Lecture 2

Capital Budgeting

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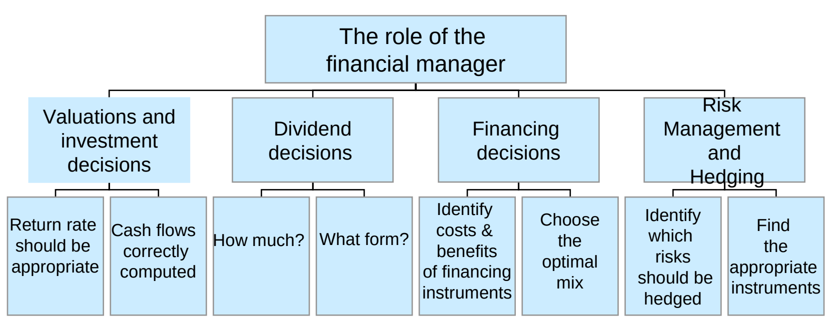
What is corporate finance?



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Capital allocation decisions

"Part of our problem may be that our business plan fails to mention anything about making money."

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Capital Allocation: Why is it so important?

"…the heads of many companies are not skilled in capital allocation. This inadequacy is not surprising. Most bosses rise to the top because they have excelled in an area such as marketing, production, engineering, administration – or sometime institutional politics…Once they become CEOs they face new responsibilities. They must make capital allocation decisions, a critical job that they have never tackled and that is not easily mastered. … it's as if the final step for a talented musician was not to perform at Carnegie Hall, but, instead, to be named chairman of the Federal Reserve."

"CEOs who recognize their lack of capital allocation skills (which not all do) will often try to compensate by turning to their staffs, management consultants, or investment bankers… I have frequently observed the consequences of such 'help.' On balance we feel it is more likely to accentuate the capital-allocation problem than to solve it. In the end, plenty of unintelligent capital allocation takes place … (that's why you hear so much about 'restructuring')."

Warren Buffet, 1987 Letters to BH Shareholders

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The investment decision: invest in project with positive NPV

- Compute expected cash flow
- Choose the appropriate discount rate

⇒NPV

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Choose the appropriate discount rate

$$E(r_{project}) = r_{riskfree} + \beta_{project} E(r_{market} - r_{riskfree})$$

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CAPM review

- Implications:
  - Only market risk is "priced":

    (Expected) returns are only earned as compensation for bearing market risk. All other (idiosyncratic) risk can be diversified away.
  - Covariance (with the market) is everything: β=cov(ri,rm)/var(rm), so higher covariance with mkt ⇒ higher beta = higher risk ⇒ higher return.

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Choosing the correct risk free rate: $r_{risk\ free}$

$r_{riskfree}$

- Select correct maturity
- Select one type of default-free bond
- The term structure of interest rates
- Re-consider your risk premium assumptions

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Choosing the correct risk free rate: $r_{risk\ free}$

- Select correct maturity
  - Same maturity of your project
- Select one type of default-free bond
  - Government bonds
  - For example, if your project is a 2years project, choose $r_{0,2}$
  - Are government bonds risk free?

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Choosing the correct risk free rate: Are government bonds risk free?

- Consider the following strategies
  - Buy 2-years maturity government bond at t=0 and wait till maturity (t=2)
  - Buy 1 year maturity government bond. At the end of the first year reinvest the proceeds into another 1 year maturity government bond
- Are the two strategies the same?
  - Only if there is no uncertainty

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Choosing the correct risk free rate: Are government bonds risk free?

- No uncertainty ⇒government bonds would be risk free.
- Uncertainty ⇒
  - Inflation risk
  - Real interest rate risk
- How do we deal with this?
  - If long term government bonds carry risk, we need to subtract the risk premium

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Choosing the correct risk free rate: Finding the risk premium of LT gov bonds

- Assume that 3 months maturity T-bills are risk free. Good assumption for US T-bills
- Two alternatives
  - Take the average difference between LT bonds and T-bills. Example: 10 yr risk premium=1.7
  - Use a CAPM model to estimate the risk premium in government bonds:

    $E(r_{10years}) = r_{T\text{-}bills} + \beta_{10year}(r_m - r_{T\text{-}bills})$

    $\beta_{10year}=0.13;\ \beta_{10year}(r_m - r_{T\text{-}bills})=1.1\%$

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Calculating the correct market price for risk

Returns for US Assets, 1926-2003

Security class	Arithmetic mean (%)	Average risk premium	Standard deviation, σ
S&P 500	12.4	8.6	20.4
Long-term corporate bonds	6.2	2.4	8.6
Long-term government bonds	5.8	2.0	9.4
Intermediate government bonds	5.5	1.7	5.7

Source: Ibbotson Associates (2004). Stocks, Bonds, Bills, and Inflation. 2004 Yearbook. Market Results for 1926-2003. Chicago, Ibbotson Associates. Tables 1-3 and 2-1.

