Operating Risk and Financial Leverage in Stock Returns

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Abstract: In contrast to the leverage irrelevance propositions in Modigliani and Miller (1958, 1963), prior empirical research has not been able to find a robust positive association between stock returns and leverage. Several reasons have been proposed for this, including the mispricing of financial risk. However, the results can also be due to the applied regression models not being able to capture the relation between stock returns and the investment risk caused by leverage. Regression tests should allow both for an *amplifying risk effect* and an *interest cost effect* of leverage. Modelling these effects explicitly, we perform tests of the association between expected stock returns and leverage for US data from 1966-2017. With the *enterprise book-to-market* as an indicator of operating viability risk, we find a *positive* coefficient of the amplifying risk effect of leverage and a *negative* coefficient of leverage. Including other indicators of operating risk, coefficients of the amplifying risk effect become muted, while the coefficient of leverage remains negative for non-viable firms. We hence find that the return effect of leverage is picked up differently depending on the commercial viability of firms. Excluding firms with negative leverage, our results furthermore indicate that there is a *mitigating operating risk effect* of leverage, potentially caused by the disciplining of agency risks and/or information signalling due to debt financing. Nevertheless, the total return effect of leverage is on average positive, confirming a *positive* association between leverage and expected stock returns for a majority of firms.

Keywords: Capital structure, credit risk, cost of capital, enterprise book-to-price, historical cost accounting, interest expense, financial risk, leverage, operating risk, stock returns.
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1. Introduction

Going back to Modigliani and Miller's pioneering work (Modigliani & Miller, 1958; 1963), the idea of a positive association between expected stock returns and financial leverage is well established. Nevertheless, prior empirical research has been inconclusive on this, typically finding that the association between equity returns and leverage has been insignificant or even negative (Johnson, 2004; Penman, Richardsson & Tuna, 2007; Sivaprasad & Muradoglu, 2010). Various explanations have been suggested for this, including effects due to agency risks (Piotroski, 2007), distress costs (George & Hwang, 2010), or market mispricing (Penman et al., 2007; Caskey, Hughes & Liu, 2012). However, the results might also be due to the applied statistical modelling, since most prior research has not properly recognized the *amplifying risk effect* of leverage.

The purpose of this paper is to test the inferences that follow from Modigliani and Miller (1958) (henceforth M&M) by explicitly recognizing all return effects of leverage. M&M's leverage formula implies that the equity holders' risk is amplified through the interaction between operating risk and leverage, whereas leverage in itself will affect stock returns negatively through debt interest costs. There is hence a twofold effect of leverage in stock returns, a *positive* effect due to the amplification of operating risk and a *negative* effect due to debt interest costs. Not allowing for both these effects in regression tests can lead to misguided inferences. In particular, if the leverage amplification of operating risk is strongly correlated with operating risk and/or other control variables, coefficients of leverage might be negatively biased.

There are several methodological hurdles in tests of the association between stock returns and leverage. First, capital structure theories are concerned with *expected* stock returns, not *observed* returns. Prior research has investigated the association between returns and leverage with *observed* returns as the dependent variable. In line with Vouleteenaho (2002), we control for *'cash flow' news* and *macro news* to capture the effect of leverage on *expected* stock returns. In complementary tests, we replace observed returns with *implied cost of capital* estimates. Another methodological hurdle is to select appropriate indicators of *operating risk*. Based on prior research, we investigate three such risk indicators - *unlevered beta*, the *enterprise book-to-price* ratio, and the *enterprise earnings yield*. Unlevered beta reflects the standard type finance covariance return metric, while the enterprise book-to-price and the enterprise earnings yield are viewed as indicators of commercial viability risk (i.e. the risk that the business operations are value destructive) of firms. Modelling the operating risk premium as a linear function of these indicators, allows us to make inferences about the magnitude of estimated regression coefficients.

Our sample consists of non-financial US companies with financial data for the period 1966-2017. Our main findings are as follows. With the *enterprise book-to-price* ratio as an indicator of operating risk, we find a *positive* association between stock returns and the amplifying risk effect of leverage, and a *negative* association between stock returns and leverage. Replacing observed returns with *implied costs of equity* corroborate these findings. The *enterprise earnings yield* is positively associated with stock returns for in particular more commercially viable firms. However, the interaction between the enterprise earnings yield and leverage turns out to be negatively associated with stock returns. This holds especially for viable firms, indicating a signalling phenomenon where firms with more leverage are *less* exposed to this profitability downside risk. *Unlevered beta* does not capture operating risk as expected, getting insignificant or negative coefficients. Excluding observations with *negative* leverage (i.e. financial net *assets*), the leverage coefficients remain negative only for commercially non-viable firms. The results hence indicate that the negative leverage coefficients that have been observed in prior literature are due to *incomplete controls* for the interaction between operating risk and leverage, return effects of *negative* leverage, and/or high *credit risk premiums*. Our modelling of the operating risk premium also allows inferences about *debt interest costs* from estimated coefficients. Such estimates indicate that the coefficients of leverage and its interaction with operating risk – in addition to the amplifying risk effect of leverage and the credit risk premium – are affected by other phenomena. To incorporate this into our modelling, we articulate a revised linkage between leverage and operating risk (where leverage has a *mitigating* effect on operating risk) and allow the credit risk premium to also be a function of operating risk. The revised models provide justification for our observed coefficients of the interaction variable and coefficients of leverage.

Our paper contributes to a clarification of a confounding observation in prior research. Indicators of the amplifying risk effect of leverage help to resolve the puzzle of insignificant or negative leverage coefficients in prior research. The amplifying risk effect of leverage is crucially important for tests of the association between expected stock returns and leverage. This effect has not been sufficiently recognized in most prior empirical research. A methodological contribution is that we control for *unexpected news* in stock returns, or use implied costs of capital, in our statistical tests. This has not been done in prior literature, implying that prior results have low statistical power and/or biased regression coefficients. Furthermore, we find that *negative* leverage is differently related to stock returns than positive leverage. Since M&M’s capital structure theory primarily concerns the return effect of *positive* leverage, tests should be restricted to settings where negative leverage is controlled for. Concluding, we find that one of the assumptions of M&M’s capital structure theory – that operating risk is *independent* of leverage – does not appear to hold. Even though average total return effects of leverage are positive, coefficients of leverage interaction variables appear to be negatively biased for viable firms in particular. This might be explained by the ‘disciplining’ hypothesis (Jensen, 1986), where financial debt mitigates opportunistic behavior by managers or majority shareholders, or information signaling. On the other hand, leverage coefficients for viable firms appear to be positively biased. This can be due to credit risk premiums for viable firms being more associated with the amplifying risk effect of leverage than with leverage itself. There are hence several phenomena that affect the association between leverage and stock returns, influencing leverage coefficients differently depending in particular on the commercial viability of firms.

Our paper concerns an important issue in corporate finance and financial analysis, of interest to business managers and investment professionals. For example, our results imply that leveraged buy-out transactions or increased leverage in private equity owned firms, should not be expected to reduce the firms’ cost of capital. Our observations should also be of interest to financial controllers, auditors and regulators, as we find that *historical cost* accounting measures of operating net assets and operating income, together with market values of invested capital, are meaningful indicators of operating viability risk.

The outline of the paper is as follows. Inferences that follow from M&M’s capital structure theory are presented in Section 2. In section 3, empirical research addressing the association between stock returns and leverage is reviewed. Research design and hypotheses are specified in Section 4, and sampling criteria and operationalization of variables are presented in Section 5. Empirical results are reported in Section 6, with tests including additional operating risk indicators and controls for extreme leverage in Section 7. The applicability of M&M’s capital structure theory is addressed in Section 8, together with further modelling of the association between indicators of operating and credit risk and their corresponding risk premiums, that follow from our stastical results. Concluding remarks follow in the last section.

2. M&M’s capital structure theory

The capital structure proposition in M&M (1958) is based on the premise that operating risk is exogenous,[1] meaning that the firm’s operations are known to belong to a specific risk class and are unaffected by financing decisions. Assuming friction free capital markets, no bankruptcy costs, no income taxes, and no information asymmetries, M&M concluded:[2]

> *“The average cost of capital to any firm is completely independent of its capital structure and is equal to the capitalization rate of a pure equity stream of its class.”*

In order for M&M’s proposition to hold, *expected* equity returns have to follow the leverage formula:

$$E_t(\tilde{r}_{(E)t+1}) \; = \; E_t(\tilde{r}_{(U)t+1}) \; + \; [E_t(\tilde{r}_{(U)t+1}) - r_{(D)t+1}] \cdot L_t \qquad (1)$$

where:
$\tilde{r}_{(E)t}$ = return on owners' equity in period *t*,
$\tilde{r}_{(U)t}$ = return on owners' equity in period *t* if the firm is unlevered,
$r_{(D)t}$ = interest cost rate of debt in period *t*,
L_t = financial debt divided by market value of owners' equity at the end of period *t*, and
$E_t(\dots)$ = expectation operator, given available information at time *t*.

Simplifying the notation such that $E_t(\tilde{r}_{(E)t+1}) = \bar{r}_{(E)t+1}$ and $E_t(\tilde{r}_{(U)t+1}) = \bar{r}_{(U)t+1}$, we have:

$$\bar{r}_{(E)t+1} - \bar{r}_{(U)t+1} \; = \; [(\bar{r}_{(U)t+1} - r_{f,t+1}) - (r_{(D)t+1} - r_{f,t+1})] \cdot L_t \qquad (1')$$

where:
$r_{f,t}$ = risk-free interest rate in period *t*.

$(\bar{r}_{(E)t+1} - \bar{r}_{(U)t+1})$ is the equity holders' *risk premium* for taking on the financial risk of the firm. As the expected *operating risk premium* $(\bar{r}_{(U)t+1} - r_{f,t+1})$ is larger than the *credit risk premium* $(r_{(D)t+1} - r_{f,t+1})$, (1´) means that the return premium for financial risk should be positive. Since M&M assumed the operating risk premium to be unaffected by leverage, the derivative of $\bar{r}_{(E)t+1}$ with respect to L_t is:

$$\frac{\delta\,(\bar{r}_{(E)t+1})}{\delta(L_t)} \; = \; [(\bar{r}_{(U)t+1} - r_{f,t+1}) - (r_{(D)t+1} - r_{f,t+1})] - \frac{\delta(r_{(D)t+1})}{\delta(L_t)} \cdot L_t \qquad (2)$$

The derivative of $\bar{r}_{(E)t+1}$ with respect to leverage equals the difference between the operating risk premium and the credit risk premium, complemented by the derivative of the interest cost rate with respect to leverage. If leverage is not 'excessively' high, $(\bar{r}_{(U)t+1} - r_{f,t+1})$ presumably is larger than $(r_{(D)t+1} - r_{f,t+1})$ plus $\frac{\delta(r_{(D)t+1})}{\delta(L_t)} \cdot L_t$, meaning that association between the equity return and leverage will be *positive*. However, the second derivative $\frac{\delta^2(\bar{r}_{(E)t+1})}{\delta(L_t^2)}$ of (2) is negative, implying a non-linear relationship between the interest cost rate $r_{(D)t+1}$ and L_t, and thus a non-linear relation between $\bar{r}_{(E)t+1}$ and L_t. In line with the modelling in Leland (1994) and Ross (1977; 2005), $\frac{\delta(r_{(D)t+1})}{\delta(L_t)}$ should be increasing in L_t, meaning that increases of $\bar{r}_{(E)t+1}$ are smaller as L_t goes up. For very high ('*excessive*') leverage, the difference between $(\bar{r}_{(U)t+1} - r_{f,t+1})$ and $(r_{(D)t+1} - r_{f,t+1})$ might become smaller than $\frac{\delta(r_{(D)t+1})}{\delta(L_t)} \cdot L_t$ and the derivative of $\bar{r}_{(E)t+1}$ becomes negative. M&M explicitly commented on this possibility (M&M used the notation *r = debt interest cost, i = expected return owners' equity, and D/S = leverage ratio*):[3]

"If r increases with leverage, the yield i will still tend to rise as D/S increases, but at a decreasing rather than a constant rate. Beyond some high level of leverage, depending on the exact form of the interest function, the yield may even start to fall." (M&M, 1958; pp. *274-275*).

Expression (3) allows for the following Proposition:

***Proposition*:** The capital structure theory in M&M (1958) implies that an *increase*
in leverage leads to
(i) a *positive* effect on $\bar{r}_{(E)t+1}$ reflecting the firm's operating risk premium,
equal to $+\left(\bar{r}_{(U)t+1} - r_{f,t+1}\right)$, and
(ii) a *negative* effect on $\bar{r}_{(E)t+1}$ reflecting the firm's credit risk premium,
equal to $-\left(r_{(D)t+1} - r_{f,t+1} + \frac{\delta(r_{(D)t+1})}{\delta(L_t)} \cdot L_t\right)$.

The Proposition means that there is a twofold effect of leverage on expected equity returns. Part (i) is *positive* and depends on the return premium equity investors demand for taking on the firm's operating risk. Part (ii) is *negative* and becomes more negative as leverage increases.

Note that M&M's formula (1) is concerned with *expected* values of $\tilde{r}_{(E)t+1}$ (for the levered firm) and $\tilde{r}_{(U)t+1}$ (for the unlevered firm). The interest cost rate $r_{(D)t+1}$ is assumed to be deterministic and known at time *t*. As in M&M (1958), the Proposition does not specify the factors being reflected in the operating and credit risk premium. Both premiums can be affected by a number of different investment risks (for example, return covariance risk, distress risk, profitability downside risk, and/or return volatility risk). However, it is assumed in M&M (1958) that the operating risk premium cannot be lower than the credit risk premium.

A regression model based on M&M's leverage formula can straightforwardly be written as:

$$\bar{r}_{(E)t+1} = r_{f,t+1} + \left(\bar{r}_{(U)t+1} - r_{f,t+1}\right) + \left(\bar{r}_{(U)t+1} - r_{f,t+1}\right) \cdot L_t - \left(r_{(D)t+1} - r_{f,t+1}\right) \cdot L_t =$$

$$= \gamma_0 + \gamma_1 \cdot \widehat{Oprm}_{t+1} + \gamma_2 \cdot \widehat{Oprm}_{t+1} \cdot L_t + \gamma_3 \cdot L_t + \tilde{\varepsilon}_{t+1} \qquad (3)$$

where:
$Oprm_t$ = operating risk premium period *t*.
$\tilde{\varepsilon}_t$ = regression error term

Provided that a reliable estimate of the operating risk premium $Oprm_{t+1}$ can be assessed, (3) shows that the leverage coefficient γ_3 should be an estimate of the average credit risk premium of the sample with a negative sign (i.e., $-\left(r_{(D)t+1} - r_{f,t+1}\right)$). Hence, the coefficient of leverage is expected to be *negative* if the credit risk premium is positive, and *0* if the average credit risk premium for the sample firms is negligible.

3. Prior empirical research

Prior research on the association between equity returns and leverage is reviewed in this section. The review is focused on empirical studies that have tested the importance of leverage for equity returns, typically in cross-sectional regressions. We exclude research that has dealt with other return metrics than equity or stock returns, for example unlevered returns (cf. Doshi, Jacobs, Kumar & Rabinovitch, 2019).[4]

A first test of M&M's capital structure theory was conducted in M&M (1958), where the net income divided by the market value of owners' equity was regressed on financial leverage for US electric or oil companies. As the sampling was restricted to singular industries, operating risk was assumed to be constant across firms. In line with M&M's proposition, the regressions revealed a positive coefficient of leverage. However, we then have to consider that the return metric was operationalized as the net income yield and the numbers of observations were small (*43* electric utilities over *2* years, or *42* oil companies *1* year).

