Operating Leverage, Credit Ratings and the Cost of Debt

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Abstract

We explore operating leverage and credit ratings and observe a one standard deviation higher degree of operating leverage results in an average of 7 percent lower unconditional likelihood of investment grade ratings and 22 basis point higher corporate bond spread, even after controlling for the effect of financial leverage. This effect on credit ratings is exacerbated by revenue variability, while operating leverage mutes positive effects of traits like profitability and growth. We find evidence the difference in spreads relates to the ratings process, documenting no discernable difference in bond spreads for firms without credit ratings. Further, we observe that operating leverage impacts the cost of debt less than the cost of equity. However, this difference is largely the result of low revenue variation and financial leverage, eroding once interactive effects are included. Overall, our results suggest operating leverage has a distinct impact on debt markets.

JEL Classification: G32; G33; G10; G21

Key Words: Operating Leverage, Credit Ratings, Cost Structure, Cost of Debt, Cost of Capital

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I. INTRODUCTION

Operating leverage is a key component of corporate financial information long thought to influence asset pricing through risk. Lev (1974) and Hamada (1972) suggest operating leverage positively relates to systematic risk, increasing beta and equity costs, similar to financial leverage. Further, empirical observations show operating leverage positively relates to equity returns, also impacting analysts and market participants (Mandelker and Rhee 1984; Chen et al. 2011; Gahlon 1981; Weiss 2010; Novy-Marx 2011). Yet, researchers have spent less time investigating how operating leverage is incorporated into credit markets, despite the importance of debt (Baker and Wurgler 2000; Beltratti and Stulz 2012; Acharya et al. 2012). Further, ambiguity around the credit rating process, the difficulty in measuring operating leverage as of a specific point in time, and countless distinctions between the cost of debt and the cost of equity result in an empirical question on the magnitude and importance of the effect (Barth et al. 2012; Blankespoor et al. 2013; Edmans and Liu 2010). Therefore, we explore the role of operating leverage on debt securities.

Much of the literature evaluating corporate investment risks focuses on the cost of equity, rather than exploring risks to debt holders, despite important differences (Barth et al. 2012; Blankespoor et al. 2013; Edmans and Liu 2010). For instance, equity owners' value rises significantly with large increases in expected future earnings, while creditors share little upside (Campbell and Taksler 2003; Blankespoor et al. 2013). Though the value of both debt and equity securities may increase with profitability, the magnitude depends upon the firm's profitability and solvency. Similarly, idiosyncratic risk relates negatively to debt security prices, due to increased default risk. On the other hand, economic theory predicts equity prices may be unrelated or even positively related to diversifiable, idiosyncratic volatility, due to the additional value stockholders receive from the option to sell stocks at the peak price (Campbell and Taksler 2003; Merton 1974).

The majority of financial assets are invested in debt markets, and the financial crisis performance and resulting regulation encourages low risk assets (Baker and Wurgler 2000; Beltratti and Stulz 2012; Acharya et al. 2012). Additionally, corporate debt holders and managers place importance on firm credit ratings, which have large-scale economic implications for risk assessment and the resulting debt and equity prices (Holthausen and Leftwich 1986; Hand et al. 1992; Ayers et al. 2010; Daniels and Jensen 2004; Graham and Harvey 2001). Lenders are ultimately concerned with outcomes influencing debtors' ability to repay, which are frequently extreme negative results. However, lending arrangements are typically structured such that debtors exhibiting extreme positive outcomes offer little value. Therefore, we posit that firms with high operating leverage have high credit risk.[1] While debt typically offers the benefits of lower risk and predictable cash flow, the credit ratings process has risks as well, including the recent scrutiny of the financial crisis (Barth et al. 2012; Ayers et al. 2010; Griffin and Tang 2011). We thus seek to measure the magnitude of this effect in debt markets, as compared to equity markets, and discern the extent to which it results in lower credit ratings and ultimately effects the cost of debt compared to the cost of equity.

As a result, we examine credit markets and the extent and magnitude of financial information related to firm-specific risk, in the form of operating leverage, on the cost of debt. We follow Chen et al. (2011) by utilizing time-series variation in operating earnings and revenue to estimate each firm's degree of operating leverage. Time-series measurements are employed because operating leverage cannot be easily discerned from a single period of financial statements.

[1] Lenders have limited ability to diversify due to the structure of lending agreements, where all outcomes in which the firm is able to repay the debt are identical as far as lenders are concerned, limiting the ability for outcomes to be unexpectedly positive, which in turn, limits risk avoidance through diversification. In contrast, equity holders realize unexpected gains from positive events and unexpected losses from negative events, which can allow for an additional level of diversification unavailable to lenders.

However, revenue fluctuations from a series of financial statements offer information to predict cost structure variation. By construction, higher operating leverage, especially in this measure, results in higher variability in operating profits, losses and, perhaps most importantly, cash flow. Specifically, revenue variability more closely relates to volatility in profitability for firms with relatively fixed cost structures (higher operating leverage). Importantly, operating leverage differs from variability in performance in that, when revenue fluctuates, operating leverage dictates earnings volatility, influencing return variation.[2]

Our results show firms with higher operating leverage have significantly lower credit ratings. We observe that a one standard deviation higher degree of operating leverage corresponds to a 7 percent lower likelihood of being rated as investment grade, which significantly affects the cost of debt (Altman 1989; Altman 1968). In addition to credit ratings, we also examine corporate bond spreads, since credit rating agencies may have private information and different incentives than debt markets (deHaan 2017). Our results indicate operating leverage also affects corporate bond spreads, with firms that have a one standard deviation higher degree of operating leverage also having a 22 basis point higher spread. Interestingly, this result appears to be primarily driven by firms that have credit ratings rather than unrated firms, suggesting ratings agencies provide a unique role in assessing the risk associated with operating leverage.[3] Overall, our main results show operating leverage has an economically and statistically significant role on the cost of debt and in credit markets.

[2] This phenomenon is documented by Jaedicke and Robichek (1964) as well as Adar et al. (1977), which can also be replicated via statistical simulation methods.

[3] We posit that the source of this finding is due to the fact that ratings agencies may have access to more information than the average market participant or be more sophisticated than the typical market participant.

We also perform cross-sectional tests and show that firms with highly variable revenues, where operating leverage is most likely to affect profit and cash flow, have even lower credit ratings, especially where the cross-sectional differences in revenue variation are greatest. Additional tests suggest operating leverage weakens relations of traditional accounting measures of performance and profitability, such as firm growth or profit (e.g., return-on-assets and operating margins), with credit ratings.

We further examine the impact of operating leverage on the cost of debt relative to the cost of equity and document substantial differences. We begin by analyzing the magnitude of the effects and find that the main impact to the cost of equity is higher than to the cost of debt. We posit that this difference is primarily due to two factors. The first is due to the fact that debt holders are typically insulated from losses due to the presence of equity holders, which limits their overall exposure to operating leverage, while equity holders are afforded no such condition. The second is due to the fact that operating leverage, from the standpoint of a debtholder, only creates risk when revenues are subject to significant variance or unpredictability. Further, we analyze differences in the manner in which operating leverage is priced into debt and equity costs uniquely. For example, equity holders are not compensated for risk if fluctuations are idiosyncratic and random in nature, due to the ability to diversify this risk away. Thus, the presence of either high leverage (i.e., lower equity to shield debt holders) or highly unpredictable revenue should accentuate the impact of operating leverage upon debt relative to equity. In empirical tests, we observe interactive effects for the cost of debt between operating leverage and both high financial leverage and revenue variability, which do not significantly impact the cost of equity, accentuating the magnitude of the total effect of operating leverage on the cost of debt, without affecting equity.

Overall, our results suggest ratings agencies measure operating leverage as an important determinant of credit ratings, which investors and corporate executives should consider when making financing and risk evaluation decisions since the economic effects are large. We contribute to academic research studying operating leverage, capital markets, financial distress, and credit ratings. We offer implications for the literature on operating leverage by showing the importance for credit markets relative to equity markets. While the cost of equity is highly studied, far less is known about the cost of debt (Barth et al. 2012; Blankespoor et al. 2013).

We document that operating leverage is an economically important determinant of credit ratings, significantly influencing bond spreads and the likelihood of corporations receiving an investment grade rating. We also find evidence that ratings agencies supply valuable information to bond markets within this setting, providing differences in the role of operating leverage in bond spreads for rated versus unrated firms. We continue the literature seeking to understand ratings agencies and the intricacies of the ratings process (Barth et al. 2012; Ayers et al. 2010; Griffin and Tang 2011; deHaan 2017). Managers may benefit from the understanding of the implications that cost structure allocation decisions could hold for financing costs, which may be relevant for managers considering the implications of changes in technological innovation and human capital, due to frequent discrepancies in fixed and variable cost structures for employees, compared to technological investment and usages. Further, market participants may benefit from the knowledge of the role operating leverage may play for credit markets, debt securities and equity securities. We organize the rest of the paper as follows. Section II discusses the background, literature and hypothesis development. Section III describes our empirical methods and results, and Section IV concludes.

II. BACKGROUND, RELATED LITERATURE AND HYPOTHESIS DEVELOPMENT

Operating leverage has long been linked with equity pricing through its effect on risk. The theoretical literature on operative leverage is vast and extensive, suggesting operating leverage is important for financial performance. Links between operating leverage and equity markets have been documented through stock performance and financial analysts (Mandelker and Rhee 1984; Chen et al. 2011; Gahlon 1981; Weiss 2010; Novy-Marx 2011). However, the literature has not extended to debt markets, despite the opacity of the credit rating process and numerous distinctions between the cost of equity and debt (Barth et al. 2012; Blankespoor et al. 2013).

A. Operating Leverage Theory and Empirics

Conventional wisdom uses operating leverage to explain risk and expected return increases associated with the value premium (Guthrie 2013, 2011). However, the academic literature has largely explored operating leverage in the context of equity markets. Lev (1974), Subrahmanyam and Thomadakis (1980), and Gahlon (1981) posit that operating leverage increases the systematic risk of a firm, increasing a firm's cost of equity in a way similar to financial leverage (Hamada 1972; Prezas 1987). Most empirical work supports the notion of a positive relation between operating leverage and equity returns (Mandelker and Rhee 1984; Chen et al. 2011; Gahlon 1981; Novy-Marx 2011). For example, Thompson (1976) suggests beta is largely explained by co-movements between fluctuations in earnings, while Garcia-Feijoo and Jorgensen (2010) show that the book-to-market equity ratio, stock returns, and systematic risk all positively relate to the degree of operating leverage. Hamada (1972) and Mandelker and Rhee (1984) show that both financial and operating leverage have important implications for systematic risk in stocks. However, much of the early literature on operating leverage and equity has data limitations.

