Operating leverage and bond yield spreads: Differentiating between cash and accrual operating leverage

TING-KAI CHOU, *National Cheng Kung University*
HENOCK LOUIS, *Penn State University*
ZILI ZHUANG, *Chinese University of Hong Kong*

Abstract

The cost of debt is expected to increase with operating leverage. However, this expectation may not hold because of the countervailing effect of collaterals on the cost of debt. Default risk is more likely to be associated with the cash component of operating leverage, which is less likely to be related to collateralized assets. Fixed cash costs could exacerbate the risk associated with more volatile future cash flows and downside cash flow risk, and thus increase the cost of debt. Consistent with our conjecture, the evidence shows that higher bond yield spreads increase with cash operating leverage but not with accrual operating leverage. The effect of cash operating leverage get stronger as the bond market gets more efficient, when investors are more pessimistic about a firm's prospects, when the firm is operated less efficiently, and when the firm's sales are volatile and difficult to predict.

Keywords: Cost of debt; Bond yield spreads; Cost structure; Operating leverage

Operating leverage and bond yield spreads: Differentiating between cash and accrual operating leverage

Abstract

The cost of debt is expected to increase with operating leverage. However, this expectation may not hold because of the countervailing effect of collaterals on the cost of debt. Default risk is more likely to be associated with the cash component of operating leverage, which is less likely to be related to collateralized assets. Fixed cash costs could exacerbate the risk associated with more volatile future cash flows and downside cash flow risk, and thus increase the cost of debt. Consistent with our conjecture, the evidence shows that higher bond yield spreads increase with cash operating leverage but not with accrual operating leverage. The effect of cash operating leverage get stronger as the bond market gets more efficient, when investors are more pessimistic about a firm's prospects, when the firm is operated less efficiently, and when the firm's sales are volatile and difficult to predict.

1. Introduction

We analyze the effects of operating leverage on the cost of debt. Given the essential role of the cost of capital in asset valuation, the financial economics literature is replete with studies on risk and the cost of capital. One primary source of risk that is universally recognized by both academics and practitioners is leverage. While the discussion is framed more often in terms of financial leverage, a firm's operating risk is also important for a credit analyst because, as Merkel (2016) notes, "if a firm has high fixed costs and low variable costs (high operating leverage), its financial position is less stable." A high operating leverage essentially means a high ratio of fixed-to-variable cost, which is a very pervasive phenomenon that imposes constraints on business operations and drives business risk. [1] However, surprisingly, while the determinants of the cost of debt has been exhaustively analyzed, there is thus far no evidence in the literature that operating leverage is a relevant factor.

One might speculate that operating leverage is simply an understudied phenomenon. However, starting with Hamada (1972) and Lev (1974), who relate operating leverage to systematic risk, financial economists have extensively analyzed operating leverage. Several studies have analyzed the relation between operating leverage and financial leverage (Ferri and Jones 1979, Mandelker and Rhee 1984; Reinartz and Schmid 2016; Chen, Harford, and Kamara 2017; Mihov 2017). Others have analyzed the effect of operating leverage on the cost of equity. Rubinstein (1973), Mandelker and Rhee (1984), Booth (1991), and Ortiz-Molina and Phillips (2014) suggest that operating leverage increases expected stock returns; and Kogan (2004), Gomes, Kogan, and Zhang (2003), Carlson, Fisher, and Giammarino (2004), Cooper (2006); and Garcia-Feijoo and Jorgensen (2010) suggest that operating leverage explains the value premium. Yet, the literature remains largely silent on the effect operating leverage on the cost of debt.

[1] Rubinstein (1973), Mandelker and Rhee (1984), Booth (1991), Gomes, Kogan, and Zhang (2003), Carlson, Fisher, and Giammarino (2004), Kogan (2004), Zhang (2005), Cooper (2006), Garcia-Feijoo and Jorgensen (2010), Ortiz-Molina and Phillips (2014), and Mihov (2017).

Our inquiry leads us to a more puzzling observation. Using corporate bond issues in the US from 1981 to 2016, we find no evidence that bond yield spreads significantly increase with operating leverage. Bond investors are generally institutions, which are sophisticated investors. Bond yield spreads are more likely to fully reflect investors' information and credit risk assessment of the borrower than loan yield spread (Liao 2015).[2] Therefore, if operating leverage is associated with the cost of debt, the effect should be reflected in bond yield spreads.

Our failure to document a significant association operating leverage and bond yield spreads suggests that the literature is silent on the effect of operating leverage on the cost of debt presumably because of a lack of corroborating evidence, which presents a real challenge to the common wisdom that operating leverage increases credit risk. Fixed costs reduce a firm's ability to respond to changing business environments, and are somewhat analogous to inside debt, which firms have to incur even when they are facing sales downturns. During persistent sales downturns, some firms are burdened with large contractual expenses and unproductive assets that constrain their degrees of freedom, reduce their operating profits, and impede their ability to avoid default. It appears then that both the cost of equity and the cost of debt would increase with operating leverage.

We speculate that the failure to document a positive association between operating leverage and bond yield spreads possibly relates to the countervailing effect of collaterals on the cost of debt. All else being equal, collaterals reduce the cost of debt (Bester 1985; Besanko and Thakor 1987a, b; Chan and Kanatas 1985, 1987; Chan and Thakor 1987; Benmelech and Bergman 2009). To the extent that fixed costs increase with fixed assets, which can serve as collaterals, higher operating leverage would be associated with lower cost of debt, neutralizing the positive effect of operating leverage.

[2]Private lenders often use a wide range of non-price factors to protect themselves against downside risk and have a monitoring advantage over bondholders (Diamond 1984). In contrast, bondholders' information is reflected almost exclusively in the prices that they are willing to pay for the bonds. Moreover, loan contracts are often modified and restructured, and often include variable interest rates and flexible refinancing options, which is not the case for bond contracts.

Not every fixed cost is associated with tangible assets that are suitable to serve as collaterals. Costs associated with long-term contractual obligations are generally fixed. For instance, as Donangelo, Gourio, Kehrig, and Palacio (2018) show, labor expenses induce an important form of operating leverage. Labor expenses per se, which are largely fixed costs, do not necessarily increase collateralizable assets. We also note that fixed costs that are related to collateralizable assets are generally accruals (e.g., depreciation expenses), which do not jeopardize a firm's default risk. In contrast, fixed costs that are not related to collateralizable assets are generally cash expenditures that can jeopardize a firm's default risk. Fixed contractual cash obligations are much more concerning to debtholders than depreciation and other accrual fixed costs. Exploiting this important difference, we have devised a novel approach to capture the component of operating leverage that is most likely to increase the cost of debt by sorting operating leverage into cash operating leverage and accrual operating leverage.

Accrual accounting generates numbers, earnings in particular, that are better measures of firm performance than cash flows (Dechow 1994), with revenue, costs, and profits having both accrual and cash components. Operating leverage is calculated with accounting data, which mix accruals and cash flows, though the two have very different implications for debtholders. Operating leverage is traditionally measured from the coefficient of the regression of operating costs on sales. Accordingly, we measure cash operating leverage based on the coefficient of the regression of cash operating costs on cash sales revenues, and accrual operating leverage based on the coefficient of the regression of accrual operating costs on accrual sales revenues.[3]

We expect cash operating leverage to affect bond yield spreads through higher variance of expected cash flows and specifically lower expected cash flows than usual in the case of an eventual downturn. This conjecture implies that cost structure contains credit risk relevant information that is incremental to the information content of

[3]Interest payments are a type of fixed costs. However, they are associated with financial leverage and not operating leverage. Therefore, they are not included in our cash basis or accrual basis operating leverage calculations.

observed (past) operating performance and volatility. Considering that (1) a firm's default risk decreases with its expected cash flows and increases with the variance of its expected cash flows and (2) a bond's payoff is an asymmetric function of a borrower's economic performance, the implications of cost structure on bond prices can be substantial.

The empirical evidence is consistent with our conjecture that cash operating leverage increases the cost of debt. More specifically, we find strong evidence that higher cash operating leverage results in higher bond yield spreads, consistent with cash basis operating leverage increasing the risk of future profit streams and the cost of debt. We find no such evidence for accrual operating leverage.

We address concerns that our finding might be biased due to the endogeneity of a firm's cost structure using two approaches. First, we use a firm fixed effects estimation approach, where the potential omitted correlated variables are assumed to be unobservable time-invariant firm characteristics. Second, we use a difference-in-differences research design that exploits a natural experiment created by the passage of state-level wrongful discharge laws as an exogenous increase in a firm's operating leverage. Our main results hold with both approaches. The evidence that the cash operating leverage effect holds within firms is remarkable. Operating leverage is a firm-specific characteristic that is estimated using rolling time series regressions. Therefore, most of the cash operating leverage variation is observed in the cross-section. The significant within-firm effect provides strong evidence that bond yield spreads respond to changes in cash operating leverage.

To further assess whether the association between cash operating leverage and bond yield spreads is casual, we examine whether the association varies in predictable ways. First, we posit that cash operating leverage is associated with bond yield spreads because it contains incremental information about expected firm fundamentals. Under this conjecture, the association between operating leverage and bond yield spreads would weaken in periods when prices are less reflective of fundamentals. Accordingly, using Hu, Pan, and Wang's (2013) measure of bond pricing noise, we find that the effect of cash operating leverage increases on bond yield spreads is attenuated when there is more pricing noise in the financial markets.

Second, we note that the effect of operating leverage should be particularly concerning to debtholders if future sales are more volatile or difficult to predict, because costs do not co-move with sales sufficiently for issuers with high operating leverage. Operating leverage is high when firms make few sales but earn high margins on these sales, exacerbating the risk associated with incorrect sales forecasts. When realized sales are lower than forecasted sales, the impacts on cash flows and the firm's operating ability and debt servicing ability tend to be more severe. Accordingly, we find that the effect of cash operating leverage on bond yield spreads increases with analysts' earnings forecast dispersion and sales volatility, both reflecting the difficulty to predict an issuer's future sales and income.

Third, cash operating leverage increases cash flow volatility by pushing net operating cash flows much higher (lower) when sales increase (decrease). However, bondholders are primarily concerned with downside risk. This concern is exacerbated (mitigated) when investors hold pessimistic (optimistic) views about a business's prospects. When a firm's prospects are good, a sales decrease and thus the scenario of insufficient cash flows (i.e., the downside risk) is less likely to materialize. Accordingly, we also find that the association between cash basis operating leverage and bond yield spreads is weaker when investors are optimistic about a firm's future prospects.

