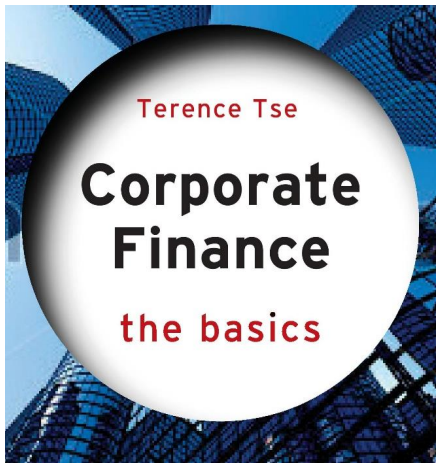

Corporate Finance

Book 1

Dr Terence Tse

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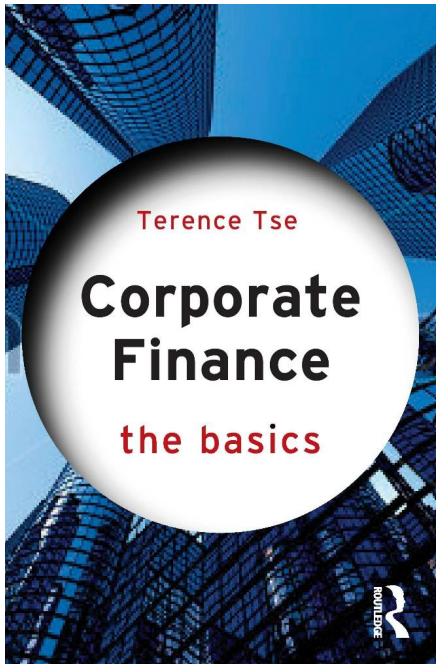
Is this a good investment? Now available for sale



Corporate Finance: The Basics *is a concise introduction to the inner workings of finance at the company level. It aims to take the fear out of corporate finance and add the fun in, presenting the subject in a way that is simple to grasp and easy to digest. Its aim is to explain – and demystify – the essential ideas of corporate finance, avoiding the heavy use of maths and formulae. The calculations and figures in the book are purely to illustrate fundamental concepts, appealing to readers' common sense, rather than stretch their ability to do "number-crunching".*

On your journey to understanding corporate finance, you may wish to consult several textbooks. But are they necessary evils?

Text book	Description and comments
Main text book	• Jonathan Berk and Peter DeMarzo (2011) 'Corporate Finance', 2nd Global Edition, Pearson • Newer and older editions as well as international editions are perfectly good substitutes
Other good references	• Stephen Ross, Randolph Westerfield and Bradford Jordan (2006) 'Corporate Finance Fundamentals', 7th edition, McGraw Hill • Richard Brealey, Steward Myers and Franklin Allen (2006) 'Corporate Finance', 8th edition, McGraw Hill • Almost all corporate finance-related text books cover the same concepts

- The fact is that every corporate finance textbook will cover all the topics in this course

Topic 1: Financial Ratios for Financial Analysis

Introduction to Financial Analysis

Financial analysis can be achieved through different methods

- Financial analysis refers to the analysis of the financial and the economic prospects of a firm
- It also provides a tool for evaluating the viability, stability and profitability of a business, sub-business or project
- There are different methods to do so:

Methods	Description
Financial ratios	• The most common way to perform financial analysis is by going through ratios that concentrate on leverage, liquidity, efficiency, profitability and firm value
Valuation	• Valuation through the use of cash flows and other 'comparables' • This is mostly used for valuation of a business
Competition	• Benchmarking other comparable firms to identify advantages and shortcomings of the firm

Financial ratios are the most common method used for financial analysis

- Financial analysts calculate ratios to:
  - Understand the significance of accounting data by comparing:
    - Over time
    - Across the industry/sector
  - Ratios can help normalise and facilitate meaningful comparisons
  - Taking apart a ratio can help develop insights

Financial ratios are ways of comparing and investigating the relationship between pieces of financial information

Aspects	Description
Definition	• Financial ratios are measures of relative values of key financial information
Use	• Ratio analysis involves methods of calculating and interpreting financial ratios to assess a firm's performance

Measurements	• Ratio analysis comes in various measurements such as
	  ◦ Percentages ['%']
	  ◦ Times or multiples ['x']
	  ◦ Number of days ['days']

Use	• Ratios are of interest to the following people as they are key indicators of financial health
	  ◦ Management team of the company
	  ◦ Creditors
	  ◦ Shareholders
	  ◦ Prospective investors

There are two main types of ratio comparison

Types	Description
1 **Cross-sectional analysis**	• Cross-sectional analysis involves the comparison of different firms at the same point of time • Benchmarking firm performance against industry averages is very popular

Price-Earning ratio

	2004A
Barclays	9.1x
HBOS	8.9x
HSBC	4.2x
Lloyds	9.9x
9 UK Banks	*10.7x*

There are two main types of ratio comparison (cont'd)

Types

Description

2 **Time-series analysis**

- Time-series analysis evaluates performance over time, allowing comparisons of current and past ratio values to take place

Price-Earning ratio

	2004A	2005E	2006E
Barclays	9.1x	9.6x	8.8x

Combination

- Combined analysis mixes both features of cross-sectional and time-series analysis

Price-Earning ratio

	2004A	2005E	2006E
Barclays	9.1x	9.6x	8.8x
HBOS	8.9x	9.5x	8.9x
HSBC	4.2x	4.6x	5.1x
Lloyds	9.9x	10.5x	9.7x
9 UK Banks	*10.7x*	*10.5x*	*9.7x*

There are five broad categories of ratios, each revealing different aspects of a firm's performance

Types

Description

1 **Leverage**

- Leverage ratios address a firm's long-term ability to meet its obligations and financial leverage

2 **Liquidity**

- Liquidity ratios refer to a firm's ability to satisfy its short-term obligations when needed
- The primary concern is the firm's ability to pay its bills in the short term without undue stress

3 **Efficiency/ Activity**

- Efficiency or activity ratios measure how efficiently and intensively a firm uses its assets to generate sales

4 **Profitability**

- Profitability ratios measure how efficiently a firm uses its assets and how efficiently a firm manages its operations
- The focus is on the bottom line (i.e. net income)

5 **Market-to-value**

- Market-to-value ratios measure how the market views the performance of a firm

Topic 1: Financial Ratios for Financial Analysis

Financial Ratios

1 Leverage ratios address a firm's long-term ability to meet its obligations and financial leverage

Types	Description	Equation
1 **Debt ratio**	• Takes into account all debts of all maturities to all creditors • Sometimes, value of leases are counted as long-term debt because they resemble long-term debt • Can be expressed in 'x', '%' or ':'	$\frac{Long\ term\ debt\ ^{*}}{Long\ term\ debt + Equity}$
2 **Debt-equity ratio**	• The proportion of equity and debt the company is using to finance its assets • Again, sometimes the value of leases are counted as long-term debt because they resemble long-term debt • Can be expressed in 'x', '%' or ':'	$\frac{Long\ term\ debt\ ^{*}}{Equity}$

** Long-term debt is the most common form of debt. Debt often includes other types of debt that run for a long period of time such as convertible debt, non-current capital leases and non-current long-term debt. In many cases these are all added together and called long-term debt*

1 Leverage ratios address a firm's long-term ability to meet its obligations and financial leverage (cont'd)

Types	Description	Equation
3 **Interest coverage**	• The extent to which interest is covered by EBIT [plus depreciation] • Usually expressed in 'x'	$\frac{EBIT}{Interest}$

2 Liquidity ratios refer to a firm's abilities to satisfy its short-term obligations as they come due

Types	Description	Equation
1 **Current ratio**	• Current ratio measures the margin liquidity – how assets can readily be turned into cash • Can be expressed in 'x' or ':'	$\frac{Current\ assets}{Current\ liabilities}$
2 **Quick or Acid test ratio**	• Quick ratio measures the margin the liquidity, taking into consideration certain current assets that are not readily convertible into cash • Can be expressed in 'x' or ':'	$\frac{Cash + marketable\ securities + accounts\ receivable}{Current\ liabilities}$
3 **Cash ratio**	• Cash ratio measures a company's most liquid assets – cash – against current liabilities • Can be expressed in 'x' or ':'	$\frac{Cash + marketable\ securities}{Current\ liabilities}$

3 Efficiency or activity ratios measure how efficiently and intensively a firm uses its assets to generate sales

Types	Description	Equation
1 **Sale-to-assets**	• Sales-to-assets or asset turnover ratio shows how hard a firm's assets are being put to use • Usually expressed in 'x'	$\frac{Sales}{Total\ assets}$

Example

	2007	2006	Δ
Turnover	£1,110,678	£697,720	↑59.19%
Average total assets	£315,528	£171,160	↑84.35%
Asset turnover	3.52x	4.08x	N/A

3 Efficiency or activity ratios measure how efficiently and intensively a firm uses its assets to generate sales (cont'd)

Types	Description	Equation
2 **Inventory turnover**	• Inventory turnover shows how many times a company's inventory is sold and replaced over a period • Usually expressed in 'x'	$\frac{Cost\ of\ goods\ sold}{Inventory}$
3 **Days in inventory**	• Days in inventory measures the speed with which a company turns over its inventory (i.e. number of days that a firm takes to produce and sell the goods to be produced and sold) • Expressed in 'days'	$\frac{Inventory}{Cost\ of\ goods\ sold\ \div 365}$ … which is the same as … $\frac{365}{Cost\ of\ goods\ sold\ \div Inventory}$

Example

	2007	2006	Δ
COGS	£830,126	£505,738	↑ 64.14%
Inventory	£52,437	£51,482	↑ 1.86%
Days in inventory	23.06 days	37.42 days	

3 Efficiency or activity ratios measure how efficiently and intensively a firm uses its assets to generate sales (cont'd)

Types	Description	Equation
4 **Accounts receivable days**	• Accounts receivable days (also called Average Collection Period) measures how quickly customers pay their bills • The industry average was 60 days • Expressed in 'days'	$\frac{Accounts\ receivable}{Sales \div 365}$ … which is the same as… $\frac{365}{Sales \div Accounts\ receivable}$
5 **Accounts payable days**	• Accounts payable days measures how quickly the firm pays the bill and pay off the outstanding balance owed to the suppliers • Expressed in 'days'	$\frac{Accounts\ payable}{Cost\ of\ goods\ sold \div 365}$ … which is the same as… $\frac{365}{Cost\ of\ goods\ sold \div Accounts\ payable}$

Exercise

(£ millions)	2006	2005	2004
Tesco			
Inventory	1,464	1,309	1,199
Cost of good sold	36,426	31,231	28,936
Inventory turnover			
Days in inventory			
Sainsbury			
Inventory	576	559	753
Cost of good sold	14,994	14,544	15,655
Inventory turnover			
Days in inventory			
WM Morrisons			
Inventory	399	425	150
Cost of good sold	9,156	9,110	3,681
Inventory turnover			
Days in inventory			

4 Profitability ratios measure how efficiently a firm uses its assets and how efficiently a firm manages its operations

Types	Description	Equation
1 **Net profit margin**	• Net profit margin shows the proportion of sales that finds its way into profits • Usually expressed in '%' • It is useful to compare net profit margin with gross profit margin • Example 1	$\frac{Net\ income}{Sales}$

	Premium Airline A	Low-cost Airline B
Gross profit margin	5.62%	27.46%
Net profit margin	4.05%	10.87%

• Example 2

	Software Business
Gross profit margin	89.55%
Net profit margin	27.15%

4 Profitability ratios measure how efficiently a firm uses its assets and how efficiently a firm manages its operations (cont'd)

Types	Description	Equation
2 **Return on assets**	• Return on assets measures how profitable a company is relative to its assets • Expressed in '%'	$\frac{Net\ income}{Total\ assets}$
3 **Return on equity**	• Return on equity shows how much profit a company generates with the money shareholders have invested • Expressed in '%'	$\frac{Net\ income}{Equity}$
4 **Payout ratio**	• Payout ratio measures the proportion of earnings that is paid out as dividends • Can be expressed in '%' or 'x'	$\frac{Dividends}{Earnings}$

5 Market-to-value ratios measure how the market views the performance of a firm

Types	Description	Equation
1 **Price-earning ratio**	• Price-earning ratio measures the price that investors are prepared to pay for each pound of earnings • Can be expressed in 'x'	$\frac{Share\ price}{Earnings\ per\ share}$
2 **Dividend yield**	• Dividend yield shows the proportion of dividend embedded in the stock price • Can be expressed in '%' or 'x'	$\frac{Dividend\ per\ shares}{Share\ price}$
3 **Market-to-book ratio**	• Market-to-book ratio shows the ratio of the share price to book value per share • Can be expressed in 'x'	$\frac{Market\ value\ per\ share}{Book\ value\ per\ share}$

