Chapter 9: Capital Budgeting

Budgeting in the Business World

- Projects
  - Expanding or replacing an existing project.
  - New ventures (e.g., self-driving car or electric vehicle).
  - Long-term investment.
- Why is it important?
  - This is how companies decide what to do!
  - Mistakes hurt a lot, while good decisions can add significant shareholder value.

Classical Approaches

- **Accounting Return** The average annual return as a percent of initial investment.

Period	Project A	Project B
0	(100)	(100)
1	10	60
2	20	40
3	50	20
4	80	10
Return	15%	7.5%

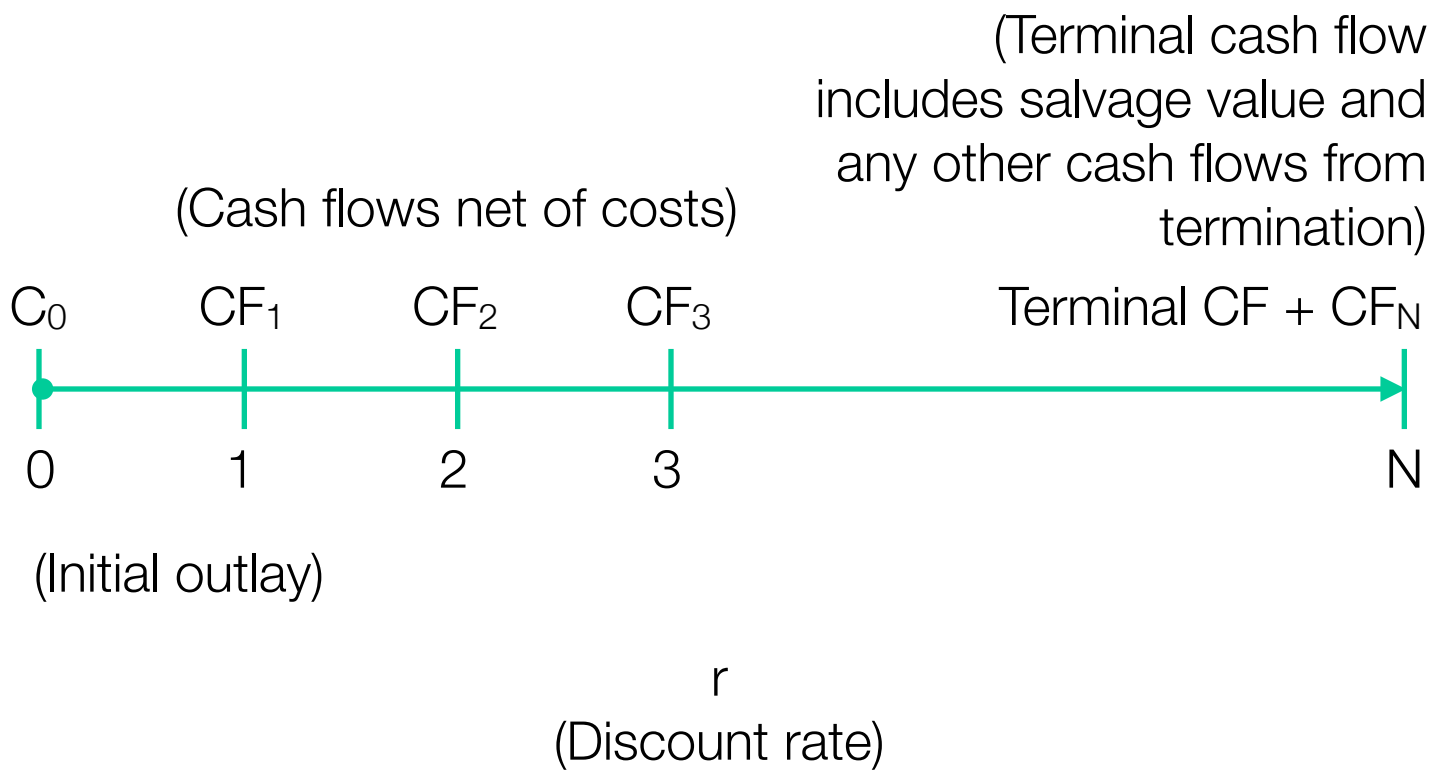
Classical Approaches

- **Payback** The number of years until the project pays off its initial investment.

