Quiz 1

Lecture 1

Leverage and Firm Value

MM Proposition I states that the total market value of the firm's securities is equal to the market value of its assets, whether the firm is unlevered or levered:

$$E + D = U = A$$

- E = Market value of equity in a levered firm
- D = Market value of debt in a levered firm
- U = Market value of equity in an unlevered firm
- A = Market value of the firm's assets

Leverage and Equity Cost of Capital

The cash flows from holding unlevered equity can be replicated using homemade leverage by holding a portfolio of the firm's equity and debt.

The return on unlevered equity (R_U) is related to the returns of levered equity (R_E) and debt (R_D):

$$R_U = \frac{E}{D+E}R_E + \frac{D}{D+E}R_D$$

We can rearrange the equation on the previous slide to solve for R_E:

$$R_E = R_U + \frac{D}{E}(R_U - R_D)$$

The levered equity return equals the unlevered return, plus a premium due to leverage.

WACC

If a firm is levered, its assets ("project") cost of capital r_A is equal to the firm's weighted average cost of capital (r_{wacc} or simply "WACC"):

Weighted Average Cost of Capital (No Taxes)

$$r_{wacc} = \frac{E}{D+E} r_E + \frac{D}{D+E} r_D$$

Levered & Unlevered Beta

The effect of leverage on the risk of a firm's securities can also be expressed in terms of beta:

$$\beta_U = \frac{E}{E+D}\beta_E + \frac{D}{E+D}\beta_D$$

This implies

$$\beta_E = \beta_U + \frac{D}{E}(\beta_U - \beta_D)$$

Leverage amplifies the market risk of a firm's assets, β_U, raising the market risk its equity

Leverage and EPS

LVI currently has no debt.

Since there is no interest and no taxes, LVI's earnings would equal its EBIT.

LVI's earnings per share without leverage would be:

$$EPS = \frac{\text{Earnings}}{\text{Number of Shares}} = \frac{\$10m}{10m} = \$1$$

Lecture 2

MM I with taxes

The total value of the levered firm exceeds the value of the firm without leverage due to the present value of the tax savings from debt.

$$V_{Levered} = V_{Unlevered} + PV(\text{Interest Tax Shield})$$

PV of tax shield with permanent debt

Suppose a firm borrows debt D and keeps the debt permanently.

If

- the firm's tax rate is τ_C and
- the debt is riskless with a risk-free interest rate r_f

Then the interest tax shield each year is $\tau_C \times r_f \times D$, and the tax shield can be valued as a perpetuity:

$$\begin{aligned} PV(\text{Interest Tax Shield}) &= \frac{\tau_C \times Interest}{r_f} = \frac{\tau_C \times D \times r_f}{r_f} \\ &= \tau_C \times D \end{aligned}$$

WACC and taxes

With tax-deductible interest, the effective after-tax borrowing rate is $r(1-\tau_C)$ and the weighted average cost of capital becomes

$$\begin{aligned} r_{wacc} &= \frac{E}{E+D} r_E + \frac{D}{E+D} r_D(1-\tau_c) \\ r_{wacc} &= \underbrace{\frac{E}{E+D} r_E + \frac{D}{E+D} r_D}_{\text{Pretax WACC}} - \underbrace{\frac{D}{E+D} r_D \tau_c}_{\substack{\text{Reduction Due} \\ \text{to Interest Tax Shield}}} \end{aligned}$$

Lecture 3

Tradeoff Theory

The firm weighs the benefits of debt that result from shielding cash flows from taxes against the costs of financial distress associated with leverage.

According to the tradeoff theory, the total value of a levered firm equals the value of the firm without leverage plus the present value of the tax savings from debt, less the present value of financial distress costs.

$$V^L = V^U + PV(\text{Interest tax shield}) - PV(\text{Financial distress costs})$$

Cash Out

Estimating the debt overhang

Suppose equity holders invest an amount I in a new investment project. Let D and E be the market value of the firm's debt and equity, and let β_D and β_E by their respective betas. Equity holders will benefit from the new investment if:

$$\frac{NPV}{I} > \frac{\beta_D D}{\beta_E E}$$

Value of a Levered Firm

- The value of the levered firm can now be shown as $V^L = V^U + PV(\text{Interest tax shield}) - PV(\text{Financial distress costs}) - PV(\text{Agency costs of debt}) + PV(\text{Agency benefits of debt})$