Finally, we find that the effect of cash operating leverage on bond yield spreads decreases with managerial ability to operate the firm efficiently. A more competent manager is more likely to make the right adjustments regarding operating leverage and other business decisions to minimize the downside consequence. The effect is also less pronounced if issuers operate in more competitive product markets, as product market competition improves the efficiency of resource decisions by managers and mitigates managerial slacks (Giroud and Mueller 2010, 2011). Because of the disciplinary role of competition, managers are likely to respond more appropriately to potential sales reductions and minimize the chance of continuing deterioration of future sales and the impact on sales profit downturns.

Our study contributes to several streams of literature. First, it contributes to the literature on operating leverage. Prior research largely focuses on the implications of operating leverage on equity markets. We investigate how operating leverage affects debt pricing, filling in this large void in extant research. Second, we extend the literature on the relations between the characteristics of firms' real assets and securities pricing (e.g., Rubinstein 1973; Sagi and Seasholes 2007; Ortiz-Molina and Phillips 2014) by showing that cash operating leverage affects bond yield spreads. Third, while the literature is replete with studies on operating leverage, our study is the first to propose measures of cash-based and accruals-based operating leverage, two components of operating leverage with very different implications for firm risk and stability. Finally, prior studies document that accruals are better performance measures than cash flows (Dechow 1994) or examine aspects of the accruals anomaly, where equity investors fail to understand the properties of accruals versus cash flows (Sloan 1996). We show that cash operating leverage and accrual operating leverage also have different pricing implication for debt market investors.

The remainder of this paper is organized as follows. Section 2 discusses related studies. Section 3 discusses our research design. Section 4 describes the sample. Section 5 reports the empirical results. Section 6 concludes.

2. The extant literature on operating leverage

Operating leverage is a measure of the combination of fixed costs and variable costs in a company's cost structure. A company with high fixed costs and low variable costs has high operating leverage; whereas a company with low fixed costs and high variable costs has low operating leverage. High operating leverage results in a strong sensitivity of profits to changes in revenue and thus higher volatility of earnings. In other words, a company with high operating leverage results in a low co-movement in revenues and costs because of its cost structure of high fixed costs and low variable costs (Garrison, Noreen, and Brewer 2017).

Studies have long been linking operating leverage with equity risk. Lev (1974) provides early evidence that operating leverage is positively associated with systematic risk. Gahlon and Gentry (1982) and Mandelker and Rhee (1984) demonstrate theoretically and empirically that operating leverage explains a large proportion of variation in beta. Beta is a linear function of operating leverage in the model of capital investment and asset prices of Carlson, Fisher, and Giammarino (2004), providing further theoretical ground for the relation between operating leverage and systematic equity risk. Consistent with that, Garcia-Feijoo and Jorgensen (2010) and Nova-Marx (2011) document that operating leverage is positively associated with stock returns and value premium.

Another strand of the literature examines the interactions between operating leverage and financial leverage. Prezas (1987) demonstrates that operating leverage and financial leverage are simultaneously determined and often move in the same direction pushing the firm into a new risk class. In contrast, Kahl, Lunn, and Nilsson (2016) argue that firms with high operating leverage pursue more conservative financial policies (i.e., lower financial leverage) because they face greater risk. Similarly, Chen, Harford, and Kamara (2017) find that operating leverage is negatively associated with financial leverage.

The literature also investigates determinants and consequences of operating structure. Chen, Kacperczyk, and Ortiz-Molina (2011) find that unionization is positively related to operating leverage and cost of equity. Donangelo (2014) and Donangelo et al. (2018) labor mobility and labor expenses lead to a form of operating leverage and such leverage has asset pricing implications, being associated with expected equity returns. Chang, Hall, and Paz (2017) find that firms with greater customer concentration choose more rigid cost structure, i.e., high operating leverage, and underperform those with low operating leverage. Holzhacker, Krishnan, and Mahlendorf (2015) show that cost structure responds to regulatory changes. Aboody, Levi, and Weiss (2018) show that managers reduce operating leverage when they face a reduction of option-based compensation and thus a decrease in risk-taking incentives.

To the best of our knowledge, none of the prior studies examines the effect of cost structure on the cost of debt or bond pricing. Higher operating leverage gives rise to greater expected volatility in earnings for the same amount of changes in revenues. Operating leverage thus increases the likelihood of extreme earnings both on the upside and on the downside. Because of their asymmetric payoff function, the extreme negative earnings events induced by operating leverage concern bondholders but the extreme positive earnings events induced by operating leverage are irrelevant to them. Therefore, bondholders cannot diversify away a bond's downside risk with the upside events of another bond as they do not share any upside gains. Consequently, operating leverage represents a credit risk that should be priced.

While the above argument implies that operating leverage should be positively associated with bond yield spreads, the relation depends on whether operating leverage is accrual driven or cash driven. In particular, bondholders do not concern as much about the accrual basis operating leverage. For example, depreciation expenses are a form of accrual basis fixed costs. A firm who has a high proportion of fixed costs and whose fixed costs are mainly depreciation expenses would have high operating leverage. However, its operating leverage is mainly driven by accruals. When this firm's revenue goes down, its costs do not go down much because of its high fixed costs. However, the fixed costs such as depreciation expenses do not involve any cash outflows. To the extent that the borrowing firms have to pay cash to bondholders on a regular basis, bondholders are more much more concerned about cash basis operating leverage than accrual basis operating leverage.

It is difficult to gauge operating leverage from a single year's financial statements. Furthermore, discerning and analyzing cash flows and accruals require reasonable accounting knowledge. However, bondholders are typically institutional investors who are sophisticated and have access to more firm-specific information. Therefore, they are more likely to understand the pricing implications of operating leverage, cash flows, and accruals. The sophistication of bond investors implies that they are able to analyze the cash basis versus accrual basis operating leverage and price the cost structure accordingly. In sum, because a firm's default risk increases as its expected cash flow decreases or the variance of its expected cash flows increases, and the bond market is dominated by sophisticated institutional investors, we posit the following predictions. First, bond yield spreads increase with cash basis operating leverage, but not with accrual basis operating leverage. Second, to the extent that accruals drive operating leverage, the positive relation between bond yield spreads and overall operating leverage is muted.

3. Research design

In this section, we describe our regression models and the measurement of operating leverage and other variables.

3.1 Modeling bond yield spreads

We model bond yield spreads (*SPREAD*) as a function of operating leverage (*OL*). The at-issue bond yield spreads represent the risk premium that firms must pay to borrow money in the bond market and is a measure of a firm's cost of debt (Shi 2003; Qiu and Yu 2009). If a firm has more than one bond issue in a given fiscal year, we use the proceeds-weighted spread, with the weight being the proceeds of each bond issue relative to the total proceeds of all bonds issued by the firm during the year. We expect the coefficient on *OL*, our test variable, to be positive (i.e., the higher the operating leverage, the higher the yield spread).

To ensure that we capture the impact of operating leverage on bond yield spreads, we control for a number of firm- and bond-specific variables used in prior studies (e.g., Bhojraj and Sengupta 2003; Khurana and Raman 2003; Klock, Mansi, and Maxwell 2005; Ortiz-Molina 2006; Francis, Hasan, John, and Waisman 2010). More specifically, we estimate the following model:

$$SPREAD_{it}=\beta_0+\beta_1 OL_{it-1}+Controls+Industry\ effects+Year\ effects+\varepsilon_{it} \quad (1)$$

SPREAD is the at-issue yield spreads, defined as the difference between the bond offering yield and the comparable Treasury bond yield with equivalent duration as the bond issue. *OL* is our measure for operating leverage, which we describe in Section 3.2.

Controls includes firm-specific and issue-specific characteristics that could affect bond yield spreads. Specifically, we control for firm size (*lnMV*), measured as the natural logarithm of market value of equity, because larger firms tend to be less risky. We control for leverage (*LEV*) because highly leveraged firms generally face a higher probability of default. We include return on assets (*ROA*) in the model because more profitable firms generally have lower default risk. We include interest coverage (*INTCOV*) which indicates a firm's ability to generate income to cover its interest expense and therefore is expected to be negatively associated with bond yield spreads. We control for the intensity of a firm's tangible assets (*CAPINT*) because it is viewed as potential collateral and bond investors are expected to demand lower yields on firms with more tangible assets. We control for the volatility of operating cash flows (*STDOCF*) and the volatility of firm stock returns (*STDRET*), and expect both to be positively related to bond yield spreads. We control for a firm's bond issuance frequency (*MULTI*) because generally a frequent bond issuing and trading pattern conveys information about the firm to investors and thus reduces adverse selection costs

(Francis et al. 2010). We include bond maturity (*LnMAT*) in the model because lenders tend to issue long-term debts to larger and healthier firms, implying a negative relationship between maturity and spreads. All else being equal, we expect the cost of debt to increase with the bond proceed (*lnPROC*), which captures the size of the debt. However, as Shi (2003) notes, the size of a debt issue might proxy for greater marketability of the debt, which could mitigate the risk-exposure effect associated with a large issuance. We include bond rating at the issue date (*RATING*) in the model to control for information that the credit agencies possess about the issuers and the bonds that are not captured by the other variables in the model.

Finally, we control for industry fixed effects because some industries are riskier than others and, therefore, firms in these industries have larger spreads on their debts. We also control for year fixed effects to isolate the impacts of time-series changes in bond yield spreads. *Industry Effects* are based on the Fama and French (1997) 48-industry classification. Variables relating to firm characteristics are measured at the end of the fiscal year preceding the bond issues for the stock variables and over the fiscal year preceding the bond issues for the flow variables, assuming a three-month reporting lag. To reduce the effects of outliers, we winsorize all continuous variables at the 1st and 99th percentiles. Please see the Appendix for detailed definitions of all variables used in regressions.

