Chapter 13: Risk, Cost of Capital, & Capital Budgeting (Important)

Overview and Learning Objectives

Overview

This chapter focuses on the estimation of the appropriate discount rate for calculating the NPV of a project in capital budgeting analysis. We first cover the cost of common equity capital, which is also the cost of capital for an unlevered (all-equity) firm that uses no debt financing. We then discuss the **Weighted Average Cost of Capital** (WACC) for a levered firm, and examine the impact of financial leverage and taxes on the appropriate discount rate. A levered firm uses debt capital, in addition to common equity capital, to finance its investments and operations. Furthermore, we learn about the biases of using WACC to evaluate projects with risk levels different from the overall risk level of the firm. Such biases lead to incorrect investment decisions that do not meet the long-term value maximization objective of the firm. In addition, we learn the flotation costs associated with raising external capital (via issuing new securities) to finance projects and adjust the initial investment of the project for the incremental flotation costs.

Recall from earlier chapters that NPV is calculated as:

$$NPV = C_0 + \Sigma^{T}_{t=1} \ [E(C_t) / (1 + r)^t]$$

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

Learning Objectives

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

- Use the Capital Asset Pricing Model (CAPM) to correctly estimate the cost of capital for an all-equity (unlevered) firm, i.e., the cost of equity capital.
- Explain 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.
- Explain and calculate 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.
- Explain and calculate the Weighted Average Flotation Costs (f_A) associated with external financing, and incorporate it in the evaluation of projects.

General Concepts on the Cost of Capital

Why is it important to have an 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 the 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 to determine the "fair" return in some regulated industries (e.g. utilities).

Some remarks on the cost of capital and its estimation -

The cost of capital is an opportunity cost. Hence, 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 (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, but NOT the source of the funds.

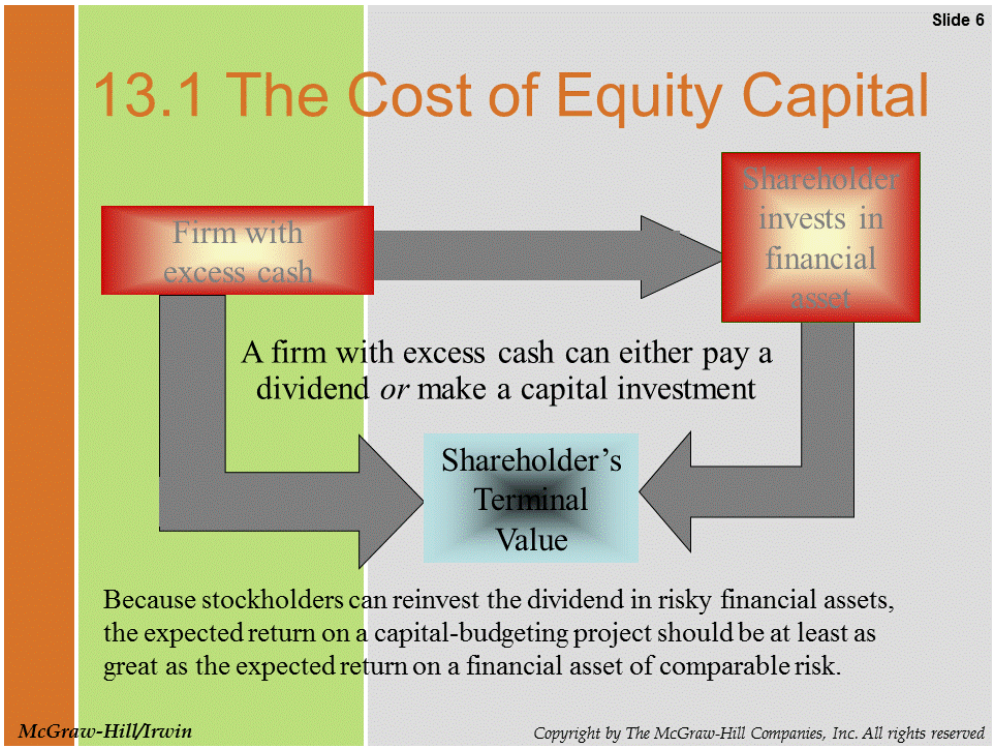
- It is also called the investment's required return as well as the appropriate discount rate.