Share price

Book equity divided by number of shares outstanding

Topic 1: Financial Ratios for Financial Analysis

The Dupont System

By linking profitability and efficiency ratios, the DuPont system provides some useful information

Types

1 **Return on assets**

Description

- Return on assets links a firm's sales-to-asset ratio and its profit margin

$$ROA = \frac{Net\ income}{Total\ assets} = \frac{Sales}{Total\ assets} \times \frac{Net\ income}{Sales}$$

Sales-to-assets ratio

Profit margin

Example

	Asset turnover	x	Profit margin	=	Return on assets
Fast-food	2.0		5%		10%
Luxury hotel	0.5		20%		10%

By linking profitability and efficiency ratios, the DuPont system provides some useful information (cont'd)

Types

2 **Return on equity**

Description

- Return on equity can be expanded into 3 components

$$ROE = \frac{Net\ income}{Equity}$$

- Let us break this formula down and look at the individual components

$$ROE = Profit\ margin \times Asset\ turnover \times Leverage$$

$$\frac{Net\ income}{Sales} \times \frac{Sales}{Total\ assets} \times \frac{Total\ assets}{equity}$$

ROA

- Since the first two terms are ROA, ROE must therefore mean:

$$ROE = ROA \times Leverage$$

- This makes sense because the return that the equity shareholders can get must be the return generated by the assets plus the return generated by the leverage

Topic 2: Introduction to Corporate Finance

Introduction to corporate finance

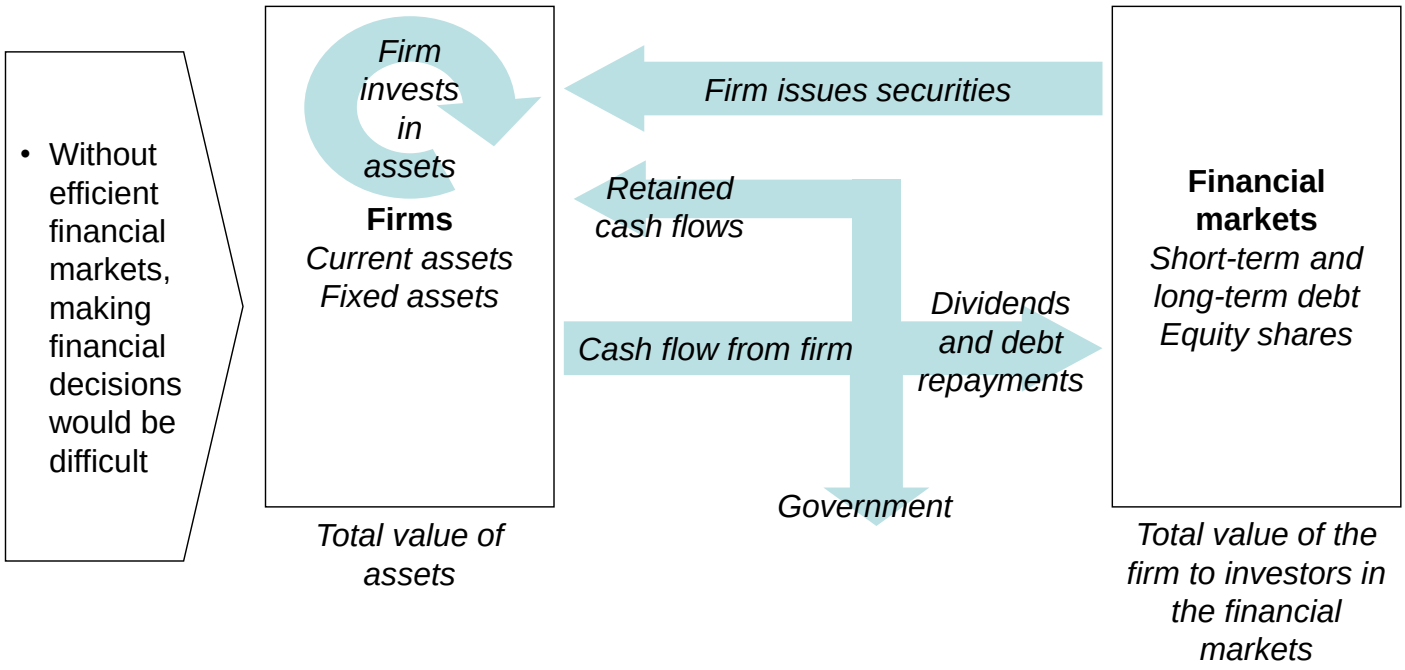
Corporate finance focuses on three main concerns

Main concerns	Description	Main question to ask
1 Capital budgeting	• The process of planning and managing a firm's long-term activities	• In what long-lived assets should you invest? Which lines of business do you want to enter, and what sort of buildings, machinery and equipment will you need?
2 Capital structure	• The financing of the firm through a mixture of debt and equity	• How can you raise cash for your investment?
3 Working capital	• The amount of money available for day-to-day operation of a business	• How should short-term operating cash flows be managed (e.g. collecting from customers and paying suppliers)?

Corporate finance focuses on three main concerns (cont'd)

Main concerns	Related concepts of finance
1 **Capital budgeting**	• Net present value • Internal rate of return • Cost of capital
2 **Capital structure**	• Equity securities (e.g. shares) • Debt securities (e.g. bonds, short- and long-term loans) • Cost of capital
3 **Working capital**	• Current assets • Current liabilities • The formula for calculating working capital is *current assets – current liabilities*

Financial markets play an extremely important role in corporate finance



Source: Ross et al. (2005)

There are many types of financial instruments available in the financial markets. They can be placed in 2 broad categories

Categories	Description
Basic	• Shares (with or without voting rights) • Debt (credit, bonds, treasury bills, notes, commercial papers)
Advanced	• Options • Futures • Swaps • Convertibles

- These instruments allow the following actions to take place:
  1. Inter-temporal exchange
  2. Exchange of risk to take place

1 Inter-temporal exchange enables participants in the financial markets to make the optimal choice of the time of consumption

- Andy wants to buy some flower seeds, plant them in his garden and get a profit of 20% in 6 months
- But Andy has no money to buy the seeds

- Betty works day and night throughout the year at a bank
- She has no time to spend her salary right now but wants to take a long vacation in 6 months
- But her salary cannot cover the dream vacation she wants

- *Without* financial markets, Andy will not be able to grow flowers and Betty will have to spend her holiday at her parents' place
- *With* the financial markets, Betty can lend Andy the money today. In return, Andy return Betty with a bit of profit. In this way, everyone gains

- Financial markets allow money to be exchanged according to the optimal time of consumption and resources to be transferred over time

2 Financial markets allow their participants to transfer risk

- Caroline owns an umbrella company. If the summers are dry, then she will not have enough money to retire 10 years from now
- Derek owns a swimsuit company. Business will be bad if the summers are wet. If that is the case, then he will not be able to retire 10 years from now

- *Without* financial markets, neither Caroline nor Derek will be able to change the risk that they face
- *With* the financial markets, Derek can sell shares of his company to Caroline and vice versa
- Alternatively, they can sell shares of their company to Euan (to share potential losses or gains)

- Financial markets benefit everyone through adjusting the level of risk one wants to carry
- The level of risk undertaken should be compensated by a corresponding level of return

The financial markets come in various forms

Forms	Description
1 Money markets	• Money markets are the markets for debt securities that will pay off in the short-term (usually less than one year) • They are comprised of a series of closely connected wholesale 'over-the-counter' (OTC) short-term financial markets • Interbank market is a form of money markets
2 Capital markets	• Capital markets are markets for long-term debt (with a maturity at over one year) and for equity shares
3 Foreign exchange markets	• Markets in which foreign currencies are bought and sold
4 Hedging markets	• Buying and selling of risk though derivative products such as options, futures and forwards

- Markets can also be described as primary and secondary
- Primary market is used when governments and corporations initially sell securities or initial public offerings (IPOs). Corporations engage in 2 types of primary-market sales of debt and equity: public offerings and private placements
- Secondary markets are places where, after debt and equity securities are originally sold, they are traded in the secondary markets

There are 3 basic forms of business organisation. Each has its own advantages and disadvantages:

Main areas	Strengths	Weaknesses
1 **Sole proprietorship**	• Low organisational cost • Income taxed once as personal income • Independence • Secrecy • Ease of dissolution	• Unlimited liability • Limited funding • Proprietor must be all • Difficult to develop staff career opportunities • Lack of continuity on death of proprietor
2 **Partnership**	• Improved funding sources • Increased managerial talent • Income split by partnership contract, taxed as personal income	• Unlimited liability to all partners • Partnership dissolved upon death of partner • Difficult to liquidate or transfer ownership
3 **Corporation**	• Owners' liability limited • Large capitalisation possible; greater funding • Ownership readily transferable • Indefinite life • Professional management	• Higher tax rates • Expensive organisation • Greater government regulation • Lacks secrecy when publicly traded • Agency problem

There are allegedly many financial objectives that company managers should be achieving. But there is only one goal that these managers should be pursuing:

- General goals can include
  - Survival
  - Avoidance of financial distress and bankruptcy
  - Beating the competitors
  - Maximisation of sales and market shares
  - Minimisation of costs
  - Maximisation of profits

- But from a shareholder's (owner's) viewpoint, the goal of the financial manager should be acting in their best interests by making decisions that increases the value of the share

- In other words, corporations should only have one goal: *To maximise the value of each share*

- But *value* maximisation is **not** the same as *profit* maximisation. Why?

Hiring managers to run companies is effectively separating ownership from management. There are both pros and cons associated with this separation

Aspects	Descriptions
Advantages	• Makes a large business manageable and less costly to run • Changes ownership without interfering with the day-to-day business • Possibility of hiring professional managers

Disadvantages	• Principal-agent problems
	  • Shareholders want the value of their firm increased but managers may have other objectives
	  • Agency costs

Topic 2: Introduction to Corporate Finance

Introduction to Time Value of Money

Time value of money is one of the most fundamental ideas of finance, one which is firmly grounded in the concept of compound interest

Types	Description	Example
1 **Simple interest**	• Interest is **not** paid on previous interest	

Year	2007	2008	2009
Principle	£100	£100	£100
Interest @ 10%	£10	£10	£10

Types	Description	Example
2 **Compound interest**	• Interest is paid on previous interest	

Year	2007	2008	2009
Principle	£100	£110	£121
Interest @ 10%	£10	£11	£12.1

- For the purpose of this course, we are **only** concerned with compound interest

Using compound interest, we can calculate an investment over several periods of time

Example
- If you deposit £100 into a saving account that gives 10% interest and keep it there for 2 years, you will get £121

Calculation

$$£100 \times (1+0.10)^2 = £121$$

Since £100 in 2 years will become £121, we can say that the **future value** of £100 in 2 years is £121

If we turn this into a generic formula …

$$FV = C \times (1+r)^t$$

where C is cash flow, r is interest rate and t is time

From this example, it is possible to see the relationship between present and future values

Premise
- If £121 is the future value of £100, then…

… we can say that the ***present value*** of £121 in two years is £100

- Following this logic, we can say that £121 in two years time is worth as much as £100 today

From this relationship between present and future values, we can reach a very important concept of finance – time value of money

Hence, we can say that ***a pound today is worth more than a pound tomorrow***

You can think about this statement this way:

A pound today is worth more than a pound tomorrow because you can invest the pound today and start earning interest immediately

- This is the 1st principle of corporate finance
- Money has different value over time – hence the expression *Time Value of Money*
- Indeed, the further a £ is into the future, the less it is worth

The formula for calculating future value is shown earlier. To calculate present value, we simply have to re-arrange the same formula

- Taking the formula for calculating future value (FV) earlier,

$$FV = C \times (1 + r)^t$$

- it is possible to re-arrange it to calculate the present value (PV), that is, today's value of a cash flow or a series of cash flows in the future

$$PV = \frac{C}{(1 + r)^t}$$

$\frac{1}{(1 + r)^t}$ is called the **discount factor**

Using the earlier example…

$$\frac{£121}{(1+0.10)^2} = £100$$

Exercises

Questions	Description
1 Future value	• You deposit €10,000 today in an account that pays 6% interest (therefore, you get a rate of return of 6%). How much would you have in 5 years?
2 Present value	• You are thinking about recommending your client to invest in a piece of land that costs £85,000. You are certain that next year the land will be worth £91,000, representing a sure gain of £6,000. Given the discount rate is 10%, should your client undertake this investment?
3 Present value	• Suppose you have just celebrated your 19th birthday. A rich aunt has set up a trust fund for you that will pay £150,000 the day you turn 30. If the discount rate is 9%, how much is the fund worth today?