3.2 Measuring operating leverage

To measure operating leverage, we estimate total operating leverage as the elasticity of a firm's operating costs with respect to its sales, a method originated in Lev (1974) and widely used in subsequent studies. For example, Kallapur and Eldenburg (2005) and Aboody et al. (2018) all use a similar specification to estimate time-series regressions of costs on revenue. Specifically, we estimate the following time-series model for each firm i and year t, using the eight most recent yearly observations from year t-1 to year t-8.

$$OC_{ik}=\alpha_0+\alpha_{it}REV_{ik}+\varepsilon_{it}\ ,\ k=t-1,\ldots,t-8 \tag{2}$$

where OC is total operating costs, measured as the sum of cost of goods sold, general and administrative expenses, as well as research and development expenses. REV is net sales revenue. Because the fixed-variable cost model underlying the operating leverage measurement assumes linearity, α_i, the coefficient on REV, is interpreted as the proportion of variable costs to total costs, capturing operating leverage (Kallapur and Eldenburg 2005). For ease of interpretation, we use 1-α as our proxy for operating leverage. If costs are primarily fixed, then the estimated 1-α is high, indicating a high ratio of fixed to variable costs, which results in a high operating leverage.

In this study, we focus on the differential effect of cash-based versus accrual-based operating leverage on bond yield spreads. We decompose operating costs and revenues into the cash-based operating costs and revenues and the accrual-based operating costs and revenues, as in Ball, Gerakos, Linnainmaa, and Nikolaev (2015) and Ball, Gerakos, Linnanmaa, and Nikolaev (2016). Cash-based operating leverage is estimated over the previous eight years using the coefficient of a time-series regression of cash-based operating costs to cash-based revenues. The model is specified as follows:

$$CBOC_{ik}=\gamma_0+\gamma_{it}CBREV_{ik}+\varepsilon_{ik}\ ,\ k=t-1,\ldots,t-8 \tag{3}$$

where $CBOC$ is cash-based operating costs, measured as total operating costs plus change in inventory and change in prepaid expenses minus change in trade accounts payable and change in accrued expenses. $CBREV$ is cash-based revenue, defined as net sales revenue minus change in accounts receivable plus change in deferred revenue. For ease of interpretation, we refer to 1-γ as cash-based operating leverage (COL).

Accrual-based operating leverage is estimated using a time-series regression of accrual-based operating costs to accrual-based revenues, specified as follows:

$$ABOC_{ik}=\theta_0+\theta_{it}ABREV_{ik}+\varepsilon_{ik}\ ,\ k=t-1,\ldots,t-8 \tag{4}$$

where *ABOC* is accrual-based operating costs, measured as total operating costs minus cash-based operating costs. *ABREV* is accrual-based revenue, defined as reported sales minus cash-based revenue. We refer to 1-θ as accrual-based operating leverage (*AOL*).

With cash basis operating leverage and accrual basis operating leverage measured separately, we run the following regression, where all the variables are defined as before.

$$SPREAD_{it}=\beta_0+\beta_1 COL_{it-1}+\beta_2 AOL_{it-1}+Controls+Industry\ effects$$
$$+Year\ effects+\varepsilon_{it} \quad (5)$$

In all the regression analyses, we use robust standard errors corrected for heteroskedasticity and clustered at the firm level.

4. Sample and descriptive statistics

We start with straight (nonconvertible) fixed-rate bond issues from U.S. firms over 1981–2016 taken from the Securities Data Corporation (SDC) Global New Issues database. We impose the following sample selection criteria: (1) the issuing firm is not a financial institution or a regulated utility (SIC codes 6000-6999 and 4900-4999, respectively); (2) the issuing firm has the necessary accounting data on Compustat and return data on the Center for Research in Security Prices (CRSP) database; (3) data on bond yield spreads, bond rating, bond proceeds, and bond time to maturity are available on the SDC; and (4) sales and total operating costs are non-negative. Data used in the cross-sectional tests are obtained from various sources, which are identified later in the paper. For firms with multiple bond issues in a given year, following prior studies (e.g., Klock et al. 2005), we convert the multiple same-year issues into one observation weighted by issue proceeds so that the unit of observation in our analyses is an issuing firm and not a bond issue. These restrictions yield a final sample of 2,849 bond issues conducted by 797 firms. The Appendix provides detailed definitions of variables.

Table 1 provides descriptive statistics for the variables used in the regression analyses, including those used in the subsequent cross-sectional analyses. Operating leverage has a mean value of 0.226. Cash basis operating leverage has a mean of 0.224 and accrual basis operating leverage has a mean of 0.837. All measures display reasonable cross-sectional variations. The table also presents statistics on the characteristics of both the issuers and the bonds. All the statistics are similar in magnitude to those reported in prior studies (e.g., Klock et al., 2005; Francis et al., 2010).

Table 2 presents the correlations between the variables in Table 1. We note that bond yield spread (*SPREAD*) is positively correlated with operating leverage (*OL*) and cash-based operating leverage (*COL*), but is not correlated with accrual-based operating leverage (*AOL*). The correlations between SPREAD and other variables are generally consistent with expectations. For example, *SPREAD* is negatively correlated with profitability (*ROA*) and credit rating (*RATING*), and is positively correlated with variables measuring performance volatility, such as the standard deviations of operating cash flows (*STDOCF*), returns (*STDRET*), and sales (*STDSALE*).

5. Empirical results

We start this section with an analysis of the association between bond yield spreads and operating leverage. Next, in an effort to draw causal inferences, we address the potential problems associated with the endogeneity of cost structure. Finally, to further strengthen our causal inferences, we conduct several cross-sectional analyses.

5.1 The main effect of operating leverage on the cost of debt

We report the results of the OLS regressions of yield spreads on operating leverage in Table 2. Column (1) reports the results for the overall operating leverage measure *OL*. We find that the coefficient on *OL* is insignificant. In other words, operating leverage is not associated with bond yield spreads.

In column (2), we put cash basis operating leverage *COL* and accrual basis operating leverage *AOL* instead of the overall operating leverage in the regression. We find a significantly positive association between bond yield spreads and *COL*, but not significant relation between bond yield spreads and *AOL*. This finding suggests that bondholders are primarily concerned with operating leverage induced by unpredictable sales revenues and operating costs that are cash based. The risk of cash shortage as a result of a revenues decline but fixed cash outflows increases bond yield spreads. In contrast, if the fixed costs are primarily accruals without immediate cash outflows, cost of debt does not go up because while revenues decline but there is no committed fixed cash outflows to siphon off cash that could be used to pay back debtholders.

The coefficients on the control variables are also generally consistent with our expectations and prior literature. More specifically, offering bond yield spreads decrease with size, profitability, good credit ratings, and issuance frequency, and increase with leverage, return volatility, and issuance size. The regression results in columns (1) and (2) are consistent with our conjecture that bond yield spreads increase with cash basis operating leverage but not accrual basis operating leverage, and that operating leverage without separating the cash flow and accruals components fails to yield any insight regarding the impact of firms' internal cost structure on cost of debt.

5.2 Potential endogeneity bias

Cost structure is a choice variable. Even though we control for the determinants of bond yield spreads suggested in prior research, it is possible that operating leverage and cost of debt are both affected by the same unobserved firm characteristics. To mitigate the endogeneity concern, we use two different approaches: (1) firm fixed effects estimation; and (2) a difference-in-differences research design in a panel regression using the adoption of state-level wrongful discharge laws as an exogenous shock to a firm's cost structure, i.e., an exogenous increase in the firm's operating leverage.

5.2.1 Firm fixed effect estimation

Operating leverage is a firm-specific characteristic, and a firm's cost structure is presumably relatively stable over time. In addition, it is estimated using rolling time series regressions. Accordingly, most of the cash operating leverage variation is observed in the cross-section. Therefore, the operating leverage effect does not have to hold within firms, particularly in cross-sectional analyses.[4] Hence, we do not include firm-fixed effects in our main analysis; we instead cluster the standard errors at the firm level. Nonetheless, if the unobservable firm-specific characteristics that potentially affect both a firm's cost structure and its bond yield spread are time invariant, then a firm fixed-effect estimation can account for the firm level heterogeneity and thus help to address the endogeneity problem. Therefore, in this section, we conduct firm fixed effects estimation, exploiting the within-firm, albeit weak, variation in cost structure. The year-fixed-effect estimation also helps to assess whether transitory aggregate economic conditions might be driving the bond yield spread effect.

We report the firm fixed-effect results in column (1) of Table 3. The coefficients on *CBOL* remain positive and statistically significant, and the coefficient on *ABOL* remains insignificant. The firm fixed effects regressions give us the within-firm estimation results with changes in operating leverage, both cash based and accruals based, and changes in bond yield spreads. Therefore, to the extent that both cost structure and credit spreads are affected only by time invariant unobservable firm characteristics, the results suggest that the association between cash based and accruals

[4]A well-known caveat of fixed effects estimation is that it exacerbates the attenuation bias caused by measurement error (Griliches and Hausman 1986). This concern may be particularly relevant to our setting because our operating leverage variables are estimated and thus potentially more prone to measurement error.

based operating leverage and credit spreads is unlikely to be driven by endogenous forces.

5.2.2 Difference-in-differences research design

To further alleviate the endogeneity concern and strengthen causal inferences, we also use a difference-in-differences research design. Specifically, we exploit the natural experiment created by the passage of state-level wrongful discharge laws as an exogenous increase in a firm's operating leverage. These laws, passed by all 50 states between 1967 and 1995, allow employees to sue employers for unjust dismissal and for lost earnings and punitive damages associated with such dismissals. As exceptions to the practice that employers can terminate employees at will, these laws increase the costs associated with dismissing employees (Jung 1997). After a wrongful discharge law is passed in a state, it is more difficult for a firm in that state to adjust number of employees and thus labor costs become more fixed. This represents an increase in operating leverage. The adoption of wrongful discharge laws occurs at the state level and in various years, and the change in operating leverage resulting from wrongful discharge laws is exogenous with respect to any specific firm. To the extent that most labor costs are cash based, wrongful discharge laws affect mostly cash basis operating leverage, the operating leverage measure of our focus.

