FIN2010 Financial Management
Lecture 20: Cost of Capital

Review

- What if analysis:
  - Sensitivity analysis: what happens if we change the assumption of one variable?
  - Scenario analysis: what happens under different scenarios
- Break even analysis:
  - Accounting break even: Q_{BE} = (FC + D) / (P – v)
  - Cash break even: Q_{BE} = (FC) / (P – v)
  - Financial break even: the level of Q when NPV=0
- Operating leverage:
  - $DOL = 1 + \frac{FC}{OCF} = \frac{\%Change\ in\ OCF}{\%Change\ in\ sales}$ (assuming no tax)
  - The higher the operating leverage, the more volatile the OCF.
- Managerial option: Project Worth = NPV + Option(s) Value

Agenda

- What is cost of capital – motivation and intuition
- Cost of capital of equity
- Cost of capital of debt
- WACC
- Project cost of capital

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Motivation

- To make investment decisions, we calculate NPV
- NPV=$\sum \frac{CF_t}{(1+r)^t} - CF_0$
- But, what is the appropriate r?
  - r is called: discount rate, required return, cost of capital

Cost of Capital - Intuition

Return and **cost** are flip sides of an coin.

- Investors' **required return** is the firm's **cost of capital**.
- Example: a firm borrows $100 from an investor and promises to repay $106 in one year. Assume there is no tax. The return for the investor is 6%. The cost for the firm is also 6%.

Cost of Capital - Calculation

- Firms raise money in various forms. The cost of capital should represent the overall cost of the firm's financing components.
- One way to estimate cost of capital is weighted average cost of capital (WACC)

$$\text{WACC} = \frac{E}{E+D} r_E + \frac{D}{E+D} r_D$$

Where:

- E = market value of equity, r_E=cost of equity
- D = market value of debt, r_D=cost of debt

Project Cost of Capital

- Law of one price: projects with similar risk should have similar cost of capital
  - If one project is similar to other projects in a firm, then
    firm WACC = project WACC
  - If one project's risks differ from those of other projects in the firm
    - Use other similar firms' WACC: the pure play approach

      OR
    - Make adjustment based on own firms' cost of capital: subjective method (also called risk adjusted discount rate)
- No matter which method you use, we should first be able to back out the cost of equity/debt for a firm given the market data.

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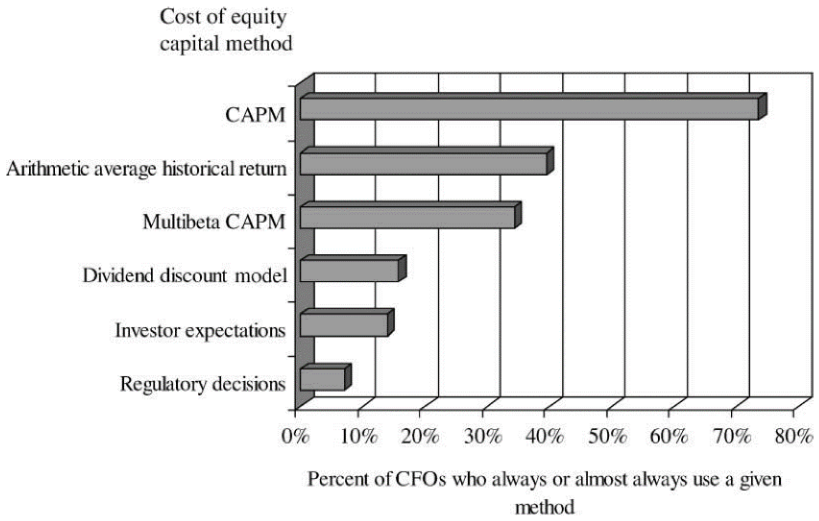
Cost of Equity

- Cost of equity: how much return shareholders require.
- No way to directly observe the return shareholders' require due to the uncertainties in stocks' future cash flows.
- Instead, we look for rough estimations.
  - CAPM and dividend discount model are among the most popular methods.



- Source: Graham, J.R. and Harvey, C.R. (2001) The Theory and Practice of Corporate Finance: Evidence from the Field. Journal of Financial Economics, 60, 187-243.

CAPM Method

- Also called SML approach
- The idea: investors' require higher return on riskier stocks.
- As we learned in lecture 10, CAPM is one of the most classical model of risk and return.
- $r_E = r_f + \beta_E(E(r_m) - r_f))$
- Where
  - r_f: risk-free rate
  - β_E: systematic risk of the equity or beta coefficient
  - $E(r_m) - r_f$: market risk premium

CAPM Method

- Suppose your company has an equity beta of 0.58, and the current risk-free rate is 6.1%. If the expected market risk premium is 8.6%, what is your cost of equity capital?

