CHAPTER 10:
Investment Appraisal Methods

First hour – 23.11.11

- *Payback*
- *ARR*

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Slide 10.2

Chapter 10 Making capital investment decisions

LEARNING OUTCOMES

You should be able to:

- Explain the nature and importance of investment decision making
- Identify the four main investment appraisal methods found in practice
- Use each method to reach a decision on a particular investment opportunity
- Discuss the attributes of each of the methods

Investment appraisal methods used in practice

- **Investment appraisal** – the process of appraising the potential investment projects.
- Assessment of the level of expected **returns** earned for the level of **expenditure** made.
- Estimates of **future** costs and benefits over the project's life.

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Investment Appraisal

- Every business would like to do everything
- But it all costs
- Capital expenditure on new projects or purchases (fixed assets) needs to be planned
- Capital is always rationed

Scenario:

- Your business wishes to expand its product line
- It is considering Products A and B but it can only afford to do one.
- How does it decide? What main factors affect the investment decision

- How much will it cost ?
- How much will I get back ?
- When will I get the income ?
- 4 main techniques available ranging from simple to moderately complex

Investment appraisal methods used in practice

MULTIPLE APPRAISAL METHODS:

- **Non-discounted cash flow techniques:**

1. Payback period *(PBP)*
2. Accounting rate of return *(ARR/ROCE/ROI)*

- **Discounted cash flow techniques(DCF):**

3. Net Present Value *(NPV)*
4. Internal Rate of Return *(IRR)*

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Objectives (1)

Non-discounted cash flow techniques:

i) Calculate **payback period** and discuss the usefulness of payback as an investment appraisal method.

ii) Calculate **accounting rate of return** *(return on capital employed)* and discuss its usefulness as an investment appraisal method.

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PBP - Relevant Cash Flows

Payback is a *cash-flow* based technique and so considers the '**Relevant cash flows**' which are:

- Future
- Incremental
- Cash-based

Ignore:

- Sunk costs
- Non-cash items
- Committed costs

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1. Payback Period (PBP)

- **PBP** = The time it takes the cash inflows from a project to equal the cash outflows.
- **Decision rule** – projects with a PBP up to defined maximum period are acceptable; the shorter the PBP, the more desirable.

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Payback

- When does cash inflow cover cash outflow?

	A	B
Outflow	(1,000,000)	(1,000,000)
Inflows:		
1	250,000	100,000
2	250,000	200,000
3	250,000	300,000
4	250,000	300,000
5	100,000	400,000
6	50,000	500,000

- **Project A** gets repaid after 4 years
- **Project B** is still not repaid – only 900,000
- It is 100,000 short
- Year 5 project B has 400,000 coming in
- 100,000/400,000 = 25%
- 25% of year = 3 months
- Thus payback equals 4 years 3 months
- [or: 4 yrs + (100/400 x 12)]

Payback

The time it takes the cash inflows from a project to equal the cash outflows

✓ Advantages?

× Disadvantages?

See textbook & extra reading

2. Accounting Rate of Return (ARR)

ARR = $\frac{\text{Average annual PBIT}}{\text{Average investment}}$ x 100%

Where **average investment = $\frac{\text{initial outlay + scrap value}}{2}$**

Or ARR = $\frac{\text{Average annual PBIT}}{\text{Initial capital costs}}$ x 100%

Profit is after depreciation but before interest and tax.

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Accounting Rate of Return (ARR)

- Also known as Return on Capital Employed (ROCE) or Return On Investment (ROI).
- Can be used to rank projects taking place over a number of years (using average profits and investment).
- Can also rank mutually exclusive projects.
- **Decision rule – project with an ARR above a defined minimum are acceptable; the greater the ARR, the more desirable.**

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Accounting Rate of Return (ARR)

Example – A project involves the immediate purchase of an item of plant costing £110,000.

It would generate annual cash flows of £24,400 for five years, starting in Year 1. The plant purchased would have a scrap value of £10,000 in five years, when the project terminates.

Depreciation is on a straight-line basis.

Required:

- **Calculate ARR.**

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Workings:

Years	Cash Flow	Depreciation	Profit
1 – 5	24,400	(20,000)*	**4,400**

Average investment =

ARR = $\frac{\quad\quad}{\quad\quad}$ x 100 =

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Accounting Rate of Return (ARR)

Accounting profits VS. Cash flows:

- Profits cannot be spent
- Profits are subjective
- Cash is required to pay dividends

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Accounting Rate of Return (ARR)

ARR = $\frac{\text{Average annual PBIT}}{\text{Average investment}}$

✓ Advantages?

