Introduction to Finance

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Taking Stock

- Capital Budgeting process:
  1. Given the capital structure find the appropriate discount rate of the firm using WACC

$$r_{WACC} = \frac{E}{E+D} r_E + \frac{D}{E+D}(1-T) r_D$$

  2. Compute the NPV of the project

$$NPV = \sum_{t=0}^{T} \frac{CF_t}{(1+r_{WACC})^t}$$

  3. Make investment decision using the appropriate investment decision rule.

WACC

Financing Weights

$$r_{WACC} = \frac{E}{E+D} r_E + \frac{D}{E+D}(1-T) r_D$$

- WACC corresponds to the weighted average of r_E and r_D.
- Weights correspond to the share of equity in total assets ($\frac{E}{E+D}$) and the share of debt in total assets ($\frac{D}{E+D}$).
- In some cases the share of common equity *vs.* preferred equity must be distinguished.
- When possible, E and D are computed using their **market value**. This is the value that matters for investors.

WACC

Cost of Debt

$$r_{WACC} = \frac{E}{E+D} r_E + \frac{D}{E+D}(1-T) r_D$$

- r_D is the cost of debt. This is the opportunity cost of holding debt of the company.
- r_D is such that given the price of the debt, investors want to keep holding it: $P_{debt} = NPV_{debt}(r_D)$.
- This is the **yield-to-maturity**: $r_D = YTM$.
  - This is the rate an investor would earn by buying the bond at today's price and holding it to maturity.
- The cost of debt vis-a-vis investors is the YTM but this is not the actual cost of issuing debt. The tax shield of debt reduces the effective cost of debt: $r_D^* = r_D \times (1-T)$.

WACC

Cost of Equity

$$r_{WACC} = \frac{E}{E+D} r_E + \frac{D}{E+D}(1-T) r_D$$

- r_E is the cost of equity. This is the opportunity cost of holding firm's equity or the foregone return for investors of holding other firm's equity with similar risk.
- To evaluate the return, one has to use an asset pricing model.
  - The CAPM is one of the most used asset pricing model.
  - The Constant Growth model is an alternative.

WACC

Cost of Equity: the CAPM

- $$\underbrace{r_i}_{\text{Expected return of stock } i} = \underbrace{r_f}_{\text{Return of the risk-free asset}} + \beta_i \underbrace{(r_M - r_f)}_{\text{Expected risk premium of the market}}$$
- Expected returns depend only on the asset's non-diversifiable (systematic) risk.
- What differentiates expected returns across assets is β_i, a measure of covariation between i's return and the market return. It is a measure of non-diversifiable risk.
- $\beta_i = \frac{cov(r_i, r_M)}{Var(r_M)}$.

- To compute r_E using the CAPM, we need:
  1. Which alternative projects should be used to compare the current firm to.
  2. Forecast the returns from investing in these alternative opportunities.

- The Constant Growth Model is an alternative pricing model.
- Assuming the firm's dividend grow at a constant rate g, we can use the DCF model to forecast returns.
- $r = \frac{DIV_1}{P_0} + g$

WACC

Cost of Equity: CAPM *vs.* CGM

- Both models should give similar estimates but might also differ.
- Which one to chose?
  - CGM sensitive to analysts forecasts of dividend growth (especially over multiple years).
    - Best fit for large companies with stable dividend streams.
  - CAPM assumes only one factor can predict returns.
    - After 40 years of research, many other factors have been found to predict returns.
    - Best fit for companies paying no dividends, or volatile dividends that are hard to predict.
- In practice, the CAPM is more popular.

WACC

Cost of Equity: CAPM *vs.* CGM

	Capital Asset Pricing Model	Constant Dividend Growth Model
Inputs	Equity beta	Current stock price
	Risk-free rate	Expected dividend next year
	Market risk premium	Future dividend growth rate
Major Assumptions	Estimated beta is correct	Dividend estimate is correct
	Market risk premium is accurate	Growth rate matches market expectations
	CAPM is the correct model	Future dividend growth is constant

WACC

- r_E and r_D must always be based on **comparable** projects.
- One has to use historical values of comparable projects to chose them.

Net Present Value

General Formula

- Once r_{WACC} and the CF are known, one can compute the NPV.

$$NPV = C_0 + \frac{C_1}{(1+r)} + \frac{C_2}{(1+r)^2} + ... + \frac{C_T}{(1+r)^T} = \sum_{t=0}^{T} \frac{C_t}{(1+r)^t}$$

- This formula is always right. Use it for complex CF structures and when the number of period is not too large.

Net Present Value

Specific Securities

- Some securities have specific CF payment that are easy to compute.
- Projects' CF structure generally follows a combination of these specific structures:
  - (Growing) Perpetuity.
  - (Growing) Annuity.

Net Present Value

Specific Securities

- Growing Perpetuity: a CF payment with an infinite horizon and a constant growth rate g:

$$PV = \frac{C}{r-g}$$

- Growing Annuity: a CF payment until (finite) time horizon T and a constant growth rate g:

$$PV = \frac{C}{1+r} + \frac{C(1+g)}{(1+r)^2} + .. + \frac{C(1+g)^{T-1}}{(1+r)^T}. = \frac{C}{r-g}\left(1 - \frac{(1+g)^T}{(1+r)^T}\right)$$

- Take $g = 0$ if the payment is constant.

Net Present Value

Important Rules

- Always bring the CF at different horizons at the same period.
  - CF at different points in time cannot be aggregated.
  - It generally happens when a project has a CF profile that combines different types of formula (*e.g.* an annuity and a growing perpetuity).
- In the above formulas, the first payment is always in year 1. Add manually the CF (*e.g.* investment) in year 0 if necessary.

Decision Rules

Investment Rules

- How to chose to invest in a project? To invest between different projects?
- Different criteria can be used depending on the constraints and on available information.
  - The Net Present Value.
  - The Internal Rate of Return.
    - It is the unknown in:

$$NPV(IRR) = C_0 + \frac{C_1}{1+r} + \frac{C_2}{(1+r)^2} + ... + \frac{C_T}{(1+r)^T} = 0$$

  - The Payback period
    - The amount of time it takes a project to pay back investment.
- How to chose between these alternatives?

Decision Rules

Investment Rules

- How to chose between these alternatives?
  - NPV is the most informative and reliable rule: chose it when possible.
  - Information-intensive but necessitates less information than the IRR.
  - The Payback rule requires less information but is less reliable.
  - Good practice is to use several different rules.

Decision Rules

Alternative Projects and Limited Funds

- Mutually exclusive projects:
  - Chose the project with the highest NPV.
- When resources are limited:
  - Compute the profitability index of each project: $\frac{\text{NPV}}{\text{Investment}}$
  - Rank the projects by profitability.
  - Pick projects until resources are exhausted.
- Always discard projects with negative NPV.