So, we can calculate the PV of a future cash flow by discounting the latter. But what is *r* exactly? *r* is tricky because it carries different names to represent different concepts

$$\frac{1}{(1+r)}$$

Names & concepts	Description
1 **Discount rate**	• The rate used calculating the *present value* of future cash flows • In other words, the rate for discounting future cash flows
2 **Hurdle rate**	• Minimum acceptable rate of return on a project (associated with IRR)
3 **(Opportunity) cost of capital**	• The return that you can earn by investing elsewhere

- The reasons for the different names will be gradually revealed in this course

Previously, we examined the concepts of future and present value as well as their relationship

Concepts	Direction	Formula
1 **Future value**	• When you are trying to figure out the value of £1 at a future date • Present ⇨ Future	$FV = C \times (1+r)^t$
2 **Present value**	• When you are trying to figure out today's value of £1 in the future • Present ⇦ Future	$PV = \frac{C}{(1+r)^t}$

Hence:

- *A £ today is worth more than a £ tomorrow*
- *2 amounts are not directly comparable if they are not available in the same time period*
- *Conversely, comparison between the 2 amounts can only be made in the same time period*

Topic 3: Net Present Value and Cost of Capital

The Concept of Risk

Example

Aspects	Description
Problem	• *Suppose your equipment supplier suggests to you a new machine that will produce £500,000 worth of products next year. The machine costs £450,000. Is it a good purchase if the discount rate is 5%?*
Solution	$PV = \frac{£500,000}{(1+0.05)}$ $= £476,190$ • Since £476,190 is greater than the cost of the machine of £450,000, it is a good purchase

When making investment decisions, in addition to timing and size of the cash flow, we need to consider the risk involved in the investment

Premise
- All investment projects carry some degree of risk…

…it is therefore necessary to take risk into consideration when making an investment decision

- Logic dictates that the more risky a project is, the greater the return you would expect/want to get from it

Risk is reflected and taken into consideration in the calculation of PV

Therefore, you would **use a higher discount rate to adjust for the higher risk undertaken** and decide whether the project is worth undertaking

Example
- *Suppose in the previous example you believe there is some risk involved in the project and that you believe that it is as risky as another investment that requires a 11% return. So:*

$$PV = \frac{£500{,}000}{(1+0.11)}$$
$$= £450{,}450$$

- Since £450,450 is greater than the cost of the machine of £450,000, it is a good purchase
- *But what happens if the project is as risky as a project that requires a 14% return?*

Risk is reflected and taken into consideration in the calculation of PV (cont'd)

Premise

- Note that the PV of the project with higher risk (reflected by r=11% and 14%) is *smaller* than the PV of the project with lower risk shown earlier (r=5%)

- Why? It is because ***a safe pound is worth more than a risky pound***
- This is the 2nd principle of corporate finance
- Therefore you will find that the PV of more risky projects will always be smaller than the PV of those projects that are less risky

Topic 3: Net Present Value and Cost of Capital

NPV and Cashflows

While we can calculate the PV for a cash flow in one period, we can calculate the PV for a stream of cash flows in multiple periods

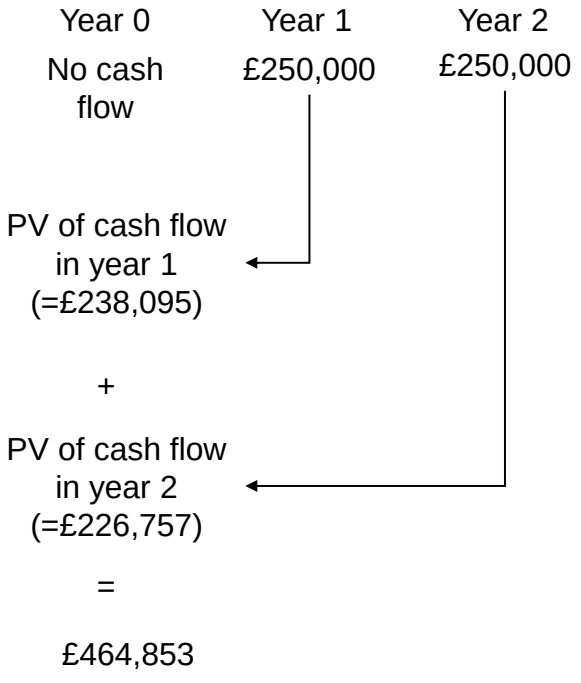
Aspects	Description
Problem	• *Now suppose your equipment supplier proposes to you a new machine that will produce £250,000 worth of products next year and another £250,000 in the year that follows. The machine costs £450,000. Is it a good purchase if the discount rate is 5%?*
Solution	$PV = \frac{£250,000}{(1+0.05)} + \frac{£250,000}{(1+0.05)^2}$ $= £464,853$

• Since £464,853 is greater than the cost of the machine of £450,000, it is a good purchase

Why is this answer smaller than the one in the earlier slide with the same discount rate?

One of the best ways to understand the calculation of the PV of multiple cash flows is to translate it into a diagram

• It is possible to break down the previous example like this…



• Formally, the formula is written as:

$$PV = \frac{C_1}{(1+r)} + \frac{C_2}{(1+r)^2}$$

This calculation method for reaching the PV of a series of cash flow is called discounted cash flow (DCF)

- Extending the same formula and logic, if there are *t* cash flows, then…

Formula

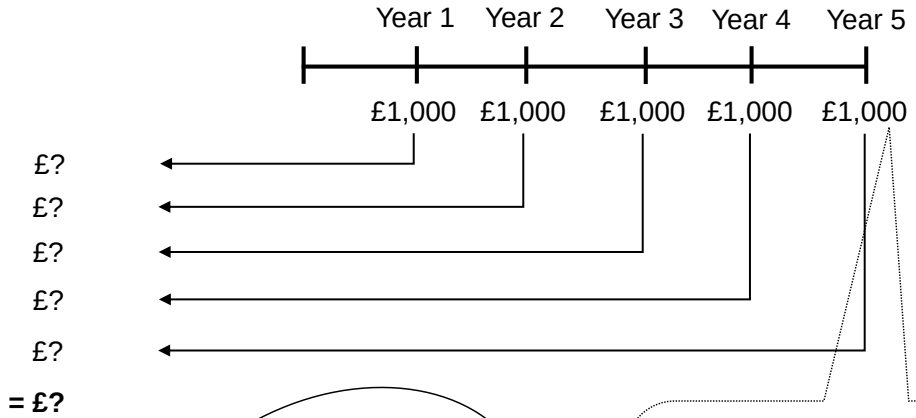
$$PV = \frac{C_1}{(1+r)} + \frac{C_2}{(1+r)^2} + \cdots + \frac{C_t}{(1+r)^t}$$

- In other words, discounted cash flow is merely addition of all the future cash flows that take into account time value of money

$$\sum_{t=1} \frac{C_t}{(1+r)^t}$$

This calculation method for reaching the PV of a series of cash flows is called discounted cash flow (DCF) (cont'd)

- What is the PV of this cash flow stream if the cost of capital is 6%?



If you are unfamiliar with calculating DCF, it is a good idea to use this as a visual aid

While the cash flows are all the same here, they can of course be different from each other

Example 1

Aspect	Description
Problem	• *Frankie Boyd wants to sell his old car. His friend, Jim Bow, has agreed to buy it for £4,000. However, he can only pay for it 2 years from now. At the same time, a car dealer is offering £3,500 for the car. If the interest rate is 8%, which offer represents a better deal for him?*
Solution	• Given that the 2 amounts (£4,000 and £3,500) occur in 2 different time periods, they cannot be compared directly. Hence, we will calculate the PV of Jim's offer: $$PV = \frac{£4,000}{(1+8\%)^2} = £3,429$$ • By bringing both offers to today's value, they can be put side-by-side for comparison. Since, the car dealer's offer represents a higher amount/value, it is a better deal than what Jim offers

Example 2

Aspects	Description
Problem	• *Ricky Mann, another friend of Frankie, proposes to pay £2,000 in year 2 and £2,300 in year 4 for the old car. Should Frankie accept Ricky's or Jim's offer if the discount rate is 8%?*
Solution	• There are 2 ways to answer this question 1 Discount all the cash flows to the present $$PV = \frac{£2,000}{(1+8\%)^2} + \frac{£2,300}{(1+8\%)^4} = £3,405$$ • This amount is smaller than £3,429. Therefore, Jim's offer is better 2 Alternatively, discount the year 4 cash flow to year 2 $$PV = \frac{£2,300}{(1+8\%)^2} = £1,971$$ • Adding the £2,000 due in year 2 to this amount, the total is £3,971. This is smaller than the £4,000 offered by Jim. Therefore, Jim's offer is better (which is the same conclusion from method 1).

Example 3

Aspects	Description
Problem	• *Zara "Lipstick" Palin is also interested in buying the car from Frankie. She wants to pay £2,500 twice, once in year 2 and once in year 4. As tough as a pit bull, she asks Frankie to pay £500 to replace the brakes in year 3. What is the value of this offer if the discount rate is 8%?*
Solution	• The PV can be calculated this way: $$PV = \frac{£2,500}{(1+8\%)^2} + -\frac{£500}{(1+8\%)^3} + \frac{£2,500}{(1+8\%)^4} = £3,584$$

While the DCF method discussed so far allows you to make investment decisions, it does not tell you the value of the return that you make

Aspects	Description
Problem 1	• *Following up the machine purchase example: Now suppose your equipment supplier proposes to you a new machine that will produce £250,000 worth of products next year and another £250,000 in the year that follows. The machine still costs £450,000. Is it a good purchase if the discount rate is 5%?* • Since £464,853 is greater than £450,000, it is a good purchase
Problem 2	• *But do you pocket the £464,853?*
Solution	• The answer is no. This is because the cost of the machine is £450,000 • This means that you only make £14,853 (£464,853 - £450,000) • This £14,853 is the value that you can create by undertaking this investment

The amount that you can actually pocket is called the *Net Present Value* (NPV)

Aspects	Description
Definition	• NPV is the project's net contribution to wealth • NPV is the measure of how much value is created or added by undertaking the investment • NPV is one of the most popular methods to make investment decisions (i.e. whether to go ahead with a project)
Calculation	• NPV is equal to present value of cash flows **minus** the initial cost of investment (also called the cash outlay) [See next slide for the mathematical representation]
Decision criterion	• If the PV of cash flows is greater than the initial cost of investment, then one should go ahead with the project

Hence,

- *If NPV > 0, then a project is worth undertaking and should be accepted*
- *If the NPV < 0, then a project is not worth undertaking and should be rejected*

Mathematically, NPV can be depicted in the following way:

$$\sum_{t=1} \frac{C_t}{(1+r)^t} - Initial\ cash\ outlay$$

PV of all cash flows, as shown above

Depicted as C_0

- *Usually, the formula is written this way…*

$$NPV = -C_0 + \sum_{t=1} \frac{C_t}{(1+r)^t}$$

This is ***negative*** because it is usually a ***cost***

Exercise

Problems	Description
Problem 1	• *What is the net present value of the following cash flow stream if the discount rate is 6% and the cash outlay is €5,400?*
Problem 2	• *Would you rather receive €100 in year 1 and €1,500 in the following year or just €1,600 in year 2 if the interest rate is 5%?*

Year	Cash flow
1	€ 2,000
2	€ 4,000
3	€ 6,000

Topic 3: Net Present Value and Cost of Capital

Cashflows and Arbitrage

Before moving onto the different mechanisms in calculating PV, it is necessary to look at how cash flows are determined…

Aspects	Description
Valuing costs and benefits	• Need to quantify the costs and benefits from a variety of management disciplines, such as marketing, economics, organisational behaviour, strategy and operations • It is important to use **market prices** and not perceived value as the basis of calculating costs and benefits
Arbitrage	• The practice of buying and selling equivalent goods in different markets to take advantage of a price difference is known as arbitrage • Arbitrage opportunity exists when it is possible to make a profit without taking any risk or making any investment • Arbitrage should not exist in a normal, competitive market because the price difference will disappear quickly once it is spotted
Law of one price	• The logical extension to arbitrage is that if the prices in 2 markets differ, investors will profit immediately, buying in the market where it is cheap and selling in the market where it is expensive • The law of one price dictates that if equivalent investment opportunities trade simultaneously in different competitive markets, then they must trade of the same price in both markets • Hence, it is possible to use any competitive price without checking the price in all possible markets