- **Solution:**
  - r_E = 6.1% + 0.58*8.6% = 11.1%

CAPM Method – Pros and Cons

- Advantages
  - Explicitly adjusts for systematic risk
  - Applicable to all companies, as long as we can estimate beta

- Disadvantages
  - Have to estimate the expected market risk premium, which does vary over time
  - Have to estimate beta, which also varies over time
  - We are using the past to predict the future, which is not always reliable
  - CAPM does not work well in reality

DDM Approach

- The idea:
  - In lecture 7, we learned to use discount dividend model (DDM) to look for fair price.
  - $P_0 = \sum \frac{Div_t}{(1+r)^t}$
  - Assume investors use this model to determine P, we can then infer the implied r based on observed P and an assumption about future dividends.
  - For example, under the assumption of constant dividend growth, $P_0 = \frac{Div_1}{r_E - g}$. Therefore, $r_E = \frac{Div_1}{P_0} + g$
- The challenge:
  - P_0 is directly observed from the market. But we do not know investors' prediction for future dividends.

How To Estimate g?

- Two commonly used methods:
  - Method 1: in lecture 7, we mentioned one simple model of growth rate:

    g= ROE * retention ratio
  - Method 2: use the historical average.
    - Example: assume firm A paid dividend from 2014-2018. What is the average dividend growth rate?

Year	Dividend	Percent change
2014	1.23	
2015	1.3	5.7%
2016	1.36	4.6%
2017	1.43	5.1%
2018	1.5	4.9%
Average growth rate		5.1%

DDM Approach - Example

- Suppose that your company is expected to pay a dividend of $1.50 per share next year. There has been a steady growth in dividends of 5.1% per year and the market expects that to continue. The current price is $25. What is the implied cost of equity?

- **Solution:**

$$r_E = \frac{1.50}{25} + 5.1\% = 0.111 \; or \; 11.1\%$$

DDM Approach -Pros and Cons

- Pros
  - Easy to understand
  - Easy to use

- Cons
  - Hard to apply to companies NOT paying dividends currently
  - Not applicable if dividends aren't growing at a reasonably constant rate
  - Extremely sensitive to the estimated growth rate. An increase in g of 1% increases the cost of equity by 1%
  - Does not explicitly consider risk

Cost of Equity- Example

- Suppose our company has a beta of 1.5. The market risk premium is expected to be 9%, and the current risk-free rate is 6%. We have used analysts' estimates to determine that the market believes our dividends will grow at 6% per year and our last dividend was $2. Our stock is currently selling for $15.65. What is our cost of equity?

- **Solution:**
  - Using CAPM: r_E = 6% + 1.5*9% = 19.5%
  - Using dividend discount model:
    - Div_1=2*(1+6%)=2.12
    - r_E = (2.12 / 15.65) + 6% = 19.55%
  - Often take averages of R_E from different methods.
  - r_E = 19.525%

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Cost of Debt

- Before-tax cost of debt is the required rate of return of the lenders of a company.
  - Often uses YTM
- The tax is paid after interest payments are deducted and before dividend payments are deducted. Consequently: debt offers a tax advantage.
  - After-tax cost of debt $r_D = R_D * (1 - T_C)$
- In contrast, as dividends are not tax deductible, cost of equity is not affected by tax.

After-Tax Cost of Debt – Example

- Firm A has an outstanding debt with market value equal to $1 million and the yield is 6% (EAR). Assume that the firm has an EBIT of x before considering interest payment. Assume there is no NWC, and the firm pays a marginal tax rate of T_c. What is the after-tax cost of debt for the firm?

- **Solution:**
  - The firm's operating cash flow w/o considering interest payment:

    $x\ (1- T_c)$
  - The firm's operating cash flow after considering interest payment:

    $(x – 1{,}000{,}000 * 6\%)\ *(1- T_c)$
  - The firms' after-tax cost of debt = change in cash flow

    $1{,}000{,}000\ *6\%\ (1- T_c)$

    Percentage cost of debt = $6\%*(1 - T_c)$

After-Tax Cost of Debt – Example

- What if instead of borrowing, the firm issued equity and pays 6% dividend?
  - The firm's operating cash flow after considering dividend payment
    $$x\ (1- T_c) - 1{,}000{,}000 * 6\%$$
  - Cost of equity = 6%

- In summary, because interest is paid <u>before</u> tax payment, there is tax saving for debt! Dividend is paid <u>after</u> tax payment, there is NO tax saving for equity.

