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A Precisely Practical Measure of the Total Cost of Debt for Determining the Optimal Capital Structure and the Weighted Average Cost of Capital

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Abstract

This paper develops a precise method of estimating the cost of debt to a firm that is based on standard financial theories and empirical evidence on default risk and financial distress costs. An analysis with current data on the S&P 500 demonstrates that the capital structures of large firms are consistent with the model's simple implications.

Keywords: Capital Structure, Cost of Capital, Cost of Debt

Introduction

The capital structure of large corporations has been a source of controversy in the financial literature for decades, as the levels of debt leverage observed in corporations tend to be lower than what might be considered optimal given the tax-deductibility of interest expenses to corporate debtors (Elkamhi, Ericsson, and Parsons, 2012). That after-tax advantage of payments by firms to creditors would seem to make debt a cheaper form of financing than equity, whose payouts are made after deducting income tax expenses (Modigliani and Miller, 1963).[1]

Early research attempted to explain why companies don't use more debt to finance their assets, given its seeming relative cheapness to the indebted firms on an after-tax basis, by hypothesizing that investors require relatively higher pretax returns on fixed-rate investments. For instance, Miller (1977) speculated that the pretax cost of debt might be higher than on equity because the debt interest received by creditors can be subjected to higher taxation than the returns to shareholders, whose common equity holdings earn mostly capital gains that are taxed at preferential rates, or not at all if unrealized. In addition, income taxes on stock investments (and therefore the required expected return on equity) are reduced by the option investors have to defer capital gains (and deduct realized capital losses when security prices fall) that are more valuable on common equities, whose prices tend to be more volatile than those on bonds (Murphy, 2001).

However, many debt instruments are held by tax-exempt institutions such as pension funds, or in tax-deferred accounts owned by individual investors, and therefore would not require higher risk-adjusted returns (Murphy, 2000). In addition, empirical studies indicate an integrated market for stocks and bonds with similarly priced risk-return trade-offs on a pretax basis for investors in those securities (Fu, Murphy, and Benzschawel, 2015). Thus, the capital structure puzzle cannot be explained by invoking an assumption that debt investors require a higher pretax risk-adjusted than stockholders do.

More recent research has tended to hypothesize that there are special financial distress costs associated with more debt financing that do not exist for equity capital; in addition, these implicit costs could offset the explicit tax savings to firms arising from the deductibility of interest expenses when computing taxable income (Almeida and Philloppon, 2007). The costs of financial distress are similar to those in bankruptcy, which Bergman and Callen (1995) indicate include decreased access to credit on favorable terms, a reduced financial flexibility with respect to obtaining new financing for investments and other purposes, diversion of management time as well as legal expenses associated with renegotiation of financial obligations, turnover of valuable employees (who may seek opportunities with other firms that have

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a better long-term outlook), and loss of customers (who fear distressed companies will provide poor quality goods and be unable to honor commitments such as product warranties). Since financial distress also results in reduced access to external capital, the loss of key employers, diversion of management time, and decreased sales that cause abnormally low returns to shareholders, those implicit costs of debt financing may considered to be a function of the expected value of bankruptcy costs that increase as the probability of default rises (Avramov, Chordia, Jostova, and Philipov. 2013). Nevertheless, much of the empirical research in this area has found that the estimates of financial distress costs are too small to offset the explicit after-tax cost advantages of debt capital (Elkamhi, Ericsson, and Parsons, 2012).

This paper utilizes a novel method of measuring financial distress costs, which is consistent with existing theory and prior studies to enable more precise empirical estimation of the total cost of debt. Applying this new measure of financial distress costs to the individual firms in the S&P 500, the study discovers empirical evidence that those implied costs do offset the tax-advantages of debt capital at the actual levels of financial leverage existing at those large firms. In particular, the findings imply that the actual capital structures of large corporations generally approximate the optimal ones they should have given all the implicit and explicit costs of each type of financing. The results of this study thus illustrate a justifiably precise method for computing the total costs of debt that need to be incorporated into computations of any company's weighted-average cost of capital and decisions regarding optimal capital structure.