A related line of literature shows that firms trade off financial and operating leverage (Mandelker and Rhee 1984; Dugan et al. 1994; Ferri and Jones 1979; Serfling 2015). Recently, Kumar and Yerramilli (2016) show financial and operating leverage can be either complements or substitutes, depending on taxes, distress, and growth. Kahl et al. (2014) also link operating leverage to other conservative financial policies. Likewise, Shrieves (1981) suggests operating leverage relates to risk faced by the firm and determines the risk-taking by owners. Other research relates operating leverage to financial policy. For example, Huffman (1983) and Wong (2009) relate operating leverage to investment. Ultimately, operating leverage is concerned with how a firm structures contracts in its production function, which can result in both variable and fixed costs.

However, the construct of operating leverage, unlike financial leverage, is difficult to measure at any particular point in time, as complete and timely information of the actual cost structure of the firm is rarely available.[4] Researchers have supported the notion that measures of profit elasticity appropriately measure the operating leverage construct (Mandelker and Rhee 1984; Rosett 2001; Garcia-Feijoo and Jorgensen 2010; Chen et al. 2011). Thus, we draw from the prior literature and use time-series models of operating earnings regressed on revenues, using fifteen lagged quarterly observations (Mandelker and Rhee 1984; Rosett 2001; Garcia-Feijoo and Jorgensen 2010; Chen et al. 2011). By relating the fluctuations in revenues and earnings together over time, we measure the propensity for a change in revenue to result in a change in earnings (i.e., the degree of operating leverage). Specifically, firms with more fixed cost structures display greater variance in earnings when revenues fluctuate, exhibiting greater operating leverage. Most other operating leverage measures use a similar methodology. For example, Obrien and Vanderheiden (1987) measure the degree of operating leverage as the ratio of the percent of

[4] This is especially true for highly aggregated data such as that presented in SEC 10K and 10Q filings.

expected operating earnings realized and the percent of expected sales realized, also using time-series regressions.

Our measure specifically focuses on the relation between changes in operating earnings and revenue over time, irrespective of other business risks. Since fixed expenses predominantly remain constant, we capture the fluctuation in variable costs by measuring the differences in changes for revenues and income through time. While operational and capacity changes present challenges to estimation, statistical randomness can be overcome through large sample properties.

B. Credit Ratings and Debt Markets

We continue this literature by investigating the importance of operating leverage in the capital markets, specifically as it relates to lenders and credit rating agencies. Credit ratings have large-scale economic implications as changes to credit ratings have a direct effect on the pricing of stocks and bonds (Holthausen and Leftwich 1986; Hand et al. 1992). Credit ratings even affect the behavior of information intermediaries, such as financial analysts (Cheng and Subramanyam 2008). Further, credit ratings are also included in financial contracts for covenants, and many institutional investors require certain minimum credit rating levels before they will invest in a firm (Ayers et al. 2010; Daniels and Jensen 2004). Due to this pricing effect, firm management is very concerned with maintaining and improving the firm's credit rating, affecting their actions and decisions (Graham and Harvey 2001). While debt typically provides lower risk investment alternatives with more predictable cash flows, credit rating agencies and various rating processes for financial securities have come under increased scrutiny since the late 2000s' financial crisis in part due to the complications of credit rating agency models and agency concentration, resulting in the importance of ratings models for debt securities.[5] Therefore, understanding the relation of financial information and credit ratings is both relevant and important.

We know operating leverage is important in equity markets and for participants such as financial analysts (Weiss 2010), but much of the impact on debt markets is still unexplored. Importantly, determinants of the cost of debt differ from the cost of equity due to the varying implications of credit and default risk and the structure of financial rights to the assets (Barth et al. 2012; Blankespoor et al. 2013). In certain situations, factors influencing the cost of equity can have different impacts on the cost of debt, in both magnitude and direction (Campbell and Taksler 2003). Thus, the cost of debt and the cost of equity are separately constructed outcomes, each important to be analyzed empirically.

While the credit rating process imposes large scale economic ramifications, the credit rating process incorporates a mixture of public and private information as well as quantitative and qualitative information (Damodaran 2012; Griffin and Tang 2012).[6] As a result, credit ratings are different from other measures of the cost of debt due to different information sets and incentives (Barth et al. 2012; Hull et al. 2004; deHaan 2017).[7] Consequently, the overall relation between credit ratings and operating leverage is an open empirical question.

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[5] See e.g., the Council on Foreign Relations, "The Credit Rating Controversy," February 19, 2015.

[6] For instance, Standard & Poor's describes the data gathering process as one that incorporates data from audited and unaudited financial information, site visits, and meetings with management. See e.g., S&P ratings process: http://www.standardandpoors.com/prot/ratings/articles/en/us.

[7] Such information includes the risk-taking incentives of management (Kuang and Qin 2013). Hence, credit ratings are different from other measures of the cost of debt based on public information (Barth et al. 2012; Hull et al. 2004; deHaan 2017). For example, empirical evidence of optimistic bias in credit ratings during the financial crisis suggests debt market participants may be increasingly relying upon accounting information in favor of credit ratings (deHaan 2017). Additionally, ratings agencies, which favor stability in credit ratings, tend to have a long-term view and are solely concerned with default risk. On the other hand, prices of individual bonds and credit default swaps are more likely to incorporate idiosyncratic risk features attributable to a particular debt issue and focus on short-term liquidity (Hull et al. 2004; Bongaerts et al. 2011; Longstaff et al. 2005). Further, changes in ratings impact the pricing of bonds and credit default swaps. Thus, ratings are a source of information for both bond prices and credit default swaps (Daniels and Jensen 2004; Hull et al. 2004). Due to this pricing effect, managers attempt to smooth earnings and manage credit ratings (Jung et al. 2013).

C. Hypothesis Development

The presence of operating leverage, ceteris paribus, could induce greater volatility in net income and cash flows. This volatility would be induced by the inherent unpredictability of revenues. For a firm with a cost structure that is perfectly variable, the percentage change in revenue would result in the same percentage change in profitability. However, if the same firms were to substitute some of the variable cost structure in favor of a fixed cost structure, any change in revenues would lead to an even greater percentage change in operating earnings or net income. Thus, holding all else equal, operating leverage results in greater uncertainty for income and cash flow.

Since earnings and cash flows service financing obligations, earnings volatility provides undiversifiable risk for creditors, which would increase the likelihood of extreme cash flow events, both positive and negative. Lenders are motivated to avoid extremely negative events (i.e., left-tail events) more than equity holders because lenders do not share in any upside to extremely positive events, unlike equity holders. As a result, creditors are not able to diversify portfolios to avoid this risk and must price it accordingly. The undiversifiable and idiosyncratic components of credit risk thus should affect the pricing of financial obligations. To the extent that operating leverage increases expected volatility with respect to earnings and cash flows, operating leverage represents a form of credit risk that should be priced into financial obligations.

Despite a directional theoretical prediction, several items could potentially limit or obscure a negative relation between operating leverage and credit ratings. First, creditors are shielded from losses by the presence of equity investors. To the extent that equity holders significantly buffer lenders, the previously documented relations between operating leverage and equity risk may not hold for credit ratings (Mandelker and Rhee 1984; Gahlon 1981; Chen et al. 2011; Novy-Marx

2011). Further, operating leverage, unlike financial leverage, is difficult to discern from a single set of financial statements. Assessing the degree of operating leverage requires advanced analytical techniques, access to more granular information than is typically contained within 10-K reports, or perhaps heuristic qualitative knowledge of the industry. Furthermore, such difficulties are not always easily mitigated by sophisticated market participants or information intermediaries (Chang et al. 2017). Additionally, operating leverage could be an asset to the firm at times. For instance, for firms currently in a loss position (e.g., highly financially distressed or unprofitable), the presence of operating leverage can enhance the ability of the firm to attain financial viability with incremental growth in revenues. Despite theory that suggests a negative relation between credit ratings and operating leverage, uncertainty could limit the magnitude or significance of the relation. Regardless, based upon the directional prediction of theory, we state hypothesis one as follows:

H1: Higher operating leverage is associated with lower credit ratings.

We offer further support for our results by analyzing the relation between operating leverage and credit ratings in the presence of revenue variability. Since operating leverage is likely to exacerbate earnings and cash flow volatility, this effect is most likely to be pronounced for firms with higher levels of revenue variability. For instance, operating leverage would have little impact on the volatility of earnings for firms with little or no expected revenue variability. As a result, we expect higher levels of revenue variability to amplify the main effect of hypothesis one. We state hypothesis two as follows:

H2: The overall relation between operating leverage and credit ratings will be amplified by more uncertainty and variability in revenue.

Ceteris paribus, the presence of operating leverage may impact the relation between traditional accounting-based measures of financial health and a firm's credit ratings. For instance, metrics such as return on assets, whether or not the firm is incurring a loss, margins, or the historical growth rate of the firm should have strong predictive capabilities toward a firm's probability of default and, thus, its credit ratings. Return on assets, margins, and growth should all positively increase ratings while losses should do the opposite. However, in the presence of operating leverage and due to the period-to-period volatility it can induce, such historical accounting-based signals may become less reliable as predictors of financial health. As such, we state hypothesis three as follows:

H3: The overall relation between accounting-based measures of financial performance and credit ratings will be moderated in the presence of higher levels of operating leverage.