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 flotation cost and tax effects. In other words, the cost of debt capital corresponds to the bond yield, the costs of equity and preferred capital correspond to, respectively, the required return on common and preferred stocks. The required return (from the investor's perspective) and the cost of capital (from the issuer's or firm's perspective) can be considered as the two sides of the same coin! Since we have learned the basics about the required returns in earlier chapters such as bond yield (YTM) in Chapter 8 and CAPM in Chapter 11, we are half-way through our learning of this chapter's material even before we start studying this chapter.

- **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 according to the CAPM Analysis introduced in Chapter 11. Hence, we could use the Dividend Discount Model to estimate the cost of component capital. Recall from Chapter 9 expected rates of return for no-growth stocks (i.e., cost of preferred equity capital) and constant growth stocks (i.e., cost of common equity capital).

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

The cost of equity capital is the required return demanded by risk averse investors (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 common 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 being considered 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 appropriate discount rate (or the cost of capital) of such project should be the required return on a financial asset of comparable risk.

We apply the Capital Asset Pricing Model (CAPM) to determine the **cost of equity capital, R_S**,

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

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, β_S
   - Beta is defined as $\beta_S = \sigma_{iM} / \sigma_M^2$ (Chapter 11)

Advantages and Disadvantages of the CAPM Approach for R_S Estimation

- This approach explicitly adjusts for risk that is consistent with capital market history (Chapter 10).
- 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 may 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 appropriate discount rate to calculate the NPVs of the projects as well as using the 30% as the benchmark for the IRR rule.

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Example

Suppose Stansfield Enterprises is evaluating the following independent projects. Each costs $100 and lasts one year.

Project	Project β	Project's Estimated Cash Flows Next Year	IRR	NPV at 30%
A	2.5	$150	50%	$15.38
B	2.5	$130	30%	$0
C	2.5	$110	10%	-$15.38

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Comment: 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 (or rejected) because it is 'underpriced' (or 'overpriced').

The Dividend Discount Model Approach (Section 13.5)

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

- **Note** that the DDM 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 for R_S Estimation

- It only works for dividend paying firms.
- It is very sensitive to the estimate of the constant (perpetual) growth rate, g.
- Historical growth rates may not reliably predict future growth.
- The stock price only indirectly accounts for risk.

Estimation of Historical Beta (Ref: Section 13.3)

As a starting point, we can apply the review in Chapter 10 to construct a sample of historical (monthly) return data on the security, say i is Merck & Company (MRK), and the contemporaneous return data on the market portfolio proxy, say M is S&P 500 Index, over a measurement period of, say five years from January 2013 through December 2017, 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 the posted 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 advanced statistical techniques such as statistics 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 (with the pure play method covered in FIN 581).

The Use of Industry Beta

As indicated above, one common concern of using historical beta is the stability of the estimate over time. Since the historical beta is used in the CAPM to determine the appropriate cost of equity capital, which is part of the cost of capital used in capital budgeting analysis, its stability over time may have a material impact on the effectiveness of the investment decision in achieving the long-term value maximization objective of the firm. Empirical findings on this issue indicate that while stability of an individual company's historical beta estimate over time can be a concern, the average historical beta estimate of a portfolio of firms is found to be reliable over time. As such, the industry beta could be a valid solution for addressing the stability concern associated with the historical beta of individual company.

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:
  - the company has a significant amount of business in more than one industry,
  - 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.

- ***If the operations of the firm are similar to the operations of the rest of the industry, the industry beta should be used!*** *On the other hand, if the operations of the firm are fundamentally different from the operations of the rest of the industry, the firm's beta should be used.*

Note: The authors did a fine job in explaining the relationships among beta, covariance and correlation in Section 13.4 that I recommend you study closely for further details.

