Why Does DCF Undervalue Equities?

Jacob Oded and Allen Michel

Academics and professionals frequently use the yield to maturity (YTM) as a proxy for the cost of debt when valuing firms using discounted cash flow (DCF). This paper demonstrates that this practice is incorrect because YTM is calculated based on promised cash flows, whereas the traditional DCF valuation of firms is based on expected cash flows. The correct cost of debt in DCF valuations of firms is the expected return on debt. Valuations of firms that use the YTM as the cost of debt underestimate the correct value. This distortion is particularly large for highly levered firms where the difference between YTM and expected return on debt is sizable. These results are demonstrated using the recent highly publicized leveraged buyout of Clear Channel Communications Inc. We show that if YTM rather than expected return on debt were used in the valuation process, the price offered for the shares would have significantly underestimated their fair value.

■A standard methodology for finding a firm's value is the discounted cash flow (DCF). With this approach, the firm's expected cash flows are discounted by the weighted average cost of capital (WACC).[1] It is a common practice to use the yield to maturity (YTM) as a proxy for the firm's cost of debt in this valuation process.[2] In this paper we demonstrate that this practice is flawed because the proper use of the YTM for the cost of debt requires that the cash flows being discounted are contractually promised by the firm, not merely the expected cash flows. In a DCF valuation of a firm, however, the cash flows being discounted represent the expectation of future cash flows, not a promise made by the firm to generate those cash flows. The correct cost of debt that should be used in a DCF valuation is the expected return on debt rather than the YTM. Failing to use the correct cost of debt can lead to significant distortion in the calculated value of the firm.[3] This distortion results in undervaluation of the firm and its equity.

Unlike the valuation of firms, the valuation of bonds can be correctly performed using either the YTM or the expected return on debt. This is because bonds have promised (contracted) payments. The value of a bond can thus be derived correctly by either discounting the promised cash flows at the bond's YTM or by discounting the bond's expected cash flow at its expected return. In contrast, in the valuation of a firm, cash flows are never contracted and can only be estimated. As a result, the DCF valuation of a firm is always based on

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The authors gratefully acknowledge the helpful comments of the Editor and an anonymous reviewer.

[1]Although other forms of the DCF exist to value firms (e.g. Capital Cash Flows, Cash Flows to Equity), this method is the most frequently applied. See for example, Mukerjee, Kiymaz and Baker (2004), Oded and Michel (2007), Fernandez (2004, 2007). For another perspective, see Cornell (2001).

[2]See, for example, Anderson, Mansi, and Reeb (2003), Brealey, Myers, and Allen (2006), Bruner (2004), Damodaran (2002), Weston, Mitchell, and Mulherin (2004) and Weston (2002).

[3]Adsera and Vinolas (2003) indicate that the promised yield should not be used in DCF valuations of firms, but focus on integrating valuation methodologies rather than on the correct cost of debt.

expected cash flows, with the correct cost of capital consisting of the expected return on debt, not the YTM.

In order to simply describe the proper valuation process, we first demonstrate the DCF valuation process for a bond, using both YTM and the expected return on debt. Next, we consider the DCF valuation of a firm. Here we show that only the expected return can be used for the cost of debt in the valuation, and demonstrate the distortion that results if the YTM is used instead. Our analysis suggests that the distortion is particularly large for highly levered firms because the gap between the YTM and expected return on debt is the most significant for such firms. Accordingly, we apply our argument to the highly publicized leveraged buyout of Clear Channel Communications Inc.

I. DCF Valuation of Bonds Using YTM and Expected Return

The following simplified example demonstrates the difference between the use of YTM and expected return on debt in the valuation of a bond. In this example, we ignore all market imperfections such as taxes, bankruptcy costs, and information asymmetry. Market imperfections are discussed in later sections of the paper.

A. Example 1: Valuation of a Risky Bond

AGW Inc. is developing a product aimed at reducing global warming. They are planning on issuing a one-year zero-coupon bond with face value of $500 million. At the end of the year, if the world continues to warm, AGW expects the public to continue to buy into the need for a global warming solution, in which case it is likely to sell the product successfully. In this case, it will repay the $500 million. If the world unexpectedly cools down during the year, AGW will likely be bankrupt, and the bondholders will not get the $500 million. Instead, it is estimated that the bondholders would get only $200 million (the salvage value of the assets). We assume that these are the only two possible states of the world, with probability of .7 that the product is likely to sell (continued global warming) and a probability of .3 that sales are unlikely (global cooling).

Here is some additional information:

- Because the risk of global warming is completely unsystematic, the risk of bankruptcy is completely unsystematic.[4]
- The current rate of interest on a one-year t-bill is 5% (risk-free rate, r_f).
- The expected market premium is 7% = $(E[r_m] - r_f)$.

[4]This simplifying assumption is without loss of generality and is relaxed later in the paper.

The following process is used to price the bond:
The expected cash flow is:

0.7*500 + 0.3*200 = $410 million.

Because the risk of the bond is completely unsystematic, $\beta_D = 0$. Thus using the CAPM, the correct discount rate for the project is

$$r_p = r_f + \beta_D(E[r_m] - r_f) = 5\%.$$

The correct price for the bond can be calculated using the expected return on debt, 5%, to discount the expected cash flow, $410 million,

410/1.05 = $390.48 million.

Thus, immediately following the issuance of the bond, it would trade at a price of $390.48 million.

The YTM is defined as the discount rate that, when applied to the promised cash flows, results in the bond price. If the bond price is known, this price can be used to determine the YTM. For example, in this case it is calculated as (($500/390.48) – 1) = 28.05%, where $500 is the promised cash flow. If one did not have the price of the bond, the price is frequently calculated from the imputed yield to maturity associated with the bond's rating, where the YTM is inversely related to the bond's rating. It is important to note that, by definition, if the bond price is calculated using the YTM as the discount rate, the proper cash flow to discount is the promised cash flow ($500 million), not the expected cash flow ($410 million). In other words, the value of a bond can be calculated using either the firm's expected cash flow discounted by the expected return on debt or the promised cash flow discounted by the YTM. In the previous example, assuming the YTM is obtained, the bond price could be determined as follows:

500/1.2805 = $390.48 million.

Thus, both approaches result in the correct bond valuation. As long as the calculation is performed consistently, either approach will lead to the correct value.

The expected cash flow arising in a risky bond valuation incorporates the possibility of distress since, by definition, the expected cash flow probabilistically weighs all possible outcomes. The appropriate discount rate for the bond's expected cash flow is the expected return on debt calculated using the CAPM, where this discount rate compensates only for the market risk of the bond. However, unlike the expected cash flow, the promised cash flow does not account for the scenario of distress. It only includes the outcome of full repayment of principal, and does not include any of the likely outcomes of less than full repayment associated with distress. In situations of distress, the bond's YTM must be high enough to compensate for the fact that the promised cash flow does not account for the possibility that the firm will not pay the entire promised amount.

More generally, this points to caution when thinking about rates on bonds. The yield to maturity is not the expected return on the bond. The yield is the maximum return on the bond. This is an important point and is the source of much confusion regarding debt financing. Failing to acknowledge this difference can lead to significant distortion in the valuation of the bond.