III. METHODOLOGY AND RESULTS

To investigate our predictions regarding operating leverage and credit ratings, we follow the literature by employing changes in operating income relative to sales (Chen et al. 2011; Mandelker and Rhee 1984; Lev 1974). This results in an elasticity interpretation; the percentage change in operating income given a percentage change in sales. This elasticity interpretation results in an estimate of a firm's degree of operating leverage, which provides a useful proxy to measure and explore the importance of operating leverage on corporate outcomes. Specifically, we can observe how credit rating agencies evaluate the corporate risk profile. The specific model used to capture a measure of operating leverage for each firm-year is the natural log of operating profit regressed on the natural log of sales for the previous 15 quarters.[8] The econometric specification of this times-series model, where γ_1 captures the measure of operating leverage, is as follows:

$$LN\_OPERATING\_PROFIT_{it} = \gamma_0 + \gamma_1\, LN\_SALES_{it} + \mu_{it} \qquad [1]$$

A. Research Design

For our primary analysis, we estimate pooled cross-sectional ordered logistic regressions:

$$\begin{aligned} LT_{it} = {} & \lambda_0 + \lambda_1\, OPER\_LEV_{it} + \lambda_2\, FIN\_LEV_{it} + \lambda_3\, MARGINS_{it} + \lambda_4\, ROA_{it} + \lambda_5\, LOSS_{it} \qquad [2] \\ & + \lambda_6\, LIQUIDITY_{it} + \lambda_7\, MKT\_BK_{it} + \lambda_8\, INT\_COVERAGE_{it} + \lambda_9\, ZMIJEWSKI_{it} \\ & + \lambda_{10}\, LN\_AT_{it} + \lambda_{11}\, GROWTH_{it} + \lambda_{12}\, REV\_VAR_{it} + \lambda_{13}\, CAP\_INTENSITY_{it} \\ & + \lambda_{14}\, INTANGIBILITY_{it} + \sum YEAR_{it} + \sum INDUSTRY_{it} + \mu_{it} \end{aligned}$$

The dependent variable, LT_{it}, is an ordered variable ranging from 1 to 22 depending upon firm *i*'s Standard & Poor's domestic long-term issuer credit rating.[9] A high number (e.g., 22) represents an excellent credit rating while a low number represents a poor credit rating. To limit the influence of statistical outliers, all variables, except for $OPER\_LEV_{it}$, are winsorized at the 99 percent and 1 percent levels.[10] All standard errors are clustered at the firm level.[11,12]

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[8] For instances in which a firm incurs negative operating earnings in a quarter, the natural log will not exist. In order to properly adjust for these instances without biasing our sample against loss firms, we follow Chen et al. (2011) and modify this specification to remove the log transformations for firms with a loss quarter. A similar 15 quarter time-series regression is estimated, and the resulting coefficient is then multiplied by the average ratio of sales to operating income over the estimation period to produce an estimate of γ_1. We also winsorize this variable at the 5 percent and 95 percent levels to limit the impact of statistical outliers, similar to Chen et al. (2011).

[9] All variable definitions are detailed within the Appendix.

[10] We follow the literature on credit ratings, which employs ordered logistic regression models when credit ratings are the dependent variable (Barth et al. 2012).

[11] We cluster our standard errors along the firm dimension and include time indicator variables within the model specification to alleviate concerns regarding correlation across error terms and time period effects that relate to our variable of interest. Both our dependent variable and our variable of interest express a high to moderate degree of serial correlation that is statistically significant through at least 5 lagged periods.

[12] Our econometric model includes industry indicators using the Fama-French 48 taxonomy. The inclusion of these indicators potentially over-specifies the model since operating leverage likely highly varies between industries. This potentially biases the model against finding a hypothesized result. In our main tests in Table 4, we include specifications with and without industry fixed effects.

$OPER\_LEV_{it}$ is the variable of interest and our primary measure of operating leverage. We follow Chen et al. (2011) and use γ_1 from equation *[1]*, which is also similar to measures employed by Mandelker and Rhee (1984) and Lev (1974). The measure captures the elasticity (i.e., percentage change) of operating income for every one percent change in firm revenue. A higher value is indicative of higher operating leverage.

FIN_LEV_{it} is used to control for financial leverage and is the firm's ratio of interest bearing debt relative to the market value of equity. Higher levels of financial leverage are expected to result in lower credit ratings. $MARGINS_{it}$ is used to control for firm *i*'s overall level of profitability and is the ratio of earnings before interest and taxes to revenues. Higher margins are expected to be indicative of lower credit risk as they provide lenders with a higher repayment likelihood. ROA_{it} is used to control for a firm's profitability based upon the assets deployed and is measured as net income before special items divided by total assets. A higher return-on-assets is expected to indicate lower credit risk. $LOSS_{it}$ is a binary variable used to control for whether firm *i* incurred negative net income before special items during the year. Firms incurring net losses are expected to have higher credit risk.

$LIQUIDITY_{it}$ is employed to control for firm *i*'s level of financial liquidity. This is measured using total operating cash flow divided by liabilities. Firms with higher levels of liquidity are expected to have lower credit risk (i.e., higher credit ratings). MKT_BK_{it} controls for a firm's level of growth opportunities. It is measured using the market value of assets divided by the book value of assets. Higher growth opportunities are expected to result in better credit ratings. $INT\_COVERAGE_{it}$ proxies for firm *i*'s ability to service its debt and is firm *i*'s earnings before interest and taxes divided by total interest expense. Higher levels of interest coverage are expected to result in higher credit ratings.

ZMIJEWSKI$_{it}$ is used to control for firm *i*'s overall level of financial distress and follows Zmijewski (1984). This measure is similar to other measures of financial distress such as the Altman z-score (Altman 1968; Altman 1989). A higher Zmijewski score suggests higher financial distress and should be associated with a lower credit rating. *LN_AT*$_{it}$ is used to proxy for the overall size of the firm and is the natural log of total assets. Larger firms are expected to be more financially stable, thus having higher credit ratings. *GROWTH*$_{it}$ is used to control for firm *i*'s recent rate of growth. It is the average annual percentage change in revenue for the previous three years. *REV_VAR*$_{it}$ is used to control for volatility in revenues. Such volatility is expected to result in lower credit ratings and potentially exacerbate the effects of operating leverage. *CAP_INTENSITY*$_{it}$ is used to control for the capital intensity of the firm and is measured as the ratio of property, plant, and equipment to total assets. In a similar vein, *INTANGIBILITY*$_{it}$ is used to control for the level of intangible assets employed by the firm and is measured as the ratio of research and development and advertising expenses to the total assets of the firm.

B. Sample Selection

We begin with the Compustat universe of firms with available data from 2004 to 2014 to include the full economic cycle. Our final sample results in 13,126 firm-year observations, which include 2,187 unique firms.[13] All accounting variables and credit ratings are obtained from the

[13] Sample selection is a potential concern given our variable of interest. Our variable of interest, which involves historical time-series regression techniques, limits the sample size to firms with at least 15 quarters of historical data. This potentially biases the sample towards more established and larger firms. However, our dependent variable, credit ratings, also is primarily only present for large, established firms. As a result, our choice of measurement for operating leverage ultimately has little impact on the sample size. For Table 4, we re-estimate our results (untabulated) using the industry average level of operating leverage for each firm to limit selection bias from the variable of interest and find similar results.

The dependent variable also represents potential for selection bias, as many firms elect not to undergo the ratings process. Within our sample, a two sample t-test of rated and unrated firms yields a statistically significantly (t-stat = 3.69, p-value < 0.01) higher operating leverage for unrated firms. This suggests firms with high degrees of operating leverage may opt out of the ratings process, perhaps in part due to higher degrees of risk. Such firms are also less likely to employ debt as a result.

Compustat. Table 1 summarizes descriptive statistics for the sample. The average firm in our sample is financed with debt approximating 105 percent of equity value (the median is substantively smaller at 43.5 percent) and has a credit rating just below investment grade (12.2 for the mean and 12 for the median compared to the investment grade credit rating of 13). The average return on assets for our sample is 4.4 percent, and approximately 13.7 percent of firm-years suffer a loss before special items. The average operating leverage for the sample is approximately 1.9 with a median of 1.6, suggesting that a 1 percent change in revenue approximately influences operating earnings 1.6 percent - 2.0 percent. The standard deviation of operating leverage is approximately equal to the median, just under 1.6. This indicates some firms have considerably higher operating leverage and considerable variation exists in the variable of interest.

[INSERT TABLE 1 HERE]

Table 2 shows the correlation of variables included in the analysis. The results, in a univariate sense, suggest operating leverage and long-term credit ratings are significantly negatively correlated. While financial leverage is negatively correlated with long-term credit ratings, operating leverage and financial leverage appear to have a low correlation. Our measure of distress negatively relates to credit ratings and interest coverage but positively relates to financial leverage. Finally, our measure of size suggests higher levels of safety as it is positively correlated with ratings.

[INSERT TABLE 2 HERE]

We also analyze our sample by industry and compare operating leverage between industries. In Table 3, we observe that certain industries have higher levels of operating leverage, including agriculture, automobiles, construction materials, steel production, recreation, electronic equipment, and coal. Alternatively, industries such as financial services, banking, pharmaceutical products, and healthcare appear to have lower operating leverage. These results are consistent with expectations based on expected allocations of cost structure, where industries that are highly capital intensive have substantive fixed costs and vice versa. This suggests the operating leverage measure provides an expected description of cross-sectional corporate cost structure variation.

[INSERT TABLE 3 HERE]

C. Multivariate Analysis of Credit Ratings and Operating Leverage

We begin our analysis by testing the relation between operating leverage and long-term credit ratings. In Table 4, we perform four separate analyses. In Column 1, we employ an ordered logistic regression model using our main research design equation *[2]*. The results of Column 1 indicate that credit ratings are negatively and significantly related to operating leverage (coefficient = -0.151, z-statistic = -7.672). In Column 2 we remove the industry fixed effects, and the results remain predominantly unchanged. The other control variables appear to have predictable relations with credit ratings. Financial leverage, loss occurrence, revenue variability, and financial distress are all negatively related to credit ratings, in addition to being statistically significant. Margins, growth opportunities, cash flow to service debt, and size are all positively and significantly related to credit ratings.

[INSERT TABLE 4 HERE]

In Column 3, we also measure credit ratings using a binary variable (INV_GRADE_{it}) equal to one if the firm is rated as investment grade (BBB- or above, which is at least 13 out of 22 possible ratings) and zero otherwise. In this column, we employ a logistic regression. This regression has similar results to Column 1; higher operating leverage negatively relates to investment grade ratings (coefficient = -0.183), and this result is statistically significant (z-statistic = -5.224). Column 4, similar to Column 2, drops industry level-fixed effects. Our results suggest a firm with operating leverage that is one standard deviation higher is 3.3 percent less likely to be rated investment grade, relative to otherwise comparable firms.[14] Given that only 49.0 percent of the sample is rated investment grade, this is economically meaningful, signaling an adjustment of approximately 7 percent in the likelihood of being classified as investment grade.[15]

These results are consistent with the idea that firms with more operating leverage are more likely to observe tail events (i.e., more volatile earnings events), and since creditors asymmetrically suffer from left-tail events without gaining any upside potential from right-tail events, high operating leverage is costly to creditors. By construction, the resulting effect upon perceptions of credit risk impacts the corresponding cost of debt. Hypothesis one is supported.

