- Capital Budgeting
- Cost of Capital

Capital Budgeting

Capital Budgeting

- Identify and evaluate projects
- Most important responsibility
    - Purchase of costly long-term assets
    - Principle apply to other corporate decisions
    - Consistent with primary goal of maximizing shareholder value

Capital Budgeting Steps

- **Idea** generation
    - Most important step
- **Analyse** project proposals
    - Based on expected future cash flow
- Create the firm-wide **capital budget**
    - **Prioritize** profitable projects according to timing of cash flows, available resources, overall strategic plan
- Monitoring decisions and conducting a post-audit
    - Follow up, compare results
    - Identify systematic errors in forecasting process

Project Categories

- Replacement projects to maintain
- Replacement projects for cost reduction
- Expansion
    - Very detailed analysis
- New project or market development
- Mandatory projects
    - Required by government or insurance
    - Little or no revenue
- Other projects

Capital Budgeting Principles

- Decisions based on **cash flow**, not accounting income 现金流
    - Incremental cash flows
        - Cash flow will occur if the project is **undertaken**
    - Sunk costs
        - Cannot be avoid, even if the project is not undertaken
        - Consulting fee
    - Externalities
        - Effects may have on other frim cash flows
        - Cannibalization/negative externalities
            - A new project takes **sales** from an existing project
        - Positive externalities

    - **Conventional** cash flow pattern
        - Sign on cash flow changes only **once**, with one or more cash outflows
    - Unconventional cash flows
        - More than one sign change
- Cash flows are based on **opportunity** costs 机会成本
    - **opportunity** costs
        - cash flows that a firm will **lose** by undertaking the project
- **timing** of cash flows is important 时间点
    - earlier is better
- cash flows are analysed on an **after-tax** basis 税后收益
- **financing costs** are reflected in the project's **required rate of return**

Independent or mutually exclusive projects 独立和互斥项目

- independent
    - unrelated
- mutually exclusive
    - only one can be accepted

Project sequencing 项目顺序

- projects must be undertaken in a certain order, investing a project today creates opportunity to invest in other projects in the future

Unlimited Funds vs. Capital Rationing

- Unlimited fund
    - invest all projects with expected return that exceed the cost of capital
- capital rationing
    - must rationally prioritize the capital

Net present value (NPV)

- $\mathrm{NPV} = \mathrm{CF}_0 + \frac{CF_1}{1+k} + \cdots + \frac{CF_n}{(1+k)^n} = \sum_{t=0}^{n} \frac{CF_t}{(1+k)^t}$
    - CF_0: initial investment
    - CF_t: after-tax cash flow
    - k: **required rate** of return
- NPV: expected present value of future cash inflows – initial cash outflows
- Value
    - NPV > 0: create value
    - NPV = 0: no value
    - NPV < 0: decrease value
- Independent projects
    - accept all projects with **positive** NPV
    - reject all projects with **negative** NPV

Internal Rate of Return (IRR)

- discount rate that make NPV = 0
    - $\mathrm{PV(inflows)} = \mathrm{PV(outflows)}$
    - $\mathrm{NPV} = 0 \rightarrow \mathrm{IRR}$

- Decision Rule
  - $\text{IRR} > \text{required rate of return} \rightarrow \text{accept}$
  - $\text{IRR} < \text{required rate of return} \rightarrow \text{reject}$

Payback Period 多少年收回成本、流动性

- Number of years it takes to recover the initial cost of an investment
  - net cash flows (NCF)
  - Cumulative net cash flows (CNCF)
  - $minimze_t\ for\ which\ \text{CNCF}_\text{t} = 0$
  - $C\text{NCF}_{\text{t}-1} < 0, and\ \text{CNCF}_\text{t} > 0$
  - Linear interpolation: $\text{PP} = \text{t} - 1 + \frac{-\text{CNCF}_{\text{t}-1}}{NCF_t}$
- A good measure of **Liquidity**
- Drawback
  - No time value of money
  - No cash flows beyond the payback period
  - Useless as a measure of profitability

