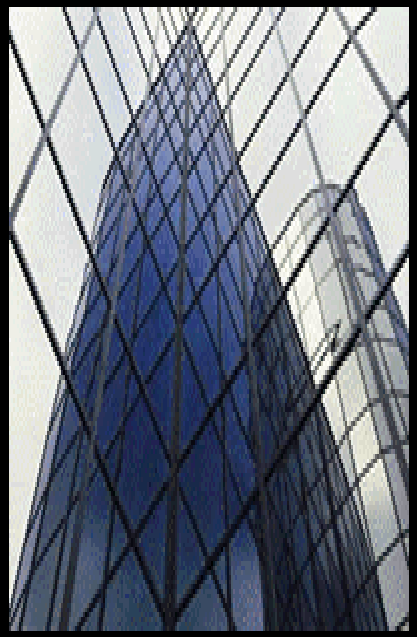
Seminar on 'Financial Management for Engineers'

Institute of Engineers Pakistan (IEP)



Capital Budgeting: Techniques

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Data used in examples

Year	Project L NOI	Project L Deprec	Project L Oper. Cash Flow	Project S NOI	Project S Deprec.	Project S Oper. Cash Flow
0			-100			-100
1	-23	33	10	37	33	70
2	15	45	60	5	45	50
3	58	22	80	-2	22	20
Total	50	100	150	40	100	140

Cost of Capital = 10%

Before We Begin the Discussion

- Capital budgeting is an analysis of the financial value of a a specific investment
- This requires the following:

  1. Estimation of all future cash flows
  2. Nature and extent of risk associated with each source of cash inflow/outflow
  3. Estimation of proper discount rates to apply to cash flows
  4. Determination of whether the project will COVER THE COSTS OF FINANCING

ANALYTIC TECHNIQUES

- ARR = Accounting Rate of Return
- PB = Payback (and Discounted Payback)
- NPV = Net Present Value
- IRR = Internal Rate of Return
- MIRR = Modified IRR

Accounting Rate of Return

- Widely used in the past
- Divides "Average Yearly Income" by "Average Book Value of Investment "

  For Example, one way of estimating ARR is:

$$\text{ARR} = \frac{\text{Average Yearly Operating Profit}}{(\text{Cost minus Salvage Value}) / 2}$$

ARR of Projects L and S

$$ARR_L = \frac{(-23 + 15 + 58) / 3}{(100 - 0) / 2}$$

$$= 33.33\%$$

$$ARR_S = \frac{(37 + 5 - 2) / 3}{(100 - 0) / 2}$$

$$= 26.67\%$$

Advantages:
Simple to understand

Disadvantages:
Ignores TVM
Subject to Acct Procedures

Potential Accounting Problems with ARR

- Average Annual Income :
  allocation of joint product costs can influence results (but this is a problem for cash flow techniques also)
- Average Book Value of Investment:
  - can be influenced by type of depreciation if define average book value as the book value in middle of project life
  - for example, accelerated depreciation will lead to lower book value in middle of project life than straight line depreciation

Payback

	Project L		Project S	
Year	Cash Flow	Cum CF	Cash Flow	Cum CF
0	-100	-100	-100	-100
1	10	-90	70	-30
2	60	-30	50	+20
3	80	+50	20	+40
PB =		2.4 years		1.6 years

Payback Pros & Cons

- Pros

  Simple to understand

  Decent measure of “Liquidity”

  Probably related to risk

- Cons

  What is a “Good” or “Bad” Payback

  Ignores when cash is received (TVM)

  MOST IMPORTANTLY: Ignores cash flows after PB period

Payback is a useful measure. But it should not be the single criteria to select projects

Discounted Payback

- Future cash flows are discounted at the Cost of Capital and “Payback” is calculated based on these discounted values
- Same Pros and Cons as before

- And, if you know the discount rate, why not calculate the NPV

Net Present Value

The worth today
of the cash flows generated by a project
in excess of the costs of financing the project

NPV Equation

$$NPV = (\text{Cash Flow}_0) / (1 + K_a)^0$$
$$+ (\text{Cash Flow}_1) / (1 + K_a)^1$$
$$+ (\text{Cash Flow}_2) / (1 + K_a)^2$$
$$+ (\text{Cash Flow}_3) / (1 + K_a)^3$$
$$.$$
$$.$$
$$+ (\text{Cash Flow}_T) / (1 + K_a)^T$$

