Beta and Leverage

In situations where the risk of the project differs significantly from the average risk of the firm, the discount rate (for all three approaches) should reflect the risk of the project. For example, we can use CAPM to estimate the unlevered discount rate:

$$\text{Asset Beta, } \beta_{ASSET} = \text{Cov(UCF,Market)} \;/\; \text{Var(Market)}$$

and the unlevered discount rate, $r_0 = r_F + \beta_{ASSET} * (r_M - r_F)$.

The asset beta and unlevered discount rate do not take into account the effects of financial leverage. If the project generates debt capacity, the following formulas can be used to adjust beta for financial leverage.

The No-tax Case

In a world without taxes, the asset beta of a levered firm is simply the weighted average of the betas of debt and equity:

$$\beta_{ASSET} = (\text{Debt/Asset})*\beta_{Debt} + (\text{Equity/Asset})*\beta_{Equity}$$

If corporate debt is risk-free, i.e., $\beta_{Debt} = 0$ then:

$$\beta_{ASSET} = (\text{Equity/Asset})*\beta_{Equity}$$

By rearranging this equation, we have $\beta_{Equity} = (1 + \text{Debt/Equity}) * \beta_{ASSET}$.

The Corporate-tax case

In a world with corporate taxes and risk-free corporate debt, the relationship between levered equity beta and unlevered beta is:

$$\beta_{Equity} = [1 + (1 - T_C)*B/S_L] * \beta_{Asset}$$

With risky corporate debt, the relationship between levered equity beta, unlevered beta, and risky debt beta is:

$$\beta_{Equity} = \beta_{Asset} + (B/S_L) * (1- T_C) * (\beta_{Asset} - \beta_{Debt})$$

This equation parallels MM Proposition II with corporate taxes: $r_S = r_0 + (B/S_L) * (1-T_C) * (r_0-r_B)$

Note that the beta of the assets is the same as the beta of the unlevered firm. In an unlevered firm, all of the assets are financed with equity, implying that B or Debt = 0 in the above equations and hence $\beta_{Equity} = \beta_{ASSET}$.

Reference Lecture Slides 28 - 30 for further information on this topic, and Slides 31 - 34 for numerical examples.