The Basics of Capital Budgeting

BUS207 Financial Management

Capital Budgeting

Analysis of potential additions to fixed assets.

Long-term decisions; involve large expenditure.

Very important to firm's future.

Steps

1. Estimate CFs (inflows & outflows)

2. Assess riskiness of CFs

3. Determine k = WACC

4. Apply valuation techniques (Payback period, NPV, IRR, and/or MIRR)

5. Accept or reject the project following the decision criteria of each technique)

Normal vs. Nonnormal Projects

Normal Project:

Cost (negative CF) followed by a series of positive cash inflows. One change of signs

Nonnormal Project:

Two or more changes of signs. Most common: Cost (negative CF), then string of positive CFs, then cost to close project

Normal vs. Nonnormal Projects –cont'd…

Inflow (+) or Outflow (-) in Year

0	1	2	3	4	5	N	NN
-	+	+	+	+	+		
-	+	+	+	+	-		
-	-	-	+	+	+		
+	+	+	-	-	-		
-	+	+	-	+	-		

Payback Period

The number of years required to recover a project's cost,
Or how long does it take to get our money back?

Strengths of Payback Period Approach

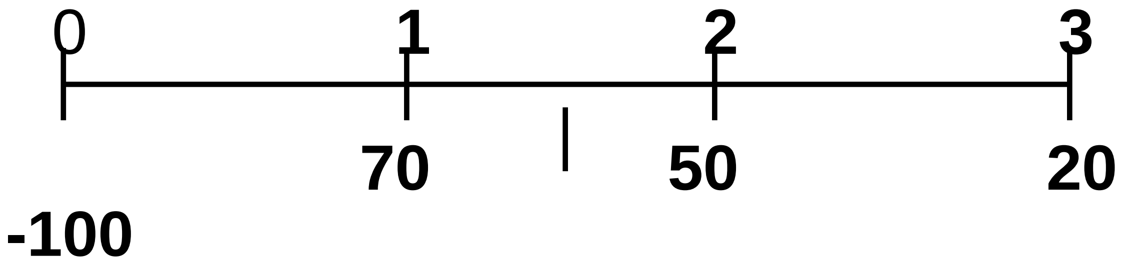
1. Provides an indication of project's risk and liquidity
2. Easy to calculate

Weakness of Payback Period Approach

1. Ignores the TVM
2. Ignores CFs occurring after the payback period

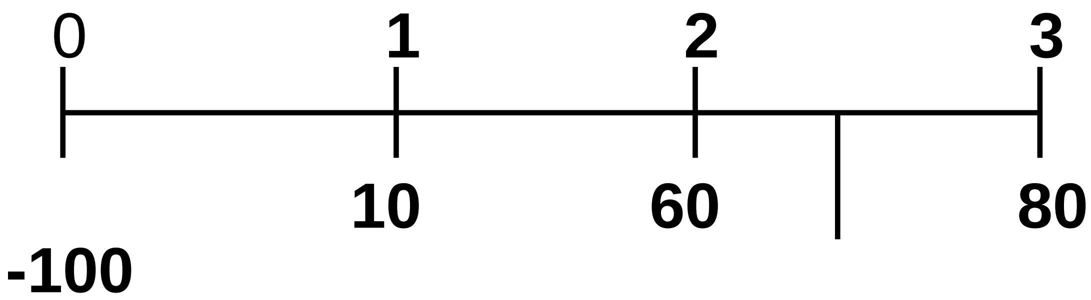
Payback Period –cont'd…

Project S (Short: CFs come quickly)



Payback Period –cont'd…

Project L (Long: Most CFs in out years)



Discounted Payback

Uses discounted rather than raw CFs

	0	1	2	3
	10%			
CF_t	-100	10	60	80
$PVCF_t$	-100	9.09	49.59	60.11
Cumul	-100			18.79
Disc. payback	=			

Recover invest + cap costs in

Net Present Value (NPV) Approach

Sum of the PVs of inflows and outflows.

