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The Impact of Financial Leverage on the Cost of Equity

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ABSTRACT

Using a sample of industrial companies traded on the NYSE, this study examines the effect of financial leverage (L) on the cost of equity (K_E). The goal is to test the theoretical relationship between K_E and L under various types of market imperfections such as taxes and bankruptcy costs, and compare theoretical models incorporating each market imperfection with actual values. All of the empirical results in each model tested point to a positive relationship between K_E and L regardless of the measures used for the key variables. Specifically, we establish four main findings: (1) The relationship between K_E and L is positive, (2) R-squared is substantially higher in the risky debt models than in the risk free debt models, (3) The market measures of L tend to generate a higher R-squared than the book measures of L, and (4) The model that is the most accurate representation of the relationship between the K_E and L incorporates a measure of risky debt. Thus, the findings suggest that risky debt should be employed in the estimation of K_E, otherwise K_E and the resulting weighted average cost of capital may be biased, leading to incorrect capital budgeting decisions

Keywords: Cost of Equity, Financial Leverage, Market Imperfections, Risky Debt
JEL Classifications: G32, G33

1. INTRODUCTION

This paper tests the theoretical relationship between the cost of equity (K_E), and leverage (L) empirically. An initial version of the theoretical relationship between K_E and L was formulated by Modigliani and Miller (MM, 1958) and was later extended to include additional market imperfections such as personal taxes and bankruptcy costs as well as risky debt. Previous studies have examined the relationship between K_E and L empirically, but they did not test the theoretical relationship *directly* (See for example Dhaliwal et al. 2006). In addition, the theoretical relationship between K_E and L in the presence of risky debt, taxes and bankruptcy costs has not yet been tested directly, nor has the theoretical effect of these variables been compared with their actual counterparts. In this respect, we extend the literature in at least two ways. First, we test the theoretical relationship between K_E and L proposed in the literature directly. Second, we test the degree to which the empirical findings correspond to their theoretical counterparts. Our findings may help corporate managers and financial analysts estimate K_E when market imperfections are present.

Previous studies have examined how corporate and personal taxes affect a firm's value and K_E empirically but ignored the possibility of debt default. For example, Mackie-Mason (1990), Dhaliwal et al. (1992), and Graham (1999) investigate the effect of corporate and personal taxes on a firm's financial leverage and incremental financing decisions. These studies assume that taxes drive the managers' decisions about capital structure, but they do not provide evidence that the tax implications of debt are reflected in the K_E. Another body of studies focuses on the impact of dividend taxation on the K_E using ex-post realized returns in the case of Dhaliwal et al. (2003) or event studies around changes in the statutory tax rates in the cases of Ayers et al. (2002) and Lang and Shackelford (2000). Dhaliwal et al's. (2006) study does provide such evidence when they test the K_E expression as a function of leverage and taxes empirically. They predict that the K_E increases when the firm engages in leveraging and that corporate taxes mitigate this leverage-related risk premium, while the personal tax disadvantage of debt increases this premium. Using estimates for the ex-ante K_E implied by accounting-based valuation models, they generally find evidence consistent with the prediction that corporate tax benefits reduce the leverage-related risk premium demanded by equity investors. However, they point out that the results are sensitive to the leverage estimates used. To address this issue, in this paper we will conduct robustness tests using eight L estimates based on long-term debt versus total debt, book measures versus market measures, and two computation methods. Note, too, that none of the existing studies includes a comparison between risky debt and risk free debt models in the context of the K_E–L relationship. Therefore, we test this relationship (with the presence of corporate and personal taxes) with and without risky debt. Specifically, we test the K_E–L theoretical relationship (formulated by Yagil, 1982) to determine which model corresponds better with the impact of leverage on K_E-risky debt models or risk free debt models. To mitigate the possible bias of measurement errors and for robustness purposes, we test the K_E–L relationship using several estimates of financial leverage and other key variables such as taxes and bankruptcy costs. Doing so creates an empirical foundation for understanding the impact of managers' decisions about the capital structure on the K_E. Our empirical tests are divided into two parts. First we determine whether the K_E–L relationship is positive as theory suggests. Then, we test whether the ordinary least squares (OLS) regression coefficients are consistent with the theoretical counterparts for both risky debt and risk free debt models.

The empirical results generally support the theoretical predictions. First, consistent with the extant literature, the K_E is positively associated with financial leverage. All of our tests underscore the positive relationship in both the risk free debt and risky debt models tested. Second, as the results of the risk free debt models imply, the cost of capital decreases with leverage, suggesting that equity holders are compensated with the tax shield created, and the personal taxes associated with debt increase the cost of capital. These results are consistent with Miller's (1977) study, which argues that individual investors demand a higher return on debt to compensate for the personal tax on interest income. Still, it is worth noting that the results point to a net tax benefit for debt compared to the case of a perfect capital market. Third, the risky debt expressions are a better reflection of the relationship between the K_E and financial leverage than the risk free debt expressions. Most of the results indicate that the regression parameters are more accurate in risky debt models rather than risk free debt assumptions. The R-squared value also supports this point. To summarize, the paper contributes to the recent literature by taking into consideration market imperfections and their impact on the K_E in risk free debt and risky debt models.

The remainder of the paper is organized as follows. Section 2 discusses the scientific background. Section 3 presents the theory and the research hypotheses. Section 4 describes the research sample, data and methods for measuring the variables. Section 5 discusses the results and the robustness tests, while Section 6 summarizes and concludes.

2. SCIENTIFIC BACKGROUND

The empirical literature on the relationship between leverage and K_E is extensive, but inconclusive. While some studies show a positive relationship between K_E and L, others conclude that returns are either insensitive or decline with leverage. Fama and French (1992) and George and Hwang (2007) determine that equity returns are insensitive or even decline with book leverage, but Nielsen (2006) and Penman et al. (2007) find that after controlling for size and book-to-market factors, equity returns are insensitive or fall with market leverage. A large number of studies tested different definitions of expected returns to determine whether there is any empirical relationship. For example, Arditti (1967) finds a negative but statistically insignificant association between leverage and expected equity returns. Using inflation adjusted stock returns for a cross section of all firms including financials without assuming different risk classes, Bhandari (1988) shows that the expected returns increase with leverage. Lang and Shackelford (2000) find evidence of positive abnormal returns when the 1997 Tax Act reduced the tax rate on capital gains from 28% to 20%. Furthermore, they demonstrate that the abnormal returns during the week the 1997 Tax Act became effective decline with leverage. These results suggest that the K_E declines when tax rates on equity income drop, but this effect is smaller for highly leveraged firms. Korteweg (2010) establishes a negative association between stock returns and leverage based purely on changes in the capital structure such as exchange offers. By studying changes in leverage and showing that they are negatively related to current and future returns, Dimitrov and Jain (2008) demonstrate a negative relationship between leveraging and stock returns. Dhaliwal et al. (2006) examine the associations among leverage, corporate and investor level taxes, and the firm's implied K_E. Their results suggest that the equity risk premium associated with leverage declines with the corporate tax benefits from debt. They find some evidence that the equity risk premium from leverage increases with the personal tax penalty associated with debt. Dhaliwal et al. (2007) demonstrate that the implied K_E decreased after the 2003 Tax Act reduced the tax rate on dividends from 38.6% to 15% and the tax rate on capital gains from 20% to 15%. George and Hwang (2007) find a negative relationship between returns and leverage. They also argue that firms that are affected more adversely by financial distress engage in lower leverage. Penman et al. (2007) investigate the book-to-price effect in expected stock returns and its relation to leverage, demonstrating that the leverage component is negatively related to ex-ante stock returns. Gomes and Schmid (2010) and Obreja (2013) explore returns using dynamic models in which capital structure and investment decisions interact, thus violating the assumption of MM about the separation between financing and investment decisions. Obreja's (2013) model studies the interaction between book-to-market and leverage. After calibration, the model is able to generate samples that replicate the empirical evidence provided by Bhandari (1988) and Fama and French (1992). George and Hwang (2010) argue that leverage may be negatively correlated with future returns because highly leveraged firms are less exposed to systematic distress risk. This could be true because firms facing high distress costs endogenously choose low financial leverage.

To summarize, prior empirical studies have examined the relationship between leverage and expected equity returns.

However, a key factor missing in these studies is risky debt, which can be associated with bankruptcy costs. Despite the extensive empirical literature, there is no study that examines the effect of risky debt associated with bankruptcy costs on returns in a direct manner provided here. Furthermore, there are no studies comparing risky debt results with corresponding situations that assume risk free debt. Thus, we test the K_E−L relationship for the case of risky debt and bankruptcy costs as well as when market imperfections such as corporate and personal taxes exist.

3. THEORY AND HYPOTHESES

Following MM, Yagil (1982) derived the general theoretical expression that links the K_E to the corporate and personal tax rates, assuming risky debt associated with bankruptcy costs. Eq. (1) expresses this relationship:

$$K_E = K_U+[K_U(1-\Psi]-R(1-T_C)(1-T_E)]L, \quad (1)$$

Where K_E is the K_E, K_U is the return required by equity holders for the unleveraged firm, Ψ is (1−q−T), which is the factor that includes the bankruptcy factor (q) as a percentage of the firm's debt, the tax ratio (T) given by $(1-T_C)(1-T_E)/(1-T_D)$, T_C is the corporate tax rate, T_E is the tax rate applicable to equity holders and T_D is the tax rate for debt holders, R is the cost of risky debt, and L is the financial leverage ratio of debt to equity (D/E) where D and E are the values of the debt and equity, respectively.

