Net Present Value & Other Investment Criteria

CHAPTER 9

Key Concepts and Skills

- Compute payback & discounted payback and understand their shortcomings
- Understand accounting rates of return and their shortcomings
- Be able to compute internal rates of return (standard and modified) and understand their strengths and weaknesses
- Be able to compute the net present value and understand why it is the best decision criterion
- Be able to compute the profitability index and understand its relation to net present value

Chapter Outline

- Net Present Value
- The Payback Rule
- The Discounted Payback
- 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 capital budgeting decision rules:
  - 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?

Net Present Value

- The difference between the market value of a project and its cost
- How much value is created from undertaking an investment?
  - Step 1: estimate the expected future cash flows.
  - Step 2: estimate the required return for projects of this risk level.
  - Step 3: 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.

Project Example Information

- You are reviewing a new project and 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 level is 12%.

Computing NPV for the Project

- Using the formulas:
  - NPV = -165,000 + 63,120/(1.12) + 70,800/$(1.12)^2$ + 91,080/$(1.12)^3$ = 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 rule?

Example 9.1

Suppose we are asked to decide whether a new consumer product should be launched. Based on projected sales and costs, we expect that the cash flows over the five-year life of the project will be $2000 in the first two years, $4000 in the next two and $5000 in the last year. It will cost about $10000 to begin production. We use a 10 percent discount rate to evaluate new products. What should we do here?

Example 9.1

- Present Value of the expected cash flows = $(2000/1.1) + (2000/1.1^2) + (4000/1.1^3) + (4000/1.1^4) + (5000/1.1^5) = \$12313$

- NPV = -10000 + 12313 = $2313

- Decision : accept the project because NPV is positive.

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 in year 3*
- ***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 rule?

Example 9.2

The proposed cash flows for a proposed project that costs $500, are as follows:

$100 in one year, $200 in two years and $500 in three years.

Should we accept or reject this project if the payback period in the market is 3 years?

Example 9.2

Year 1: 500 – 100 = $400

Year 2: 400 – 200 = $200

Year 3: 200 – 500 = (300)

- We only need $200 from the third year 500, so we have to wait 200/500 = 0.4 years

- The payback period is 2.4 years and since it is less than 3 years the market payback period the project should be accepted.

Advantages and Disadvantages of Payback

- Advantages
  - Easy to understand
  - Adjusts for uncertainty of later cash flows
  - Biased toward 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

Discounted Payback Period

- Compute the present value of each cash flow and then determine how long it takes to pay back on a discounted basis
- Compare to a specified required period
- Decision Rule - ***Accept the project if it pays back on a discounted basis within the specified time***

Computing Discounted Payback for the Project

- Assume we will accept the project if it pays back on a discounted basis in 2 years.
- Compute the PV for each cash flow and determine the payback period using discounted cash flows
  - Year 1: $165,000 - 63,120/1.12^1 = 108,643$
  - Year 2: $108,643 - 70,800/1.12^2 = 52,202$
  - Year 3: $52,202 - 91,080/1.12^3 = -12,627$ project pays back in year 3
- ***Do we accept or reject the project?***

Decision Criteria Test – Discounted Payback

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

Advantages & Disadvantages of Discounted Payback

- Advantages
  - Includes time value of money
  - Easy to understand
  - Does not accept negative estimated NPV investments when all future cash flows are positive
  - Biased towards liquidity
- Disadvantages
  - May reject positive NPV investments
  - Requires an arbitrary cutoff point
  - Ignores cash flows beyond the cutoff point
  - Biased against long-term projects, such as R&D and new products

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 rule?

Advantages & 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 & 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?***

IRR Example

Consider a project that costs $100 today and pays $110 in one year. Suppose you were asked, “What is the return on this investment?” What would you say?

- NPV = -$100 + [$110/(1+R)]
- 0 = -$100 + [$110/(1+R)]
- $100 = $110/(1+R)
- 1+R = 110/100 = 1.1
- R = 10%

Example 9.4

A project has a total up-front cost of $435.44. The cash flows are $100 in the first year, $200 in the second year and $300 in the third year. What's the IRR? If we require an 18 percent return, should we take this investment?

- The NPV is zero at 15% ➔ IRR = 15%.
- Decision: reject this investment because its 15% return is below the required return of 18%.

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***
Discounted 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 (issue of scale)
    - Timing of cash flows is substantially different

IRR & Nonconventional Cash Flows

- When the cash flows change sign 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?

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?

