

Chapter 8

Net Present Value and Other Investment Criteria

Key Concepts and Skills

- Understand the payback rule and its shortcomings
- Understand accounting rates of return and their problems
- Understand the internal rate of return and its strengths and weaknesses
- Understand the net present value rule and why it is the best decision criteria

Chapter Outline

- Net Present Value
- The Payback Rule
- The Average Accounting Return
- The Internal Rate of Return
- The Profitability Index
- The Practice of Capital Budgeting

Good Decision Criteria

- We need to ask ourselves the following questions when evaluating decision criteria
 - Does the decision rule adjust for the time value of money?
 - Does the decision rule adjust for risk?
 - Does the decision rule provide information on whether we are creating value for the firm?

Project Example Information

- You are looking at a new project and you have estimated the following cash flows:
 - Year 0: CF = -165,000
 - Year 1: CF = 63,120; NI = 13,620
 - Year 2: CF = 70,800; NI = 3,300
 - Year 3: CF = 91,080; NI = 29,100
 - Average Book Value = 72,000
- Your required return for assets of this risk is 12%.

Net Present Value

- The difference between the market value of a project and its cost
- How much value is created from undertaking an investment?
 - The first step is to estimate the expected future cash flows.
 - The second step is to estimate the required return for projects of this risk level.
 - The third step is to find the present value of the cash flows and subtract the initial investment.

NPV Decision Rule

- **If the NPV is positive, accept the project**
- A positive NPV means that the project is expected to add value to the firm and will therefore increase the wealth of the owners.
- Since our goal is to increase owner wealth, NPV is a direct measure of how well this project will meet our goal.

Computing NPV for the Project

- Using the formulas:
 - $NPV = 63,120/(1.12) + 70,800/(1.12)^2 + 91,080/(1.12)^3 - 165,000 = \$12,627.41$
- Using the calculator:
 - $CF_0 = -165,000$; $C01 = 63,120$; $F01 = 1$; $C02 = 70,800$; $F02 = 1$; $C03 = 91,080$; $F03 = 1$; NPV ; $I = 12$; $CPT NPV = 12,627.41$
- **Do we accept or reject the project?**

Decision Criteria Test - NPV

- Does the NPV rule account for the time value of money?
- Does the NPV rule account for the risk of the cash flows?
- Does the NPV rule provide an indication about the increase in value?
- Should we consider the NPV rule for our primary decision criteria?

Payback Period

- How long does it take to get the initial cost back in a nominal sense?
- Computation
 - Estimate the cash flows
 - Subtract the future cash flows from the initial cost until the initial investment has been recovered
- Decision Rule – **Accept if the payback period is less than some preset limit**

Computing Payback For the Project

- Assume we will accept the project if it pays back within two years.
 - Year 1: $165,000 - 63,120 = 101,880$ still to recover
 - Year 2: $101,880 - 70,800 = 31,080$ still to recover
 - Year 3: $31,080 - 91,080 = -60,000$ *project pays back during year 3*
 - $Payback = 2 \text{ years} + 31,080/91,080 = 2.34 \text{ years}$
- **Do we accept or reject the project?**

Decision Criteria Test - Payback

- Does the payback rule account for the time value of money?
- Does the payback rule account for the risk of the cash flows?
- Does the payback rule provide an indication about the increase in value?
- Should we consider the payback rule for our primary decision criteria?

Advantages and Disadvantages of Payback

- Advantages
 - Easy to understand
 - Adjusts for uncertainty of later cash flows
 - Biased towards liquidity
- Disadvantages
 - Ignores the time value of money
 - Requires an arbitrary cutoff point
 - Ignores cash flows beyond the cutoff date
 - Biased against long-term projects, such as research and development, and new projects

Average Accounting Return

- There are many different definitions for average accounting return
- The one used in the book is:
 - Average net income / average book value
 - Note that the average book value depends on how the asset is depreciated.
- Need to have a target cutoff rate
- Decision Rule: **Accept the project if the AAR is greater than a preset rate.**

Computing AAR For the Project

- Assume we require an average accounting return of 25%
- Average Net Income:
 - $(\$13,620 + 3,300 + 29,100) / 3 = \$15,340$
- $AAR = \$15,340 / 72,000 = .213 = 21.3\%$
- **Do we accept or reject the project?**

Decision Criteria Test - AAR

- Does the AAR rule account for the time value of money?
- Does the AAR rule account for the risk of the cash flows?
- Does the AAR rule provide an indication about the increase in value?
- Should we consider the AAR rule for our primary decision criteria?