In the absence of taxes and risk free debt, Ψ=0 and Equation (1) reduces down to:

$$K_E=K_U+[(K_U-r)L] \quad (2)$$

Which is equivalent to MM Proposition II for the K_E in the absence of taxes. Eq. (2) states that K_E is equal to the K_E for the unleveraged firm plus a premium expressed as the product of the leverage ratio (L) and the spread between K_U and the cost of debt, which in this case, is simply the risk free rate of interest. If corporate taxes are the only market imperfection and debt is risk free, Ψ reduces down to T_C, and Equation (2) becomes:

$$K_E=K_U+(1-T_C)(K_U-r)L \quad (3)$$

This equation is equivalent to MM'S tax case expression. Eq. (3) indicates that the risk premium is lower than its value in Equation (2), due to the tax deductibility of debt financing.

If personal taxes are a factor in addition to corporate taxes, and debt is still risk free, then q=0, and Ψ is simply (1−T). Thus, Equation (1) will be reformulated as Equation (4):

$$K_E=K_U+T[K_U-r(1-T_D)]L \quad (4)$$

In theory, as the tax rate on interest income increases relative to the tax rate on equity income, bondholders demand higher relative pretax returns to leave them equally well off on an after-tax basis. The resulting higher interest cost reduces the tax benefits of debt accruing to equity holders. As a result, the equity risk premium from leverage should increase in the personal tax penalty on interest income and decrease from the effect of the corporate tax shield.

Equations. (2-4) describe the return that equity holders require when relaxing the assumption of risk free debt. If debt is considered risky and corporate and personal taxes exist, then Ψ simply equals (−q), and Equation (1) is reformulated by Equation (5):

$$K_E=K_U+[K_U(1+q)-R]L \quad (5)$$

If personal taxes do not exist, then $\Psi=[1-(1-T_C)-q]$, which is simply (T_C−q), and Equation (1) will be phrased as Equation (6):

$$K_E=K_U+[K_U(1-T_C+q)-R(1-T_C)]L \quad (6)$$

It is worth noting that Equation (5) and Equation (6) differ from their corresponding risk free formulations only in the addition of the bankruptcy costs factor (q) in the coefficient of the financial leverage ratio of the firm. Since the value of q is surely a positive term, it indicates the extra penalty in the K_E as the risk of default increases. Note too that if only debt is considered risky, and there are no taxes or bankruptcy costs, then Equation (1) is simply the following Equation (7):

$$K_E=K_U+[K_U-R]L \quad (7)$$

According to Equation (7), K_E is the K_E which is the required return by equity holders for the unleveraged firm plus a premium related to the product of the financial leverage ratio (L) and the spread between the return required for the unleveraged firm (K_U) and the cost of the risky debt (R).

To summarize, we present seven different formulations to describe the relationship between the K_E and financial leverage. Equations 2-4 deal with the risk free debt models. Equation (2) describes the perfect capital market case, Equation (3) assumes corporate taxes only, and Equation (4) takes into account both corporate and personal taxes. Similarly, for the risky debt models, Equation (1) is the formulation for the K_E when corporate and personal tax rates exist, and debt is risky and associated with bankruptcy costs. Equation (5) deals with the situation where only corporate taxes exist. Equation (6) considers both corporate and personal taxes. Finally, Equation (7) describes the perfect capital market case but debt is risky.

We test the relationship between K_E and L using these regression models. The first three models represent the case of risk free debt, which we call henceforth "Case A." The other four models represent the case of risky debt, which we call henceforth "Case B." Model (1) (both equations 1a and 1b below) is for the case of perfect capital markets. Model (2) (both 2a and 2b) is for the case where corporate taxes are the only type of market imperfection. Model (3) (both 3a and 3b) is for the case of both corporate and personal taxes. Model (4b) incorporates bankruptcy costs as well. The equations governing these models appear below:

Case A: Risk free debt models:

$$K_E=K_U+[(K_U-r)L] \quad (1a)$$

$$K_E=K_U+[(K_U-r)(1-T_C)L] \quad (2a)$$

$$K_E=K_U+T[K_U-r(1-T_D)]L \quad (3a)$$

Case B: Risky debt models:

$$K_E=K_U+[(K_U-R)L] \quad (1b)$$

$$K_E=K_U+[(K_U-R)(1-T_C)L] \quad (2b)$$

$$K_E=K_U+T[K_U-R(1-T_D)]L \quad (3b)$$

$$K_E=K_U+[K_U(1-\Psi)-R(1-T_C)(1-T_E)]L \quad (4b)$$

Starting with the first model, the direct estimation of Equation (1a) where market frictions do not exist and debt is risk free is as follows:

$$K_E=\gamma_0+\gamma_1[L] \quad (11)$$

In this case, the dependent variable is the K_E, which we estimate using the familiar capital asset pricing model (CAPM), and the term in the squared brackets is the independent variable, which is simply the financial leverage of the firm.

The null hypothesis from regressing L directly versus K_E is that the intercept of this equation model γ_0 represents K_U. If γ_0 truly represents K_U, the observed γ_0 parameter will not differ statistically from $(K_E+rL)/(1+L)$, which is the K_U derived by unlevering Equation (1a). Similarly, if Equation (1a) holds true, γ_1 should be equal to the value of (K_U-r). To test whether γ_0 and γ_1 correspond to their theoretical counterparts, we use the mean value of K_U derived for each firm, the risk free rate (r) and the financial leverage (L).

Accordingly, if corporate tax is the only market friction, then the direct estimation model is:

$$K_E=\gamma_0+\gamma_1[(1-T_C)L] \quad (12)$$

The term in the squared brackets is the explanatory variable used, and K_E is again the dependent variable. According to this specification, γ_0 should be equal to K_U, which is estimated as the mean value across of all firms by $K_U=(K_E+r(1-T_C)L)/(1+(1-T_C)L)$, and γ_1 should be equal to the value of (K_U-r). Theory suggests that due to corporate taxes, the equity risk premium from leverage here is smaller by a factor of one minus the corporate tax rate. In other words, the tax benefit from debt offsets the leverage-related risk premium demanded by equity holders. Thus, comparing the results of the perfect capital market with the case of corporate taxes only should yield a slope that is closer to (K_U-r) in the last case relative to the perfect capital market case. Next, if personal taxes also exist, the direct estimated regression equation is:

$$K_E=\gamma_0+\gamma_1[TL] \quad (13)$$

In this case K_U is estimated by $[(K_E+TLr(1-T_D)]/(1+TL)$. Thus, if Equation (3a) holds true [tested by Equation (13) above], γ_0 should be equal to the K_U derived above and γ_1 to the value of $[K_U-r(1-T_D)]$. Note that the effect of leverage on the K_E is positive as long as the after-tax return on equity is greater than the after-tax return on debt. According to the theory, the firm's K_E increases with leverage, decreases with the firm's tax benefit from debt, and finally, increases with the personal tax penalty associated with debt.

In cases where the debt is considered risky and taxes do not exist, the estimated regression of Equation (1b) will be as follows:

$$K_E=\gamma_0+\gamma_1[(K_U-R)L] \quad (14)$$

Note that the only difference now is that R is the cost of debt, which is estimated exogenously by applying the CAPM according to the beta of debt (β_D). In this case γ_0 should be equal to K_U and γ_1 should be equal to 1. In cases where the debt is considered risky and corporate taxes do exist, the estimated regression of Equation (2b) will be as follows:

$$K_E=\gamma_0+\gamma_1[(K_U-R)(1-T_C)L] \quad (15)$$

Where the null hypothesis (H0) is that $\gamma_0=K_U$ and $\gamma_1=1$. When personal taxes are introduced, the direct estimation of Equation (3b) will be as follows:

$$K_E=\gamma_0+\gamma_1 T[K_U-R(1-T_D)]L \quad (16)$$

Accordingly, by the null hypothesis, $\gamma_0=K_U$ and $\gamma_1=1$. In other words, if Equation (3b) [tested by Equation (16) above] represents the true relationship between the K_E and financial leverage when debt is risky and corporate and personal taxes exist, the observed γ_0 should be no different from K_U. In this situation, K_U is the mean value of the required return by equity holders for a pure equity firm, and γ_1 should be no different from 1, because theoretically, all market imperfections are included except bankruptcy costs. Finally, we test the last equation, Equation (4b), which includes corporate and personal taxes, and risky debt associated with bankruptcy costs. We use the following regression equation to estimate Equation (4b):

$$K_E=\gamma_0+\gamma_1\{[K_U[(1-\Psi]-R(1-T_C)(1-T_E)]L\} \quad (17)$$

Where the term in the curly brackets is the explanatory variable, where the null hypothesis is $\gamma_0=K_U$ and $\gamma_1=1$.

To summarize, the empirical methodology involves testing seven different models. The comparison of the results may possibly allow us to identify which models (risk free or risky debt) correspond to the theoretical K_E–L relationship. One of the important reasons for making this determination is that K_E is one of the components of the weighted average cost of capital (WACC) that is used in capital budgeting decisions. Using inappropriate models might lead to incorrect decisions based on a bias in the estimation of the K_E and the net present value of the firm's projects.

