# Overview and Learning Objectives

## Overview

This chapter applies the Capital Asset Pricing Model (CAPM) introduced in Chapter 11 to estimate the appropriate discount rate for computing the NPV in the capital budgeting analysis. We will discuss the cost of equity capital, which is also the cost of capital for an unlevered (all equity) firm that uses no debt financing. We will also discuss the **Weighted Average Cost of Capital** (WACC) for a levered firm by examining the impact of financial leverage and taxes on the discount rate. Furthermore, we look at biases of the Weighted Average Cost of Capital (WACC) in evaluating projects with different risks.

Previous discussions of the NPV method did not explicitly account for the risk of a project. When the outcome of the project is uncertain, the NPV should be calculated as:

$$NPV = C_0 + \sum_{t=1}^{T} \frac{E(C_t)}{(1+r)^t}$$

**where**:

$E(C_t)$ is the expected cash flow at time t and r is the discount rate (often called the cost of capital) that is consistent with the risk of the project. The cost of capital depends on the business risk of the project, the financial leverage, and taxes.

## Learning Objectives

After reading course materials on this chapter, students should be able to:

- Use the Capital Asset Pricing Model (CAPM) to correctly estimate the cost of capital for an all-equity firm, i.e., the cost of equity.
- Know when to use the industry beta versus the company beta appropriately.
- Convert between the asset beta and the equity beta with the appropriate adjustment for debt financing or financial leverage.
- Estimate the Weighted Average Cost of Capital (WACC) for a levered firm, i.e., a firm that uses debt financing.
- Explain the biases resulted from using the WACC of the firm as the discount rate in evaluating projects with different risk levels.
- Incorporate the flotation costs associated with external financing in the evaluation of projects.

Financial Management I (FIN 531)

# General Concepts on the Cost of Capital

Why is it important to have a good estimate for the cost of capital? Here are some thoughts -

- For good capital budgeting decisions - neither the NPV rule nor the IRR rule can be implemented without knowledge of the appropriate discount rate
- For financing decisions - the optimal/target capital structure minimizes the cost of capital
- For operating decisions - the cost of capital is used by regulatory agencies in order to determine the "fair" return in some regulated industries (e.g. utilities).

## Here are some remarks on the cost of capital and its estimation -

The cost of capital is an opportunity cost. It must reflect the best investment opportunity of equal risk available to the suppliers of the firm's capital in financial markets.

- The Opportunity Cost Principle (See Chapter 4)!

The cost of capital should reflect the risk of the investment that is financed by the capital raised, i.e., the **use** of the funds (rather than the source of the funds).

- It is also called the investment's required return as well as the appropriate discount rate.

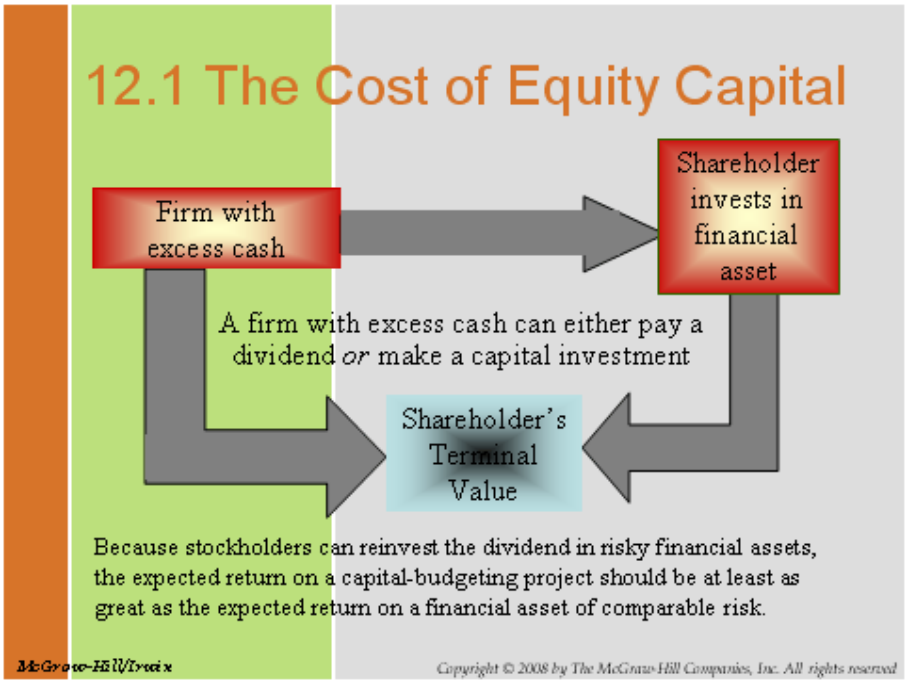
Since risk averse investors are the suppliers of capital, the required return that is demanded by investors on a security is also the cost of that type of capital to the firm that issues it, adjusted for any flotation cost and tax effects. (Reference: Section 13.7)