Standard Financial Theory of Optimal Capital Structure and the Cost of Debt

Corporate finance textbooks, such as by Ross, Westerfeld, Jaffe, and Jordan (2016), tend to specify a simple measure of the weighted-average cost of capital that is typically computed as the percent of a firm's assets financed by debt multiplied by its after-tax cost (calculated as the product of the yield to maturity required on a firm's debt and one minus the company's marginal income tax) plus the percent financed by equity times the required return on the stock(s). In the same texts, it is indicated that the costs of financial distress must also be considered when determining the optimal capital structure. However, existing textbooks fail to provide a method or formula for incorporating such costs associated with the increased chance of bankruptcy caused by higher levels of debt financing into capital structure decisions and ignore them in measures of the cost of capital. This research provides a practical solution to this problem that is consistent with both the levels of debt leverage used by large firms and the existing financial theory.

Since the costs of debt financing increase with financial leverage, it is straight-forward to solve the problem of the optimal capital structure by continuing to increase the amount of debt financing up to the point where the extra costs of financial distress associated with more financial leverage equal the tax shield provided by that debt. While the latter benefit of debt is easily calculated by multiplying the marginal business income tax rate by the interest expense of debt financing, the former implicit costs of debt can only be estimated.

Firms theoretically default on their debts when the value of their liabilities exceeds that of their assets, as there is no benefit to shareholders to continue to fund the firm's operations at that point (Merton, 1974). Thus, the cost of financial distress costs to stockholders must at a minimum equal the annual probability of bankruptcy times any positive net present value (NPV) to stockholders lost due to such discontinuation of operations.[2] This NPV may be estimated as the market capitalization of the firm's equity minus its book value listed on the balance sheet, as the latter value represents shareholders' total existing investment, directly made or retained, in the company.

If a company defaults on its debts as soon as the value of its assets falls below that of its obligations, the default losses to the average creditor equal the amount by which the firm's assets decline due to bankruptcy. Creditors charge interest rates on a company's debt to cover not only the time value of money at the prevailing risk-free rate, but also the expected value of default losses on their debts.[3] As a result, there is an annual cost to the company equal to those extra interest expenses that are incurred regardless of whether the firm remains solvent or not. Bankruptcy costs have been estimated to be about 5% of assets on average (Warner, 1977), and thus a firm's creditors should optimally require an extra promised yield equal to the expected value of that cost to investors in the company's debts. This extra interest expense represents an additional annual expense that reduces the after-tax profits available to shareholders each year.

Since companies have the flexibility to change their debt levels at any time,[4] decisions on the optimal capital structure should only reflect the point at which the annual tax benefit from using more debt is offset by the financial distress costs to the firms' owners in the coming year. Any such net benefits (or losses) from a firm financing with debt should be included into the existing NPV of the firm's expected future expected cash flows to shareholders. Decisions on capital structure must therefore weigh the tax benefit of debt against the sum of the extra interest cost and the increased chance of losing all shareholder NPV in bankruptcy. These incremental costs to debt financing can therefore be measured by multiplying the increased chance of bankruptcy resulting from taking on more debt by the sum of (i) 5% of the company's assets (that represents the extra interest paid by the firm for the expected value of default losses to creditors, as previously explained) and (ii) the difference between the market and book value of the equity (that represents the loss to shareholders in bankruptcy).[5]

A Method for Measuring the Total Cost of Debt and Determining the Optimal Capital Structure

As indicated in Section 1, the cost of any debt to shareholders includes both the after-tax cost of the interest payments and the incremental financial distress costs caused by the debt financing. Adding those two components separately bracketed yields

$$\text{Cost of \$1 in Additional Debt} = [R_B(1 - T)] + [d\{E + .05A\}], \quad \text{Eq. (1)}$$

where R_B is the current market yield to maturity on the firm's debt, T is the marginal business income tax rate, d is the change in the probability of the firm defaulting on its debts over the next year as a result of a replacing $1 in equity financing with $1 in new debt, E is the different between the equity market capitalization and book value, and A is the book value of the company's assets. The cost of $1 in new debt in Eq. (1) effectively represents a percentage that can be measured for increases in debt larger than $1 by effectively multiplying $R_B(1 – T)$ by the size of the new debt issue and using d as the increase in the chance of default arising from that potential use of the higher level of financial leverage.[6]