Determinants of Beta (Ref: Section 13.4)

The systematic risk (beta) 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***, an ***external factor*** driven by the lines of business and the global macro environments.
  - ***Operating leverage***, an ***internal factor*** driven by the mode of production that determines the extent of fixed costs in the cost structure.

- **(Systematic) Financial Risk:** The incremental risk on the owners (i.e., equity holders) of the firm due to the use of debt financing. Its major determinant is:
  - ***Financial leverage***, i.e., the use of ***debt financing*** in the capital structure that determines the extent of fixed interest obligations.

Business Risk

Cyclicality of Revenues (external factor)

- ***Highly cyclical stocks have high asset betas.*** For examples -
  - 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. Hence, retailers and automotive firms tend to have high asset betas, i.e., more systematic business risk. Note that cyclicity is not the same as variability – stocks with high standard deviations need not have high betas.
  - On the other hand, revenues of transportation firms and utilities are less dependent upon the business cycle and hence are likely associated with low asset betas, i.e., less systematic business risk.

Operating Leverage (internal factor)

- ***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 the fraction of fixed costs rises while that of variable costs falls in the cost structure*. Hence, DOL tends to be higher for capital intensive production mode than for labor intensive production mode.

The degree of operating leverage (DOL) 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. In other words, the use of more debt financing leads to a higher level of financial risk, and vice versa.
- 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*. In practice, asset beta, which depends on business risk, usually represents the sensitivity of operating cash flows to the market.

Relationship between the firm's debt beta (β_{Debt}), equity beta (β_{Equity}), and asset beta (β_{Asset}):

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

By assuming that the debt beta is zero (i.e., $\beta_{Debt}=0$), which is the likely case for investment grade bonds (Chapter 8), we can express the equity beta (β_{Equity}) as a simple positive function of both the asset beta (β_{Asset}) and the financial leverage (Debt/Equity).

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

Note that, for an unlevered firm, i.e., Debt/Equity=0, its equity beta equals to its asset beta, i.e., $\beta_{Equity}=\beta_{Asset}$, as there is no financial risk when no debt financing is used.

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:

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

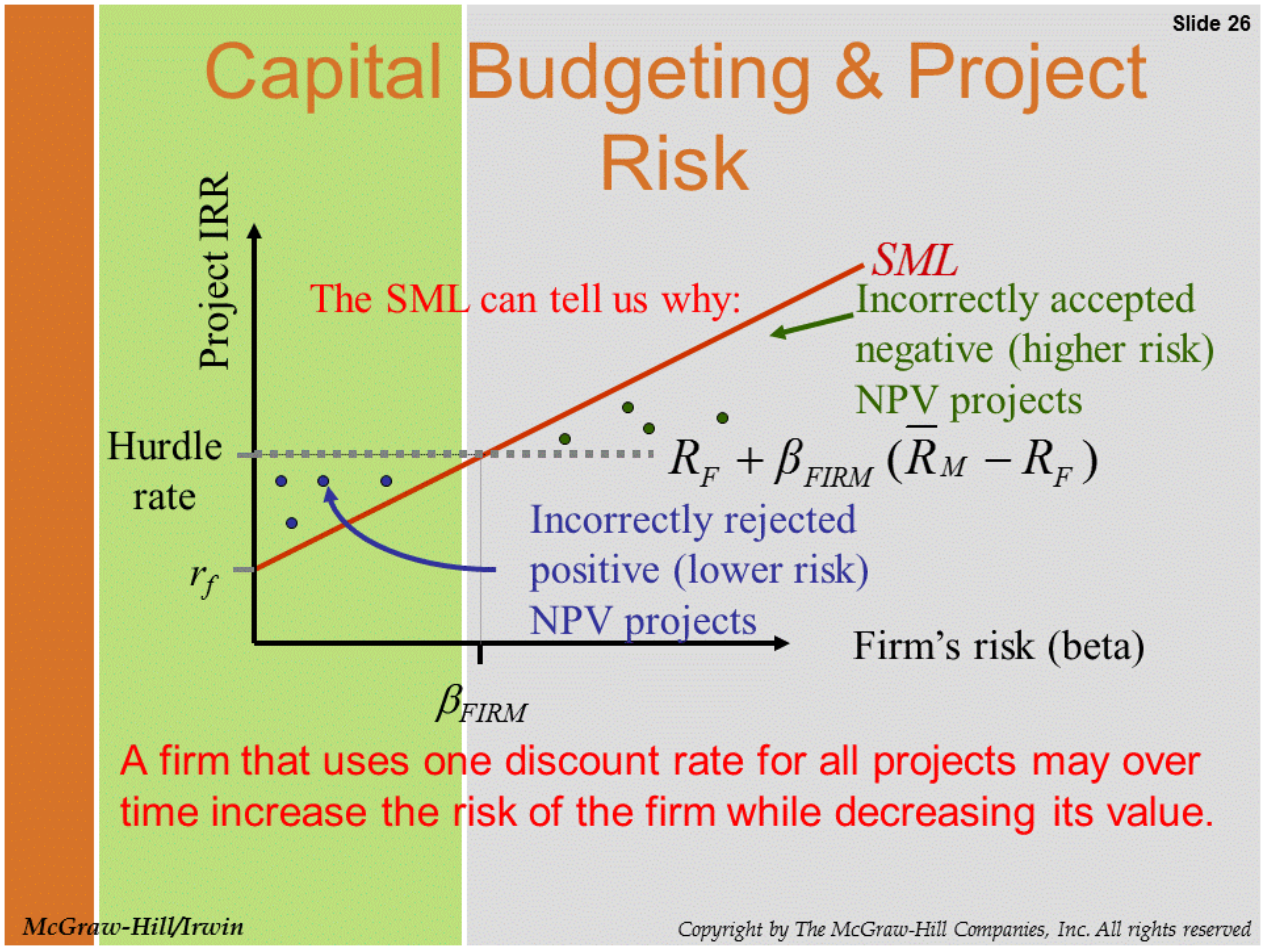
This example illustrates that the level of systematic risk borne by stockholders, β_{Equity}, is driven by both business risk, β_{Asset}, and financial risk, i.e., debt/equity ratio. While there is no change in the business operations, the systematic risk level increases with the use of debt financing. In other words, the increase in systematic risk level is driven solely by financial risk in this example.

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, the cost of capital used for evaluating a project should depend on the **riskiness of the project,** which does not necessarily have the same risk level of the company.

As such, using the corporate discount rate (also known as hurdle rate, cutoff rate, benchmark, and cost of capital), which is determined by the overall risk level of the firm, for all projects despite their risk levels may **INCORRECTLY**:

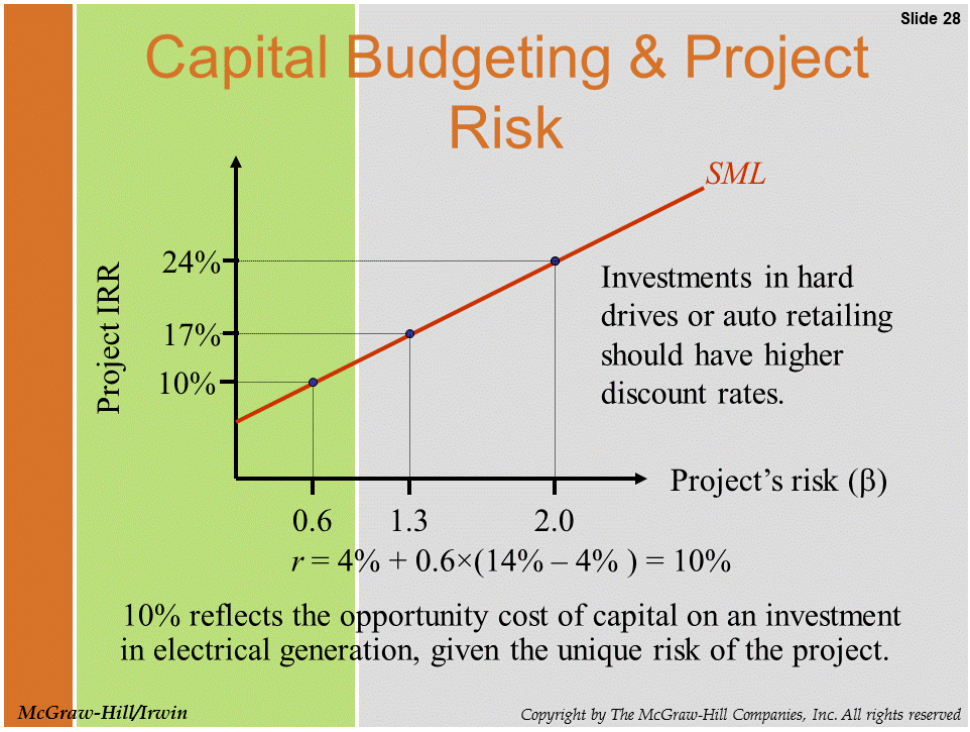
- ACCEPT NPV < 0 projects that are riskier than the company (green dots);
- REJECT NPV > 0 projects that are less risky than the company (blue dots).