- **NOTE** - In this chapter, we implicitly assume that the financial market is at equilibrium such that financial securities are fairly priced. Under this assumption, the required return on a security will be equal to its expected return per the CAPM Analysis. Hence, we could use the Dividend Discount Model to estimate the cost of component capital. (Reference: Expected rates of return for no-growth and constant growth stocks, respectively, in Chapter 9 and Chapter 13.7!)

Financial Management I (FIN 531)

# The Cost of Equity Capital (Ref: Sections 13.1 and 13.2)

The cost of equity capital is the required return demanded by risk averse stockholders on the risky cash flows generated by the company. Since the company competes with other companies in the financial market, the required return on its stock should be at least competitive to those offered by other securities of comparable risk, i.e., the Opportunity Cost Principle.




For an **unlevered (all equity)** firm, i.e., it does NOT use any debt financing, its cost of equity capital is also its cost of capital. Furthermore, if the risk of a project is the SAME as the risk of the unlevered firm, then the project's cost of capital is the same as the firm's cost of capital.

The discount rate (or the cost of capital) of such project should be the expected return on a financial asset of comparable risk.

We apply the Capital Asset Pricing Model (CAPM) introduced in Chapter 11 to determine the cost of equity capital, $R_S$,

$$R_S = R_F + \beta_S \times [R_M - R_F].$$

To determine the cost of equity capital, we need to estimate the following 3 items:

1. The risk-free rate, $R_F$
   - The T-Bill rate is often used as a proxy for the risk-free rate:
2. The market risk premium, $[R_M - R_F]$
   - The historic market risk premium (Table 10.2) is often a good place to start;
3. The company's systematic risk, $\beta_S$
   - Beta is defined as $\beta_S = \sigma_{iM} / \sigma_M^2$ (Chapter 11)

Advantages and Disadvantages of the CAPM Approach

- - This approach explicitly adjusts for risk in a fashion that is consistent with capital market history.
- - This approach is applicable to virtually all publicly traded stocks.

- - The main disadvantage is that the past is not a perfect predictor of the future, and both beta and the market risk premium vary through time.

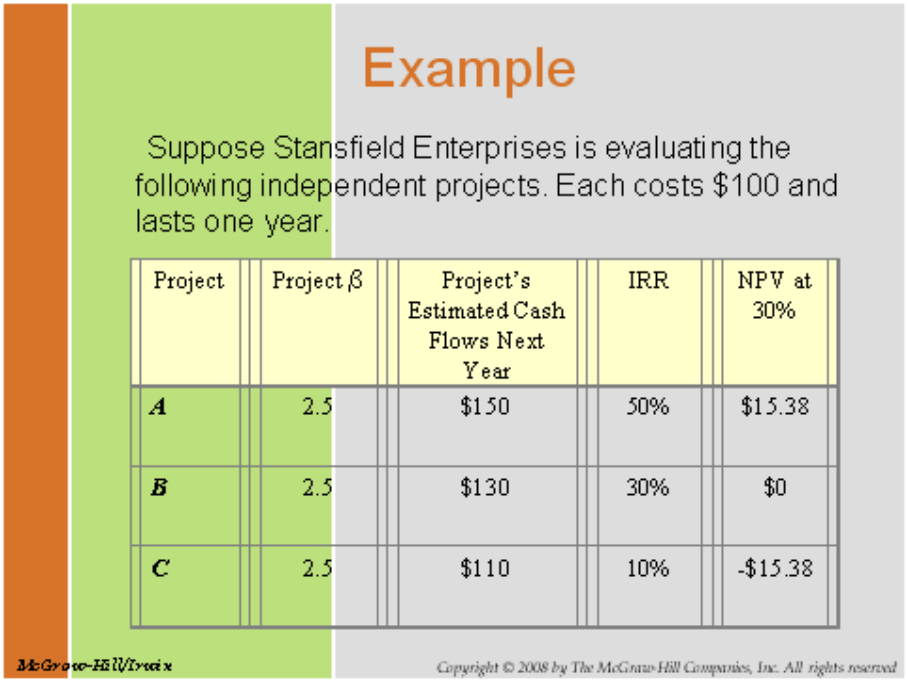
# An Example:

Suppose the stock of Stansfield Enterprises, a publisher of PowerPoint presentations, has a beta of 2.5. The firm is 100-percent equity financed.
Assume a risk-free rate of 5-percent and a market risk premium of 10-percent.