There are three exceptions to the terminate-at-will rule and states can choose to adopt none, any, or all three: good faith exception, implied contract exception, and public policy exception.[5] To analyze the effect of the adoption of the wrongful discharge laws, we define an indicator variable *WDL*, which equals one if the state where a firm is headquartered has adopted anyone of the three exceptions as of year t. Hence, *WDL* takes the value 1 when a firm is subject to wrongful discharge laws and,

[5]For detailed discussions and legal definitions of these wrongful discharge laws (i.e., exceptions to the terminate-at-will rule), see Miles (2000), Kugler and Saint-Paul (2004), and Autor, Donohue, and Schwab (2006).

consequently, experiences an exogenous shock in labor operating leverage. We then estimate the following panel regression:

$$SPREAD_{it} = \beta_0 + \beta_1 WDL_{it} + \sum_j \gamma_j Control_{jit} + Firm\,Effects + Year\,Effects + \varepsilon_{it} \quad (6)$$

We include firm fixed effects in the difference-in-differences model to control for fixed differences between treated firms (i.e., firms headquartered in states that are affected by the laws in year *t*) and control firms (i.e., firms headquartered in states that are unaffected by the laws in year *t*). The fixed effects ensure that β_1 reflects average within-firm changes in bond yield spreads from before to after the exogenous shock to operating leverage, rather than simple cross-sectional correlations. We also include year effects to account for potential omitted macro-economic factors that could affect bond yield spreads and the likelihood that a state adopts wrongful discharge laws.[6] The identification strategy can be understood with an example. Suppose we wish to estimate the impact of the wrongful discharge law (operating leverage) passed in Alabama in 1987. We calculate the difference in bond yield spreads before 1987 and after 1987 for all firms headquartered in Alabama. However, other economic factors in 1987 may have affected bond yield spreads and the before-after difference may not be due to a change in operating leverage (associated with wrongful discharge laws). Choosing a control state, for example Louisiana, would help to control for such factors. We calculate the same difference between before and after 1987 for firms headquartered in Louisiana, which does not pass any wrongful discharge laws in 1987. We can then compare the bond yield spread differences in Alabama and Louisiana before and after 1987. The panel regression we use account for the staggered passage of wrongful discharge laws by different states. As such, the control group is not just states that never pass such a

[6] Acharya et al. (2013) argue that wrongful discharge laws affect innovation and Shi (2003) documents that R&D investment affects bond risk premium. Therefore, we control for R&D activity *(RDINT*) in regression (3). Moreover, the model also includes leverage (*LEV*), which controls for the effect of wrongful discharge laws on capital structure (Serfling 2016).

law; it consists of firms in all the states that do not pass a law in a particular year *t*, even if the states have already passed a law before year *t* or will pass a law later on. Our approach is similar to the difference-in-differences estimation used in the literature (e.g., Bertrand and Mullainathan 2003).

We report the results from the difference-in-differences estimation in column (2) of Table 3. The coefficient on *WDL*, which measures the effect of increases in cash basis operating leverage on bond yield spreads, is positive and statistically significant. Wrongful discharge laws should increase the operating leverage of labor-intensive issuers more than other issuers. Therefore, we expect the impact of the exogenous shock to be stronger for firms with higher labor intensity. We test this conjecture in columns (3) and (4) of Table 3. Column (3) use a measure of labor intensity in terms of number of employees per dollar of total sales (Serfling 2016). Specifically, we calculate the ratio of the number of employees over sales for each firm-year and denote it *EMPINT*. We find that the coefficient on *WDL* is insignificant, but that on *WDL×EMPINT* is positive and statistically significant. These results indicate that the wrongful discharge laws affect labor-intensive firms more and such an exogenous increase in the operating leverage of those firms causes an increase in bond yield spreads. Column (4) uses an expense-based measure of labor intensity. Specifically, we create a variable, *PAYROLL*, as the ratio of labor and pension expenses to sales following Levine et al. (2015). Again, we note that the coefficient on *WDL* is not statistically significant. However, the coefficient on *WDL×PAYROLL* is positive and statistically significant, confirming that the labor laws affect labor-intensive firms more and that the exogenous increase in the operating leverage of those firms causes an increase in bond yield spreads. Overall, although operating leverage can be a firm choice variable, the evidence suggests that the positive association between cash basis operating leverage and bond yield spreads is not likely to be driven by some endogeneity bias.

5.3 Cross-sectional analyses

5.3.1 The effect of pricing noise

There are periods, such as during crises, when prices are less reflective of firm fundamentals. If cash operating leverage is associated with bond yield spreads because it contains incremental information about expected firm fundamentals, then bond yield spreads should be less reflective of the impact of cash operating leverage during such periods. We proxy for the extent to which prices deviate from fundamentals using Hu, Pan, and Wang's (2013) measure of pricing noise (*NOISE*). This measure is computed as the aggregate root mean squared error (in basis points) of the deviation of the market yield on a bond at a given point in time from the yield predicted by a model of the yield curve applied to all bonds at the same point in time (please see Hu et al., 2013 for details).[7] The pricing error reflects the relative scarcity of arbitrage capital and thus the barriers to arbitrage, leading to asset mispricing. We augment Equation (5) with *NOISE* and the interaction term between *NOISE* and operating leverage.

The results of the analysis are reported in Table 4. While the main effect of cash operating leverage (*COL*) is significantly positive, the coefficient on the interaction term between *COL* and *NOISE* is significantly negative. This evidence that bond yield spreads reflect issuers' cash operating leverage less as prices deviate from fundamentals is consistent with the notion that cash operating leverage contains incremental information about expected firm fundamentals.

5.3.2 The effect of analyst forecast dispersion and sales volatility

Operating leverage is high when firms make few sales but earn high margins on these sales. Such firms face higher risk associated with incorrect sales forecasts. For bondholders, lower actual sales relative to forecasted sales can give rise to insufficient

---

[7]We thank Jun Pan for making the data publicly available at http://www.mit.edu/~junpan/. The data are at daily frequency, starting at 01/02/1987. We use the monthly average in the month of bond issuance.

cash flows (relative to budgeted or forecasted cash flows), which hurts the borrower's debt repayment ability. Therefore, we expect that the effect of cash operating leverage on bond yield spreads to concentrate in firms whose sales revenues are volatile and difficult to predict. We test this conjecture by conditioning our analysis on two variables. First, we use the dispersion of analysts' forecast of earnings (*DISP*) to measure the degree of difficulty in forecasting a firm's future revenues and income. We also use the standard deviation of sales revenues over the five years prior to the bond issuance (*STDSALE*) to measure the expected sales volatility of the firm.

The results of the analysis are presented in Table 5. The coefficients on the interaction terms between *COL* and both *DISP* and *STDSALE* are positive and significant. Hence, the evidence is consistent with our expectations that, while an issuer with higher operating leverage would tend to have higher bond yield spreads, the operating leverage spread effect is exacerbated when the firm's future sales is expected to be volatile and difficult to predict.

5.3.3 The effect of investors' expectations about future firm prospects

As explained earlier, we posit that the association between operating leverage and bond yield spreads would decrease with investors' expectations about a firm's future prospects. We measure the market's expectation of an issuer's future prospects in two ways. First, we use the one-year stock return prior to the bond issuance (*RET*). Using returns to measure investors' expectations of firms' prospects is consistent with both theoretical models and numerous prior empirical studies (e.g., Barberis, Shleifer, and Vishny 1997; Collin-Dufresne, Goldstein, and Martin 2001). Second, we use analysts' expected growth in the issuer's earnings (*LTG*). Specifically, *LTG* is expected long term growth rate of earnings per share, computed by IBES as the median of analysts' forecasts of earnings per share growth rate over the next five years as of the fiscal year end before bond issuance. A higher *RET* or *LTG* is generally an indication that investors are optimistic about a firm's future operating performance. We augment Equation (5) with *RET*, *LTG*, and the interaction terms between these future prospect variables and operating leverage. The results reported in Table 6 are consistent with our expectations that the impact of cash basis operating leverage on bond yield spreads would decrease with perceived firm prospects. The coefficients on the interaction terms between *COL* and *RET* and *LTG* are both significantly negative. The results suggest that while bondholders are concerned about cash basis operating leverage, such a concern is abated if the market perceives the firm as having good prospects such that the likelihood for an extreme revenue decline, and thus for operating leverage to magnify the reduction in cash flows, is lower.

5.3.2 The effect of operating efficiency and competition

We expect the association between operating leverage and bond yield spreads to be weaker when bond investors have reasons to believe that a firm is managed efficiently. With a given degree of operating leverage, an efficiently operated firm is more likely to make adjustments to minimize the impact of declining revenues and turn things around. Therefore, the effect of operating leverage on exacerbating cash shortfall could be potentially mitigated with an effective manager. We proxy for the level of efficiency with which a firm is operated by Demerjian, Lev, and McVay's (2012) managerial ability measure. Demerjian, Lev, and McVay's (2012) measure, which we label *MGR_ABILITY*, is a within-industry relative efficiency estimate based on data envelopment analyses (DEA).[8]

It has long been argued that product market competition helps to ensure that managers make more efficient operation decisions and do not waste corporate resources (e.g., Alchian 1950; Stigler 1958). Product market competition puts pressure on

[8] Please refer to Demerjian, Lev, and McVay (2012) for detailed discussions about the measure. The dataset containing the measure is available at https://community.bus.emory.edu/personal/PDEMERJ/Pages/Download-Data.aspx.

managers to make value maximizing decisions and mitigate managerial slack (e.g., Giroud and Mueller 2010, 2011).[9] Therefore, in a competitive market, managers tend to respond quickly and optimally to potential and ongoing reductions, thus more likely to minimize (cash) losses suffered by the firm as a result of changing business conditions. We measure competition with *FLUIDITY*, which is based on a textual analysis of firms' product descriptions in 10-K filings to capture changes in other firms' products relative to a firm's own products. Following Hoberg, Phillips, and Prabhala (2014), *FLUIDITY* measures the product threats faced by a firm and is retrieved from the Hoberg-Phillips Data Library.[10] A higher value of *FLUIDITY* indicates more competition and higher operating efficiency. Consistent with Valta (2012), we expect bond spreads to increase with *FLUIDITY* because of the uncertainties in cash flow and liquidation associated with product market competition. However, because competition generally forces managers to make more efficient decisions and to respond faster to changing economic conditions, it is likely to mitigate the impact of operating leverage on bond spread.

The results are reported in Table 7. The coefficients on the interaction terms between both *COL* and *MGR_ABILTIY* and *FLUIDITY* are significantly negative. Hence, the evidence is consistent with our expectations that, while an issuer with higher operating leverage would tend to have higher bond yield spreads, the operating leverage spread effect is mitigated when the firm is operated with relatively efficient managers or in a highly competitive product market.