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What have we done?

- In order to estimate the future rate, we have used the term structure of interest rates.
- Question 1: What can you say about future rates by looking at an upward sloping yield curve?
  - The term structure can be upward sloping because of (1) expectations, (2) risk. To distinguish between the two you have to estimate the risk premium, as we did before
- Question 2: Can the term structure be negatively sloped?

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Sum up: the correct risk free rate

- Select correct maturity
- Select one type of default-free bond
  - government bond
- Re-consider your risk premium assumptions
  - inflation and real interest rate risk. Subtract the risk premium to compute the correct interest risk free rate

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Calculating the correct project beta

- Suppose you want to estimate the return for a new software project.
  - Select a firm in the same industry classification
    - Project beta may be different from asset beta
  - Stock beta≠Asset beta ⇒
    - Unlever: $\beta_A = \beta_E * \frac{E}{D+E} + \beta_D * \frac{D}{D+E}$
    - Debt and equity ratios
    - The debt beta

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Calculating the correct project beta

- Go from estimated B_{equity} (say, from regression) and assumed / estimated B_{debt} to compute B_{assets}
- This is called **unlevering beta**
- To unlever beta, just remember:

$$B_{assets} = B_{debt} *(D)/(A) + B_{equity} *(E)/(A)$$

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Pinnacle West Corp.

	βequity	Std. Error	D/A	E/A	βdebt
Boston Electric	0.60	0.19	0.57	0.43	0.38
Central Hudson	0.30	0.18	0.51	0.49	0.10
Consolidated Edison	0.65	0.20	0.37	0.63	0.43
DTE Energy	0.56	0.17	0.23	0.77	0.36
Eastern Utility Assoc	0.66	0.19	0.53	0.47	0.44
GPU Inc	0.65	0.18	0.49	0.51	0.42
NE Electric System	0.35	0.19	0.45	0.55	0.15
OGE Energy	0.39	0.15	0.39	0.61	0.19
PECO Energy	0.70	0.23	0.45	0.55	0.49
Pinnacle West Corp.	0.43	0.21	0.45	0.55	0.23
PP &L Resources	0.37	0.21	0.32	0.68	0.16
Industry Average	0.51	0.19	0.43	0.57	0.30

Pinnacle West Corp.

Average market returns

$R_{equity} = r_f + B_{equity} (r_m - r_f)$

$= 4.5 + .51(8.0) = 8.62\%$

(Used industry average B_{equity} since PW's B_{equity} was measured with lots of error)

$R_{debt} = 4.5 + .30(8.0)=6.94\%$

Unlever betas:

R_{assets} =0.43*.0694+0.57*0.0862=7.89%

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An example of de-levering

RedHat has two assets. Cash ($19B) and Software Assets ($151B). It has $10B of debt outstanding and its equity beta is .986 and the debt beta is .20.

Total assets=Software+Cash=151+19=170

Total Assets=Debt+Equity=10+160

What is the beta of RedHat's software assets?

Solution: Beta of software=1.06

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Beta for International Projects

- Same principles apply, with complications
- If project is owned by US investors, they care more about project's beta **with US market**. Not about project's beta with local market.
- The theory is clearest if investors are globally diversified. Then relevant beta is beta with **world market.**

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Sum-up: Calculating the correct project beta

- Project beta may be different from asset beta
- Calculating the asset beta
  - if you start with equity beta, de-lever;
  - to de-lever you need:
    - Current market debt and equity ratios
    - The debt beta

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Calculating the correct market price for risk

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Capital Structure and betas

$$r_{assets} = r_{debt} \, \underline{(D)}/ (A) + r_{\underline{equity}} \, (E)/ (A)$$

$$\beta_{assets} = \beta_{\ debt} \, \underline{(D)}/ (A) + \beta_{\ \underline{equity}} \, (E)/ (A)$$

$$\mathbf{r_{equity} = r_f + \beta_{\ equity} \, (r_m - r_f)}$$

IMPORTANT

E, D, and A are all market values

Capital Structure & beta

- Changing capital structure can change the risk of the debt relative to the risk of the equity, but does not change the overall risk of the firm.
- Changing capital structure therefore does not change the company cost of capital.
- Let's see how changes in capital structure change the costs of equity vs. debt…

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Example

$r_{assets} = 12.2\%$

$r_{debt=} 8\%$

A=50

D=20

$r_{equity} = r_{assets} + (r_{assets} - r_{debt})*(D)/ (E)$

$r_{equity} = 15\%$

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Example (cont)

Digression:Where are those returns coming from?