4. DATA AND VARIABLE MEASUREMENT

4.1. Data

Our data come from COMPUSTAT for the financial data and the Yahoo Stock Screener database that provides market data including the adjusted stock prices. For each firm in the sample, we gathered the following accounting data: The total debt, long term debt, total equity, pretax income and total taxes paid, total dividend paid and number of shares of preferred stock, and also the historical stock returns in the preceding 5 years to each sample year. Due to data availability, our sample ends in 2007 since The University of Haifa's subscription to COMPUSTAT ended in 2008. Thus, we could not gather data after 2007. Given that we needed data from five normal years before our start date, we begin with the period of 2003 since the preceding years were associated with the high-tech bubble years that resulted in abnormal returns.

Testing the various theoretical models outlined above requires a reference to the risk class issue. Theory states that K_U should be identical across all firms in the same risk class. Consequently, an empirical problem that can arise is that K_U is supposed to be constant in the defined risk class, but practically it may vary across the companies in the same risk class. Taken to the extreme, K_U may practically even vary from one company to another. The empirical tradeoff involved then, is between selecting a very small sample in order to maintain a homogenous risk class on one hand, and the low statistical reliability that may be associated with a relatively small sample. Given this tradeoff, we selected our sample to consist of the Industrial sector according to the GICS definition of COMPUSTAT and, at the same time, is sufficiently large for obtaining statistically reliable results. Furthermore, in order to reduce the "survival bias" discussed in the literature, our sample in the various years contains precisely the same set of companies (which naturally reduced the size of our initial sample). In addition, to minimize the potential measurement errors caused, among other things, by our relatively broad risk class assumption, we employed various sensitivity analyses and robustness tests discussed later in this study. The initial sample consisted of all 306 firms from the Industrial sector covered by COMPUSTAT. We then required a complete data (as detailed above) for each of the companies in the sample and for each of the sample years. This additional screening procedure reduced our sample down to 182 firms.

4.2. Variable Measurement

We investigate the relationship between K_E and L will be tested here by employing an OLS regression analysis. This relationship will be investigated for different types of market imperfections such as corporate taxes, personal taxes and bankruptcy costs. The general analysis will use the following variables: The K_E, the financial leverage (L), the values of debt (D) and equity (E), tax rates, both corporate (T_C) and personal (T), and the bankruptcy costs factor (BC). We use several estimates of the financial leverage and tax variables to test the robustness of the results and to mitigate the potential problem of measurement errors. In the next sub sections we describe in detail the estimation procedure for each of the above key variables.

4.3. K_E

Table 1 reports the descriptive statistics for the two key variables in this study: The K_E and the financial leverage (L). Following the familiar procedure in the literature, we use the CAPM for measuring the K_E to each firm in the sample. Specifically, we measure K_E of each firm using $K_E=r+\beta_E(E_m-r)$. In other words, the

Table 1: Descriptive statistics of the corporate variables ($M)

Variable	Mean	Med	SD	CV	Minmum	Maximum
K_E	0.103	0.108	0.022	0.209	0.076	0.125
Relative Lev1	0.84	0.81	0.06	0.07	0.77	0.92
Relative Lev2	0.51	0.51	0.08	0.16	0.40	0.59
Relative Lev3	1.65	1.61	0.09	0.05	1.56	1.78
Relative Lev4	1.02	1.03	0.15	0.15	0.82	1.19
Absolute Lev1	0.80	0.81	0.04	0.05	0.76	0.84
Absolute Lev2	0.38	0.34	0.15	0.4	0.23	0.61
Absolute Lev3	1.55	1.55	0.07	0.05	1.45	1.64
Absolute Lev4	0.74	0.69	0.26	0.35	0.49	1.14
β_E	1.13	1.03	0.73	0.64	−0.52	4.56
Relative T_C	0.358	0.354	0.078	0.219	0.205	0.572
Absolute T_C	0.348	0.347	0.067	0.193	0.209	0.519
D	0.205	0.170	0.222	1.078	0.000	1.000
T_E	0.061	0.057	0.025	0.411	0.038	0.150
T_R	1.445	1.451	0.038	0.027	1.308	1.481

Table 1 reports the descriptive sample statistics. All financial statement data is gathered from the COMPUSTAT database. The values reported are measured in $millions except for common shares outstanding. The reported statistics are the Mean, Median (Med), Standard Deviation (SD), coefficient of variation (CV), Minimum (Min) and Maximum (Max). Lev1 is the ratio of LTD/Equity_{BV}, Lev2 is the ratio of LTD/Equity_{MV}, Lev3 is the ratio of (LTD+CL/Equity_{BV}) and Lev4 is the ratio of (LTD+CL/Equity_{MV}), where Lev denotes the financial leverage, LTD is long-term debt in book value, equity is the total value of common equity, CL is current liabilities and the subscripts BV and MV stand for book and market values, respectively. The estimate of the financial leverage for each year is based on the mean value over the preceding five years. Two such estimates have been constructed--Relative and Absolute. The relative Lev estimate for a given year is the mean value of the Lev variable across the preceding five years, while the Absolute Lev is given as the 5-year mean value of the "debt" numerator divided by the 5-year mean value of the "equity" denominator. Using the CAPM, we estimate K_E for each year where $K_E=r+\beta(Em-r)$, r is the 1-year Treasury Constant Maturity Rate as a proxy for the risk free rate of interest, which equals 1.2%. 1.9% and 3.6% for 2003, 2004 and 2005, and 4.9%, 4.5% for 2006, 2007, respectively, β is the systematic equity risk derived from historical 60 monthly returns for both the stock and the market index (NYSE), and (Em−r) is the market risk premium estimate which is 6% here based on the surveys of Fernandez, Aguirreamalloa and Linares (2013). The Relative T_C estimate for a given year is the mean value of the T_C variable across the preceding five years, while the Absolute T_C is given by the 5-year mean value of the firm's total tax expense divided by the 5-year mean value of the firm's taxable income. The table also reports the payout ratio (d), the personal tax rate (T_E) and the taxes ratio [(T_R); $T_R=(1-T_E)/(1-T_D)$]. T_E is the tax rate applicable to equity holders, and T_D is the tax rate applicable to debt holders. T_D is the highest statutory tax rate on interest income, which is 39.6% for 1998 through 2000, 38.6% for 2001 through 2002 and 35% thereafter. We estimate T_E as a weighted-average tax rate on dividend and capital gains income using the following term: $T_E=[d\,T_d+(1-d)\alpha T_{cg}]$, where d is the proportion of the net income distribution paid out in dividends, and (1−d) is the retention ratio. Following the procedure devised by Dhaliwal, Heitzman and Li (2006), we winsorize d at zero and one. T_d is the personal tax rate on dividend income, set equal to the values of T_D for years prior to 2003, and 15% thereafter. T_{cg} is set equal to the top statutory tax rate on long-term capital gains income, which equals 20% for 1998 through 2002 and 15% thereafter. α is the benefit of capital gains deferral. Following Graham (1999) and Dhaliwal, Heitzman and Li (2006), we assume that α=0.25.

K_E for a particular stock is simply the risk free rate of return (r) plus the product of the market premium risk (E_m) and equity systematic risk (β_E). Accordingly, we estimate the β_E by regressing the stock's rate of return against the market index's rate of return, in this case, the NYSE composite index. We use 60 monthly returns for both the stock index and the market index. Given that the sample consists of NYSE stocks, the market index employed here is the NYSE Composite index. Table 1 reports the descriptive statistics of the β_E estimate for each year. We measure r as the 1-year Treasury Constant Maturity Rate published by the Board of Governors of the Federal Reserve System. Accordingly, the risk free rate of return in each year is 1.2%. 1.9% and 3.6% for 2003, 2004 and 2005, and 4.9%, 4.5% for 2006, 2007, respectively.

We then construct the risk premium estimate based on surveys conducted by Fernandez et al. (2013), who report that the risk premium for the U.S capital market was 6.3%, 6%, 6%, for 2008, 2009, 2010, 5.5% in 2011 and 2012, and 5.7% in 2013. Accordingly, our estimate for the risk premium is 6%. To test the robustness of our findings, we also used 5% and 7%, and obtained similar results regardless of the estimated E_m.

4.4. Financial Leverage

The literature suggests a long list of financial leverage variables that are book or market measures. Appendix 1 presents a summary of the financial leverage estimates in recent studies. While the market estimation of equity is available, it is difficult to assess the debt component due to the problem of gathering the historical market value of debt and other statistical problems such as stationary in bond prices. As a result, most studies use book measures for the financial leverage or a hybrid financial leverage ratio that combines market equity estimations with the book value of debt. Many studies consider the latter a market measure. In addition, the literature refers to various types of debt such as short-term, long-term and total debt. Denis and McKeon (2012) use the total debt over total debt plus the market value of equity. Giroud et al. (2012) define the market measure of financial leverage as the ratio of the book value of total debt to the book value of assets. George and Hwang (2010) calculate the ratio of the book value of long-term debt to the book value of assets, while Brav (2009) uses the ratio of short-term debt plus long-term debt to total assets. Based on recent studies we create four estimates of financial leverage: (1) Lev1=LTD/$Equity_{BV}$, (2) Lev2=LTD/$Equity_{MV}$, (3) Lev3=(LTD+CL)/$Equity_{BV}$, (4) Lev4=(LTD+CL)/$Equity_{MV}$, where Lev denotes financial leverage, LTD is long-term debt, Equity is the value of common equity, CL is current liabilities, and the subscripts BV and MV stand for book and market values, respectively. $Equity_{MV}$ includes the common equity in MV calculated as the product of the number of common shares outstanding and the mean value of the 12 monthly closing stock prices. We also used the leverage ratios that include preferred stock, and the results remained very similar. The estimate of financial leverage (Lev) for each year is based on the mean value of the preceding 5 years. We also create two such estimates--relative and absolute. The Relative Lev estimate for a given year is the mean value of the Lev variable across the preceding 5 years, while the Absolute Lev is calculated as the 5-year mean value of the "debt" numerator divided by the 5-year mean value of the "equity" denominator. To summarize, we use eight different versions of the financial leverage ratio in the empirical analysis – four for each of the two calculation methods—relative and absolute. Table 1 presents a summary of the statistics for the various leverage estimates used in this study.