6. Conclusion

It is generally assumed that operating leverage would increase default risk and

[9] The argument in Giroud and Mueller (2010, 2011) implies that competition can reduce agency problem. We perform agency related cross-sectional analysis next, using additional measures of agency problem.
[10] For details of this measure, please see Hoberg, Phillips, and Prabhala (2014). The Hoberg-Phillips industry data web page is at: http://hobergphillips.usc.edu/

consequently the cost of debt. However, there is no empirical evidence of such a relation between operating leverage and the cost of debt. We argue the expected relation may not hold because of the countervailing effect of collaterals on the cost of debt. We further note that default risk is more likely to be associated with cash operating leverage, which is less likely to be related to collateralized assets. Accordingly, we sort operating leverage into cash operating leverage and accrual operating leverage. We expect fixed cash costs to exacerbate the risk associated with more volatile future cash flows and downside cash flow risk, and thus to increase the cost of debt.

Consistent with our expectations, the evidence shows that higher cash operating leverage results in higher bond yield spreads. We find no such evidence for accrual operating leverage. We find that the spread-increasing effect of cash operating leverage is weaker in period of apparent financial market mispricing, when investors are optimistic about the firm's prospects, or when the firm is operated more efficiently. We also find that the effect is stronger when a firm's sales revenue is difficult to predict. Our main results are robust to controlling for the endogeneity of firms' cost structure. The study integrates the credit spread research and the cost structure research and extends both literatures.

References

Aboody, D., Levi, S. and Weiss, D., 2018. Managerial incentives, options, and cost-structure choices. *Review of Accounting Studies* 23: 422-451.

Acharya, V., Baghai, R. and Subramanian, K., 2013. Wrongful discharge laws and innovation. *Review of Financial Studies* 27: 301-346.

Alchian, A. 1950. Uncertainty, evolution, and economic theory. *Journal of Political Economy* 58: 211-221.

Autor, D. Donohue, I., and Schwab, S., 2006. The costs of wrongful discharge laws. *Review of Economics and Statistics* 88: 211-231.

Ball, R., Gerakos, J., Linnainmaa, J. T., and Nikolaev, V., 2015. Deflating profitability. *Journal of Financial Economics* 117: 225-248.

Ball, R., Gerakos, J., Linnainmaa, J. T., and Nikolaev, V., 2016. Accruals, cash flows, and operating profitability in the cross section of stock returns. *Journal of Accounting and Economics* 121: 28-45.

Barberis, N., Shleifer, A., and Vishny R., 1998. A model of investor sentiment. *Journal of Financial Economics* 49: 307-343.

Benmelech, E. and Bergman, N. 2009. Collateral pricing. *Journal of Financial Economics* 91: 339-260.

Bertrand, M. and Mullainathan, S., 2003. Enjoying the quiet life? Corporate governance and managerial preference. *Journal of Political Economy* 111: 1043-1075.

Besanko, D. and Thakor, A. 1987a. Collateral and rationing: Sorting equilibrium in monopolistic competitive credit markets. *International Economic Review* 28: 671-689.

Besanko, D. and Thakor, A. 1987b. Competitive equilibrium in the credit market under asymmetric information. *Journal of Economic Theory* 42: 167-182.

Bester, H. 1985. Screening vs. rationing in credit market with imperfect information. *American Economic Review* 75: 850-855.

Bhojraj, S. and Sengupta, P., 2003. Effect of corporate governance on bond ratings and yields: The role of institutional investors and outside directors. *Journal of Business* 76: 455-475.

Booth, L. 1991. The influence of production technology on risk and the cost of capital. *Journal of Financial and Quantitative Analysis* 26: 109-127.

Carlson, M., Fisher, A., and R. Giammarino, R. 2004. Corporate investment and asset price dynamics: Implications for the cross-section of returns. *Journal of Finance* 59: 2577-2603.

Chan, Y. and Kanatas, G., 1985. Asymmetric valuations and the role of collateral in loan agreements. *Journal of Money, Credit and Banking* 17: 84-95.

Chan, Y. and Kanatas, G., 1987. Collateral and competitive equilibria with moral hazard and private information. *Journal of Finance* 42: 345-363.

Chang, H., Hall, C. M., and Paz, M., 2017. Customer concentration, cost structure, and performance. Working paper, Drexel University.

Chen, Z., Harford, J., and Kamara, A., 2017. Operating leverage, profitability and capital structure. Working paper, Chinese University of Hong Kong and University of Washington.

Collin-Dufresne, P., Goldstein, R., and Martin, S., 2001. The determinants of credit spread changes. *Journal of Finance* 56: 2177-2207.

Cooper, I., 2006. Asset pricing implications of non-convex adjustment costs and irreversibility of investment. *Journal of Finance* 61: 139-170.

Dechow, P. 1994. Accounting earnings and cash flows as measures of firm performance: The role of accounting accruals. *Journal of Accounting and Economics* 18: 3-42.

Demerjian, P., Baruch, L., and McVay, S., 2012. Quantifying managerial ability: A new measure and validity tests. *Management Science* 58: 1229-1248.

Diamond, D. 1984. Financial intermediation and delegated monitoring. *Review of Economic Studies* 51: 393-414.

Donangelo, A., 2014. Labor mobility: Implications for asset pricing. *Journal of Finance* 69: 1321-1346.

Donangelo, A., Gourio, F. and Kehrig, M. and Palacios, M., 2018. The cross-section of labor leverage and equity returns. *Journal of Financial Economics*, forthcoming.

Fama, E. and French, K., 1997. Industry costs of equity. *Journal of Financial Economics* 43: 153-193.

Ferri, M. and Jones, W., 1979. Determinants of financial structure: a new methodological approach. *Journal of Finance* 34: 631-644.

Francis, B. B., Hasan, I., John, K. and Waisman, M., 2010. The effect of state antitakeover laws on the firm's bondholders. *Journal of Financial Economics* 96: 127-154.

Gahlon, J. and Gentry, J., 1982. On the relationship between systematic risk and the degrees of operating and financial leverage. *Financial Management* 11: 15-23.

Garcia-Feijoo, L. and Jorgensen. R., 2010. Can operating leverage be the cause of the value premium? *Financial Management* 39: 1127-1153.

Garrison, R., Noreen, E., and Brewer, P., 2017. *Managerial Accounting 16th Edition*, McGraw-Hill Education.

Giroud, X. and Mueller, H., 2010. Does corporate governance matter in competitive industries? *Journal of Financial Economics* 95: 312-331.

Giroud, X. and Mueller, H., 2011. Corporate governance, product market competition, and equity prices. *Journal of Finance* 66: 563-560.

Gomes, J., Kogan, L., and Zhang, L. 2003. Equilibrium cross section of returns. *Journal of Political Economy* 111: 693-732.

Griliches, Z. and Hausman, J., 1986. Errors in variables in panel data. *Journal of Econometrics* 31: 93-118.

Hamada, R., 1972, The effect of firm's capital structure on the systematic risk of common stocks. *Journal of Finance* 27: 435-452.

Hoberg, G., Phillips, G., and Prabhala. N., 2014. Product market threats, payouts, and financial flexibility. *Journal of Finance* 69: 293-324

Holzhacker, M., Krishnan, R., and Mahlendorf, M., 2015. The impact of changes in regulation on cost behavior. *Contemporary Accounting Research* 32: 534-566.

Hu, G., Pan, J., and Wang, J., 2013. Noise as information for illiquidity. *Journal of Finance* 68: 2341-2382.

Jung, D., 1997. Jury verdicts in wrongful termination cases. Report, Public Law Research Institute, University of California Hastings.

Kahl, M., Lunn, J., and Nilsson, M., 2016. Operating leverage and corporate financial policies. Working paper, UT Austin and Penn State University.

Kallapur, S. and Eldenburg, L., 2005. Uncertainty, real options, and cost behavior: Evidence from Washington state hospitals. *Journal of Accounting Research* 43: 735-752.

Khurana, I. and Raman, K., 2003. Are fundamentals priced in the bond market? *Contemporary Accounting Research* 20: 465-494.

Klock M. S., Mansi S. A. and Maxwell, W. F, 2005. Does corporate governance matter to bondholders? *Journal of Financial and Quantitative Analysis* 40: 693-719.

Kogan, L. 2004. "Asset prices and real investment. *Journal of Financial Economics* 73: 411-431.

Kugler, A. and Saint-Paul, G., 2004. How do firing costs affect worker flows in a world with adverse selections? *Journal of Labor Economics* 22: 553-548.

Lev. B., 1974. On the association between operating leverage and risk. *Journal of Financial and Quantitative Analysis* 9: 627-641.

Levine, R., Lin, C., and Shen, B. 2015. Cross-border acquisitions and labor regulations.

Working paper, University of California, Berkeley.

Liao, S. 2015. Outside blockholders' monitoring of management and debt financing. *Contemporary Accounting Research* 32: 1373-1404.

Mandelker, G and Rhee, S., 1984. The impact of the degrees of operating and financial leverage on systematic risk of common stock. *Journal of Financial and Quantitative Analysis* 19: 45-57.

Merkel, D., 2016. The value of risk-based capital in financial regulation. *Seeking Alpha* (Dec 5, 2016). https://seekingalpha.com/article/4028339-value-risk-based-capital-financial-regulation

Miles, T., 2000. Common law exceptions to employment at will and the U.S. labor markets. *Journal of Law, Economics, and Organization* 16: 74-101.

Mihov, A., 2017. Cost inflexibility and capital structure: Evidence from SOX Section 404. Working paper, Federal Reserve Bank of Richmond.

Novy-Marx, R., 2010. Operating leverage. *Review of Finance* 15: 103-134.

Ortiz-Molina**,** H., 2006. Top management incentives and the pricing of corporate public debt. *Journal of Financial and Quantitative Analysis* 41: 317-340.

Ortiz-Molina, H. and Phillips, G., 2014. Real asset illiquidity and the cost of capital. *Journal of Quantitative and Financial Analysis* 49: 1-32.

Qiu, J. and Yu, F., 2009. The market for corporate control and the cost of debt. *Journal of Financial Economics* 93: 505-524.

Prezas, A., 1987. Effects of debt on the degrees of operating and financial leverage. *Financial Management* 16: 39-44.

Reinartz, S. and T. Schmid., 2016. Product flexibility, product market, and capital structure decisions. *Review of Financial Studies* 29: 1501-1548.

Rubinstein, M., 1973. A mean-variance synthesis of corporate financial theory. *Journal of Finance* 28: 167-182.

