_t$	−0.04	−0.01	0.25	0.08	0.07	0.20	0.04	0.05	0.23
$\Delta NI_t - \Delta UD_t$	−0.10	−0.07	0.25	0.08	0.05	0.23	−0.00	0.00	0.23

Panel B: Comparison of Income and Pro Forma Income

		NI		*NI* − Δ*UD*	
***NI* Range**	**n**	**Mean**	**Median**	**Mean**	**Median**
Downgrades (n = 1,655 of 1,719)					
−0.45 to −0.40	16	−0.43	−0.42	−0.38	−0.38
−0.40 to −0.35	20	−0.37	−0.37	−0.30	−0.36
−0.35 to −0.30	26	−0.32	−0.32	−0.24	−0.33
−0.30 to −0.25	32	−0.28	−0.28	−0.31	−0.25
−0.25 to −0.20	57	−0.22	−0.21	−0.16	−0.21
−0.20 to −0.15	80	−0.17	−0.17	−0.18	−0.17
−0.15 to −0.10	127	−0.12	−0.12	−0.12	−0.14
−0.10 to −0.05	212	−0.07	−0.07	−0.09	−0.07
−0.05 to 0.00	365	−0.02	−0.02	−0.01	−0.03
0.00 to 0.05	360	0.03	0.03	0.05	0.03
0.05 to 0.10	270	0.07	0.07	0.10	0.08
0.10 to 0.15	70	0.12	0.12	0.12	0.16
0.15 to 0.20	20	0.17	0.17	0.23	0.21
Upgrades (n = 1,603 of 1,626)					
−0.10 to −0.05	11	−0.06	−0.06	0.02	−0.07
−0.05 to 0.00	27	−0.02	−0.02	−0.05	−0.03
0.00 to 0.05	343	0.03	0.03	0.00	0.02
0.05 to 0.10	614	0.07	0.07	0.07	0.07
0.10 to 0.15	327	0.12	0.12	0.12	0.12
0.15 to 0.20	153	0.17	0.17	0.14	0.16
0.20 to 0.25	59	0.22	0.22	0.14	0.20
0.25 to 0.30	37	0.27	0.26	0.21	0.25
0.30 to 0.35	19	0.32	0.32	0.29	0.28

(*continued on next page*)

TABLE 8 (continued)

All Panel A means and medians are significantly different from 0, using a t-test for means or signed rank test for medians, except the median $\Delta NI_t - \Delta UD_t$ for firms without risk changes, and the median $NI_t - \Delta UD_t$ for downgrade firms.

Panel B presents statistics for income (*NI*) and pro forma income ($NI - \Delta UD$), after sorting observations into 5 percent intervals of the *NI* distribution. Intervals with less than ten observations are excluded. Sample of 3,994 Compustat firms from 1986–2003.

The market values of net assets and debt are estimated using the Merton (1974) model. Each is deflated by beginning of period market value of equity.

Variable Definitions:

NI = income before extraordinary items (Compustat #18);
UA (unrecognized assets) = market value of net assets − book value of net assets; and
UD (unrecognized debt) = market value of debt − book value of debt.

The fact that not all concurrent asset value changes are recognized contributes to the concern about potentially anomalous income effects arising from recognizing change in debt value. This should be less of a problem for downgrade firms because required asset write-downs reduce *NI*, at least for recognized assets. When assessing the net income effect of recognizing ΔUD, one would like to compare ΔUD to the amount of recognized asset write-downs, which is not available to us. However, if NI_{t-1} is a proxy for income before the decline in the firm's economic fundamentals, then ΔNI is a proxy for asset write-downs recognized in year *t*.

Table 8, Panel A, reveals that for downgrade firms, mean (median) $\Delta NI - \Delta UD$ is −0.10 (−0.07). These statistics indicate that for downgrade firms, on average, recognized asset write-downs are larger than unrecognized decreases in debt value. Thus, on average, the net effect of recognized decreases in asset value and increases in debt value is negative for these firms, which is consistent with them experiencing a decline in economic fundamentals. Untabulated statistics reveal that for approximately 73 percent (27 percent) of downgrade firms, recognized asset write-downs are larger (smaller) than unrecognized gains from decreases in debt value. This suggests the concern that debt value decreases would exceed recognized contemporaneous asset value decreases is unwarranted (warranted) for a large majority (substantial minority) of downgrade firms. Also, the negative mean and median $\Delta UA - \Delta UD$ reveals that, on average, downgrade firms have unrecognized decreases in equity value. This indicates that if ΔUD were recognized and these unrecognized decreases in asset value were not, net income would be higher than justified by the net change in value of the firms' assets and liabilities.