4.5. Corporate and Personal Taxes

Following Arena and Roper (2010), and Dyreng et al. (2010), we use the total tax expense divided by pretax income as the corporate tax rate variable (T_C). We estimate T_C for each firm in each year based on the mean value of the preceding 5 years. Accordingly, we again construct two estimates - relative and absolute - to test the sensitivity of the results. The Relative T_C estimate for a given year is the mean value of the T_C variable across the preceding 5 years. The Absolute T_C is given by the 5-year mean value of the firm's total tax expense divided by the 5-year mean value of the firm's taxable income. The tax ratio (T_R) is defined here as: $T_R=[(1-T_E)/(1-T_D)]$, where T_D is the tax rate for debt holders, and T_E is the tax rate applicable to equity holders. T_E is the weighted-average tax rate on dividends and capital gains income. In other words, it is the tax rate on dividends (T_d) and capital gains (T_{cg}) income expressed as: $T_E=[d\,T_d+(1-d)\cdot\alpha\cdot T_{cg}]$, where d is the dividendpayout ratio computed as the most years' dividend divided by the mean value of the net income over the prior 3 years. Accordingly, (1−d) is the earnings rate. Following the procedure devised by Dhaliwal et al. (2006) we winsorize d at zero and one. T_d is the personal tax rate on dividend income, set equal to the values of T_D for the years prior to 2003, and 15% thereafter. T_{cg} is set equal to the top statutory tax rate on long-term capital gains income, which equals 20% for 1998 through 2002, and 15% thereafter. α is the benefit of capital gains deferral. Following Van Binsbergen et al. (2010), Graham (1999), and Dhaliwal et al. (2006), we assume that α=0.25. Following Dhaliwal et al. (2006), T_D is measured as the highest statutory tax rate on interest income, which is 39.6% for 1998 through 2000, 38.6% for 2001 through 2002, and 35% thereafter. The final results are similar to those of Dhaliwal et al. (2006), while the relative and absolute computation methods also yield very similar estimates.

4.6. The Required Return on Debt

As with the K_E, we also use the CAPM to estimate the required return on debt (R) with the following equation: $R= r+\beta_D(E_m-r)$, where R is the required return on the firm's debt, β_D is the debt beta coefficient, (E_m-r) is the market risk premium and r is the 1-year U.S Treasury Constant Maturity Rate as a proxy for the risk free rate of interest. The market premium (E_m-r) estimate is based on the surveys of Fernandez et al. (2013). As stated earlier in sub section 4.3 using other estimates of 5% and 7% obtained similar results.

We estimate the mean value of β_D, using the Bloomberg interface by applying the CAPM in each sample year to the iBoxx ETF, which represents a bond index designed to provide a broad representation of the U.S. dollar-denominated high and low yield liquid corporate bonds. The findings for the mean value and standard deviation of the ETF betas across the sample years came to 0.3 and 0.063, respectively. At the same time, Choi (2013) has recently reported a mean range β_D value of 0.16−0.24. To compensate for a possible bias in the beta estimate, and also to account for potential measurement errors, we employ below a range of mean bond betas of 0.1, 0.2 and 0.3 that may appear consistent with the mean bond beta values reported in the literature, and which very likely may contain the true unobservable mean bond betas. Each mean value is then adjusted separately for each firm to reflect the individual bond beta by incorporating the deviation of the specific company's financial leverage from the entire sample financial leverage. Consider for example the following parameter values: the mean and standard deviation of β_D for the entire sample are 0.3 and 0.063 (based on Bloomberg ETF sample), the mean and standard deviation values for the financial leverage of the entire sample of 1.5 and 0.5, respectively, and the specific company's financial leverage is 2.5. The estimate for the specific company's β_D then will be given as follows: β_D=0.3+20.063=0.426, where the Z score of 2 is given by: (2.5−1.5)/0.5=2.

Note also, that for compatibility purposes we estimated debt betas using the same market index – the NYSE composite index. With regard to the equity betas, we followed the practice in the empirical literature and employed an all-equity index for estimating the stock betas. Given this practice, using the same index for bonds as well may result in a lower bias than using an alternative index such as an all-debt index or a debt-and-equity index Weinstein (1981) also employed the NYSE index for estimating bond betas); It seems that it is not an uncommon practice

4.7. Bankruptcy Costs

Over the years since the first publication of MM study, researchers have tried to determine the association between market frictions and capital structure. One of the potential frictions that affect the K_E is expected bankruptcy costs. The literature includes a variety of studies in the context of bankruptcy costs, but we focus on the most recent ones. Estimating such costs has proven difficult and yielded mixed results. For example, in a study of companies entering Chapter 7 or Chapter 11 proceedings, Bris et al. (2006) find that bankruptcy costs range from 2% to 20% of a firm's assets but advise caution when using these results. They argue that their measures are sensitive to the procedure, particularly to the denominator (how the assets are measured). More specifically, they advise theorists not to claim either uniformly low or uniformly high bankruptcy costs, but rather to recognize that bankruptcy costs are modest in some firms and large in other firms. Garlappi and Yan (2011) provide a measure of expected default probability (EDF, henceforth - p). A firm's p measure represents an assessment of the likelihood of default for that firm within a year. They report an average p measure of 3.30%. They also state that 75% of firms have a default probability of <3.5%, and about 5% of firms have a p score of 20%. Finally, Hortaçsu et al. (2013) present a mechanism through which a firm's decisions about its financial structure create indirect costs of financial distress in the auto market. Using wholesale auction prices, credit default swap spreads, and data for used cars sold, they find that a 1,000-basis-point movement in credit default swap spreads causes a price reduction of $68 - about 0.5% of the average sales price in their sample.

Warner (1977) estimates the direct bankruptcy costs of 11 US railroad companies that were in bankruptcy proceedings from 1933 to 1955. He finds that these costs averaged 1% of the market value of the firm 7 years before entering into Chapter 11 and rose to 4% 1 year prior to bankruptcy. However, Warner notes that his results should be interpreted cautiously because they are based on a narrowly defined bankruptcy cost definition. In addition, his small sample of railroad bankruptcies is not necessarily indicative of the population of firms. Weiss (1990) conducts a study on 37 industrial firms between 1979 and 1986. He finds that on average, the direct costs are 3.1% of the book value of the debt and market value of the firm's equity. Miller (1977) argues that the direct cumulative bankruptcy costs average only 5.3% of the value of the firm and 1.7% for the largest firms. Miller also suggests that the total loss of the market value 84 months prior to the bankruptcy date equals 1.3% of the firm's value. Altman (1984) estimates the total bankruptcy costs (both direct and indirect) as 16.7% of a firm's value in the year in which the firm becomes insolvent, 11.2% of the firm's value 1 year prior to the bankruptcy, 11.7% of the firm's value 2 years prior to the bankruptcy and 12.4% of the firm's value 3 years prior to the bankruptcy. He also argues that indirect bankruptcy costs are not limited to firms that actually fail. Firms that have a high probability of bankruptcy, whether they eventually fail or not, can still incur these costs. Andrade and Kaplan (1998) point out that many previous studies that examined the indirect costs of financial distress fail to distinguish financial distress from economic distress. By examining a sample of 31 highly leveraged transactions, their results show that the indirect costs of financial distress are 10–23% of a firm's value.

To create a reliable estimate of the bankruptcy costs factor (q), we use a set of four alternative measures--3%, 7%, 11%, and 15%--to proxy for the true value of bankruptcy costs. Since a higher level of financial leverage is associated with a greater potential for bankruptcy, we adjust the coefficient of each firm's specific expected bankruptcy costs according to the relative Z score derived from its estimated degree of financial leverage. Note too that q=C/D, where C is the expected value of the bankruptcy costs, and *D* is the value of the debt. In determining this set we already took into account that q is in terms of the debt rather than the total value of the firm in the empirical studies referred to at the beginning of the current section.

5. EMPIRICAL FINDINGS

5.1. Descriptive Statistics

Table 1 presents the descriptive statistics for the key variables in the study. That is, the K_E, the financial leverage (L), the tax variables (T_C, T_E and T_R) and the equity beta (β_E). For example, the mean (median) value of K_E is 10.3% (10.8%) across the sample years, while the standard deviation is 2.2%. For the financial leverage (L), the estimates for the relative and *Absolute* L measures are almost similar. However, market L measures, which use the market value of equity, are lower than their corresponding book measures. For example, relative Lev_1 is 0.84 compared to 0.80 for the absolute Lev_1. However, the mean value for the relative and *Absolute* Lev_2 (which are market measures) is 0.51 and 0.38, respectively. As expected, the market measures are more volatile and lower than the book measures (due to the higher market value of equity than the book value of equity). Using the median values yields similar results.