Complex analysis might be required to estimate d. However, Altman (1968) has shown that a few ratios, such as times interest earned ratio (TIE) computed as earnings before interest and taxes (EBIT) divided by interest (I), are effective in forecasting the default on its debts, at least over the next year. A firm's TIE is especially important in impacting the chance of default because that ratio measures how much operating income exists to pay a dollar worth of interest and therefore indicates the cushion a company has against a deterioration of its operations that would inhibit its capacity to make contractual debt payments. To estimate a company's credit rating, Murphy (2000) has therefore suggested using the average of the three prior years' TIEs and then evaluating the relative volatility of those TIEs in order to adjust for the level of the company's operating risk that requires higher TIEs to have the same credit rating as firms with less operating volatility.

An optimal evaluation of credit quality might employ human judgment, which might incorporate complex mathematical models such as that used by Callaghan and Murphy (1998), who employed numerous accounting relationships relating to the capacity of firms to pay their debts and a rough empirical proxy for the firm's financial outlook in a set of equations, and who found that methodology to be empirically consistent with actual observed yield spreads existing in the market for debt investments. However, Eq. (1) only requires a measure of the change in the probability of default d resulting from adjusting the level of financial leverage, and thus a simpler, mechanical procedure may be employed to solve that equation.

In particular, a company's existing computed TIE can be normalized to the reported cross-sectional average for each credit rating granted to companies by an agency such as Standard & Poors and then determining the percentage drop in the TIE that would cause a change in a credit rating. That rating change is then matched with the reported cross-sectional average past default rate for firms with the two different ratings reported by the agency. It is then possible to measure d as the difference between the reported average probability of default D_{New} at the new credit rating and the reported average probability of default D_{Old} at the firm's existing credit rating.

Armed with an estimate of $d = D_{New} – D_{Old}$, it is possible to determine the optimal capital structure as being the one that minimizes the total weighted-average cost of capital. In particular, a firm would optimally increase its debt financing up to the point where Eq. (1) indicates that higher levels of financial leverage impose financial distress costs that exceed the benefits created by the reduced income taxation associated with financing the company with less equity capital. Once that decision is made on the optimal capital structure that maximizes shareholder value, Eq. (1) can be utilized to measure the after-tax cost of debt for inclusion in the standard formula for the weighted-average cost of all capital.

A Simple Illustration of Applying the Model

Assume a company with A = \$130 (so that .05A = 6.5), E = \$90.7, EBIT = 16.1, I = 1.00, R_B = 6%, and T = 21% (with all dollar amounts potentially representing thousands, millions, or billions). Then,

TIE = 16.1/1.00 = 16.1,

Therefore, implying from past S&P data,[7] a AAA rating that indicates the probability of default to be

D = 0.10%..

An increase in the portion of the firm's existing assets financed by debt that would cause the firm's credit rating to fall to the next lowest credit rating letter (AA) would entail issuing new debt to make

TIE = 16.1/1.45 = 11.1

for a AA firm, where (1.45 – 1.00)/0.06 = 7.5 in new debt at can be issued at the current R_B = 6% to replace existing equity financing (such as through issuing new bonds to buy back stock at market prices).

Because the firm's new credit rating of AA would imply

D = 0.15%,

Eq. (1) indicates

Cost of Additional Debt = [.06(1 – .21)] + [(0.0015 – 0.0010)(\$90.7 + \$6.5)]

= .0474 + .0486 = 9.60%.

This 9.60% would be the proper figure to include in a weighted-average cost of capital equation if the capital structure were changed to add more debt.