Advantages and Disadvantages of AAR

- Advantages
 - Easy to calculate
 - Needed information will usually be available
- Disadvantages
 - Not a true rate of return; time value of money is ignored
 - Uses an arbitrary benchmark cutoff rate
 - Based on accounting net income and book values, not cash flows and market values

Internal Rate of Return

- This is the most important alternative to NPV
- It is often used in practice and is intuitively appealing
- It is based entirely on the estimated cash flows and is independent of interest rates found elsewhere

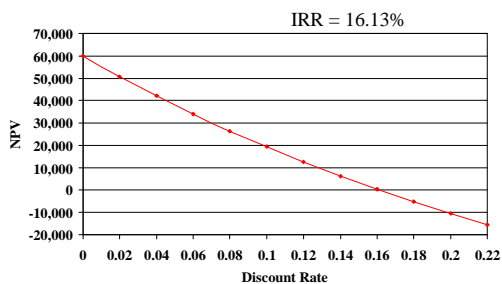
IRR – Definition and Decision Rule

- Definition: IRR is the return that makes the NPV = 0
- Decision Rule: **Accept the project if the IRR is greater than the required return**

Computing IRR For the Project

- If you do not have a financial calculator, then this becomes a trial-and-error process
- Calculator
 - Enter the cash flows as you did with NPV
 - Press IRR and then CPT
 - IRR = 16.13% > 12% required return
- **Do we accept or reject the project?**

NPV Profile For the Project



Decision Criteria Test - IRR

- Does the IRR rule account for the time value of money?
- Does the IRR rule account for the risk of the cash flows?
- Does the IRR rule provide an indication about the increase in value?
- Should we consider the IRR rule for our primary decision criteria?

Advantages of IRR

- Knowing a return is intuitively appealing
- It is a simple way to communicate the value of a project to someone who doesn't know all the estimation details
- If the IRR is high enough, you may not need to estimate a required return, which is often a difficult task

Summary of Decisions For the Project

Summary	
Net Present Value	Accept
Payback Period	Reject
Average Accounting Return	Reject
Internal Rate of Return	Accept

NPV vs. IRR

- NPV and IRR will generally give us the same decision
- Exceptions
 - Nonconventional cash flows – cash flow signs change more than once
 - Mutually exclusive projects
 - Initial investments are substantially different
 - Timing of cash flows is substantially different

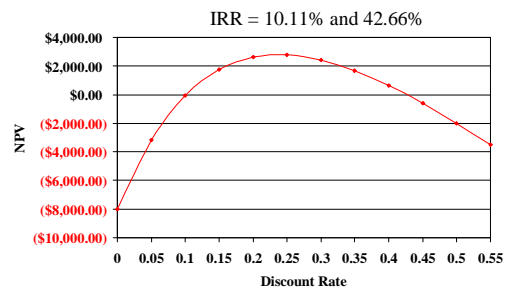
IRR and Nonconventional Cash Flows

- When the cash flows change signs more than once, there is more than one IRR
- When you solve for IRR, you are solving for the root of an equation and when you cross the x-axis more than once, there will be more than one return that solves the equation
- If you have more than one IRR, which one do you use to make your decision?

Another Example – Nonconventional Cash Flows

- Suppose an investment will cost \$90,000 initially and will generate the following cash flows:
 - Year 1: \$132,000
 - Year 2: \$100,000
 - Year 3: -\$150,000
- The required return is 15%.
- Should we accept or reject the project?