Similarly, the median value of the relative and absolute Lev_1 is 0.81, while the median value of the corresponding market measures is 0.51 and 0.34. Similar results were found for Lev_3 and Lev_4, which consider the total debt of the firm. The bottom of Table 1 reports the descriptive statistics for the tax variables including corporate and personal taxes. It can be noticed that the relative and absolute measures for the corporate taxes yield similar results. Overall, the mean value across the sample years is 0.358 and 0.348 for the relative and absolute measures. Using the median values yield similar results. Note too, that in the context of personal taxes, our results are similar to those of Dhaliwal et al. (2006). The mean value of the tax ratio (T_R) in their study for 2003 and 2004 (their study ends in 2004) is 1.450, while in our study it equals 1.440 and 1.441. Overall, the mean value across the sample years is 1.445. Finally, with accordance to Dhaliwal et al. (2006) study the majority of the sample firms pay dividends, because the median payout ratio (*d*) is positive in each sample year.

5.2. Regression Results

Table 2 presents the regression results for testing Equation s. (1a)- (4b), starting with the perfect capital market in the risk free debt model, and ending with the case including taxes and

Table 2: Regression results

Lev_4(Mv) Abs			Mean	Median	SD	Minimum	Maximum
Case A: Risk free debt models							
Model (1a)	$K_E=K_U+(K_U-r)[L]$, $K_E=\gamma_0+\gamma_1[L]$	Intercept	0.076	0.078	0.022	0.050	0.100
		Slope	0.018	0.019	0.005	0.011	0.023
		R^2	0.195	0.217	0.084	0.077	0.278
		Slope Sig	0.000	0.000	0.000	0.000	0.000
Model (2a)	$K_E=K_U+(K_U-r)[(1-Tc)\ L]$, $K_E=\gamma_0+\gamma_1[(1-Tc)\ L]$	Intercept	0.085	0.087	0.024	0.057	0.110
		Slope	0.034	0.035	0.008	0.022	0.043
		R^2	0.185	0.201	0.088	0.080	0.276
		Slope Sig	0.000	0.000	0.000	0.000	0.000
Model (3a)	$K_E=K_U+[K_U-r(1-T_D)][TL]$, $KE=\gamma_0+\gamma_1[TL]$	Intercept	0.085	0.087	0.024	0.057	0.110
		Slope	0.023	0.024	0.005	0.015	0.030
		R^2	0.189	0.205	0.089	0.085	0.281
		Slope Sig	0.000	0.000	0.000	0.000	0.000
Case B: Risky debt models							
Model (1b)	$K_E=K_U+[(K_U-R)\ L]$, $K_E=\gamma_0+\gamma_1[(KU-R)\ L]$	Intercept	0.067	0.070	0.025	0.036	0.093
		Slope	1.027	1.017	0.067	0.940	1.098
		R^2	0.417	0.413	0.126	0.282	0.587
		Slope Sig	0.000	0.000	0.000	0.000	0.000
Model (2b)	$K_E=K_U+(K_U-R)(1-Tc)\ L$, $K_E=\gamma_0+\gamma_1[(K_U-R)(1-Tc)\ L]$	Intercept	0.064	0.067	0.025	0.032	0.089
		Slope	1.145	1.122	0.130	1.017	1.334
		R^2	0.547	0.500	0.153	0.420	0.718
		Slope Sig	0.000	0.000	0.000	0.000	0.000
Model (3b)	$K_E=K_U+T[(K_U-R(1-T_D)]L$, $K_E=\gamma_0+\gamma_1\{T[(K_U-R(1-T_D)]L\}$	Intercept	0.061	0.064	0.024	0.031	0.086
		Slope	1.054	1.033	0.119	0.936	1.227
		R^2	0.547	0.500	0.153	0.420	0.718
		Slope Sig	0.000	0.000	0.000	0.000	0.000
Model (4b)	$K_E=K_U+[K_U(1-\Psi)-R(1-T_C)(1-T_E)]L$, $K_E=\gamma_0+\gamma_1[K_U(1-\Psi)-R(1-T_C)(1-T_E)]L$	Intercept	0.063	0.064	0.021	0.040	0.085
		Slope	1.475	1.465	0.153	1.290	1.690
		R^2	0.663	0.664	0.039	0.605	0.706
		Slope Sig	0.000	0.000	0.000	0.000	0.000

Table 2 presents the regression results of: Model (1a): $K_E=K_U+K_U[L]$ using the estimated regression equation given by: $K_E=\gamma_0+\gamma_1[L]$. Model (2a): $K_E=K_U+K_U[(1-TC)\ L]$ using the estimated regression equation given by: $K_E=\gamma_0+\gamma_1[[(1-T_C)\ L]$, Model (3a): $K_E=K_U+K_U[TL]$ using the estimated regression equation given by :$K_E=\gamma_0+\gamma_1[TL]$, Model (1b): $K_E=K_U+[(K_U-K_D)\ L]$ using the estimated regression equation given by: $K_E=\gamma_0+\gamma_1[(K_U-K_D)\ L]$, Model (2b): $K_E=K_U+[(K_U-K_D)(1-T_C)\ L]$ using the estimated regression equation given by: $K_E=\gamma_0+\gamma_1[(K_U-K_D)(1-T_C)\ L]$, Model (3b): $K_E=K_U+[(K_U-K_D)\ TL]$ using the estimated regression equation given by: $K_E=\gamma_0+\gamma_1[(K_U-K_D)\ TL]$, Model (4b): $K_E=K_U+[(K_U\ (1+q/T)-K_D)\ TL]$ using the estimated regression equation given by: $K_E=\gamma_0+\gamma_1[(K_U\ (1+q/T)-K_D)\ TL]$. K is the cost of the equity; T_C is the Absolute corporate tax rate applicable to the corporation; T is the final tax factor, which is given by $T=(1-T_C)(1-T_E)/(1-T_D)$, where T_C (Absolute), T_E and T_D are the tax rates applicable to the corporation, equity holders and debt holders, respectively. L is the financial leverage of the firm using the Relative estimate (Rel) for a given year. The table presents the regression results for the risky debt models while the mean values of β_D and q equal 0.1 and 7%, correspondingly. Slope sig refers to the usual null hypothesis: H0: $\gamma_1 = 0$ vs. H1: $\gamma_1 \neq 0$

bankruptcy costs. For the sake of parsimony, we focus on the results using a set of variables measures such as the absolute Lev_4 measure. However, in Tables 3 and 4 we expand the reported results for additional measures of key variables such as taxes, bankruptcy costs and financial leverage. The results for the other measures, are not reported here, are similar.

The results for the risk free debt case (Case A) are reported for the case of a perfect capital market, corporate taxes only and both corporate and personal taxes. The results for the corresponding risky debt models (Case B) are presented also in the bottom part in Table 2. The upper part in Tables 3 and 4 reports the theoretical values that should be found according to each model in each case,

Table 3: The differences of the observed and theoretical parameters by direct estimation