With financial data for US firms, Bhandari (1988) investigated whether leverage was a risk factor in addition to equity beta and size. Running regressions on portfolio returns over the period 1948-1981, Bhandari found a positive association between stock returns and leverage. However, Bhandari did not include any variable representing operating risk in these tests, implying that there was a confounding overlap in his risk indicators (cf. Penman et al., 2007).

Penman et al. (2007) decomposed the *equity* book-to-price into the *enterprise* book-to-price (NOA/P^{NOA}) and leverage. The decomposition was inspired by the leverage formula, but the authors did not test any interaction between operating risk and leverage. Estimating regressions for US firms with data from 1962-2001, the coefficient of NOA/P^{NOA} was found to be positive and the coefficient of leverage negative. Analysing sample partitions where $NOA/P^{NOA} < 1$ and $NOA/P^{NOA} \geq 1$, the coefficients of NOA/P^{NOA} and leverage mainly remained. Also, the leverage coefficient remained negative after including controls for size, equity beta, return volatility, momentum, and firm default risk. The authors suggested that the negative leverage coefficient might be due stock market mispricing.

Several studies following Penman et al. (2007) have tried to find explanations for a negative association between stock returns and leverage. Piotroski (2007) claimed that the association could be affected by errors in the measurement of operating risk and/or financial leverage. Another suggestion was the influence of omitted variable/-s, for example representing management agency risks in firms with 'excess cash'. 'Excess cash' (i.e., *negative* leverage) might then increase the risk of agency problems, causing a negative coefficient of leverage.

George and Hwang (2010) suggested that negative leverage coefficients could be caused by distress costs. In line with the trade-off theory, capital structure choices are based on the benefits and drawbacks of leverage, implying that firms with high distress costs should have low leverage. Firms with low leverage would then have more default risk than firms with high leverage, and stock returns could be negatively associated with leverage. Sampling US firms from 1965-2003, the authors estimated regressions with dummy variables capturing ‘high’ and ‘low’ leverage. In line with the proposed hypothesis, a negative coefficient was observed for the high leverage dummy.

Studying UK data from 1980-2008, Sivaprasad and Muradoglu (2010) found that stock returns decreased or were unaffected by leverage in all industries but the utilities sector. The results were robust to controls representing size, equity beta, market-to-book, tax rates, and industry concentration. The authors suggested that firms in some industries were more exposed to distress risk and that stock returns might decrease in leverage in these industries. The positive association between stock returns and leverage in the utilities sector could then be due to firms in this sector having a low distress risk.

Caskey et al. (2012) argued that *observed* leverage might deviate from the optimal level due to historic random events, and that market frictions might cause ‘excess’ leverage to prevail over time. With US data from 1980-2006, the authors found a negative association between stock returns and ‘excess’ leverage, whereas the coefficient of ‘normal’ leverage was insignificant. Firms with ‘excess’ leverage were also likely to have poor profitability prospects and the authors suggested that this might not be timely reflected in stock prices.

Based on a conceptual idea for identifying accounting characteristics of investment risk, Penman et al. (2018) proposed the *earnings-to-price* and *book-to-price* ratios to be indicators of investment risk. Decomposing these ratios, the *enterprise earnings yield* together with the *enterprise book-to-price* ratio, would capture operating risk. They also included an interaction between the enterprise earnings yield and leverage as an additional risk indicator. No significant coefficient of leverage was found for the full sample, but for a sample partition of more profitable firms the leverage coefficient was positive when the interaction variable was excluded.

Zhang and Zhang (2020) argued that a negative association between stock returns and leverage might be caused by off-balance sheet operating assets and financial net assets. Firms with risky operations and substantial off-balance sheet assets were supposed to rely more on internal financing and have more financial assets. Analysing US data over the period 1965-2018, the authors found a positive association between stock returns and leverage when controlling for a number of risk indicators, off-balance sheet financing and financial assets. Somewhat surprisingly the coefficient of financial assets was found to be *positive*, contradictory to the expected risk reduction from such assets.

Concluding, testing M&M's capital structure theory requires controlling for operating risk. One way of doing this is – as in M&M (1958) – to estimate *industry specific regressions*. Investigating the association between stock returns and leverage for firms in different industries is more complicated. Since the return effect of operating risk and the amplifying risk of leverage both are positive, the latter can easily be subsumed by variable(-s) representing operating risk in regression tests. The coefficient of leverage might then just reflect the credit risk premium of the sample firms, with a *negative* sign. Penman et al. (2018) included a leverage interaction variable. However, the leverage interaction effect was only estimated for a subsample of firms where leverage generated a positive stock return. Investment theory is *not* concerned with stock returns for such choice based samples, but instead ex ante *expected* stock returns. Furthermore, the modelling in Penman et al. (2018) is indeed mute on the issue of why estimated leverage coefficients might be zero or negative.

Several studies (George & Hwang, 2010; Sivaprasad and Muradoglu, 2019; Caskey et al., 2012) have found negative leverage coefficients to be associated with high leverage and/or financial distress. This might be due to financially weak firms having higher credit risk premiums, as implied by the *Proposition* in Section 2. Furthermore, note that prior research has used *observed* stock returns as the dependent variable in the regression tests. It thus becomes hard to assess whether estimated coefficients are due to investment risk, or if they rather are caused by sample specific regularities (which are not controlled for) in observed returns.

4. Operating risk and empirical hypotheses

Our research design for testing the association between stock returns, operating risk and leverage is outlined in this section. As in prior research, we investigate the association through linear regressions based on the methodology pioneered in Fama and MacBeth (1973).

Starting with our rewrite of leverage formula in (3) above, set $OPR_{j,t}$ = operating risk of firm *j* at time *t* and let the operating risk premium be a function of $OPR_{j,t}$. The *expected* stock return is then:

$$\bar{r}_{(E)j,t+1} = r_{f,t+1} + f\left(OPR_{j,t}\right) + f\left(OPR_{j,t}\right) \cdot L_{j,t} - \left[r_{D,t+1} - r_{(f)j,t+1}\right] \cdot L_{j,t} \qquad (4)$$

where:
$f\left(OPR_{j,t}\right)$ = operating risk premium of firm *j* at time *t.*

The dependent variable in (4), the *expected* stock return in year *t+1*, is neither observable ex ante nor ex post. Unexpected random events might occur in year *t+1*, causing deviations between *observed* and *expected* stock returns. To mitigate this problem, we control for firm specific news and macro news in line with Voulteenaho (2002) and Botosan, Plumlee and Wen (2011). Furthermore, to validate our results, observed stock returns are replaced by implied costs of capital estimated by Hou, van Dijk and Zhang (2012) as the dependent variable.

A firm's operating risk might be due to several phenomena. Based on prior research we have chosen an unlevered covariance return metric, *unlevered beta* $\beta(u)_{j,t}$, and two indicators of commercial viability, the *enterprise book-to-price* $(NOA/P^{NOA})_{j,t}$ and the *enterprise earnings yield* $(OI/P^{NOA})_{j,t}$, as a starting point. Unlevered beta is an established metric of investment risk in the *Market model* and the *Capital Asset Pricing model*. The *enterprise book-to-price* has in prior research (cf. Brainard & Tobin, 1968; Tobin, 1969; Fama & French, 1992; Vassalou & Xing, 2004) been interpreted as an indicator of *commercial viability risk,* the risk that the firm's operations are 'value destroying' rather than 'value creating'. $(NOA/P^{NOA})_{j,t} > 1.0$ means that the market value of invested capital is below the historical acquisition cost of the firm's net operating assets, $NOA_{j,t}$. Firms having $(NOA/P^{NOA})_{j,t} > 1.0$ are thus more financially distressed, with potential harsh economic consequences for equity investors. On the other hand, if $(NOA/P^{NOA})_{j,t} < 1.0$ the firm's business activities are more likely to be commercially viable. This is in line with Brainard and Tobin (1968) and Tobin (1969), as operationalized in the well-known measure *Tobin's q*.[5,6] Also, $(NOA/P^{NOA})_{j,t}$ was a main indicator of operating risk in Penman et al. (2007).

The *enterprise earnings yield*, $(OI/P^{NOA})_{j,t}$, is motivated as an indicator of operating earnings growth risk (Penman et al., 2018). If market expectations imply that future operating earnings will decrease (i.e., the risk of "negative growth"), the value of invested capital ($P^{NOA}_{j,t}$) reflects a less profitable future. $(OI/P^{NOA})_{j,t}$ might thus indicate the risk of the firm becoming worse off next year, not being able to meet the market's return requirement and becoming a financially distressed firm.

We view both $(NOA/P^{NOA})_{j,t}$ and $(OI/P^{NOA})_{j,t}$ as indicators of operating viability risk, where $(NOA/P^{NOA})_{j,t}$ indicates the longer term viability risk, and $(OI/P^{NOA})_{j,t}$ indicating a more near-term downside profitability risk. High values of the ratios are then associated with a high operating viability risk. We explain how these risks are linked to the commercial operating viability of a firm in Appendix I

In line with most prior literature (for example, Penman et al., 2007; Penman et al., 2018) we assume a linear association between the operating risk premium and indicators of operating risk. Suppressing firm index and denoting indicators of operating risk $OPR(i)_t$, we model the *operating risk premium* as:

$$Oprm_{t+1} = f(OPR_t) = b_0 + \sum_{i=1}^{I} b_{i,1} \cdot OPR(i)_t \qquad (5)$$

where $b_0 \geq 0$ and $b_{i,1} > 0$, $i = 1, \ldots I$.

As we have three indicators of operating risk ($\beta(u)_t$, $(NOA/P^{NOA})_t$ and $(OI/P^{NOA})_t$) the number of indicators in (5) can be up to three in our main tests. In additional tests we also include industry fixed effects, allowing the intercept b_0 to differ between industries.

Assuming that the *credit risk premium* is positively associated with leverage, we model this as:

$$Cprm_{t+1} = c_0 + c_1 \cdot \left(\frac{ND}{P^{NOA}}\right)_t \qquad (6)$$

where $c_0 \geq 0$ and $c_1 > 0$.

Inserting the operating risk premium and the credit risk premium in the leverage formula (4), recognizing that $L_{j,t} = (ND/P)_{j,t}$, we get:

$$\bar{r}_{E,t+1} = r_{f,t+1} + b_0 + \sum_{i=1}^{I} b_{i,1} \cdot OPR(i)_t + \sum_{i=1}^{I} b_{i,1} \cdot OPR(i)_t \cdot (ND/P)_t +$$

$$+ \left(b_0 - c_0 - c_1 \cdot \left(\frac{ND}{P^{NOA}}\right)_t\right) \cdot (ND/P)_t \qquad (7)$$

Our regressions will thus be configured ($Control_c$ represents control variable *c*) as:

$$r_{E,t+1} = \gamma_0 + \sum_{i=1}^{I} \gamma_{i,1} \cdot OPR(i)_t + \sum_{i=1}^{I} \gamma_{i,2} \cdot OPR(i)_t \cdot (ND/P)_t +$$

$$+ \gamma_3 \cdot (ND/P)_t + \sum_{c=1}^{C} \gamma_{c,4} \cdot Control_c + \tilde{\varepsilon}_{t+1} \qquad (8)$$

The intercept in (8), γ_0, corresponds to $(r_{f,t+1} + b_0)$ in (7), $\gamma_{i,1}$ in (8) corresponds to $b_{i,1}$ in (7), and γ_3 in (8) corresponds to $(b_0 - c_0 - c_1 \cdot (ND/P^{NOA})_t)$ in (7). According to the modelling, we get the following hypotheses:

***H(1)*:** Coefficients of $OPR(i)_t$ are *positive*, i.e. values of $\gamma_{i,1}$ in (8) are *positive*.

***H(2)*:** Coefficients of $OPR(i)_t \cdot (ND/P)_t$ are *positive,* i.e. values of $\gamma_{i,2}$ in (8) are *positive*.

***H(3)*:** The difference between the intercept (γ_0) and the leverage coefficient (γ_3) in (8) is *positive*, reflecting the sample average of debt interest cost rates.

H(1) and *H(2)* follow directly from (5) and (7) above. Hypothesis *H(3)* is motivated by the intercept and coefficient of $(ND/P)_t$ in (7) and (8), where $\gamma_0 = (r_{f,t+1} + b_0)$ and $\gamma_3 = (b_0 - c_0 - c_1 \cdot (ND/P^{NOA})_t)$.

Since the coefficient of leverage in (8) reflects the difference between the intercept in (5) and the credit risk premium, we expect the leverage coefficient to be more *negative* for financially distressed firms. Hence, we have our fourth hypothesis:

H(4)**:** The coefficient of $(ND/P)_t$ is more negative for firms having commercially non-viable operations, i.e., γ_3 in (8) is smaller for non-viable firms.

5. Sample and variables

Our sample consists of non-financial US firms with annual stock returns for the period 1966-2017.[7] Accounting information has been collected from *Compustat*[8] and market data from the *Center for Research in Security Prices* (CRSP). The sample includes all companies with the following data items available (Compustat label in parenthesis): *Total assets* (AT), *Income before extraordinary items* (IB), *EPS basic* (EPSPX), *Common shares outstanding* (CSHO), *Book value of common equity* (CEQ), and *Stock price at the end of the financial year* (PRCC).

In our regression tests with observed stock returns the dependent variable is the *12* months buy-and-hold return, where return periods start four months after financial year ends to ensure that financial statement information for the prior year was available at the beginning of the return period. Monthly returns for delisted companies are set to *0* after the delisting month.

The independent variables are as follows. Assuming net debt (ND_t) has a beta value of *0*, unlevered betas, $\beta(u)_t$, have been calculated as (cf. Taggart, 1991; Doshi et al., 2019):[9]

$$\beta(u)_t = \frac{\beta(e)_t}{1+\left(\frac{\overline{ND}}{P}\right)_t} \qquad (9)$$

Equity betas, $\beta(e)_t$, have been estimated in regressions of monthly excess stock returns on market excess returns over up to *48* months preceding the return periods.[10] Excess market returns have been collected from Kenneth French's website.[11] Equity betas are winsorized at *-1.5* and *+5.0* to eliminate non-representative outliers. $\left(\overline{ND/P}\right)_t$ in (9) are firm-specific averages of net debt divided by the market value of owners' equity at the end of four prior years. Values of $\beta(u)_t$ are winsorized at *-3.0* and *+10.0* to eliminate outliers.

B_t is the book value of owners' equity and P_t is the market value of owners' equity, both measured at the end of financial years. Following Nissim and Penman (2001), equity book value is the sum of *common equity* (CEQ) and *preferred treasury stock* (TSTKP), less *preferred dividends in arrears* (DVPA). The market value of owners' equity is the *number of common shares outstanding* (CSHO) multiplied by the *stock price at the end of the financial year* (PRCC). Net debt is the book value of financial liabilities less financial assets at the end of financial years.[12] Financial assets are *cash and short-term investments* (CHE) and financial liabilities include *long-term debt* (DLTT), *debt in current liabilities* (DLC), *preferred stock* (PSTK), *preferred dividends in arrears* (DVPA), less *preferred treasury stock* (TSTKP). The enterprise book-to-price, $(NOA/P^{NOA})_t$, is the book value

$(B_t + ND_t)$ divided by the market value of invested capital $(P_t + ND_t)$ at the end of the financial year. The numerator in the enterprise earnings yield, OI_t, is *operating income* (before tax) year *t* (OIADP).

