

- **Discount Rate** We need estimate of the discount rate to determine the net present value of a project. The discount rate depends on the project's business risk and financial risk. Under CAPM, the equity beta captures both the business risk and the financial risk. Financial risk arises when the firm uses debt.
- **Opportunity Cost of Capital** Following the *M–M* proposition I, the opportunity cost of capital can be calculated as the pre-tax weighted average cost of capital.
- **Asset Beta** β_a reflects the business risk of the firm or the project. Thus, under CAPM the firm's or the project's opportunity cost of capital is given by the risk-free rate plus the product of the risk premium and the asset beta. You can estimate the equity beta and the debt beta from the market data and then estimate the asset beta. Assuming the debt is risk-free and the debt beta is zero, the asset beta and the equity beta are given as follows:

$$\beta_a = \beta_e \frac{E}{V}$$

$$\beta_e = \beta_a \frac{V}{S} = \beta_a \left[1 + \frac{D}{E} \right]$$

In case of fixed amount of debt, the interest tax shields reduce the systematic risk. If debt is risk-free, the asset beta is given as follows:

$$\beta_a = \beta_e \left[\frac{E}{E + D(1 - T)} \right]$$

- **Equity Beta** and the asset beta of an all-equity (unlevered) firm will be same. But the equity beta of a levered firm (assuming fixed amount of debt) will be as follows:

$$\beta_e = \beta_a \left(1 + \frac{D}{E}(1 - T) \right)$$

In practice, the interest tax shields depend on the firm's profitability, which fluctuates randomly. Therefore, the interest tax shields may not reduce the systematic risk. Under this assumption, the levered firm's cost of equity shown below includes compensation for financial risk as well:

$$k_e = r_f + (r_m - r_f) \beta_a + (r_m - r_f) \beta_a \frac{D}{S}$$

- Following *M-M's* proposition II, the levered firm's cost of equity can also be calculated as follows:

$$k_e = k_a + (k_a - k_d) \frac{D}{S}$$

- **Free Cash Flows Approach** The most popular method of the project evaluation is to discount the free cash flows at the firm's weighted average cost of capital (WACC):

$$V = \sum_{t=1}^n \frac{FCF_t}{(1 + \text{WACC})^t} + \frac{TV_n}{(1 + \text{WACC})^n}$$

WACC is calculated as follows:

$$\text{WACC} = k_e \frac{S}{V} + k_d(1 - T) \frac{D}{V}$$

The free cash flow approach adjusts the effect of the interest tax shields in the discount rate (WACC) rather than the project's cash flows. This approach is based on the assumption that the capital structure (debt ratio) is constant over time. It also assumes that the project's and the firm's risk and capital structures are the same. Hence, this approach will not work if the project's and the firm's risk and capital structure are different, and where the project's capital structure is not constant.

- **Equity Cash Flow (ECF) Approach** is similar to the FCF approach and it is based on the same assumptions. In the ECF approach the equity cash flows, which are residual cash flows available to the equity shareholders, are discounted by the levered cost of equity.
- **Capital Cash Flow (CCF) Approach** is much easier to use when the project's debt amount is fixed and the capital structure does not remain constant. CCFs are calculated as the free cash flows plus the interest tax shields, and they are discounted by the project's all-equity or opportunity cost of capital. The project's opportunity cost of capital depends on its business risk and is not affected by the capital structure. In the CCF approach the effect of the interest tax shields are adjusted in the cash flows rather than the discount rate.
- **Adjusted Present Value (APV) Approach** is an alternative approach for the project's evaluation. It is a flexible approach that unbundled the project's value into several parts. It separates the operational part from the financing effects. The base-case NPV is calculated by discounting the free cash flows at the project's opportunity cost of capital. The present values of the financing effects are calculated separately using the discount rates appropriate to the risk of

these effects. For example, the interest tax shields are treated as risky as debt. Hence, the interest tax shields are discounted at the cost of debt. APV is the sum of the base-case NPV and the value of financing effects:

APV = Base – NPV + value of interest tax shields + value of other financing effects

APV is a useful approach in the project financing where the debt is fixed and there are several other financing effects like issue costs, investment incentives and special tax benefits.

The APV formula under the assumption of the perpetual cash flows and the perpetual fixed amount of debt and without other financing effects is as follows:

$$APV = \frac{FCF}{k_a} + \frac{T k_d D}{k_d}$$

- **Adjusted Cost of Capital (or Discount Rate)** Use it to discount the free cash flows (perpetual):

$$ACC = k^* = k_a [1 - T D/V]$$

$$NPV = \frac{FCF}{k^*}$$

The concept of the adjusted cost of capital is based on the $M-M$ tax-corrected hypothesis. Two critical assumptions are that the cash flows are perpetual and the amount of debt is fixed. In case of the fixed debt ratio, which implies rebalancing of debt, the adjusted cost of capital can be estimated using the Miles-Ezzell formula as given below:

$$ACC = k^* = k_a - T k_d D/V \left[\frac{1 + k_a}{1 + k_d} \right]$$

This formula is same as WACC except for the last term, $(1 + k_a)/(1 + k_d)$. Both WACC and the Miles-Ezzell formula assume the fixed debt ratio and debt rebalancing.

- **Value of the Firm** The use of the DCF techniques can be extended to value a business firm. In the valuation of a firm a financial analyst usually assumes a constant debt ratio.

The firm can be valued using FCFs and WACC. Further, the analyst assumes a horizon period for analysis and calculates the horizon value at the end of the

horizon period. Horizon value depends on the growth prospects of the firm after the horizon period. Thus, the value of the firm is given as follows:

$$V = \sum_{t=1}^H \frac{FCF_t}{(1 + WACC)^t} + \frac{TV_H}{(1 + WACC)^H}$$

The value of equity is obtained by subtracting the outstanding amount of debt from the value of the firm. The value of equity divided by the number of outstanding shares gives the equity value per share.