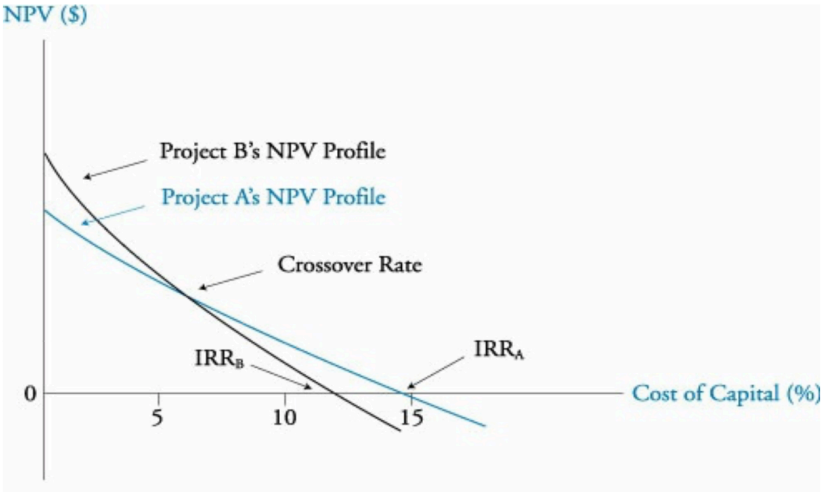
Discounted Payback Period 多少年收回成本、流动性

- Uses present values of estimated cash flows
- DPP is larger than PP (DPP > PP) 折现值变小，因此需要跟多的时间
- Similar to PP, but use discounted cash flow
  - net cash flows (NCF) -> discounted net cash flow (DNCF) -> cumulative discounted net cash flows (CDNCF)

Profitability index (PI)

- present value of a project future cash flows divided by initial cash inflow
- $\text{PI} = \frac{\text{PV(future cash flows)}}{|CF_0|} = 1 + \frac{NPV}{|CF_0|}$
  - $\text{NPV} = -|\text{CF}_0| + PV(future\ outflows)$
  - $\rightarrow\ PV(future\ outflows) = |CF_0| + NPV$
- Decision
  - $\text{PI} > 1 \rightarrow \text{accept}$
  - $\text{PI} < 1 \rightarrow \text{reject}$

NPV Profile



- Crossover rate
  - Difference in **timing**
  - Difference in Cash flow -> NPV=0 -> IRR -> crossover rate

NPV

- advantages
  - Direct measure of expected increase in firm value
  - Theoretically the best measure
- Weakness
  - Fail to consider project size (budget dollar)

IRR

- Advantages
  - Measure profitability as a percentage
  - Provides information on the margin of safety
- Weakness
  - Possibility of ranking for mutually exclusive projects different from NPV
  - Can have no or multiple IRR
    - Unconventional cash flow

NPV and IRR Conflicts

- Use NPV for decision for mutually exclusive projects
- Difference: Cash flow timing and Project size
- NPV
  - Cash flow is reinvested at **costs of capital** (discount rate used for NPV)
  - Realistic assumption
- IRR
  - Assume reinvested at **project's IRR**
  - Unrealistic

NPV and company value

- A positive NPV project should cause a proportionate increase in stock price
- Raise expectation

Cost of Capital

Weighted average cost of capital (WACC)

- Is also referred to as Marginal cost of capital (MCC)
- Financing department
  - Reduce cost of capital
  - Sources: common equity, preferred equity, and debt
  - Long-run target weight for each funding sources
- Investment departments
  - WACC reflects the **average** costs
  - Not appropriate for evaluating **new** projects
  - Adjust **upward** for projects with greater-than-average risk
  - Adjust **downward** for projects with less-than-average risk

WACC

- Reflect the **average** cost
- $\mathrm{WACC} = \mathrm{w_d} \times k_d \times (1-t) + w_p \times k_p + w_c \times k_c$
  - k_d: $cost\ of\ before-tax\ debt$
  - $k_d \times (1-t)$: $cost\ of\ after\ tax\ debt$
  - k_p: $cost\ of\ preferred\ stock$
  - k_p: $cost\ common\ equity$
- Should use **target** capital structure