Observations with *negative* values of NOA_t and/or P_t^{NOA} have been deleted. Also, observations of $(ND/P)_t$ and $(NOA/P^{NOA})_t$ above/below the upper/lower percentiles have been excluded and observations of $(OI/P^{NOA})_t$ have been winsorized at *0*. Our final sample includes *126,877* firm-year observations from the period 1966-2017, comprising *31 764* observations with $(NOA/P^{NOA})_t \geq 1.0$ and *95 113* observations with $(NOA/P^{NOA})_t < 1.0$.

A direct estimate of the *expected* stock return is the *implied cost of capital* (Lee, So & Wang, 2010). As discussed above, we have also performed regression tests with estimates of this cost of capital as the dependent variable. To avoid the need of analysts' forecasts,[13] we have used a *composite cost of capital* estimated in Hou, van Dijk and Zhang (2012).[14] This metric is an average based on two residual income valuation models, two abnormal earnings growth valuation models, and one dividend discount model.[15]

6. Results

Empirical results are presented in this section. Descriptive statistics and bivariate correlations for the main variables are reported in Section 6.1 and regressions with controls for *earnings news* and *macro news* are presented in Section 6.2. We perform tests using *implied costs of capital* in Section 6.3. To simplify the notation, firm and time indices are suppressed in the section unless specifically needed.

6.1 Descriptive statistics

Table 1 shows descriptive statistics for our main variables and additional key metrics for our sample of *126,877* firm-year observations. In order to highlight differences between commercially viable and non-viable firms, the sample is partitioned with about *75* % of the observations representing viable firms ($NOA/P^{NOA} < 1.0$) and about *25* % represent non-viable firms ($NOA/P^{NOA} \geq 1.0$). Note that, setting $(NOA/P^{NOA})_{j,t} = 1.0$ as the threshold when classifying firms as 'viable' or 'non-viable' can be problematic when the accounting is conservative. However, as we show in Appendix II, in the presence of accounting conservatism, $(NOA/P^{NOA})_{j,t} > 1.0$ indicates that the business operations are non-viable, while $(NOA/P^{NOA})_{j,t} < 1.0$ can include both viable and (marginally) non-viable firms. The enterprise book-to-price ratio is thus a more garbled indicator of business viability when $(NOA/P^{NOA})_{j,t} < 1.0$.

The mean of NOA/P^{NOA} for the full sample is *0.760*, implying that the average firm in our sample is commercially viable. The average enterprise earnings yield, OI/P^{NOA}, is *0.092* for the full sample, higher (*0.128*) for non-viable firms and lower (*0.082*) for viable firms. Hence OI/P^{NOA} also appears to indicate financial distress, where firms doing poorly in terms of NOA/P^{NOA} have higher values of this metric too. $G(NOA)$ is the relative growth of net operating assets, and OI/NOA is the book return on net operating assets. Both metrics are higher for the sample partition where $NOA/P^{NOA} < 1.0$, i.e. as expected viable firms have stronger growth of net operating assets and higher operating profitability. Financial leverage (ND/P) is on average *0.399* for the viable firms and *1.241* for the non-viable firms. Firms belonging to the latter group hence appear to have a significantly weaker financial position. The mean of unlevered beta ($\beta(u)$) is *0.940* for the viable firms, but only *0.736* for the non-viable firms. Interestingly, the covariance return metric of more distressed firms is lower, indicating that covariance risk is negatively related to commercial viability (in line with Jennergren, 2013). However, non-viable firms are on average much smaller, implying a higher 'small-minus-big' risk. The mean observed stock return ($r_{(E)}$) for non-viable firms (*17.5* %) is almost twice as large as for viable firms (*9.9* %). Even though this would be a very coarse measurement of expected stock returns, it indicates that the non-viable firms are associated with higher equity risk.

[Table 1 in here]

Table 2 shows bivariate correlations for NOA/P^{NOA}, OI/P^{NOA}, $G(NOA)$, OI/NOA, ND/P, $\beta(u)$ and $r_{(E)}$.[16] The correlations are reported separately for $NOA/P^{NOA} \geq 1.0$ in Panel A and $NOA/P^{NOA} < 1.0$ in Panel B. *Spearman* correlations are reported in the upper halves of the panels and *Pearson* correlations in the lower halves.

[Table 2 in here]

As expected, correlations between stock returns $r_{(E)}$ and ND/P are small for both sample partitions. In line with prior research (Penman et al., 2007; Penman et al., 2018) the operating risk indicators NOA/P^{NOA} and OI/P^{NOA} have positive but low correlations with stock returns. This holds in particular for firms where $NOA/P^{NOA} \geq 1.0$. Also, in line with prior research (Fama & French, 1993; Baker, Bradley & Wurgler, 2011; Frazzini & Pedersen, 2014) $\beta(u)$ has weak but negative correlations with stock returns in both panels. As regards the enterprise book-to-price, there is a negative correlation (Pearson correlation *-0.207*) between NOA/P^{NOA} and ND/P for non-viable firms, but a positive correlation (Pearson correlation *+0.410*) for viable firms in Panel B. This stands in contrast to the enterprise earnings yield and unlevered beta, where both OI/P^{NOA} and $\beta(u)$ are negatively correlated with ND/P in both partitions of firms. In principle, a negative correlation between operating risk and leverage is in line with the capital structure trade-off theory, where firms strive to reach a value-maximizing balance between the tax benefits and bankruptcy costs associated with debt. A positive correlation between an indicator of operating risk and leverage, as we observe for NOA/P^{NOA} in Panel B, is rather in line with the capital structure pecking order theory, where less profitable firms prefer to finance investments with debt rather than issuing owners' equity. Furthermore, the correlation between OI/P^{NOA} and NOA/P^{NOA} is about 0 when $NOA/P^{NOA} \geq 1$, but positive when $NOA/P^{NOA} < 1$. The enterprise book-to-price and the earnings yield hence appear to depict different aspects of operating risk for in particular non-viable firms.

As noted, correlations between stock returns and leverage are negligible in both panels of Table 2. This is consistent with the *positive* amplifying risk effect and the *negative* interest cost effect of leverage being of the same absolute magnitude, resulting in a return net effect of 0 (cf. the Proposition in Section 2). This might hence be an important reason for leverage coefficients in prior research to be insignificant.

6.2 Regression results: Observed stock returns with news controls

To control for deviations between *expected* and *observed* returns, we include two *news variables* (in line with Voulteenaho (2002) and Botosan et al. (2011)) in all regressions:[17]

- *Earnings news* ($EARNNEWS_{j,t}$), being the *difference* between observed earnings and expected earnings for year $t+1$.

$$EARNNEWS_{j,t+1} = \frac{\left(ROE_{j,t+1} - \overline{ROE}_{j,t+1}\right) \cdot B_{j,t}}{P_{j,t}} \qquad (10)$$

where:
$ROE_{j,t} = EARN_{j,t}/B_{j,t-1}$ = net income year *t*, divided by the book value of owners' equity for firm *j* at the end of year *t-1*,
$\overline{ROE}_{j,t}$ = expected book return on owners' equity for firm *j* in year *t*, and
$B_{j,t}$ = book value of owners' equity for firm *j* at the end of year *t*.

- *Macro news* ($MACRNEWS_{j,t}$), being the difference between an *ex post 'normal'* return premium and the expected return premium.

$$MACRNEWS_{j,t+1} = \left[\left(r_{m,t+1} - r_{f,t+1}\right) - \overline{Mprm}\right] \cdot \beta(e)_{j,t} \qquad (11)$$

where:
$\overline{Mprm} = \left(\overline{r_{m,t} - r_{f,t}}\right)$ = expected market premium.

$EARNNEWS_{j,t+1}$ is included to control for 'cash flow' news that become known in year $t+1$. Expected earnings are estimated as a three-year historical average of the book return on owners' equity ($ROE_{j,t}$), multiplied by the book value of owner's equity at the end of the previous financial year.[18, 19] $MACRNEWS_{j,t+1}$ is calculated as equity betas multiplied by the difference between the observed market portfolio excess return in year *t* and its *expected* return premium, where the latter is the average market risk premium over the period 1967-2017. $MACRNEWS_{j,t+1}$ takes on positive or negative values depending on whether the realized market excess return is higher or lower than its expected value. Presumably, if the market excess return turns out to be higher or lower than the expected return premium, $MACRNEWS_{j,t+1}$ should capture the return effect due to this.[20]

We expect a positive coefficient of $EARNNEWS_{j,t+1}$, as stock prices should increase when there is positive 'cash flow' news. The sign of the coefficient of $MACRNEWS_{j,t+1}$ is less clear-cut. As our methodology follows Fama and MacBeth (1973), part of the macro news for each year will be incorporated in the regression intercept. The coefficient of $MACRNEWS_{j,t+1}$ can then be positive or negative, depending on how much macro news the intercept picks up and how sensitive the firm's market value is to such macro news.

Regressions with controls for earnings news and macro news are shown in Table 3,[21] with estimated coefficients for the full sample in Panel A and for the partitions of non-viable and viable firms in panels B and C. The 'cash flow' news variable ('$EARNNEWS$') gets positive and significant coefficients in all regressions in the table, confirming that it reflects such news as expected. The coefficients of macro news ('$MACRNEWS$') are weakly negative in all regressions, indicating a weaker return impact of macro news for firms with high beta values.

Looking at $\beta(u)$ in Table 3, the coefficients of this measure are negative or insignificant in regressions (i) and (v). On the other hand, the coefficients of NOA/P^{NOA} and OI/P^{NOA} are positive in regressions (ii), (iii) and (iv) in all panels, consistent with these ratios representing operating risk factors. However, the significance of the ratios varies between Panel B and Panel C, showing NOA/P^{NOA} to be more important for non-viable firms, while OI/P^{NOA} appears to be important only for viable firms. The variable $(NOA/P^{NOA}) \cdot (ND/P)$ gets positive coefficients in all panels, consistent with a positive amplifying risk effect of leverage. The variable $(OI/P^{NOA}) \cdot (ND/P)$ shows a more unexpected pattern, with its coefficients weakly positive in Panel B but weakly negative in Panel C. The amplifying risk effect of the enterprise earnings yield hence appears to be negatively associated with firm leverage, potentially indicating a risk-mitigating effect of leverage for this indicator.

[Table 3 in here]

Regarding leverage, coefficients of ND/P are negative in regressions (ii), (iv) and (v) in Table 3. The coefficients are more negative in Panel B than in Panel C, consistent with debt investors demanding higher credit risk premiums for non-viable firms. In regression (iii), including only the enterprise earnings yield, the coefficient of ND/P is close to 0 in Panel B, but weakly positive in Panel C. However, given the low significance for the coefficient of the interaction variable

$(OI/P^{NOA}) \cdot (ND/P)$ and the coefficient of (ND/P), this might indicate that the enterprise earnings yield is differently related to the credit risk premium of financial debt. We return to this issue in Section 8 below.

6.3 Regressions with implied costs of capital

To improve the validity of our analyses, we have re-estimated regressions in Table 3 with implied cost of capital estimates from Hou et al. (2012) as the dependent variable. Specifically, Hou and co-authors have provided us with a composite metric of the cost of equity capital, $ICC(Composite)$, calculated as an average of estimates from five valuation models based on Gebhardt et al. (2001), Claus and Thomas (2011), Ohlson and Juettner-Nauroth (2005), Easton (2004), and Gordon and Gordon (1997).

The sampling criteria in Hou et al. (2012) were the same as ours, but with a time period covering 1964-2008. Our tests with implied costs of capital are hence confined to this period, meaning that we lose *25,747* firm-year observations, or about *20 %* of our sample.[22] Results are reported in Table 4.

[Table in 4 here]

The coefficients of $\beta(u)$ and $\beta(u) \cdot (ND/P)$ are not significant in regression (i) in Panel A of Table 4. When $\beta(u)$ is included together with NOA/P^{NOA} and OI/P^{NOA} in regression (iv), $\beta(u)$ and $\beta(u) \cdot (ND/P)$ get insignificant and/or negative coefficients. This corroborates our findings with observed stock returns in section 6.2, i.e. the operating risk premium does not appear to be associated with $\beta(u)$. In principle, this is consistent with results in prior research on the lack of importance of a covariance return metric (Fama & French, 1993; Baker, Bradley & Wurgler, 2011; Frazzini & Pedersen, 2014).

In contrast to the weak results for $\beta(u)$, coefficients of NOA/P^{NOA} are positive in all panels of the table and coefficients of $(NOA/P^{NOA}) \cdot (ND/P)$ are positive in all regressions but two in Panel C. The R-squared of regression (ii) is *15.7 %* in Panel A, distinctively higher than the R-squared for observed stock returns in Table 3 (R-squared *6.2 %*), corroborating NOA/P^{NOA} as a meaningful indicator of operating risk. As regards the enterprise earnings yield, coefficients of OI/P^{NOA} are positive but the interaction variable $(OI/P^{NOA}) \cdot (ND/P)$ gets coefficients close to *0* or negative. This is not in line with expectations, indicating a somewhat persistent negative association between OI/P^{NOA} and ND/P.

Coefficients of ND/P are negative in regression (ii) in all panels, and in regressions (iii) and (iv) in Panel B. An estimate of the average interest cost rate (i.e. the difference between the intercept and the coefficient of the leverage interaction variable) is *0.056 -(- 0.014) = 7.0 %* for the full sample in regression (ii). In Panel B, this estimate is *0.082 -(- 0.008) = 9.0 %* and in Panel C *0.053 -(- 0.024) = 7.7 %*, i.e., in line with our hypothesis that the negative leverage coefficients are caused by the credit risk premium of financial debt. Also note that the leverage coefficients are insignificant or positive in regressions (iii) and (iv) in Panel C, consistent with the credit risk premium being negligible for commercially viable firms.

6.4. Unexpected interest rate changes

In most regressions including the enterprise book-to-price and the enterprise earnings yield ratios in Table 3 and Table 4, we observe negative coefficients of ND/P for the full sample and the partition of non-viable firms. This is in line with leverage coefficients representing the credit risk premium of financial debt. To further investigate this issue, we estimate regressions for years with unexpected *increases* and *decreases* of the risk-free rate. Debt interest costs should (albeit with some time lag for debt with fixed interest cost rates) follow changes in the risk-free rate. The coefficient of leverage should be more negative in periods with unexpected increases in the risk-free rate, and more positive in periods with unexpected decreases in the risk-free rate.

Unexpected changes in the risk-free rate, denoted $News(r_{f(1)})_{t+1}$, are calculated as in (12.a) and (12.b), where $E_t\left(r_{f(1),t+1}\right)$ is the *expected* risk-free rate for year t+1 implied by the risk-free rate with a two-year duration at time *t*.

$$News(r_{f(1)})_{t+1} = r_{f(1),t+1} - E_t\left(r_{f(1),t+1}\right) \qquad (12.a)$$

and

$$E_t\left(r_{f(1),t+1}\right) = \frac{\left(1+r_{f(2),t}\right)^2}{1+r_{f(1),t}} - 1 \qquad (12.b)$$

where:
$r_{f(1),t}$ = one-year risk-free rate, assessed at the end of year *t*, and
$r_{f(2),t}$ = two-year (annual) risk-free rate, assessed at the end of year *t*.