Before moving onto the different mechanisms in calculating PV, it is necessary to look at how cash flows are determined … (cont'd)

Aspects	Description
Valuing a security	• An investment opportunity that trades in the financial market is known as a financial security or simply security • In a normal market, Price (security) = PV (all cash flows paid by the security)
The NPV of trading security	• Since there should be no arbitrage opportunity existing in a normal market, trading securities should neither create nor destroy value • Value on a security is created by real investment projects in which firms engage • This leads to the so-called separation principle, which says that it is possible to evaluate the NPV of an investment decision separately from the decision the firm makes, regarding how to finance the investment or any other security transactions the firm is considering
Valuing a portfolio	• Since the price for a security should be the same in all possible markets in which it exists, the combined price of 2 securities must be the same as the prices of the 2 securities added together. Ergo: • Price (A + B) = Price (A) + Price (B)

…and how risk is assessed

Aspects	Description
Risky vs. risk-free cash flows	• Individuals who take a higher risk must be compensated • Hence, risk premium must be paid • The risk that an individual is willing to take depends on his/her risk appetite • Risk is relative to the overall market – the risk of a security must be evaluated in relation to the fluctuations of other investments in the economy • A security's risk premium will be higher the more its returns tend to vary with the overall economy and the market index. The opposite is also true • Therefore, to calculate PV of cash flows, it is necessary to use a discount rate that includes both risk-free rate and the risk premium for the investment • $r_{investment} = r_{risk\text{-}free}$ + risk premium for the investment • Risk-free rate is the interest rate at which money can be borrowed or lent without risk over a period • When there are transaction costs, the prices of equivalent securities can deviate from each other but not by more than the transaction costs of the arbitrage

Topic 3: Net Present Value and Cost of Capital

Perpetuities and Annuities

A perpetuity refers to a constant stream of payments without end

Aspects	Description and example
Perpetuity	• A perpetuity is a level stream of cash flow which continues forever (e.g. £1,000 a year forever) • Formula for calculating the PV of a perpetuity is: $$PV\ of\ a\ perpertuity = \frac{C_1}{r}$$
Question	• *You want to create a scholarship that pays £2,000 a year. How much do you have to donate if the interest rate is 10%?*

A growing perpetuity, on the other hand, is a payment stream without end and is expected to rise at the same rate indefinitely

Aspects	Description and example
Growing Perpetuity	• A growing perpetuity is a stream of cash flows that grow at a rate forever • Formula for calculating the PV of a growing perpetuity is: $$PV\ of\ a\ growing\ perpertuity = \frac{C_1}{r-g}$$
Question	• *How much do you have to donate to create the above scholarship if the annual inflation rate is 3% with £2,000 paying out starting in year 1?*

It is important to note that the numerator in this and the previous equation is the cash flow in period 1 (C_1) and **not** *at date 0 (C_0)*

An annuity is a level stream of regular payments that lasts for a fixed number of periods

Aspects	Description and example
Annuity	• An annuity is a stream of constant or level cash flows that occurs at the end of each period for a fixed number of periods (e.g. the £1,000 a year for 5 years) • Formula for calculating the PV of an annuity is: $$PV\ of\ an\ annuity = C \times \left[\frac{1}{r} - \frac{1}{r(1+r)^t}\right]$$
Questions	• *A) An asset that promised to pay £500 at the end of each of the next 3 years and you want to earn 10% a year on your investment. What is the present value of this asset?* • *B) What is the present value of this asset if it is 30 years instead of 3 years?*

A growing annuity is a stream of growing cash flows that occur at regular intervals and eventually come to an end

Aspects	Description and example
Growing Annuity	• A growing annuity is a stream of cash flows that occurs at the end of each period. It grows at a constant rate for a fixed number of periods • The formula for calculating the PV of a growing annuity is: $$PV\ of\ growing\ annuity = C \times \frac{1}{r-g}\left[1 - \left(\frac{1+g}{1+r}\right)^t\right]$$
Questions	• *You have been offered a job at £80,000 a year. You anticipate your salary increasing by 9% a year until your retirement in 40 years. Given the interest rate of 20%, what is the PV of your lifetime salary?*

Exercise

Problem	Description
Problem 1	• *Frankie wants to use the money from selling the old car towards buying a new one in 5 years. How much money would he have if he accepts the offer from Ricky (i.e. £2,000 in year 2 and £2,300 in year 4)? The discount rate is 8%.*
Problem 2	• *But Frankie has no confidence in Ricky. Ricky is often over-optimistic with his finance and will always pay a year later. What would be the PV of his offer now?*
Problem 3	• *You are considering a plan that would allow you to draw $8,000 every year until the day you turn 60. What is the value of this plan today if you have just turned 30 and the interest rate is 10%?*
Problem 4	• *I. M. Smart has been working on an advanced technology in laser eye surgery. His technology will be available in the near term. He anticipates his first annual cash flow from the technology to be C$200,000, received next year. Subsequent annual cash flows will grow at 5% forever. What is the PV of the technology if the discount rate is 10%?*

Exercise (cont'd)

Question	Description

Question 5a	• *Frankie has decided that he has to buy a BMW 330i (a red 2 door with 6-speed gear box and leather seats, of course). The dealer offers him a 4-year leasing contract with the following conditions:*
	  • *Down payment: £1,748*
	  • *A security deposit that will be returned at the end of the contract: £300*
	  • *4 annual payments: £3,020*
	  • *Buy back: £16,454 (this is the price that you pay in year 4 to pay off the car. If Frankie does not pay this, he will have to hand the car back to the dealer)*
	If the interest rate is 10%, what is the price of the car?

Question 5b	• *A second dealer has a special offer for the same car with the specifications for £22,000. This special offer is only available for immediate purchase. Is this a better deal for Frankie?*

Topic 4: Equity Share

Book, Liquidation and Market Values

Shares (also known as stocks) refer to the partial ownership of a company. There are at least 3 ways to put a value on a share

Types	Description

1 **Book values**	• Net worth of the firm according to the balance sheet
	• Book values record all the money that a company has raised from its shareholders plus all the earnings that have been ploughed back on their behalf
	• Book value is not equal to share price
	  ◦ e.g. Vodafone
	  - Book value as of fiscal year ending 30th March, 2008 = £28.2
	  - Share price = £26.98
	  - The price/book ratio is 0.98x
	  - Hence, investors in the stock market do *not* just buy and sell shares at book value
	• This is so because book value does not capture the true value of a business

Shares (also known as stocks) refer to the partial ownership of a company. There are at least 3 ways to put a value on a share (cont'd)

Types	Description
2 Liquidation values	• The amount of cash per share a company could raise if it sold off all its assets in second hand markets and paid off all its debts • It does not equal to share price because a successful company ought to be worth more than liquidation value. Hence, it does not capture the value of a successful going concern

Shares (also known as stocks) refer to the partial ownership of a company. There are at least 3 ways to put a value on a share (cont'd)

Types	Description

3 Market values	• Market value is the amount that investors are willing to pay for the shares of the firm
	• This depends on the earning power of *today's* assets and the expected profitability of *future* investments
	• Therefore, market value is not the same as book or liquidation value as it, unlike book value and liquidation value, treats the firm as a going-concern – and hence the share price
	• The value of a going-concern comes from:
	  • Extra earning power from using the assets both tangible and intangible
	  • Intangible assets such as R&D (e.g. Amgen's price to book ratio is 3.62x is partly attributable to this)
	  • Value of future investments (betting that the company's know-how and brand name will allow it to expand)

Topic 4: Equity Share

Important Concepts and Ratios Related to Share Valuation

There are several concepts and ratios related to share valuation

Concepts and ratios	Description	Formula
Types of shares	• Growth shares – investors expect to benefit from capital gains; interested in future growth of earnings • Income shares – investors seek cash dividends	
Book equity per share (*BVPS*)	• A measure that represents a per share assessment of the (theoretical) minimum value of a company's equity	$\frac{\text{Value of common equity on balance sheet}}{\text{Average shares outstanding}}$
Earnings per share (*EPS*)	• The portion of a company's profit allocated to each outstanding common share • It serves as an indicator of a company's profitability	$\frac{\text{Net income} - \text{Dividends to preferred shares}}{\text{Average shares outstanding}}$
Return on equity (*ROE*)	• A measure of a corporation's profitability that reveals how much profit a company generates with the money shareholders have invested	$\frac{\text{Net income}}{\text{Shareholders' equity}}$ *or* $\frac{\text{EPS}}{\text{BVPS}}$

There are several concepts and ratios related to share valuation (cont'd)

Concepts and Ratios	Description	Formula
Payout ratio	• Fraction of earnings paid out as dividends • Investors can use the payout ratio to determine what companies are doing with their earnings	$\frac{\text{Dividends}}{\text{EPS}}$
Plowback/ retention ratio (*b*)	• The fraction of earnings retained by the firm for re-investing in the firm • For companies that are experiencing high growth, they can choose to pay less or no dividend and use the profit to re-invest into the business	1 −payout ratio
Price earnings ratio (*PER*)	• A valuation ratio of a company's current share price compared to its per-share earnings	$\frac{\text{Market value per share (i.e. share price)}}{\text{EPS}}$

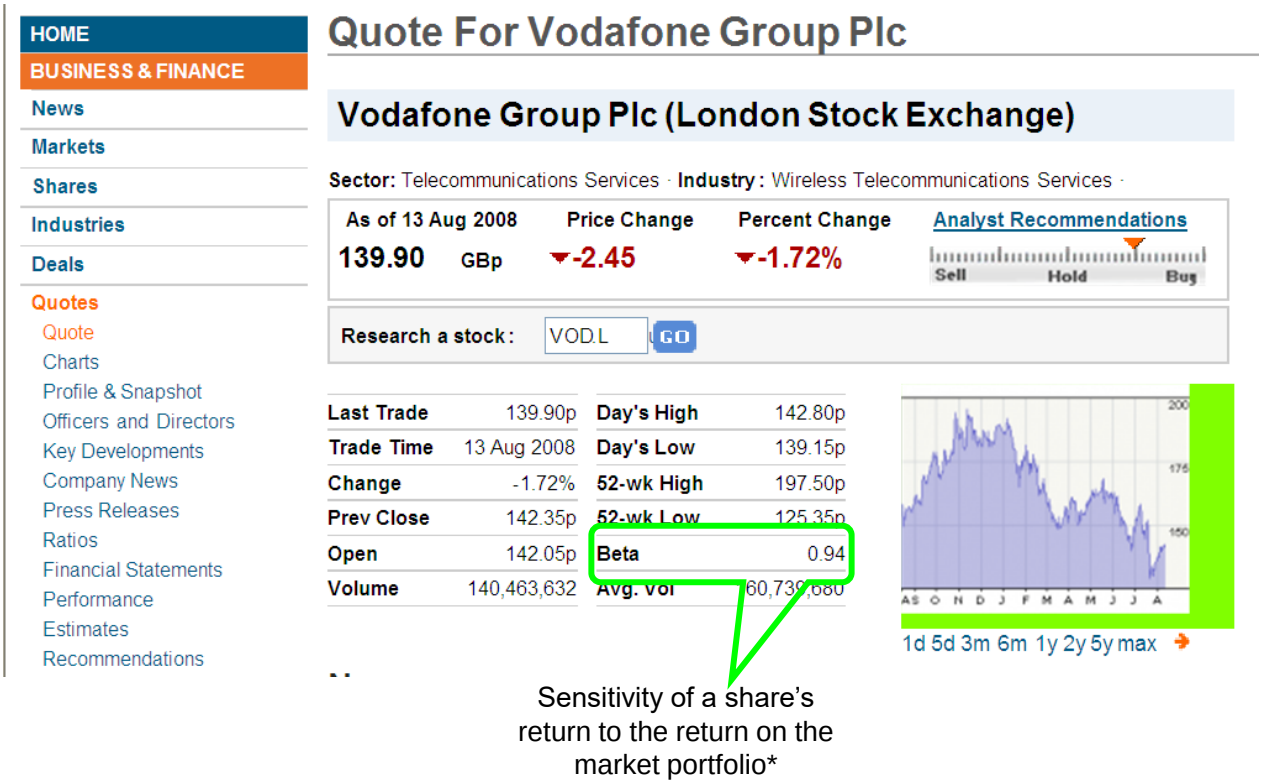
Shares are often quoted with other important information

Name	Price	Chng	52 week High	52 week Low	Yld	P/E	Vol' 000s
Vodafone	142.35	+1.05	197.50	125.35	5.3	11.7	141,592

- **Name**: Name of the company
- **Price**: Vodafone closed this price on 12th August 2008
- **Chng**: Price changed from the trading day before
- **52 week High**: Vodafone has been as high as this in the last rolling 52 weeks
- **52 week Low**: Vodafone has been as low as this in the last rolling 52 weeks
- **Yld**: Given the current price, the dividend yield is %
- **P/E**: Given the current price, the PE ratio is this many times
- **Vol' 000s**: This number of shares trades hands on 12th August 2008

Source: Financial Times, 13th August 2008

Shares are often quoted with other important information (cont'd)



Sensitivity of a share's return to the return on the market portfolio*

Source: Thomson Reuters, 13th August 2008

** Something to be covered in the future advanced finance course*

Topic 4: Equity Share

Valuation of Share

We can use the DCF method to calculate the price of a share, which is the PV of next year's dividend and share price

- The cash payoff to owners of common shares comes in two forms…

Types	Description
Dividends	• 'Discretionary' payments made by the company to its shareholders
Capital gains or losses	• Capital gain is the appreciation of a capital asset over its purchase price • If the price of the asset has declined instead of appreciated, this is called a capital loss

- So, the current share price is a composition of both dividend to be paid next year and the price of the share in the next year
- Mathematically, it can be represented by the following:

$$P_0 = \frac{D_1 + P_1}{(1 + r)}$$

We can use DCF to calculate the price of a share, which is the PV of next year's dividend and share price (cont'd)

Example

- An investor anticipates that the share of Company XYZ to be \$110 (P_1) and the dividend in the next year is \$5 (D_1)
- What is the share worth today if the cost of capital is 15% (r)?