Tax issues

- Interest paid to corporate debt is tax deductible -> focus on after-tax cost of capital

Weight - Target Capital Structure

- Use **current** (market values) capital structure
  - Incorporate a noticeable trend
- Use **industry** average capital structure
  - **Arithmetic** average of current market weights from a sample of industry firms

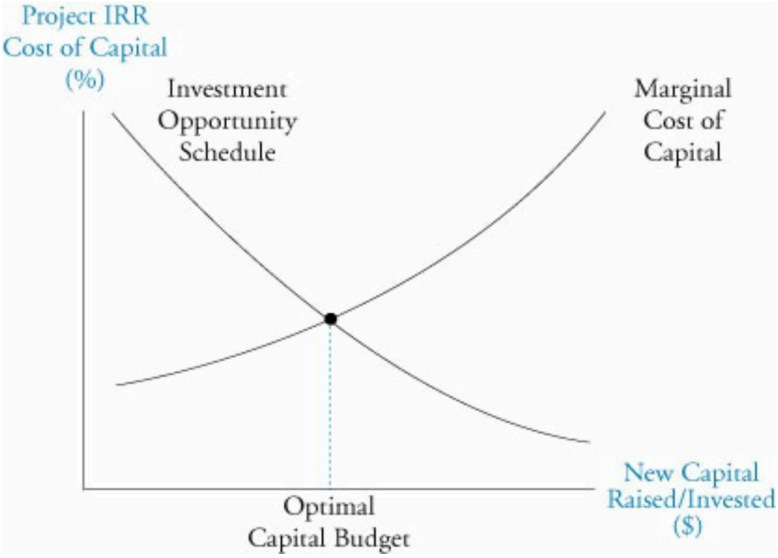
WACC and NPV

- Projects do not have the same risk, should adjust WACC when computing NPV
- WACC - existing
  - Based on **existing** level of firm risk
  - Appropriate discount rate for existing projects
  - Should **adjust** it based on specific project risk
    - Higher risk -> higher WACC
- WACC - assumption
  - Capital structure of a firm will **remain** at the target capital structure over the life of the project

Optimal capital budget

- Marginal cost of capital curve

    - WACC increase as more capital are raised
- Investment opportunity schedule
    - Order projects from highest to lowest IRR
- Intersection
    - Fund projects with IRR > WACC



Cost of debt capital

- k_d the **market interest** rate (YTM)
- Publicly traded company -> market YTM
- Not publicly traded company
    - Matrix pricing: use existing debt with the same rating and maturity
- covenants or seniority
    - Make adjustment
- Floating-rate debt
    - Use longer-term cost of debt

Cost of Preferred Stock (non-callable, nonconvertible)

- $k_p = \frac{\mathrm{D_p}}{P}$
- dividend divided by **market** price

Cost of Equity

- CAPM
    - $k_c = R_f + \beta \times (R_m - R_f)$
    - β project beta
- **Dividend discount model**
    - $k_c = \frac{D_1}{P_0} + g$
    - g is the growth rate
        - $use\ the$ growth rate projected by security analysts
        - Use the **sustainable** growth rate

        - $g = \text{retention rate} \times \text{ROE} = (1 - \text{payout}) \times \text{ROE}$
    - D_1 is the expected (next year's) dividend
- **Bond yield plus risk premium**
    - $k_c = long\ term\ bond\ yield + risk\ premium$
    - Risk premium is usually 3% to 5% to the yield of long-term debt

CAPM project beta (un-lever and re-lever)

- Project equity beta
    - Measure of its systematic or market risk
- Firm beta
    - business risks of its projects (lines of business)
    - its **financial** structure
- Pure-play method -> **Comparable** company
    - Find publicly traded firms who **purely** engage in a business similar to that of the project
    - $\beta_{\text{asset}} \times \left((1 - t_c) \times D_c + E_c\right) = \beta_{equity} \times E_c$
    - $\rightarrow\ \beta_{\text{asset}} = \frac{\beta_{equity}}{1+(1-t_c)\times\frac{D_c}{E_c}}$
- Project Equity beta
    - $\beta_{\text{asset}} = \beta_{asset} \times \left(1 + (1 - t) \times \frac{D}{E}\right) = \beta_{equity} \times \frac{1+(1-t)\times\frac{D}{E}}{1+(1-t_c)\times\frac{D_c}{E_c}}$
    - For a given set of projects, the greater it relies on **debt** financing, the greater its equity beta
- Challenges
    - Beta is estimated using historical data
    - Estimate is affected by which index is chosen to represent the market return
    - Betas are believed to revert toward 1 over time, need to adjust for this tendency
    - Adjust beta of small-capitalization firms **upward**