Suppose we again consider Example 1 to determine a bond's value. The use of YTM to discount expected cash flows or the use of expected return on debt to discount promised cash flows will result in an incorrect bond price. Using the YTM in this example as the discount rate to value the expected cash flows to the bond holder results in the bond's calculated value of

$$410/1.2805 = \$320.19 \text{ million.}$$

This results in a valuation distortion of about 390 – 320 = \$70 million, or approximately 18%.

The greater the difference between the expected return on debt and the YTM, the greater the valuation distortion will be. The degree of distortion from using YTM instead of expected return on debt depends on both the probability of default and on the recovery rate to debt holders in the case of default. In Example 1, the probability of default is assumed to be 0.3 and the recovery rate is 0.4 = 200/500. The higher the default rate and the lower the recovery rate, the more significant the gap between the YTM and the expected return will be, and the greater the distortion. Figures 1 and 2 demonstrate these arguments graphically.

Figure 1 depicts the effect of the probability of default on YTM and cost of debt in Example 1. Panel 1A demonstrates how the gap between the YTM and expected return on debt widens with increases in default probability. Panel 1B demonstrates the valuation distortion when YTM is used instead of the expected return on the debt in the DCF valuation of the bond. The distortion increases with the probability of default. The figure suggests that the distortion is likely to be particularly troublesome for bonds of distressed firms, where the probability of default is large, resulting in a large difference between expected return on debt and YTM.

Figure 2 describes the effect of the recovery rate on YTM and cost of debt in the valuation described in Example 1. Panel 2A demonstrates that the gap between YTM and the expected return on debt increases as the recovery rate from default decreases. Panel 2B illustrates that when YTM is used instead of expected return on debt, the valuation distortion increases as the recovery rate from default decreases. In practice, a key driver of the recovery rate is the firm's industry. While some industries, particularly those with tangible assets (i.e. commercial real estate) may have relatively high recovery rates, other industries with substantial intellectual property may have lower recovery rates.

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II. DCF Valuation of Firms – The Inappropriateness of YTM

While the prior section demonstrates the distortion that can result from the improper use of YTM in bond valuation, it is in corporate valuations where this distortion most frequently arises. This is because standard DCF corporate valuations are generally based on expected cash flows, and hence the YTM is never appropriate.

In this section, we consider the valuation of a levered firm, introducing corporate taxes and systematic risk associated with the firm's debt. We show that if YTM is erroneously included as the cost of debt in the WACC calculation, the resulting firm value is distorted. Without loss of generality, we focus on the traditional DCF valuation procedure and we use the free cash flow valuation method (FCF). With this method, the expected cash flow corresponding to an all equity financed firm is discounted at the weighted average cost of capital (WACC). As in the previous section, we demonstrate our insights using a numerical example.

A. Example 2: Valuation of a Levered Firm

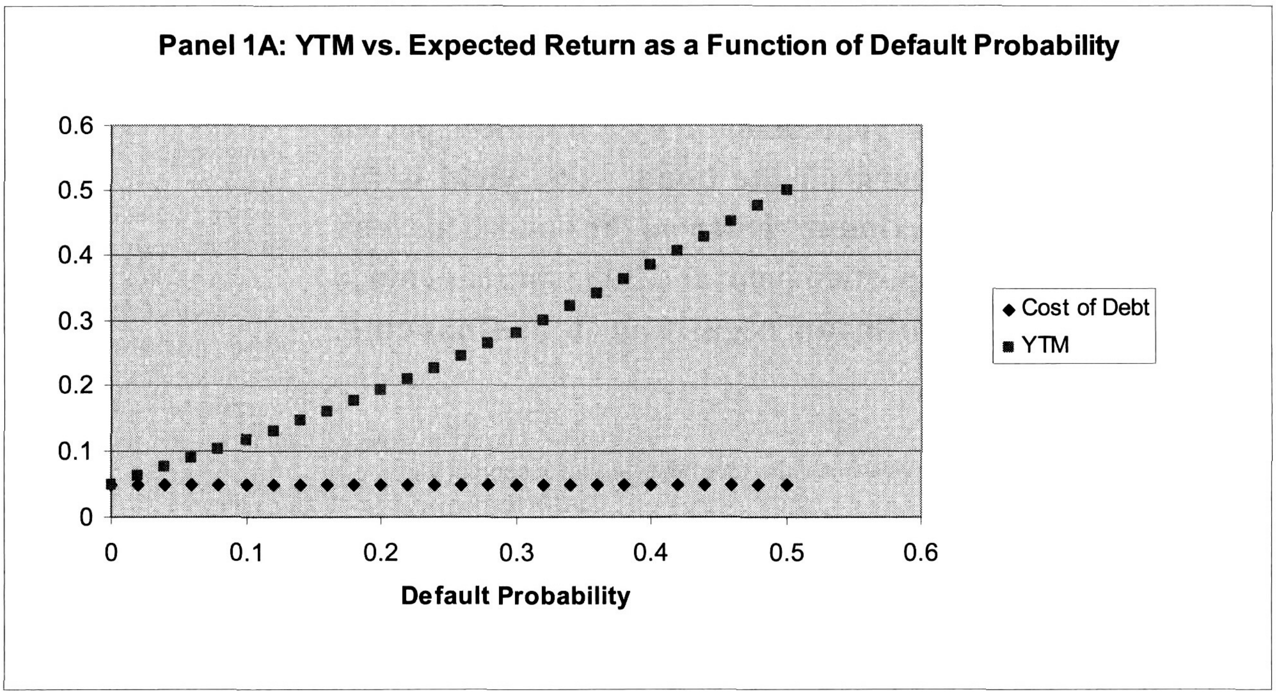
Consider a firm that has expected cash flow of \$100 million per year. The firm has debt with a beta β_D of 0.2 and finances itself with 60% debt, namely, D/V=60%. The asset (unlevered) beta, β_A, is equal to 1.2. The firm's tax rate is T = 0.35, and the market risk of the firm's debt is assumed not to vary with leverage. For simplicity we assume that the firm operates in perpetuity. Assuming a risk free rate of 5% and a risk premium of 7%, the implied cost of debt is

$$r_D = 5 + 0.2*7 = 6.4\%.$$

By levering the asset beta and assuming 60% debt financing,

Figure 1: DCF Valuation of a Bond: YTM and Valuation Distortion as a Function of Default Probability.

This figure depicts the effect of the probability of default on the YTM and on the valuation in Example 1. Panel 1A demonstrates how the gap between the YTM and the expected return on debt widens with the probability of default. Panel 1B demonstrates the valuation distortion when YTM is used instead of the expected return on the debt in the DCF valuation of the bond. It is shown that the distortion ($millions) increases with the probability of default.