Period	Project A	Project B
0	(100)	(100)
1	10	60
2	20	40
3	50	20
4	80	10
Payback	3.25 years	2 years

Modern Approaches
(NPV, IRR, and MIRR)

Typical Project



General Process

1. Estimate the project cash flows.
    - Use before financing cash flows (i.e., cash flows that can be paid to **all** claimants).
2. Determine project risk and find the discount rate.
    - This is the **project-specific WACC**.
3. Analyze using a suitable method (e.g., NPV).
4. Made a decision.

Free Cash Flow to Firm: FCFF

- Goal: measure the **actual** cash flow created by the project.

Revenues
(Costs)
(Depreciation)
EBIT
(Tax)
$EBIT_{after\text{-}tax}$
Depreciation
(Capital expenditures)
(Working capital)
FCFF

Net Present Value: NPV

- Measures the dollar value added to equity, taking the project's risk into account.

NPV Steps

1. Discount all **future** cash flows (FCFFs) to the present using WACC.
2. Add the present value of future cash flows to the (typically negative) initial cash flow ➟ NPV.

Net Present Value: Logic

- NPV = 0 ➟ The project exactly covers the costs—investors are just satisfied. The project doesn't add or subtract value from the firm.
- NPV > 0 ➟ The project provides additional return beyond what investors require based on the project's risk. The project adds value to the firm.
- NPV < 0 ➟ The project fails to generate enough return to fairly compensate investors. The project reduces the value of the firm.
- **Maximizing shareholder value means accepting NPV > 0 projects.**

Net Present Value: Example

- As CFO of Amtrak you are deciding whether to build an airline division. You estimate the new airline will cost $6.92 billion to start and produce free cash to the firm of $1.2 billion per year for 25 years. At the end of the project's life the terminal value will be zero. The appropriate WACC is 10.3%. Should you build the airline?

Internal Rate of Return: IRR

- What discount rate sets the NPV to zero? I.e. What return is earned (per year), given the initial outlay and the future cash flows?
- Do this on the calculator:
  1. Clear the memory…
  2. Input the cash flows…
  3. Ask for IRR

Internal Rate of Return: Logic

- Given you earn the IRR on the project, and given you "pay" the WACC, IRR > WACC ➟ NPV > 0 ➟ extra return above risk-adjusted costs.
- **If IRR > WACC, accept the project.**