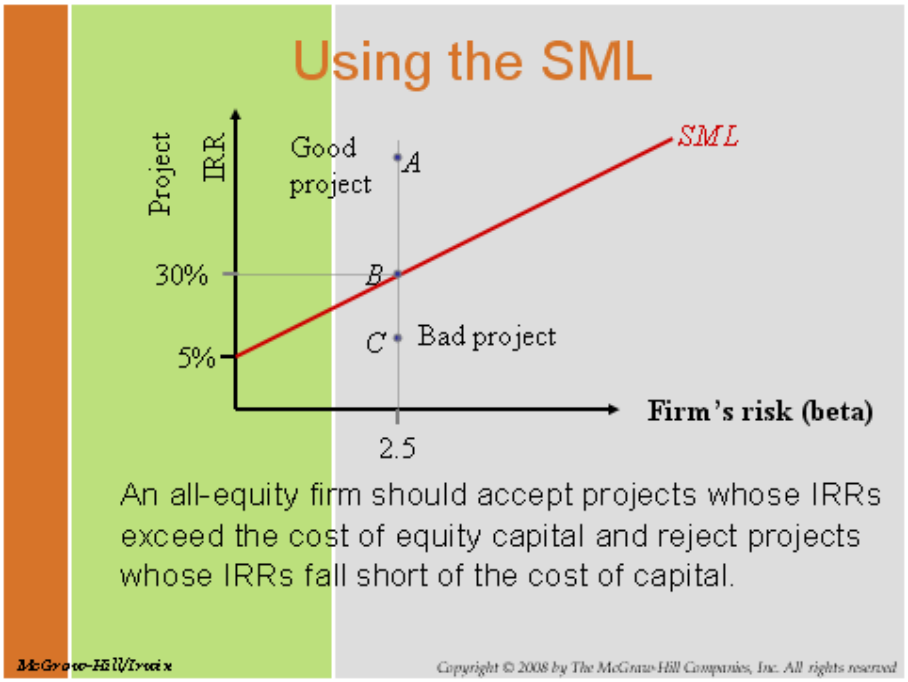
What is the appropriate discount rate for an expansion of this firm?

$R_S = R_F + \beta_S \times [R_M - R_F]$
$= 5\% + 2.5 * (10\%) \rightarrow R_S = 30\%$

When evaluating projects with the same risk as that of this all-equity financed company, Stansfield Enterprises can use the 30% as the discount rate to compute the NPVs of the projects as well as using the 30% as the benchmark for the IRR rule.




The evaluation of projects using the IRR rule is an application of the CAPM analysis to identify mispriced investment opportunities discussed in Chapter 11. In this context, the IRR of the project is the expected return on the project. If the IRR of the project, say A (or C), is greater (or less) than the cost of capital, i.e., located above (or below) the SML, it should be accepted (rejected) because it is 'underpriced' (or 'overpriced').




# The Dividend Discount Model (DDM) Approach (Section 13.5)

The dividend discount model discussed in Chapter 9 can also be used to estimate the cost of equity: $R_S = (Div_1/P_0) + g$. To apply the DDM, we need to estimate future dividend ($Div_1$) and the constant growth rate (g).

- **Note**that the Dividend Discount Model approach assumes that the stock of the issuing company is fairly priced in the financial market such that its expected return equals to its required return (per the CAPM Analysis discussed in Chapter 11).