Relating to upgrade firms, Table 8, Panel A, reveals, on average, these firms have positive *NI* in year *t* and year $t-1$, and positive change in *NI* from year $t-1$ to year *t*. The means (medians) for NI_t, NI_{t-1}, and ΔNI are 0.10, 0.00, and 0.10 (0.08, 0.04, and 0.05), respectively. It also reveals that the mean (median) ΔUD is positive, 0.02 (0.00). As a result, had these firms recognized ΔUD, their net income would have been lower. Mean (median) ΔUA also is positive for these firms, 0.14 (0.10), as is mean (median) $\Delta UA - \Delta UD$, 0.12 (0.08). Overall, these statistics reveal a picture opposite to that of downgrade firms. That is, the statistics are consistent with upgrade firms experiencing an improvement in economic fundamentals between year $t-1$ and year *t*. Table 8, Panel A, reveals that the mean (median) $NI - \Delta UD$ is positive for upgrade firms, 0.08 (0.07). Thus, on average, upgrade firms would have positive net income even if unrecognized change in debt value were recognized. Mean (median) $\Delta NI - \Delta UD$ also is positive, 0.08 (0.05), which indicates that recognized increases in asset values exceed unrecognized increases in debt values.

Relating to firms with no change in credit risk, the statistics in Table 8 are as expected. For example, mean (median) ΔNI, ΔUD, and $\Delta NI - \Delta UD$ are small, 0.00 (0.01), 0.01 (0.00), and −0.00 (0.00), respectively. However, all variables have noticeable standard deviations, which is consistent with some of these firms experiencing larger effects or with random estimation error.

Table 8, Panel B, tabulates separately for downgrade and upgrade firms the mean and median *NI* and $NI - \Delta UD$ for each 5 percent of *NI*/*MVE* band for which there are at least ten observations. For downgrade (upgrade) firms *NI* ranges from −45 percent to 20 percent (−10 percent to 35 percent) of *MVE*. For downgrade firms, for most *NI* bands the means and medians of $NI - \Delta UD$ are somewhat less negative or more positive than *NI*. This is consistent with the overall statistics in Panel A that indicate these firms would report higher net income if change in debt value were recognized. However, the differences are small. The signs of mean and median *NI* do not differ from the signs of mean and median $NI - \Delta UD$ in any *NI* band, which indicates that the effect on net income of recognizing changes in debt value is not large enough to change the sign of net income for most downgrade firms. It also indicates that the differences between *NI* and $NI - \Delta UD$ are fairly uniform across the distribution of *NI*.

For upgrade firms, Panel B reveals that for most *NI* bands the means and medians of $NI - \Delta UD$ are somewhat more negative or less positive than *NI*. As with downgrade firms, this is consistent with the overall statistics in Panel A that indicate these firms would report lower net income if changes in debt value were recognized. Also as with downgrade firms, the signs of mean and median *NI* do not differ from the signs of mean and median $NI - \Delta UD$ in any *NI* band. This finding indicates that the effect on net income of recognizing changes in debt value is not large enough to change the sign of net income for most upgrade firms. It also indicates that the differences between *NI* and $NI - \Delta UD$ are fairly uniform across the distribution of *NI*.[32]

VII. CONCLUSION

This study tests whether equity value reflects gains and losses associated with changes in the value of debt, consistent with predictions of Merton (1974). It contributes not only to the extant debt and equity valuation literature, but also to the debate about using fair value accounting for liabilities. If fair values were recognized, then firms experiencing increases in credit risk would recognize gains because increases in credit risk result in decreases in debt value; the opposite would be the case for firms experiencing decreases in credit risk. These outcomes are counterintuitive to some—they contradict the views that debt holders of solvent firms are insulated from declines in the firms' economic fundamentals because debt has priority over equity, and that equity holders are the sole beneficiaries of firms' upside potential.

Consistent with prior research, we find that equity returns are significantly negatively related to changes in credit risk. More importantly for our research question, we find that the relation between credit risk change and equity returns is significantly less negative when the firm has more debt. This result is consistent with debt holders sharing in wealth increases and subsidizing wealth decreases. When we consider separately upgrade and downgrade firms, we find that equity returns for downgrade firms are significantly less negative when the firm has more debt, and we find the opposite for upgrade firms. Our findings hold

[32] For firms with no change in credit risk, untabulated statistics reveal that *NI* and $NI - \Delta UD$ differ little at the mean and median for all *NI* bands.

for all credit risk groups, except for firms downgraded within investment grade and upgraded to investment grade. Thus, equity increases associated with increases in credit risk are evident for a broad cross-section of firms, including quite solvent firms.

As an alternative way to link equity value changes and debt value changes associated with credit risk changes, we calculate the gain or loss arising from change in debt value associated with a firm's change in credit risk and use it in our estimating equation in lieu of the credit risk change and debt interaction variable. Consistent with our primary findings, we find that the gain or loss is significantly positively associated with equity returns. We also find that the effect we document is associated with changes in systematic risk, as reflected in changes in equity cost of capital, and changes in expected cash flows, as reflected in analyst earnings forecast revisions.