D. Cross-Sectional Analyses

We also test to see which firms the relation between the degree of operating leverage and credit ratings most influences by considering cross-sectional differences. We first study the differential effect of revenue variability or unpredictability upon the relation between operating leverage and credit ratings. Since higher levels of variability and higher levels of operating leverage should mathematically interact to produce an overall higher variance in operating profits, we expect higher revenue variability would exacerbate the already documented negative relation between operating leverage and credit ratings. We measure revenue variability as the coefficient of variation (i.e., the ratio of the standard deviation to the mean) of the previous five years of

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[14] Our computation uses the average marginal effect.

[15] We also follow Barth et al. (2012) and perform our analysis using an ordinary least squares regression model to measure economic significance. The statistically significant coefficient on $OPER\_LEV_{it}$ is -0.158, which implies that a one standard deviation change in $OPER\_LEV_{it}$ results in an approximate 0.25 lower rating. For non-investment grade securities, this could have a large impact on the cost of debt as credit spreads can be 80 basis points or higher between ratings levels for these types of firms.

revenue. In Table 5, we employ a cross-sectional research design that interacts our measure of revenue variability, REV_VAR_{it}, with our main variable of interest, $OPER\_LEV_{it}$.

[INSERT TABLE 5 HERE]

Table 5 documents a negative and significant interaction between revenue variability and operating leverage but for only one of the analyses. We employ two regressions, a continuous variant (Column 1) and a dichotomous variant (Column 2). In Column 2, we dichotomize REV_VAR_{it} at the median value. Column 1 displays a negative (coefficient = -0.240) and significant (z-statistic = -1.965) interaction term. Both base terms of the interaction retain their negative and statistically significant effects. Our results in Column 1 support hypothesis two.[16] We show higher revenue variability can be associated with a more significant negative relation between operating leverage and credit ratings. However, in Column 2, the interaction term is not statistically significant, and the coefficient is of marginal magnitude. This is likely due to the loss of information and cross-sectional variability that the dichotomization process induces. We further explore this dichotomized analysis in an untabulated fashion, employing the 90th percentile of *REV_VAR* as the break point instead of the median.[17] When this is performed, the interaction term for Column 2 is negative (-0.102) and the z-statistic is significant (-1.853). The base variables of the interaction also retain their relations. Only the firms with the highest levels of variation or uncertainty have an observable relation between operating leverage and revenue variation.

[16] We also re-estimate this table using average industry revenue variability in lieu of firm specific revenue variability. When this is performed, both Columns 1 and 2 yield statistically significant interaction results.

[17] This break point may be better in theory since Table 1 reveals that *REV_VAR* has a fairly high degree of skewness; the mean has a value that is much higher than the median. This suggests that a minority of firms have extremely high levels of revenue variation and it is in these firms that we expect to see the most cross-sectional differences in both revenue variability and the resulting interactive relation with operating leverage on credit ratings.

Next, we study the differential effect that operating leverage may have on the relations between accounting-based measures of financial health and credit ratings. We identify ROA_{it} and $MARGINS_{it}$ as profitability variables that should have a positive relation with credit ratings. We identify $LOSS_{it}$ as a profitability measure that should have a negative relation with credit ratings. Furthermore, we identify historical growth, $GROWTH_{it}$, as an additional accounting-based measure that should have a positive relation with credit ratings. We hypothesize that the presence of operating leverage, due to the volatility and uncertainty it induces, weakens (reverses) the relation between these accounting-based measures of financial health and credit ratings. We test hypothesis three using these variables and an interaction term with $OPER\_LEV_{it}$. Table 6 documents these results.

[INSERT TABLE 6 HERE]

Overall, the results of Table 6 are supportive of hypothesis three. The interaction terms across all four specifications reverse the direction of the base measure of financial health and all are statistically significant. Each measure except for $LOSS_{it}$ utilizes both a continuous and a dichotomous specification (above and below the median). Further, the base cash flow variable for each interaction is directionally consistent with expectations and statistically significant while the interaction reverses this direction but at a lower magnitude than the base variable. This suggests the presence of operating leverage reduces or moderates the positive impact that measures of cash flow can have on a firm's credit ratings. Our results also suggest that the predictive element of these metrics becomes less certain in the presence of operating leverage. Hypothesis three is supported.[18]

[18] In an untabulated analysis, we also consider a *DISTRESS* interaction, as measured by Zmijewski (1984), which is also an accounting measure of financial health. This analysis reveals similar results. *DISTRESS* is negatively related to credit ratings but the interaction term with *OPER_LEV* reverses this impact and is statistically significant.

E. Additional Analysis: Bond Spreads

We also examine the effect of operating leverage on corporate bond spreads since credit rating agencies can have different incentives and private information that could result in a different understanding or implication of a firm's corporate risks like operating leverage (deHaan 2017). If operating leverage is, in fact, influencing corporate credit ratings, we might also expect it to affect corporate bond spreads. Typically, credit ratings are incorporated into corporate bond spreads. However, it is also possible that operating leverage, due to its difficulty in measurement, only impacts bond spreads when a sophisticated monitor such as a ratings agency is engaged. The general market for bonds may thus not adequately measure the risk associated with operating leverage in the absence of an information intermediary such as a rating agency.[19]

In order to construct a sample for bond spreads, we use the same period as in Table 4. The bond spread is the difference between the bond's yield-to-maturity and the yield-to-maturity of the one-year U.S. treasury debt security. Corporate bond yields and other pertinent information are obtained from the TRACE database. U.S. treasury yields are obtained from the Federal Reserve's website. We use Equation *[2]* with corporate bond spreads ($SPREAD_{it}$) as the dependent variable. We also introduce two additional control variables to the model specification to better control for the bond-specific features, TTM_{it} (time-to-maturity) and CPN_RTE_{it}, (coupon rate). The model is estimated using ordinary least squares. For firms possessing multiple bond issuances, only one of the issuances is randomly retained within the sample.[20] Table 7 presents the results. Panel A

[19] We posit that the ratings agencies may have an opportunity to add value here for two reasons. First of all, they may be more likely to employ quantitative methods such as those used to measure our variable of interest than is the general bond market participant. Second, and more importantly, they have access to more granular information than the typical market participant and from this granularity it may be easier to discern a firm's degree of operating leverage.
[20] We also perform a similar analysis in which we average the spreads and bond specific variables for a firm at a particular point in time if the firm has multiple issuances outstanding. Our results and inferences remain unchanged.

tabulates the results for all firms with spreads information, while Panel B compares these results between rated and unrated firms.

[INSERT TABLE 7 HERE]

The results in Panel A of Table 7 are consistent with the results we document in Table 4. The relation between operating leverage and bond spreads is positive and significant. These results are also economically meaningful. Using the result from Column 1, a one standard deviation higher $OPER\_LEV_{it}$ (1.527) would result in a 22 (1.527 x 0.141) basis point higher corporate bond spread. These results suggest that operating leverage imposes large-scale effects upon the cost of debt beyond merely influencing corporate credit ratings.

The results in Panel B of Table 7 essentially bifurcate the analysis from Panel A into separate regressions for firms with credit ratings versus firms without credit ratings. Columns 1 and 3 are for rated firms and Columns 2 and 4 are for unrated firms. Industry fixed effects are employed in Columns 1 and 2; they are omitted in Columns 3 and 4. These results appear to support the notion that rated firms are the predominant driver of the results in Panel A of Table 7 as the coefficient for *OPER_LEV* is positive and significant in Columns 1 and 3, but they are not in Columns 2 and 4.[21] This suggests that operating leverage plays a meaningful role in pricing credit risk once a sophisticated information intermediary such as a ratings agency is involved but no evidence exists that operating leverage plays a role in the absence of a ratings process. Further examination of the r-squared values also supports this view. The r-squared values are much higher when a ratings agency is involved in the process; this suggests that their role as information

[21] In untabulated analysis, we also combine these analyses and employ an interaction term between being rated and operating leverage. This yields similar results as the interaction term is statistically insignificant.

intermediaries reduces noise in the credit pricing decision process. This extends to the assessment of the role of operating leverage in regard to default risk.

F. Additional Analysis: Differences Between Cost of Debt and Cost of Equity

While the theory and results documented thus far support that higher operating leverage increases the cost of debt and prior research theorizes and documents a similar directional impact to the cost of equity, it is important to delineate differences between the two when possible (Chen et al. 2011; Mandelker and Rhee 1984; Lev 1974; Barth et al. 2012; Blankespoor et al. 2013). We propose two primary differences that could result, given that the risks and incentives for debt holders versus equity holders can be very different. The first difference could be a magnitude effect: the impact of operating leverage could have a larger impact on the cost of capital for one type of capital component compared the other. The second could be an interactive effect: the impact of operating leverage could interact differently with other determinants of the cost of capital between the two primary ways to structure a firm's capital.

In regard to the cost of debt, the primary determinant of pricing is default risk. [22] While certain variables such as operating leverage impact default risk, as supported by the findings in Tables 4 and 7, other moderating factors may limit its overall impact upon the cost of debt. For instance, operating leverage should be of little concern to a creditor when revenues are stable and predictable. Further, in the presence of low financial leverage, operating leverage may be more limited in its impact to potential losses by creditors as they are buffered by a wide margin of equity

[22] Market risk can also, in theory, impact the pricing of debt. However, to the extent that debt holders are long-term investors and they hold to maturity in hope of receiving a stable and reliable stream of cash flows, default risk should take primacy over any notions of market risk. Interest rate risk is another concern, but its primary determinant is the maturity horizon of the debt instrument and the term structure of interest rates.

investors in regard to claims upon the firm's assets. However, in regard to equity investors, the presence of leverage (e.g., financial or operating), under theory produced by Hamada (1972) and Lev (1974), will have an ever present impact upon the cost of equity as leverage, ceteris paribus, will increase the systematic risk (i.e., covariance of returns with the overall market) of the firm.

Given these differences, our first proposed major difference between how operating leverage impacts the cost of debt and the cost of equity is a magnitude effect. Since operating leverage may be of little or no concern to debt holders in certain situations, while prevailing economic theory suggests that operating leverage should always be a concern to equity holders, we expect an overall, on average, lower impact to the cost of debt than to the cost of equity.