Sagi, J. and Seasholes, M., 2007. Firm-specific attributes and the cross-section of momentum. *Journal of Financial Economics* 84: 389-434.

Serfling, M., 2016. Firing costs and capital structure decisions. *Journal of Finance* 71: 2239-2286.

Shi C., 2003. On the trade-off between the future benefits and riskiness of R&D: A bondholders' perspective. *Journal of Accounting and Economics* 35: 227–254.

Sloan, R. 1996. Do stock prices fully reflect information in accruals and cash flows about future earnings? *Accounting Review* 71: 289-315.

Stigler, G., 1958. The economics of scale. *Journal of Law and Economics* 1: 54-71.

Valta, P., 2012. Competition and the cost of debt. *Journal of Financial Economics* 105: 661-682.

Appendix: Variable definitions

Variable	Description
AOL	The accrual-based operating leverage measure, defined as one minus the coefficient estimate of θ from firm-specific regressions of the following model using the last 8 years of observations prior to the bond issuance: $ABOC_{ik}=\theta_0+\theta_{it}ABREV_{ik}+\varepsilon_{ik}$, $k=t\text{-}1\ldots t\text{-}8$, where *ABOC* is accrual-based operating costs, measured as total operating costs minus cash-based operating costs. *ABREV* is accrual-based revenue, defined as reported net sales minus cash-based revenue.
CAPINT	Capital intensity calculated as the ratio of gross property, plant and equipment to total assets at the fiscal year end prior to the bond issuance.
COL	The cash-based operating leverage measure, defined as one minus the coefficient estimate of γ from firm-specific regressions of the following model using the last 8 years of observations prior to the bond issuance: $CBOC_{ik}=\gamma_0+\gamma_{it}CBREV_{ik}+\varepsilon_{ik}$, $k=t\text{-}1\ldots t\text{-}8$, where *CBOC* is cash-based operating costs, measured as total operating costs plus change in inventory and change in prepaid expenses minus change in trade accounts payable and change in accrued expenses. *CBREV* is cash-based revenue, defined as net sales revenue minus change in accounts receivable plus change in deferred revenue.
DISP	Analyst earnings forecast dispersion is measured as the standard deviation of the final analyst forecast prior to the firm's annual earnings announcement, divided by the absolute value of the mean forecast.
EMPINT	Employee intensity, defined as the number of employees divided by sales.
FLUIDITY	A measure of product market threats faced by a firm, constructed by Hoberg, Phillips, and Prabhala (2014) based on a textual analysis of firms' product descriptions in 10-K filings to capture changes in other firms' products relative to the firm's own products. See Hoberg et al. (2014) for details.
INTCOV	Interest coverage defined as the ratio of net income plus interest expense to interest expense at the most recent fiscal year end prior to the bond issuance.
LEV	Financial leverage defined as long-term debt over total assets at the fiscal year end prior to the bond issuance.
LnMAT	The natural logarithm of the number of years until maturity on the issue. If a firm issues multiple bonds in a year, this variable is calculated as a weighted average based on each bond's proceeds.
LnMV	The natural logarithm of market value of equity at fiscal year-end prior to the bond issuance.
LnPROC	The natural logarithm of the total amount of proceeds received from the issue. If a firm issues multiple bonds in a year, this variable is calculated as a weighted average based on each bond's proceeds.
LTG	The expected long-term growth rate of earnings per share, computed by IBES as the median of analysts' forecasts of earnings per share growth rate over the next five years as of the fiscal year end before bond issuance.
MGR_ABILITY	The decile rank (by industry and year) of managerial ability from Demerjian et al. (2012).
MULTI	An indicator variable that equals one if a firm has multiple bond issues during the sample period, and zero otherwise.
NOISE	The aggregate root mean squared error (in basis points) of the deviation of the market yield on a bond at a given point in time from the yield predicted by a model of the yield curve applied to all bonds at the same point in time (see Hu, Pan, and Wang, 2013 for details). The data are publicly available at http://www.mit.edu/~junpan/. The data are at the daily frequency, starting on 01/02/1987. We use the monthly average in the month of bond issuance.
OL	The operating leverage measure related to Lev (1974), defined as one minus the coefficient estimate of α from firm-specific regressions of the following model using the last 8 years of observations prior to the bond issuance: $OC_{ik}=\alpha_0+\alpha_{it}REV_{ik}+\varepsilon_{ik}$, $k=t\text{-}1\ldots t\text{-}8$, where *OC* is total operating costs, measured as the sum of cost of goods sold, general and administrative expenses, as well as research and development expenses; *REV* is net sales revenue.
PAYROLL	Labor payroll intensity, defined as the ratio of total labor expenses to sales.
RATING	Standard & Poor's credit rating on the bond issue, converted to numerical scale ranging from 1 (D or SD) to 22 (AAA). If a firm issues multiple bonds in a year,

	this variable is calculated as a weighted average of the ratings based on each bond's proceeds.
RDINT	R&D intensity defined as R&D expenses divided by net sales at the fiscal year end prior to the bond issuance.
RET	Annual buy-and-hold-returns for the year prior to the bond issuance.
ROA	Return on assets defined as income before extraordinary items divided by total assets at the fiscal year end prior to the bond issuance.
SPREAD	Bond yield spread, measured as the yield to maturity of the corporate bond at issuance minus the yield to maturity of a Treasury security with a similar duration and expressed in basis points. If a firm issues multiple bonds in a year, this variable is calculated as a weighted average of all bond issues based on each bond's proceeds.
STDRET	Standard deviation of monthly stock returns over the year prior to the bond issuance.
STDOCF	Standard deviation of operating cash flows divided by total assets over the five years prior to the bond issuance.
STDSALE	Standard deviation of net sales scaled by total assets over the five years prior to the bond issuance.
WDL	An indicator variable that equals one if a state has passed any wrongful discharge laws, and zero otherwise.

Table 1: Summary statistics

	N	Mean	Std. Dev.	P25	Median	P75
Dependent Variable						
SPREAD	2,849	162.754	125.355	76.702	121.000	200.000
Main Variables						
OL	2,849	0.226	0.160	0.111	0.197	0.303
COL	2,849	0.224	0.187	0.092	0.195	0.310
AOL	2,849	0.837	0.820	0.437	0.856	1.207
Control Variables						
LnMV	2,849	8.714	1.556	7.726	8.656	9.763
LEV	2,849	0.244	0.139	0.146	0.225	0.320
ROA	2,849	0.062	0.051	0.035	0.061	0.090
INTCOV	2,849	7.124	11.193	2.438	4.230	7.524
CAPINT	2,849	0.381	0.227	0.202	0.338	0.543
STDOCF	2,849	0.028	0.029	0.011	0.020	0.034
STDRET	2,849	0.085	0.039	0.059	0.076	0.103
RDINT	2,849	0.021	0.037	0.000	0.004	0.027
MULTI	2,849	0.953	0.211	1.000	1.000	1.000
LnMAT	2,849	2.355	0.562	2.015	2.303	2.738
LnPROC	2,849	5.523	0.926	5.005	5.520	6.204
RATING	2,849	15.396	3.093	14.000	16.000	17.000
Variables used in Cross-Sectional Analyses						
RET	2,849	0.135	0.322	-0.067	0.109	0.301
LTG	2,664	12.192	4.222	9.750	11.800	14.150
MGR_ABILITY	2,737	0.638	0.321	0.300	0.700	1.000
FLUIDITY	1,674	5.530	3.360	3.183	4.642	7.031
DISP	1,691	0.128	0.493	0.015	0.034	0.089
STDSALE	2,849	0.041	0.036	0.019	0.030	0.051
NOISE	2,669	3.389	2.080	2.218	2.942	4.058
EMPINT	1,982	5.451	4.727	2.532	4.406	6.906
PAYROLL	597	0.224	0.084	0.175	0.211	0.260

The table reports summary statistics for the variables used in subsequent analyses. The sample consists of nonconvertible bond issues in the US from 1981 to 2016. The variables are defined in the Appendix.