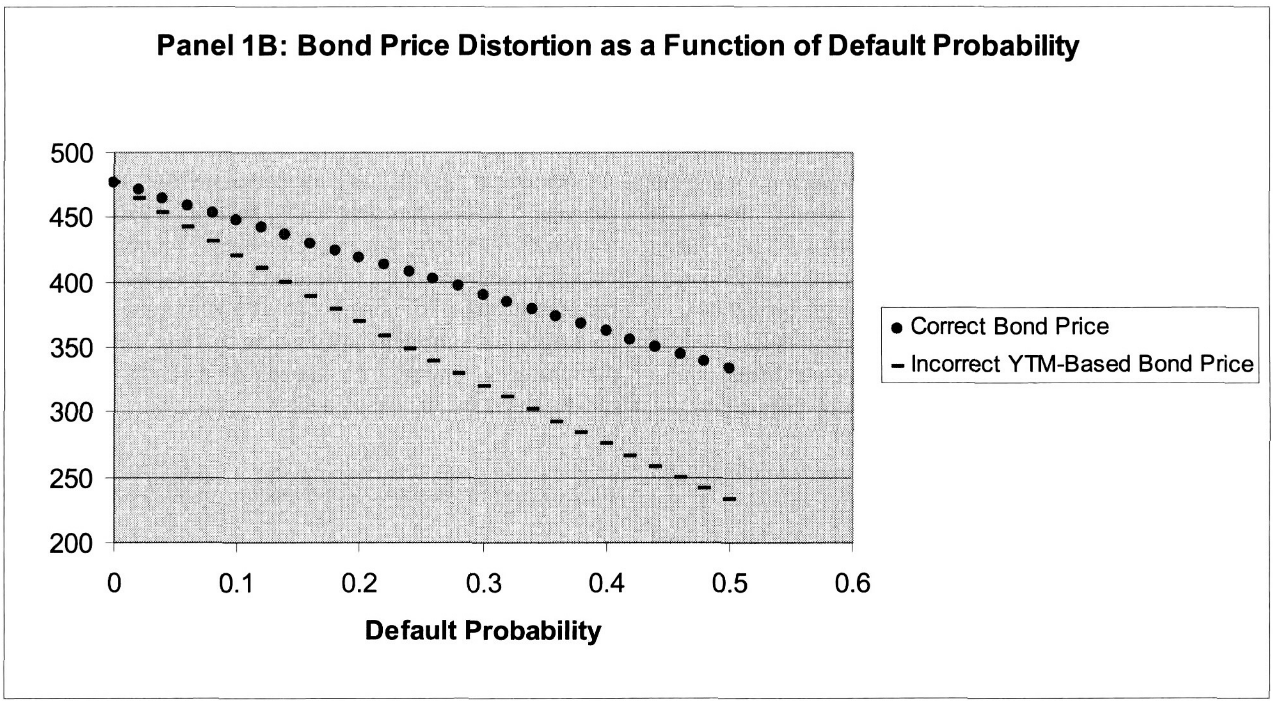
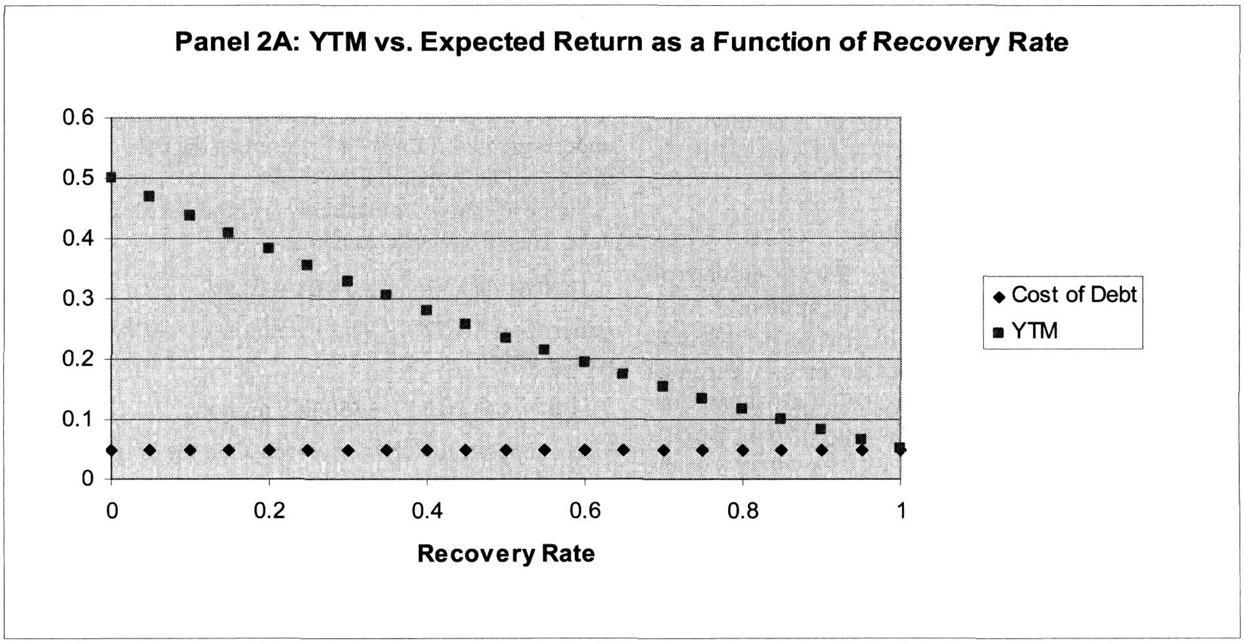
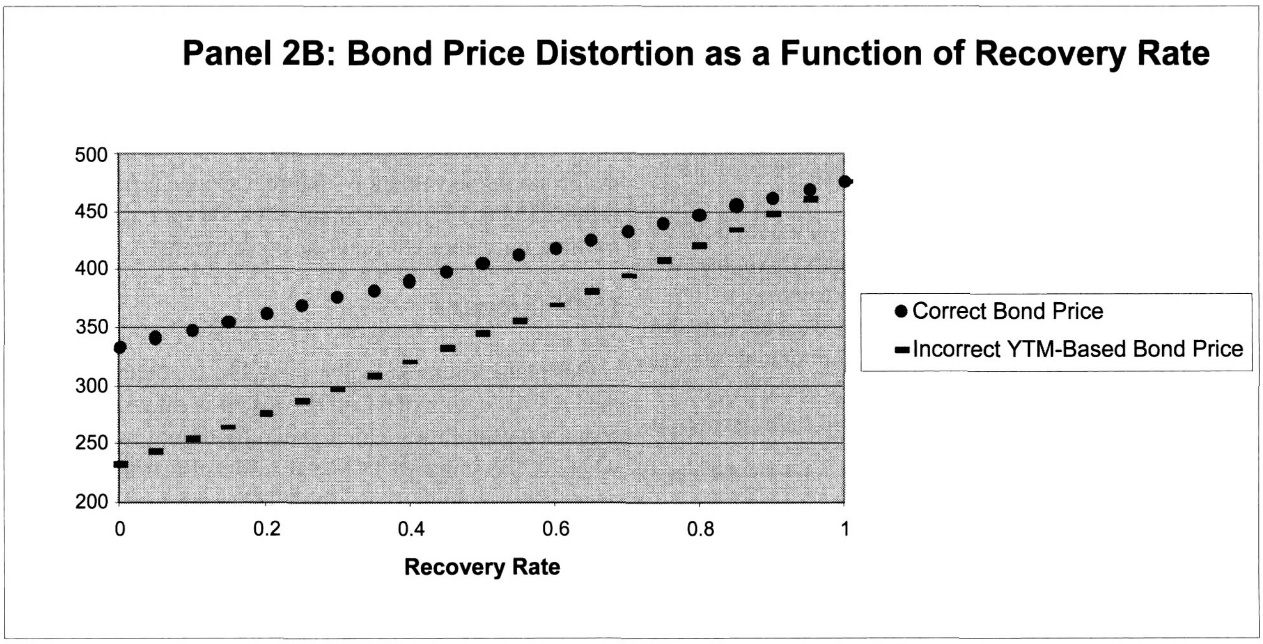


Figure 2: DCF Valuation of a Bond: YTM and Valuation Distortion as a Function of Recovery Rate from Default.