However, the second major difference we expect is that, in certain situations, this on average lower magnitude effect to the cost of debt should converge towards the impact of operating leverage upon the cost of equity. We posit this will happen in two settings: 1) when the underlying revenues of the business are less certain or predictable and 2) when the capital structure of the firm is exposed to higher levels of financial leverage (i.e., a lower equity buffer). Less revenue predictability will amplify the effects of operating leverage to the cost of debt. However, for equity, to the extent it is non-systematic, it should not amplify the impact of operating leverage upon the cost of equity because such randomness can be diversified away. In a similar fashion, high amounts of financial leverage will lessen the margin of safety available to debtholders and operating leverage will thus become even more of a concern and a more significant source of default risk. However, it is unclear if this will impact the cost of equity in a similar fashion.

In order to empirically explore these notions, we employ our original model from Equation [*2*] but must modify it with dependent variables that are comparable. In this setting, such variables that yield and expected percentage return or cost of capital would be the most comparable between the cost of debt and the cost of equity. Our *SPREAD* variable for bond yields would capture the cost of debt, free of the influence of the risk free rate. In order to capture the cost of equity, we utilize the Fama-French 5 Factor Model (Fama and French 2015).[23] We choose to employ this model due to several factors. First of all, the Fama-French 5 Factor Model, like the Fama-French 3 Factor Model, is superior at predicting actual equity returns in comparison to a more traditional CAPM estimation method. Second of all, unlike some implied cost of equity estimations, the Fama-French 5 Factor Model is readily determined for most securities and does not require other data beyond stock returns such as analyst forecasts, among other things. Finally, the Fama-French 5 Factor Model also does not require assumptions about terminal values, rates of growth or dividend payout rates like many prominent implied cost of equity models do. The Appendix provides a detailed description of how the cost of equity was calculated for each observation.

Panel A of Table 8 explores the base impact of operating leverage upon both the cost of debt and the cost of equity. The sample size of 5,592 is smaller than the sample size in Table 7 since the analysis is limited to only the firm-years that had both an observable bond yield and an observable cost of equity estimate. Columns 1 through 4 examine the impact to bond spreads while Columns 5 and 6 examine the impact to the cost of equity. Industry fixed effects are alternated throughout and Columns 1 & 2 also apply the additional bond specific control variables (i.e., *CPN_RTE* and *TTM*) from Table 7. Within this sample, *OPER_LEV* has a mean value of 1.872 and a standard deviation of 1.462, *SPREAD* has a mean value of 4.387 percent and a standard

[23] We thank Ken French for making the Fama-French 5 factor model data available on his website, http://mba.tuck.dartmouth.edu/pages/faculty/ken.french/data_library.html#Research

deviation of 3.274 percent; *COE* has a mean value of 9.656 percent and a standard deviation of 7.421 percent.

All columns have statistically significant and positive coefficients, as expected. Overall, the results appear to suggest that large differences exist. The most comparable analyses are Columns 3 to 5 and Columns 4 to 6, since the additional bond controls are not present in these columns. A comparison of Columns 3 and 5 suggests the impact to the cost of equity is nearly 3.297 (0.488 / 0.148) times that of the cost of debt. This difference narrows once industry fixed effects are considered in Columns 4 and 6 as the impact to the cost of equity appears to be 2.246 (0.292 / 0.130) times that of the cost of debt. Regardless, this appears to be a sizeable magnitude difference. Panel B places estimates of statistical significance upon these differences.

[INSERT TABLE 8 HERE]

In Panel B, the samples from Columns 3 and 5, as well as from 4 and 6 are stacked. This means each firm-year now has two observations, one with the cost of debt as the dependent variable and one with the cost of equity as the dependent variable. An indicator variable, *DEBT_SAMPLE*, is created to signal whether the observation comes from the cost of debt sample or from the cost of equity sample. An interaction is computed to measure if the net impact of operating leverage on the cost of debt is statistically different than on the cost of equity. In both columns of the analysis, this appears to be the case. The interaction terms are both negative and highly significant, signaling that the base impact is lower for the cost of debt than the cost of equity.[24]

[24] In untabulated analysis, we also conduct these tests without the use of interaction terms by employing seemingly unrelated regression (SUR) techniques. Our inferences are unchanged when this is conducted.

As a result, there appears to be, at minimum, a lower base level magnitude impact to the pricing of debt versus equity. However, we expect this relation to dissipate in two specific settings. The first is when revenue variability is high since low revenue variability has little impact to the volatility of cash flows as amplified by operating leverage. The second is when financial leverage is considered to be high. The volatility induced by operating leverage will be of much greater concern in this circumstance as creditors are no longer afforded a large margin of safety from a large buffer of equity investors. Panel C of Table 8 explores these notions by examining interactions between operating leverage and both revenue variability and financial leverage for both the cost of equity and debt.

As suggested, the overall inferences from Table 8, Panel C imply that operating leverage does in fact become more impactful to debt in the presence of both higher financial leverage and higher variability or uncertainty in revenues. The interaction terms in Columns 1 and 3 are both positive and statistically significant. However, the same interaction terms do not exhibit statistical significance for the cost of equity (Columns 2 and 4). This suggests that, despite the lower base effect documented in Panels A and B of Table 8, the impact of operating leverage upon the cost of debt begins to converge towards the cost of equity once either high variability in revenues or high financial leverage become a factor.

G. Additional Robustness

First, we extend our results to an untabulated test of short-term credit ratings. Most bond ratings studies are limited to analyses of long-term ratings, as the sample size for short-term bond ratings is less expansive. To perform this analysis, we substitute, within our primary research design, a measure for short-term ratings in place of long-term ratings. Operating leverage has the same impact on short-term credit ratings as it does for long-term ratings despite the considerably smaller sample size. The coefficient is negative (-0.202) and significant (z-statistic = -3.120). These results indicate that this effect is significant for all debt structures rather than being an effect that firms can avoid by simply utilizing short-term debt. In further tests, we use logistic regression to analyze the effect on investment grade short-term ratings and find a similar pattern in the results. Overall, our results suggest firms with higher degrees of operating leverage also suffer from lower short-term credit ratings which leads to a higher cost of short-term debt.

We also conduct several additional robustness analyses. We perform subsample analyses by financial leverage. Since the literature suggests that some firms use financial and operating leverage to trade-off and limit overall firm risk, we perform our main analysis by financial leverage quartile. Our results are significant in each level of financial leverage with similar economic and statistical significance in each quartile.

A few of the correlations in Table 2 appear to suggest that our sample may be exposed to multicollinearity issues as some variable combinations exhibit moderate levels of correlation. We explore and rule this out with several techniques. Initially, we calculate the variance inflation factor (VIF) for each of our independent variables in the specification for Table 4. Of our independent variables, only one, LN_AT_{it}, has a VIF that exceeds 20 and only one other, MKT_BK_{it}, has a variance inflation factor that exceeds 10. The variance inflation factor for our variable of interest is only 2.94. We re-estimate Table 4 using various permutations with or without the two above-mentioned variables with VIFs in excess of 10 and find consistent results. With these techniques, we conclude that our results are not sensitive to variables susceptible to multicollinearity concerns.

We further re-specify our model using other econometric models. First, we replace our ordered logistic regression model with an ordered probit model and find similar results. We also specify the main regression in Table 4 with an ordinary least squares regression model and continue to find similar results. For the logistic regression model in Table 4, we also re-specify this model employing a probit regression technique, and our results remain unchanged.

We explore whether the inclusion of corporate governance controls influence our results. Governance variables were omitted from the primary model specification since they tend to limit sample size in a dramatic fashion. Despite this, we populate Equation [*2*] with six additional corporate governance variables. They include the number of analysts following the firm, the percentage of stock owned by institution investors, the percentage of the CEO's total compensation that is at-risk (not salary), the percentage of the company's stock owned by directors, the percentage of directors that are independent, and whether the chairman of the board and the CEO positions are held by the same individual. The inclusion of these variables does drastically limit sample size, but the main results of Table 4 are robust to their inclusion.[25]

We further include additional variables in our main model specifications (Table 4) that have been employed in credit rating models in prior research. They include the firm's beta coefficient, the standard deviation of historical net income, and the standard deviation of historical stock returns. The results in Table 4 are robust to the inclusion of these additional controls with statistically significant effects at the 1 percent threshold. Our primary rationale for not including these variables in our tabulated model specification is two-fold. First of all, we desire parsimony

[25] The remaining results are qualitatively similar to other tables. While most of the results are quantitatively similar as well, those that are not may suffer from the drastic reduction in sample size. In addition, the average size of the firm is increased in this robustness test, which reduces both cross-sectional variation and the generalizability of this test.

in our econometric model. Second, and more importantly, operating leverage would have a direct causal impact on these variables. The presence of operating leverage, ceteris paribus, would generate higher volatility in net income and, as a result, stock returns. Further, operating leverage, through both theory and empirical testing, has long been considered a determinant of beta, or systematic risk (Lev 1974). Since causality flows towards these variables from operating leverage, and not the opposite, their inclusion, like that of industry fixed effects, possibly over-controls for operating leverage, over-specifies the econometric model, and would bias the coefficient and effect size for operating leverage downwards.[26]

IV. CONCLUSION

We analyze the relation between firm operating leverage and credit ratings. We find that credit ratings are negatively related to operating leverage, which has significant implications for investment grade ratings and the cost of debt. Signals of financial health (e.g., return-on-assets and operating margins) and their relation to credit ratings are also weakened in the presence of operating leverage. Further, we find the negative relation between operating leverage and credit ratings is exacerbated when a firm has highly variable revenues, suggesting revenue variability and operating leverage offer higher credit risk together than alone.

We also document an economically significant impact to bond yields and this is less than half of the impact to the cost of equity, suggesting equity holders are harmed more on average by operating leverage. However, we find this difference is explained in part by, and begins to close with the inclusion of interactive effects from financial leverage and revenue variability; the risks

[26] The effect of operating leverage upon these variables could in theory be limited by computing orthogonal components of each variable with operating leverage effects. However, this process would also limit correlations between these variables and operating leverage, in addition to the threat of bias in the econometric specification.

operating leverage presents to creditors become much more pronounced in the presence of these. Furthermore, we find evidence that the ratings process plays a crucial role in pricing credit risk; operating leverage appears to be priced for firms that undergo the ratings process, differentiating rated firms from unrated firms.