Panel A		**2007**		**2006**		**2005**		**2004**		**2003**	
Method 1						**Risk free debt models**					
Lev_1(Bv) Rel		**Intercept γ_0**	**Slope γ_1**	**Intercept γ_0**	**Slope γ_1**	**Intercept γ_0**	**Slope γ_1**	**Intercept γ_0**	**Slope γ_1**	**Intercept γ_0**	**Slope γ_1**
	1a	0.118	0.008	0.109	0.012	0.094	0.013	0.072	0.011	0.065	0.008
Abs T_C	2a	0.118	0.012	0.109	0.019	0.094	0.022	0.071	0.020	0.065	0.013
Abs T_C	3a	0.117	0.008	0.109	0.013	0.094	0.015	0.071	0.014	0.065	0.009
Risky debt models											
		Intercept γ_0	**Slope γ_1**	**Intercept γ_0**	**Slope γ_1**	**Intercept γ_0**	**Slope γ_1**	**Intercept γ_0**	**Slope γ_1**	**Intercept γ_0**	**Slope γ_1**
β_D=0.2	1b	0.096	0.942	0.098	1.005	0.077	0.978	0.047	1.027	0.035	1.039
β_D=0.3	1b	0.094	1.077	0.096	1.123	0.076	1.102	0.046	1.217	0.035	1.207
β_D=0.2	2b Abs	0.098	1.163	0.102	1.141	0.080	1.131	0.051	1.190	0.039	1.238
β_D=0.3	2b Abs	0.079	1.129	0.082	1.211	0.065	1.074	0.035	1.284	0.029	1.123
β_D=0.2	3b Abs	0.136	1.027	0.137	0.997	0.110	1.102	0.079	0.924	0.069	0.744
β_D=0.3	3b Abs	0.140	1.029	0.141	0.985	0.114	1.146	0.083	0.892	0.073	0.587
β_D=0.2	**Abs T_C**	**Intercept γ_0**	**Slope γ_1**	**Intercept γ_0**	**Slope γ_1**	**Intercept γ_0**	**Slope γ_1**	**Intercept γ_0**	**Slope γ_1**	**Intercept γ_0**	**Slope γ_1**
q=3%	4b	0.094	0.946	0.090	0.912	0.075	1.071	0.053	1.323	0.051	1.199
q=7%	4b	0.094	0.874	0.090	0.838	0.075	1.001	0.052	1.270	0.050	1.181
q=11%	4b	0.094	0.809	0.090	0.771	0.074	0.937	0.051	1.215	0.049	1.158
q=15%	4b	0.094	0.750	0.090	0.712	0.074	0.877	0.051	1.159	0.047	1.131
β_D=0.3	**Abs T_C**										
q=3%	4b	0.093	1.057	0.089	1.028	0.075	1.190	0.054	1.466	0.056	1.132
q=7%	4b	0.093	0.976	0.089	0.941	0.074	1.111	0.053	1.413	0.054	1.137
q=11%	4b	0.093	0.901	0.089	0.863	0.074	1.037	0.052	1.354	0.053	1.134
q=15%	4b	0.093	0.833	0.089	0.792	0.074	0.967	0.051	1.292	0.051	1.124
Panel B		**2007**		**2006**		**2005**		**2004**		**2003**	
Method1						**Risk free debt models**					
Lev_1(Bv) Rel		**$\gamma_0-\gamma_0$***	**$\gamma_1-\gamma_1$***	**$\gamma_0-\gamma_0$***	**$\gamma_1-\gamma_1$***	**$\gamma_0-\gamma_0$***	**$\gamma_1-\gamma_1$***	**$\gamma_0-\gamma_0$***	**$\gamma_1-\gamma_1$***	**$\gamma_0-\gamma_0$***	**$\gamma_1-\gamma_1$***
	1a	0.029***	−0.036***	0.020***	−0.028***	0.021***	−0.024***	0.020***	−0.022***	0.023***	−0.022***
Abs TC	2a	0.021***	−0.040***	0.015***	−0.026***	0.013***	−0.023***	0.012***	−0.020***	0.016***	−0.024***
Abs TC	3a	0.041***	−0.052***	0.029***	−0.050***	0.026***	−0.040***	0.022***	−0.028***	0.024***	−0.028***
Risky debt models											
		$\gamma_0-\gamma_0$*	**$\gamma_1-\gamma_1$***	**$\gamma_0-\gamma_0$***	**$\gamma_1-\gamma_1$***	**$\gamma_0-\gamma_0$***	**$\gamma_1-\gamma_1$***	**$\gamma_0-\gamma_0$***	**$\gamma_1-\gamma_1$***	**$\gamma_0-\gamma_0$***	**$\gamma_1-\gamma_1$***
β_D=0.2	1b	0.002	−0.058	0.006	0.005	−0.002	−0.022	−0.010***	0.027	−0.013***	0.039
β_D=0.3	1b	−0.003	0.077	0.001	0.123	−0.006	0.102	−0.015***	0.217**	−0.016***	0.207**
β_D=0.2	2b Abs	−0.003	0.163**	0.003	0.141*	−0.005	0.131	−0.013***	0.190***	−0.015***	0.238***
β_D=0.3	2b Abs	−0.024***	0.129	−0.019***	0.211*	−0.022***	0.074	−0.031***	0.284**	−0.028***	0.123
β_D=0.2	3b Abs	0.050***	0.027	0.053***	−0.003	0.038***	0.102	0.025***	−0.076	0.024	−0.256***
β_D=0.3	3b Abs	0.052***	0.029	0.056***	−0.015	0.040***	0.146	0.028***	−0.108	0.026***	−0.413***
β_D=0.2	**Abs T_C**	**$\gamma_0-\gamma_0$***	**$\gamma_1-\gamma_1$***	**$\gamma_0-\gamma_0$***	**$\gamma_1-\gamma_1$***	**$\gamma_0-\gamma_0$***	**$\gamma_1-\gamma_1$***	**$\gamma_0-\gamma_0$***	**$\gamma_1-\gamma_1$***	**$\gamma_0-\gamma_0$***	**$\gamma_1-\gamma_1$***
q=3%	4b	0.009***	−0.054	0.008*	−0.088*	0.004	0.071	0.000	0.323***	0.006	0.199***
q=7%	4b	0.010***	−0.126*	0.009*	−0.162***	0.006	0.001	0.000	0.270***	0.006	0.181***
q=11%	4b	0.012***	−0.191***	0.011***	−0.229***	0.006	−0.063	0.000	0.215***	0.006	0.158**
q=15%	4b	0.013***	−0.250***	0.012***	−0.288***	0.007	−0.123***	0.001	0.159***	0.005	0.131*
β_D=0.3	**Abs T_C**										
q=3%	4b	0.006	0.057	0.005	0.028	0.002	0.190***	−0.001	0.466***	0.009	0.132
q=7%	4b	0.008	−0.024	0.006	−0.059	0.003	0.111	0.000	0.413***	0.008	0.137*
q=11%	4b	0.009	−0.099	0.008*	−0.137***	0.004	0.037	0.000	0.354***	0.008	0.134*
q=15%	4b	0.011***	−0.167***	0.009***	−0.208***	0.005	−0.033	0.000	0.292***	0.007	0.124*

Table 3 presents the observed parameters obtained by the direct regression of each model and their differences from their counterparts' theoretical values. The financial leverage measure used here is Lev1(Bv) Rel. Panel A presents the observed parameters and Panel B presents the differences test conducted for each value. Each row specifies the relevant model and the measures for taxes, the beta of debt and bankruptcy costs used for the direct test. The uppercase letter * represents P≤0.1, ** represents P≤0.05, and *** represents P≤0.01.

while the bottom part presents the findings of the statistical t test employed for the differences between the theoretical and observed regression parameters. Note that all of the regression tables report the results for a market premium estimate of 6%, but the results remain essentially unchanged when we use two 5% and 7%.

In accordance with the theoretical predictions, the relationship between K_E and L is positive in all of the regression equations estimated. Table 2 demonstrates a positive relationship between financial leverage (L) and the K_E for the results of all of the regressions. As the last line of each model in Table 2 indicates, the significance level of γ_1 (the slope) is ≤1% for each of the sample years of the sample and for each of the L estimates. Although not reported in the tables, γ_1 (the intercept) in the various equations is also statistically significant. Thus, the relationship between K_E and L is positive and statistically significant for the values of all of the variables in the regression equations: The corporate tax rate, personal tax rate, debt beta, and the bankruptcy costs.

Table 4: The differences of the observed and theoretical parameters by direct estimation