× Disadvantages?

See textbook & further reading

Comparing PBP with ARR

The cash flows for projects Z and S are as follows and there is no residual value for either investment:

	Z	S
Year	**£**	**£**
0	(20,000)	(25,000)
1	4,000	8,000
2	6,000	8,000
3	6,000	6,000
4	7,000	6,000
5	6,000	5,000
Anticipated PBP	**3 years 7 months**	**3 years 6 months**

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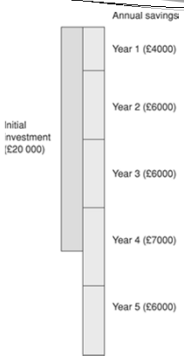

Figure 5.1 Payback period for the Zenith machine

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Comparing PBP with ARR

Using ARR:

Project Z:

$\frac{[(4000+6000+6000+7000+6000)-20000]/5}{10,000}$ = **18.0%**

Project S:

$\frac{[(8000+6000+5000+6000+8000)-25000]/5}{12,500}$ = **12.8%**

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Objectives (2)

Discounted cash flow (DCF) techniques

a) Explain and apply concepts relating to interest and discounting, including:

i) the time value of money and the role of cost of capital in appraising investments;

ii) the calculation of present values, and the use of discount and annuity tables;

b) Calculate net present value and discuss its usefulness as an investment appraisal method.

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Discounted Cash Flow Techniques

- DCF is an investment appraisal technique which takes into account both the **timings** of cash flows and also **total returns** over a project's life.
- Two DCF methods to evaluate capital investments:
  - (i) Net Present Value **(NPV)**
  - (ii) Internal Rate of Return **(IRR)**

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Time value

Money has a time value – i.e. the timing of a cash flow affects how much it is really worth to us.

For example, if offered £100 now or £100 in one year's time, most people would choose the money now.

***The main reasons for this time value are as follows*:**

- ***Inflation*** **– time erodes the purchasing power of the money.**
- ***Investment opportunities*** **– the money now can be invested to grow into more than £100 in one year.**
- ***Cost of finance*** **– the receipt now could be used to repay a loan, say, and save/ reduce interest charges.**
- ***Risk*** **– the earlier cash flow is less risky than the promise of cash in the future.**

Compounding & Discounting

- **Compounding** = multiplying a present sum by a return % to give a future value of an investment,

i.e. $FV = PV\ (1 + r)^n$

- **Discounting** = dividing the future value of an investment by a return % to give the present value,

i.e. $PV = FV \frac{1}{(1 + r)^n}$

DCF Assumptions – timing!

- Cash flows incurred at the beginning of project occur in **year 0**.
- Cash flows occurring during time period assumed to occur **at period-end**.
- Cash flows occurring at beginning of period assumed to occur **at end of previous period**.

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Net Present Value

NPV = the sum of the discounted (present) values of the cash flows from the investment.

If the discounted future cash flows **>** cost of setting up the project today

⇩

The project has a **+ net present value (NPV)**

Decision rule – Accept all positive NPV investments as they enhance shareholders' wealth; the greater the NPV, the greater the enhancement and the more desirable.

NPV Example

Saga Co. estimates the relevant cash flow of project A as follows:

Year	Cash flow
	£
0	(100,000)
1	60,000
2	80,000
3	40,000
4	30,000

If Discount rate = **15%**, is project A acceptable for the company?

Homework

Net Present Value

✓ Advantages?

× Disadvantages?

Over non-discounted techniques studied earlier

Internal Rate of Return (IRR)

- **IRR** = the discount rate that causes a project to have a zero NPV.
- It represents the average percentage return on the investment, taking account of the fact that cash may be flowing in and out of the project at various points in its life.
- **Decision rule** – projects that have an IRR greater than the cost of capital are acceptable; the greater the IRR, the more desirable.

IRR

Example – Single cash inflow

Year	Cash flow	Discount rate	PV
	£		£
0	(120)	1.00	(120)
1	138	?	120
			NPV = 0

IRR = ?