Table 2: Correlation Matrix

	SPREAD	*OL*	*CBOL*	*ABOL*	*LNMV*	*LEV*	*ROA*	*INTCOV*	*CAPINT*	*STDROA*	*STDRET*	*RDINT*	*MULTI*	*LNMAT*	*LNPROC*	*RATING*
SPREAD		**0.053**	**0.038**	0.006	**-0.383**	**0.349**	**-0.326**	**-0.148**	-0.013	**0.319**	**0.481**	**-0.153**	**-0.218**	**-0.065**	**0.123**	**-0.710**
OL	**0.090**		**0.855**	**-0.107**	**0.253**	**-0.061**	**0.284**	**0.270**	**0.153**	**0.140**	**-0.037**	**0.374**	0.023	0.020	**0.147**	**0.155**
COL	**0.082**	**0.849**		**-0.132**	**0.222**	**-0.050**	**0.220**	**0.238**	**0.161**	**0.086**	**-0.048**	**0.298**	0.011	-0.006	**0.131**	**0.130**
AOL	-0.024	**-0.091**	**-0.129**		**-0.161**	-0.014	-0.007	0.002	**-0.152**	-0.023	**0.037**	0.002	-0.023	-0.028	**-0.120**	**-0.056**
LnMV	**-0.336**	**0.246**	**0.235**	**-0.167**		**-0.323**	**0.424**	**0.313**	**-0.104**	**-0.113**	**-0.331**	**0.315**	**0.252**	-0.011	**0.592**	**0.604**
LEV	**0.304**	**-0.073**	**-0.061**	-0.031	**-0.258**		**-0.328**	**-0.404**	**0.276**	0.007	**0.164**	**-0.331**	-0.033	-0.013	**-0.074**	**-0.501**
ROA	**-0.299**	**0.284**	**0.243**	-0.003	**0.427**	**-0.334**		**0.551**	**-0.075**	**-0.147**	**-0.305**	**0.203**	**0.069**	**-0.048**	**0.135**	**0.454**
INTCOV	**-0.304**	**0.252**	**0.216**	-0.027	**0.470**	**-0.570**	**0.862**		**-0.152**	**0.039**	**-0.109**	**0.365**	**-0.046**	**-0.053**	**0.218**	**0.265**
CAPINT	**-0.049**	**0.062**	**0.103**	**-0.151**	**-0.095**	**0.280**	**-0.061**	**-0.193**		-0.029	0.020	**-0.312**	**0.037**	**0.127**	**-0.148**	**-0.043**
STDOCF	**0.240**	**0.146**	**0.102**	-0.016	**-0.139**	**-0.047**	**-0.109**	**-0.087**	0.002		**0.327**	**0.152**	**-0.117**	-0.016	**0.061**	**-0.295**
STDRET	**0.426**	**-0.047**	**-0.069**	0.025	**-0.324**	**0.106**	**-0.277**	**-0.263**	0.026	**0.279**		**-0.045**	**-0.132**	**-0.097**	-0.022	**-0.422**
RDINT	**-0.247**	**0.282**	**0.226**	**0.070**	**0.244**	**-0.398**	**0.182**	**0.268**	**-0.358**	**0.101**	**-0.095**		-0.002	-0.021	**0.169**	**0.304**
MULTI	**-0.161**	0.026	0.006	-0.028	**0.218**	0.002	**0.068**	**0.040**	0.036	**-0.094**	**-0.102**	0.025		**0.044**	**0.055**	**0.249**
LnMAT	0.029	0.018	0.012	**-0.038**	0.005	-0.009	**-0.040**	**-0.051**	**0.128**	-0.003	**-0.088**	**-0.038**	**0.051**		0.019	**0.051**
LnPROC	**0.194**	**0.132**	**0.122**	**-0.153**	**0.630**	**-0.070**	**0.166**	**0.274**	**-0.185**	**0.039**	**-0.046**	**0.074**	**0.064**	-0.024		**0.050**
RATING	**-0.707**	**0.193**	**0.175**	-0.018	**0.551**	**-0.421**	**0.463**	**0.467**	-0.017	**-0.268**	**-0.366**	**0.341**	**0.199**	**0.064**	0.020	
RET	**-0.125**	-0.023	-0.029	**0.040**	**0.049**	-0.007	**0.112**	**0.067**	0.002	**-0.037**	**-0.121**	-0.031	-0.027	**0.059**	**-0.073**	-0.019
LTG	**-0.044**	**0.046**	-0.002	**0.061**	-0.006	-0.016	**0.058**	**0.051**	**-0.061**	**-0.108**	**0.150**	**-0.116**	**-0.052**	**-0.042**	**-0.105**	0.000
MGR_ABILITY	**-0.228**	**0.046**	**0.074**	0.015	**0.305**	**-0.213**	**0.209**	**0.210**	**-0.081**	0.009	**-0.052**	**0.127**	**0.074**	-0.020	**0.130**	**0.320**
FLUIDITY	**0.154**	**0.238**	**0.221**	**-0.101**	**0.081**	**-0.065**	**-0.083**	0.012	-0.026	**0.215**	**0.114**	0.018	**-0.053**	0.047	**0.252**	**-0.153**
DISP	**0.263**	**-0.090**	**-0.055**	-0.027	**-0.323**	**0.108**	**-0.478**	**-0.437**	**0.175**	**0.374**	**0.370**	**-0.138**	**-0.102**	**0.068**	**-0.101**	**-0.351**
STDSALE	**0.122**	**-0.443**	**-0.419**	**0.121**	**-0.162**	0.000	**-0.066**	**-0.083**	**-0.078**	**0.150**	**0.183**	**-0.245**	**-0.063**	**-0.045**	**-0.053**	**-0.178**
NOISE	**0.171**	-0.005	-0.025	**0.042**	**-0.127**	0.027	**-0.040**	**-0.139**	**0.090**	**-0.036**	**0.211**	**0.051**	**0.050**	**-0.042**	**-0.167**	**0.119**
EMPINT	**-0.148**	**-0.109**	**-0.098**	**0.179**	**-0.272**	**0.050**	**-0.059**	**-0.155**	**0.076**	**-0.180**	**0.049**	-0.015	**-0.042**	0.018	**-0.414**	**0.071**
PAYROLL	-0.028	-0.032	-0.070	**0.255**	**-0.248**	**-0.441**	**-0.141**	0.026	**-0.317**	**0.122**	**0.139**	**0.381**	-0.044	-0.016	**-0.156**	0.050

Table 2: Correlation Matrix (cont'd)

	RET	*LTG*	*MGR_ABILITY*	*FLUIDITY*	*DISP*	*STDSALE*	*NOISE*	*EMPINT*	*PAYROLL*
SPREAD	**-0.105**	-0.012	**-0.205**	**0.160**	**0.228**	**0.098**	**0.254**	**-0.055**	0.045
OL	**-0.037**	**0.064**	**0.113**	**0.275**	-0.034	**-0.368**	0.016	**-0.114**	-0.087
COL	-0.035	0.025	**0.122**	**0.264**	-0.034	**-0.337**	-0.007	**-0.098**	**-0.116**
AOL	0.029	**0.059**	0.020	**-0.103**	-0.022	**0.090**	-0.014	**0.064**	**0.182**
LnMV	0.008	-0.021	**0.290**	**0.097**	**-0.142**	**-0.142**	0.013	**-0.202**	**-0.226**
LEV	0.013	-0.011	**-0.186**	**0.057**	**0.095**	**0.082**	-0.026	**0.101**	**-0.373**
ROA	**0.084**	**0.049**	**0.222**	**-0.095**	**-0.268**	**-0.066**	0.010	-0.033	**-0.159**
INTCOV	0.010	**0.046**	**0.199**	**0.067**	**-0.111**	**-0.048**	-0.020	**-0.118**	0.065
CAPINT	-0.009	**-0.044**	**-0.103**	**0.080**	**0.075**	**-0.061**	0.013	**0.105**	**-0.294**
STDOCF	0.000	-0.041	**0.002**	**0.228**	**0.240**	**0.075**	-0.034	**-0.108**	0.075
STDRET	-0.031	**0.132**	**-0.065**	**0.085**	**0.213**	**0.132**	**0.117**	0.021	0.081
RDINT	-0.023	0.010	**0.216**	**0.234**	**-0.048**	**-0.190**	0.024	**-0.103**	**0.233**
MULTI	**-0.049**	**-0.084**	**0.066**	-0.041	**-0.049**	-0.021	**0.057**	**-0.069**	-0.053
LnMAT	**0.042**	-0.035	-0.034	**0.085**	0.010	-0.033	**-0.041**	0.010	-0.021
LnPROC	**-0.074**	**-0.086**	**0.101**	**0.253**	-0.007	-0.022	0.018	**-0.281**	**-0.132**
RATING	**-0.077**	**-0.044**	**0.303**	**-0.153**	**-0.180**	**-0.181**	**0.096**	0.001	0.017
RET		**0.128**	-0.019	0.009	**-0.111**	**0.062**	**-0.136**	**0.056**	-0.009
LTG	**0.109**		0.022	0.040	-0.013	0.032	-0.025	**0.193**	**0.109**
MGR_ABILITY	-0.023	0.028		0.014	**-0.080**	**0.136**	**0.054**	**-0.161**	**-0.237**
FLUIDITY	-0.027	0.038	0.010		**0.055**	**-0.072**	**-0.053**	**-0.203**	-0.056
DISP	**-0.126**	**-0.134**	**-0.060**	**0.208**		0.029	-0.002	-0.005	0.091
STDSALE	**0.060**	**0.061**	**0.149**	**-0.110**	**0.126**		0.013	-0.004	**-0.140**
NOISE	**-0.081**	0.021	**0.065**	**-0.083**	**0.118**	**0.066**		0.032	0.078
EMPINT	**0.067**	**0.242**	**-0.142**	**-0.344**	**-0.067**	**0.057**	**0.175**		**0.165**
PAYROLL	-0.018	**0.175**	**-0.197**	0.044	**0.214**	**-0.102**	**0.151**	**0.496**	

Pearson correlations are reported above diagonal and Spearman correlations are below diagonal. Correlation coefficients in bold indicate two-tailed statistical significance at 10% or lower level. All variables are defined in the Appendix.

Table 2: Operating leverage and bond yield spreads

	Dependent variable: *SPREAD*	
	(1)	(2)
OL	11.853	
	(0.95)	
COL		24.452**
		(2.46)
AOL		-2.246
		(-1.14)
LnMV	-10.721***	-11.062***
	(-5.17)	(-5.33)
LEV	40.582**	39.510**
	(2.63)	(2.57)
ROA (%)	-1.538***	-1.575***
	(-3.49)	(-3.63)
INTCOV	0.119	0.105
	(0.64)	(0.56)
CAPINT	-2.252	-5.450
	(-0.20)	(-0.50)
STDOCF (%)	3.325***	3.366***
	(5.32)	(5.40)
STDRET (%)	4.651***	4.641***
	(8.61)	(8.60)
RDINT (%)	0.429	0.291
	(0.57)	(0.39)
MULTI	-39.308***	-39.009***
	(-5.02)	(-4.98)
LnMAT	5.007*	5.110*
	(1.73)	(1.77)
LnPROC	9.942***	10.119***
	(3.70)	(3.78)
RATING	-20.524***	-20.491***
	(-21.09)	(-21.08)
Industry fixed effects	Yes	Yes
Year fixed effects	Yes	Yes
Adjusted-R^2	0.709	0.710
Observations	2,849	2,849

This table reports the results of regressing the at-issue yield spread (in basis points) on operating leverage and a vector of firm- and bond-specific control variables, with industry fixed effects and year fixed effects. The industry indicators are defined based on the Fama and French (1997) 48-industry classification. The other variables are defined in the Appendix. All the continuous variables are winsorized at the top and bottom one-percentiles. The *t*-statistics are calculated using robust standard errors corrected for heteroskedasticity and clustered at the firm level. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively, in a two-tailed test.