Our findings link and empirically document the existence of two countervailing equity value effects associated with increases in credit risk: (1) decreases in equity value, presumably arising from decreases in asset value, and (2) increases in equity value associated with decreases in debt value, presumably arising from decreases in asset value or increases in asset risk. These findings indicate that changes in debt value are associated with predictable and measurable effects on changes in equity value.

Establishing that changes in debt value arising from changes in credit risk are associated with changes in equity value for a broad sample of primarily solvent firms indicates that such debt value changes are component of firms' economic income. Because faithful representation of firms' liabilities and income is consistent with the conceptual framework underlying financial reporting, our results indicate that debt value changes are candidates for inclusion in firms' accounting income. Thus, we provide evidence on what firms' reported net income would be if changes in debt value were recognized in order to inform the accounting debate about recognizing in net income such changes. We do this by inverting the Merton (1974) model to obtain an estimate of each firm's asset and debt value and asset volatility.

We find that upgrade firms would recognize higher net income than they do under current accounting standards if all changes in debt and asset values were recognized, and downgrade firms would recognize lower net income. This is consistent with firms' unrecognized asset value changes exceeding their unrecognized debt value changes. As one would expect, we also find that if only unrecognized changes in debt value were recognized, on average, upgrade firms would recognize lower net income and downgrade firms would recognize higher net income. However, we find that for downgrade firms recognized asset write-downs are larger, on average, than unrecognized gains from decreases in debt value, which mitigates the concern that debt value decreases would exceed recognized contemporaneous asset value decreases. Because this does not hold for all downgrade firms, the concern is not unwarranted for some firms. Our results suggest that anomalous effects on net income more likely arise from the failure to recognize all changes in asset values, than from the recognition of changes in debt values.

APPENDIX
CREDIT RISK ESTIMATION

Estimation Equation

We estimate the relation between credit rating and financial statement variables using the subsample of firms with credit ratings (Barth, Beaver, and Landsman 1998; Ashbaugh et al. 2006). We set *CR*, our proxy for credit risk, equal to the predicted value from Equation (A1) for firms with and without credit ratings. ΔCR in Equation (4) is the annual change in *CR*.

$$SP_t = a_0 + a_1TA_t + a_2ROA_t + a_3DBTA_t + a_4DIV_t + a_5SUBDBT_t + a_6NEG_t + \upsilon_t. \quad \text{(A1)}$$

SP_t is the firm's S&P credit rating at the end of year t; *TA* is the natural logarithm of end-of-year total assets; *ROA* is income before extraordinary items divided by total assets; and *DIV*, *SUBDBT*, and *NEG* are indicator variables that equal 1 if in year t the firm pays a cash dividend, has subordinated debt, or has negative *ROA*.[33] Estimating Equation (A1) using annual data to calculate *CR* and then calculating annual changes in *CR* for use in our tests mitigates the effects of credit ratings being revised with a lag (Pinches and Singleton 1978).[34]

We estimate Equation (A1) with year and industry fixed effects. *SP* ranges from 1 to 4, where larger *SP* corresponds to higher risk; groups 1, 2, 3, and 4 include firms with ratings of AAA to A−, BBB+ to BBB−, BB+ to BB−, and B+ to D, respectively.[35] Because *SP* has integer values, we use maximum likelihood estimation and an ordered probit model. We predict a_1, a_2, and a_4 are negative, and a_3, a_5, and a_6 are positive. We have no prediction for a_0.

Empirical Estimates

Table A1, Panel A, presents regression summary statistics from Equation (A1) for the 11,399 observations for firms with credit ratings. Consistent with prior research, S&P credit ratings, *SP*, are significantly negatively related to *TA*, *ROA*, and *DIV*, and significantly positively related to *DBTA*, *SUBDBT*, and *NEG*. The pseudo R^2 from the estimation is 0.66, indicating that these variables explain a substantial portion of the variation in credit ratings.[36]

Table A1, Panel B, presents the distributions of actual credit rating levels and changes and the distributions of estimated credit risk levels and changes. It reveals the distributions are similar. However, in group 1 there are fewer firms with estimated credit risk (10.11 percent) than with actual ratings (29.25 percent). The opposite is true for group 4, which comprises 40.24 percent of firms with estimated credit risk, but only 19.55 percent of firms with actual credit ratings. Panel B also reveals that changes in actual ratings are concentrated in the 0, 1, and −1 change groups, whereas changes in estimated credit risk are more

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[33] Ashbaugh et al. (2006) also includes in Equation (A1) interest coverage and capital intensity. We do not include these variables because doing so noticeably reduces our sample size. However, our inferences are unchanged if we include these variables and conduct our tests on the reduced sample. Also, Equation (A1) does not include variables related to debt covenants. Thus, our estimated credit risk might not capture all aspects of debt relevant to its value. Implicitly, our design assumes debt for unrated firms has covenants similar to those of debt for rated firms. To the extent this assumption is not valid, our tests could be biased. The direction of the bias is not obvious. However, Table 6 reports results when we control for the existence of covenants our inferences are unchanged.