Cont'd

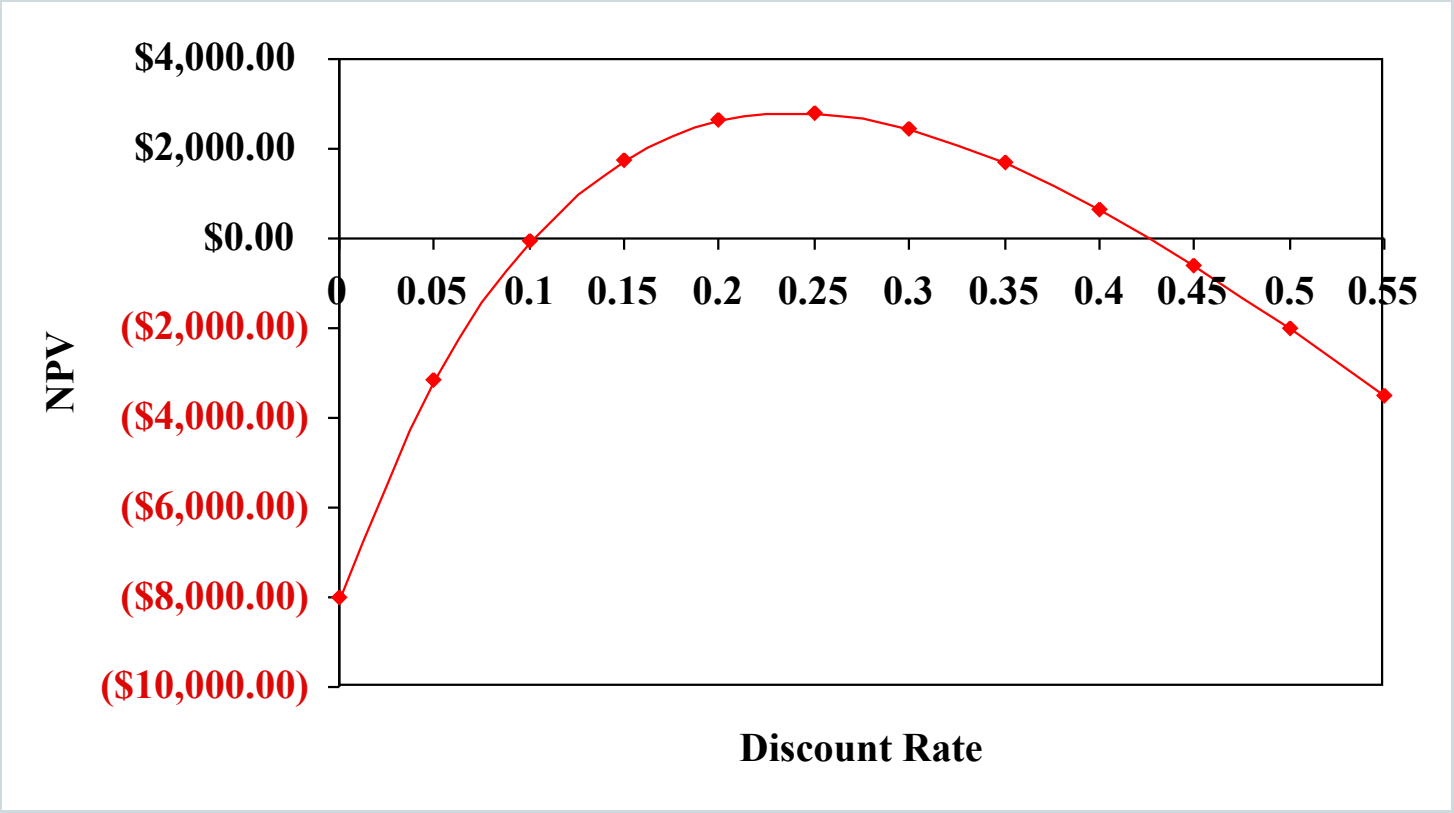
- NPV = – 90,000 + 132,000/1.15 + 100,000/$(1.15)^2$
  - 150,000/$(1.15)^3$ = 1,769.54

- Calculator:
  - CF_0= -90,000; C01= 132,000; F01= 1; C02= 100,000; F02= 1; C03= -150,000; F03= 1; I= 15; CPT NPV = 1769.54

- IRR= 10.11%

NPV Profile

IRR = 10.11% and 42.66%



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 non-conventional cash flows and look at the NPV profile

IRR and Mutually Exclusive Projects

- Mutually exclusive projects:
  - If you choose one, you can't choose the other
  - Ex: You can choose to attend graduate school at either Harvard or Stanford, but not both

