



SPROTT
SCHOOL OF BUSINESS

BUSI 2504i - Essentials of Business Finance

Wednesday, February 10, 2010

§9 Capital Budgeting

- next week spring break!
- no lecture week after spring break
(to compensate for friday midterms)
- next class wednesday march 13

- §9.1 - Net Present Value
- §9.2 - Payback and Discounted Payback
- §9.3 - Average Accounting Return
- §9.4 - Internal Rate of Return
- §9.5 - Profitability Index
- §9.6 - Practice of Capital Budgeting

- method for evaluating investment opportunities
 - long-term projects (lasting more than one year)
 - also known as capital expenditures (capex)
- cash flows
 - **year 0** - initial or "startup" costs, eg. purchase of machinery
 - **years 1, 2, ...** - incremental revenues (inflow)
 - **years 1, 2, ...** - operating costs, salaries, maintenance, ... (outflow)
 - salvage value (inflow)
- capital rationing (limited capital to invest)
 - rank investments based on NPV
 - invest in projects until available capital exhausted

- 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?

- 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%.

- 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

- **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

- Using the BA II Plus calculator:

$$CF_0 = -165,000 \text{ [ENTER] } \downarrow;$$

$$C01 = 63,120 \text{ [ENTER] } \downarrow; F01 = 1 \downarrow;$$

$$C02 = 70,800 \text{ [ENTER] } \downarrow; F02 = 1 \downarrow;$$

$$C03 = 91,080 \text{ [ENTER] } \downarrow; F03 = 1 \downarrow;$$

$$\text{[NPV]}; I = 12 \text{ [ENTER] } \downarrow;$$

$$\text{[CPT]}; NPV = 12,627.41$$

- Do we accept or reject the project?**

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

A project has an initial cash outlay of \$16,500. Cash inflows are \$5,200 in year 1, \$6,800 in year 2, and \$8,100 in year 3. What is the net present value if an 8.30% discount rate is applied to this project?

answer: \$475.88

- 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**

- 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

- If the preset limit is 3 years, do we accept or reject the project? **ACCEPT**

You are considering a project with an initial cost of \$4,300. What is the payback period for this project if the cash inflows are \$550, \$970, \$2,600, and \$500 a year over the next four years respectively?

answer: 3.36 years

9.2: payback period - example 2

- say you want to decide which (if any) green technology to install at your house
- cash flows
 - **initial investment** - installation costs
 - **inflows** - reduction in electrical/gas bills
 - **outflows** - maintenance costs
- payback periods
 - **geothermal** - 6 years (400% efficiency vs. 90-95% efficiency furnace)
 - **residential wind turbine** - 25 years
 - **solar panels** - 80 years

- Does the payback rule account for the time value of money? **NO**
- Does the payback rule account for the risk of the cash flows? **NO**
- Does the payback rule provide an indication about the increase in value? **NO**
- Should we consider the payback rule for our primary decision criteria? **NO**

- 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

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

9.2: 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

$$\text{Year 1} \quad 165,000 - \frac{63,120}{1.12^1} = 108,643$$

$$\text{Year 2} \quad 108,643 - \frac{70,800}{1.12^2} = 52,202$$

$$\text{Year 3} \quad 52,202 - \frac{91,080}{1.12^3} = -12,627$$

project pays back in year 3

- Do we accept or reject the project? **REJECT**

- Does the discounted payback rule account for the time value of money? **YES**
- Does the discounted payback rule account for the risk of the cash flows? **NO**
- Does the discounted payback rule provide an indication about the increase in value? **NO**
- Should we consider the discounted payback rule for our primary decision criteria? **NO**

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

9.3: average accounting return (aar)

- There are many different definitions for average accounting return, the one used in the book is:

$$\text{AAR} = \frac{\text{Average net income}}{\text{Average book value}}$$

- Need to have a target cutoff rate
- Decision Rule - **Accept the project if the AAR is greater than a preset rate**

- Assume we require an average accounting return of 25%

$$\text{Average Net Income} = \frac{13,620 + 3,300 + 29,100}{3} = 15,340$$

$$\Rightarrow \text{AAR} = \frac{\text{Average net income}}{\text{Average book value}} = \frac{15,340}{72,000} = .213 = 21.3\%$$

- Do we accept or reject the project? **REJECT**

- Does the AAR rule account for the time value of money? **NO**
- Does the AAR rule account for the risk of the cash flows? **NO**
- Does the AAR rule provide an indication about the increase in value? **NO**
- Should we consider the AAR rule for our primary decision criteria? **NO**
- AAR is even worse than payback rule since it doesn't even use cash flows for the analysis. It uses net income and book value

- Advantages
 - Easy to calculate
 - Needed information is usually 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

Suppose a firm invests \$600 in a project. The initial cost is depreciated straight-line to zero over 3 years. Net income from the project is \$100, \$125, and \$140 in each of the three years of the project's life. What is the average accounting return?

answer: 40.56%

9.4: internal rate of return (irr)

- 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
- The IRR rule is very important. Management often has a much better feel for percent returns than they do for dollar increases. A dollar increase doesn't provide as much information if we don't know what the initial expenditure was.