To determine whether a change in the capital structure is optimal, it is possible to compare the benefits of additional debt (i.e., the tax shield) to the cost of increasing the expected value of financial distress. In particular, in the company example provided in this illustrative section, it can be deduced that more debt would impose more financial distress costs than are supplied by the tax savings provided by the additional interest expense. In particular, the benefit to the firm of \$1 more in interest expense deductions [T = .06×.21] = 0.0126 is less than the resulting increase in incremental financial distress costs [(0.0015 – 0.0010)(\$90.7 + \$6.5)] = 0.0486, which indicates a net decline in firm NPV as a result of increasing financial leverage

$.0126 < .0486$.

Thus, an increase in financial leverage is ill-advised in this illustration, as each \$1 of debt financing (instead of equity capital) would thereby reduce shareholder value by .0486 – .0126 = \$0.0360. Taking on more debt would therefore cause a percentage decrease in the value of the firm's stock by \$0.0360/\$90.7 = 0.03%.

The company would then optimally iterate to determine if lower levels of financial leverage would result in lower financial distress costs exceeding the higher tax expenses resulting from reduced debt interest payments. However, since it is not possible for the model to measure any positive effects from reducing leverage for companies that are already at the highest AAA rating, it can be assumed that the current debt load is optimal.

If reducing financial leverage also did not decrease the cost of debt, the existing capital structure can be deduced to be optimal. As such, the marginal tax benefits are implicitly equal the financial distress cost caused by the debt, and thus the after-tax total cost of debt would be equal the existing interest rate of 6%. This total net cost of 6.00% for debt financing at the current leverage level (that adjusts for the tax benefit and the financial distress costs associated with debt at the current leverage level) is substantially higher than that computed by the standard textbook equation of $R_B(1 - T)$, which equals $(1 - .21) \times 6\% = 4.74\%$ in this example. The model thus indicates a rather serious adjustment is needed in the standard textbook hurdle rate, or discount rate utilized in NPV computations, to make capital budgeting decisions

Empirical Testing of the Model on the S&P 500

The validity of the model in explaining corporate financial policies is tested with empirical data on the companies of the S&P 500 in 2016. Financial statement and market price information is collected from the Bloomberg Professional Service on all those firms for that year. Numerous companies had to be eliminated because they had no interest expenses over that or the prior 2 years and therefore mathematically undefined average TIEs needed for estimating d. The data on each of the remaining 431 corporations are plugged into Eq. (1) to compute the annual difference between the tax benefit of interest expense deductiblity resulting from taking on additional debt and the incremental financial distress costs indicated by the model for each company. The resulting positive (negative) numbers indicate that additional (less) debt financing may be optimal.

The cross-sectional averages, medians, standard deviations, and ranges of the percentage changes in equity capitalization that would occur from increasing financial leverage at each firm are provided in Table 1. This table indicates that the aggregate sample of firms would not benefit from the use of more debt funding, with the average corporation losing 0.07% of shareholders' equity by increasing their financial leverage.[8] The median value is –0.23%, with the ranges indicating 77.96% of the 431 firms in the sample optimally not increasing their debt levels. However, there are 95 of those companies that are computed to benefit from using more debt to finance their assets with equity, with a 9.52% increase in the equity market capitalization of the sample firm that would gain the most from raising the portion of debt in its capital structure.[9]

Deviations from the optimal capital structure computed by Eq. (1) could be explained by numerous factors. For instance, higher cash resources at a firm reduce the chance of bankruptcy (Murphy and Callaghan, 1998). As a result, Gryglewicz (2011) has explained that larger amounts of short-term bank deposits and marketable securities might be indicative of a company with greater earnings capacity that generates relatively larger shareholder value, which the corporation hoarding the cash assets seeks to protect from loss due to bankruptcy as a result of future adverse cash flow shocks that could induce default on the company's financial obligations. That researcher showed that such a firm would optimally have lower levels of financial leverage than otherwise to decrease the resulting risk of losing that extra value to shareholders.