Classifying our observations into years with unexpected *positive* or *negative* changes of the risk-free rate, we have estimated regressions including $\beta(u)$, NOA/P^{NOA}, OI/P^{NOA} and ND/P. Our results are shown in Table 5, with observations affected by *increases* in the risk-free rate in Panel A and observations affected by *decreases* in the risk-free rate in Panel B.

[Table 5 in here]

Comparing Panel A and Panel B in Table 5, the leverage coefficients are more negative for the sub-sample affected by unexpected increases in the risk-free rate. As the regression intercept minus the coefficient of ND/P constitutes an estimate of the average debt interest cost rate, we calculate these values in Panel C. In regression (i), this difference is larger in Panel A than in Panel B (*0.174 - 0.108 = 0.066*, *t*-statistic *3.17*). The same result holds for regressions (ii) and (iii). This supports the negative coefficients of ND/P being caused by the credit risk premium of financial debt.

7. Other indicators of operating risk and extreme leverage

In this section we first test whether our results might be specific for our main indicators of operating risk, NOA/P^{NOA} and OI/P^{NOA}, complementing our regressions with *industry fixed effects* and additional indicators of operating risk. Second, we investigate whether our negative leverage coefficients can be due to *negative leverage* (i.e. financial *net assets*) or very high, *'excessive'*, leverage.

7.1. Other indicators of operating risk

To test whether the coefficients of ND/P might only be due to some characteristic of NOA/P^{NOA} and/or OI/P^{NOA}, we complement our regressions with more indicators of operating risk. First, we include *industry fixed effects,* based on the idea that a large portion of operating risk might be due to industry characteristics.[23] Second, we add new indicators of operating risk, *Operating capacity overhang* (Aretz & Poope, 2018), *operating leverage* (Penman, 2013) and *business growth prospects.* Indicators of operating capacity overhang and operating leverage are defined as below, where operating capacity overhang is denoted $Diff\left(Sls_{j,t}/NOA_{j,t}\right)$ and operating leverage $OLR_{j,t}$.

$$Diff\left(Sls_{j,t}/NOA_{j,t}\right) = \frac{Sales_{j,t}}{NOA_{j,t}} - \left(\frac{\overline{Sales_t}}{NOA_t}\right)_{Ind(j)} \qquad (13)$$

where:
$Sales_{j,t}$ = total sales for firm *j* in year *t*, and
$(\bar{X})_{Ind(j)}$ = average value for the industry which firm *j* belongs to.

$$OLR_{j,t} = \frac{OI_{j,t}/OI_{j,t-1}}{Sales_{j,t}/Sales_{j,t-1}} \qquad (14)$$

where:
$OI_{j,t}$ = operating income for firm *j* in year *t*.

$Diff\left(Sls_{j,t}/NOA_{j,t}\right)$ is the difference between the firm's *operating net asset turnover* and the industry average of this ratio.[24] The variable is motivated by Aretz and Poope (2018), implying that firms with large operating capacity overhang have lower operating risk. Since the variable is an inverted measure of operating capacity overhang, we expect it to be positively associated with equity returns. $OLR_{j,t}$ is measured as the relative change in operating income divided by the relative change in total sales.[25] $OLR_{j,t}$ reflects the magnitude of fixed operating costs, where a high value indicates higher fixed costs and higher operating risk, and vice versa.

Our indicator of *business growth prospects* is defined as $\left(NOA_{j,t-1} + OI_{j,t}\right)/NOA_t$ and constitutes a measure of reinvestment aptitude. A high value of this ratio – i.e., a low reinvestment rate – indicates that the firm's business prospects might be value destroying.

Simplifying the notation, we henceforth supress *firm* and *year* indices in all indicators of operating risk. Regressions including NOA/P^{NOA}, OI/P^{NOA}, *industry fixed effects*, $Diff(Sls/NOA)$, OLR and $(NOA + OI)/NOA$ are shown in Table 6. In regression (i), a regression including only NOA/P^{NOA} is complemented with industry fixed effects. We here corroborate the positive coefficients of NOA/P^{NOA} and $(NOA/P^{NOA}) \cdot (ND/P)$ in panels A and B. However, the coefficient of the interaction variable is insignificant in Panel C, meaning that the amplifying risk effect of leverage is subsumed by the industry fixed effects. This also holds when we include more indicators of operating risk in regressions (ii) and (iii).

The coefficients of OI/P^{NOA} remain positive in all panels of Table 6 (albeit with low significance in Panel B). This also holds for the new indicators of operating risk. However, it is only the interaction variable $Diff(Sls/NOA) \cdot (ND/P)$ that gets positive coefficients in panels A and B, all other interaction variables receive coefficients that are not significant. A potential explanation for this is that financial leverage has a mitigating effect on the type of operating risk that the indicators represent. We return to this issue in section 8, where we more closely investigate the effect of relaxing the assumption of operating risk being independent of financial leverage.

[Table 6 in here]

Regarding the leverage coefficients in Table 6, ND/P gets negative coefficients in panels A and B, but insignificant coefficients in Panel C. This is in line with non-viable firms having higher credit risk premiums than viable firms. The intercept and the coefficient of ND/P in regression (iii) implies an average interest cost rate for our 'norm' industry (SIC code *4000-4999*) of *7.7 %* (*= 0.060 - (-0.017)*) in Panel A. With an average (sample-weighted) risk-free rate of *4.6 %* for the period 1967-2017, the average credit risk premium is then about *3.2 %*. For the non-viable firms in Panel B, a correspondingly estimated credit risk premium is about *5.7 %*. Even though the estimates appear to be somewhat high, they provide support for the negative coefficients of financial leverage being caused by the credit risk premium of financial debt.

7.2. Extreme leverage

'Excess cash', i.e. *negative* leverage, can be associated with agency conflicts between managers and/or shareholders, and thus cause a negative relation between leverage and stock returns (cf. Jensen, 1986, 1999; Piotroski, 2007; Guo, Hotchkiss & Song, 2011). Furthermore, as discussed in Section 2 and shown in the online Appendix *OA.I*, a negative association between equity returns and leverage might be caused by *'excessive'* leverage. This would be consistent with M&M (1958) if there is a large increase in the credit risk premium as leverage becomes high,[26] and was argued to explain the negative association between leverage and stock returns in Caskey et al. (2012).

To investigate the importance of *negative* leverage, we add a dummy variable D^{neg} and for each indicator of operating risk $(OPR) \cdot D^{neg}$ and $(OPR) \cdot (ND/P) \cdot D^{neg}$, where $D^{neg} = 1.0$ if ND/P is negative. Coefficients of these variables will then reflect *changes* in the coefficients of ND/P and $(OPR) \cdot (ND/P)$ due to negative *leverage*. Regarding the importance of 'excessive' leverage, we include $(ND/P) \cdot D^{xtr}$ in our regressions, where $D^{xtr} = 1.0$ for observations of ND/P belonging to the top *5 %*.[27]

[Table 7 in here]

Regressions including industry fixed effects are shown in Table 7, where regressions (i) and (ii) include controls for negative leverage and (iii) and (iv) control for 'excessive' leverage. Regressions (i) and (ii) show that negative leverage affects stock returns *negatively* in Panel C, coefficients of $(ND/P) \cdot D^{neg}$ are negative with t-values *-1.81* and *-2.08*. This means that negative leverage is associated with *higher* stock returns for viable firms. On the other hand, negative ND/P *reduces* stock returns for the non-viable firms in Panel B. We hence find support for the 'disciplining hypothesis' only for viable firms. Our finding for the partition of non-viable firms can be explained by a reduction of distress risk for firms having financial assets available to handle negative cash outflows, and/or low returns due to the entrenchment of financial assets in such firms. Controlling for negative leverage, coefficients of ND/P are negative in Panel B but insignificant in Panel C. This supports the intuition that credit risk premiums are higher for non-viable firms.

Regarding the importance of 'excessively' high leverage, Table 7 shows that its effect is weakly positive in Panel C but insignificant in Panel B. The coefficient of 'excessive' leverage is hence about the same as for 'normal' leverage for non-viable firms, but more positive for viable firms. In contrast to the findings in Caskey et al (2012), our results show that the negative coefficients of ND/P in Panel B are *not* caused by 'excessively' high leverage.[28]

Summing up our analyses of extreme values of leverage, we find that negative leverage affects non-viable and viable firms differently. Coefficients of ND/P become positively biased for non-viable firms due to negative leverage, while the opposite holds for viable firms. Also, we find that 'excessive' leverage cannot be the reason for negative coefficients of ND/P.

8. Reconciling M&M's capital structure theory

M&M (1958, 1963) predicts that financial leverage increases the risk of equity capital – the generic idea of financial risk – and that leverage therefore should be positively related to expected stock returns. At the same time, however, leverage reduces expected stock returns through interest costs, as the leverage formula shows.

In our tests of the association between stock returns, indicators of operating risk and leverage, we find several regularities that are in line with M&M's leverage formula. For example, except for unlevered beta our indicators of operating risk are positively associated with stock returns, and almost all leverage coefficients are negative for non-viable firms. However, we also find regularities that are harder to reconcile with M&M's theory, for example that coefficients of the amplifying risk effect of leverage often are found to be insignificant or negative (and hence predict a counter-intuitive *decreasing* return effect of leverage).

In order to better understand the association between stock returns and ordinary, non-negative, leverage – which M&M's capital structure theory primarily deals with – we have re-estimated regressions including NOA/P^{NOA}, OI/P^{NOA} and industry fixed effects, excluding observations with negative leverage. The results are shown in Table 8. In relation to our hypotheses *H(1), H(2), H(3),* and *H(4)* in section 4, we find:

H(1): *Confirmed.* Coefficients of NOA/P^{NOA} and OI/P^{NOA} are positive in all panels, even though the significance of NOA/P^{NOA} is somewhat low for non-viable firms.

H(2): *Confirmed* for $(NOA/P^{NOA}) \cdot (ND/P)$ for the full sample and the partition of non-viable firms. However, *not confirmed* for $(OI/P^{NOA}) \cdot (ND/P)$ (which gets negative or un-significant coefficients).

H(3): *Confirmed.* The difference between intercepts (γ_0) and leverage coefficients (γ_3) are positive in all panels.

H(4): *Confirmed.* Coefficients of leverage (γ_3) are negative for non-viable firms, but positive or insignificant for viable firms.

[Table 8 in here]

An intriguing issue in prior research has been whether the negative association between stock returns and leverage might indicate market mispricing (cf. Penman et al., 2007; Caskey et al., 2012). Our finding of negative leverage coefficients only for non-viable firms, is consistent with positive credit risk premiums for non-viable firms. This is in line with economic theory, as credit risks should be material for non-viable firms, but lower or negligible for viable firms. We also find the composite return effect of leverage in for example regression (ii) to be positive in all panels of Table 8. In Panel A, the coefficients of $(NOA/P^{NOA}) \cdot (ND/P)$, $(OI/P^{NOA}) \cdot (ND/P)$ and ND/P are *0.024*, *−0.108* and *−0.012*, respectively. Together with average values for observations with non-negative leverage of *0.937*, *0.075* and *0.923*, respectively, we get the marginal return effect ($\Delta(\bar{r}_E)_A$) of leverage to be:

$$\Delta(\bar{r}_E)_A = \gamma_2 \cdot \overline{\left((NOA/P^{NOA}) \cdot (ND/P)\right)} + \gamma_5 \cdot \overline{\left((OI/P^{NOA}) \cdot (ND/P)\right)} + \gamma_6 \cdot \overline{(ND/P)} \qquad (15)$$

$$= 0.024 \cdot 0.937 + (-0.108) \cdot 0.075 + (-0.012) \cdot 0.923 = +0.33\ \%$$

Performing the same calculations for non-viable ($\Delta(\bar{r}_E)_{NV}$) and viable ($\Delta(\bar{r}_E)_V$) firms, excluding coefficients with *t*-statistics $|t|$ *<1.50*, we get:[29, 30]

$$\Delta(\bar{r}_E)_{NV} = 0.043 \cdot 2.006 + (-0.038) \cdot 1.602 = +2.54\ \% \qquad (16)$$

$$\Delta(\bar{r}_E)_V = (-0.147) \cdot 0.046 + 0.031 \cdot 0.654 = +1.35\ \% \qquad (17)$$

The average return effect of a marginal increase in leverage is thus positive both for non-viable and viable firms. The effect is about twice as large for non-viable firms, mainly due to the positive coefficient of the interaction variable $(NOA/P^{NOA}) \cdot (ND/P)$ for these firms. This is in line with M&M's capital structure theory – equity returns should increase when leverage increases, and returns should increase more when the operating viability risk is higher.

However, there are also peculiarities to be observed in Table 8. Estimating average interest cost rates (the difference between the intercept and the coefficient of *ND/P*) for regression (ii) in Table 8, we find this to be *0.107 -(- 0.038) = 14.5 %* for non-viable firms and *0.054 - 0.031 = 2.3 %* for viable firms. Even though it is reasonable that the average interest cost rate is higher for non-viable firms than for viable firms, both estimates appear to be strongly biased (too high for non-viable firms, and too low for viable firms). Also, we have only been able to confirm hypothesis *H(2)* for the interaction variable $(NOA/P^{NOA}) \cdot (ND/P)$ for non-viable firms. Even though the weakly negative coefficients of $(NOA/P^{NOA}) \cdot (ND/P)$ in Panel C in Table 8 might be due to multicollinearity issues,[31] coefficients of $(OI/P^{NOA}) \cdot (ND/P)$ are negative in all panels of the table. This is not in line with

M&M's capital structure theory, based on the premise that operating risk should be *independent* of leverage.

Negative coefficients of $(NOA/P^{NOA}) \cdot (ND/P)$ and $(OI/P^{NOA}) \cdot (ND/P)$ indicate a so far unrecognized negative association between operating risk and leverage. An association of this kind might be due to the 'disciplining hypothesis' (Jensen, 1986, 1999; Piotroski, 2007; Guo et al. 2011), where financial debt is believed to reduce the risk of opportunistic actions by firm managers and/or majority shareholders, or the 'signalling hypothesis' (Ross, 1977; 2005). Another reason for such negative coefficients is that credit risk can be more associated with operating risk, meaning that the credit risk premium is explained by firms' financial risk rather than by leverage solely.

Allowing financial leverage to have a mitigating operating risk effect and assuming that operating risk influences credit risk, negative coefficients of the interaction variables are possible. Assume for example that instead of $f(OPR)$ in (5) and $Cprm$ in (6) above, operating risk and credit risk premiums are modelled as (firm and time index being suppressed):

$$Oprm = k_0 \ + \ \sum_{i=1}^{I} k_{1,i} \cdot OPR_i \ + \ \sum_{i=1}^{I} k_{2,i} \cdot OPR_i \cdot (ND/P^{NOA}) \qquad (5')$$

where $k_0 \geq 0$, $k_{1,i} > 0$ and $k_{2,i} \leq 0$, $i = 1, \ldots I$.

$$Cprm = d_0 \ + \ d_1 \cdot (ND/P^{NOA}) \ + \ \sum_{i=1}^{I} d_{2,i} \cdot OPR_i \qquad (6')$$

where $d_0 \geq 0$, $d_1 > 0$ and $d_{2,i} > 0$, $i = 1, \ldots I$.