This figure depicts the effect of the recovery rate from default on the YTM and on the valuation in Example 1. Panel 2A demonstrates how the gap between YTM and the expected return on debt increases as the recovery rate from default decreases. Panel 2B demonstrates that when YTM is used instead of the expected return on the debt as the cost of debt, the valuation distortion ($ millions) increases as the recovery rate from default decreases.





we find the equity beta to be[5]

$\beta_E = \beta_A + (1\text{-}T)(D/E)(\beta_A - \beta_D) = 1.2 + 0.65(0.6/0.4)*(1.2 - 0.2) = 2.18$,

and using the CAPM

$r_E = 5 + 2.18*7 = 20.23\%$.

The WACC, representing the weighted average after tax cost of debt and equity, is thus

$WACC = r_D(1\text{-}T)(D/V)+r_E(E/V) = 6.4\%*0.6*(1 - 0.35) + 20.23\%*0.4 = 10.59\%$.

The valuation of the firm using the FCF method, and assuming a perpetuity, is the firm's EBIAT divided by its WACC, or

(100*0.65) / 0.1059 = $614.02 million.

The value of equity is thus 0.4*$614.02 = $245.61 million and the value of debt is 0.6*$614.02 = $368.41 million.

The expected payment to debt holders is 6.4%* $368.41 = $23.58 million. This leaves expected pre-tax earnings available to equity holders of $100 - $23.58 = $76.42 million. The after-tax cash flow to equity is thus $76.42*0.65 = $49.67 million. Note that this cash flow is consistent with the valuations of the equity and debt that we have found. Indeed, discounting the cash flow to equity at the cost of equity yields $49.67/ 0.2023 = $245.61 million, whereas discounting the cash flow to debt at the cost of debt yields $23.58/0.064 = $368.41 million. Also note that while the expected payment to the firm's debt holders is $23.58, the promised cash flow to debt must be higher. This is driven by the positive default risk and partial recovery in case of default. In other words, the firm must have promised more than $23.58 to be received by the debt holder. Thus, in order to raise $368.41 of debt, the firm would have had to promise debt holders a cash flow high enough above $23.58, such that the expected cash flow to debt would be $23.58.

We can estimate the promised cash flow that debt holders will require for any given yield to maturity. Suppose we impute the YTM from bonds with comparable ratings as 10%.[6] Given our assumption of perpetual debt, we can calculate the promised cash flow to debt holders. The contractual interest is the YTM on this perpetual debt which is equal to 368.41 * 10% = $36.841 million per year compared to the expected cash flow to debt of $23.58 million.[7] Thus, assuming a yield to maturity of 10%, the promised contractual interest is 56.2% greater than the expected rate.

Furthermore, because the firm is highly levered, its cost of capital is heavily weighted by its debt component. Consequently, the cost of debt has sizeable influence on both the WACC calculation and on the valuation. Should a flawed cost of debt be used, the calculated value of the firm will also be flawed. In this situation where a high risk of insolvency and low expected recovery exist, a high YTM relative to the expected return on debt will result. Furthermore, the WACC will be significantly overestimated and the value of the firm underestimated if the YTM is used as the cost of debt in the traditional DCF calculation.

Suppose that we mistakenly use the YTM as the cost of debt. Then the WACC becomes

10*0.6*(1-0.35) + 22.5*0.4 = 12.9% ,

rather than 10.59%. The valuation of the firm using the wrong WACC is

(100*0.65) / 0.129 = $503.88 million.

This is approximately 18% lower than the correct valuation of $614.02 million.

Figure 3 demonstrates the distortion in valuation when the YTM is used instead of the CAPM-based cost of debt in Example 2 at different levels of YTM. In the figure, the horizontal line represents the value of the firm ($614 million) when calculated correctly using the DCF method based on the expected cost of debt 6.4%. The downward sloping line depicts the incorrect value of the firm when calculated based on the YTM for different values of YTM. When the YTM is identical to the expected return on debt (6.4% in Example 2) there is no distortion in the firm value. The greater the gap between YTM and expected return, the greater will be the distortion in the valuation. Figure 3 shows, for example, that if the YTM is 13%, the valuation yields approximately $500 million, only about 80% of the correct value.

B. Discussion

Our main argument is that the YTM is not appropriate for the DCF valuation of a firm because it is calculated based on promised cash flows which generally do not exist for firms, whereas the standard DCF valuation of a firm is based on expected cash flows. Using the YTM as the cost of debt results in penalizing the firm twice for the same factor – the default risk – once in the numerator (cash flows are expected rather than promised), and once in the denominator (discount rate is the yield rather than the expected return). As a result, the

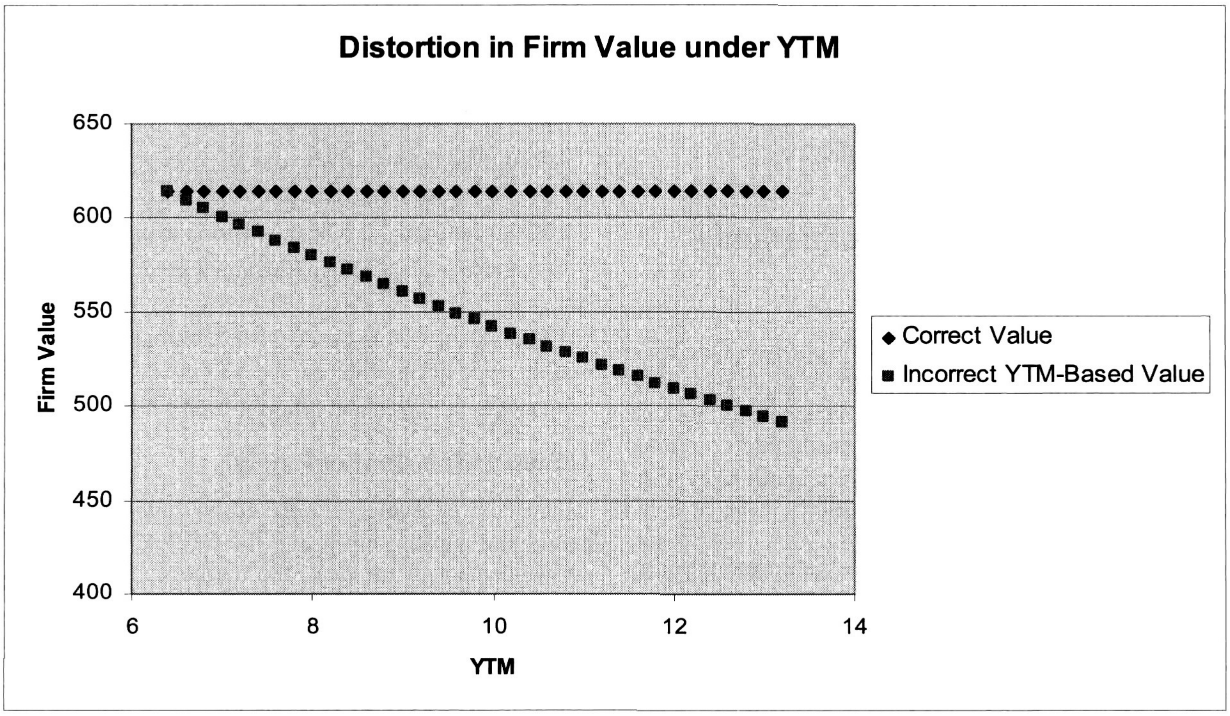
[5] This formula assumes fixed debt. Alternatively, if the firm is assumed to rebalance its debt, the relation $\beta_E = \beta_A + (D/E)(\beta_A - \beta_D)$ should be used. See, for example, Ruback (2002)).