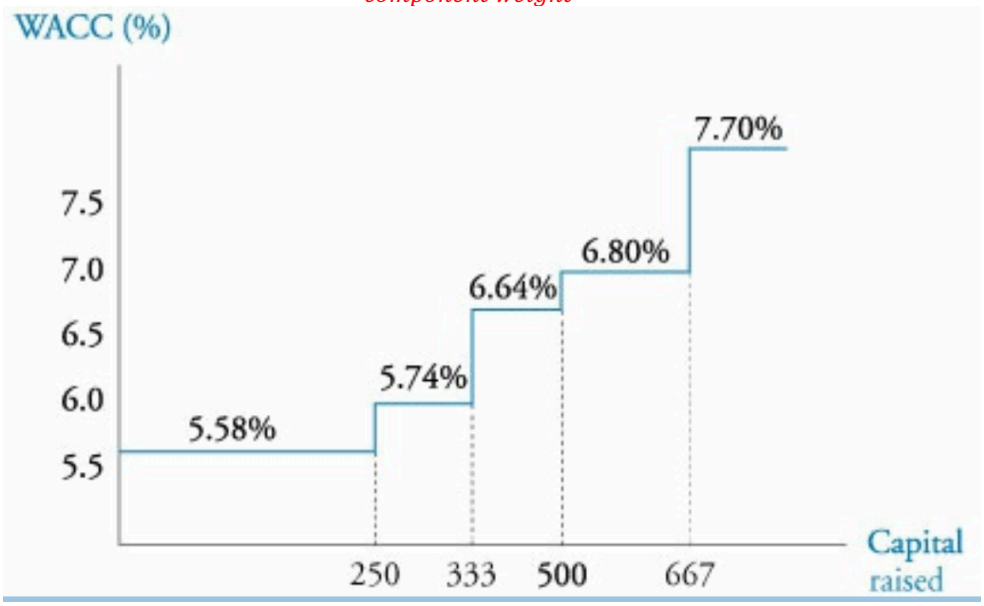
Country Risk Premium

- Country risk in developing countries
- $k_c = R_f + \beta \times (R_m - R_f + CRP)$
- Sovereign yield spread
    - Difference in yields between **developing country's government** bonds (denominated in **developed** market's currency) and **Treasury** bonds of a similar maturity
- Volatility of country's equity market
- Volatility of country's government bond market (denominated in **developed** market's currency)
- $CRP = sovereign\ yield\ spread \times \frac{equity\ market\ volatility}{bond\ marekt\ volatility}$

Marginal Cost of Capital Schedule (MCCS)

- Marginal cost of capital (MCC) is the cost of last new dollar of capital a firm raises
- Raise more capital, the cost of different sources of finance will increase

- Issue new equity is more **expensive** than using retained earnings due to floatation costs
- Margin cost of capital **schedule**
  - WACC for different amount of financing
- Break points
  - The cost of one finance component (source) change
  - $\text{break point} = \frac{\text{capital amount whose cost change}}{component\ weight}$



Flotation cost

- fees charged by investment bankers to raise equity capital for a firm
- wrong way: consider it in the cost of equity
- flotation costs are a **cash outflow** at the beginning
  - $\textbf{flotation cost} = \textbf{capital} \times \textbf{equity weight} \times \textbf{flotation percentage}$
- if it is tax redactable
  - $\text{new flotation cost} = \text{flotation cost} \times (1 - \text{t})$
- it won't affect WACC
- it only affects NPV (extra cash outflow, adjust initial project cost)