In (5´) the interaction variables $OPR_i \cdot (ND/P^{NOA})$ mitigate the operating risk premium if $k_{2,i}$ is negative, while in (6´) operating risk indicators OPR_i are positively associated with the credit risk premium. In principle, the latter assumption is in line with well-recognized bond valuation modelling (cf. Leland, 1994; Leland & Toft, 1996). Inserting (5´) and (6´) in the leverage formula (4), we get the following expression for the equity return (cf. Appendix III for a derivation):

$$\begin{aligned}\bar{r}_E = r_f \ + \ k_0 \ + \ \sum_{i=1}^{I} k_{1,i} \cdot OPR_i \ + \ \sum_{i=1}^{I} \left(k_{1,i} + k_{2,i} - d_{2,i}\right) \cdot OPR_i \cdot (ND/P) \ + \\ + \ [k_0 - d_0 - d_1 \cdot (ND/P^{NOA})] \cdot (ND/P) \qquad (7')\end{aligned}$$

In regression analyses the coefficients $\gamma_{1,i}$, $\gamma_{2,i}$ and γ_3 now correspond to $k_{1,i}$, $(k_{1,i} + k_{2,i} - d_{2,i})$, and $(k_0 - d_0 - d_1 \cdot (ND/P^{NOA}))$, respectively, in (7´). Coefficients of operating risk indicators would still be positive ($k_{1,i} > 0$), but coefficients of the interaction variables $OPR_i \cdot (ND/P)$ are smaller than $\gamma_{1,i}$ (since $k_{2,i} \leq 0$ and $d_{2,i} > 0$). Depending on the magnitude of $k_{2,i}$ and $d_{2,i}$, coefficients of $OPR_i \cdot (ND/P)$ might even become negative. Also, the impact of the credit risk premium on $\bar{r}_E$ in (7´) is split up between $\gamma_{2,i}$ and γ_3, meaning that the leverage coefficient can be less negative and possibly even positive.

Regarding our empirical observations in Table 8, the modelling of $Oprm$ and $Cprm$ in (5´) and (6´) means:

- The credit risk premium for non-viable firms in Panel B is mainly captured by $d_0 + d_1 \cdot (ND/P^{NOA})$ in (7´) since the coefficients of (ND/P) are robustly negative. Variations in credit risk premiums are then primarily related to variations in leverage for non-viable firms, and the coefficients of $OPR_i \cdot (ND/P)$ increase (as $d_{2,i}$ in (7´) is less important).
- The credit risk premium for viable firms in Panel C is captured by the interaction variables $OPR_i \cdot (ND/P)$, causing the coefficients of $OPR_i \cdot (ND/P)$ to decrease. In turn this means that $d_0 + d_1 \cdot (ND/P^{NOA})$ in (7´) has less explanatory power for the credit risk premium, allowing the leverage coefficient to be positive (since $k_0 \geq 0$).

Summing up, a *negative* linkage between financial leverage and operating risk, together with a *positive* linkage between operating risk and the credit risk premium, can explain why the coefficients of the interaction variables are negative in Table 8. We can then also infer that credit risk premiums for viable firms appear to be more associated with operating risk, while credit risk premiums for non-viable firms primarily appear to only be associated with financial leverage.

9. Concluding remarks

The capital structure theory in M&M (1958, 1963) predicts a positive association between expected equity returns and leverage due to the amplifying risk effect of leverage. At the same time, financial debt is associated with interest costs which has a negative effect on equity returns. M&M's leverage formula is conditioned on operating risk being independent of financial leverage and credit risk premiums being negligible, i.e. a simplified setting that might have limited empirical validity. Still, several of our results are well in line with the inferences that can be made from M&M's theory. We find that credit risk premiums are positive for non-viable firms, and possibly also for a portion of viable firms. The latter issue is somewhat ambiguous though, as credit risk premiums for viable firms appear to be more associated with the interaction between operating risk and leverage, than leverage itself. Furthermore, our results indicate that the assumption of operating risk being independent of leverage might not hold empirically.

Summing up, we find the following. First, our modelling shows that tests of the association between stock returns and leverage require the inclusion of the *amplifying risk effect* of leverage to capture the importance of financial risk. Second, we find that the choice of operating risk indicators affects the association between stock returns and leverage. Complementing the *enterprise book-to-price* (NOA/P^{NOA}) and *enterprise earnings yield* (OI/P^{NOA}) with *industry fixed effects* and other operating risk indicators (‘*operating capacity overhang*’, ‘*operating leverage*’, and *‘business growth prospects’*), the amplifying risk effect of leverage is positive for a limited set of indicators and mainly for non-viable firms. In line with M&M, leverage coefficients are negative for non-viable firms. Third, negative leverage (i.e. financial *net assets*) affects expected stock returns differently than positive leverage, and in different ways for viable and non-viable firms. Stock returns for viable firms are positively affected by financial net assets. This might be due to higher expected investment returns for such assets, and/or that more financial assets are associated with more agency conflicts. Stock returns are decreasing in financial net assets for non-viable firms, possibly due to an asset ‘entrenchment’ effect with poor profitability prospects of future investments, and/or a lower risk of short term financial distress.

Limiting our sample to observations with non-negative leverage, coefficients of leverage are robustly negative for non-viable firms, but positive for viable firms. Somewhat surprisingly, we coefficients of in particular the interaction variable $(OI/P^{NOA}) \cdot (ND/P)$ are negative. This is likely due to a mitigating risk effect of leverage, and/or credit risk premiums being more associated with this interaction variable than with leverage itself.

To better understand the importance of financial leverage, we propose further research on the relation between indicators of operating risk and leverage, and the importance of negative leverage. Including leverage as an explanatory variable in our modelling of operating risk helps to explain the leverage coefficients. The coefficients will then not only be related to the credit risk premium, but also reflect the signalling or mitigating risk associated with financial leverage. Our tests show that both these effects are of importance to understand coefficients of leverage. More research should address this issue, in order to better understand how firms’ debt contracting affects the operating characteristics of firms. Furthermore, our tests robustly show that the stock return effect of negative leverage is different for viable and non-viable firms. More research on the motivation and consequences of negative leverage is hence of interest to better understand why firms want to hold financial net assets.

Appendix I: NOA/P^{NOA} and OI/P^{NOA} as indicators of operating risk

Assuming that the market value of owners' equity plus financial debt coincides with the present value of future operating free cash flows, the average cost of capital $r_{wacc} = r_u$, and the 'operating asset relation' (Feltham & Ohlson, 1995) holds, the market value of P_t^{NOA} is (cf. Skogsvik, 2002; Penman, 2013):[32]

$$P_0^{NOA} = NOA_0 + \sum_{t=1}^{\infty} \frac{\left(\bar{R}^*_{(NOA)t} - r_u\right) \cdot \overline{NOA}_{t-1}}{(1+r_u)^t} \qquad \text{(A.1)}$$

where:

$R^*_{(NOA)t}$ = book return on net operating assets (after tax) in year *t*,

r_u = unlevered cost of capital, and

$\overline{...}$ = denotes expected value given available information at *t* = *0*.

To simplify the analysis, assume a steady state at date *t* = 0, meaning:

- A constant future growth rate of net operating assets, i.e. $\overline{NOA}_{t+1} = \overline{NOA}_t \cdot (1 + g_{ss})$.
- A future book return on net operating assets (after tax) being constant, i.e. $\bar{R}^*_{(NOA)t} = \bar{R}^*_{(NOA)ss}$ for *t* = *1, 2, …∞*.
- $\bar{R}^*_{(NOA)ss} > g_{ss}$.

Given the above assumptions, (A.1) can be simplified:

$$P_0^{NOA} = NOA_0 + \sum_{t=1}^{\infty} \frac{\left(\bar{R}^*_{(NOA)ss} - r_u\right) \cdot NOA_0 \cdot (1+g_{ss})^{t-1}}{(1+r_u)^t} =$$

$$= NOA_0 \cdot \left[1 + \frac{\bar{R}^*_{(NOA)ss} - r_u}{r_u - g_{ss}}\right] = NOA_0 \cdot \left[\frac{\bar{R}^*_{(NOA)ss} - g_{ss}}{r_u - g_{ss}}\right] \qquad \text{(A.2)}$$

The *enterprise book-to-price*, $(NOA/P^{NOA})_t$, at date *t* = 0 is then:

$$(NOA/P^{NOA})_0 = \frac{r_u - g_{ss}}{\bar{R}^*_{(NOA)ss} - g_{ss}} \qquad \text{(A.3)}$$

$(NOA/P^{NOA})_0$ in (A.3) is an indicator of the *commercial viability* of the firm's operating activities in the sense that:

- If $r_u > \bar{R}^*_{(NOA)ss}$, $(NOA/P^{NOA})_0$ is *>1.0*, indicating that the operating profitability of the firm is below the cost of capital. This means that positive growth will be value destructive (increasing the value of $(NOA/P^{NOA})_0$) and the firm is headed for financial distress in the future.
- If $\bar{R}^*_{(NOA)ss} > r_u$, the operations of the firm are commercially viable, and growth is value enhancing (decreasing the value of $(NOA/P^{NOA})_0$).

The ratio $(NOA/P^{NOA})_0$ thus works as an indicator of the commercial viability of the firm's operations, reflecting the risk that the business model fails and becomes value destroying.

Based on P_0^{NOA} in (I.2), the *enterprise earnings yield*, $(OI/P^{NOA})_t$, at date *t* = 0 is:

$$(OI/P^{NOA})_0 = \frac{NOA_{-1}\cdot\bar{R}^*_{(NOA),-1}\cdot(r_u-g_{ss})}{NOA_0\cdot\left(\bar{R}^*_{(NOA)ss}-g_{ss}\right)} = \tag{A.4}$$

$$= \frac{(r_u-g_{ss})\cdot\bar{R}^*_{(NOA),-1}}{\left(\bar{R}^*_{(NOA)ss}-g_{ss}\right)\cdot(1+g(NOA)_{-1})} = (NOA/P^{NOA})_0\cdot\left(\frac{\bar{R}^*_{(NOA),-1}}{1+g(NOA)_{-1}}\right)$$

$(OI/P^{NOA})_0$ in (A.4) can be an indicator of *financial distress* in the sense that:

- $(OI/P^{NOA})_0$ gets a high value if the operating viability is low ($(NOA/P^{NOA})_0$ is high) and the book return on net operating assets in year *t = -1* is high in relation to the net operating asset growth in the same period.
- In addition to the information provided by $(NOA/P^{NOA})_0$, $(OI/P^{NOA})_0$ is informative of the firm's reinvestment decisions. A high value of $\bar{R}^*_{(NOA),-1}/(1+g(NOA)_{-1})$ means that the reinvestment rate of the prior year's operating earnings is low, signaling that the firm's operations are value destroying and soon might have to be closed down.

The enterprise earnings yield $(OI/P^{NOA})_0$ can thus provide complementary information about the viability a firm's business growth prospects, where the ratio signals the timing risk of the closure of its operations.

Appendix A.II: The impact of accounting conservatism on NOA/P^{NOA}

The numerator of NOA/P^{NOA} is the acquisition cost of net operating assets and the denominator is the market value of invested capital (owners' equity plus financial net debt). We claim that NOA/P^{NOA} is an indicator of the commercial viability of the firm. In principle, commercial viability hinges on the firm's ability to execute positive net-present-value projects. As the numerator of NOA/P^{NOA} depicts the acquisition cost of the firm's net operating assets, $NOA/P^{NOA} > 1$ indicates that the firm's business operations are commercially 'non-viable' (the acquisition cost value is *higher* than the corresponding market value) and $NOA/P^{NOA} < 1$ that the operations are commercially 'viable' (the acquisition cost value is *lower* than the corresponding market value). However, as historical cost accounting typically is conservatively biased, NOA/P^{NOA} does not reflect the viability of firms in this simple fashion. The question is then to what extent NOA/P^{NOA} nevertheless can work as an indicator of commercial viability risk.

Assuming that the market price of invested capital is unbiased and the '*operating asset relation*' (Feltham & Ohlson, 1995) holds, the denominator of NOA/P^{NOA} is (cf. Skogsvik, 2002; Penman, 2013) (valuation date $t = 0$, firm index suppressed):

$$V_0(NOA) = NOA_0 + \sum_{\tau=1}^{\infty} \frac{\left(\bar{R}^*_{(NOA)\tau} - r_{wacc}\right)\cdot \overline{NOA}_{\tau-1}}{(1+r_{wacc})^{\tau}} \qquad \text{(A.5)}$$

where:

$R^*_{(NOA)\tau}$ = book return on net operating assets (after company tax) year τ,

r_{wacc} = average cost of capital, and

$(\overline{\ldots})$ = denotes expected value given available information at t = 0.

Without limiting the analysis, assume furthermore:

- No growth in net operating assets, i.e. $\overline{NOA}_\tau = \overline{NOA}_0$ for $\tau = 1, 2, \ldots$
- Future values of $\bar{R}^*_{(NOA)\tau}$ are constant, i.e. $\bar{R}^*_{(NOA)\tau} = \bar{R}^*_{(NOA)ss}$ for $\tau = 1, 2 \ldots$.

Given the above, (A.5) can be rewritten:

$$V_0(NOA) = NOA_0 + \sum_{\tau=1}^{\infty} \frac{\left(\bar{R}^*_{(NOA)ss} - r_{wacc}\right)\cdot NOA_0}{(1+r_{wacc})^{\tau}} =$$

$$= NOA_0 \cdot \left[1 + \frac{\bar{R}^*_{(NOA)ss} - r_{wacc}}{r_{wacc}}\right] = NOA_0 \cdot \frac{\bar{R}^*_{(NOA)ss}}{r_{wacc}} \qquad \text{(A.5´)}$$

Since $\bar{R}^*_{(NOA)ss}$ is based on historical cost accounting, $\bar{R}^*_{(NOA)ss}$ and r_{wacc} are not directly comparable. However, knowing that (Skogsvik, 2002):

$$\bar{R}^{*}_{(NOA)ss} \;=\; \bar{R}^{*o}_{(NOA)ss} + q(NOA) \cdot \left(\bar{R}^{*o}_{(NOA)ss} - g_{ss}\right) \qquad \text{(A.6)}$$

where:

$\bar{R}^{*o}_{(NOA)ss}$ = *unbiased* book return on net operating assets (after company tax) year *t = 1,2,…*,
$q(NOA)$ = conservative bias of net operating assets, and
g_{ss} = relative growth of the conservative bias of net operating assets.

$\bar{R}^{*o}_{(NOA),ss}$ in (A.6) is an *unbiased* book return metric, i.e. the book return that would be observed if the accounting principles were *neutral* (Penman, 2013). The conservative bias $q(NOA)$ is equal to $(NOA^{o}_{t} - NOA_{t})/NOA_{t} = Cb(NOA)_{t}/NOA_{t}$, where NOA^{o}_{t} = net operating assets with neutral accounting and $Cb(NOA)_{t}$ is the value of the conservative bias. (A.6) is presumes that $Cb(NOA)_{t}/NOA_{t}$ is constant over time and the growth of NOA_{t} being g_{ss}.