Our results should be of particular interest to practitioners, academics, and regulators. Hamada (1972) predicts an impact of operating leverage upon the cost of equity, which has been documented (Lev 1974; Mandelker and Rhee 1984; Chen et al. 2011; Novy-Marx 2011). However, little research has examined the relation between operating leverage and credit risk or the cost of debt. Understanding debt cost determinants is important and differs from the cost of equity. Theoretical differences amplify the importance of examining risk to debt holders that cannot be inferred from that of equity holders (Barth et al. 2012; Blankespoor et al. 2013). Further, given the recent scrutiny of ratings agencies, allegations of bias, and their overall role in the financial crisis, any light that can be shed on the ratings process should be of value to capital market participants (Ayers et al. 2010; Griffin et al. 2013; Griffin and Tang 2011, 2012). For example, in an era of accelerated technological innovation, managers may frequently be faced with the decision to employ variable human capital costs as opposed to large fixed investments in technological changes. Understanding the risk of fixed costs on financing is pertinent. Managers are also particularly concerned with their creditworthiness, and we find ratings agencies factor operating leverage in as a component of risk for their processes to assess credit, which practitioners should value for the implications cost structure allocation holds for financing costs. Finally, market participants benefit from comparisons of operating leverage in debt and equity markets.

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APPENDIX

LT_{it}	Firm *i*'s Standard & Poor's domestic long-term issuer credit rating (Compustat variable *splticrm*) for year *t*. These ratings are assigned a number from 1 to 22 where the highest rating AAA equals 22 and the lowest rating D equals 1.
$INVEST\_GRADE_{it}$	Coded as a one if firm *i*'s credit rating was BBB- or higher (i.e. a value of 13 or higher for *LT*) as of time *t*. Coded as zero otherwise.
$OPER\_LEV_{it}$	Firm *i*'s measure of operating leverage as of time *t*, calculated over the previous 15 quarters using the coefficient of a times-series regression of the natural log of operating earnings to the natural log of revenues, following Chen *et al.* (2011). Firm-years experiencing at least one quarter of negative operating earnings are regressed without the log transformations and the resulting coefficient is multiplied by the average sales to operating earnings ratio for the estimation period.
$INT\_COVERAGE_{it}$	Firm *i*'s interest coverage ratio as of time *t*, defined as earnings before interest and taxes (Compustat variable *ebit*) divided by interest expense (Compustat variable *xint*).
MKT_BK_{it}	Firm *i*'s market value of assets (Compustat variables *mkvalt* + *lt*) divided by the book value of assets (Compustat variables *ceq* + *lt*).
$LIQUIDITY_{it}$	Firm *i*'s operating cash flows (Compustat variable *oancf*) divided by the total liabilities (Compustat variable *lt*).
$LOSS_{it}$	A dichotomous variable equal to one if firm *i* incurred negative net income before special items (Compustat variables *ni* and *spi*) during the year *t*.
ROA_{it}	Firm *i*'s return-on-assets as measured by net income before special items (Compustat variables *ni* and *spi*) divided by total assets (Compustat variable *at*) during the year *t*.
$MARGINS_{it}$	Firm *i*'s ratio of earnings before taxes (Compustat variable *ebit*) to revenue (Compustat variable *revt*) during the year *t*.
FIN_LEV_{it}	Firm *i*'s ratio of short-term debt (Compustat variable *dlc*) and long-term debt (Compustat variable *dlt*) to the market value of equity (Compustat variable *mkvalt*) during the year *t*.
LN_AT_{it}	Firm *i*'s natural log of total assets (Compustat variable *at*) as of time *t*.
$ZMIJEWSKI_{it}$	Firm *i*'s Zmijewski financial distress score as of time *t*. Formulated according to Zmijewski (1984).
$GROWTH_{it}$	The average of the previous three years of revenue growth for firm *i* as of time *t*.

REV_VAR_{it}	Firm *i's* coefficient of variation (the standard deviation divided by the mean) of annual revenues for the past five years.
$CAP\_INTENSITY_{it}$	The ratio of property, plant, and equipment (Compustat variable *ppent*) to total assets (Compustat variable *at*) for firm *i* as of time *t*.
$INTANGIBILITY_{it}$	The ratio of research and development (Compustat variable *xrd*) and advertising (Compustat variable *xad*) to total assets (Compustat variable *at*) for firm *i* as of time *t*.
$SPREAD_{it}$	The difference between a bond's yield-to-maturity and the one year U.S. Treasury yield-to-maturity for the same month and year. Expressed in percentage rather than decimal form (e.g., 3.00 percent instead of 0.03).
TTM_{it}	The bond's time-to-maturity (measured in years) at time *t*.
CPN_RTE_{it}	The bond's stated coupon rate in terms of yield. Expressed in percentage rather than decimal form.
COE_{it}	Firm *i*'s measure of the cost of equity as of time *t* using the Fama-French five factor model (Fama and French 2015). Calculated over the previous 60 months using the coefficient of a times-series regression of the market returns (both price and dividends) of the security to the returns (both price and dividends) of the market (value weighted), the returns of the small minus big portfolio (SMB), the returns of the high minus low portfolio (HML), the returns of robust minus weak portfolio (RMW) and the returns of the conservative minus aggressive portfolio (CMA). Resulting coefficients are multiplied times the historical equity risk premia for each portfolio, annualized, and then added together to produce an aggregate equity risk premium free of the impact of the risk free rate. Expressed in percentage rather than decimal form (e.g., 3.00 percent instead of 0.03).
$DEBT\_SAMPLE_{it}$	An indicator variable equal to one if the cost of capital observation pertains to debt and zero if the observation pertains to the cost of equity.

Table 1: Descriptive Statistics

Table 1 presents the descriptive statistics for the full sample of 2,187 firms and 13,126 firm-year observations. The sample period begins with all firm-years ending in calendar year 2004 and ends with all firm-years ending in calendar year 2014. $OPER\_LEV_{it}$ has been winsorized at the 0.05 and 0.95 levels. All other variables have been winsorized at the 0.01 and 0.99 levels and are defined in the Appendix.

	N	Mean	Std. Dev.	10th %tile	25th %tile	Median	75th %tile	90th %tile
LT	13,126	12.232	3.379	8.000	10.000	12.000	15.000	17.000
OPER_LEV	13,126	1.917	1.527	0.251	0.908	1.572	2.619	4.235
FIN_LEV	13,126	1.047	2.295	0.098	0.201	0.435	0.903	1.987
MARGINS	13,126	0.132	0.130	0.018	0.057	0.114	0.193	0.293
ROA	13,126	0.044	0.060	-0.012	0.015	0.042	0.075	0.114
LOSS	13,126	0.137	0.345	0.000	0.000	0.000	0.000	1.000
LIQUIDITY	13,126	0.152	0.134	0.000	0.066	0.127	0.211	0.321
MKT_BK	13,126	1.578	0.693	0.991	1.117	1.370	1.792	2.425
INT_COVERAGE	13,126	8.279	15.952	0.599	1.675	3.659	8.445	17.428
ZMIJEWSKI	13,126	-0.709	1.357	-2.225	-1.588	-0.865	-0.058	0.928
LN_AT	13,126	8.452	1.448	6.664	7.433	8.309	9.385	10.379
GROWTH	13,126	0.109	0.191	-0.049	0.009	0.069	0.154	0.302
REV_VAR	13,126	0.187	0.153	0.051	0.083	0.141	0.240	0.382
CAP_INTENSITY	13,126	0.333	0.270	0.018	0.097	0.261	0.556	0.749
INTANGIBILITY	13,126	0.020	0.036	0.000	0.000	0.001	0.024	0.065

Table 2: Correlation Matrices

Table 2 presents a Pearson (lower left hand side) and Spearman (upper right hand side) Correlation Coefficient matrix for all firms in the sample. All variables are defined in the Appendix. Bold, italicized values indicate significance at the 0.10 level or stronger (based on two-tailed tests).

N = 13,126	*LT*	*OPER_LEV*	*FIN_LEV*	*MARGINS*	*ROA*	*LOSS*	*LIQUIDITY*	*MKT_BK*	*INT_COVERAGE*	*ZMIJEWSKI*	*LN_AT*	*GROWTH*	*REV_VAR*	*CAP_INTENSITY*	*INTANGIBILITY*
LT		***-0.121***	***-0.460***	***0.388***	***0.385***	***-0.389***	***0.269***	***0.232***	***0.551***	***-0.309***	***0.609***	-0.002	***-0.192***	***-0.104***	0.012
OPER_LEV	***-0.168***		***-0.020***	***-0.098***	-0.005	***0.044***	***0.018***	***-0.030***	-0.013	-0.011	***-0.112***	***-0.194***	***-0.216***	***0.053***	***0.082***
FIN_LEV	***-0.360***	***0.054***		***-0.157***	***-0.610***	***0.333***	***-0.583***	***-0.622***	***-0.756***	***0.677***	***-0.099***	***-0.152***	***-0.032***	***0.157***	***-0.268***
MARGINS	***0.353***	***-0.138***	***-0.088***		***0.401***	***-0.387***	***0.269***	***0.260***	***0.373***	***-0.202***	***0.244***	***0.154***	0.008	***-0.025***	***-0.101***
ROA	***0.411***	***-0.065***	***-0.373***	***0.459***		***-0.597***	***0.631***	***0.556***	***0.794***	***-0.506***	***0.065***	***0.160***	***-0.027***	***-0.028***	***0.291***
LOSS	***-0.396***	***0.090***	***0.347***	***-0.396***	***-0.635***		***-0.303***	***-0.192***	***-0.533***	***0.319***	***-0.163***	***-0.127***	***0.078***	***0.060***	***-0.023***
LIQUIDITY	***0.259***	***-0.020***	***-0.280***	***0.240***	***0.545***	***-0.259***		***0.437***	***0.610***	***-0.612***	-0.005	***0.166***	***0.054***	***0.231***	***0.208***
MKT_BK	***0.219***	***-0.056***	***-0.198***	***0.195***	***0.493***	***-0.144***	***0.425***		***0.475***	***-0.239***	***-0.049***	***0.152***	0.009	***-0.037***	***0.339***
INT_COVERAGE	***0.333***	***-0.028***	***-0.183***	***0.187***	***0.446***	***-0.214***	***0.525***	***0.373***		***-0.569***	***0.205***	***0.173***	***-0.055***	***-0.129***	***0.248***
ZMIJEWSKI	***-0.370***	***0.044***	***0.522***	***-0.198***	***-0.478***	***0.365***	***-0.567***	***-0.124***	***-0.389***		***-0.017***	***-0.206***	***-0.148***	-0.014	***-0.109***
LN_AT	***0.610***	***-0.130***	***-0.066***	***0.231***	***0.085***	***-0.156***	-0.013	***-0.061***	***0.108***	***-0.058***		***-0.023***	***-0.094***	***-0.044***	***-0.039***
GROWTH	***-0.078***	***-0.174***	***-0.055***	***0.105***	***0.050***	***-0.043***	***0.091***	***0.071***	***0.034***	***-0.130***	***-0.041***		***0.611***	***0.032***	***-0.060***
REV_VAR	***-0.211***	***-0.201***	***0.016***	-0.001	***-0.078***	***0.101***	***0.037***	0.002	***-0.027***	***-0.084***	***-0.091***	***0.732***		***0.055***	***-0.134***
CAP_INTENSITY	***-0.095***	***0.035***	***0.030***	-0.006	***-0.092***	***0.071***	***0.156***	***-0.105***	***-0.135***	***-0.013***	***-0.043***	***0.081***	***0.102***		***-0.248***
INTANGIBILITY	***0.056***	***0.065***	***-0.092***	***-0.053***	***0.210***	-0.003	***0.225***	***0.403***	***0.228***	***-0.070***	***-0.035***	***-0.059***	***-0.087***	***-0.261***	

Table 3: Variable of Interest by Industry

Table 3 presents a breakdown of our variable of interest, $OPER\_LEV_{it}$, by the Fama-French 48 taxonomy. Mean and median values are presented.