NPV Profile



Summary of Decision Rules

- The NPV is positive at a required return of 15%, so you should **Accept**
- If you use the financial calculator, you would get an IRR of 10.11% which would tell you to **Reject**
- You need to recognize that there are nonconventional cash flows, and that you need to look at the NPV profile

IRR and Mutually Exclusive Projects

- Mutually exclusive projects
 - If you choose one, you can't choose the other
 - Example: You can choose to attend graduate school next year at either Harvard or Stanford, but not both
- Intuitively, you would use the following decision rules:
 - NPV – choose the project with the higher NPV
 - IRR – choose the project with the higher IRR

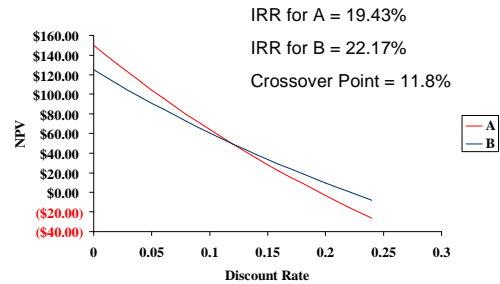
Example With Mutually Exclusive Projects

Period	Project A	Project B
0	-500	-400
1	325	325
2	325	200
IRR	19.43%	22.17%
NPV	64.05	60.74

The required return for both projects is 10%.

Which project should you accept and why?

NPV Profiles



Conflicts Between NPV and IRR

- NPV directly measures the increase in value to the firm
- Whenever there is a conflict between NPV and another decision rule, you should **always** use NPV
- IRR is unreliable in the following situations
 - Non-conventional cash flows
 - Mutually exclusive projects

Modified Internal Rate of Return (MIRR)

- Compute IRR of modified cash flows
- Controls for some problems with IRR
- Discounting Approach – Discount future outflows to present and add to CF_0
- Reinvestment Approach – Compound all CFs except the first one forward to end
- Combination Approach – Discount outflows to present; compound inflows to end
- MIRR will be a unique number for each method, but is difficult to interpret; discount/compound rate is externally supplied

Example: MIRR

- Project cash flows:
- Time 0: -\$500 today; Time 1: + \$1,000; Time 2: -\$100
- Use combined method and RRR = 11%
- PV (outflows) = $-\$500 + -\$100/(1.11)^2 = -\$581.16$
- FV (inflow) = $\$1,000 \times 1.11 = \$1,110$
- MIRR: $N=2$; $PV=-581.16$; $FV=1,110$; $CPT I/Y = MIRR = 38.2\%$

Profitability Index

- Measures the benefit per unit cost, based on the time value of money
- A profitability index of 1.1 implies that for every \$1 of investment, we receive \$1.10 worth of benefits, so we create an additional \$0.10 in value
- This measure can be very useful in situations in which we have limited capital

Advantages and Disadvantages of Profitability Index

- Advantages
 - Closely related to NPV, generally leading to identical decisions
 - Easy to understand and communicate
 - May be useful when available investment funds are limited
- Disadvantages
 - May lead to incorrect decisions in comparisons of mutually exclusive investments

Capital Budgeting In Practice

- We should consider several investment criteria when making decisions
- NPV and IRR are the most commonly used primary investment criteria
- Payback is a commonly used secondary investment criteria

Quick Quiz

- Consider an investment that costs \$100,000 and has a cash inflow of \$25,000 every year for 5 years. The required return is 9% and the required payback is 4 years.
 - What is the payback period?
 - What is the NPV?
 - What is the IRR?
 - Should we accept the project?
- What should be the primary decision method?
- When is the IRR rule unreliable?

Comprehensive Problem

- An investment project has the following cash flows: $CF_0 = -1,000,000$; $C_1 - C_8 = 200,000$ each
- If the required rate of return is 12%, what decision should be made using NPV?
- How would the IRR decision rule be used for this project, and what decision would be reached?
- How are the above two decisions related?