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

Here 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
→ The company's weighted average asset beta = 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?

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

The 10% cost of capital, which reflects the opportunity cost of capital on an investment in electrical generation given the unique risk of the project, should be used. But NOT the company's cost of capital of 17%!

Assume now that the IRR of the electrical generation project is 14%. The incorrect use of the company's cost of capital (17%) as the benchmark will INCORRECTLY reject this lower risk project. By using the 10% cost of capital that reflects the risk level of project, the project will be correctly accepted. This illustrates the concern that the use of corporate cost of capital may incorrectly reject NPV>0 projects that have less risk than the company!

Practice Exercises – (Share your work on Canvas!)

An all-equity firm is considering the following projects:

Project:	W	X	Y	Z
Beta:	0.80	0.95	1.15	1.45
IRR:	9.4%	10.9%	13.0%	14.2%

The T-bill rate is 3.5 percent, and the expected return on the market is 11 percent.

a. Which projects have a higher expected return than the firm's 11 percent cost of capital?
b. Which projects ***should*** be accepted?
c. Which projects would be incorrectly accepted or rejected if the firm's overall cost of capital was used as a hurdle rate?

Costs of Fixed Income Capital (Ref: Section 13.7)

A. ***Before-tax cost of debt capital,*** R_B, is the yield to maturity (**YTM**) of the bond issued by the company. Since interest expenses are tax deductible, ***after-tax cost of debt capital is (1 – tax rate) * R_B***