**Advantages and Disadvantages of the DDM Approach:**

- - It only works for dividend paying firms
- - It is very sensitive to the estimate of g
- - Historical growth rates may not reliably predict future growth
- - Risk is only indirectly accounted for by the use of the price

Financial Management I (FIN 531)

# Estimation of Beta (Ref: Sections 13.3 and 13.4)

As a starting point, we can use a sample of historical (monthly) return data on the security, say i is Merck & Company (MRK), and those on a proxy for the market portfolio, say M is S&P 500 Index, over a measurement period of, say 5 years from January 1998 through December 2002, to estimate the historical beta of MRK stock,

$$\beta_{MRK} = \sigma_{MRK,S\&P500} / \sigma^2_{S\&P500}$$

## Problems

1. Betas may vary over time. (See beta matrices for stocks in this Microsoft Excel SpreadSheet)
2. Betas may vary with the choice of the market proxy.
3. Changing financial leverage and business risk influences betas.

## Solutions

1. The first problem, which is related to the selection of the measurement period, can be moderated by more sophisticated statistical techniques that are beyond the scope of this course.
2. Regarding the tendency of beta estimates to vary with the choice of the market proxy, the recommendation is to use the index on which the stock is listed or the index of the market where the stock is traded.
3. The third problem can be lessened by adjusting for changes in business and financial risk.
    - Use the average of beta estimates of several comparable firms in the same industry, i.e., the industry beta, in which the firm operates.
    - An industry is a portfolio of individual companies. Therefore, the beta estimate for an industry is more accurate and more stable than the beta estimate for a single company.
    - However, using an industry beta in place of the company beta will be **incorrect** if: (Slide)
        - the company has a significant amount of business in more than one industry, and/or
        - the financial leverage, i.e., financial risk, of the company is very different from the industry average.
            - This problem of using industry beta can be solved by adjusting the industry beta for the company's financial leverage.

Note - The authors did a fine job in explaining the relationships among beta, covariance and correlation in Section 13.4 that I recommend you to take a close read for further details.

Financial Management I (FIN 531)

# Determinants of Beta (Ref: Section 13.4)

The systematic risk of a firm depends on:

- **(Systematic) Business Risk:** The risk of the firm that is associated with its operations. There are two major determinants of business risk:
  - Cyclical nature of revenues
  - Operating leverage
- **(Systematic) Financial Risk:** The incremental risk on the owners of the firm due to the use of debt financing. Its major determinant is:
  - Financial leverage
- Tax

## Business Risk

### Cyclicality of Revenues

- Highly cyclical stocks have high asset betas.
  - Revenues of retailers and automotive firms fluctuate with the business cycle, i.e., these firms do well (or poorly) in the expansion (or contraction) phase of the business cycle.
  - Revenues of transportation firms and utilities are less dependent upon the business cycle. Note that cyclicity is not the same as variability – stocks with high standard deviations need not have high betas.
    - Revenues of movie studios are highly variable, but they are not cyclical.

### Operating Leverage

- Operating leverage magnifies the effect of revenue cyclicity on beta.
- The degree of operating leverage (DOL) measures how sensitive a firm (or project) is to its fixed production costs.
  - Operating leverage increases as fixed costs rise and variable costs fall. (**Slide**)
  - The degree of operating leverage is given by:

$$DOL = \frac{\text{Change in } EBIT}{EBIT} \times \frac{\text{Sales}}{\text{Change in Sales}}$$

## Financial Risk

- It is a function of the extent of financial leverage, i.e., the proportion of debt in the overall capital structure, used by the firm.
- Financial leverage refers to the sensitivity to a firm's fixed financing costs – interest payments.
- Financial leverage always increases the equity beta relative to the asset beta, which depends on business risk. In practice, asset beta usually represents the sensitivity of operating cash flows to the market.

  The relationship between the betas of the firm's debt, equity and assets is given by:

$$\beta_{Asset} = \frac{Debt}{Debt + Equity} \times \beta_{Debt} + \frac{Equity}{Debt + Equity} \times \beta_{Equity}$$

By assuming that the debt beta is zero, we can express the equity beta as a simple positive function of both the asset beta and the financial leverage.

$$\beta_{Equity} = (1 + \frac{Debt}{Equity}) \times \beta_{Asset}$$

Note that the asset beta is also the equity beta for an unlevered (all equity) firm.

# An Example

Consider Grand Sport, Inc., which is currently all-equity and has a beta of 0.90.