[6] In practice at a D/E ratio of 0.6/0.4 = 150%, which is the debt ratio assumed in this example, debt is generally rated at BB. For this credit rating a spread above the risk free rate of 10% - 5.0% = 5.0% is reasonable. See, for example Weston et al. (2004), and Altman et al. (2006).

[7] We assume bonds are issued at par.

Figure 3: DCF Valuation of a Firm: Distortion when YTM is Used for the Cost of Debt.

This figure demonstrates the distortion in valuation ($ millions) when the YTM is used instead of the CAPM based cost of debt in the WACC when performing a valuation of the firm in Example 2. This figure demonstrates that the wider the gap between YTM and expected return, the greater the valuation distortion.



DCF valuation of a firm that uses the YTM instead of expected return underestimates the correct value.

As shown earlier in Figure 1, the gap between YTM and the expected return on debt (the correct cost of debt) increases with the likelihood of default. The greater the probability of default, the wider is the spread between expected return on debt and YTM. Only if the firm has a zero probability of defaulting is it correct to use YTM as cost of debt in a DCF valuation of a firm. In such a situation, the promised (maximum) payment is equal to the expected payment and the YTM would theoretically be identical to the CAPM based discount rate.[8]

Unfortunately, no firm has zero default risk. This insight, however, helps understand where the distortion in valuation is likely to be significant and where it might well be ignored. Namely, the higher the probability of default, the larger the difference between the expected cash flows and the maximum cash flows to debt holders. Hence, the larger the difference between the YTM and the return on debt, the greater the distortion when using the YTM in the firm's cost of capital. The firm's credit rating frequently serves as a proxy for the probability of default. Accordingly, it is reasonable to use the YTM when calculating the cost of capital for a firm with a solid debt rating (e.g. AAA) but not for a firm with a low debt rating (e.g. CCC).[9]

In practice, there are often factors for which the CAPM does not account, such as bankruptcy costs, liquidity premium, the effect of state taxes and call provisions which may have a significant affect on the firm's value. The YTM accounts

[8] Figure 2 suggests that the gap between YTM and expected return increases not only with the probability of default but also in the recovery rate. We are not aware of any studies that investigate the relation between the recovery rate and the YTM and suggest this as a direction for further research.

[9] We should acknowledge that the gap between YTM and expected return on debt also depends on the market risk of the debt (which we abstracted from in Example 1, but did account for in Example 2). Other things equal, the lower the market risk of the debt, the wider the gap. However, as discussed earlier, debt generally has very low market risk. Moreover, unlike the market risk of equity, there is very low variability in market risk and expected return on debt across firms (Cornell and Green (1991)), rendering this factor less significant for our analysis.

for these factors because it builds on the market price of debt which, in turn, incorporates all relevant factors.[10] However, the natural place to adjust for these factors in a firm's DCF valuation is the expected cash flow rather than the discount rate. Bankruptcy costs, for example, are expected losses *from* default, and hence should be factored into the firm's expected cash flows. Moreover, in the event they are not incorporated into the DCF analysis, available research suggests that the distortion associated with bankruptcy costs is generally small.[11]

We elaborate on these factors in Section IV.

III. Application – Valuation of a Highly Levered Firm

The previous discussion suggests that in practice if the YTM is used as the cost of debt, the distortion in valuation would be greatest for highly levered firms. This results because default probability and credit ratings are highly correlated with leverage.[12] During periods of severe credit tightening, both large and small to mid-size transactions are affected by the structuring of the leveraged transactions, with fewer transactions being funded and less debt being included in all such transactions. However, during robust economic times most leveraged buyouts will have sufficient debt to downward bias the calculated value of the transaction if yield-to-maturity rather than expected return is used as the cost of debt. The use of YTM would have reduced the calculated value of most recent large LBOs, including TXU, HCA, Albertson's, Hertz, and Harrah's Entertainment.

In order to demonstrate the relevance of the issues we have described, we consider the valuation of a recent highly levered transaction – the leveraged buyout of Clear Channel Communications Inc. (Ticker CCU). Our analysis is based on the information available on November 16, 2006, the date of the definitive merger agreement with an investor group led by private equity firms Thomas H. Lee Partners, L.P. and Bain Capital Partners, LLC.

A. Valuation of Clear Channel's Leveraged Buyout

Clear Channel is a media company that owns and operates radio stations. At the time of the merger announcement (November 16, 2006), Clear Channel agreed to be acquired for $18.7 billion in cash, or $37.60 a share. Including $8 billion of debt repayment, the deal carried a total value of $26.7 billion.[13] In the analysis to follow we consider the distortion that may have resulted if the YTM were used instead of the expected return on debt in the calculation of the deal value. We show that this distortion is significant.

The following assumptions are made in the analysis:

- Risk free rate – 5.07%, the 10 year government rate at the time of the announcement of the deal.
- Risk premium – 7.5%, the historic average.
- Tax rate – 35%, Clear Channel's assumed marginal tax rate.
- Equity beta before the deal – 0.78 calculated based on the market price during the year prior to the deal.
- Debt beta before and after the deal – 0.2.[14]

1. Step 1: The Cost of Equity

The cost of equity is derived by levering the beta of equity and substituting it into the CAPM. Just prior to the announcement of the deal, the market value of the equity was $15.23 billion, and the debt value was estimated to be $8 billion. This suggests that the firm's debt ratio before the deal is 34%. To obtain the post-deal cost of equity, we first unlever the pre-deal equity beta, then relever the unlevered beta, taking into account the post-deal capital structure. Unlevering the equity beta using the standard levering relationship

$$\beta_E = \beta_A + (1\text{-}T)(D/E)(\beta_A - \beta_D)$$

yields $\beta_A = 0.63$. The information released in the deal announcement suggests that after the buyout, Clear Channel would have $21.5 billion of debt and the rest, $26.7 - $21.5 = $5.2 billion would consist of new equity financing provided by the private equity group. This information indicates that following the buyout, the firm will be 80% debt financed. Levering the equity beta at 80% debt financing using the above levering relationship yields $\beta_E = 1.79$. Upon substitution into the CAPM, $r_E = 18.53\%$.

[10] For the effects of bankruptcy costs, liquidity, and state taxes on the spread see, for example, Yagil (1987), Elton et al. (2001) and Chen et al. (2007). On the costs of call provisions see, for example, Mann and Powers (2007).