FF48	Description	N	Mean	Median	FF48	Description	N	Mean	Median
1	*Agriculture*	47	2.342	1.945	25	*Shipbuilding and Railroad Equipment*	43	1.464	1.400
2	*Food Products*	268	1.444	1.278	26	*Defense*	43	1.350	0.856
3	*Candy & Soda*	61	2.070	1.939	27	*Precious Metals*	56	2.504	2.127
4	*Beer & Liquor*	59	1.806	1.483	28	*Non-metallic and Industrial Metal Mining*	117	1.981	1.790
5	*Tobacco Products*	42	1.047	1.003	29	*Coal*	74	2.350	2.293
6	*Recreation*	68	2.835	2.822	30	*Petroleum and Natural Gas*	1,124	1.669	1.487
7	*Entertainment*	267	2.405	2.048	31	*Utilities*	1,053	1.567	1.434
8	*Printing and Publishing*	100	2.859	2.310	32	*Communication*	746	2.014	1.577
9	*Consumer Goods*	197	1.974	1.688	33	*Personal Services*	124	2.489	2.204
10	*Apparel*	146	2.703	2.100	34	*Business Services*	749	1.724	1.407
11	*Healthcare*	215	1.447	1.044	35	*Computers*	227	2.100	1.593
12	*Medical Equipment*	170	1.119	1.061	36	*Electronic Equipment*	389	2.456	2.246
13	*Pharmaceutical Products*	309	1.379	1.113	37	*Measuring and Control Equipment*	151	1.677	1.435
14	*Chemicals*	442	2.096	1.909	38	*Business Supplies*	302	2.126	1.760
15	*Rubber and Plastic Products*	64	1.920	1.499	39	*Shipping Containers*	102	1.917	1.804
16	*Textiles*	50	1.904	1.880	40	*Transportation*	553	2.126	1.645
17	*Construction Materials*	263	2.579	2.147	41	*Wholesale*	400	1.829	1.669
18	*Construction*	242	1.975	1.486	42	*Retail*	793	2.179	1.705
19	*Steel Works*	249	2.589	2.300	43	*Restaurant, Hotels, and Motels*	174	2.033	1.615
20	*Fabricated Products*	29	2.360	1.817	44	*Banking*	416	1.372	1.080
21	*Machinery*	475	2.147	1.851	45	*Insurance*	431	2.020	1.654
22	*Electrical Equipment*	135	1.964	1.767	46	*Real Estate*	21	1.688	1.926
23	*Automobiles and Trucks*	205	2.459	2.140	47	*Other Finance*	596	1.477	1.218
24	*Aircraft*	107	1.404	1.152	48	*Other*	232	1.880	1.498

Table 4: Long-Term Credit Ratings Analysis

Table 4 presents the results of our main hypothesis test. The variable of interest in this table is *OPER_LEV*. Columns 1 and 2 employ ordered logistic regression, and the dependent variable is *LT*. Column 1 includes industry fixed effects while Column 2 does not. Columns 3 and 4 employ logistic regression, and the dependent variable is *INV_GRADE*. Column 3 includes industry fixed effects while Column 4 does not. All variables are defined in the Appendix. Robust two-tailed z-statistics are presented in parentheses below the coefficients. *, **, and *** indicate significance at the 0.10, 0.05, and 0.01 levels, respectively. All standard errors are clustered at the firm level.

	Predicted Sign	(1) *LT*	(2) *LT*	(3) *INV_GRADE*	(4) *INV_GRADE*
OPER_LEV	**-**	**-0.151***** **(-7.672)**	**-0.158***** **(-8.110)**	**-0.183***** **(-5.224)**	**-0.181***** **(-5.572)**
FIN_LEV	-	-0.228*** (-10.622)	-0.248*** (-11.581)	-0.488*** (-5.012)	-0.479*** (-5.158)
MARGINS	+	0.936** (2.417)	1.853*** (5.684)	0.915 (1.353)	2.653*** (4.903)
ROA	+	2.926*** (3.211)	1.343* (1.671)	2.653* (1.765)	0.649 (0.499)
LOSS	-	-0.776*** (-8.260)	-0.880*** (-9.016)	-0.833*** (-4.781)	-0.886*** (-5.938)
LIQUIDITY	+	0.953*** (2.679)	-0.381 (-1.150)	-0.361 (-0.677)	-2.414*** (-4.594)
MKT_BK	?	0.752*** (10.984)	0.655*** (10.312)	0.821*** (7.606)	0.657*** (6.790)
INT_COVERAGE	+	0.013*** (3.813)	0.015*** (4.566)	0.010** (2.142)	0.014*** (3.080)
ZMIJEWSKI	-	-0.449*** (-11.777)	-0.421*** (-12.401)	-0.541*** (-6.992)	-0.496*** (-7.469)
LN_AT	+	1.170*** (25.227)	1.214*** (25.803)	1.363*** (19.729)	1.260*** (19.649)
GROWTH	?	0.309 (1.328)	-0.058 (-0.251)	-0.026 (-0.059)	-0.441 (-1.053)
REV_VAR	-	-3.918*** (-11.971)	-3.588*** (-11.430)	-4.843*** (-8.831)	-4.420*** (-8.485)
CAP_INTENSITY	?	-0.106 (-0.440)	-0.429*** (-2.651)	-0.127 (-0.286)	0.158 (0.602)
INTANGIBILITY	?	-4.172*** (-3.325)	-3.602*** (-3.169)	-5.532*** (-2.695)	-6.974*** (-3.844)
YEAR F.E.'s		YES	YES	YES	YES
INDUSTRY F.E.'s		YES	NO	YES	NO
INTERCEPT		YES	YES	YES	YES
PSEUDO R-SQUARED		0.233	0.207	0.504	0.423
N		13,126	13,126	13,023	13,126

Table 5: Cross-Sectional Revenue Variability Analysis

Table 5 presents the results of ordered logistic regression analysis utilizing interaction terms to capture the cross-sectional variation in *OPER_LEV* based on revenue variability. Column 1 presents the results of a continuous interaction with *REV_VAR*. Column 2 presents the results of an interaction with a dichotomized version of *REV_VAR*. All variables are defined in the Appendix. Robust two-tailed z-statistics are presented in parentheses below the coefficients. *, **, and *** indicate significance at the 0.10, 0.05, and 0.01 levels, respectively. All standard errors are clustered at the firm level.

	Predicted Sign	(1) Continuous *LT*	(2) Dichotomized *LT*
OPER_LEV	-	**-0.117*****	**-0.147*****
		(-4.168)	**(-6.055)**
OPER_LEV_x_REV_VAR	-	**-0.240****	**0.006**
		(-1.965)	**(0.171)**
REV_VAR	-	**-3.544*****	**-0.677*****
		(-9.429)	**(-7.826)**
YEAR F.E.'s		YES	YES
INDUSTRY F.E.'s		YES	YES
INTERCEPT		YES	YES
OTHER CONTROLS		YES	YES
PSEUDO R-SQUARED		0.232	0.230
N		13,126	13,126

Table 6: Cross-Sectional Profitability and Income Analysis

Table 6 presents the results of ordered logistic regression analysis utilizing interaction terms to capture the cross-sectional variation of the positive impact of various accounting-based measures of financial health as affected by *OPER_LEV*. Each variable (*ROA*, *MARGINS*, *LOSS*, and *GROWTH*) is interacted with *OPER_LEV* using a continuous measure and a dichotomous measure split at the median. All variables are defined in the Appendix. Robust two-tailed z-statistics are presented in parentheses below the coefficients. *, **, and *** indicate significance at the 0.10, 0.05, and 0.01 levels, respectively. All standard errors are clustered at the firm level.

	Predicted Sign	(1) Continuous *LT*	(2) Dichotomized *LT*	(3) Continuous *LT*	(4) Dichotomized *LT*	(5) *LT*	(6) Continuous *LT*	(7) Dichotomized *LT*
OPER_LEV	-	***-0.113****	***-0.127****	***-0.122****	***-0.117****	***-0.178****	***-0.123****	***-0.086****
		(-4.859)	***(-5.663)***	***(-5.950)***	***(-5.080)***	***(-8.185)***	***(-5.924)***	***(-3.781)***
OPER_LEV_x_MARGINS	-	***-0.456****	***-0.073***					
		(-2.991)	***(-1.975)***					
OPER_LEV_x_ROA	-			***-1.116****	***-0.079***			
				(-3.895)	***(-2.390)***			
OPER_LEV_x_LOSS	+					***0.123****		
						(3.350)		
OPER_LEV_x_GROWTH	-						***-0.505****	***-0.199****
							(-4.300)	***(-6.564)***
MARGINS	+	***1.639****	***0.359****	***0.862***	***0.937***	***0.891***	***1.024****	***0.980***
		(3.627)	***(3.349)***	***(2.220)***	***(2.559)***	***(2.306)***	***(2.610)***	***(2.527)***
ROA	+	***3.053****	***3.397****	***5.164****	***0.621****	***2.911****	***3.105****	***3.143****
		(3.369)	***(4.054)***	***(4.590)***	***(6.500)***	***(3.204)***	***(3.410)***	***(3.455)***
LOSS	-	***-0.785****	***-0.790****	***-0.801****	***-0.846****	***-1.048****	***-0.781****	***-0.794****
		(-8.383)	***(-8.351)***	***(-8.557)***	***(-9.911)***	***(-8.302)***	***(-8.331)***	***(-8.444)***
GROWTH	+	***0.356***	***0.355***	***0.352***	***0.329***	***0.321***	***0.967****	***0.315****
		(1.523)	***(1.524)***	***(1.513)***	***(1.418)***	***(1.383)***	***(3.584)***	***(4.075)***
YEAR F.E.'s		YES	YES	YES	YES	YES	YES	YES
INDUSTRY F.E.'s		YES	YES	YES	YES	YES	YES	YES
INTERCEPT		YES	YES	YES	YES	YES	YES	YES
OTHER CONTROLS		YES	YES	YES	YES	YES	YES	YES
PSEUDO R-SQUARED		0.233	0.233	0.233	0.234	0.233	0.233	0.234
N		13,126	13,126	13,126	13,126	13,126	13,126	13,126

Table 7: Bond Spreads Analysis

Table 7 presents the results of a levels analysis for corporate bond spreads, *SPREAD*. The variable of interest in this table is *OPER_LEV*. Panel A has all observations combined, while Panel B separates the results for firms with credit ratings and those without credit ratings. All variables are defined in the Appendix. Robust two-tailed t-statistics are presented in parentheses below the coefficients. *, **, and *** indicate significance at the 0.10, 0.05, and 0.01 levels, respectively. All standard errors are clustered at the firm level.