Cost of Debt - Example

- Suppose we have a bond issue currently outstanding that has 25 years left to maturity. The coupon rate is 9%, and coupons are paid semiannually. The bond is currently selling for 90.872. If the firm pays a tax rate of 30%. What is the after-tax cost of debt?
- **Solution:**
  - 50 N; 4.5 PMT; 100 FV; -90.872 PV; CPT I/Y = 5%;
  - YTM = 5%*2 = 10%
  - After-tax cost of debt = 10%* (1 – 30%) = 7%

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WACC - Definition

- We can use the individual costs of capital that we have computed to get our "average" cost of capital for the firm.
- WACC = $\frac{E}{E+D} r_E + \frac{D}{E+D} r_D$
  - Where:
    - E=market value of equity, r_E=cost of equity
    - D=market value of debt, r_D=cost of debt
- This "average" is the required return on the firm's assets, based on the market's perception of the risk of those assets
- The weights are determined by the market value of each type of financing.

WACC - Example

- Equity Information
  - 50 million shares
  - $80 per share
  - Beta = 1.15
  - Market risk premium = 9%
  - Risk free rate = 5%
- Debt Information
  - $1 billion in outstanding debt (face value)
  - Current quote = 110
  - Coupon rate = 9%, semiannual coupons
  - 15 years to maturity
  - Tax rate = 40%
- **Solution:**
  - Cost of equity: $R_E = 5\% + 1.15*9\% = 15.35\%$
  - Cost of debt: YTM = 7.854%
  - After-tax cost of debt: $R_D(1-T_C) = 7.854\%* (1-40\%) = 4.712\%$
  - E = 50 million * 80 = 4 billion
  - D = 1 billion * 1.10 = 1.1 billion
  - V = 4 + 1.1 = 5.1 billion
  - $w_E = E/V = 4 / 5.1 = .7843$, $w_D = D/V = 1.1 / 5.1 = .2157$
  - WACC = 0.7843 * 15.35% + 0.2157*4.712% = 13.06%

WACC – Limitations

$$\text{WACC} = \frac{E}{E+D} r_E + \frac{D}{E+D} r_D$$

- Using the own firm's WACC as a project's discount rate is only appropriate when the project have the same risk and same capital structure as the firm's current operations.
- If a project that does NOT have the same risk as the firm, it is best to use project-specific cost of capital.
  - Commonly used methods:
  1. Pure play method
  2. Subjective adjustment

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The Pure Play Approach

- Ideally, we hope to find companies that focus as exclusively as possible on the type of project in which we are interested. Such firms are called Pure Play.

Steps:

- Find one or more companies that specialize in the product or service that we are considering
- Compute the beta for each company
- Take an average
- Use that beta along with the CAPM to find the appropriate return for a project of that risk
- Estimate WACC for similar firms and use it as the appropriate discount rate.
- Challenge: often difficult to find pure play companies

The Pure Play Approach - Example

Suppose McDonald's decides to enter the personal computer network server business with a line of machines called McPuters.

- The risks involved are quite different from those in the fast food business.
- As a result, McDonald's would need to look at companies already in the personal computer business.
- An obvious pure play candidate is Dell, which is predominantly in this line of business.
- HP, on the other hand, would not be a good choice as its primary focus is elsewhere, and it has many different product lines.

The Pure Play Approach

Assume Dell's total debt is $6903 million, and its equity market capitalization is $30,348 million. According to an estimation, its cost of debt is 4.5%, and its historical beta is 1.2. Current risk free rate is 2.51%, and market risk premium is expected to be 6%. Its tax rate is 27%. What is an appropriate WACC for McPuter if McDonald's plan to maintain a similar capital structure?

Solution:

- $W_E = \frac{30348}{30348 + 6903} = 0.8147$
- $W_D = \frac{6903}{30348 + 6903} = 0.1853$
- R_E = 2.51% + 1.2 * 6% = 9.71%
- WACC = 0.8147*9.71% +0.1853*4.5%*(1-27%) = 8.52%

Subjective Approach

- Consider the project's risk relative to the firm overall
  - If the project has more risk than the firm, use a discount rate greater than the WACC
  - If the project has less risk than the firm, use a discount rate less than the WACC
- You may still accept projects that you shouldn't and reject projects you should accept, but your error rate should be lower than not considering differential risk at all

Subjective Approach - Example

- Because of the difficulties that exist in objectively establishing discount rates for individual projects, firms often adopt an approach that involves making subjective adjustments to the overall WACC.