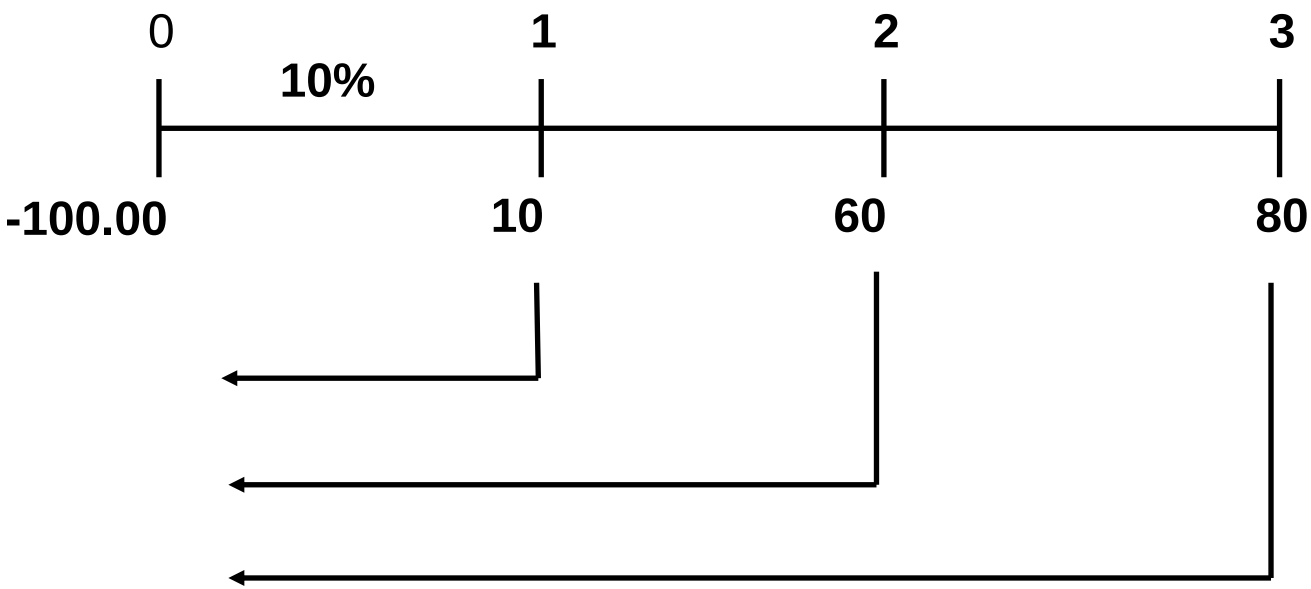
$$NPV = \sum_{t=0}^{n} \frac{CF_t}{(1+k)^t}$$

Cost often is CF_0 and is negative

Net Present Value (NPV) Approach –cont'd…

What is Project L's NPV?

Project L:



= NPV_L

NPV_S =

Rationale for the NPV method

NPV = PV (inflows) – Cost = Net gain in wealth

Accept project if

Choose between mutually exclusive projects on basis of higher NPV. Adds most value.

Rationale for the NPV method –cont'd..

Using NPV method, when project(s) should be accepted?

If Project S and L are mutually exclusive, accept , because

If S & L are independent, accept ;

Internal Rate of Return (IRR)

IRR is the discount rate that forces PV (inflows) = Cost of the project.

This is the same as forcing NPV = 0

NPV : Enter k, solve for NPV.

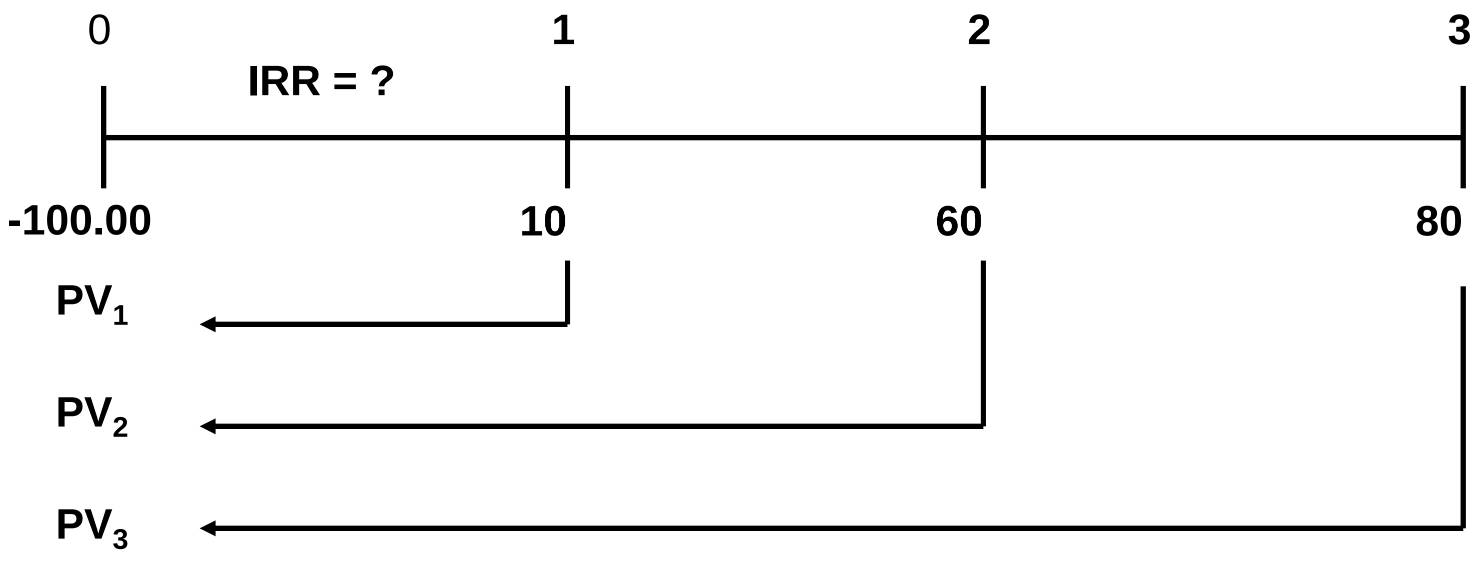
$$NPV = \sum_{t=0}^{n} \frac{CF_t}{(1+k)^t}$$

IRR : Enter NPV = 0, solve for IRR.

$$0 = \sum_{t=0}^{n} \frac{CF_t}{(1+k)^t}$$

Internal Rate of Return (IRR) –cont'd…

What is Project L's IRR?