Panel A: All Firms Combined

	Predicted Sign	(1) *SPREAD*	(2) *SPREAD*
OPER_LEV	+	**0.141*** **	**0.125*** **
		(4.690)	**(4.063)**
FIN_LEV	+	0.830***	0.853***
		(15.589)	(15.877)
MARGINS	-	-1.133***	-0.688*
		(-3.448)	(-1.878)
ROA	-	-2.630**	-3.211***
		(-2.338)	(-2.756)
LOSS	+	0.352**	0.230
		(2.232)	(1.490)
LIQUIDITY	-	0.933*	0.314
		(1.657)	(0.567)
MKT_BK	***?***	-0.033	0.015
		(-0.316)	(0.142)
INT_COVERAGE	+	0.004	0.001
		(0.520)	(0.108)
ZMIJEWSKI	+	0.034	0.008
		(0.575)	(0.123)
LN_AT	-	-0.414***	-0.408***
		(-11.472)	(-9.971)
GROWTH	***?***	0.445	0.589*
		(1.292)	(1.795)
REV_VAR	+	1.804***	1.245***
		(4.057)	(2.797)
CAP_INTENSITY	***?***	0.149	0.475*
		(0.811)	(1.658)
INTANGIBILITY	***?***	1.286	1.477
		(0.844)	(0.797)
CPN_RTE	+	0.300***	0.287***
		(11.590)	(10.939)
TTM	+	0.023***	0.024***
		(3.812)	(3.864)
YEAR F.E.'s		YES	YES
INDUSTRY F.E.'s		YES	NO
INTERCEPT		YES	YES
R-SQUARED		0.481	0.494
N		6,084	6,084

Table 7: Bond Spreads Analysis (Continued)

Panel B: Differences between Rated and Unrated Firms

	Predicted Sign	(1) Rated Firms *SPREAD*	(2) Unrated Firms *SPREAD*	(3) Rated Firms *SPREAD*	(4) Unrated Firms *SPREAD*
OPER_LEV	+	**0.096*****	**0.091**	**0.117*****	**0.161**
		(3.623)	**(0.733)**	**(4.338)**	**(1.418)**
FIN_LEV	+	0.797***	1.097***	0.781***	0.972***
		(15.354)	(7.063)	(15.523)	(5.690)
MARGINS	-	-0.420	-1.658**	-0.859**	-1.884**
		(-1.131)	(-2.169)	(-2.509)	(-2.299)
ROA	-	-2.550**	-3.914	-2.166*	-1.268
		(-2.101)	(-1.196)	(-1.862)	(-0.371)
LOSS	+	0.444***	-0.240	0.590***	-0.170
		(2.863)	(-0.478)	(3.806)	(-0.323)
LIQUIDITY	-	0.587	-0.259	1.254**	0.053
		(1.150)	(-0.175)	(2.367)	(0.034)
MKT_BK	?	-0.202**	0.457*	-0.227**	0.403
		(-2.164)	(1.874)	(-2.531)	(1.568)
INT_COVERAGE	+	-0.000	0.058*	0.003	0.069**
		(-0.021)	(1.956)	(0.392)	(2.179)
ZMIJEWSKI	+	0.095	-0.247	0.104**	-0.080
		(1.599)	(-1.417)	(2.019)	(-0.467)
LN_AT	-	-0.442***	-0.084	-0.468***	-0.225
		(-12.855)	(-0.287)	(-14.133)	(-0.829)
GROWTH	?	0.214	0.518	0.058	0.950
		(0.639)	(0.800)	(0.178)	(1.422)
REV_VAR	+	1.467***	1.058	2.077***	0.040
		(3.375)	(0.973)	(5.026)	(0.042)
CAP_INTENSITY	?	0.246	2.756**	-0.088	2.481**
		(0.847)	(2.578)	(-0.547)	(2.562)
INTANGIBILITY	?	1.412	0.547	-0.074	5.892*
		(0.748)	(0.148)	(-0.049)	(1.876)
CPN_RTE	+	0.235***	0.493***	0.257***	0.469***
		(8.312)	(4.585)	(8.829)	(4.462)
TTM	+	0.046***	-0.117***	0.046***	-0.107***
		(8.149)	(-3.924)	(7.962)	(-3.671)
YEAR F.E.'s		YES	YES	YES	YES
INDUSTRY F.E.'s		YES	YES	NO	NO
INTERCEPT		YES	YES	YES	YES
R-SQUARED		0.569	0.414	0.554	0.362
N		5,362	722	5,362	722

Table 8: Analysis of Differences between the Cost of Debt and the Cost of Equity

Table 8 compares the cost of debt and equity by analyzing each separately and then together. Panel A analyzes the different impacts that operating leverage has upon both the cost of debt and the cost of equity. Columns 1 through 4 examine the impact to the cost of debt while Columns 5 and 6 examine the impact to the cost of equity. All control variables from Equation [*2*] are employed throughout the analyses while, additional bond specific controls (i.e., *CPN_RTE* and *TTM*) are employed in Columns 1 and 2. Panel B employs the observations from the combined analysis of Panel A. The data from Columns 3 and 5 of Table 8a are combined into Column 1 below while the data from Columns 4 and 6 of Panel A are combined into Column 2 below. The *COST_OF_CAPITAL* variable is either the value for the *SPREAD* variable or the *COE* variable from Panel A. An indicator variable (*DEBT_SAMPLE*) is created to attribute the observations that come from Columns 3 and 4 (*SPREAD* observations) of Panel A. This indicator variable is interacted with *OPER_LEV* to determine if *OPER_LEV* has a different statistical impact upon the cost of debt versus the cost of equity. Panel C employs the data from Columns 4 and 6 of Panel A. *OPER_LEV*, *COEF_VAR_REV*, and *LEVERAGE* are dichotomized into indicator variables at median values and interactions are conducted to determine if either *COEF_VAR_REV* or *LEVERAGE* interact with *OPER_LEV* to impact that respective measure of the cost of capital. All control variables from Equation [*2*] are employed throughout the analyses. Robust two-tailed t-statistics are presented in parentheses below the coefficients. *, **, and *** indicate significance at the 0.10, 0.05, and 0.01 levels, respectively. All standard errors are clustered at the firm level.

Panel A: Operating Leverage and the Cost of Capital by Type of Capital

	Predicted Sign	(1) *SPREAD*	(2) *SPREAD*	(3) *SPREAD*	(4) *SPREAD*	(5) *COE*	(6) *COE*
OPER_LEV	+	**0.144***** **(4.610)**	**0.131***** **(4.099)**	**0.148***** **(4.600)**	**0.130***** **(3.982)**	**0.488***** **(4.579)**	**0.292***** **(2.868)**
YEAR F.E.'s		YES	YES	YES	YES	YES	YES
INDUSTRY F.E.'s		NO	YES	NO	YES	NO	YES
PRIMARY CONTROL VARIABLES		YES	YES	YES	YES	YES	YES
BOND SPECIFIC CONTROLS		YES	YES	NO	NO	NO	NO
INTERCEPT		YES	YES	YES	YES	YES	YES
R-SQUARED		0.465	0.479	0.431	0.450	0.135	0.259
N		5,592	5,592	5,592	5,592	5,592	5,592

Table 8: Analysis of Differences between the Cost of Debt and the Cost of Equity (Continued)

Panel B: Comparison of the Effect of Operating Leverage the Cost of Debt and the Cost of Equity

	Predicted Sign	(1) *COST_OF_CAPITAL*	(2) *COST_OF_CAPITAL*
OPER_LEV	+	0.556***	0.449***
		(5.224)	(4.469)
OPER_LEV_x_DEBT_SAMPLE	**-**	**-0.476*** **	**-0.476*** **
		(-4.288)	**(-4.279)**
DEBT_SAMPLE	-	-4.378***	-4.378***
		(-16.468)	(-16.433)
YEAR F.E.'s		YES	YES
INDUSTRY F.E.'s		NO	YES
OTHER CONTROLS		YES	YES
INTERCEPT		YES	YES
R-SQUARED		0.277	0.328
N		11,184	11,184

Table 8: Analysis of Differences between the Cost of Debt and the Cost of Equity (Continued)

Panel C: Analysis of Differences between the effects of Revenue Variability on the Cost of Debt and the Cost of Equity

	Predicted Sign	(1) *SPREAD*	(2) *COE*	(3) *SPREAD*	(4) *COE*
HI_OPER_LEV	+	**0.221****	**0.639****	**0.192**	**1.019*****
		(2.296)	**(1.963)**	**(1.643)**	**(3.225)**
HI_OPER_LEV_x_HI_COEF_VAR_REV	?	**0.313***	**-0.083**		
		(1.904)	**(-0.182)**		
HI_OPER_LEV_x_HI_LEVERAGE	?			**0.278***	**-0.664**
				(1.648)	**(-1.423)**
HI_COEF_VAR_REV	+	0.262**	-0.394		
		(2.222)	(-1.092)		
HI_LEVERAGE	+			0.600***	1.735***
				(3.973)	(4.180)
YEAR F.E.'s		YES	YES	YES	YES
INDUSTRY F.E.'s		YES	YES	YES	YES
OTHER CONTROLS		YES	YES	YES	YES
INTERCEPT		YES	YES	YES	YES
R-SQUARED		0.452	0.259	0.408	0.256
N		5,592	5,592	5,592	5,592