Taking the formula presented above:

$$P_0 = \frac{D_1 + P_1}{(1 + r)}$$

We can calculate P_0

$$P_0 = \frac{\$5 + \$110}{(1 + 15\%)}$$

$$= \frac{\$115}{1.15}$$

$$= \$100$$

- The share price of Company XYZ today is therefore \$100
- What happens then if P_1 is not given? In this case, how can P_1 be calculated?
- The answer is that P_1 or the share price in year 1 must be a composition of both dividend and share price in year 2. This can be represented as follows:

$$P_1 = \frac{D_2 + P_2}{(1 + r)}$$

Next year's share price is then the PV of the expected dividend and the PV of share price of the following year

- Following the previous calculations, the share price today is equal to:

By replacing P_1 with the formula provided above,

$$P_0 = \frac{D_1 + \frac{D_2 + P_2}{(1+r)}}{(1+r)}$$

$$= \frac{D_1}{(1+r)} + \frac{D_2}{(1+r)^2} + \frac{P_2}{(1+r)^2}$$

- Following this logic, it can be seen that the share price in the second year is determined by the expected dividend and capital gain/loss in the third year
- Therefore,

$$P_2 = \frac{D_3 + P_3}{(1+r)}$$

Extending this line of thinking, the share price today is essentially the PV of all future dividends

- We can go on to expand the previous formula and extend it to reach out to infinity

$$P_0$$

$$= \frac{D_1}{(1+r)} + \frac{D_2}{(1+r)^2}$$

$$+ \frac{D_3}{(1+r)^3} + \frac{D_4}{(1+r)^4}$$

$$+ \frac{D_5}{(1+r)^5} + \cdots$$

- In short, this formula can be presented as:

$$\sum_{t=1}^{\infty} \frac{D_t}{(1+r)^t}$$

- This is why this share price valuation model is called the **dividend discount model**

*Why is it **incorrect** to say the value of a share equals to the sum of the discounted stream of earnings per share?*

The dividend discount model comes in different variations, depending on the size of the dividends

Variations	Description and question
1 Zero dividend growth	• Assumes that future dividends will remain constant at the level of the last dividend paid by the company (in other words, all dividends in the future are exactly the same – i.e. it does not grow at all) $$D_1 = D_2 = D_3 = D_4$$ • *How do we compute the current price of a share?*
2 Constant growth	• Assumes that dividends will grow at the constant rate *g* per year beginning from the last dividend paid by the company, i.e. $$D_1 = D_0 \times (1+g)$$ • We can plug this constant growth calculation in the dividend discount model $$P_0 = \frac{D_1}{(1+r)} + \frac{D_1 \times (1+g)}{(1+r)^2} + \frac{D_1 \times (1+g)^2}{(1+r)^3} + \frac{D_1 \times (1+g)^3}{(1+r)^4} + \cdots = \sum_{t=1}^{\infty} \frac{\mathbf{D_1} \times (\mathbf{1}+\mathbf{g})^{t-1}}{(\mathbf{1}+\mathbf{r})^t}$$

The dividend discount model comes in different variations depending on the size of the dividends (cont'd)

Variations	Description
2 Constant growth (cont'd)	• Although there is an infinite number of terms, each term is proportionately smaller than the preceding one; and • because the present value of far-distant dividends will be ever closer to zero, the sum of all of these terms is finite despite the fact that an infinite number of dividends will be paid • The previous formula can be rewritten in short as: $$P_n = \frac{D_{n+1}}{r-g}$$ as long as $r > g$ • This is called the **dividend growth model** or **Gordon-Shapiro model** • It is important to note that this assumption should not be thought of as implying that dividends are expected to growth *exactly* at the rate *g*. Rather, *g* should be thought of as an *average* growth rate of dividends

The dividend discount model comes in different variations depending on the size of the dividends (cont'd)

Variations | **Description**

3 **Non-constant growth**

- Company pays different dividends before settling down with a constant dividend
- To value shares with non-constant growth requires 3 steps:
  - 1) Conducting multiple cash flow analysis for the PV of the dividends from year 1 to year n
  - 2) Calculating the value of all future dividends, i.e. the price of the share in year n-1
  - 3) Discounting 2) to the present and add 1)

$$P_0 = \underbrace{\frac{D_1}{(1+r)} + \frac{D_2}{(1+r)^2} + \frac{D_3}{(1+r)^3} + \cdots \frac{D_n}{(1+r)^n}}_{\text{Step 1}} + \underbrace{\frac{P_n}{(1+r)^n}}_{\text{Step 2}}$$

Step 1: Discount all the dividends from year 1 to year n

Step 2: Discount the share price in year n – note that P_n is the PV of all the dividends paid out from year n+1

Step 3: Discount of the result from step 2 and add to the result from step 1

Example

Problem | **Description**

Problem

- *A chemical product producer expects to pay a dividend of $1.30 at the end of next year, $1.80 at the end of the second year and $2.00 at the end of year 3. After that, the dividend paid out each year is expected to grow at 3% per year forever. If the discount rate is 7%, what is the share price of the company today?*

Solution

- *The question can broken down into 3 parts: (1) 'lining up' the dividends that are growing a non-linear fashion, (2) calculating the share price that captures all the dividends that grow linearly and (3) discount all cash flows*

	Year 1	Year 2 (1)	Year 3	Beyond year 3
Dividends	$ 1.30	$ 1.80	$ 2.00	$ 2.06
Share price			$ 51.50	
Discount factors	1.07	1.14	1.23	(2)
PV (3)	1.21	1.57	43.67	
Total PV	$ 46.46			

Exercise

Problems	Description
Problem 1	• *With the required rate of return to be 10%, what is the value of the share today for a company when you expect the dividends to be as follows:*
Problem 2	• *The gym chain MyClub is expected to pay the dividends in the next 5 years, as stated in the following table. If the discount rate is 5.60%, what is the share price of MyClub today?*

Year	Dividends
1	£ 1.00
2	£ 2.00
3	£ 2.50
Beyond 3	5% growth per year

Year	Dividends
1	£ 1.02
2	£ 1.13
3	£ 1.25
4	£ 1.39
5	£ 1.54
Beyond 5	3.36% growth per year

Topic 4: Equity Share

Determinants of "r" and "g"

So far we have focused on the calculation of share price. But what is *r*?

- How do we determine the rate of return (*r*)?
- If we rearrange the dividend growth model, we can see that there are 2 components

$$P_0 = \frac{D_1}{r - g}$$

$$r - g = \frac{D_1}{P_0}$$

$$r = \frac{D_1}{P_0} + g$$

Dividend yield

Capital gain yield (expected growth rate of dividends)

- The required rate of return is therefore made up of the dividend yield *plus g*
- Dividend yield is the % return the investors expect to earn in dividend, paid by the share
- Therefore, *r* refers to the return an investor gets from the dividends plus the expected growth rate of the dividends

… and *g*?

- To see how *g* is determined, we can start by looking at how earnings grow

- For a firm that does not issue extra shares or bonds, it can only make an investment if it does not pay all its earnings out as dividends
- So, if the firm can retain some earnings and use it to invest, it will be able to increase the earnings of next year. This leads to the following equation:

$$Earnings_{next\ year} = Earnings_{this\ year} + (Investment_{this\ year} \times Return\ on\ investment)$$

- We can divide the two sides with $Earnings_{this\ year}$:

$$\frac{Earnings_{next\ year}}{Earnings_{this\ year}} = \frac{Earnings_{this\ year}}{Earnings_{this\ year}} + \left(\frac{Investment_{this\ year} \times Return\ on\ investment}{Earnings_{this\ year}}\right)$$

- To simplify it:

$$\frac{Earnings_{next\ year}}{Earnings_{this\ year}} = 1 + \left(\frac{Investment_{this\ year} \times Return\ on\ investment}{Earnings_{this\ year}}\right)$$

But what determines the growth of dividends or *g*? (cont'd)

- Let us look deeper into how to calculate:
  1. Investment this year
  2. Return on the investment

1. The investment the firm can make this year depends on the amount of money retained and then invested. Hence:

$$Investment_{this\ year} = Earnings_{this\ year} \times Plowback\ ratio$$

Where plowback ratio (or *b*) is the percentage of the amount kept by the company and not pay out as dividend

2. As for the rate of return that can be made from the investment, it is often difficult to determine. The details on forthcoming projects are not generally public information. Therefore, many analysts rely on historical return on equity (after all, the investment is funded by retained earnings) to forecast the return

$$Return\ on\ investment = Return\ on\ equity\ (also\ called\ ROE)$$

- Substituting investment$_{\text{this year}}$ and return on investment:

$$g = \frac{Earnings_{this\ year} \times b \times ROE}{Earnings_{this\ year}}$$

$$\boldsymbol{g = b \times ROE}$$

- Therefore, g = plowback ratio x return on equity. In short, the growth rate of a firm is the result of how much money is retained and invested and the rate of return that it can get from investing it

Another way to look at growth is through the opportunities presented

- Imagine a company that does not grow at all and pays out all its earnings every year
- This type of company is often called a *cash cow*

- With all earnings paid out as dividends, earnings per share (EPS) will be equal to dividends (e.g. Earnings – dividends = retained earnings and if retained earnings is 0, the dividends must be the same as earnings). Therefore, dividends next year are equal to EPS next year

$$D_1 = EPS_1$$

- As the cash cow produces the same dividends each year forever, the share price of the firm is:

$$Share\ price = \frac{D_1}{r} = \frac{EPS_1}{r}$$

- This type of share is called *income stock* because there is no growth and there is a stable income for the shareholders each year for the foreseeable future.