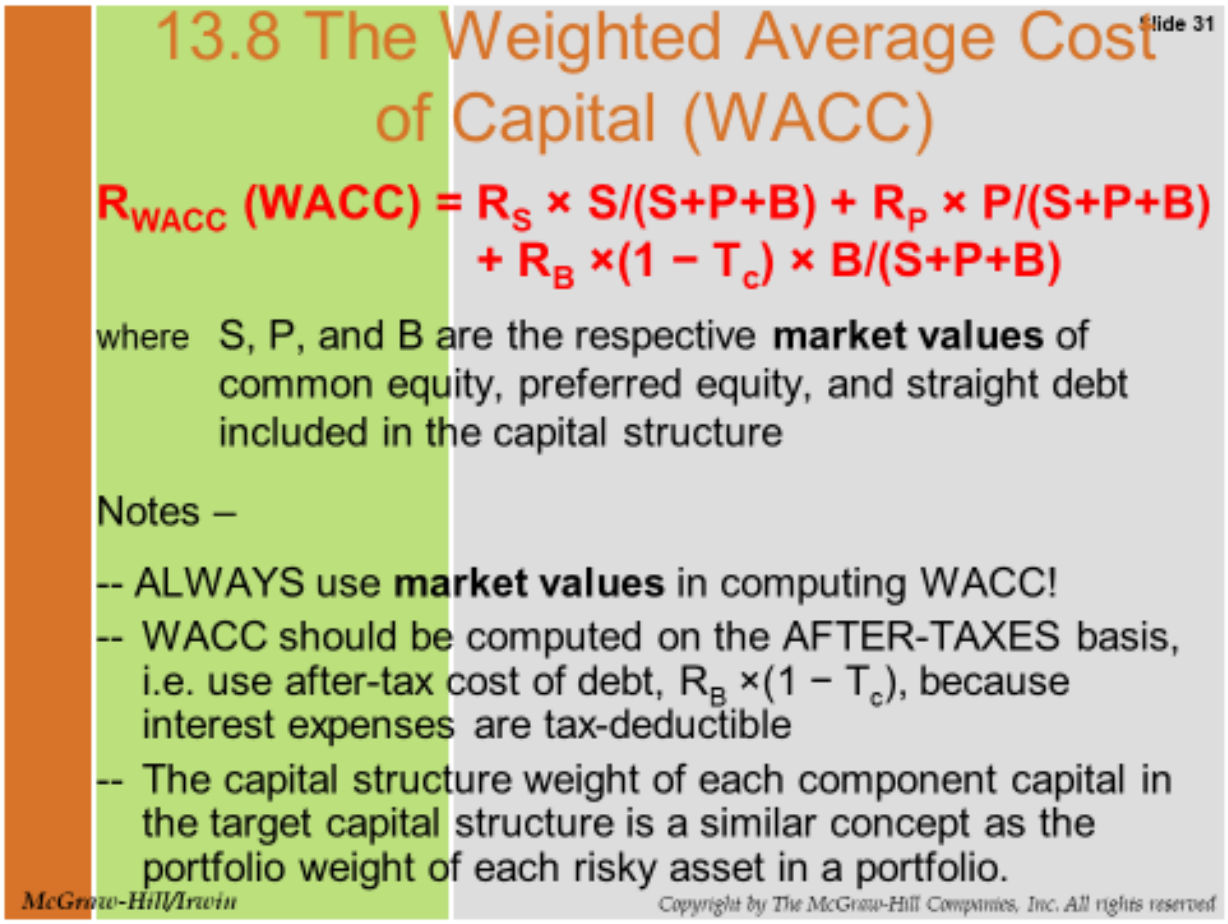
NOTE: Review *Chapter 8* for the YTM (i.e., bond yield) topic!!!

B. ***Cost of preferred stock capital,*** r_P, is the expected rate of return on a no growth stock discussed in ***Chapter 9***.

R_P = Dividend / Price

The Weighted Average Cost of Capital (Ref: Sections 13.8~13.10, and related topics in Chapters 8 & 9)

For firms that include debt, preferred and common equity in the capital structure, we estimate the Weighted Average Cost of Capital (WACC) as the appropriate discount rate.



The WACC is the weighted average of the cost of debt capital, R_B, the cost of preferred equity capital, R_P, and the cost of (common) equity capital, R_S. The capital structure weight of each component capital in the target capital structure is defined as the market value of the component capital, S, P or B, divided by the combined market value, S+P+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 on Weighted Average Cost of Capital:

- First, we estimate the cost of equity and the cost of debt, i.e., no preferred equity.
  - We estimate an equity beta to estimate the cost of equity.
  - We can often estimate the cost of debt by calculating/observing the yield to maturity (YTM) of the firm's debt.

- Second, we determine the WACC by weighting these two costs appropriately.

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Example: International Paper

- The industry average beta is 0.82, the risk free rate is 3%, and the market risk premium is 8.4%.
- Thus, the cost of equity capital is:

$$r_S = R_F + \beta_i \times (\overline{R}_M - R_F)$$
$$= 3\% + 0.82 \times 8.4\%$$
$$= 9.89\%$$

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Example: International Paper

- The yield on the company's debt is 8%, and the firm has a 37% marginal tax rate.
- The debt to value ratio is 32%

$$r_{WACC} = \frac{S}{S+B} \times r_S + \frac{B}{S+B} \times r_B \times (1 - T_C)$$
$$= 0.68 \times 9.89\% + 0.32 \times 8\% \times (1 - 0.37)$$
$$= 8.34\%$$

8.34% is International's cost of capital. It should be used to discount *any project where one believes that the project's risk is equal to the risk of the firm as a whole and the project has the same leverage as the firm as a whole*.