[11] See, for example, Altman (1984), and Elton et al. (2001)).

[12] Arzac (1996) discusses problems associated with DCF valuation of highly leveraged firms but does not focus on the correct estimation of the cost of debt.

[13] In May 2007 the offer price was raised to $39.20 per share reflecting total value of $27.5 billion in a more complex payment form that included an equity stub. Because of tightening credit markets and ensuing litigation, on May 13, 2008 the price was lowered to $36 per share. For consistency of analysis, we utilize the initial agreement information released on November 16, 2006. Using the final price does not change the results significantly.

[14] Cornell and Green (1991) findings suggest that the beta of levered firms is within the range 0.2 - 0.3. The beta of debt does not change much with leverage as bankruptcy risk is mostly non-systematic.

2. Step 2: WACC Using YTM

Because the post-transaction firm was to be private, the particular terms of the debt financing, specifically the yield, would not be publicly available. However, at 80% debt financing, Clear Channel debt would be high-yield. The spread on high-yield debt at the time of the buyout announcement was about 3% (November 16, 2006). We assume this spread is also the spread on Clear Channel's debt, implying that the debt financing is issued at YTM of 5.07 + 3 = 8.07%. Using r_E = 18.53% and r_D = 8.07%, the YTM-based WACC is

8.07%*(1-0.35)*0.80+ 18.53*0.20 = 7.83%.[15]

Using the YTM as the cost of debt results in penalizing the firm twice for the same factor – the default risk – once in the numerator (cash flows are expected rather than promised), and once in the denominator (discount rate is the yield rather than the expected return). As a result, the DCF valuation of a firm that uses the YTM instead of expected return underestimates the correct value.

3. Step 3: WACC Using Expected Cost of Debt

Next we calculate the value of Clear Channel using the correct WACC which is based on the expected return on debt. For Clear Channel, this cost can be calculated using the CAPM as

5.07 + 0.2*7.5 = 6.57%,

where 5.07% is the risk free rate, 0.2 is the assumed debt beta of Clear Channel, and 7.5% is the market premium. Accordingly, the correct WACC is

6.57*(1 - 0.35)*0.80 + 18.53*0.20 = 7.05%.

Note that this WACC is lower than the YTM-based WACC (7.83%). We then apply the correct WACC to the same cash flow stream as in the YTM-based valuation.

4. Step 4: DCF Valuation of Clear Channel as a Function of Growth Rate and WACC

The cash flow from operating and investing activity at the end of 2006 is $1,200 million (based on the 2006 financial reports submitted to the SEC). We will make a simplifying assumption that the cash flow stream in the valuation is a growing perpetuity. Namely, we will assume that the year 2006 cash flow of $1,200 million is expected to grow at a growth rate g. For any g we can calculate the implied firm value as

$$V = CF_0*(1+g) / (WACC-g),$$

where V is the estimated value of Clear Channel and CF_0 is the year 2006 cash flow of $1.2 billion. In Figure 4 we plot the value of Clear Channel as a function of the firm's cash flow growth rate for both the incorrect YTM-based WACC and the correct expected return-based WACC. The figure considers growth rates in the range 1% to 5%. As can be observed from the figure, the YTM-based value is always lower than the expected return -based value. This is because the YTM-based WACC (7.83%) is higher than the expected return based WACC (7.05%). In addition, the greater the growth rate, the more significant the effect of an error in the WACC on the discount rate. Hence, the greater the distortion in the valuation when the YTM-based WACC is used instead of the expected return on debt-based WACC.

5. Step 5: Valuation of the Deal: YTM vs. Expected Return on Debt

The initial offer to the shareholders made on November 16, 2006 reflected a firm value of $26.7 billion. We now use this valuation as a benchmark to demonstrate the significance of the distortion that results from the incorrect use of YTM as the cost of debt in the DCF analysis.

Because the methodology used to determine the valuation of $26.7 billion is not revealed in public documents, we analyze two possible scenarios in order to demonstrate the distortion that can result from a DCF analysis:

Scenario 1: The valuation of $26.7 billion was performed based on the correct WACC of 7.05%. For this scenario, we calculate the incorrect valuation that would have resulted if the wrong WACC of 7.83% had been used instead.

Scenario 2: The valuation of $26.7 billion was performed based on the incorrect WACC of 7.83%. For this scenario we calculate the correct valuation if the correct WACC of 7.05% is used.

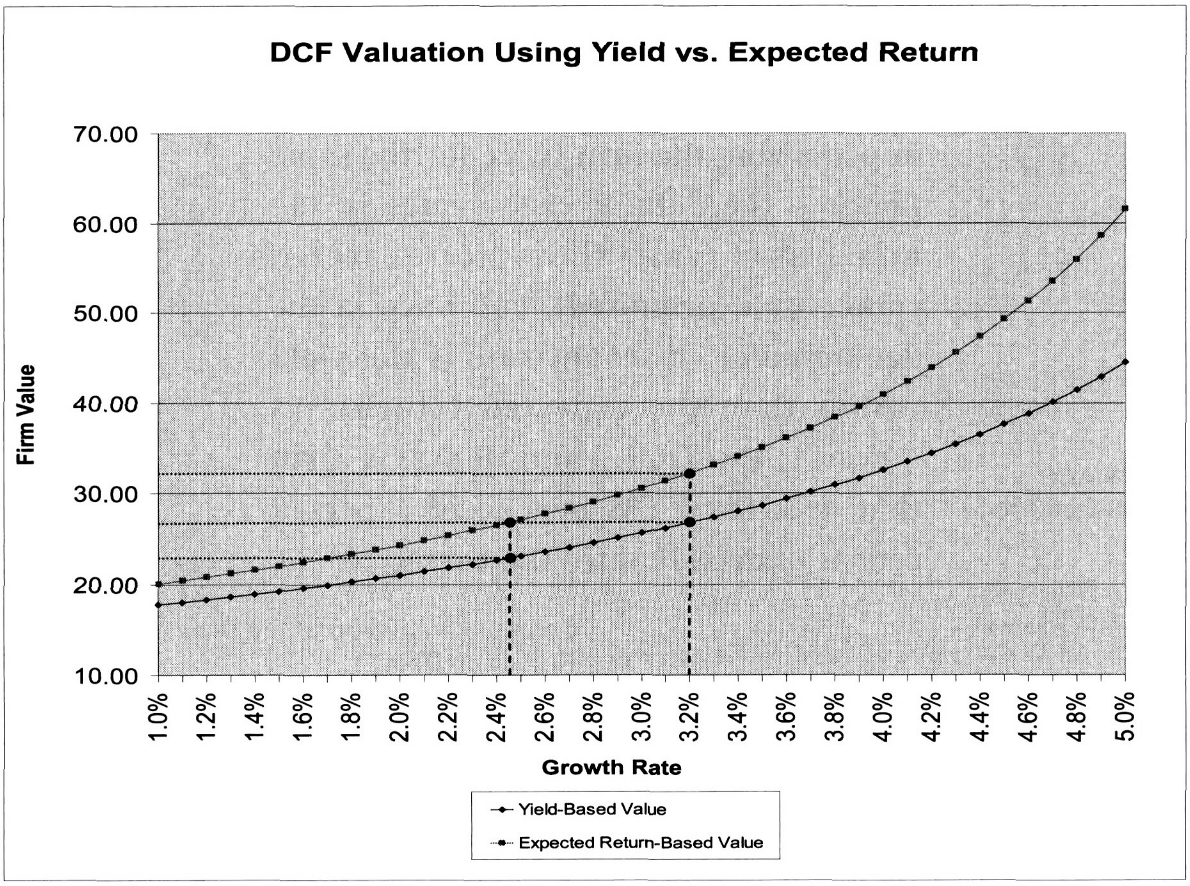
In both scenarios, the distortion in the valuation is reflected in the difference between the value calculated based on the correct WACC and the value calculated based on the incorrect WACC. For simplicity of exposition, we calculate the distortion graphically using Figure 4. The corresponding algebraic calculations are provided in the illustration: "Clear Channel: An Example of the Distortion in Valuation".