Another way to look at growth is through the opportunities presented (cont'd)

- Now let us look at another company that has some growth opportunities

- Let us assume that this is a company with a great investment opportunity – an opportunity from which it can make a return and further grow the company
- In this case, any benefits or return from this opportunity must be reflected in the share price
- To do so, we can discount all the future expected earnings resulted from the opportunity and calculate the NPV. Let us call this net present value of growth opportunity or NPVGO
- The new share price must then be:

$$Share\ price = \frac{EPS_1}{r} + NPVGO$$

This is the share price in the absence of growth opportunity – i.e. simply distributing all earnings to shareholders

The additional value if the firm uses its retained earnings to fund the new growth opportunity

- This is often call a *growth stock* because the company can continue to invest in different opportunities and keep on increasing the value and price of its shares

Example

Aspects	Description
Example 1a	• *Suppose a company earns $100,000 per year forever and does not make any investment. There are 10,000 shares. If the firm's discount rate is 10%, what is the price for each share?*
Solution	• Since all earnings are paid out to shareholders, the dividends per share or EPS for each year must be $100,000/10,000 = $10 • With a discount rate of 10%, the share price must be $100

$$\frac{DIV_1}{r} = \frac{EPS_1}{r} = \frac{\$10}{0.1} = \$100$$

Example 1b	• *Now the company has the opportunity next year to spend $100,000 to invest in a project (with no further future investment). This project will increase the earnings in each subsequent period by $21,000, representing a 21% return. What is the share price, taking into account the growth opportunity?*
Solution	• First let us calculate the NPVGO. As the firm expects to make $21,000 each year starting the year after next (year 2), and the firm is only making the investment next year (year 1), the value of all the future expected earnings in year 1 must be:

$$\text{Earnings from the opportunity (in year 1 value)} = -\$100{,}000 + \frac{\$21{,}000}{0.1} = \$110{,}000$$

Year 1

Year 2 and beyond

Example (cont'd)

Aspects	Description
Solution (cont'd)	

- But this \$110,000 represents the value of year 1. To determine its present value, it is necessary to discount back by one period:

$$\text{NPVGO} = \frac{\$110{,}000}{1+10\%} = \$100{,}000$$

- On a per share basis, NPVGO is:

$$\text{NPVGO per share} = \frac{\$100{,}000}{10{,}000 \text{ shares}} = \$10$$

- Adding the NPVGO to the original share price without the growth opportunity, it is possible to conclude that the share price of the company is

$$\begin{aligned}\text{Share price} &= \frac{EPS_1}{r} + \text{NPVGO} \\ &= \$100 + \$10 \\ &= \$110\end{aligned}$$

- So, the value of the share goes up and the company grows as a result of the investment opportunity

This example shows that growth can only be achieved if a project generates a higher return than the cost of capital

- Note that the project adds value to the share because the rate of return is higher than the discount rate.

- **When the return of an investment is higher than the discount rate (e.g. 21% > 10%)**
  - NPVGO = \$10 per share and share price is \$110
  - The project is value-creating
- **When the return of an investment is the same as the discount rate (10% = 10%)**
  - The return on the project will be

$$-\$100{,}000 + \frac{\$100{,}000 \text{ x } 10\%}{0.1} = 0$$

  - NPVGO = \$0 per share and share price stays at \$100
  - The project is neither value-creating nor value-destroying
- **What the return on an investment is lower than the discount rate (8% < 10%)**
  - The return on the project will be

$$-\$100{,}000 + \frac{\$100{,}000 \text{ x } 8\%}{0.1} = \text{-}\$20{,}000$$

  - NPVGO is

$$\frac{\text{-}\$20{,}000}{1.1} = -\$18{,}181 \text{ or } \text{-}\$1.82 \text{ per share}$$

  - The project is clearly value-destructive

- This makes sense because an investment is only worth making if it can generate a return that is higher than the cost of capital

Topic 5: Debt and Bonds

Short- and Long-term Borrowings

There is a great variety of borrowing instruments. These instruments can differ in terms of the length of the borrowing

- Borrowings or debt are stated on the right-hand side of the balance sheet under current liabilities and long-term liabilities
- Different debt instruments differ in terms of their characteristics

Types	Description
Short-term debt	• Short-term debt is due in 1 year or less
Notes	• Issues with maturity of 10 years or less are often called notes
Bonds	• Borrowings with maturity of 10 years or more • However, it is common to use the term bonds to describe debt or borrowings in general

Topic 5: Debt and Bonds

Bond Basics and Valuation

A bond has a number of core features that distinguishes itself from equity shares

- A bond is a certificate showing that a borrower owes a specified amount
- To repay the money, the borrower has agreed to make interest and principal payments on specified dates
- To determine the price of the bond (i.e. how much the lender should pay for this lending opportunity), the lender needs to consider:

Features	Description
Maturity date	• The time at which the bond expires and the issuer returns the amount on the face value to the borrowers • In other words, the final repayment date
Face value or Par value or principle	• The amount the issuer promises to pay the bondholders (investors) on the maturity date
Coupon	• The promised interest payments made between the time the bond is issued and the maturity date of the bonds
Coupon rate	• The interest rate on which the periodic interest payments are based on • Note that this is the *only* role that coupon rate plays
Yield to maturity (YTM)	• It is the discount rate that sets the present value of the promised bond payments equal to the current market price of the bond • The annual return that an investor can expect to make on a bond if the investor holds the bond until maturity • Do not confuse it with *current yield* (which is a bond's annual coupon divided by price)

To find out the fair value of the bond – how much a bond is worth – one has to discount all the cash flows that the debt security generates

Example

- Allianz AG wants to buy some bonds issued by LVMH
- What should Allianz pay if the bonds have the following characteristics?

- Maturity: 3 years
- Face value: €1,000
- Coupon rate: 15%
- Payment: Annual
- Yield to maturity: 6%

- The price of the bond is present value of all the coupons and the face value amount received at maturity

$$P = \frac{C}{(1+YTM)} + \frac{C}{(1+YTM)^2} + \cdots \frac{C+F}{(1+YTM)^n}$$

Where *C* is the coupon, *F* is the face value and *YTM* is the yield to maturity

The cash flow includes discounting all the coupons at face value at the time of maturity

- Taking the above information

$$P = \frac{150}{(1+0.06)} + \frac{150}{(1+0.06)^2} + \frac{150+1{,}000}{(1+0.06)^3}$$
$$= 1{,}240.57$$

- The price of the bond should be €1,240.57
- This is the price that Allianz should be paying for the bond that LVMH is issuing

Exercise

Questions	Description

Problem 1a	• *Compute the current price of a bond with the following features (assuming we are in 2005):*
	  ◦ *Starts on January 2006, with a face value of €100*
	  ◦ *Pays 5.8% in interest (coupon) per year*
	  ◦ *Annual coupon every year for 3 years*
	  ◦ *YTM is 4%*

Problem 1b	• *What happens if the YTM (i.e. required rate of return) is now 2%?*
Problem 1c	• *What happens if the YTM (i.e. required rate of return) is now 10%?*
Problem 1d	• *What is the difference between the price and the face value of this bond if YTM is 5.8%?*

What happens if the coupon is paid semi-annually in the question above?

- Then it is necessary to proportionate the coupon rate
- Given that the coupon payment is made every 6 months, the price of the bond must be calculated this way:

$$P = \frac{\left(\frac{C}{2}\right)}{\left(1+\frac{YTM}{2}\right)} + \frac{\left(\frac{C}{2}\right)}{\left(1+\frac{YTM}{2}\right)^2} + \cdots + \frac{\left(\frac{C}{2}\right)+F}{\left(1+\frac{YTM}{2}\right)^n}$$

What happens if the coupon is paid semi-annually in the question above? (cont'd)

Example

- Taking the bonds issued by LVMH above, what will be the price if coupon is paid semi-annually?
- Assume we are in November right now

- Maturity: 3 years
- Face value: £1,000
- Coupon rate: 15%
- Payment: May and November of each year
- YTM: 6% (annual rate)

- Since the coupon rate is 15% and there are 2 coupon payments every year for 3 years, the coupon rate would be 15% ÷ 2 = 7.5%
- Given that the YTM rate is also the annual return that investors are expecting, the YTM used for the calculation should be 6% ÷ 2 = 3%
- The price of the bond is $1,243.77

Why is price of the bond higher when coupons are paid semi-annually? Hint: why is the bond worth more in this case?

What happens if a bond does not pay any coupons at all?

- Such a bond is called zero-coupon bond because it does not have any coupon

Example

- Consider a zero-coupon with 30 years until maturity and suppose the market interest rate today is 10% per year, the face value of the bond is $1,000
- The price of the bond is

$$P = \frac{\$1,000}{(1.10)^{30}} = \$57.31$$

- Although the bond pays no interest directly, an investor is rewarded for the time value of money by purchasing the bond at a discount to its face value
- Treasure bills and government bonds are very often zero-coupon bonds

Since the face value and the price of the bond can be different, the relationship between the two can be described as premium, discount or at par

Aspects	Description
Premium	• When the bond's price is *higher* than its face value, the bond is said to sell at a premium • An investor's return from the coupons is diminished by receiving a face value less than the price paid for the bond • Thus, a bond trades a premium whenever YTM < coupon rate
Discount	• When the bond's price is *lower* than its face value, the bond is said to sell at a discount • An investor who buys the bond will have a return both from receiving the coupons and from receiving a face value that exceeds the price paid for the bond • As a result, its YTM > coupon rate
At par	• When the bond's price and face value are the same, the bond is said to sell at par • In this case, YTM = coupon rate

In addition to the aforementioned inherent characteristics, bonds distinguish themselves with other features

Features	Description

Security	• The protection afforded to the bond holder:
	  ◦ *Collateral* is a general term that means securities that are pledged as security for payment of debt. Commonly used to refer to any asset pledged on a debt
	  ◦ *Mortgages* are secured by a mortgage on a real property of the borrower. The property involved is usually real estate. A blanket mortgage pledges all the real property owned by the company
	  ◦ *Debentures* are unsecured debt for which no specific pledge of property is made (in the UK, debentures are secured obligation)
	  ◦ *Notes* are unsecured issues with maturity of 10 years or less

Seniority	• Indicates preference in position over other lenders, and debts are sometimes labelled as senior or junior to indicate seniority • Subordinated debt must give preference to other specified creditors

In addition to the aforementioned inherent characteristics, bonds distinguish themselves with other features (cont'd)

Features	Description
Repayment	• Bonds can be repaid at maturity, at which time the bondholder will receive the stated, or face, value of the bond; or they may be repaid in part or in entirely before maturity

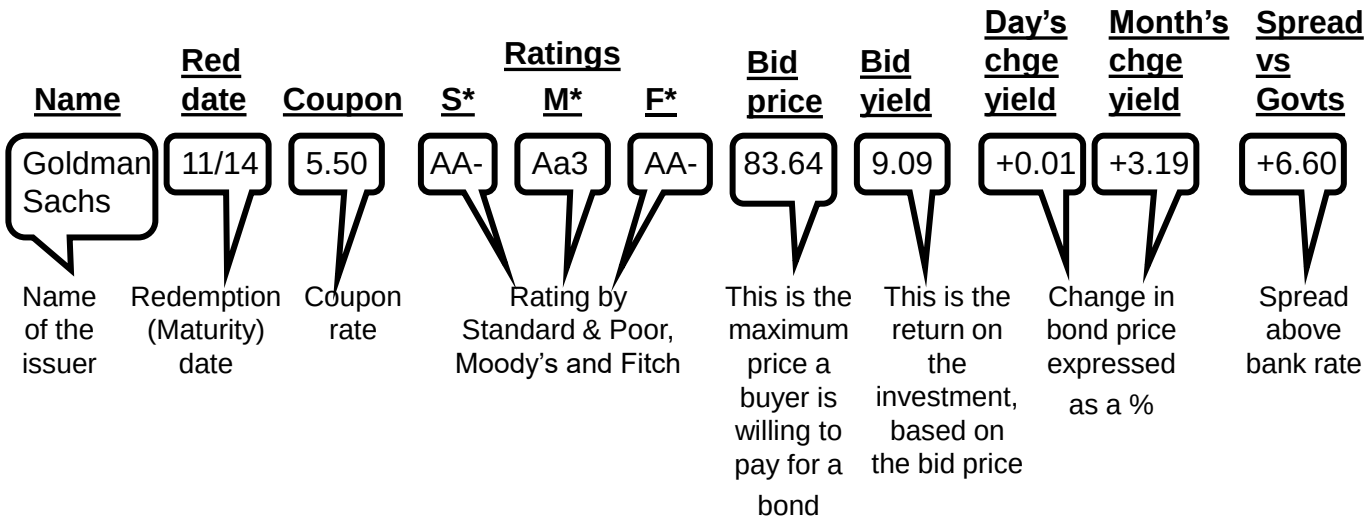
Protective covenants	• A protective covenant is that part of the loan agreement that limits certain actions a company might otherwise wish to take during the term of the loan
	  ◦ Negative covenants: Limits or prohibits actions the company might take
	  ◦ Positive covenants: Specifies an action the company agrees to take or a condition the company must abide by

In addition to the aforementioned inherent characteristics, bonds distinguish themselves with other features (cont'd)

Features	Description

Call provision	• A call provision allows the company to repurchase or "call" part or all of the bond issue at stated prices over a specific period
	• An agreement giving the corporation the option to repurchase a bond at a specified price prior to maturity
	• Corporate bonds are usually callable
	  ◦ *Call premium*: The amount by which the call price exceeds the par value of a bond
	  ◦ *Deferred call provision*: A call provision prohibiting the company from redeeming a bond prior to a certain date
	  ◦ *Call-protected bond*: A bond that, during a certain period, cannot be redeemed by the issuer

Bonds are often quoted with the key information



Source: Financial Times, 11th November 2008

Topic 5: Debt and Bonds

Yield Curve and Yield to Maturity

But how is yield determined?