Table 3: Firm fixed effects and difference-in-differences estimations

	Dependent variable: *SPREAD*			
	Firm Fixed Effects Model		Difference-in-differences	
	(1)	(2)	(3)	(4)
COL	15.387**			
	(1.98)			
WDL		17.418**	-14.660	-7.820
		(2.10)	(-0.95)	(-1.48)
*WDL*EMPINT*			4.001**	
			(2.30)	
EMPINT			-3.735**	
			(-2.13)	
*WDL*PAYROLL*				470.995**
				(2.27)
PAYROLL				-640.765**
				(-2.43)
AOL	-1.464	-0.360	-0.473	-6.748
	(-0.66)	(-0.17)	(-0.22)	(-0.20)
LnMV	-34.294***	-31.048***	-30.513***	-75.069***
	(-8.38)	(-7.72)	(-7.60)	(-4.33)
LEV	-6.720	-2.214	-0.244	-20.836
	(-0.30)	(-0.10)	(-0.01)	(-0.29)
ROA (%)	-1.861***	-187.013***	-169.589***	-63.955
	(-3.61)	(-3.68)	(-3.26)	(-0.41)
INTCOV	0.356	0.333	0.304	-0.056
	(1.37)	(1.28)	(1.18)	(-0.08)
CAPINT	40.659	51.745**	47.344*	10.470
	(1.55)	(1.99)	(1.81)	(-0.15)
STDOCF (%)	2.334***	250.237***	297.300***	-429.074
	(2.80)	(3.06)	(3.58)	(-1.21)
STDRET (%)	2.893***	285.403***	303.622***	135.466
	(4.70)	(4.71)	(5.03)	(0.67)
RDINT (%)	-2.983*	-3.240**	-3.204**	-2.372
	(-1.89)	(-2.09)	(-2.08)	(-0.47)
LnMAT	12.085***	12.051***	11.446***	20.146***
	(4.04)	(4.07)	(3.88)	(2.62)
LnPROC	3.215	4.127	3.534	-4.443
	(1.10)	(1.44)	(1.23)	(-0.59)
RATING	-15.806***	-15.647***	-14.900***	-10.483*
	(-10.19)	(-10.29)	(-9.77)	(-1.94)
Firm fixed effects	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes
Adjusted-R^2	0.854	0.861	0.813	0.793
Observations	2,849	2,849	1,982	597

Column 1 of this table reports the firm fixed effects estimation results of regressing the at-issue yield spread (in basis points) on operating leverage and a vector of firm- and bond-specific control variables. Columns 2 and 3 of the table reports the result of the difference-in-differences estimation. Other variables are defined in the Appendix. All the continuous variables are winsorized at the top and bottom one-percentiles. The *t*-statistics are calculated using robust standard errors corrected for heteroskedasticity and clustered at the firm level. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively, in a two-tailed test.

Table 4: Pricing noise and the effect of operating leverage on bond yield spreads

Dependent variable: *SPREAD*	Coefficient	*t*-value
COL	51.519***	3.10
*COL*NOISE*	-9.686**	-2.27
NOISE	16.177***	9.09
AOL	-4.854	-1.29
*AOL*NOISE*	0.810	0.82
LnMV	-12.590***	-6.34
LEV	36.539**	2.49
ROA (%)	-1.569***	-3.76
INTCOV	0.078	0.44
CAPINT	-4.701	-0.45
STDOCF (%)	3.519***	5.87
STDRET (%)	4.583***	8.86
RDINT (%)	0.197	0.28
MULTI	-38.484***	-5.16
LnMAT	5.545***	2.01
LnPROC	8.718***	3.41
RATING	-20.257***	-21.79
Industry fixed effects	Yes	
Year fixed effects	Yes	
Adjusted-R^2	0.730	
Observations	2,669	

This table reports the results of regressing the at-issue yield spread (in basis points) on operating leverage and a vector of firm- and bond-specific control variables, with the inclusion of the interaction term of operating leverage with pricing error. *NOISE* is measured as the aggregate root mean squared error (in basis points) of the deviation of the market yield on a bond at a given point in time from the yield predicted by a model of the yield curve applied to all bonds at the same point in time (see Hu, Pan, and Wang (2013) for details). Industry fixed effects and year fixed effects are included. The industry indicators are defined based on the Fama and French (1997) 48-industry classification. The other variables are defined in the Appendix. All the continuous variables are winsorized at the top and bottom one-percentiles. The *t*-statistics are calculated using robust standard errors corrected for heteroskedasticity and clustered at the firm level. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively, in a two-tailed test.

Table 5: Analyst forecast dispersion, sales volatility, and the effect of operating leverage on bond yield spreads

	Dependent variable: *SPREAD*	
	(1)	(2)
COL	15.089	-6.797
	(1.26)	(-0.46)
*COL*DISP*	74.824**	
	(2.58)	
DISP	4.864*	
	(0.60)	
AOL	-2.010	-2.551
	(-0.88)	(-0.91)
*AOL*DISP*	-3.250	
	(-0.47)	
*COL*STDSALE*		8.560**
		(2.34)
STDSALE		-2.236***
		(-3.05)
*AOL*STDSALE*		4.470
		(0.12)
LnMV	-10.378***	-11.377***
	(-4.43)	(-5.48)
LEV	36.246**	41.928***
	(2.05)	(2.73)
ROA (%)	-1.462***	-1.537***
	(-2.98)	(-3.53)
INTCOV	0.083	0.129
	(0.41)	(0.69)
CAPINT	-4.951	-7.120
	(-0.39)	(-0.64)
STDOCF (%)	2.866***	3.321***
	(4.08)	(5.26)
STDRET (%)	4.540***	4.667***
	(7.34)	(8.66)
RDINT (%)	0.131	0.374
	(0.16)	(0.50)
MULTI	-40.316***	-37.537***
	(-4.33)	(-3.80)
LnMAT	4.790	5.451*
	(1.47)	(1.88)
LnPROC	8.661***	10.216***
	(2.89)	(3.81)
RATING	-20.251***	-20.685***
	(-18.06)	(-21.27)
Industry fixed effects	Yes	Yes
Year fixed effects	Yes	Yes
Adjusted-R^2	0.724	0.701
Observations	1,691	2,849

This table reports the results of regressing the at-issue yield spread (in basis points) on operating leverage and a vector of firm- and bond-specific control variables, with the

inclusion of the interaction term of operating leverage with equity-based compensation and the volatility of sales. Industry fixed effects and year fixed effects are included. The industry indicators are defined based on the Fama and French (1997) 48-industry classification. The other variables are defined in the Appendix. All the continuous variables are winsorized at the top and bottom one-percentiles. The *t*-statistics are calculated using robust standard errors corrected for heteroskedasticity and clustered at the firm level. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively, in a two-tailed test.

Table 6: Issuer's future prospects and the effect of operating leverage on bond yield spreads

	Dependent variable: *SPREAD*	
	(1)	(2)
COL	29.845***	65.549***
	(2.82)	(2.74)
*COL*RET*	-47.643*	
	(-1.93)	
RET	-16.591*	
	(-1.78)	
AOL	-2.407	5.425
	(-1.15)	(0.94)
*AOL*RET*	1.647	
	(0.31)	
*COL*LTG*		-3.664**
		(-2.00)
LTG		0.519
		(0.70)
*AOL*LTG*		-0.634
		(-1.46)
LnMV	-9.255***	-8.781***
	(-4.41)	(-4.22)
LEV	37.634**	37.059**
	(2.46)	(2.37)
ROA (%)	-1.289***	-1.298***
	(-2.95)	(-2.99)
INTCOV	0.082	0.127
	(0.44)	(0.69)
CAPINT	-5.699	-9.714
	(-0.52)	(-0.88)
STDOCF (%)	3.282***	3.036***
	(5.28)	(4.81)
STDRET (%)	4.716***	4.960***
	(8.76)	(8.86)
RDINT (%)	0.288	0.315
	(0.37)	(0.29)
MULTI	-39.818***	-31.299***
	(-5.11)	(-3.79)
LnMAT	5.750**	5.878**
	(1.99)	(2.06)
LnPROC	9.127***	8.326***
	(3.41)	(3.13)
RATING	-21.416***	-20.673***
	(-21.71)	(-21.08)
Industry fixed effects	Yes	Yes
Year fixed effects	Yes	Yes
Adjusted-R^2	0.714	0.699
Observations	2,849	2,664

This table reports the results of regressing the at-issue yield spread (in basis points) on operating leverage and a vector of firm- and bond-specific control variables, with the

inclusion of the interaction term of operating leverage with firm future prospects. Industry fixed effects and year fixed effects are included. The industry indicators are defined based on the Fama and French (1997) 48-industry classification. The other variables are defined in the Appendix. All the continuous variables are winsorized at the top and bottom one-percentiles. The *t*-statistics are calculated using robust standard errors corrected for heteroskedasticity and clustered at the firm level. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively, in a two-tailed test.

Table 7: Issuer's operation efficiency and the effect of operating leverage on bond yield spreads

	Dependent variable: *SPREAD*	
	(1)	(2)
COL	68.996***	83.960***
	(3.26)	(3.49)
*COL*MGR_ABILITY*	-66.344**	
	(-2.35)	
MGR_ABILITY	8.688	
	(0.91)	
AOL	-4.221	2.393
	(-1.04)	(0.53)
*AOL*MGR_ABILITY*	3.103	
	(0.54)	
*COL*FLUIDITY*		-9.341***
		(-3.03)
FLUIDITY		5.359***
		(3.99)
*AOL*FLUIDITY*		-0.472
		(-0.70)
LnMV	-11.374***	-13.507***
	(-5.50)	(-4.65)
LEV	31.900**	34.411
	(2.10)	(1.63)
ROA (%)	-1.565***	-1.581***
	(-3.59)	(-2.76)
INTCOV	0.173	0.130
	(0.93)	(0.57)
CAPINT	-5.374	-10.883
	(-0.49)	(-0.68)
STDOCF (%)	3.651***	3.513***
	(5.76)	(4.63)
STDRET (%)	4.776***	4.626***
	(8.93)	(6.63)
RDINT (%)	0.523	-0.343
	(0.70)	(-0.36)
MULTI	-28.680***	-19.839*
	(-3.68)	(-1.72)
LnMAT	5.511*	3.670
	(1.93)	(0.88)
LnPROC	10.874***	13.385***
	(4.14)	(3.50)
RATING	-20.240***	-22.358***
	(-20.99)	(-16.37)
Industry fixed effects	Yes	Yes
Year fixed effects	Yes	Yes
Adjusted-R^2	0.719	0.713
Observations	2,737	1,674

This table reports the results of regressing the at-issue yield spread (in basis points) on operating leverage and a vector of firm- and bond-specific control variables, with the

inclusion of the interaction term of operating leverage with firm operational efficiency. Industry fixed effects and year fixed effects are included. The industry indicators are defined based on the Fama and French (1997) 48-industry classification. The other variables are defined in the Appendix. All the continuous variables are winsorized at the top and bottom one-percentiles. The *t*-statistics are calculated using robust standard errors corrected for heteroskedasticity and clustered at the firm level. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively, in a two-tailed test.