Panel A		**2007**		**2006**		**2005**		**2004**		**2003**	
Method 1						**Risk free debt models**					
Lev_2(Mv) Rel		**Intercept γ_0**	**Slope γ_1**	**Intercept γ_0**	**Slope γ_1**	**Intercept γ_0**	**Slope γ_1**	**Intercept γ_0**	**Slope γ_1**	**Intercept γ_0**	**Slope γ_1**
	1a	0.102	0.022	0.096	0.024	0.083	0.021	0.062	0.017	0.056	0.011
Abs T_C	2a	0.113	0.040	0.105	0.045	0.093	0.037	0.069	0.037	0.063	0.027
Abs T_C	3a	0.113	0.027	0.105	0.031	0.093	0.026	0.069	0.025	0.063	0.019
Risky debt models											
		Intercept γ_0	**Slope γ_1**	**Intercept γ_0**	**Slope γ_1**	**Intercept γ_0**	**Slope γ_1**	**Intercept γ_0**	**Slope γ_1**	**Intercept γ_0**	**Slope γ_1**
β_D=0.2	1b	0.099	1.099	0.101	1.141	0.079	1.123	0.047	1.281	0.036	1.216
β_D=0.3	1b	0.096	1.038	0.099	1.060	0.079	1.014	0.048	1.082	0.036	1.120
β_D=0.2	2b Abs	0.094	1.061	0.096	1.074	0.075	1.056	0.044	1.193	0.034	1.150
β_D=0.3	2b Abs	0.077	1.003	0.080	1.050	0.062	0.968	0.036	1.215	0.027	1.153
β_D=0.2	3b Abs	0.090	0.976	0.092	0.988	0.072	0.972	0.042	1.098	0.032	1.058
β_D=0.3	3b Abs	0.091	1.017	0.093	0.998	0.074	0.965	0.051	0.730	0.042	0.590
β_D=0.2	**Abs TC**	**Intercept γ_0**	**Slope γ_1**	**Intercept γ_0**	**Slope γ_1**	**Intercept γ_0**	**Slope γ_1**	**Intercept γ_0**	**Slope γ_1**	**Intercept γ_0**	**Slope γ_1**
q=3%	4b	0.097	1.280	0.095	0.881	0.079	0.952	0.056	1.291	0.065	1.687
q=7%	4b	0.098	1.173	0.095	0.818	0.079	0.891	0.056	1.218	0.063	1.701
q=11%	4b	0.098	1.081	0.096	0.763	0.080	0.837	0.056	1.151	0.061	1.696
q=15%	4b	0.099	1.001	0.096	0.715	0.080	0.789	0.056	1.090	0.060	1.675
β_D=0.3	**Abs TC**										
q=3%	4b	0.097	1.384	0.094	0.969	0.078	1.051	0.057	1.405	0.069	1.485
q=7%	4b	0.098	1.263	0.095	0.895	0.079	0.979	0.056	1.326	0.067	1.529
q=11%	4b	0.098	1.158	0.095	0.831	0.079	0.916	0.056	1.254	0.065	1.554
q=15%	4b	0.098	1.069	0.095	0.774	0.079	0.859	0.056	1.186	0.064	1.561
Panel B		**2007**		**2006**		**2005**		**2004**		**2003**	
Method1						**Risk free debt models**					
Lev_2(Mv) Rel		**$\gamma_0-\gamma_0$***	**$\gamma_1-\gamma_1$***	**$\gamma_0-\gamma_0$***	**$\gamma_1-\gamma_1$***	**$\gamma_0-\gamma_0$***	**$\gamma_1-\gamma_1$***	**$\gamma_0-\gamma_0$***	**$\gamma_1-\gamma_1$***	**$\gamma_0-\gamma_0$***	**$\gamma_1-\gamma_1$***
	1a	0.013***	−0.022***	0.007	−0.016***	0.010***	−0.016***	0.010***	−0.016***	0.014***	−0.019***
Abs T_C	2a	0.016***	−0.012	0.011***	0.000	0.012***	−0.008	0.010***	−0.003	0.014***	−0.010
Abs T_C	3a	0.037***	−0.033***	0.025***	−0.032***	0.025***	−0.029***	0.020***	−0.017***	0.022***	−0.018***
Risky debt models											
		$\gamma_0-\gamma_0$*	**$\gamma_1-\gamma_1$***	**$\gamma_0-\gamma_0$***	**$\gamma_1-\gamma_1$***	**$\gamma_0-\gamma_0$***	**$\gamma_1-\gamma_1$***	**$\gamma_0-\gamma_0$***	**$\gamma_1-\gamma_1$***	**$\gamma_0-\gamma_0$***	**$\gamma_1-\gamma_1$***
β_D=0.2	1b	0.005	0.099	0.009***	0.141	0.000	0.123	−0.010***	0.281***	−0.012***	0.216***
β_D=0.3	1b	−0.001	0.038	0.004	0.060	−0.003	0.014	−0.013***	0.082	−0.015***	0.120
β_D=0.2	2b Abs	−0.007	0.061	−0.003	0.074	−0.010	0.056	−0.020***	0.193**	−0.020***	0.150**
β_D=0.3	2b Abs	−0.026***	0.003	−0.021***	0.050	−0.025***	−0.032	−0.030***	0.215**	−0.030***	0.153
β_D=0.2	3b Abs	0.004	−0.024	0.008	−0.012	0.000	−0.028	−0.012***	0.098	−0.013***	0.058
β_D=0.3	3b Abs	0.003	0.017	0.008	−0.002	0.000	−0.035	−0.004	−0.270***	−0.005	−0.410***
β_D=0.2	**Abs T_C**	**$\gamma_0-\gamma_0$***	**$\gamma_1-\gamma_1$***	**$\gamma_0-\gamma_0$***	**$\gamma_1-\gamma_1$***	**$\gamma_0-\gamma_0$***	**$\gamma_1-\gamma_1$***	**$\gamma_0-\gamma_0$***	**$\gamma_1-\gamma_1$***	**$\gamma_0-\gamma_0$***	**$\gamma_1-\gamma_1$***
q=3%	4b	0.012	0.280***	0.013	−0.119*	0.008	−0.048	0.003	0.291***	0.020***	0.687***
q=7%	4b	0.014	0.173*	0.014	−0.182***	0.010	−0.109*	0.004	0.218***	0.019	0.701***
q=11%	4b	0.016	0.081	0.017	−0.237***	0.012	−0.163***	0.005	0.151**	0.018	0.696***
q=15%	4b	0.018	0.001	0.018	−0.285***	0.013	−0.211***	0.006	0.090	0.018	0.675***
β_D=0.3	**Abs T_C**										
q=3%	4b	0.010	0.384***	0.010	−0.031	0.005	0.051	0.002	0.405***	0.022***	0.485***
q=7%	4b	0.013	0.263***	0.012	−0.105	0.008	−0.021	0.003	0.326***	0.021***	0.529***
q=11%	4b	0.014	0.158*	0.014	−0.169***	0.009	−0.084	0.004	0.254***	0.020***	0.554***
q=15%	4b	0.016	0.069	0.015	−0.226***	0.010	−0.141**	0.005	0.186***	0.020***	0.561***

Table 4 presents the observed parameters obtained by a direct regression of each model and their differences from their counterparts' theoretical values. The financial leverage measure used here is Lev_2(Mv) Rel. Panel A presents the observed parameters and Panel B presents the differences test conducted for each value. Each row specifies the relevant model and the measures for taxes, beta of debt and bankruptcy costs used for the direct test. The uppercase letter * represents P≤0.1, ** represents P≤0.05, and *** represents P≤0.01

Furthermore, the findings are similar when the corporate tax variable is measured using either the absolute or relative method, or when the β_D estimate is 0.3, 0.2 or 0.1.

One of our important results is that the relationship between L and K_E, as represented by R-squared, is much higher for the risky debt models (Case B) than for the risk free models (Case A). For the perfect capital market case, the mean R-squared value increases from 19.5% for Model (1a) to 41.7% for Model (1b). Similarly, in Model (3a), that includes corporate and personal taxes case, the mean R-squared value increases from 18.9% for the risk free case to 54.7% in the risky debt case. Comparing Model (2b) and Model (2a) yields similar results. The R-squared value increases from 18.5% for the risk free case to 54.7% in the risky debt case. Interestingly, the highest R-squared values are evident in Model (4b), which incorporates both taxes and bankruptcy costs. The mean R-squared value is 66.3%.

Another important finding is that the R-squared value is higher for all of the models based on market measures rather than book measures of the financial leverage. For example, (though not reported here), the market based relative Lev_4 measure, not reported here, yields an R-squared value of 19.8% compared with 11.3% for the book based relative Lev_3 measure. This result generally holds for corresponding book and market L measures.

To summarize, all of the empirical results in each model tested point to a positive relationship between the K_E and financial leverage regardless of the measures used for the key variables. Second, the coefficient of determination (R^2) increases dramatically in the transition from risk free debt models to their parallel risky debt ones. Third, the market measures of financial leverage tend to generate a higher coefficient of determination for the goodness of fit. All of the tests we conducted confirm this result.

5.3. Comparative Analysis

As discussed above, our study yields three main findings: (1) The relationship between K_E and L is positive regardless of the specific measures of the various variables, (2) The R-squared value is substantially higher in the risky debt models than in the risk free debt models and (3) The market measures of L tend to generate higher R-squared values than the book measures of L.

Our next task is to compare the observed γ_0 and γ_1 values as given by the OLS results with their theoretical counterparts given by the direct values of the variables such as tax rates, and bankruptcy costs. The failure to reject the null hypothesis means an insignificant gap between the theoretical and observed parameters, which is in fact, the result needed to validate a model. The interpretation of the null hypothesis is that the theoretical model holds true because the observed parameter is statistically not different from it. Such a comparison will allow us to determine whether the risk free or risky debt models accord most closely with the actual K_E–L relationship. We follow the standard procedures related to the slope γ_1 and the intercept γ_0 for testing the hypotheses. First, we specify the null and alternative hypotheses. According to the null hypothesis, γ_1 equals a theoretical value that we will call γ_1*. The alternative hypothesis is that γ_1 is different from the theoretical value γ_1*. Second, we calculate the statistic T using Equation (18):

$$T_{stat} = \frac{\gamma_1 - \gamma_1^*}{\sqrt{MSE} \Big/ \sqrt{(Xi - \bar{X})^2}} = \frac{\gamma_1 - \gamma_1^*}{Se(\gamma_1)} \tag{18}$$

where, γ_1 is the observed slope obtained in the regression analysis, γ_1* is the theoretical value of the slope according to each model, and MSE is the error mean sum of squares, which is calculated by dividing the sum of squares within the groups by the error degrees of freedom. The denominator of MSE is the total sum of squares scaled by its degrees of freedom, and finally, Se (γ_1) is the standard error of the observed slope γ_1.

Similarly, the t-test for the intercept (γ_0) involves two hypotheses. According to the null hypothesis, γ_0 equals the theoretical intercept γ_0*. The alternative hypothesis is that γ_0 is different from the theoretical value γ_0*. Second, we calculate the statistic T using Equation (19):

$$T_{stat} = \frac{\gamma_0 - \gamma_0^*}{\sqrt{MSE} \times \sqrt{\frac{1}{n} + \frac{\bar{X}^2}{\Sigma(Xi - \bar{X})^2}}} = \frac{\gamma_0 - \gamma_0^*}{Se(\gamma_0)} \tag{19}$$

where γ_0 is the observed slope obtained in the regression analysis, γ_0* is the theoretical value of the intercept according to each model, MSE is the error mean sum of squares, which is calculated by dividing the sum of squares within the groups by the error degrees of freedom, and finally, $S_e(\gamma_0)$ is the standard error of the observed intercept γ_0. As stated earlier, Tables 3 and 4 present the findings of the statistical t-test that was established for the differences between the theoretical and observed regression slope and intercept for the direct estimation of each model. Due to the vast number of iteration and the similarity of results, we report only the results obtained using the *Relative* Lev_1 and Lev_2.

The theoretical intercept (γ_0*) and slope (γ_1*) for each of the risk free and risky debt models in the context of the K_E−L relationship are derived according to the hypotheses formulated in Section 3. Due to the vast number of possible iterations, we present just the estimated theoretical and observed regression coefficients according to the absolute corporate tax measure when the mean value of β_D is 0.2 and 0.3, and the bankruptcy costs are 3%, 7%, 11% and 15%. We also report the results for the Lev_1(Bv) *Rel* and Lev_2(Mv) *Rel* financial leverage measures. Using Lev_3(Bv) *Abs* and Lev_4(Mv) *Abs* yield results that remain the same but are not reported here. An illustration for the construction of the theoretical coefficients is given below. For example, Model (2a) is formulated as:

$$K_E = K_U + [(K_U - r)(1 - T_C)L] \tag{2a}$$

And the estimated regression is:

$$K_E = \gamma_0 + \gamma_1[(1 - T_C)L] \tag{11}$$

Thus, by the null hypothesis, if Model (2a) holds true, $\gamma_0=K_U$ and $\gamma_1=(K_U-r)$. Ku is estimated by unlevering Model (2a) according to the mean value of L. Using the K_E estimates, and the mean value of the relative tax measure we construct the theoretical values. For example, in 2007, the γ_0* would be computed as $[K_E+rL(1-Tc)]/[1+L(1-Tc)]$ which equals $[0.125+0.045\times0.82\times(1-0.345)]/[1+0.82\times(1-0.345)]=0.097$, while γ_1* would be computed as (K_U-r), which equals $(0.097-0.045)=0.052$.