- As interest rates in the economy fluctuate, the yields that investors seek when investing in bonds will also change

- Central banks can use monetary yield to manage the economy by increasing or decreasing interest rates – the base rate
- They can lower interest rates to stimulate economic activities while raise interest rates to 'cool down' the economy
- To determine what the rate of return debt investors required, we need to understand what their expectations of the future are
- To do so, we can compare different bonds with the same risk characteristics but differ in terms of maturities (also called *term structure of interest rates*)

How is yield determined? (cont'd)

- Consider 4 zero-coupon bonds that are the same in all aspects with the only difference that they have different maturity
- Not surprisingly, the bond with the longer maturity will have to provide a higher return to the investors through prices

Face value SFr. 1,000

Maturity (years)	Current price
1	SFr. 952.38
2	SFr. 890.00
3	SFr. 816.30
4	SFr. 735.03

- To calculate the YTM for the 2-year zero-coupon bond, $(1{,}000/890.00)^{1/2}-1 = 0.06$
- Hence, if we calculate all 4 bonds:

Maturity (years)	YTM
1	5.00%
2	6.00%
3	7.00%
4	8.00%

How is yield determined? (cont'd)

- Suppose we want to know the YTM for a 10% coupon bond with a 3-year maturity and face value of SFr.1,000
- Using the yields calculated from the prices of the zero-coupon bonds above, it can

first calculate the bond prices, which is,

$$\frac{100}{1.05}+\frac{100}{1.06^2}+\frac{(100+1{,}000)}{1.07^3}$$
$$=\text{SFr.}1{,}082.17$$

And then, calculate the YTM, which is,

$$1{,}082.17=\frac{100}{1+\text{YTM}}+\frac{100}{(1+\text{YTM})^2}+\frac{1{,}100}{(1+\text{YTM})^3}$$
$$\text{YTM}=6.88\%$$

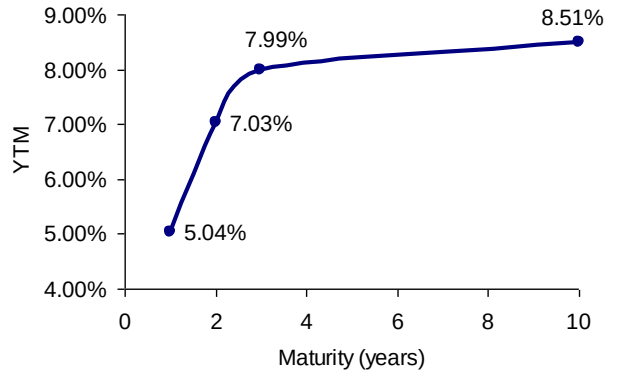
- Hence, it is possible to use the yields of different zero-coupon bonds to derive the YTM of many bonds
- Indeed, it is possible to see that many bonds are simply a combination of different zero-coupon bonds

With the prices and subsequently the YTM of zero-coupon bonds of various maturities, it is possible to plot a yield curve

- Let us say we have 4 zero-coupon bonds with maturity of 1, 2, 3 and 10 years
- Otherwise, they are the same in all aspects and have a face value of €1,000
- With the current prices these bonds are on offer, it is possible to calculate the YTM

Maturity (years)	Current price	YTM
1	€ 952	5.04%
2	€ 873	7.03%
3	€ 794	7.99%
10	€ 442	8.51%

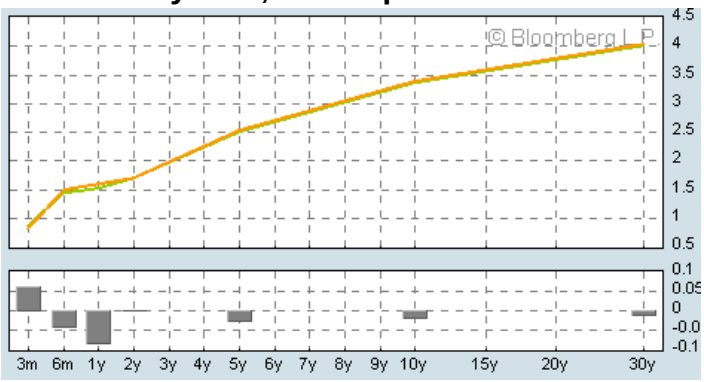
- Using the calculated YTMs, we can create a yield curve



- Yield curve can allow us to gain insights into the market

Yield curves are usually upward sloping…

US Treasury bills, 16th September 2008



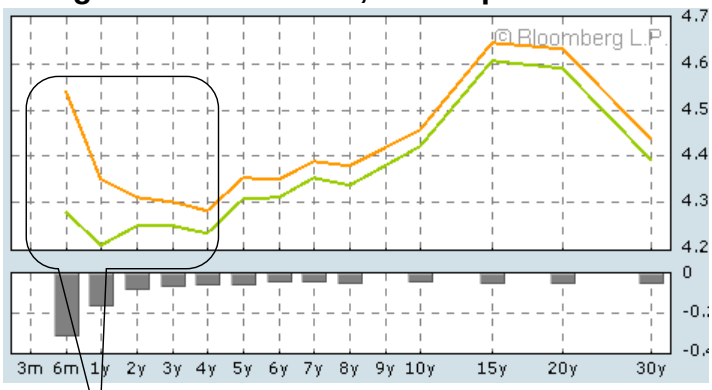
- This is the most common type of yield curve
- It shows that investors anticipate increases in interest rates, suggesting that the market holds a bullish view of the economy

The graph is sourced from Bloomberg.com

… but they can also come in the form of downward sloping

- The UK government bond yield curve looks very different
- It has a *humped* curve that shows that in a short-run, the yield is going to drop and will only start increasing in 4 years time

UK government bonds, 16th September 2008



Inverted curve

- If interest rates are expected to fall in the future, then investors anticipate that the economy will not be doing as well as now
- An inverted yield curve therefore shows a decline in long-term rates, which tends to be the case when the economy slows down

The graph is sourced from Bloomberg.com

The price of the bond is subject to changes in YTM

- In problems 1b and 1c above, it can be noted that there is an inverse relationship between interest rates and bonds

Aspects	Description
When interest rate rises (⇧)	• The present value of the payments to be received by the bondholder falls (⇩) and bond prices fall (⇩)
When interest rate falls (⇩)	• The present value of the payments to be received by the bondholder increases (⇧) and bond prices increase (⇧)

- Hence, there is a risk that the value of the bond would go up or down as a result of interest rate change
- Mathematically, this can be easily demonstrated: as the 'discount rate' gets smaller, the output gets bigger, and vice versa
- But, conceptually, why is this the case?

Topic 5: Debt and Bonds

Risks Related to Bonds

The yield, and in turn the price of the bond, depends on the different types of risk that a bond is exposed to

- The value of the bond is heavily affected by the YTM
- Hence, if the investors demand higher return to compensate for the risk of holding a bond, YTM would have to increase
- There are at least 4 types of risk that investors can be exposing themselves to:

Types	Descriptions
1 Default risk	• This is the risk that a bond issuer will default on making its promised interest and principal payments to the buyer of the bond
2 Liquidity risk	• The risk that a bond can be sold at a predictable price with low transaction costs on short notice
3 Regulatory risk	• The risk that regulators will change the rules so as to adversely impact the earnings of the institution
4 Interest rate risk	• Since bond holders receive a fixed coupon (hence the term 'fixed income' to describe this type of instrument) and will only realise all the returns when the bond expires, volatility in the interest rate can change the value of the bond

1 The higher the default risk, the higher the required rate of return demanded by investors

- Bond-rating firms such as Moody's and S&P assess the creditworthiness of bond issuers to protect lenders in the event of a default

	Investment-Quality Bond Ratings				Low-Quality Speculative Bond Ratings					
	High grade		Medium grade		Low grade		Very low grade			
S&P	AAA	AA	A	BBB	BB	B	CCC	CC	C	D
Moody's	Aaa	Aa	A	Baa	Ba	B	Caa	Ca	C	D

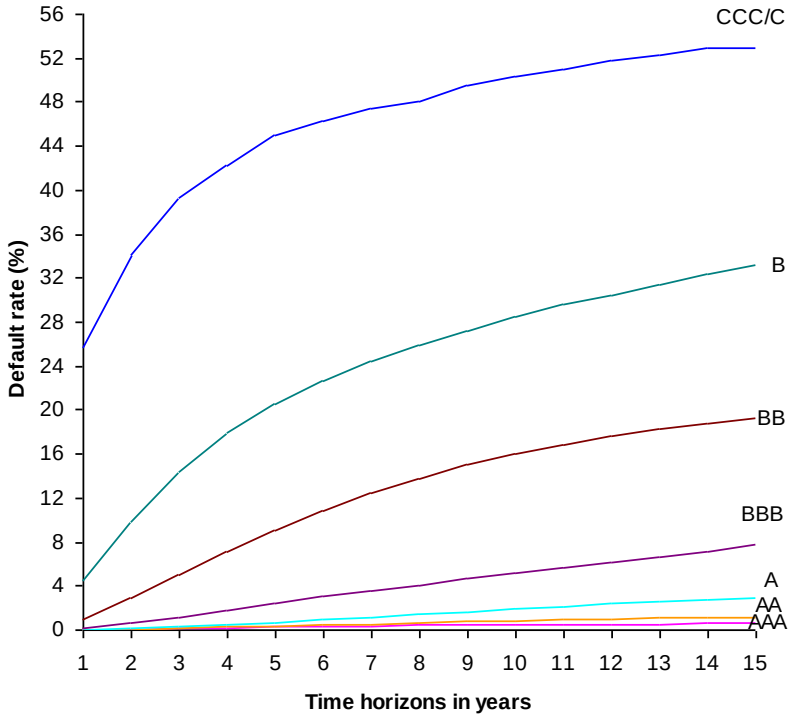
- The lower the rating, the higher the cost of debt will be to the issuers

Also called 'Junk' or high-yield bonds

The firm is in default

1 The higher the default risk, the higher the required rate of return demanded by investors (cont'd)

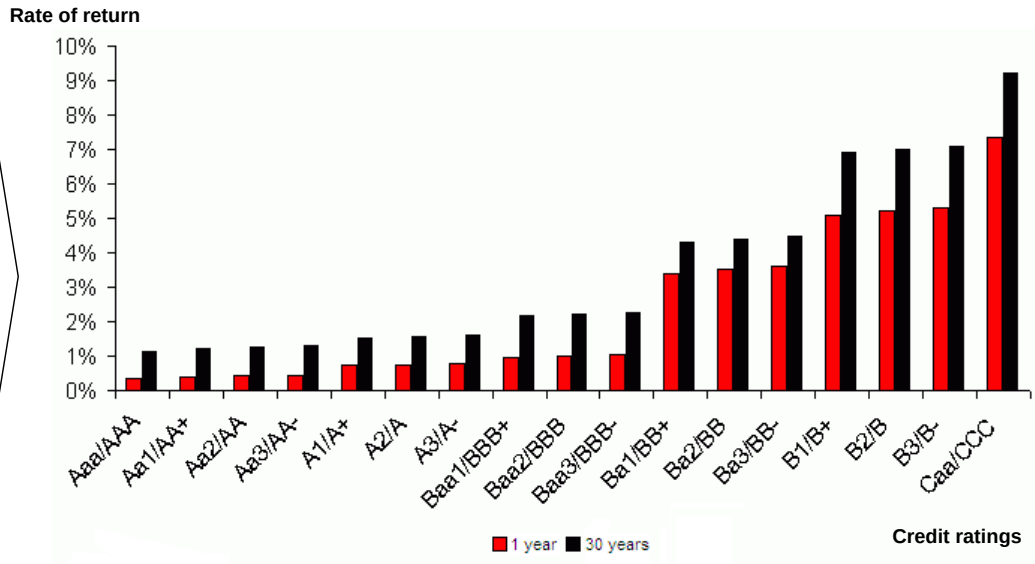
- The lower the rating, the higher the probability that a company will default



Source: Standard and Poor's (2009) ***Default, Transition, and Recovery: 2008 Annual Global Corporate Default Study And Rating Transitions***

1 The higher the default risk, the higher the required rate of return demanded by investors (cont'd)

- Investors also demand a higher spread if a bond has a longer time before it matures



Source: Standard and Poor's 2002

2 Bond holders are exposed to liquidity risk if they cannot sell the bonds easily

- Liquidity refers to the ease with which a transaction or a trade can be executed at a reasonable price