The firm has decided to lever up to a capital structure of 1 part debt to 1 part equity, i.e., Debt/Equity = 1. Since the firm will remain in the same industry, its asset beta should remain 0.90. However, assuming a zero beta for its debt, its equity beta would become twice as large:

$$\beta_{Equity} = (1 + \frac{Debt}{Equity}) \times \beta_{Asset} = (1+1)x0.90 = 1.80$$

Financial Management I (FIN 531)

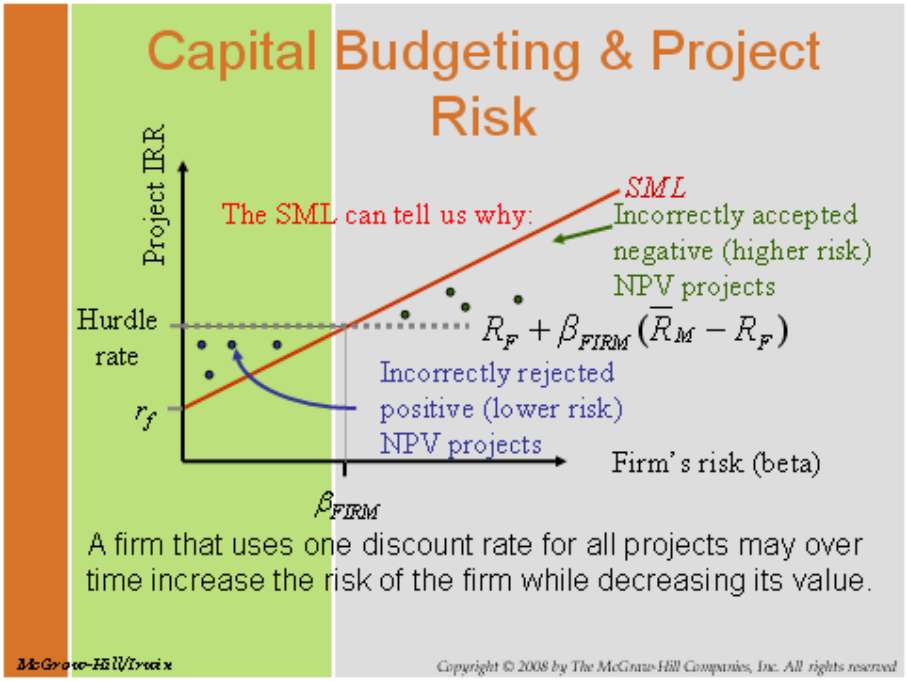
# Extensions - Firm versus Project, WACC and Flotation Cost (Ref: Sections 13.6~13.11)

## The Firm versus the Project (Ref. Section 13.6)

A project's cost of capital depends on the **use** of the capital, not the source. Therefore, it depends on the **riskiness of the project** and not that of the company.

As such, using the risk of the company to determine the same corporate discount rate (also known as hurdle rate, cutoff rate, benchmark, and cost of capital) for all projects may **INCORRECTLY**:

- ACCEPT NPV < 0 projects that are riskier than the company.
- REJECT NPV > 0 projects that are less risky than the company.




## An Example

Suppose the Conglomerate Company has a cost of capital, based on the CAPM, of 17%. The risk-free rate is 4%; the market risk premium is 10% and the firm's beta is 1.3:

$$17\% = 4\% + 1.3 \times [14\% - 4\%]$$

This is a breakdown of the company's investment projects:

40% in Automotive Retailing that has a beta of 2.0
20% in Computer Hard Drive Manufacturing that has a beta of 1.3
40% in Electric Utility that has a beta of 0.6
→ Average asset beta of 0.4*2.0 + 0.2*1.3 + 0.4*0.6 = 1.3

When evaluating a new electrical generation investment, which cost of capital should be used? (Slide)

$$r = 4\% + 0.6 \times (14\% - 4\%) = 10\%$$

10% reflects the opportunity cost of capital on an investment in electrical generation, given the unique risk of the project, but NOT the corporate cost of capital of 17%!