Distortion in the Valuation of Clear Channel under

[15]Numerical differences in this example due to rounding.

Figure 4: Clear Channel Example - DCF Valuation Using Yield vs. Expected Return in the Cost of Capital (WACC) as a Function of the Assumed Growth Rate.

The top curve represents the correct valuation of Clear Channel ($ billions) whereas the bottom curve represents the incorrect valuation of Clear Channel.



Scenario 1:
Given that the value of $26.7 billion was obtained using the correct WACC of 7.05%, the growth rate that was assumed in the valuation (under the assumption that cash flows are a growing perpetuity) can be derived from the upper line in Figure 4. Namely, the growth rate that corresponds to the value of $26.7 billion using the upper line in Figure 4 is 2.45%. That is, since the upper line reflects the valuation that is based on the correct WACC, we can use this line to impute the growth rate (2.45%) assumed in the correct valuation of the firm. The incorrect value that would have resulted if the wrong WACC of 7.83% was used can be calculated graphically using the lower line in Figure 4. Namely, using the lower line, the value that corresponds to the growth rate of 2.45% is only $22.9 billion.

Thus, under the wrong WACC, the value is approximately 14% lower than the $26.7 billion value determined using the correct WACC. This implies that given an assumed yearly cash flow growth rate of 2.45% and pre-deal debt financing of $8 billion, a wrong YTM-based valuation would have indicated that the selling shareholders should receive $22.9 – $8 = $14.9 billion for their shares rather than $18.7 billion. On a per share basis this amounts to $29.95 rather than the deal offer of $37.60 per share. The use of the YTM-based WACC results in a valuation that is too low and adversely affects the selling shareholders.

Distortion in the Valuation of Clear Channel under Scenario 2:
Given that the value of $26.7 billion was obtained using the

Clear Channel: An Example of the Distortion in Valuation

Algebraic Calculation

First, consider the scenario in which the correct WACC of 7.05% is incorporated into the valuation (Scenario 1). In this case we can derive the growth rate that was imputed by the $26.7 billion offer using

$$V = CF_0*(1+g)/(WACC-g),$$

which can be rearranged to

$$g = V*WACC/(V+ CF_0).$$

Given V= $26.7 billion, CF_0 = $1.2 billion, and an expected return on debt-based WACC of 7.05%, we find an imputed long-term growth rate, g = 2.45%. If this g were used together with the YTM-based WACC of 7.83%, the value calculated for Clear Channel would have been:

$$1.2*(1.0245)/((0.0783-0.0245) = \$22.9 \text{ billion}.$$

Alternatively, suppose the valuation is performed using the incorrect YTM-based WACC, 7.83% (Scenario 2). Inputting this WACC into the standard valuation model above and solving for g yields a long-term growth rate of 3.19%. Indeed using this growth rate with the incorrect WACC results in

$$1.2*(1.0319)/((0.0783-0.0319) = \$26.7 \text{ billion}.$$

With this growth rate, the value of Clear Channel using the correct WACC is

$$1.2*(1+0.0319)/(0.0705-0.0319) = \$32.1 \text{ billion}.$$

incorrect WACC (again under the assumption that cash flows are a growing perpetuity), a growth rate of 3.19% is derived from the lower line in Figure 4. That is, since the lower line reflects the valuation that is based on the wrong WACC, we can impute the growth rate of 3.19% using this line. Assuming that this growth rate is correct, the correct value can be calculated graphically using the upper line in Figure 4. Namely, using the upper line, the value that corresponds to a growth rate of 3.19% is $32.1 billion.

Thus, if the valuation based on the $26.7 billion offer price was calculated using the wrong WACC, then under the correct WACC, the valuation is about 20% higher, or $32.1 billion. This suggests that given the assumed cash flow stream and the pre-deal debt financing of $8 billion, the selling shareholders should receive $32.1 – $8 = $24.1 billion for their shares rather than $18.7 billion. On a per share basis, this amounts to $48.50 rather than the deal offer of $37.60 per share. Again, the YTM-based WACC results in a valuation which is too low and adversely affects the selling shareholders.

After the bidding for Clear Channel started, the bidding group raised its offer by $1.60 to $39.20 per share which, given the assumption of $8 billion of debt, reflects a deal value of $27.5 billion instead of the initial offer of $26.7 billion. Repeating the above analysis using an offer of $27.5 billion does not change the results significantly.[16] Yet the significant deterioration in the credit markets caused the banks to refuse to finance the transaction at the original terms. The deal eventually closed at $36 per share, which is $1.60 below the initial offer price. Repeating the analysis using this closing price also does not change the results significantly. However, note that any change in the value of Clear Channel caused by the ensuing credit crisis is not incorporated in this analysis.

IV. Practical Implications and Implementation

A. Estimating the Expected Return on Debt - YTM vs. CAPM

Our analysis demonstrates that the use of YTM as the

[16] Instead of growth rates of 2.45% and 3.19% the imputed growth rates are 2.32% and 3.32%. If the valuation of $27.5 billion is correct, then an incorrect valuation which uses the YTM would have resulted in the value $23.4 billion, about 15% lower than the correct value (instead of 14% lower based on the initial offer of $26.7 billion). Alternatively, if the valuation of $27.5 billion was performed incorrectly using the YTM, the correct valuation is $33.2 billion, about 21% higher (instead of 20% higher based on the initial offer of $26.7 billion).

cost of debt in the standard DCF valuation is conceptually wrong. Since the expected return on debt should be used as the debt cost, we estimate the cost of debt using the CAPM. Practitioners, however, have been reluctant to use the CAPM for this purpose. Although debt betas have been widely available, practitioners broadly use YTM as the cost of debt in their DCF valuations. In this section we present several practical reasons why CAPM is potentially more advantageous than YTM in DCF valuations. However, we also indicate that practitioners may benefit from using both as measures for the cost of debt and suggest how to improve the estimation of the cost of debt.

The empirical evidence suggests that YTM should not be used as the cost of debt for low-grade (high-yield) debt because a significant component of the YTM reflects diversifiable risk. For example, Altman and Hotchkiss (2006, Table 7.15) document that the spread between the average annualized YTM on high-yield debt and the 10 year treasury over the years 1978 – 2004 to be 4.9% whereas the spread between the average realized return on 10 year treasury bonds and the average realized return on high-yield debt over the same period is only 2.36%.