T is last year of Cash Flow

K_a is cost of capital

Net Present Value Project L

Year	0	1	2	3
Cash Flow	-$100	+$10	+$60	+$80
Discount Factor	1.0	1/1.1	1/1.21	1/1.331
PV	-$100	+$9.09	+$49.59	+$60.11
NPV	+$18.78			

Net Present Value Project S

Year	0	1	2	3
Cash Flow	-$100	+$70	+$50	+$20
PV				
-$100.00				
+$63.64		Divided by 1.1		
+$41.32			Divided by 1.1^2	
+$15.03				Divided by 1.1^3

+$19.98 = Net Present Value

Another Way to Look at NPV

- Consider Project L
- And allow for financing cash flows

	Yearly Cash Flows			
Year	0	1	2	3
Investment	-100	+10	+60	+ 80
Financing	+100	-10	-10	-110
Net	0	0	+50	- 30

+ 0 .00
+41.32
-22.54
Net Present Value +18.78

This is a self financing Project
The investment cash flows
are more than sufficient to cover
repayment of financing plus a fair return

Further Comments on NPV(#1)

- NPV is the present value of excess cash flows generated by a project
- Excess cash flows are those in excess of the required financing costs and repayment of financing
- NPV increases the Market Value of Assets (MVA)
- If debt is relatively default free, all (or most) of NPV goes to shareholders in the form of higher stock prices
- If debt faces some risk of default, then some of the NPV is shared by debtholders by an increase in the value of outstanding debt

Further Comments on NPV(#2)

- NPV is based on Time Value of $ concepts
- All projects with a positive NPV should be accepted
- This means that the last project accepted will provide a return exactly equal to the cost of capital
- The discount rate used should reflect the risk of the project

Internal Rate of Return

The interest rate which will discount all cash flows to a value of zero today

The interest rate that results in a present value of all inflows equal to the present value of all outflows

A measure of the annual rate of return on a project

IRR Calculation

$$0.00 = (\text{Cash Flow}_0) / (1 + \text{IRR})^0 + (\text{Cash Flow}_1) / (1 + \text{IRR})^1 + (\text{Cash Flow}_2) / (1 + \text{IRR})^2 + (\text{Cash Flow}_3) / (1 + \text{IRR})^3 + \ldots + (\text{Cash Flow}_T) / (1 + \text{IRR})^T$$

In concept:
Select all projects if their IRR is greater than Cost of Capital

Internal Rate of Return Project L

The following is a copy of cells in an Excel worksheet used to calculate the IRR of Project L

		D	E	F	G
5		-100	10	60	80
6	IRR	18.126%			

The formula used for the calculation is :
=irr(d5:g5,0.1)
The 0.1 represents an initial "guess" at the IRR since the calculation is based on an iterative procedure which tries many possible values of IRR until a present value close enough to 0.0 is achieved.

Internal Rate of Return Project S

The following is worksheet output for Project S.

		D	E	F	G
5		-100	70	50	20
6	IRR	23.564%			
Year	Cash Flow	PV @ IRR			
1	70	56.65077			
2	50	32.74806			
3	20	10.60116			
	Sum	100			

Each cash flow is discounted at the IRR of 23.564%. Notice that they sum to the cost of 100

IRR: Comments

- Advantages:
  - It is based on TVM concepts
  - Easily understood as a return measure

- Disadvantages:
  - Assumes that all cash flows from project will be reinvested at the same return as the IRR calculated
  - NPV can rank projects differently than IRR
  - Multiple IRRs

IRR: The Reinvestment Rate Assumption

Consider Project S with an IRR of 23.564%

and assume that all cash flows

are reinvested at 0.0% return

What would be the Terminal Value at Year 3

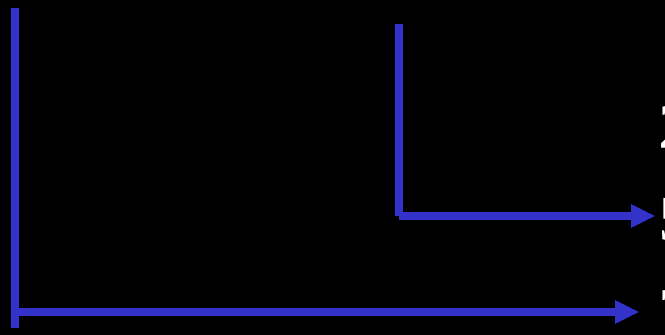
and what return over the

3-year period is implied

by this terminal value?