Since $g_{ss} = 0$ in (A.5´), $V_0(NOA)$ can be written:

$$V_0(NOA) \;=\; NOA_0 \cdot \left[\frac{\bar{R}^{*o}_{(NOA)ss} \cdot (1+q(NOA))}{r_{wacc}}\right] \qquad \text{(A.5´´)}$$

Replacing $V_0(NOA)$ with P^{NOA}_{0} in (A.5´´), the *enterprise book-to-price* is:

$$(NOA/P^{NOA})_0 \;=\; \frac{r_{wacc}}{\bar{R}^{*o}_{(NOA)ss}} \cdot \frac{1}{(1+q(NOA))} \qquad \text{(A.7)}$$

With neutral accounting principles, $q(NOA) = 0$ and $(NOA/P^{NOA})_0$ will be above (below) *1.0* if r_{wacc} is higher (lower) than $\bar{R}^{*o}_{(NOA)ss}$. The threshold $NOA/P^{NOA} = 1.0$ would then be appropriate to separate commercially ‘non-viable’ from ‘viable’ firms. However, if the accounting is conservative, $q(NOA) > 0$ and $(NOA/P^{NOA})_0$ is a biased indicator of commercial viability. Even if $\bar{R}^{*}_{(NOA)ss} < r_{wacc}$, $(NOA/P^{NOA})_0$ can then be below *1*. Rewriting (A.7), this happens if:

$$q(NOA) \;>\; \frac{r_{wacc}}{\bar{R}^{*o}_{(NOA)ss}} \;-\; 1 \qquad \text{(A.8)}$$

Since $q(NOA)$ is positive when accounting is conservatively biased, firms having $\bar{R}^{*o}_{(NOA)ss} < r_{wacc}$ can get $(NOA/P^{NOA})_0 < 1{,}0$, but firms having $\bar{R}^{*o}_{(NOA)ss} > r_{wacc}$ cannot get $(NOA/P^{NOA})_0 > 1.0$. Hence, a sample of firms for which $NOA/P^{NOA} > 1.0$ will only include *non-viable* firms, while a sample for which $NOA/P^{NOA} < 1.0$ can include both viable and non-viable firms. This means that NOA/P^{NOA} is a more reliable indicator of commercial distress when the ratio is above *1.0*, but will include both viable and non-viable firms if $NOA/P^{NOA} < 1.0$.

Appendix III: Alternative specifications of $Oprm$ and $Cprm$

Instead of assuming that $Oprm$ is a function of indicators of operating risk only (as in Section 4), we now include a mitigating risk effect of financial leverage. Specifically, we assume that the interaction between OPR_i and ND/P^{NOA} can affect $Oprm$ negatively, for example though the disciplining effect that debt might have on agency/principal conflicts. Hence, we write $Oprm$ as:

$$Oprm = \ k_0 \ + \ \textstyle\sum_i^I k_{1,i} \cdot OPR_i \ + \ \sum_i^I k_{2,i} \cdot OPR_i \cdot (ND/P^{NOA}) \qquad \text{(A.9)}$$

where $k_0 \geq 0$, $k_{1,i} > 0$ and $k_{2,i} \leq 0$, $i = 1, \ldots I$

Furthermore, we assume that $Cprm$ in addition to being a function of (ND/P^{NOA}), is positively associated with one or several operating risk indicators:

$$Cprm = d_0 + d_1 \cdot (ND/P^{NOA}) + \textstyle\sum_i^I d_{2,i} \cdot OPR_i \qquad \text{(A.10)}$$

where $d_0 \geq 0$, $d_1 > 0$ and $d_{2,i} > 0$, $i = 1, \ldots I$.

Inserting (A.9) and (A.10) in the leverage formula (in line with the derivation of (7) in Section 4), we get:

$$\begin{aligned}
\bar{r}_E = \ & r_f \ + \ Oprm \ + \ (Oprm - Cprm) \cdot ND/P \ = \\
= \ & r_f \ + \ k_0 \ + \ \textstyle\sum_{i=1}^I k_{1,i} \cdot OPR_i \ + \sum_{i=1}^I k_{2,i} \cdot OPR_i \cdot (ND/P^{NOA}) \\
& + \left[\ k_0 \ + \ \textstyle\sum_{i=1}^I k_{1,i} \cdot OPR_i \ + \ \sum_{i=1}^I k_{2,i} \cdot OPR_i \cdot (ND/P^{NOA}) \right. \\
& \quad \left. - \, d_0 - \ d_1 \cdot (ND/P^{NOA}) \ - \ \textstyle\sum_{i=1}^I d_{2,i} \cdot OPR_i \right] \cdot (ND/P) \ = \\
= \ & r_f \ + \ k_0 \ + \ \textstyle\sum_i^I k_{1,i} \cdot OPR_i \ + \\
& + \left[\textstyle\sum_{i=1}^I k_{2,i} \cdot OPR_i \cdot (ND/P^{NOA}) \cdot (P/ND) \ + \right. \\
& \quad + k_0 \ + \ \textstyle\sum_i^I k_{1,i} \cdot OPR_i \ + \ \sum_{i=1}^I k_{2,i} \cdot OPR_i \cdot (ND/P^{NOA}) \\
& \quad \left. - \, d_0 \ - \ d_1 \cdot (ND/P^{NOA}) \ - \ \textstyle\sum_{i=1}^I d_{2,i} \cdot OPR_i \right] \cdot (ND/P) \ = \\
= \ & \left(r_f \ + \ k_0 \right) \ + \ \textstyle\sum_i^I k_{1,i} \cdot OPR_i \ + \\
& \ + \ [\textstyle\sum_{i=1}^I \left(k_{1,i} \ + \ k_{2,i} \ - \ d_{2,i} \right) \cdot OPR_i \cdot (ND/P) \ + \\
& \ + [k_0 - d_0 \ - \ d_1 \cdot (ND/P^{NOA})] \cdot (ND/P) \qquad \text{(A.11)}
\end{aligned}$$

In a linear regression model, the intercept γ_0 corresponds to $\left(r_f + k_0 \right)$ and $\gamma_{1,i} = k_{1,i}$, $\gamma_{2,i} = \ \left(k_{1,i} + k_{2,i} - d_{2,i} \right)$ and $\gamma_{3,i} = \left(k_0 - d_0 - d_1 \cdot (ND/P^{NOA}) \right)$, where:

- $\gamma_0 > 0$ (since $r_f + k_0 > 0$),
- $\gamma_{1,i} > 0$ (since $k_{1,i} > 0$),

- $\gamma_{2,i} \gtrless 0$ (since $k_{1,i} + k_{2,i} - d_{2,i} \gtrless 0$), and
- $\gamma_{3,i} \gtrless 0$ (since $k_0 - d_0 - d_1 \cdot (ND/P^{NOA}) \gtrless 0$).

In regression analyses where we exclude negative leverage (cf. Table 8 in Section 8), we find:

1. Estimates of $\gamma_{2,i}$ tend to be smaller for viable firms, indicating that the risk mitigating coefficients $k_{2,i}$ are more negative and/or the credit risk premium coefficients $d_{2,i}$ are higher for viable firms.
2. Estimates of $\gamma_{3,i}$ are positive for viable firms but negative for non-viable firms, indicating that d_0 and d_1 of the credit risk premium are negligible for viable firms.

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Table 1: Descriptive statistics.

	Full sample (126,877 firm-year obs.)			**$NOA/P^{NOA} \geq 1$: (31,764 firm-year obs.)**			**$NOA/P^{NOA} < 1$: (95,113 firm-year obs.)**		
	Mean	**Median**	**Stddev**	**Mean**	**Median**	**Stddev**	**Mean**	**Median**	**Stddev**
B/P	0.781	0.630	0.708	1.640	1.383	0.826	0.494	0.500	0.334
NOA/P^{NOA}	0.760	0.723	0.453	1.348	1.220	0.389	0.564	0.585	0.265
OI/P^{NOA}	0.092	0.079	0.075	0.128	0.106	0.110	0.082	0.074	0.059
$G(NOA)$	1.157	1.065	0.460	1.058	1.025	0.276	1.191	1.080	0.519
OI/NOA	0.168	0.140	0.300	0.089	0.088	0.129	0.193	0.164	0.353
ND/P	0.610	0.207	1.317	1.241	0.686	1.874	0.399	0.136	0.982
$Size$	5.407	5.308	2.322	3.882	3.638	1.975	5.916	5.870	2.204
$\beta(e)$	0.967	0.893	0.608	0.986	0.933	0.539	0.961	0.879	0.630
$\beta(u)$	0.889	0.620	1.078	0.736	0.616	0.607	0.940	0.622	1.191
$r_{(E)}$	0.118	0.080	0.384	0.175	0.128	0.403	0.099	0.066	0.375

Table shows means, medians, and standard deviations over the period 1966-2017 for the full sample and for sample partitions where $NOA/P^{NOA} \geq 1$ and $NOA/P^{NOA} < 1$. Firm-years with negative values of NOA or P^{NOA} and observations corresponding to the upper or lower percentiles of B/P, ND/P, NOA/P^{NOA} and OI/P^{NOA} have been excluded. B/P is the book value of owners' equity (B) divided by the market value of equity (P) at year ends. NOA/P^{NOA} is the book value of operating net assets (NOA) divided by the sum of the market value of equity (P) and the book value of net debt (ND), at year ends. OI/P^{NOA} is operating income (OI) in year t divided by P^{NOA} at year ends. $G(NOA)$ is NOA at the end of year t divided by NOA at the end of year t-1. OI/NOA is operating income in year t divided by NOA at the end of year t-1. ND/P is the book value of financial net debt divided by the market value of owners' equity at year ends. 'Size' is log of the market value of owners' equity at year ends. $\beta(e)$ is equity beta estimated from up to 48-months regressions of excess stock returns on the excess return for the CRSP sample. $\beta(u)$ is calculated as $\beta(e)$ divided by [1+(ND/P)], where ND/P is measured as firm-specific averages at the end of four historical years. $r_{(E)}$ is the 12-month stock return, starting four months after year ends.

Table 2: Correlations between enterprise book-to-price (NOA/P^{NOA}), enterprise earnings yield (OI/P^{NOA}), financial leverage (ND/P), unlevered beta ($\beta(u)$), and stock returns ($r_{(E)}$).

Panel A: $NOA/P^{NOA} \geq 1$

	NOA/P^{NOA}	OI/P^{NOA}	$G(NOA)$	OI/NOA	ND/P	$\beta(u)$	$r_{(E)}$
NOA/P^{NOA}	-	0.005	-0.173	-0.240	-0.254	0.279	0.013
OI/P^{NOA}	0.056	-	0.147	0.588	-0.253	0.055	0.061
$G(NOA)$	-0.115	0.084	-	0.329	0.055	0.006	-0.031
OI/NOA	-0.194	0.492	0.301	-	-0.168	-0.064	0.073
ND/P	-0.207	-0.264	0.042	-0.107	-	-0.512	-0.010
$\beta(u)$	0.229	0.078	0.061	-0.114	-0.374	-	-0.044
$r_{(E)}$	0.026	0.040	-0.032	0.051	0.007	-0.030	-

Panel B: $NOA/P^{NOA} < 1$

	NOA/P^{NOA}	OI/P^{NOA}	$G(NOA)$	OI/NOA	ND/P	$\beta(u)$	$r_{(E)}$
NOA/P^{NOA}	-	0.221	-0.101	-0.430	0.589	-0.345	0.065
OI/P^{NOA}	0.214	-	-0.012	0.445	-0.087	-0.020	0.127
$G(NOA)$	-0.089	-0.042	-	0.315	-0.0 06	0.098	-0.051
OI/NOA	-0.322	0.348	0.264	-	-0.424	0.211	0.068
ND/P	0.410	-0.147	-0.031	-0.210	-	-0.644	0.013
$\beta(u)$	-0.345	-0.013	0.134	0.128	-0.352	-	-0.061
$r_{(E)}$	0.056	0.094	-0.053	0.052	0.012	-0.044	-

Table shows weighted average correlations across years over the period 1966-2017, weights being the square root of the number of observations each year. Correlations in the upper (lower) halves are Spearman (Pearson) correlations. The data set is the same as in Table 1, and variables are defined in Table 1.

Table 3: Regressions for observed stock returns, unlevered beta ($\boldsymbol{\beta(u)}$), enterprise book-to-price ($\boldsymbol{NOA/P^{NOA}}$), and enterprise earnings yield ($\boldsymbol{OI/P^{NOA}}$), controlling for earnings and macro news.

	Panel A: Full sample (126,877 firm-year observations)					**Panel B: $NOA/P^{NOA} \geq 1$ (31,764 firm-year observations)**					**Panel C: $NOA/P^{NOA} < 1$ (95,113 firm-year observations)**				
Regression	**(i)**	**(ii)**	**(iii)**	**(iv)**	**(v)**	**(i)**	**(ii)**	**(iii)**	**(iv)**	**(v)**	**(i)**	**(ii)**	**(iii)**	**(iv)**	**(v)**
Intercept	0.133	0.102	0.087	0.073	0.077	0.46	0.092	0.139	0.095	0.084	0.122	0.088	0.068	0.056	0.064
	(6.65)	(5.27)	(4.58	(3.86)	(4.04)	(5.84)	(2.92)	(5.85)	(3.30)	(3.45)	(5.84)	(4.10)	(3.21)	(2.47)	(2.84)
$\boldsymbol{\beta(u)}$	-0.004	-	-	-	-0.019	0.010	-	-	-	-0.012	-0.011	-	-	-	-0.021
	(-0.72)				(-2.86)	(0.66)				(-0.56)	(-1.81)				(-2.49)
$\boldsymbol{\beta(u)\cdot(ND/P)}$	0.005	-	-	-	-0.012	0.023	-	-	-	-0.006	-0.017	-	-	-	-0.011
	(0.42)				(-1.17)	(1.59)				(-0.66)	(-1.70)				(-1.08)
$\boldsymbol{NOA/P^{NOA}}$	-	0.038	-	0.030	0.028	-	0.038	-	0.033	0.038	-	0.057	-	0.031	0.027
		(3.05)		(2.44)	(2.41)		(2.88)		(2.65)	(3.50)		(2.52)		(1.42)	(1.22)
$\boldsymbol{(NOA/P^{NOA})\cdot(ND/P)}$	-	0.035	-	0.037	0.051	-	0.049	-	0.055	0.051	-	0.031	-	0.015	0.057
		(3.35)		(3.36)	(3.91)		(3.20)		(3.46)	(2.11)		(1.34)		(0.71)	(1.90)
$\boldsymbol{OI/P^{NOA}}$	-	-	0.351	0.282	0.282	-	-	0.033	0.044	0.064	-	-	0.449	0.403	0.396
			(5.30)	(4.76)	(4.77)			(0.52)	(0.79)	(1.10)			(4.90)	(4.78)	(4.61)
$\boldsymbol{(OI/P^{NOA})\cdot(ND/P)}$	-	-	-0.055	-0.086	-0.081	-	-	0.099	0.134	0.153	-	-	-0.079	-0.067	-0.072
			(-1.42)	(-1.72)	(-1.60)			(1.02)	(1.29)	(1.38)			(-1.25)	(-0.85)	(-1.03)
$\boldsymbol{ND/P}$	0.003	-0.032	0.012	-0.025	-0.041	0.004	-0.045	-0.000	-0.064	-0.057	0.001	-0.031	0.011	-0.005	-0.046
	(0.82)	(-2.94)	(2.62)	(-2.25)	(-3.13)	(0.54)	(-2.24)	(-0.06)	(-3.44)	(-2.10)	(0.25)	(-1.45)	(1.65)	(-0.29)	(-1.62)
$\boldsymbol{EARNNEWS}$	0.766	0.778	0.776	0.781	0.769	0.650	0.724	0.597	0.670	0.661	1.466	1.459	1.410	1.452	1.449
	(7.43)	(7.64)	(7.00)	(7.73)	(8.12)	(11.40)	(9.51)	(8.27)	(9.12)	(6.92)	(5.66)	(5.74)	(5.90)	(5.53)	(5.61)
$\boldsymbol{MACRNEWS}$	-0.814	-0.909	-0.807	-0.886	-0.792	-0.887	-1.207	-1.023	-1.179	-1.150	-0.748	-0.842	-0.730	-0.812	-0.683
	(-1.65)	(-1.66)	(-1.70)	(-1.60)	(-1.37)	(-1.68)	(-1.33)	(-1.35)	(-1.36)	(-1.32)	(-1.60)	(-1.68)	(-1.70)	(-1.60)	(-1.33)
Adj. R^2	0.054	0.062	0.058	0.068	0.072	0.065	0.074	0.064	0.076	0.082	0.053	0.061	0.060	0.070	0.074

Table shows average coefficients from annual regressions of observed stock returns on indicators of operating risk ($\beta(u)$, NOA/P^{NOA} and OI/P^{NOA}), the amplifying risk of leverage and financial leverage, with controls for earnings news and macro news over the period 1966-2017. Coefficients are mean values from cross-sectional regressions for the sample years and t-values in parenthesis are mean coefficients divided by standard errors estimated from the time series of coefficients. Adjusted R^2 are mean values of annual adjusted R^2. The data set is the same as in Table 1. $EARNNEWS$ is the difference between observed earnings and firm-specific predictions of earnings for year t+1, divided by the market value of owners' equity at year ends. $MACRNEWS$ is equity betas multiplied by the difference between the excess market return year t+1 and the average market risk premium over the period 1967-2016. All other variables are defined in Table 1.