0 = NPV

Enter CFs in CFLO, then press, IRR:

IRR_L = 18.13%.

IRR_S =

Internal Rate of Return (IRR) –cont'd…

Q. How is a project's IRR related to a bond's YTM?

A.

Rationale for the IRR method

If IRR > WACC, then the project's rate of return is greater than its cost: some return is left over to boost stockholder's returns.

Example: WACC = 10%, IRR = 15%, Take it.

IRR acceptance criteria

If IRR k, accept project

If IRR k, reject project

Decisions on our Project S and L per IRR:

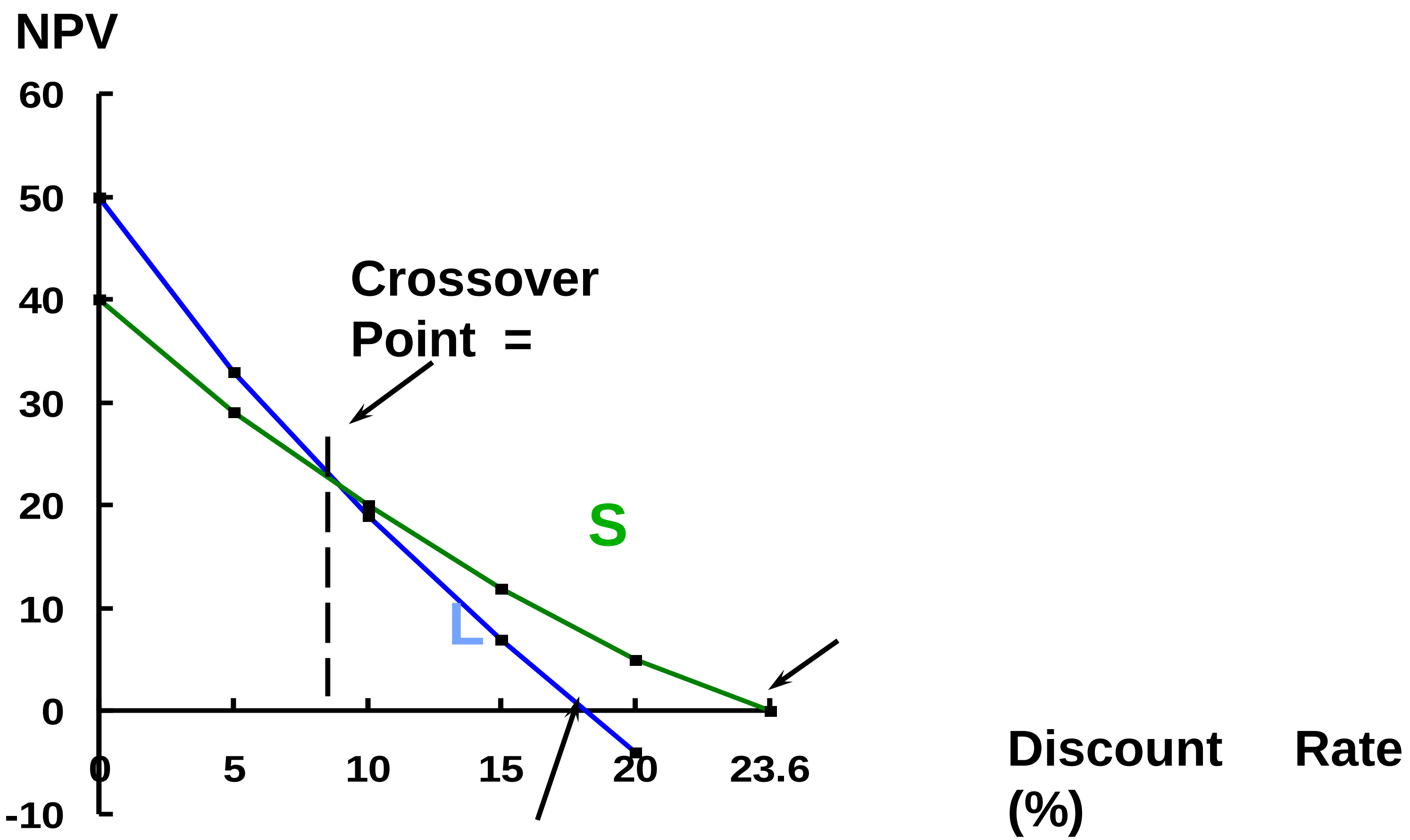
- If S and L are independent, accept both. IRR > k = 10%
- If S and L are mutually exclusive, accept S because $IRR_S > IRR_L$

Construct NPV Profiles

Enter CFs in CFLO and find NPV_L and NPV_S at different discount rates:

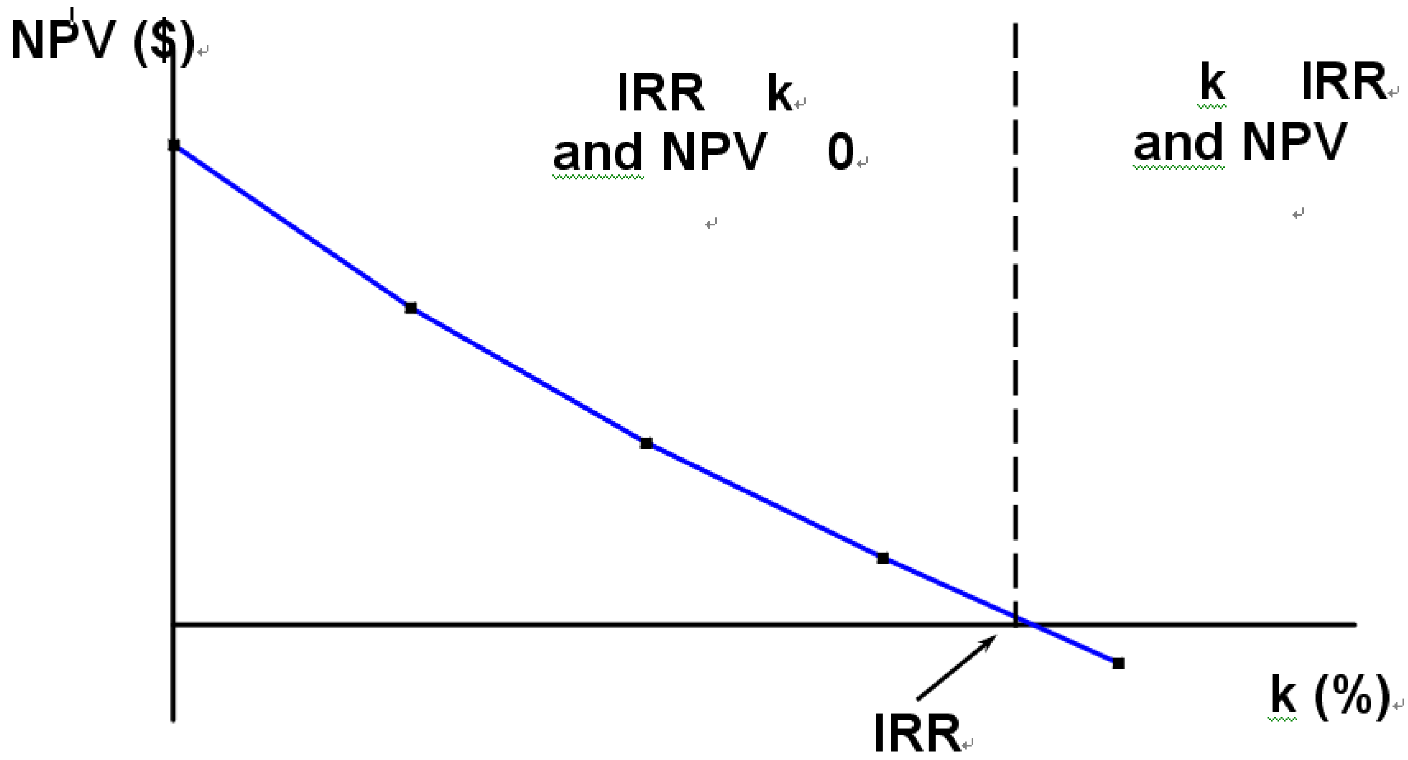
k	NPV_L	NPV_S
0	50	40
5	33	29
10	19	20
15	7	12
20	(4)	5

Construct NPV Profiles – cont'd…



Construct NPV Profiles – cont'd…

NPV and IRR always lead to the ***same*** accept/reject decision for ***independent projects***:

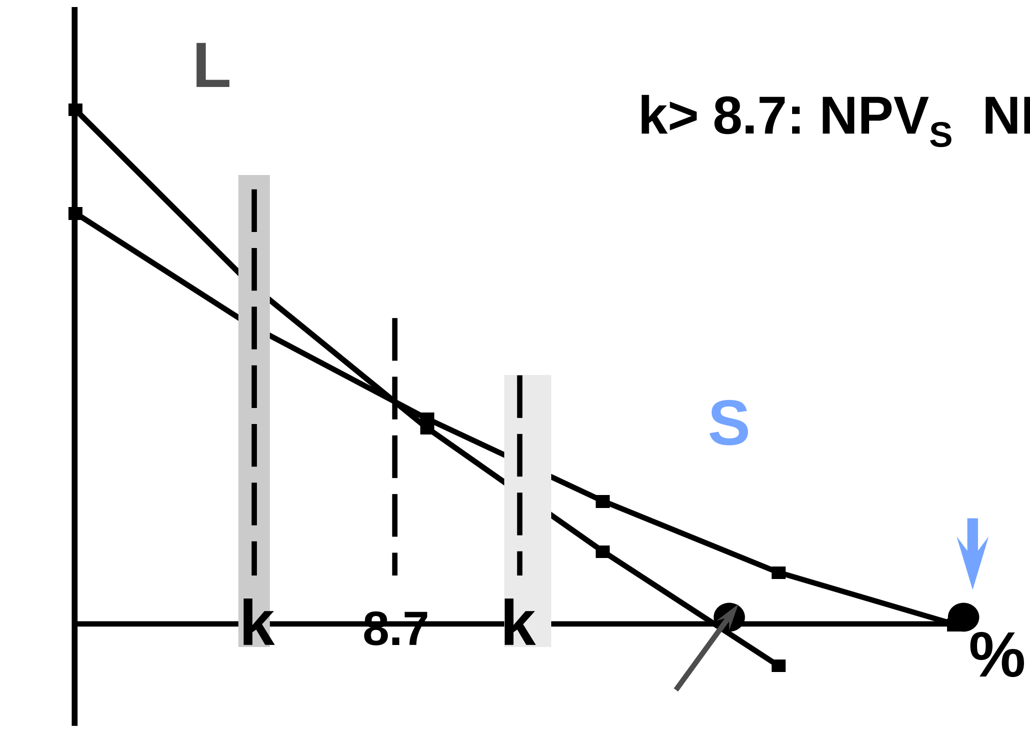


Construct NPV Profiles – cont'd…

Mutually Exclusive Projects

k< 8.7: NPV_L NPV_S , IRR_S IRR_L

k> 8.7: NPV_S NPV_L , IRR_S IRR_L



Construct NPV Profiles – cont'd…

To find the crossover rate:

1. Find cash flow differences between the projects.

2. Find the IRR of cash flow difference. Crossover rate = 8.68, rounded to 8.7%

3. Can subtract S from L or vice versa, but better to have first CF negative

4. If profiles don't cross, one project dominates the other.

Construct NPV Profiles – cont'd…

Two reasons why NPV profiles cross:

1. Size (scale) difference.

2. Timing differences.

Construct NPV Profiles – cont'd…

Reinvestment Rate Assumptions:

- *NPV assumes reinvest at*
- *IRR assumes reinvest at*
- *Reinvest at opp. cost, k, is more realistic.*

Modified IRR (MIRR)

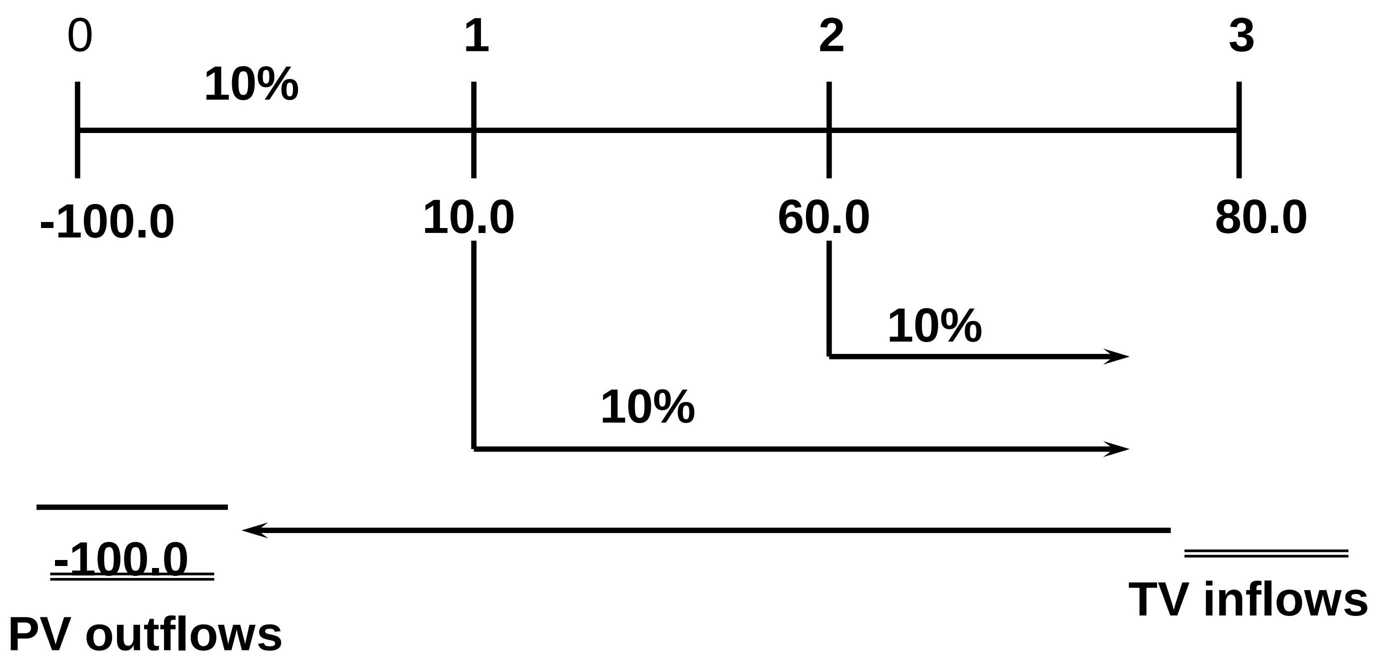
MIRR is the discount rate that causes

TV is found by compounding inflows at WACC.

Thus, MIRR assumes cash inflows are reinvested at WACC.