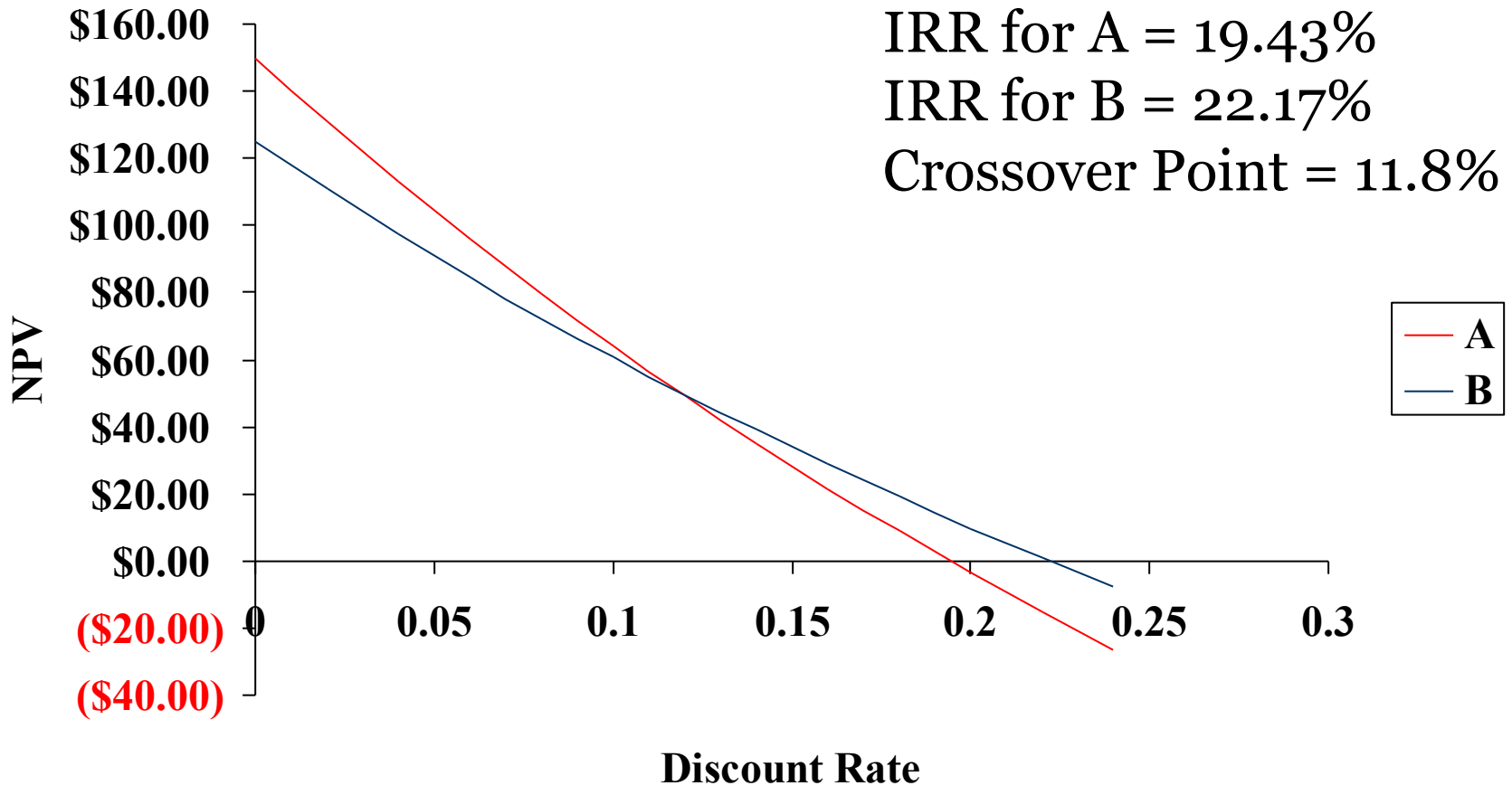
- Intuitively, you would use the following decision rules:
  - NPV – choose the project with the higher NPV
  - IRR – choose the project with the higher IRR

Example with Mutually Exclusive Projects

- The required return for both projects is 10%.
- Which project should we accept & why?

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

NPV Profiles



IRR for A = 19.43%

IRR for B = 22.17%

Crossover Point = 11.8%

Example 9.7

- Suppose we have the following two mutually exclusive investments:

Year	Investment A	Investment B
0	-400	-500
1	250	320
2	280	340

- What is the crossover rate?
  - $NPV(B - A) = -100 + [70/(1 + R)] + [60/(1 + R)^2]$
  - $R = 20\%$

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
  - Nonconventional cash flows
  - Mutually exclusive projects

Modified IRR

- Calculate the net present value of all cash outflows using the borrowing rate.
- Calculate the net future value of all cash inflows using the investing rate.
- Find the rate of return that equates these values.
- Benefits: single answer and specific rates for borrowing and reinvestment

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 create an additional $0.10 in value
- This measure can be very useful in situations in which we have limited capital
- PV of the future cash flows / initial investment

Advantages & 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

Summary – DCF Criteria

- Net present value
  - Difference between market value and cost
  - Take the project if the NPV is positive
  - Has no serious problems
  - Preferred decision criterion
- Internal rate of return
  - Discount rate that makes NPV = 0
  - Take the project if the IRR is greater than the required return
  - Same decision as NPV with conventional cash flows
  - IRR is unreliable with nonconventional cash flows or mutually exclusive projects

Summary – DCF Criteria

- Profitability Index
  - Benefit-cost ratio
  - Take investment if PI > 1
  - Cannot be used to rank mutually exclusive projects
  - May be used to rank projects in the presence of capital rationing

Summary – Payback Criteria

- Payback period
  - Length of time until initial investment is recovered
  - Take the project if it pays back within some specified period
  - Doesn't account for time value of money, and there is an arbitrary cutoff period
- Discounted payback period
  - Length of time until initial investment is recovered on a discounted basis
  - Take the project if it pays back in some specified period
  - There is an arbitrary cutoff period

Summary – Accounting Criterion

- Average Accounting Return
  - Measure of accounting profit relative to book value
  - Similar to return on assets measure
  - Take the investment if the AAR exceeds some specified return level
  - Serious problems and should not be used