Risk Level	Discount Rate
Very Low Risk	WACC minus 8%
Low Risk	WACC minus 3%
Same Risk as Firm	WACC
High Risk	WACC plus 5%
Very High Risk	WACC plus 10%

Impact of Leverage on R_E

- Follow up on the MacPuter example. If McDonald's plans to use 40% of debt instead of 18% as Dell has, can we still use Dell's cost of capital as an estimate for MacPuter's cost of capital?
- No! As financial leverage increases, the risk for equity holder increases. As a result, r_E will increase, and cost of capital will change.

Financial Leverage – Example

- Assume that there are two firms with identical EBIT but different capital structure. Which firm is riskier for stockholders?

	Firm A	Firm B
Assets	$8,000,000	$8,000,000
Debt	$0	$4,000,000
Equity	$8,000,000	$4,000,000
Debt/Equity Ratio	0	1
Share Price	$20	$20
Shares Outstanding	400,000	200,000
Interest rate	N/A	10%

- Future is uncertain. Expectation for future EBIT is as follows

	Recession	Expansion
EBIT	$500,000	$1,500,000

- As a stockholder, we care about risk of equity – the uncertainty in stockholders' profit (ROE or EPS):
  - The lower the variability in ROE or EPS, the less risky it is for the firm.

Financial Leverage – Example

- What is the variability of EPS/ROE for the current and proposed capital structure?

Firm A: No Debt		
	Recession	Expansion
EBIT	$500,000	$1,500,000
Interest	0	0
Net Income	$500,000	$1,500,000
ROE	6.25%	18.75%
EPS	$1.25	$3.75

Firm B: Debt = $4 million		
	Recession	Expansion
EBIT	$500,000	$1,500,000
Interest	400,000	400,000
Net Income	$100,000	$1,100,000
ROE	2.50%	27.50%
EPS	$0.50	$5.50

- Firm B's EPS or ROE is more volatile than Firm A's.
- Why? Firm B has higher financial leverage.

Financial Leverage

- Degree of financial leverage (DFL): the percentage change in a firm's earnings per share (EPS) resulted from a 1% change in operating profit.
- DFL $at\ Q\ units\ of sales$

$$= \frac{\%\ \text{change in EPS}}{\%\ \text{change in EBIT}}$$

$$= \frac{\partial \text{EPS}}{\partial \text{EBIT}} \cdot \frac{1/\text{EPS}}{1/\text{EBIT}}$$

- Recall that EPS = $\frac{(\text{EBIT} - \text{I}) * (1 - \text{Tc})}{N}$
- DFL = $\frac{(1 - \text{Tc})}{\text{N}} * \frac{\text{EBIT}}{\frac{(\text{EBIT} - \text{I}) * (1 - \text{Tc})}{\text{N}}} = \frac{\text{EBIT}}{\text{EBIT} - \text{I}}$
- Where
  - I : interest payment. Tc : corporate tax rate. N : number of shares outstanding

Financial Leverage

- In the previous example of Firm A and B:
  - A's DFL = $\frac{500{,}000}{500{,}000 - 0}$ =1
  - B's DFL = $\frac{500{,}000}{500{,}000 - 400000}$ =5
  - A 200% change in EBIT leads to 200% change in A's EPS and 1000% change in B's EPS.
- Higher the debt ratio-> higher financial leverage -> higher risk for equity holder -> higher r_E.
- Consequently, if two firms have different leverage, they will have different equity cost of capital.

Impact of Leverage on r_E

- From previous analysis, we know that McDonald's cannot simply use Dell's equity cost of capital if it plans to adopt a different capital structure.
- How to adjust for the differences then?
  - Will discuss about the issue in the next lecture.

Summary

- Equity cost of capital
  - CAPM method
  - DDM method
- Debt cost of capital: need to consider after-tax effect
  - After-tax cost of debt $r_D = R_D(1 - T_C)$
  - WACC = $\frac{E}{E+D} r_E + \frac{D}{E+D} r_D$
- Limitation of using firm level WACC
  - Does not account for differences in risk
  - Does not account for differences in capital structure.
    - A firm's equity cost of capital changes with leverage.
- Project WACC
  - Pure play approach
  - Subjective adjustment approach

Next Time—Capital Structure

- Motivation
- Capital structure in a perfect world
  - MM I proposition
  - MM II proposition
- Capital structure in an imperfect world
  - The effect of tax
  - Other effects