Modified IRR (MIRR) – cont'd…

MIRR for Project L (k = 10%):



MIRR_L =

Modified IRR (MIRR) – cont'd…

To find TV with financial calculator, enter in CFLO:

CF0 = 0, CF1 = 10, CF2 = 60, CF3 = 80

i = 10

NPV = = PV of inflows

PV = , N = , I = , PMT =

FV = = FV of inflows

Enter FV = , PV = , PMT = , N =

Press I = = MIRR

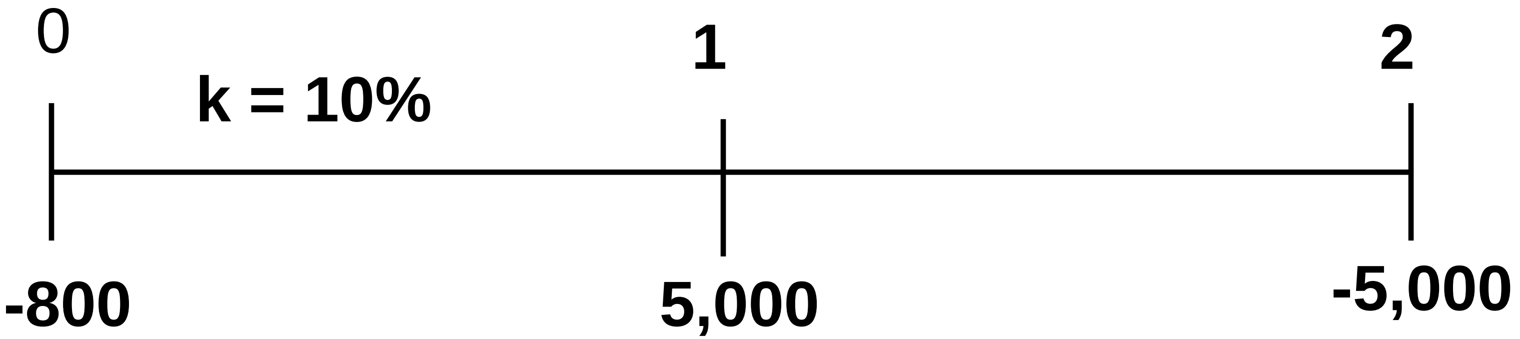
Modified IRR (MIRR) – cont'd…

Why use MIRR versus IRR?:

MIRR correctly assumes reinvestment at opp. cost = WACC. MIRR also avoids the problem of multiple IRRs.

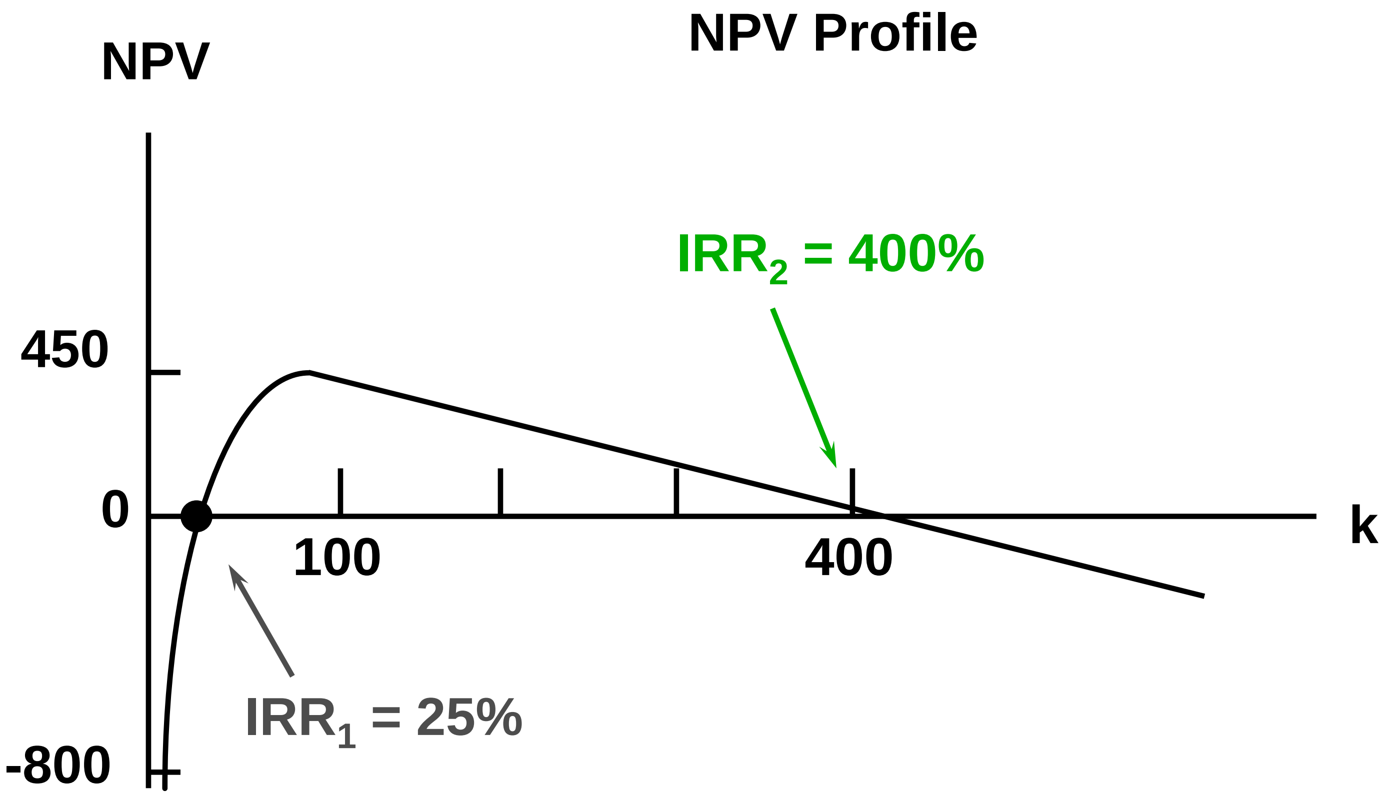
Managers like rate of return comparisons, and MIRR is better for this than IRR.