Some firms may also optimally maintain some financial flexibility to have access to more cash from other sources. In particular, the existence of larger credit lines enables more borrowings to finance short-term liquidity needs in case of cash flow shocks (Acharya, Almeida, Ippolitr, and Perez, 2014). Lower levels of financial leverage and higher credit ratings may also enhance a firm's capacity to take on more debt to access cash when needed. As a result, to evaluate deviations from the model in Eq. (1), a regression is run on four independent variables that incorporate for all these liquidity factors, with the dependent variable specified as the empirically measured $R_B T\text{-}(d[E + .05A] /E)$. The four regressors are defined to be Cash/Assets (where Cash here includes short-term marketable securities and certificates of deposit), Credit Lines/Assets, Liabilities/Assets, and a numeric indicator for the S&P rating (that assigns a 1 for AAA and adds 1 for each signed decline in the rating below that level).

The results of the regression are shown in Table 1, which indicate that only Cash/Assets has a significant impact at the .05 level of confidence.[10] The negative sign of the parameter estimate for this single independent variable, which has a coefficient that is statistically significant from zero, implies that firms with the most cash might have an optimally lower level of debt financing than implied by Eq. (1) when including cash into total assets A. These results indicate that, for the minority of firms for which the application of Eq. (1) here implies is deviating from their optimal capital structures, the optimal level of debt financing is being used after adjustment for the benefits associated with liabilities being utilized to finance greater short-term liquidity.

However, since only the Cash/Assets variable significantly affects deviations from Eq. (1) given the input of all assets into Eq. (1), it is possible that the negative parameter coefficient estimate for that variable in the regression results from overestimating the loss on those assets arising from bankruptcy at 5% of total assets Eq. (1). In particular, cash assets may not suffer a 5% loss due to bankruptcy, especially since more cash increases the flexibility a bankrupt firm has to avoid losses on its other assets in creditor-forced fire sales (Murphy, 2018). As a result, it might be optimal to reset A in Eq. (1) to equal only non-cash assets.[11] By doing so, it is not necessary to explicitly invoke Gryglewicz's (2011) theory for determining the optimal capital structure because the incentive of the company owner(s) to protect the value of profit growth from bankruptcy is subsumed in the measure of financial distress costs used in Eq. (1) through the dE term.[12]

Thus, the model developed here appears to represent a theoretically and empirically valid method for estimating the cost of debt that is practically easy to implement and that should optimally be used in capital structure and capital budgeting decisions.[13] To utilize it to estimate the weighted-average cost of capital, it is only necessary to measure the cost of equity that itself can be practically estimated using a theoretically and empirically validated equation shown in the Appendix.

Conclusion

This paper develops a simple, theoretically valid method for measuring the cost of debt and hence the correct cost of capital to firms that should optimally be used by companies to compute their hurdle or discount rates in capital budgeting processes. The model, which enables determining the cost of capital strictly from market and financial statement data, is discovered here to be consistent with the observed capital structures of large corporations.

Appendix: Estimating the Cost of Equity

The cost of equity in the computation for the cost of capital can be most easily measured using existing theory-based models that are practically implementable, widely used, and empirically validated, such as the Capital Asset Pricing Model (CAPM) developed by Sharpe (1964).[14] In this model, the cost of equity is computed by a risk-free rate R_f (that can be measured by the yield to maturity on long-term government Treasury bonds) that is added to the product of a premium return on the market portfolio of all assets and the beta of the company's stock. The beta for an equity investment project can be readily measured as the regression coefficient estimate from regressing the past return on a stock (or investment with a similar beta to that of a project's systematic risk) in excess of past Treasury yields on the excess or premium return on the market portfolio.

The market portfolio is often proxied in practice by a US stock market index, thereby resulting in the weighted-average beta for stocks in the index equaling one. The required risk premium on such a diversified equity portfolio is widely estimated to be 5% based on long-term past equity returns (Murphy, 2000). However, that equity premium can be more accurately estimated at any time using empirically validated theories. For instance, a formula for estimating the premium expected return on the market portfolio that has been empirically validated by Murphy and Sahu (2001) is

$$R_M = 1/p/e + \text{expected inflation} - R_f, \quad (2)$$

where R_M is the equity premium, and p/e is the price/earnings ratio (based on the highest past earnings level of the equities in that index) of some index of stocks such as the S&P 500. The expected inflation rate can be estimated as R_f minus the existing real interest rate Y_F promised on long-term Treasury Inflation Protected Securities (TIPS).