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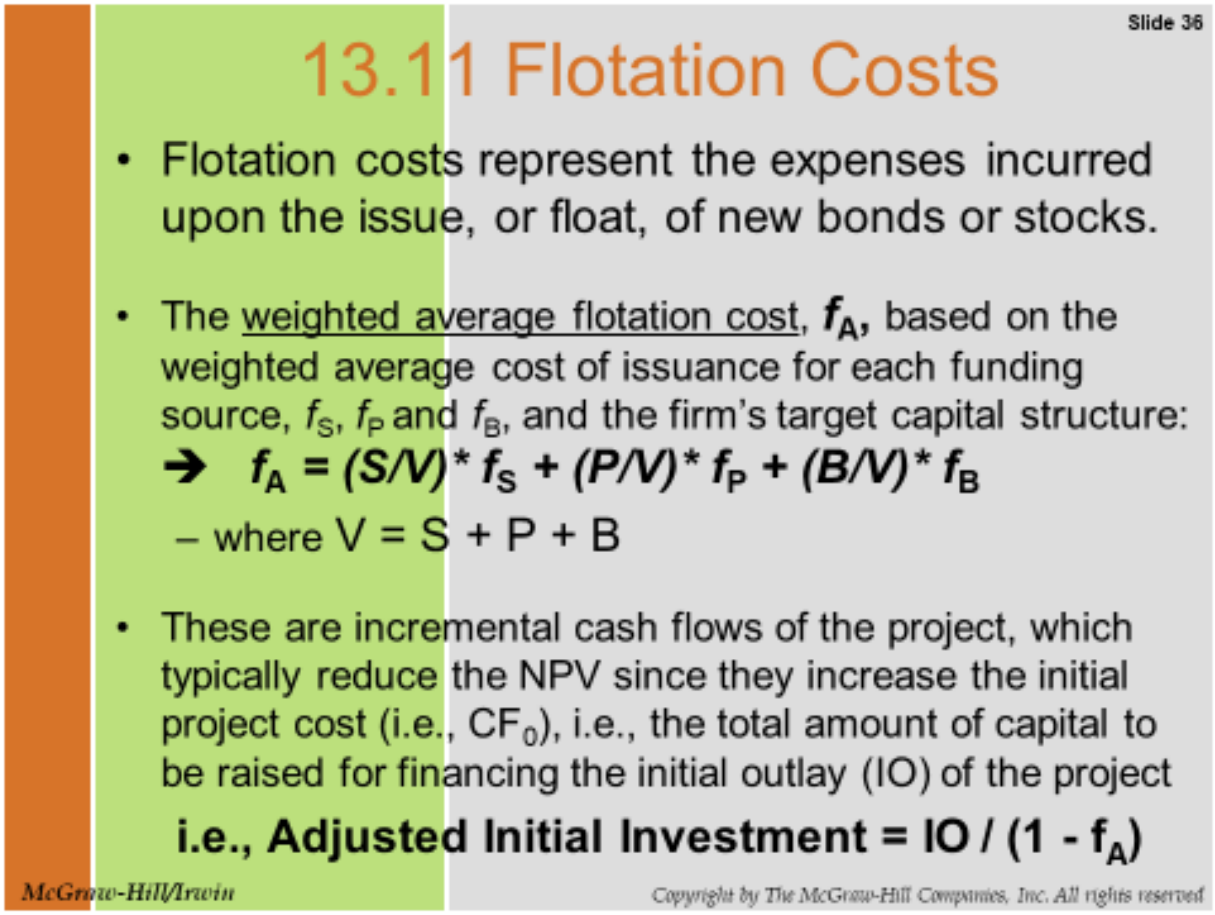
Adjustment for Flotation Costs in Capital Budgeting (Ref. Section 13.11)

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 (CF_0; IO) of the project.