[34] Our inferences are unchanged if we estimate Equation (4) using two-year returns for our primary results and those based on only firms with credit ratings (see Table 6).

[35] Prior studies partition group 4 into two groups—one for credit ratings of B+ to B− and one for ratings CCC+ to D. We combine these two groups because the CCC+ to D group has few observations; these two groups combined have fewer observations than do the other three credit rating groups.

[36] Because *CR* is the estimated, rather than actual, credit rating, the standard errors from Equation (4) are biased downward. To correct for the additional variance in *CR*, as a robustness check, we add a component to the estimated variance of the parameters estimated in Equation (4). We obtain the added component from bootstrapping Equation (A1). Specifically, following Petrin and Train (2002, footnote 11), we repeatedly estimate Equations (A1) and (4) using bootstrapped samples. The added component is the variance in the Equation (4) parameter estimates obtained over the bootstrapped samples. Our inferences are unaffected by using this procedure.

TABLE A1
Credit Risk Estimation

Panel A: Regression Summary Statistics from

$$SP_t = a_0 + a_1TA_t + a_2ROA_t + a_3DBTA_t + a_4DIV_t + a_5SUBDBT_t + a_6NEG_t + \upsilon_t$$

	Pred.	Coef.	t-statistic
TA	−	−0.57	−57.99
ROA	−	−4.28	−19.10
DBTA	+	2.19	31.80
DIV	−	−1.03	−40.05
SUBDBT	+	0.35	13.96
NEG	+	0.31	8.59
Pseudo R^2		0.66	

Panel B: Distributions of Actual and Estimated Credit Rating Groups

		Actual		Estimated	
		n	Percent	n	Percent
Credit Rating Group					
AAA to A−	1	3,685	29.25	4,962	10.11
BBB+ to BBB−	2	3,298	26.18	8,793	17.92
BB+ to BB−	3	3,151	25.01	15,576	31.74
B+ to D	4	2,463	19.55	19,750	40.24
Change in Credit Rating Group					
Upgrades	−3			4	0.01
Upgrades	−2	6	0.05	72	0.15
Upgrades	−1	381	3.34	4,143	8.44
No change	0	10,394	91.18	40,081	81.66
Downgrades	1	585	5.13	4,673	9.52
Downgrades	2	28	0.25	99	0.20
Downgrades	3	5	0.04	9	0.02

Panel A is based on an ordered probit estimation using the 11,399 observations for firms with credit ratings. The model is estimated with year and industry fixed effects (untabulated). Estimated credit rating groups in Panel B are predicted values from the Panel A regression. Sample of Compustat firms from 1986–2003.

Variable Definitions:

SP = S&P credit rating (Compustat #280) (1 = highest to 4 = lowest);
TA = natural log of total assets (#6), in $ millions;
ROA = return on assets; net income before extraordinary items (#18) divided by total assets;
DBTA = ratio of debt (#9 + #44) to total assets;
DIV = 1 if the firm paid a cash dividend (#21) in year *t*, and 0 otherwise;
SUBDBT = 1 if the firm has subordinated debt (#80), and 0 otherwise; and
NEG = 1 if *ROA* is negative, and 0 otherwise.

widely distributed. These distributional differences are not unexpected because the explanatory variables reflect systematic differences between firms with and without credit ratings. For example, firms with credit ratings tend to have larger total assets.[37]

[37] The validity of *CR* as a proxy for credit risk does not depend on consistent levels of the prediction variables between firms with and without credit ratings. Rather, its validity depends on consistency of the parameters associated with the explanatory variables between the two groups of firms. Unfortunately, we are unable to determine this because credit ratings are not observable for firms without them. However, as Table 6 reports, our inferences are unaffected by using only firms with credit ratings.

As an internal validity check, we compare actual and estimated credit ratings for firms with actual ratings. Because for these firms *CR* is the predicted value for an observation used to estimate Equation (A1), the comparisons should be interpreted cautiously. However, untabulated statistics reveal similar distributions for actual and estimated credit ratings. For actual ratings, groups 1 through 4 are 31 percent, 27 percent, 24 percent, and 18 percent of the observations; for estimated ratings they are 33 percent, 27 percent, 23 percent, and 17 percent. The statistics also reveal that Equation (A1) correctly predicts 62 percent of actual ratings; it has prediction errors of more than one credit rating group only 2 percent of the time.

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