Table 4: Regressions for implied costs of capital (ICC(Composite)) from Hou et al. (2012), unlevered beta ($\boldsymbol{\beta}(\boldsymbol{u})$), enterprise book-to-price ($\boldsymbol{NOA/P^{NOA}}$) and enterprise earnings yield ($\boldsymbol{OI/P^{NOA}}$).

	Panel A: Full sample (101,130 firm-year observations)				**Panel B: $\boldsymbol{NOA/P^{NOA}} \geq 1$ (26,043 firm-year observations)**				**Panel C: $\boldsymbol{NOA/P^{NOA}} < 1$ (75,087 firm-year observations)**			
Regression	**(i)**	**(ii)**	**(iii)**	**(iv)**	**(i)**	**(ii)**	**(iii)**	**(iv)**	**(i)**	**(ii)**	**(iii)**	**(iv)**
Intercept	0.097	0.056	0.043	0.038	0.138	0.082	0.061	0.065	0.084	0.053	0.044	0.036
	(24.44)	(24.64)	(3.41)	(2.01)	(30.75)	(19.30)	(12.95)	(12.98)	(27.35)	(21.60)	(4.91)	(2.58)
$\boldsymbol{\beta}(\boldsymbol{u})$	0.002	-	-	0.009	-0.001	-	-	-0.008	0.002	-	-	0.009
	(0.72)			(0.95)	(-0.17)			(-1.54)	(0.68)			(1.65)
$\boldsymbol{\beta}(\boldsymbol{u})\cdot(\boldsymbol{ND/P})$	0.001	-	-	-0.010	-0.004	-	-	-0.001	-0.004	-	-	-0.011
	(0.98)			(-2.06)	(-1.25)			(-0.14)	(-3.59)			(-3.67)
$\boldsymbol{NOA/P^{NOA}}$	-	0.057	0.056	0.055	-	0.040	0.040	0.042	-	0.060	0.055	0.060
		(24.08)	(8.04)	(8.17)		(16.21)	(11.91)	(12.26)		(17.25)	(8.24)	(7.85)
$(\boldsymbol{NOA/P^{NOA}})\cdot(\boldsymbol{ND/P})$	-	0.017	0.012	0.014	-	0.009	0.012	0.012	-	0.027	-0.002	-0.019
		(10.38)	(1.93)	(2.32)		(3.60)	(3.44)	(2.35)		(4.23)	(-0.19)	(-1.79)
$\boldsymbol{OI/P^{NOA}}$	-	-	0.169	0.155	-	-	0.111	0.104	-	-	0.149	0.134
			(2.92)	(3.03)			(6.07)	(6.00)			(3.26)	(3.09)
$(\boldsymbol{OI/P^{NOA}})\cdot(\boldsymbol{ND/P})$	-	-	0.011	0.028	-	-	0.001	0.003	-	-	-0.042	-0.011
			(0.41)	(0.88)			(0.05)	(0.23)			(-2.10)	(-0.48)
$\boldsymbol{ND/P}$	0.009	-0.014	-0.007	-0.005	0.002	-0.008	-0.010	-0.011	0.010	-0.024	0.010	0.027
	(13.63)	(-7.97)	(-1.10)	(-0.63)	(1.21)	(-2.65)	(-2.61)	(-2.36)	(10.31)	(-3.89)	(0.87)	(2.56)
Adj. R^2	0.044	0.157	0.186	0.199	0.025	0.050	0.071	0.089	0.039	0.089	0.132	0.149

Table shows average coefficients from annual regressions for implied costs of capital (ICC(Composite)) from Hou et al. (2012) on indicators of operating risk ($\beta(u)$, NOA/P^{NOA} and OI/P^{NOA}), the amplifying risk of leverage and financial leverage over the period 1968-2008. Coefficients, adjusted R^2 and t-values are calculated as described in Table 3. Only observations with ICC(Composite) available from Hou et al. are included in the analyses. Observations with implied costs of capital less than 0 % or exceeding 40 % have been excluded. ICC(Composite) is an average of five implied cost of capital estimates – ICC(GSL), ICC(CT), ICC(OJ), ICC(MPEG) and ICC(Gordon) (cf. Hou et al., 2012), being assessed at the end of June each year over the period 1966-2008. All variables are defined in Table 1.

Table 5: Regressions with observations affected by *unexpected positive* or *unexpected negative* changes of the risk-free rate, with operating risk measured as unlevered beta ($\beta(u)$), enterprise book-to-price (NOA/P^{NOA}) and enterprise earnings yield (OI/P^{NOA}).

	Panel A: *Positive* unexpected changes of risk-free rate (35,439 firm-year observations)			**Panel B: *Negative* unexpected changes of risk-free rate (90,612 firm-year observations)**		
Regression	**(i)**	**(ii)**	**(iii)**	**(i)**	**(ii)**	**(iii)**
Intercept	0.116	0.083	0.088	0.098	0.069	0.074
	(2.68)	(2.09)	(2.20)	(5.38)	(3.96)	(4.16)
$\boldsymbol{\beta(u)}$	-	-	-0.026	-	-	-0.015
			(-2.12)			(-2.88)
$\boldsymbol{\beta(u)\cdot(ND/P)}$	-	-	-0.008	-	-	-0.009
			(-0.27)			(-1.25)
$\boldsymbol{NOA/P^{NOA}}$	0.007	-0.010	-0.011	0.046	0.041	0.039
	(0.29)	(-0.49)	(-0.58)	(4.41)	(4.06)	(3.91)
$\boldsymbol{(NOA/P^{NOA})\cdot(ND/P)}$	0.054	0.057	0.074	0.014	0.015	0.025
	(2.15)	(2.18)	(2.52)	(2.42)	(2.52)	(3.55)
$\boldsymbol{OI/P^{NOA}}$	-	0.380	0.398	-	0.251	0.251
		(3.71)	(3.71)		(4.00)	(4.02)
$\boldsymbol{(OI/P^{NOA})\cdot(ND/P)}$	-	-0.065	-0.086	-	-0.056	-0.045
		(-0.62)	(-0.65)		(-1.27)	(-1.41)
$\boldsymbol{ND/P}$	-0.058	-0.051	-0.069	-0.010	-0.004	-0.016
	(-2.34)	(-2.27)	(-2.59)	(-1.39)	(-0.40)	(-1.75)
$\boldsymbol{EARNNEWS}$	0.767	0.733	0.673	0.602	0.611	0.611
	(3.39)	(3.47)	(4.01)	(7.90)	(8.06)	(8.09)
$\boldsymbol{MACRNEWS}$	-0.290	-0.334	-0.057	-1.128	-1.097	-1.115
	(-0.63)	(-0.74)	(-0.41)	(-1.65)	(-1.52)	(-1.39)
Adj. R^2	0.070	0.079	0.085	0.056	0.061	0.065

Panel C: Difference between intercept (γ_0) and leverage coefficient (γ_3):		
(i)	**(ii)**	**(iii)**
($\gamma_0-\gamma_3$) for years with *positive* interest rate changes:		
0.174	0.134	0.157
($\gamma_0-\gamma_3$) for years with *negative* interest rate changes:		
0.108	0.073	0.090
Difference ($\gamma_0-\gamma_3$):		
0.066	0.061	0.068
(3.17)	(2.92)	(3.24)

Table shows average coefficients from annual regressions of observed stock returns on indicators of operating risk ($\beta(u)$, NOA/P^{NOA} and OI/P^{NOA}), the amplifying risk of leverage and financial leverage, with controls for earnings news and macro news over the period 1966-2017. The data set is the same as in Table 1. Coefficients, adjusted R^2 and t-values are calculated as described in Table 3. $EARNNEWS$ and $MACRNEWS$ are defined in Table 3, other variables are defined in Table 1.

Table 6: Regressions for observed stock returns, enterprise book-to-price (NOA/P^{NOA}), enterprise earnings yield (OI/P^{NOA}), operating capacity overhang ($Diff(Sales/NOA)$), operating leverage (OLR), business growth prospects ($(NOA+OI)/NOA$) and industry fixed effects.

	Panel A: Full sample			**Panel B: $NOA/P^{NOA}\geq 1$**			**Panel C: $NOA/P^{NOA}<1$**		
Regression	**(i)**	**(ii)**	**(iii)**	**(i)**	**(ii)**	**(iii)**	**(i)**	**(ii)**	**(iii)**
Intercept	0.110	0.083	0.060	0.101	0.095	0.067	0.108	0.077	0.053
	(5.63)	(4.50)	(3.18)	(4.16)	(4.05)	(2.50)	(4.66)	(3.15)	(2.09)
NOA/P^{NOA}	0.040	0.032	0.029	0.041	0.038	0.036	0.051	0.029	0.029
	(3.29)	(2.64)	(2.26)	(3.86)	(3.61)	(3.27)	(2.21)	(1.34)	(1.28)
$(NOA/P^{NOA})\cdot(ND/P)$	0.023	0.025	0.028	0.040	0.042	0.040	-0.003	-0.010	-0.008
	(3.38)	(3.61)	(4.00)	(4.31)	(4.45)	(4.26)	(-0.21)	(-0.69)	(-0.46)
OI/P^{NOA}	-	0.269	0.236	-	0.071	0.066	-	0.380	0.314
		(4.91)	(4.43)		(1.42)	(1.28)		(5.16)	(4.33)
$(OI/P^{NOA})\cdot(ND/P)$	-	-0.051	-0.058	-	-0.048	-0.074	-	-0.048	-0.023
		(-1.91)	(-1.87)		(-1.36)	(-2.02)		(-1.19)	(-0.56)
$Diff(Sales/NOA)$	-	-	0.002	-	-	0.001	-	-	0.002
			(2.06)			(0.39)			(2.37)
$Diff(Sales/NOA)\cdot(ND/P)$	-	-	0.002	-	-	0.004	-	-	-0.000
			(2.33)			(2.19)			(-0.01)
OLR	-	-	0.011	-	-	0.011	-	-	0.006
			(2.93)			(2.48)			(1.66)
$OLR\cdot(ND/P)$	-	-	-0.003	-	-	-0.000	-	-	-0.003
			(-1.28)			(-0.23)			(-0.60)
$(NOA+OI)/NOA$	-	-	0.016	-	-	0.011	-	-	0.022
			(2.25)			(1.14)			(2.59)
$[(NOA+OI)/NOA]\cdot(ND/P)$	-	-	0.002	-	-	0.006	-	-	-0.007
			(0.40)			(0.72)			(-0.90)
ND/P	-0.021	-0.017	-0.017	-0.042	-0.040	-0.036	0.001	0.016	0.022
	(-2.75)	(-2.12)	(-1.93)	(-3.74)	(-3.55)	(-3.11)	(0.10)	(1.07)	(1.17)
$EARNNEWS$	0.672	0.680	0.682	0.682	0.686	0.693	1.303	1.327	1.422
	(9.93)	(10.01)	(10.12)	(9.73)	(9.60)	(9.90)	(6.36)	(6.07)	(6.51)
$MACRNEWS$	-0.579	-0.551	-0.515	-0.998	-0.906	-0.868	-0.639	-0.597	-0.556
	(-1.45)	(-1.37)	(-1.37)	(-0.95)	(-0.94)	(-0.91)	(-1.48)	(-1.38)	(-1.37)
Adj. R^2	0.088	0.093	0.099	0.102	0.108	0.113	0.084	0.095	0.100

Table shows average coefficients from annual regressions of observed stock returns on indicators of operating risk (NOA/P^{NOA}, OI/P^{NOA}, $Diff(Sales/NOA)$, OLR and $(NOA+OI)/NOA$), the amplifying risk of leverage, financial leverage and industry fixed effects over the period 1966-2017. Coefficients, adjusted R^2 and t-values are calculated as described in Table 3. The data set is the same as in Table 1, but reduced to 126,051 firm-year observations in regression (iii) due to data requirements for additional risk indicators. $Diff(Sales/NOA)$ is the difference between the operating net asset turnover and the average industry value of the ratio, OLR is the relative change in operating income year t divided by the relative change in total sales year t, and $(NOA+OI)/NOA$ is net operating assets at the beginning of the year plus operating income divided by net operating assets at the end of the year. $EARNNEWS$ and $MACRNEWS$ are defined in Table 3, other variables are defined in Table 1.

Table 7: Regressions for observed stock returns, enterprise book-to-price (NOA/P^{NOA}), enterprise earnings yield (OI/P^{NOA}), industry fixed effects and controls for negative leverage (D^{neg}) or extreme positive leverage (D^{xtr}).