Internal Rate of Return: Example

- Let's try the previous NPV example, this time using IRR…

Mutually Exclusive Projects

Example

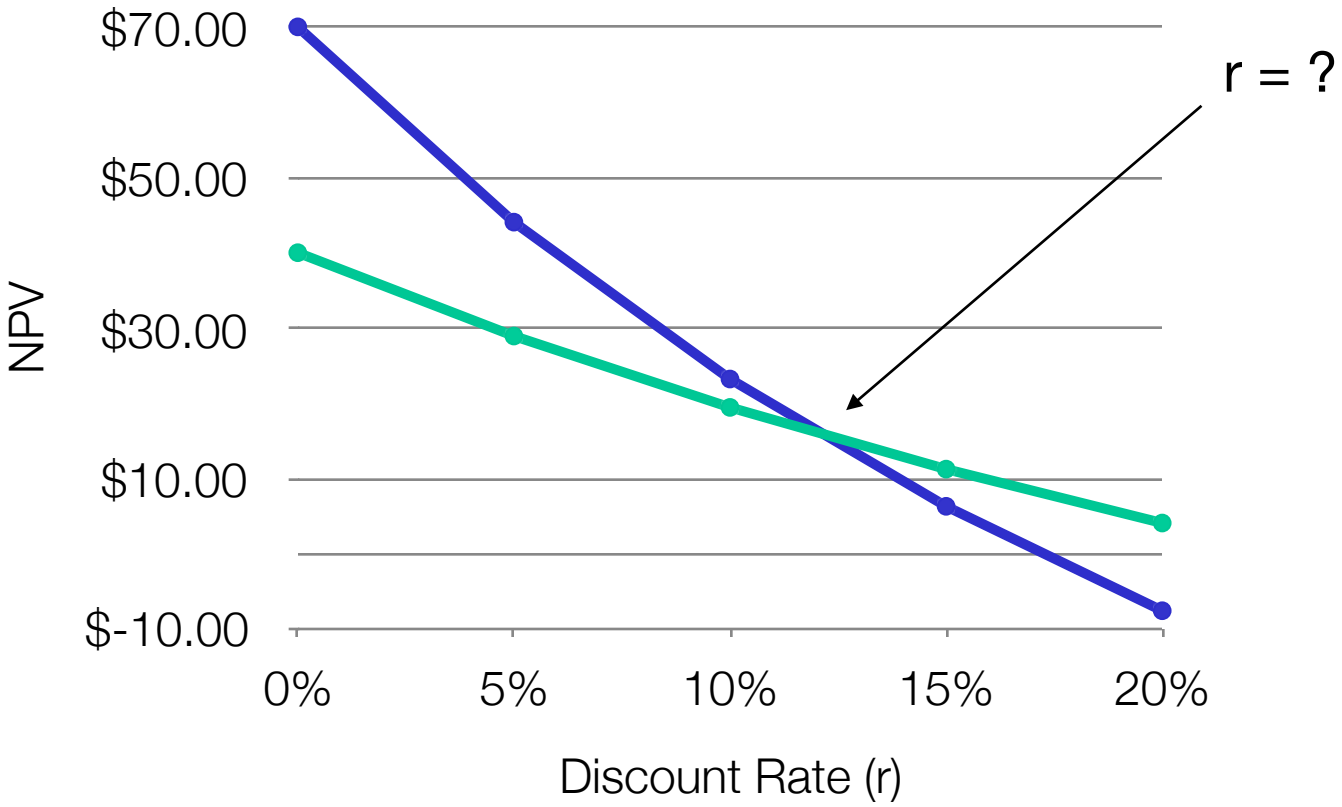
- Consider the following mutually exclusive projects. Assume WACC=10% for each. Which to choose?

Period	Project A	Project B
0	(100)	(100)
1	80	10
2	40	10
3	0	50
4	20	100
NPV	$19.45	$23.22
IRR	23%	17%

Example

- **NPV Rule** Choose the project with higher NPV.
- **IRR Rule** Choose the project with higher IRR.
- The two rules imply different conclusions, so there is a conflict between NPV and IRR rules.
- What's going on?

Example



Example

- What discount rate gives the same NPV for both projects?
- Set $NPV_A = NPV_B$ and solve for the discount rate.
- Equivalent to the IRR of Project A - B!

IRR: Issues

- Assumes reinvestment of intermediate cash flows at IRR.
  - Might not be accurate/reasonable assumption?
- Non-uniqueness.
  - Some cash flows streams have multiple rates that set NPV to zero!

Modified Internal Rate of Return: MIRR

- Let's "fix" the implicit reinvestment rate assumption of IRR.
- Presumably, cash flows can be reinvested at the WACC (which is generally different from IRR).

MIRR Steps

1. Send all positive cash flows to the end of the project using WACC. Sum to get terminal value (TV).
2. Bring all negative cash flows to the beginning of the project using WACC. Sum to get present value (PV).
3. [FV] = TV, [PV] = PV, [N] = N, [CPT] [I/Y] ➟ MIRR

Modified Internal Rate of Return: Logic

- TV summarizes the pile of money you could receive at the end of the project.
- PV summarizes the pile of money you need at the beginning of the project to cover its costs.
- The project is equivalent to investing PV today and earning TV at the end of the project, which implies MIRR is the (annual) rate of return.

Modified Internal Rate of Return: Example

- Let’s look at the Amtrak example one more time.

IRR vs. MIRR

- The IRR of the project in the previous example is 17%.
- Why is IRR > MIRR (in this example)?
- Note that WACC = 10% < IRR. Therefore, IRR assumes cash flows are reinvested at a higher rate than the MIRR, which makes the project look more profitable.
- What if WACC > IRR?