Modified IRR (MIRR) – cont'd…



IRR = ?

Modified IRR (MIRR) – cont'd…



Modified IRR (MIRR) – cont'd…

Logic of Multiple IRRs:

1. At very low discount rate, the PV of CF_2 is large & negative, so NPV < 0.

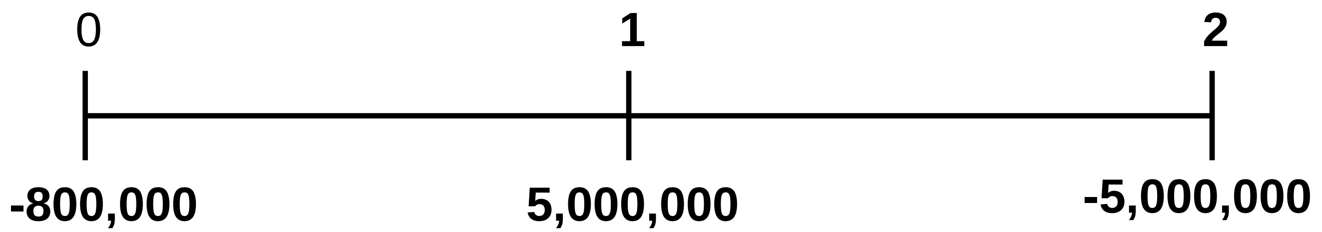
2. At very high discount rate, the PV of CF_1 and CF_2 are both low, so CF_0 dominates and again NPV < 0.

3. In between, the discount rate hits CF_2 harder than CF_1, so NPV > 0.

4. Result: 2 IRRs

Modified IRR (MIRR) – cont'd…

When there are nonnormal CFs and more than one IRR, use MIRR:



PV outflows @ 10% =

TV inflows @ 10% =

MIRR =

Cash Flow Estimation and Other Issues in Captial Budgeting

Overview

- Cash Flow Estimation
  - New or Expansion project
  - Replacement project

- Comparing projects with unequal lives

Cash Flow Estimation

Need to estimate that the project is expected to generate.

General form:

Cash flow = Incremental Net Income + Depreciation

Other "special" cash flows:

Initial costs

Extra ending or terminal cash flows at the end of the project's expected useful life

Example: New Beanie Babies Plant Project

- To meet unprecedented demand for their product, the Beanie Babies Corporation is considering building a new $1,000,000 plant to produce more Beanie Babies. The project is expected to have a 4-year useful life and would require a $100,000 increase in inventory (working capital) at the beginning of the project. The increased inventory can be sold at the end of the project's life. The plant will be depreciated over the life of the project using the straight line method.
- Each new Beanie Baby produced will be sold for $1.50 each. Manufacturing costs (cost of goods sold) are $0.50 each and fixed costs are expected to be $200,000 per year. The company estimates sales at 1,000,000 units for year 1, 800,000 units in year 2, 500,000 units in year 3, and 450,000 units in year 4.
- The equipment and the land for the plant can be sold for $150,000 at the end of the project's life.
- Estimate the after-tax cash flows for the project. Beanie Babies marginal tax rate is 30%.
- Decide if Beanie Babies Corp. should undertake this project if their cost of capital is 14%.

Beanie Babies Project

- Step 1: Estimate initial cost

  Time 0 (today) cash flow (cost):

Plant cost:	$1,000,000
Increase in inventory	$ 100,000
Total Cost (t=0)	$1,100,000

Annual Depreciation (Straight Line Method)

$$= \frac{\text{Depreciable base - Salvage value}}{\text{Number of useful life}}$$

Beanie Babies Project - continued

- Step 2:Estimate annual cash flows

Year	1	2	3	4
Unit Sales	1 mil	0.8 mil	0.5 mil	0.45 mil
Sales (1.50/)				
-COGS (0.5/)				
-Fix. Cost	0.2 mil	0.2 mil	0.2 mil	0.2 mil
-Deprec.				
EBT				
-Tax (30%)				
Net Income				
+Deprec.				
Cash Flow				

Beanie Babies Project - continued

- Decision Time:

Year	Cash Flow
0	
1	
2	
3	
4	

Beanie Babies Project - continued

- NPV at 14% =
- IRR =
- MIRR =

Other Incremental Cash Flow Issues:

- Sunk costs = . Ask yourself if rejecting the project affects this cost.
- Financing costs = . Already included in WACC.
- Opportunity costs = . Generally revenues forgone from using land or building for another purpose other than the project.
- Externalities = effects of a project on cash flows in other part of the firm. Can be positive or negative and should be as part of the project's incremental cash flows.
- Cannibalization = . A negative externality, occurs when the introduction of a new product diminishes the sales of existing products.