$\beta_{assets} = 0.8$

$\beta_{debt=}0.2$

A=50, **(r_m - r_f)=8.6%**

Risk free rate=4.68%

D=20

$\beta_{equity} = \beta_{assets} + (\beta_{assets} - \beta_{debt})*(D)/ (E)$

$\beta_{equity} = 1.2$

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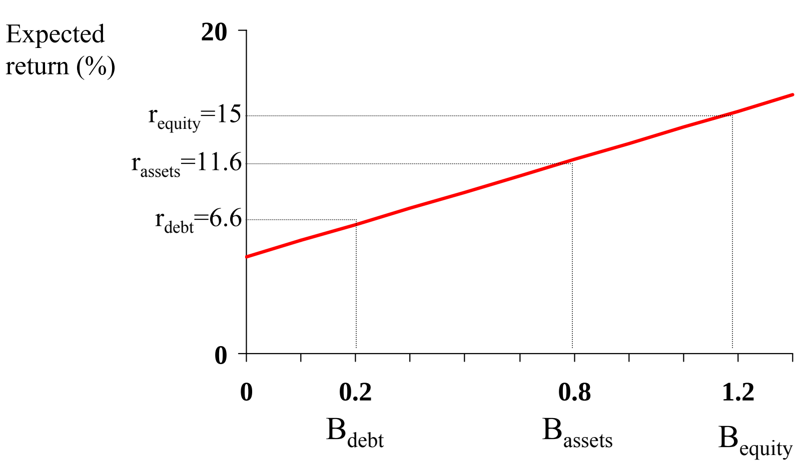
Capital Structure & beta

Expected Returns and Betas **before** refinancing



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What happens if we change leverage?

- Suppose now that we change the capital structure (total level of assets is the same)
- D=15
- E=35
- Two effects:
  - Because the debt level is less, debt risk has decreased: $\beta_{debt=}0.1$
  - Because the debt level is less, D/E is less

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What happens if we change leverage?

β_{assets} does not change – unless we change the project

$\beta_{assets\ =0.8}$

$\beta_{debt=}0.1$ -Why β_{debt} decreases?

$\beta_{equity} = \beta_{assets} + (\beta_{assets} - \beta_{debt})*(D)/ (E)=$

$=0.8+(0.8-0.1)*.43=1.1$

Why has β_{equity} decreased? What happens to r_{equity} ?

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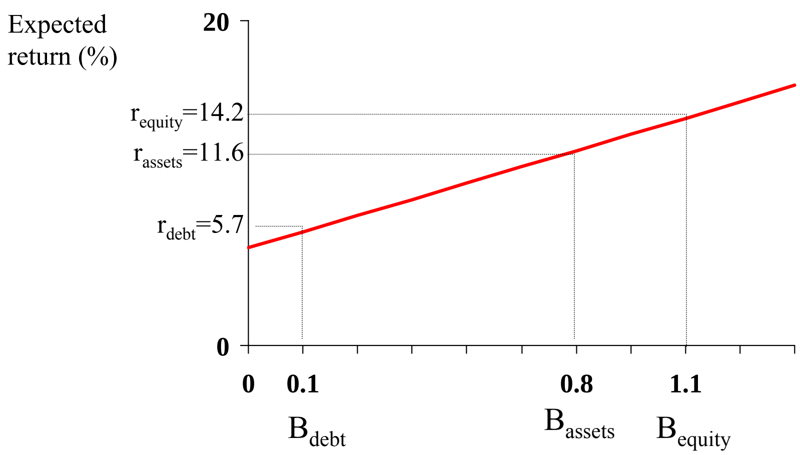
Capital Structure & beta

Expected Returns and Betas **after** refinancing



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Promised vs. expected return

- In words:
- The promised return on a bond is the return in case the bond does not default
- The expected return on a bond is the return taking into account the probability of default.

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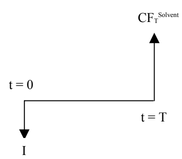
Promised vs. expected return



$$I(1+r_{promised})^{T} = Cashflow_{T}^{Solvent}$$

$$I(1+r_{expected})^{T} = (1-p)*Cashflow_{T}^{Solvent} + (p)*Cashflow_{T}^{Default}$$

- (see handout)

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What have we learned?

- The appropriate discount rate, using CAPM
  - rf : take into account maturity and risk premium
  - β: choose the appropriate “assets”; if you use equity beta, de-lever (need debt and equity ratios and debt beta)
  - the market price risk
- Three important tools:
  - term structure of interest rates (expectation and/or risk)
  - decomposing assets’ betas
  - promised versus expected returns (see handout on the web page)
- Practice problems
  - Homework 1, Problems at the end of lecture 2 outline, Additional problems on my web page. Remember: Practice, Practice, Practice.

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