Internal Rate of Return

The rate of interest (discount) at which the NPV = 0

$$IRR \approx L + \left(\frac{N_L}{N_L - N_H}\right) x\ (H - L)$$

Where L = Lower rate of interest

H = Higher rate of interest

N_L = NPV at lower rate of interest

N_H = NPV at higher rate of interest

Projects should be accepted if their IRR is greater than the cost of capital.

IRR – decision rule

- **IRR = The % return given by a project**
- As the IRR gives the discount rate ***at which the NPV is zero***, it follows that:
- *If IRR **>** Cost of capital, **ACCEPT** project;*

  (because project is bound to have a + NPV at the cost of capital)
- *If IRR **<** Cost of capital, **REJECT** project*
- *This rule is valid for all CONVENTIONAL cash flows (ie a cash outflow followed by a series of inflows)*

IRR

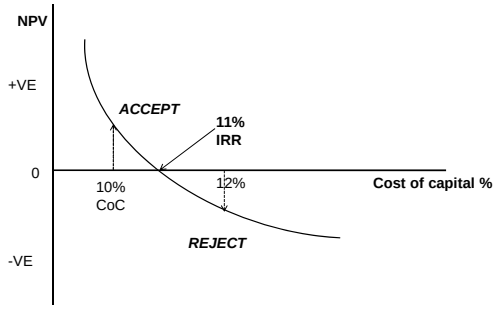
Example – Uneven cash flows

Time	CF £	10% Discount factor	PV £	12% Discount factor	PV £
Y0	(80,000)	1.000	(80,000)	1.000	(80,000)
Y1-5	20,000	3.791	75,820	3.605	72,100
Y5	10,000	0.621	6,210	0.567	5,670
			NPV = 2,030		**NPV = (2,230)**

$$IRR = 10 + \left[\frac{2{,}030}{(2{,}030 + 2{,}230)} X (12 - 10)\right]\%$$

= 10.95%

IRR – graphical illustration



IRR

- It does not relate directly to shareholders' wealth.
- Takes account of the timing of cash flow.
- Takes all relevant information into account.
- Does not always provide clear signals and can be impractical to use.

NPV and IRR compared

Will NPV and IRR always come to similar conclusions?

Time	*Project A*	*Project B*
	£	£
Yearo	(10,000)	(6,000)
1	6,000	3,650
2	6,000	3,650
NPV@10%	**413**	**334**
IRR	**13%**	**14%**

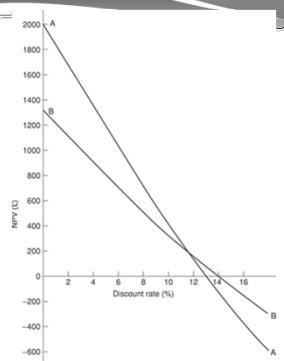


Figure 9.1 Graph of the NPV against the discount rate for two project (A and B)

NPV and IRR compared

Unconventional cash flows – Multiple IRRs and No IRRs

Time	*Project C*	*Project D*
	£	£
Year 0	(10,000)	10,000
1	33,000	(16,000)
2	(24,000)	12,000

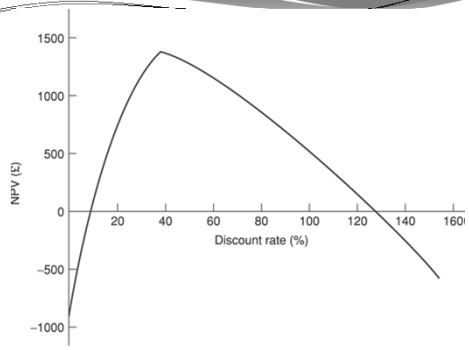


Figure 9.2 Graph of the NPV against the discount rate for Project C

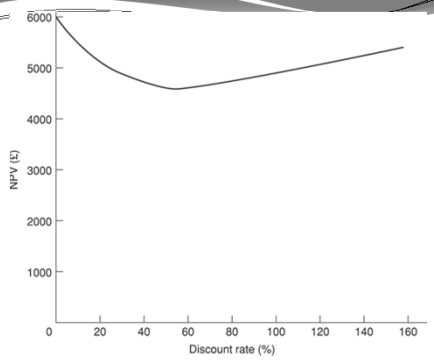


Figure 9.3 Graph of the NPV against the discount rate for Project D

Homework

Internal Rate of Return

✓ Advantages?

× Disadvantages?

Over non-discounted techniques studied earlier