Project S Year 3 Terminal Value Assuming cash flow reinvestment at 0%

Year	0	1	2	3
Cash Flow	-100	70	50	20
Terminal Values				20
				50
				70
Total				140



The annualized return from this situation would be
$100*(1+Return)^3 = 140$
Return = 11.87%

So What is the Return on this Project?

- It depends on the return from reinvestment of project cash flows
- If we can reinvest cash flows at the project's IRR, the annualized return will be the IRR of 23.564%.
- If the reinvestment rate is 0.0%, the annualized return is 11.87%.
- Probably the best assumption is that we will reinvest cash flows at the firm's cost of capital.

The Modified IRR

- An estimate is made of the return at which project cash flows can be reinvested
- The firm's Cost of Capital is a logical choice

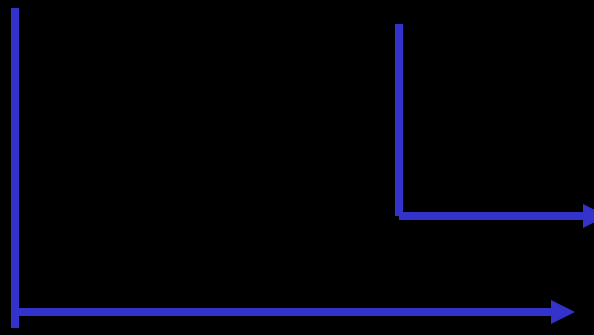
- Logic of Using Cost Of Capital as assumed reinvestment rate:

If the firm is investing optimally,
then it is accepting all projects with a
return equal to or greater than its cost of capital.
Thus the return on the next project
should be close to the cost of capital.

MIRR of Project S

Assuming cash flow reinvestment at 10% Cost of Capital

Year	0	1	2	3
Cash Flow	-100	70	50	20
Terminal Values				20
				55
				84.70
Total				159.70

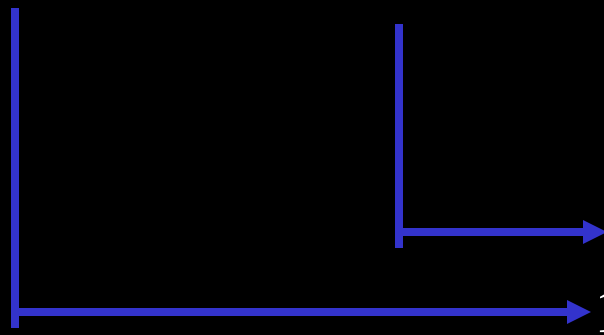


The annualized return from this situation would be
$100*(1+\text{Return})^3 = 159.70$
Return = 16.89%

MIRR of Project L

Assuming cash flow reinvestment at 10% Cost of Capital

Year	0	1	2	3
Cash Flow	-100	10	60	80
Terminal Values				80
				66
				12.10
Total				158.10



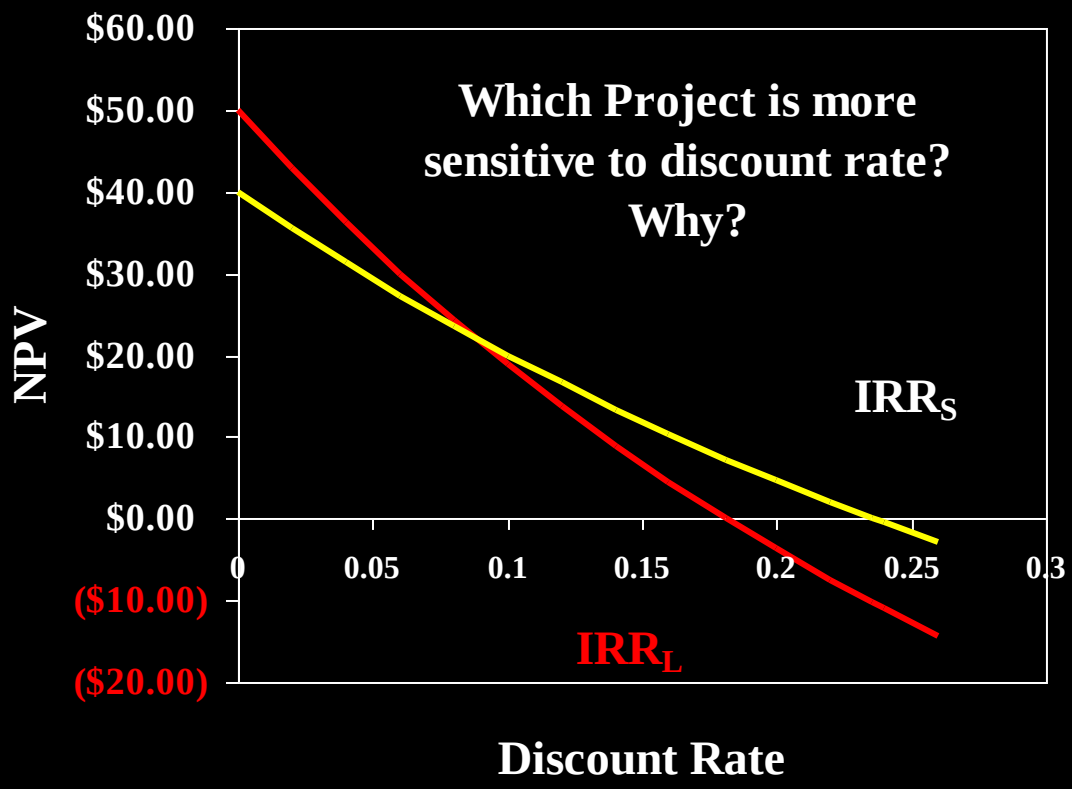
The annualized return from this situation would be
$100*(1+\text{Return})^3 = 158.10$
Return = 16.50%