	Panel A: Full sample				**Panel B: $NOA/P^{NOA} \geq 1$**				**Panel C: $NOA/P^{NOA} < 1$**			
	(126,877 firm-year observations)				**(31,764 firm-year observations)**				**(95,113 firm-year observations)**			
Regression	**(i)**	**(ii)**	**(iii)**	**(iv)**	**(i)**	**(ii)**	**(iii)**	**(iv)**	**(i)**	**(ii)**	**(iii)**	**(iv)**
Intercept	0.105	0.076	0.110	0.083	0.112	0.104	0.100	0.092	0.094	0.064	0.107	0.076
	(5.19)	(3.90)	(5.60)	(4.47)	(3.87)	(3.59	(4.24)	(4.10)	(3.86)	(2.53)	(4.61)	(3.09)
D^{neg}	-0.002	-0.006	-	-	0.020	0.017			0.009	0.003	-	-
	(-0.28)	(-0.61)			(1.24)	(0.98)			(1.15)	(0.37		
NOA/P^{NOA}	0.044	0.033	0.042	0.034	0.029	0.027	0.041	0.040	0.067	0.036	0.054	0.031
	(2.97)	(2.26)	(3.47)	(2.84)	(1.95)	(1.80)	(3.84)	(3.72)	(2.69)	(1.57)	(2.36)	(1.47)
$(NOA/P^{NOA})\cdot(ND/P)$	0.021	0.025	0.021	0.024	0.049	0.049	0.041	0.042	-0.010	-0.010	-0.005	-0.012
	(3.00)	(3.36)	(3.28)	(3.50)	(3.95)	(3.93)	(4.27)	(4.33)	(-0.62)	(-0.58)	(-0.34)	(-0.79)
$(NOA/P^{NOA})\cdot(ND/P)\cdot D^{neg}$	0.040	0.009	-	-	-0.094	-0.105	-	-	0.172	0.122	-	-
	(1.09)	(0.25)			(-1.80)	(-1.95)			(1.89)	(1.35)		
OI/P^{NOA}	-	0.348	-	0.264	-	0.076	-	0.066	-	0.480	-	0.385
		(4.59)		(4.84)		(1.00)		(1.33)		(5.08)		(5.15)
$(OI/P^{NOA})\cdot(ND/P)$	-	-0.099		-0.048		-0.045		-0.047	-	-0.124	-	-0.047
		(-2.78)		(-1.79)		(-1.08)		(-1.24)		(-2.51)		(-1.13)
$(OI/P^{NOA})\cdot(ND/P)\cdot D^{neg}$	-	0.695	-	-	-	0.120	-	-	-	0.857	-	-
		(3.79)				(0.58)				(4.13)		
ND/P	-0.019	-0.014	-0.024	-0.019	-0.050	-0.047	-0.042	-0.039	0.008	0.020	-0.001	0.015
	(-2.39)	(-1.68)	(-2.91)	(-2.29)	(-3.51)	(-3.13)	(-3.43)	(-3.07)	(0.51)	(1.18)	(-0.05)	(0.96)
$(ND/P)\cdot D^{neg}$	-0.079	-0.106	-	-	0.187	0.180	-	-	-0.113	-0.147	-	-
	(-1.54)	(-1.76)			(1.89)	(1.59)			(-1.81)	(-2.08)		
$(ND/P)\cdot D^{xtr}$	-	-	0.027	0.024	-	-	0.000	-0.008	-	-	0.022	0.016
			(2.45)	(2.23)			(-0.01)	(-0.24)			(1.82)	(1.25)
$EARNNEWS$	0.673	0.682	0.674	0.682	0.684	0.688	0.689	0.693	1.298	1.332	1.300	1.322
	(9.94)	(10.01)	(9.96)	(10.05)	(9.74)	(9.59)	(9.78)	(9.65)	(6.31)	(6.08)	(6.27)	(5.98)
$MACRNEWS$	-0.587	-0.550	-0.574	-0.543	-1.015	-0.914	-1.056	-0.956	-0.612	-0.558	-0.622	-0.581
	(-1.47)	(-1.38)	(-1.48)	(-1.39)	(-0.97)	(-0.97)	(-0.98)	(-0.98)	(-1.48)	(-1.36)	(-1.48)	(-1.37)
Adj. R^2	0.092	0.097	0.091	0.094	0.103	0.110	0.106	0.109	0.087	0.098	0.092	0.096

Table shows average coefficients from annual regressions of observed stock returns on indicators of operating risk ($NOA/P^{NOA}$and OI/P^{NOA}), the amplifying risk of leverage, financial leverage and controls for negative leverage or extreme positive leverage over the period 1966-2017. Coefficients, adjusted R^2 and t-values are calculated as described in Table 3. The data set is the same as in Table 1. D^{neg} is a dummy variable equal to 1 if ND/P is negative, and 0 otherwise. D^{xtr} is a dummy variable equal to 1 for observations of ND/P belonging to the 5% highest values of leverage, and 0 otherwise. $EARNNEWS$ and $MACRNEWS$ are defined in Table 3, other variables are defined in Table 1.

Table 8: Regressions for observed stock returns, enterprise book-to-price (NOA/P^{NOA}), enterprise earnings yield (OI/P^{NOA}), industry fixed effects and control for extreme positive leverage (D^{xtr}), where observations with negative leverage are excluded.

	Panel A: Full sample (89,490 firm-year observations)			Panel B: $NOA/P^{NOA} \geq 1$ (35,394 firm-year observations)			Panel C: $NOA/P^{NOA} < 1$ (64,096 firm-year observations)		
Regression	**(i)**	**(ii)**	**(iii)**	**(i)**	**(ii)**	**(iii)**	**(i)**	**(ii)**	**(iii)**
Intercept	0.102	0.073	0.072	0.132	0.107	0.106	0.087	0.054	0.053
	(4.98)	(3.71)	(3.62)	(4.43)	(3.69)	(3.51)	(3.55)	(2.17)	(2.15)
NOA/P^{NOA}	0.044	0.033	0.033	0.031	0.030	0.029	0.071	0.040	0.042
	(2.76)	(2.15)	(2.26)	(1.64)	(1.56)	(1.46)	(2.74)	(1.65)	(1.77)
$(NOA/P^{NOA})\cdot(ND/P)$	0.019	0.024	0.023	0.043	0.043	0.045	-0.018	-0.020	-0.022
	(2.96)	(3.43)	(3.27)	(3.19)	(3.20)	(3.29)	(-1.22)	(-1.30)	(-1.43)
OI/P^{NOA}	-	0.401	0.400	-	0.225	0.219	-	0.570	0.567
		(5.11)	(4.93)		(2.19)	(1.95)		(6.05)	(6.00)
$(OI/P^{NOA})\cdot(ND/P)$	-	-0.108	-0.105	-	-0.069	-0.059	-	-0.147	-0.142
		(-2.65)	(-2.52)		(-1.26)	(-1.01)		(-3.29)	(-3.19)
ND/P	-0.017	-0.012	-0.011	-0.045	-0.038	-0.040	0.015	0.031	0.030
	(-2.29)	(-1.52)	(-1.28)	(-2.94)	(-2.29)	(-2.04)	(1.06)	(1.97)	(1.82)
$(ND/P)\cdot D^{xtr}$	-	-	-0.001	-	-	-0.003	-	-	0.002
			(-0.19)			(-0.45)			(0.37)
$EARNNEWS$	0.623	0.629	0.630	0.644	0.646	0.646	1.187	1.186	1.196
	(10.02)	(10.24)	(10.23)	(7.63)	(7.41)	(7.46)	(5.91)	(5.74)	(5.71)
$MACRNEWS$	-0.831	-0.808	-0.804	-0.265	-0.281	-0.274	-0.832	-0.749	-0.755
	(-1.30)	(-1.30)	(-1.29)	(-1.00)	(-1.09)	(-1.06)	(-1.13)	(-1.09)	(-1.09)
Adj. R^2	0.095	0.101	0.101	0.121	0.131	0.130	0.086	0.092	0.095

Table shows average coefficients from annual regressions of observed stock returns on indicators of operating risk (NOA/P^{NOA} and OI/P^{NOA}), the amplifying risk of leverage, financial leverage and control for extreme positive leverage over the period 1966-2017. Coefficients, adjusted R^2 and t-values are calculated as described in Table 3. The data set is the same as in Table 1. D^{xtr} is a dummy variable equal to 1 for observations of ND/P belonging to the 5% highest values, and 0 otherwise. $EARNNEWS$ and $MACRNEWS$ are defined in Table 3, other variables are defined in Table 1.

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[1] M&M (1958), p. *271*.

[2] M&M (1958), pp. *268-269*.

[3] The possibility of a decreasing equity return is illustrated in Figure 2 in M&M (1958), p. *275*.

[4] The association between risk factors (asset beta, book-to-market and size) and estimates of *unlevered* equity returns were investigated in Doshi et al. (2019). The approach was motivated by concerns about heteroscedasticity in the relation between stock returns and leverage, causing the association to be non-linear. However, as the association between stock returns and leverage was *postulated* (rather than *estimated*), we have excluded the study in our review. Also, the estimated regressions were based on observed stock returns without news controls. The heteroscedasticity issue raised by Doshi et al. is alleviated in our study by our interaction variable depicting the amplifying risk effect of leverage.

[5] In principle, $(NOA/P^{NOA})_{j,t}$ is the inverse of $Tobin's\ q$, even though the latter is defined with the *replacement cost value* of operating net assets in its numerator. Tobin's q is typically viewed in the economics literature as an indicator of investment incentives.

[6] Alternative interpretations of the book-to-price ratio have been proposed in the literature. In Zhang (2005), the ratio is viewed as an indicator of 'operating cost reversibility'. Firms having low 'operating cost reversibility' are then expected to have high book-to-price ratios.

[7] The independent variables are measured at the end of 1966, 1967, …, 2015 and stock returns are measured over *12* months periods starting in May 1967, 1968, …, 2016.

[8] 'Compustat Daily Updates – Fundamentals Annual'.

[9] In unreported tests, unlevered betas have been calculated as $\left[\beta(e)_t + \beta(netdebt)_t \cdot \overline{(ND/P)}_t\right] / \left[1 + \overline{(ND/P)}_t\right]$, where $\beta(netdebt)_t$ is the beta of net debt (Doshi et al., 2019). Based on estimates in Thorsell (2008), values of $\beta(netdebt)_t$ in the interval [*0.05, 0.20*] have been tested. Compared to our results when $\beta(netdebt)_t = 0$, no material changes in the regression coefficients were observed.

[10] A minimum of *24* consecutive months of data was required in the calculation of equity betas.

[11] Available at http://mba.tuck.dartmouth.edu/pages/faculty/ken.french/data_library.html.

[12] ND should preferably be the *market value* of net debt, but in line with prior research we have not been able to find such data. Also, as shown in Bowman (1980), book and market values of financial debt are typically close substitutes.

[13] Since analysts' forecasts are lacking before the mid-seventies and often unavailable thereafter, requiring IBES earnings forecasts would have reduced our sample size by about *40 %*. Also, Easton and Monahan (2005) found that ICC estimates based on analyst forecasts were unreliable proxies of expected returns.

[14] We are grateful to Kewei Hou, Mathijs van Dijk and Yinglei Zhang for sharing their estimates of implied costs of capital, as reported in their article 'The implied cost of capital: A new approach', *Journal of Accounting and Economics, 53*, 2012.

[15] Hou et al. (2012) estimated prediction models of company earnings in pooled regressions using financial data for ten historic years. Prediction models for *t+1, t+2, t+3, t+4* and *t+5* were used to forecast next year *earnings* and *earnings growth*, forecasts that were used to estimate the value drivers in fundamental valuation models. Implied costs of capital were solved through reverse engineering and a composite cost of capital was calculated as the average for the valuation models in Gebhardt, Lee and Swaminathan (2001), Claus and Thomas (2001), Ohlson and Juettner-Nauroth (2005), Easton (2004), and Gordon and Gordon (1997)

[16] Correlations are weighted averages of cross-sectional yearly correlations, with weights based on the number of observations.

[17] Voulteenaho (2002) and Botosan et al. (2011) also suggested controlling for 'interest rate news'. However, as we apply the Fama-MacBeth approach, such a variable cannot be included in our regressions. We estimate yearly regressions and thus any 'interest rate news' will be captured in the intercepts of our year-by-year regressions.

[18] As a robustness test, we have tested a more elaborated earnings forecast model specified in Hou et al. (2012). However, estimated regression coefficients using this earnings news model were very close to our results for the model we have applied.

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[19] $ROE_{j,t}$ is measured as earnings per share excluding extraordinary items (*EPSPX)* multiplied by the number of common shares outstanding (*CSHO*) and divided by the book value of common equity (*CEQ*) at the end of the previous financial year.

[20] Assume that $\beta(e)_{j,t}$ = *1.2* and the market excess return is *+10.0 %*. With an *expected* market risk premium $\overline{Mprm}$ = *6.0 %,* the expected stock return would be $\bar{r}_{E,j,t}$=c_0+ (*6.0 %)·1.2* = c_0 *+ 7.2%.* However, if the observed market excess return is *+10.0 %,* one would rather predict $\bar{r}_{E,j,t}$= c_0 + *(10.0 %)·1.2* = c_0 *+ 12.0 %.* There is hence an unexpected change of the stock return of *+4.8 %* due to the unexpected outcome of the market return.

[21] Stock returns are winsorized at *-50 %* and *+100 %* to further improve the validity of the regressions in Table 3.

[22] Implied cost of capital estimates from Hou et al. are winsorized annually at the *1st* and *99th* percentiles and observations outside the interval]*0, 40.0 %*] have subsequently been deleted.

[23] The industry classifications are: *0100-0999* (*Agriculture, forestry and fishing*), *1000-1499* (*Mining*), *1500-1799* (*Construction*), *2000-3999* (*Manufacturing*), *4000-4999* (*Transportation, communication, electric, gas and sanitary service*), *5000-5199* (*Wholesale trade*), *5200-5999* (*Retail trade*), *7000-8999* (*Services*), *9100-9729* (*Public administration*), and *9900-9999* (*Nonclassified*). All firms but those in the interval *4000-4999* receive a *0/1* dummy variable.

[24] The Compustat item '*SALE'* is used to measure company sales, *net operating assets* are measured as in Section 5 and industry classifications are specified in footnote 23.

[25] We use *Operating income after depreciation* (Compustat item *'OIADP'*) and *Sales* (Compustat item '*SALE'*) in the calculation of $OLR_{j,t}$.

[26] In other words, if $\frac{\delta(r_{(D)})}{\delta(L)} \cdot L > \bar{r}_{(U)} - \bar{r}_{(D)}$ at high values of L (cf. formula (3) in Section 2).

[27] We do not add a fixed effect D^{xtr} as an intercept effect of 'excessive' leverage neither is part of M&M's capital structure theory, nor has been used in prior research.

[28] In additional robustness tests, we have set D^{xtr}= *1.0* for the *2.5 %* or *10 %* highest values of ND/P. No important deviations from our results in Table 7 were observed in these tests.

[29] Limiting our sample to firm-years observations with positive leverage, the average values of (NOA/P^{NOA})·(ND/P), (OI/P^{NOA})·(ND/P) and ND/P are *2.006, 0149* and *1.602*, respectively, for the partition of non-viable firms, and *0.514*, *0.046* and *0.654*, respectively, for the partition of viable firms.

[30] Including coefficients with t-statistics $|t|$ *<1.50*, composite return effects for non-viable firms and viable firms are *+1,51* % and *+0.32* %, respectively, i.e., both returns are positive but less significant.

[31] Excluding negative leverage, the univariate (Spearman) correlation between NOA/P^{NOA} and (NOA/P^{NOA})·(ND/P) is *0.75* for the partition of viable firms, but only *0.02* for the partition of non-viable firms.

[32] To simplify the notation, the valuation date is t = *0* and firm index is suppressed in Appendix I.