Indeed, while the YTM significantly differs between low-grade debt and high-grade debt, Cornell and Green (1991) show that the realized return on low-grade and high-grade debt portfolios are similar, suggesting that most of the bankruptcy risk associated with low-grade debt is diversifiable and hence does not result in a risk premium. This is consistent with their findings that the market risks, as evidenced by the betas of low-grade debt and high-grade debt, are not much different. Relative to low-grade debt, high-grade debt has a higher component of market risk that originates in its higher sensitivity to interest rate changes but lower component of market risk that originates in its lower sensitivity to the stock price.[17] In the aggregate, the overall market risk of high-grade debt and low-grade debt is similar.

One reason why practitioners are reluctant to use the CAPM in order to estimate the cost of debt is that debt betas for high-yield debt seem too low and hence result in underestimation of the cost of debt. Indeed, assuming a market premium of 7.5%, and a debt beta of 0.2 (see Footnote 13), the spread between high-yield debt and treasury bonds implied by the CAPM is only 7.5%*0.2 = 1.5%, whereas the historic spread between the average realized return on high-yield debt and treasury bonds is higher (at 2.36% according to Altman and Hotchkiss, as indicated in the previous paragraph).[18]

While the CAPM may underestimate the cost of debt, as previously demonstrated, the YTM overestimates the expected return on high-yield debt. If YTM overestimates the cost of debt while CAPM underestimates the cost of debt, analysts would benefit from using both approaches to get bounds on the valuation.

Although the CAPM is an incomplete measure of the cost of debt, it could serve as a basis for a more accurate model for estimating the cost of debt. For equity, empirical evidence suggests that small company stocks have had returns in excess of those implied by the betas of small stocks (see Harrington, 2007, page 130). Consistent with these findings, Fama and French (1995) show that adding factors for firm size and book-to-market significantly improve the explanatory power. It is possible that the CAPM-based estimation of the expected return on debt could be improved by adding factors such as bankruptcy costs, liquidity, and state taxes in the same way that Fama-French factors improve the CAPM-based estimation of the expected return on equity.

Consider bankruptcy costs first. Average bankruptcy costs account for 2.45% of the pre-distress firm value (see Altman and Hotchkiss, 2006, Table 7.7). If these costs are not included in the expected cash flows, adding a factor to the CAPM-based cost of debt could improve the estimation.[19] Liquidity is another factor that affects the cost of corporate debt and it is not accounted for by the CAPM. Corporate debt is much less liquid than risk free (government) debt, and hence a premium may be justified. Furthermore, the market for low credit debt (high-yield) is significantly less liquid than the market for high credit debt (see, for example, Stern 2003). State taxes are another factor which is not accounted for by the CAPM. Risk free (government) debt is tax exempt at the state level, while corporate debt is not (see Elton et al 2001). This tax differential increases the cost of corporate debt relative to government debt. Because size and book-to-market have been shown to improve the CAPM for equity, they are also natural factors to consider for improving the CAPM for debt.

B. Promised Cash Flows vs. Expected Cash Flows

The connotations of expected cash flows are not the same for debt as they are for equity. For debt, either promised cash flows are paid or the bond defaults. Furthermore, unlike in our

[17] High-grade debt is more sensitive than low-grade debt to changes in interest rates because low-grade debt typically has a higher coupon and it is usually called earlier and therefore it has shorter duration; Low-grade debt is more sensitive to the stock price because it is more likely to default, in which case it "becomes the equity."

[18] However, consistent with the CAPM, Brealey, Myers, and Allen (2006, page 658) suggest this spread is as low as 1.1%.

[19] However, because bankruptcy costs are cash flows, we argue that the better place to account for these costs is in the numerator.

simple example of a zero coupon bond, bonds with multiple payments have multiple points for potential default. Given that the CAPM is a one period model, it is unclear whether the CAPM could be appropriately applied to value debt cash flows. However, despite the difference in the distribution between cash flows to debt and cash flows to equity, empirical evidence suggests that the distribution of returns to debt is not different from the distribution of cash flow to equity as it may initially appear.

First, even bonds that do default have recovery rates which vary significantly. The average recovery rate for low-grade debt is about 30% and is about 60% for high-grade debt, suggesting that expectations of cash flow to debt can be estimated based on recovery rates and default probabilities.[20] Second, returns on debt do not depend solely on cash flows but also on interest rates and inflation. Even bonds that have zero probability of defaulting have market risk and thereby have a positive beta.

The use of YTM in DCF valuation is flawed primarily when promised cash flows are significantly different than expected cash flows, as in the case of low-grade debt where the likelihood of default is elevated. For high-grade debt, the difference between promised and expected cash flows is not significant, and hence the use of YTM as the discount rate for high-grade debt would not result in significant distortion. Furthermore, the YTM accounts for factors that the CAPM does not (e.g. liquidity and state taxes). Thus, while the cost of low-grade debt is better estimated with the CAPM, the cost of high-grade debt could be estimated either with the CAPM or with YTM.

C. Does DCF Undervalue Equity?

Our analysis raises one more point of interest to both academics and practitioners. If equity is undervalued when the YTM is used, as is common, are the undervalued companies earning abnormal returns? This question can be addressed by investigating the long run performance of the stocks of highly levered firms. If such firms are not earning abnormal returns, i.e., if the undervaluation is systematic, could an adjustment be incorporated into the equity betas so that the equity prices are really accurate? Specifically, if the cost of debt is too high, is there a natural adjustment in the cost of equity so that the equity values are really accurate? Is it possible that CAPM-based cost of equity is too low relative to its true cost, so that overall equity of firms with high-yield debt is correctly priced?

For example, one cost of high leverage is the loss of financial flexibility (either through harsh debt covenants, or through lower debt capacity). This cost is not reflected in the YTM because it is mainly the shareholders' problem. It is also not captured by the CAPM-based cost of equity. Similarly, the fact that low-grade debt markets are less liquid may not only mean higher cost of debt as discussed above, but also higher cost of equity. Such costs are not reflected in the CAPM-based cost of equity.

If CAPM underestimates the cost of equity for highly levered firms and YTM overestimates the cost of debt for these firms, then equity values calculated under DCF using YTM for the cost of debt and using CAPM for the cost of equity might end up as being reasonably accurate. Further investigation is needed.

V. Conclusion

This paper demonstrates that the use of YTM as the cost of debt in DCF valuations of firms is incorrect because YTM is calculated based on promised cash flows, whereas the traditional DCF valuation of firms is based on expected cash flows. The correct cost of debt in DCF valuations of firms is the expected return on debt which can be calculated using the CAPM. Valuations of firms that use the YTM as the cost of debt underestimate the correct value. The distortion in the value calculated is particularly large for highly levered firms where the difference between YTM and expected return on debt is sizable. Our argument is demonstrated using the highly publicized proposed leveraged buyout of Clear Channel Communications Inc. We show that if YTM rather than expected return on debt were used in the valuation process of Clear Channel, the price offered for the shares would have significantly underestimated their fair value on November 16th, the date of the merger agreement.■

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[20] See, for example, Altman and Hotchkiss, 2006, Table 7.9, and Brealey Myers Allen, 2006, Figure 25.1.

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