## The Weighted Average Cost of Capital ($r_{WACC}$) for a Levered Firm (Ref. Section 13.8)

If a firm is financed with both debt and equity, the cost of capital ($r_{WACC}$) is a weighted average of the cost of equity ($r_S$) and the cost of debt ($r_B$):

$$r_{WACC} = r_S \times S/(S+B) + r_B \times (1 - T_c) \times B/(S+B)$$

When estimating the weighted average cost of capital, we should:

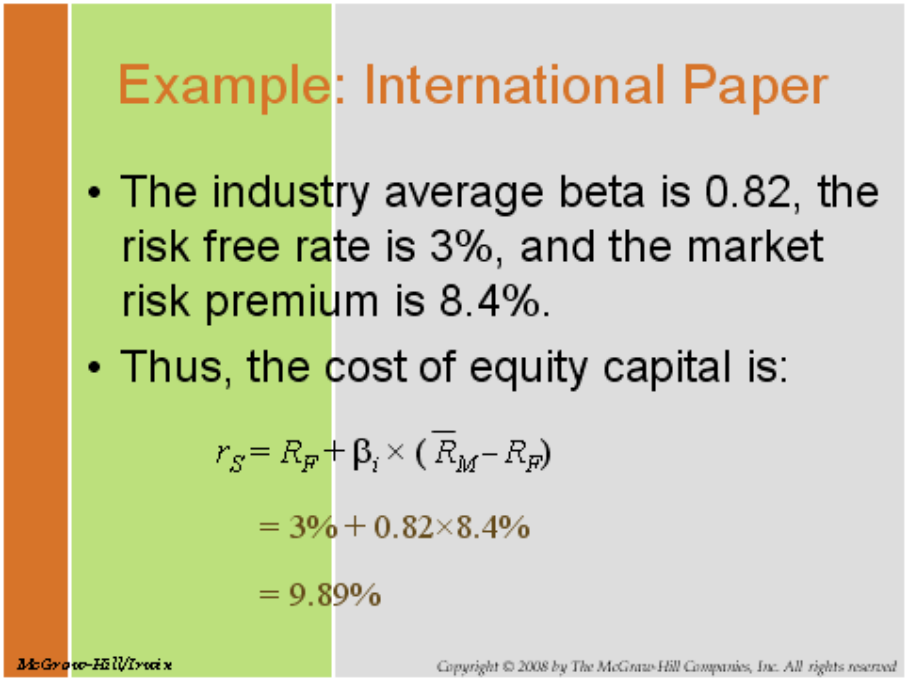
- Always use MARKET VALUE in computing the capital structure weight of each component capital.
- Be on the AFTER-TAXES basis, i.e. use after-tax cost of debt, $r_B \times (1 - Tc)$!
  - The cost of debt is the yield to maturity (YTM) of the bonds issued by the firm. (Ref. Section 13.7 and Chapter 8)

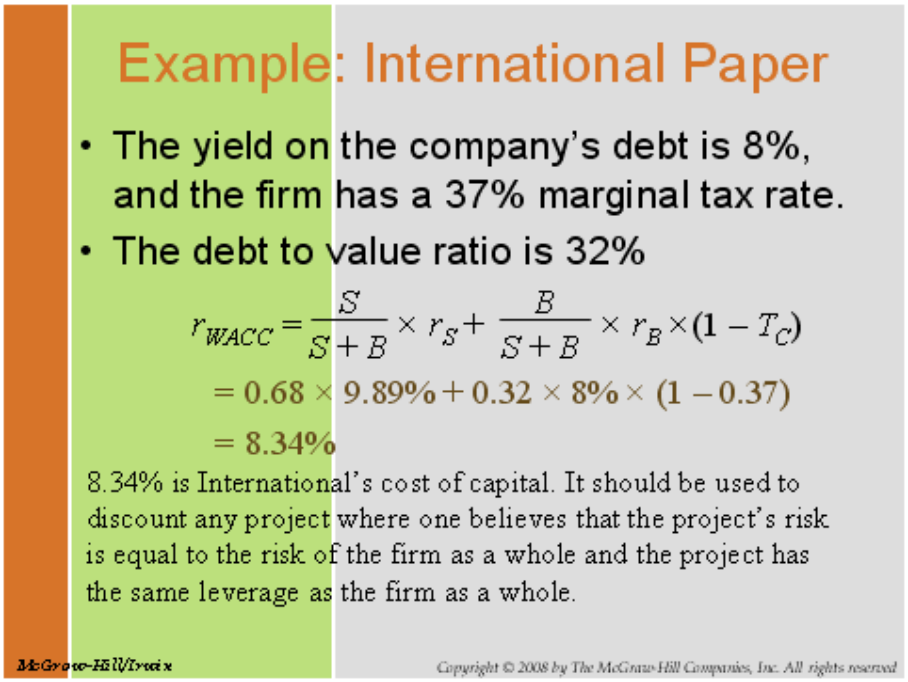
The capital structure weight of each component capital in the target capital structure is a similar concept as the portfolio weight of each risky asset in a portfolio. Thus, the capital structure weight of each component capital is defined as the market value of the component capital, S or B, divided by the combined market value, S+B.