Inflation and NPV

NPV = PV of a project's expected cash flows discounted at the WACC.

The WACC is a nominal rate = includes expected inflation

If inflation is expected in a project's cash flows, the cash flows should be adjusted to reflect expected inflation.

Otherwise, the NPV would be downward biased.

Evaluating Projects with Unequal Lives

Not a problem with independent projects: no adjustment needed

When choosing between mutually exclusive projects with unequal lives, we may need to level the playing field.

Two Methods:

- Replacement Chain
- Equivalent Annual Annuity

Example

S and L are mutually exclusive and will be repeated. K = 10%. Which is better?

	Expected Net CFs	
Year	Project S	Project L
0	($100,000)	($100,000)
1	60,000	33,500
2	60,000	33,500
3	-	33,500
4	-	33,500

Note that project S could be repeated after 2 years to generate additional profits.

Example : Replacement Chain

Use replacement chain to calculate extended NPVs to a common life.

Since S has a 2-yr life and L has a 4-yr life, the common life is 4 yrs

Example: Replacement Chain– cont'd…

L:

0	1	2	3	4
10%				
-100,000	**33,500**	**33,500**	**33,500**	**33,500**

NPV_L = $6,190 (already to Year 4)

S:

0	1	2	3	4
10%				
-100,000	**60,000**	**60,000**	**60,000**	**60,000**
		-100,000		
		-40,000		

NPV_S = $7,547 (on extended basis)

Example: Replacement Chain– cont'd…

Alternate S extended NPV

Find S's regular NPV = 60,000 ($PVIFA_{10\%, 2}$) – 100,000 = 4,132

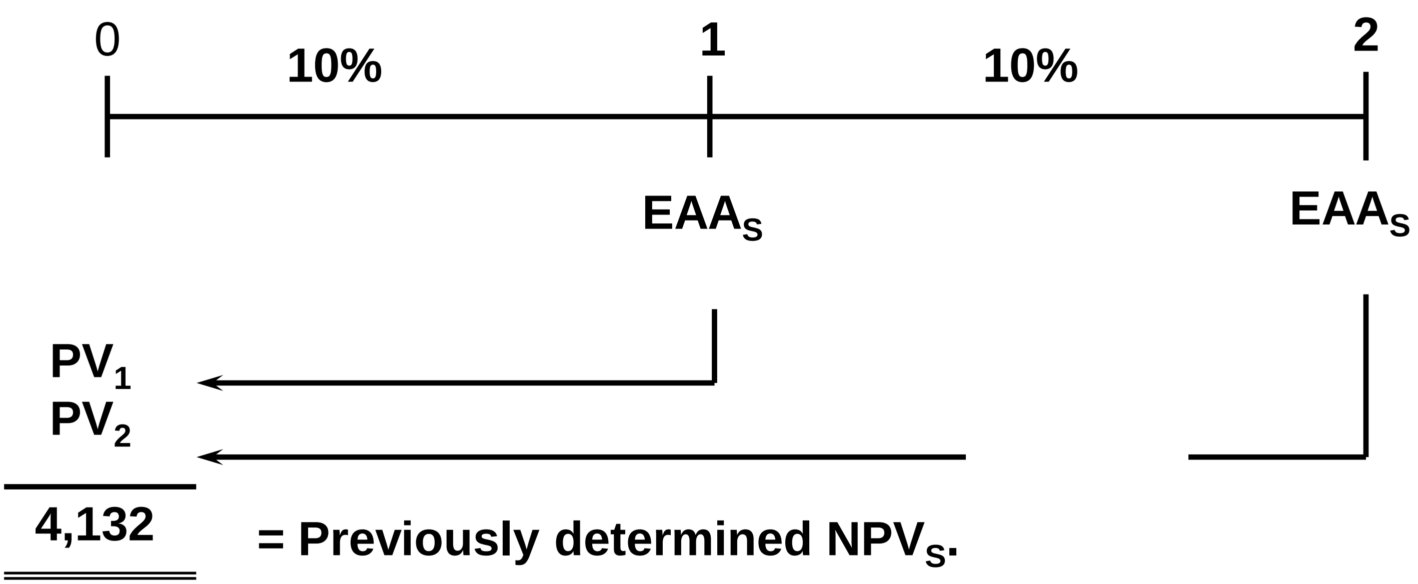
Will receive this same NPV when project is repeated 2 years from now.

Extended NPV = 4,132 + 4,132 ($PVIF_{10\%, 2}$) = 7,547

Example: Equivalent annual annuity

That annuity PMT whose PV equals the project's NPV.

S:



Example: Equivalent annual annuity – cont'd..

EAA Decision

The project, in effect, provides an annuity of EAA.

$EAA_s > EAA_L$, so pick S.

Replacement chains and EAA always lead toe the same deicision.