For example, if p/e = 24, R_f = .0281, and Y_f = .0087, then

$$R_M = 1/24 + (.0281 - .0087) - .0281 = .0330, \text{ or } 3.30\%$$

per year. The average stock with a beta of 1.0 would therefore have a required return equal to 2.81%+(1.0x3.30%) = 6.11%. This cost of equity would then be included in the standard weighted average cost of capital computations (for the average firm or project) along with the total after-tax cost of debt as indicated in the main text through the use of Eq. (1).

Footnotes

[1] Increasing the percentage of a firm's assets financed by liabilities also reduces the amount of expensive equity financing, upon which investors require higher returns

due to stock claims on company income being more risky (Black and Scholes, 1973). However, the rise in the cost of both debt and equity caused by increasing financial leverage exactly offsets the advantage associated with replacing equity financing with debt (Modigliani and Miller, 1958).

[2] Since corporate managers have inside information that may result in a different estimate of NPV to shareholders (Dong, D. Hirshleifer, and S. Teoh, 2012), they may optimally use their more informed NPV here, as may be especially necessary for closely held firms and other companies whose equity rarely if ever trades in a liquid market.

[3] The interest rate charged by creditors also includes a systematic risk premium to compensate creditors for such chances of loss (Fu, Murphy, and Benzschawel, 2015). The portion of interest rates represented by this systematic risk premium that provides an additional expected return on debt above the sum of the risk-free rate and the compensation to creditors for expected default losses to creditors is an additional cost to shareholders. However, that pretax cost of debt exactly equals the higher aggregate expected cash flows that would be needed on the company equity if shareholders had to bear the full burden of the systematic risk of the firm. Since the value of these particular costs and benefits associated with switching payouts for systematic risk from equity to debt investors is exactly (Modigliani and Miller, 1958), they do not represent an incremental cost of financial distress to shareholders. On the other hand, the tax deductibility of all of the interest paid to creditors provides a benefit to a firm's owners after corporate income taxes due to the tax shield thereby provided, and it is therefore included in standard cost of capital computations (Modigliani and Miller, 1963).

[4] For instance, solvent firms can always buy back bonds or stock at market prices and then issue more of the other type of capital to adjust the financing mix to the optimal one. Call options embedded into debt contracts (Murphy, 1988), including ones with make-whole and clawback features (Daniels, Ejara, and. Vijayakumar, 2009), can facilitate such recapitalizations.

[5] According to standard option pricing theory (Black and Scholes, 1973), shareholders actually benefit from increasing the riskiness of the firm through raising the portion of a firm's assets financed by debt that thereby increases the call option value of equity, but this positive impact is exactly offset by the higher yield required by debtholders to compensate them for the reduced value of their claim on the company's assets that results. These benefits and pretax costs to the firm do not therefore represent an issue with respect to measuring financial distress costs.

[6] The interest rate R_B in Eq. (1) does not need to explicitly incorporate the increase in the interest rates charged on new debt caused by rising financial leverage because that extra promised yield is fully offset by the resulting higher expected value of losses in default for the creditors. In particular, the increased assumption of the firm's priced risk by debtholders as a result of rising financial leverage doesn't represent an incremental change in the weighted-average cost of capital and the optimal financial leverage.

[7] The relationships between Moody's credit rating, D, and TIE are obtained from the estimates made by Murphy (2000) from past data available from Standard & Poors. Although not employed in this simple example, interpolation can be utilized to compute finer measures of financial distress costs with lower increases financial leverage by the nearest lower signed grade associated with each rating letter, and then interpolating between rating letters as is done in the empirical section of this paper. Although use of that alternative procedure, along with employment of the most recent data and longest possible history of these relationships, might be more accurate, casual observation does not indicate much effect across the last few decades.