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

- Using the BA II Plus calculator:

$$CF_0 = -165,000 \text{ [ENTER] } \downarrow;$$

$$C01 = 63,120 \text{ [ENTER] } \downarrow; F01 = 1 \downarrow;$$

$$C02 = 70,800 \text{ [ENTER] } \downarrow; F02 = 1 \downarrow;$$

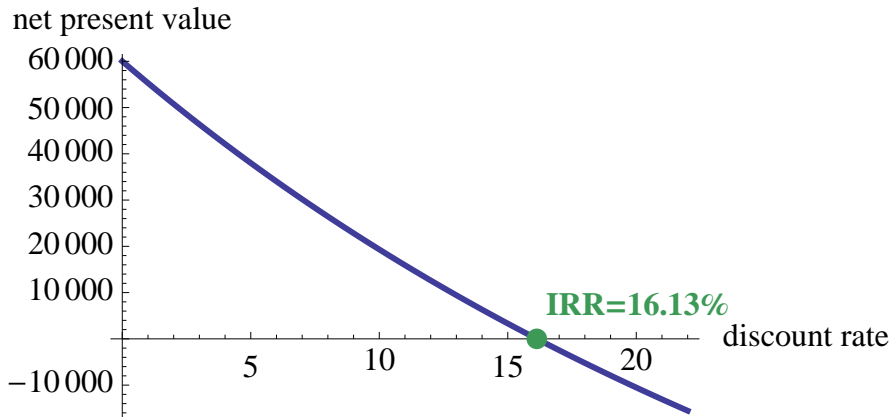
$$C03 = 91,080 \text{ [ENTER] } \downarrow; F03 = 1 \downarrow;$$

$$\text{[IRR]}; \text{[CPT]};$$

$$IRR = \mathbf{16.13\%} > 12\% \text{ required return}$$

- Do we accept or reject the project? **ACCEPT**

9.4: npv profile for the project



- Does the IRR rule account for the time value of money?
 - **YES** - because it is finding the rate of return that equates all of the cash flows on a time value basis
- Does the IRR rule account for the risk of the cash flows?
 - **YES** - because you compare it to the required return, which is determined by the risk of the project

- Does the IRR rule provide an indication about the increase in value?
 - **YES** - because we will always increase value if we can earn a return greater than our required return
- Should we consider the IRR rule for our primary decision criteria?
 - **YES** - but it has some problems that the NPV does not have

- 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
- Generally leads to the same answers as the NPV method

- NPV and IRR will generally give us the same decision
- Exceptions:
 - May result in multiple answers or no answer with non-conventional cash flows
 - May lead to incorrect decisions in comparisons of mutually exclusive investments

Suppose a project costs \$300 and produces cash flows of \$100 over each of the following six years. What is the IRR of the project?

answer: 24.3%

- 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

9.4: mutually exclusive projects - example

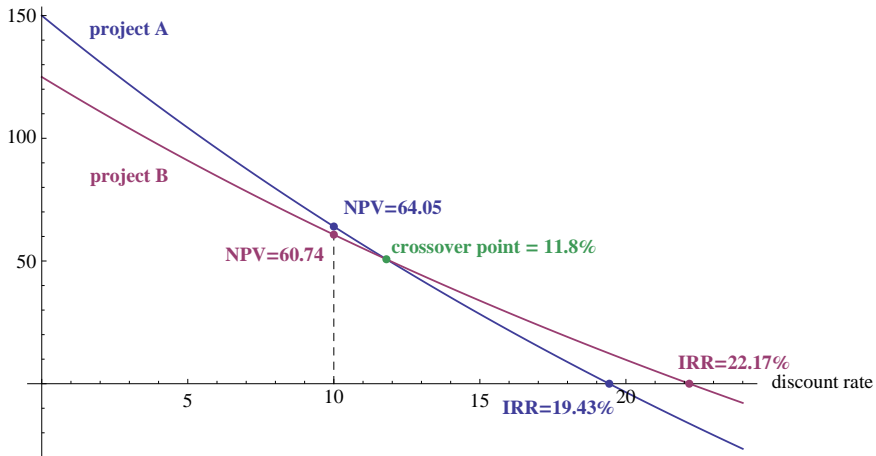
- The required return for both projects is 10%

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

- Which project should you accept and why?
- A**, because if we must choose only one, it is better to invest \$100 and get a 25% return, than to invest \$10 and get a 50% return
- We want to maximize value of the firm, not maximize the rate of return

9.4: mutually exclusive projects example - npv profiles

net present value



- 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

9.5: profitability index (aka. benefit/cost ratio)

- Measures the benefit per unit cost, based on the time value of money

$$\text{Profitability Index} = \frac{\text{PV}(\text{cash inflows})}{\text{PV}(\text{cash outflows})}$$

- A profitability index of 1.1 implies that for every \$1 of investment, we create an additional \$0.10 in value
- Similar to $\text{NPV} = \text{PV}(\text{inflows}) - \text{PV}(\text{outflows})$
- This measure can be useful in situations where we have limited capital

- 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

What is the profitability index of the following investment if the required return = 14%?

year	cash flow
0	-\$60
1	\$15
2	\$30
3	\$45

answer: 1.11

- NPV and IRR are the most commonly used primary investment criteria
- Payback is a commonly used secondary investment criteria
- Capital budgeting techniques vary with industry
- Firms that are better able to estimate cash flows precisely are more likely to use NPV
- Payback is commonly used as a secondary criteria likely because short paybacks allow firms to have funds sooner to invest in other projects without going to the capital markets