NPV Profiles

These show the affect on NPV of change in a variable

In this illustration, the variable chosen is the discount rate

Discount Rate	NPV_L	NPV_S
0.00%	50.00	40.00
6.00%	30.00	27.33
10.00%	18.78	19.98
14.00%	8.94	13.38
18.126%	0.00	7.23
22.00%	-3.70	4.63
23.564%	-10.20	0.00
26.00%	-14.28	-2.95

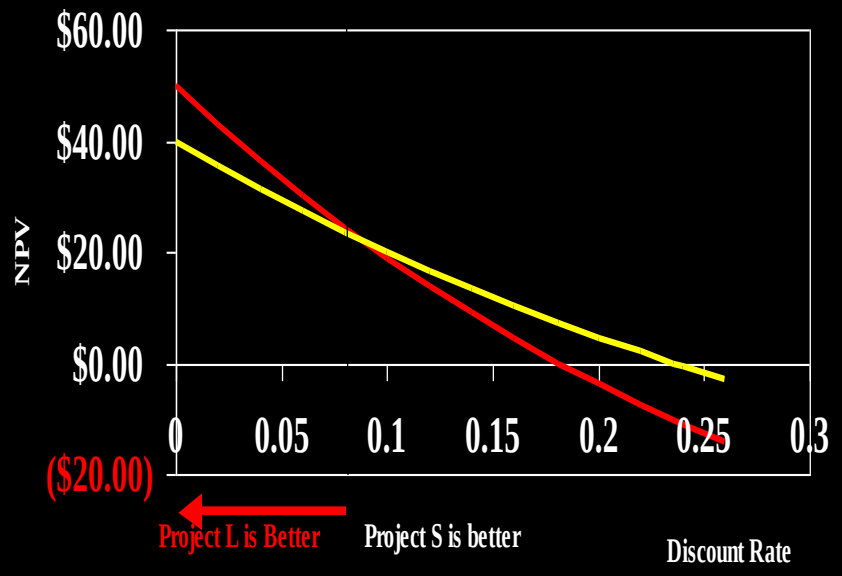


Use of NPV Profiles

- Helpful in Evaluating the sensitivity of NPV to changes in variables which affect NPV
- Such an analysis are usually referred to as "Sensitivity Analysis"
- Typical variable include sales unit demand and growth, unit sales prices, variable cash expense ratios, and salvage value

Conflicts between NPV & IRR

- This occurs only when projects are mutually exclusive
- That is, only one of the projects being evaluated may be accepted
- NPV never gives wrong selection. IRR can give wrong selection.



The use of NPV always leads to the correct decision.

But IRR can lead to the wrong decision. In this example, S has the high IRR, but lower NPV when the discount rate is less than 8%.

Causes for IRR/NPV Conflicts

- Timing of cash flows (such as in prior example)
- Project size

Project	Cost	IRR	NPV
Small	**10**	**25%**	**5**
Big	**1,000**	**12%**	**75**

Select "Big" due to greater NPV