Tables 3 and 4 present the observed coefficients of γ_0 and γ_1 and their differences from their theoretical parameters. Table 3 presents the theoretical and observed regression coefficients using the Lev_1(Bv) *Rel* financial leverage measure, while Table 4 reports the corresponding theoretical and observed regression coefficients and the T tests conducted using Lev_2(Mv) *Rel*. Panel A in Table 3 presents the observed parameters, and Panel B reports the differences from their theoretical estimates. Each row in each panel reports the results according to the model and measures used. Panel B also contains the results of the test of the statistical hypothesis for the differences between ($\gamma_0-\gamma_0$*) and ($\gamma_1-\gamma_1$*). The uppercase letter * represents the $P \leq 0.1$, ** represents the $P \leq 0.05$, and finally, *** represents the $P \leq 0.01$. While it is clear from Panel B in Table 3 that all of the differences in the risk free debt models are significantly different, the opposite is true for the risky debt models. All of the differences in the risk free debt models are significant at the 1% level. These preliminary results seem to indicate that the use of risk free debt models in practical applications would under-estimate the K_E, because all of the observed slopes are significantly lower than the theoretical slopes. Several explanations are possible for such a finding. One is the failure of risk free models to incorporate risky debt, leading to theoretical penalties for leverage that are biased upward relative to a risky debt scenario. A second explanation is measurement error. It is possible that both the dependent variable (equity return) and the independent variable (leverage) are measured incorrectly. Assuming that the theoretical model is correct, the attenuation bias caused by a measurement error might explain why the estimated coefficients are smaller than the predicted ones. To investigate this explanation, we tested the robustness of our findings using Lev_2. The results reported in Table 4 once again confirm the preference of risky debt models to risk free debt models. Using Lev_3 and Lev_4, which are based on the total debt of the firm, also confirms the results so far. However, while the results imply that risky debt models perform better than riskless debt models, it is not obvious that within the risky debt models Model (4b) performs better than the others, even though it should be the most realistic model because it incorporates all of the market imperfections discussed in this study. If one uses the ratio of insignificant differences to the total number of differences for each model, Model (4b) performs better than all of the other risky debt models with regard to the ($\gamma_0-\gamma_0$*) difference when using the Lev_1(Bv) *Rel* financial leverage measure (See Table 3 Panel B). In this case, 72.5% of the ($\gamma_0-\gamma_0$*) differences emerge as insignificant compared with 60%, 30%, and 10% for Models (1b), (2b) and (3b), respectively. Using Lev_2 (Mv) *Rel* yields similar results (See Table 8 Panel B). In this case, 87.5% of the ($\gamma_0-\gamma_0$*) differences are insignificant compared with 50%, 30%, and 80% for Models (1b), (2b) and (3b), respectively. To summarize, in the context of ($\gamma_0-\gamma_0$*) the models that fit the data most accurately are, in descending order, Model (4b) with a mean value of 80% accurate (statistically indifferent) differences, Model (1b) with a mean value of 55% [(60%+50%)/2)], Model (3b) with a mean value of 45%[(10%+80%)/2)], and finally Model (2b) with 30%. In unreported tests using Lev_3 and Lev_4, Model (4b) placed second in the ratio of insignificant differences to the total number of differences, while Model (1b) preserved the maximum mean value.

Examining the ($\gamma_1-\gamma_1$*) differences, makes the final distinction difficult. Model (1b) and Model (3b) produce a ratio of 80% insignificant differences to the total number of differences, while Model (2b) and (4b) are responsible for only 40% and 35%, respectively. Thus, of the risky debt models, Model (1b) performs the best.

Miller (1977) argued that with the addition personal taxes, the advantage of tax deductions disappears, which might explain why these two models tend to be quite similar in their findings. To summarize, our results imply that risky debt models are preferred in the context of the return-leverage relationship. While Model (4b) produces the highest ratio of insignificant differences in ($\gamma_0-\gamma_0$*), the combined results along with all of the robustness tests conducted with ($\gamma_0-\gamma_0$*) and ($\gamma_1-\gamma_1$*) differences point to Model (1b) as the most accurate representation of the return-leverage relationship. Thus, the findings suggest that measure of the riskiness of debt should be incorporated in the estimation of K_E.

6. SUMMARY AND CONCLUSIONS

The purpose of this study is to test the theoretical relationship between leverage and the K_E directly. Previous studies of this relationship have not considered various types of market imperfections such as bankruptcy costs and taxes. This study examines the theoretical relationship between the K_E and the financial leverage derived originally by MM and later extended in the literature. Underlying our empirical tests is the estimation of the K_E using the CAPM. In simple terms, we estimate the empirical relationship using a linear regression and compare the OLS coefficients to their theoretical counterparts. We consider several theoretical models, each of which deals with a different combination of market imperfections. Specifically, the models differ from each other in terms of riskless versus risky debt, positive versus zero corporate taxes, positive versus zero personal taxes, and positive versus zero bankruptcy costs. Not only do we test for the sign of the K_E- leverage relationship, but we also compare the predicted values implied by each model to the observed values. For robustness purposes, we use several measures of financial leverage and other key variables such as taxes and bankruptcy costs. Our data from 182 industrial firms on the NYSE result in three findings. First, as theory states, the K_E is positively related with financial leverage, regardless of the market imperfections included in the model. Sensitivity tests also indicate that when we include various values for the corporate variables such as leverage and taxes as well as the market risk premium underlying the CAPM estimation of K_E, we obtain similar results. Second, risky debt models produce higher R^2 values than risk free models. In addition, market measures of financial leverage produce higher R^2 values than book measures of financial leverage. Third, risk free models produce much more significant differences between the OLS coefficients and their theoretical counterparts than their risky models. This result implies that the incorporation of risky debt in the K_E-leverage relationship is very important especially in markets that are experiencing risky debt crises. Model (1b), which incorporates risky debt, outperforms Model (4b), which includes risky debt as well as taxes and bankruptcy costs. This result may possibly stem from the measurement associated with the estimation of the additional variables in Model (4b).

Adjusting for risky debt and other market imperfections has important implications for financial practitioners. Managerial finance texts emphasize that K_E is part of a firm's WACC. In practice, the WACC helps managers determine the NPV of the firm's projects. Since this study shows that risky debt models are better representations of the K_E−L relationship than the traditional risk free models, ignoring the riskiness of debt that may bias the assessment of WACC, and consequently lead to incorrect capital budgeting decisions.

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APPENDIX

Appendix 1: Summary of financial leverage proxies

Authors	Proxy for L
Leary and Roberts (2014, JF)	Book Leverage=Total debt/total book assets and market leverage=Total debt/market value of assets
Chiu, Peña and Wang (2014, JF)	Leverage is total long-term debt divided by total assets
Chen et al. (2014, JBF)	Leverage is defined as the ratio of total assets to equity. They use the book measure of financial leverage and implied market measures
Agha and Faff (2014, JCF)	Market leverage is defined as the sum of long-term debt plus debt in current liabilities, all scaled by the market value of total assets. Book leverage is defined as the sum of long-term debt plus debt in current liabilities, all scaled by the book value of total assets
Giroud, Stomper and Westerkamp (2012, RFS)	Ratio of the book value of total debt to the book value of assets
Denis and McKeon (2012, RFS)	Total debt over total debt plus the market value of equity
Chang and Dasgupta (2009, JF)	Book debt/(Total Assets-Book debt) Book debt is defined as total liabilities+preferred stock- deferred taxes-convertible debt Book equity is then defined as total assets minus book debt. They drop firm-year observations where book leverage is negative or exceeds 1
Brav (2009, JF)	Short-term debt plus long-term liabilities/total assets They also use short-term debt plus long-term debt to total assets, as well as short-term debt plus long-term liabilities to net assets, and the results remain qualitatively similar
Sibilkov (2009, JFQA)	Total Debt/Total Assets Use book values for each of the variables
Frank and Goyal (2003, JFE)	Total debt/market value of assets Total debt/book value of assets Long-term debt/market value of assets Long-term debt/book value of assets
Billet, King and Mauer (2007, JF)	(LTD+Total current liabilities)/(Total Assets+Total market value of equity-book value of equity) The book value of total debt (long-term debt plus debt in current liabilities) divided by the market value of assets, where the market value of assets is estimated as the book value of assets minus the book value of equity plus the market value of equity
Francis, Khurana and Pereira (2005, AR)	Short-term debt plus long-term debt/total assets
Lord and Farr (2003, FM)	LTD/(LTD+preferred stock+market value of common equity)
Ghosh and Jain (2000, JCF)	(LTD+Current Liabilities)/(book value of debt+market value of equity)

The table details the type of financial leverage from which the proxy was derived and the specific paper that created these proxies. Further information about the construction of the specific variable is attached to each paper in the comments column