The Weighted Average Flotation Cost, f_{Asset}



Note: The flotation costs are the costs associated with issuing new securities for raising external capital. Hence, they are **not** applicable to internal equity financing that refers to the retention of earnings, which are not distributed as cash dividends, financing investments (and operations).

An Example on Weighted Average Flotation Costs:

Trower Corp. has a debt–equity ratio of .85. The company is considering a new plant that will cost $145 million to build. When the company issues new equity, it incurs a flotation cost of 8 percent. The flotation cost on new debt is 3.5 percent.

a. What is the initial cost of the plant if the company raises all equity externally?
b. What if it typically uses 60 percent retained earnings?
c. What if all equity investments are financed through retained earnings?

Note that there is no preferred equity in the capital structure!

B/V = 0.85 / (1 + 0.85) = 0.4595; S/V = 0.5405

a. f_A = 0.5405*8% + 0.4595*3.5% = 5.9323%
   ⇨ Adjusted CF_0 = $145M/(1-0.059323) = $154,144,302

b. f_A = 0.5405*(1-60%)*8% + 0.4595*3.5% = 3.3379%
   ⇨ Adjusted CF_0 = $145M/(1-0.033379) = $150,007,087

c. f_A = 0.5405*(1-100%)*8% + 0.4595*3.5% = 1.6083%
   ⇨ Adjusted CF_0 = $145M/(1-0.016083) = $147,482,124

A Comprehensive Numerical Illustration on WACC & f_A:

Given the following capital structure -

Debt:	60,000 bonds with a coupon rate of 6 percent and a current price quote of 109.5; the bonds have 20 years to maturity. 230,000 zero coupon bonds with a price quote of 17.5 and 30 years until maturity.
Preferred stock:	150,000 shares of 4 percent preferred stock with a current price of $79, and a par value of $100.
Common stock:	2,600,000 shares of common stock; the current price is $65, and the beta of the stock is 1.15.
Market:	The corporate tax rate is 40 percent, the market risk premium is 7 percent, and the risk-free rate is 4 percent.

Calculate the weighted average cost of capital.

B1 = 60,000*109.5%*$1,000 = $65.70M; B2 = 230,000*17.5%*$1,000 = $40.25M

P = 150,000*$79 = $11.85M; S = 2,600,000*$65 = $169.0M; ➔ *V = $286.8M*

Hence, B1/V = 0.2291; B2/V = 0.1403; P/V = 0.0413; S/V = 0.5893

Bond 1: N=20*2=40; PV=-1,095; PMT=6%*1000/2=30; FV=1000
CPT I/Y=2.6142; ➔ R_{B1} = YTM = 2.6142%*2 = ***5.23%***

Bond 2: N=30*2=60; PV=-175; PMT=0; FV=1000
CPT I/Y=2.9476; ➔ R_{B2} = YTM = 2.9476%*2 = ***5.90%***

Preferred: R_P = 4%*$100 / $79 = ***5.06%***

Common: R_S = 4% + 1.15*7% = ***12.05%***

Hence, WACC = (0.2291*5.23%+0.1403*5.90%)*(1-40%) + 0.0413*5.06% + 0.5893*12.05%

⇨ **WACC = 8.5256%**

Calculate the weighted average flotation costs, and the NPV of a $250M project adjusted for the flotation costs.

Assume that flotation costs for issuing new bonds, preferred stocks, and common stocks are, respectively, 3%, 6%, and 15%. Without the adjustment for flotation costs, the NPV of the $250M project is estimated to be $20M.

f_A = (0.2291+0.1403)*3% + 0.0413*6% + 0.5893*15% **= 10.1955%**

Hence, Adjusted Initial Investment (CF_0) = $250M / (1-10.1955%) = $278.38M

➔ **Adjusted NPV** = $(250M+20M) − $278.38M **= -$8.38M**