[8] The slight deviations from the model measures of the optimal capital structure may relate to different estimates of the bankruptcy value of assets across corporations. For instance, inventory has been found to be subject to lower losses when a firm defaults on its debts compared to property, plant & equipment and intangible assets (Murphy and Callaghan, 1998). The use of linear interpolation of the value of variables between the discreet signed credit ratings may also contribute to estimation error.

[9] One cause of this and other deviations from the model's predictions may relate to temporary deviations from their optimal capital structure that are designed to minimize new issue costs. In particular, the expenses of selling a new security issue tend to be larger when issuing new

shares of stock than when borrowing from lenders and can therefore result in companies optimally issuing more debt when there is a short-term need for external capital due to insufficient retained earnings to operations (Myers, 1984). Firms may therefore maintain an extra equity buffer to allow for such possible temporary deviations from the optimal capital structure that would exist without such frictions relating to new issues. That buffer might be optimized at the point where the cost of issuing new stock or bonds equals the net total cost of maintaining such a suboptimal capital structure, just as might a decision to temporarily increase financial leverage suboptimally in order to avoid the typically higher issue cost for selling new stock. Since new issue costs would have to be incorporated either as an expense in a capital budgeting project or included as an increase in the measured cost of funds regardless, they might optimally be minimized with longer-term maturities for firms forecasting insufficient funds from internally generated equity funding in the form of retained earnings.

[10] A preliminary examination of data going back to 2001 indicates that there may be some variation in the regression model results. In addition, the change in the corporate income tax rate to 21% at the end of 2017 will affect the optimal capital structure indicated by the model that can be compared with actual future corporate capital structures. Further research is merited to investigate these phenomena.

[11] In particular, the parameter estimate of 0.28 for Cash/Assets in the regression may actually approximate the impact of including 5% of cash assets into A in Eq. (1). Use of only non-cash assets in A may not be theoretically justified since cash assets may either decrease d or lower financial distress costs.

[12] The empirical results found here also indicate that it is not necessary to invoke the agency theory that firm managers have incentives reduce the risk of bankruptcy that might cause deviations from the optimal capital structure and cash holdings (Mu, Wang, and Yang, 2017). In particular, the extensive compensation of firm managers with stock options may provide them with optimal motivation to take the optimal amount of risk to maximize the value to stockholders, and this incentive system apparently succeeds in avoiding the agency issue relating to inefficient contracting between owners and managers.

[13] It might be especially important to employ the adjustment of using only the non-cash assets for A in Eq. (1) with respect to interest-free loans such as are effectively available on much of the trade credit and accruals generated in the course of business activities. Equation (1) would then invariably indicate the optimality of accepting such free funding sources that can be employed to finance a larger cash cushion that thereby reduces d.

[14] Empirical research finding the CAPM is consistent with actual risk-return trade-offs on security investments include studies by Murphy (1990), Kim (1997), Jostov and Philopov (2005), and Fu, Murphy, and Benzschawel (2015).

Table 1:

Relationship between Liquidity Variables and Changes in Equity Values from Using More Debt[a]

Independent Variables

(1) (2) (3) (4) (5) (6)

Numeric

Dependent Variable Intercept *Cash*[b] *Credit Lines*[b] *Liabilities*[b] *Credit Rating*[c]

Characteristics of Model Estimate of Stock Price Change Estimated from Using More Debt

Mean = –0.07%

Median = –0.23%

High = 9.52%

Low = –1.44%

#% > 0 = 22.04%

Regression Results:

Coefficient Estimate	–0.06	–0.28*	–0.32	–0.19	0.33
(t statistic)	(0.25)	(–4.48)	(–1.29)	(–0.76)	(1.94)

R^2 = 0.06

*Statistically significant from 0 at the .95 level of confidence

[a]For the S&P 500 companies in 2016, with the dependent variable being the model estimate of the percentage change in equity market capitalization resulting from using more financial leverage.

[b]Repoted accounting number in the financial statements divided by Assets

[c]Computed by adding one to each numeric rating below AAA

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