If a project has the same risk as the firm and the project does not alter the financial leverage, then the proper discount rate is the firm's weighted average cost of capital.

## An Example: The International Paper Company

- First, we estimate the cost of equity and the cost of debt.
  - We estimate an equity beta to estimate the cost of equity.
  - We can often estimate the cost of debt by observing the yield to maturity (YTM) of the firm's debt.
- Second, we determine the WACC by weighting these two costs appropriately.






**NOTE** that if the company also uses preferred stocks in financing its operation and its investment, then its WACC, ($r_{WACC}$), will be a weighted average of the cost of common equity, ($r_S$), the cost of preferred equity, ($r_P$), and the cost of debt, ($r_B$). And the WACC equation will be expanded into -

$$r_{WACC} = r_S \times S/(S+P+B) + r_P \times P/(S+P+B) + r_B \times (1 - T_c) \times B/(S+P+B)$$

where

- P is the market value of preferred stock included in the capital structure of the company; and
- $r_P$ can be estimated as the expected return on the (zero growth) preferred stock, i.e., DIV/P, issued by the company per the Dividend Discount Model. (Ref. Section 13.7 and Chapter 9)

## Adjustment for Flotation Costs in Capital Budgeting (Ref. Section 13.11)

When a firm needs to raise external capital for funding a project by issuing new securities in the financial market, it incurs transaction costs, both implicit and explicit, in the process. These flotation costs are additional to the cost of capital, and are added to the initial investment of the project.

The Weighted Average Flotation Cost, $f_{Asset}$

- The value-weighted average flotation costs of component capital, $f_S$ and $f_B$.
- The flotation costs are stated in percentage.

$$f_{Asset} = \left(\frac{S}{S+B}\right) \times f_S + \left(\frac{B}{S+B}\right) \times f_B$$

- The flotation cost adjustment on the project evaluation is incorporated in the total amount of capital to be raised for financing the initial outlay of the project!
  i.e., **Adjusted Initial Investment = IO/(1-$f_{Asset}$)**

**NOTE** that if preferred stock is part of the capital structure of the issuing company, we also need to incorporate the role of preferred equity financing in the flotation costs adjustment by adding the

flotation cost of preferred equity financing component, $f_P$, in the weighted average flotation cost ( $f_{Asset}$) equation!

NOTE - Please reference the text (Section 13.9) for numerical illustrations on how the weighted average cost of capital is used as the appropriate discount rate in valuation!

Financial Management I (FIN 531)

# A Numerical Illustration

Lee Corp. uses the following sources of capital to finance its $300M project:

> Debt: 100,000 units of 20-year 8% semiannual coupon paying bonds that are selling at $1,200 a piece.
>
> Common Stock: 3,000,000 shares of common stock selling at $60 per share. The stock beta is 1.2. The riskfree rate and market risk premium are, respectively, 3% and 10%.

**1. Compute** the WACC for Lee Corp., which has a marginal tax rate of 35%.

Cost of debt:

> N=20*2=40; PV=-1200; PMT=8%*1000/2=40; FV=1000
> CPT I/Y=3.12 → $r_B$ = YTM = 3.12%*2 = 6.24%

Cost of equity:

> $r_S$ = 3% + 1.2*(10%) = 15%
> B = 100,000*$1,200 = $120M; S = 3M*$60 = $180M
> → $r_{WACC}$ = $(180M/300M)*15% + $(120M/300M)*6.24%*(1-35%) = 10.62%

**2. Compute** the weighted average flotation cost, and the NPV of this project after taking into account the flotation costs.

Flotation costs for issuing new debt and common stock capital are, respectively, 3% and 12%. Without the adjustment for flotation costs, the NPV of this project is estimated to be $20M.

> $f_{Asset}$ = $(180M/300M)*12% + $(120M/300M)*3% = 8.4%
>
> →Adjusted Initial Investment = $300M/(1-8.4%) = $327.51M
> → Adjusted NPV = $(300M+20M) − $327.51M = -$7.51M

Note that the flotation costs wipe out the value creation of this project!

Financial Management I (FIN 531)