- In an illiquid market, an investor may have difficulty selling an asset at a reasonable price, if at all
- Liquidity risk also applies if an investor can only sell part of the asset held
- Larger markets generally have greater liquidity than smaller markets

- Investors will have to be compensated if the liquidity of the bond is limited or inadequate

3 Bond holders are exposed to regulatory risk if the value of the bonds they hold are subject to uncertainties

- Investors bear the risk of not being able to obtain the full benefits from holding a bond as a result of regulatory change

Example

- Utility companies face a significant amount of regulation in the way they operate, including the quality of infrastructure and the amount that can be charged to customers
- Therefore, the regulatory risk that investors in these companies are exposed to can be a change in the fees utilities and may make operating the business more difficult

- Investors will demand a higher rate of return to compensate for the regulatory risk undertaken

4 There are 2 ways the interest rate can impact upon bond pricing. The first one is maturity

i

- The longer it is to maturity, the more time that change in interest rate can affect the bond price
- In other words, the longer it is to maturity, the greater the interest rate risk exposure

Example 1

Coupon rate: All bonds - 10%
YTM: 10%
Interest rate: 10%

Period	Price	Year 1	Year 2	Year 3	Year 4
Bond A	€ 100.00	€ 110			
Bond B	€ 100.00	€ 10	€ 10	€ 110	
Bond C	€ 100.00	€ 10	€ 10	€ 10	€ 110

If the interest rate moves by:

2% ↑

	Price	*Change*
Bond A	€ 98.21	*-1.79%*
Bond B	€ 95.20	*-4.80%*
Bond C	€ 93.93	*-6.07%*

2% ↓

	Price	*Change*
Bond A	€ 101.85	*1.85%*
Bond B	€ 105.15	*5.15%*
Bond C	€ 106.62	*6.62%*

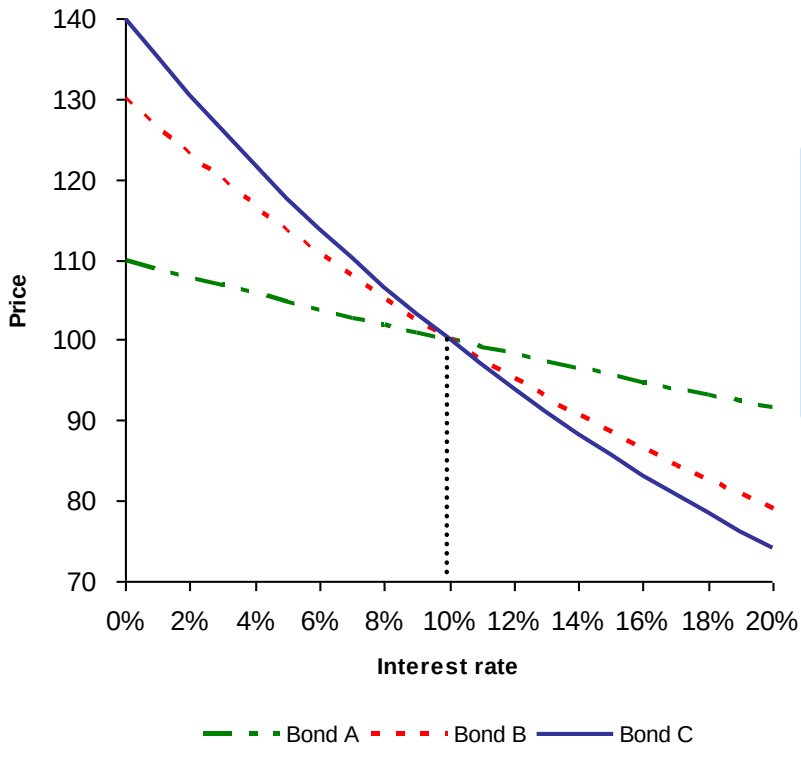
- When interest rate goes up or down, the magnitude of change in the price of the bond with the longer maturity (e.g. Bond C) is greater than that of the one with shorter maturity (e.g. Bond A)

4 There are 2 ways the interest rate can impact upon bond pricing. The first one is maturity (cont'd)

i

- Plotting the 3 bonds, it can be seen that bond prices have different sensitivity to different interest rates

Example 1



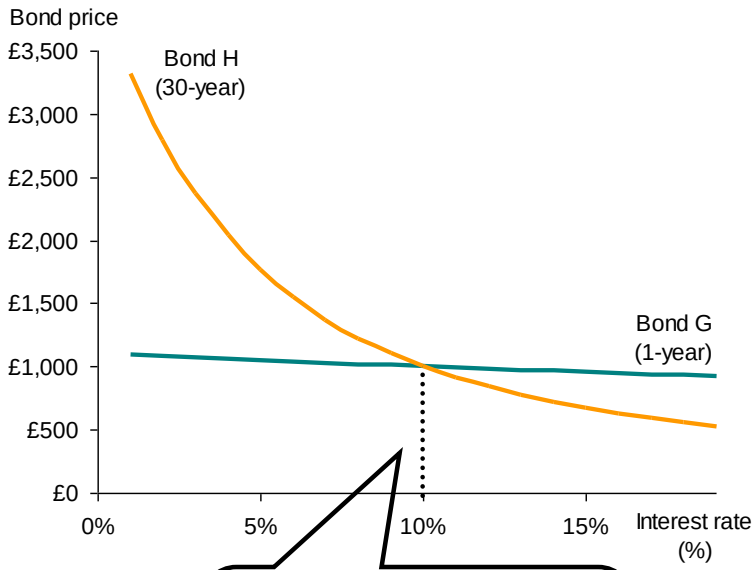
- Bond C, which has the longest maturity, has a higher exposure to interest rate risk than Bond B which is higher than Bond A
- In other words, bonds with longer maturity have a higher sensitivity to interest rate

4 There are 2 ways the interest rate can impact upon bond pricing. The first one is maturity (cont'd)

i

- Let us look at another example with both bonds G and H having a coupon rate of 10% with a face value of £1,000
- The difference lies in the length of time to maturity: Bond H is 30 years while Bond G is 1 year
- If we plot the graph

Example 2



Note that the value of the bond decreases once interest rate is greater *than coupon rate*

- Bond H is exposed to much higher interest rate risk than Bond G, as evident from the slopes of these 2 bonds
- The slope of the 30-year bond (H) is much steeper than that of the 1-year one (G)
- For this longer-life bond, a relatively small change in the interest rate will lead to a more substantial change in the bond value
- In contrast, the 1-year bond is relatively insensitive to interest changes

4 There are 2 ways the interest rate can impact upon bond pricing. The first one is maturity (cont'd)

i

- We can therefore conclude that:

- **Therefore, all things equal, the longer the maturity, the greater the interest rate risk**
- One can also think that because a bond is discounted over a shorter period of time, the PV of a cash flow that will be received in the near future is less dramatically affected by interest rates than a cash flow in the distant future

4 The second one is coupon rate

ii

- If 2 bonds have the same maturity, the one with the lower the coupon rate is exposed to greater interest rate risk

Example

Coupon rate: Bond X - 0% and Bond Y - 10%
YTM: 10%
Interest rate: 10%

Period	Price	Year 1	Year 2	Year 3	Year 4
Bond X	€ 68.30	€ -	€ -	€ -	€ 100
Bond Y	€100.00	€ 10	€ 10	€ 10	€ 110

If the interest rate moves by:

2% ↑

	Price	*Change*
Bond X	€ 63.55	*-6.95%*
Bond Y	€ 93.93	*-6.07%*

2% ↓

	Price	*Change*
Bond X	€ 73.50	*7.62%*
Bond Y	€106.62	*6.62%*

- The change in the price of the bond with the lower coupon (Bond X) is greater than that of the one with a higher coupon rate (Bond Y) when interest rate goes up or down
- One can think of it this way: a lower coupon rate will give a lot more room for the interest rate to drop before interest rate is equal to the coupon rate

4 The second one is coupon rate (cont'd)

ii

- Therefore, we can conclude that

- **Therefore, all things equal, the lower the coupon rate, the greater the interest rate risk**
- One can also think that if two bonds have the same maturity, then the value of the one with the lower coupon is proportionately more dependent on the face amount to be received at maturity
- As a result, its value will fluctuate interest rates change
- In other words, the bond with the higher coupon has a larger cash flow early in its life, so its value is less sensitive to changes in the interest rate

4 The primary tool used for measuring interest rate risk is called duration

- Duration basically measures how quickly one will recover the initial investment in a bond on a time value of money basis
- This is because bonds with coupons paid out before maturity allow the holders to recuperate their investment *sooner* than the stated maturity
- Duration (D) can be calculated using the following formula:

$$D = \sum_t \frac{PV(C_t)}{P} \times t$$

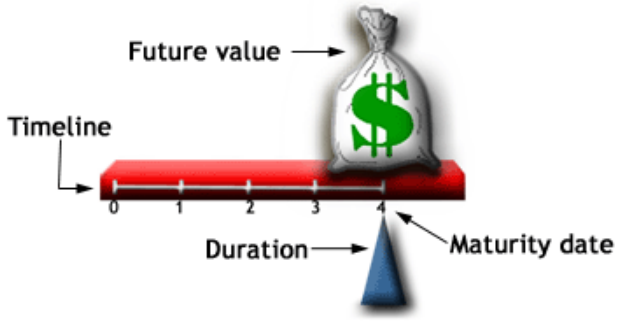
Where $PV(C_t)$ is $CF_t/(1+YTM)$, P is the price of the bond and t is the time

- It looks more daunting than it really is

4 Duration measures the weighted-average time to the maturity of the bond, using present value of its cash flows as weights

- Duration can be illustrated through the following two figures

a A zero-coupon bond with only 1 payment



b A bond with multiple payments

- Notice that the zero-coupon bond has a higher duration than a bond with multiple coupons
- This is because the some of the cash flows can be recovered before maturity
- This effectively means that the maturity of the bond in Figure b) is shorter *in terms of time value of money*
- In other words, the duration of the bond is shorter for the bond with coupon than that without

The graphs are sourced from Investopedia

4 Duration measures the weighted-average time to the maturity of the bond, using present value of its cash flows as weights (cont'd)

Note that in year 1, you capture £38.1 of £981.41 or 3.88% of the cash flow that the bond can generate with the remaining 96.12% in year 2 when the bond matures

Example 1

- Consider a bond with 2 years to maturity, a face value of $1,000, a 4% coupon and YTM of 5%

Calculation of bond price

t (years)	C_t	$PV(C_t)$
1	£ 40	£ 38.10
2	£ 1,040	£ 943.31
Price of the bond		£ 981.41

Calculation of duration

t (years)	$PV(C_t) \times t$
1	38.10
2	1,886.62
Total	1,924.72

- Duration is calculated by dividing the total $PV(C_t) \times t$ by the price of the bond or $\frac{1,924.72}{981.41} = 1.96$
- Although the maturity of this bond is 2 years, its duration or average life in terms of a cash flow sense is only 1.96 years
- On the time value of money basis, the initial investment in the bond is recovered after 1.96 years
- Duration, in other words, describes the effective maturity of a bond
- After that time, the investor earns a profit on the bond

4 Duration measures the weighted-average time to the maturity of the bond, using present value of its cash flows as weights (cont'd)

Example 2

- Consider another bond with 2 years to to maturity, a face value of $1,000, no coupon and YTM of 5%

Calculation of bond price

t (years)	C_t	$PV(C_t)$
1	£ -	£ -
2	£ 1,000	£ 907.03
Price of the bond		£ 907.03

Calculation of duration

t (years)	$PV(C_t) \times t$
1	-
2	1,814.06
Total	1,814.06

- Duration is calculated by dividing the total $PV(C_t) \times t$ by the price of the bond or $\frac{1,814.06}{907.03} = 2.00$
- Since there is no coupon, investors of this bond will have to wait until maturity in order to capture *any* return of the bond

④ By comparing the duration of bonds, it is possible to see that a bond with a higher duration has higher % price changes than a bond with a lower duration when interest rate changes

- Going back to the example used earlier to show interest rate changes

Coupon rate: Bond X - 0% and Bond Y - 10%
YTM: 10%

Period	Year 1	Year 2	Year 3	Year 4	Price
Bond X	€ -	€ -	€ -	€ 100	€ 68.30
Bond Y	€ 10	€ 10	€ 10	€ 110	€ 100.00

Period	Year 1	Year 2	Year 3	Year 4
Bond X	€ -	€ -	€ -	€ 100
PV of payment	-	-	-	68.30
Relative value	-	-	-	1.00
Weight of maturity	-	-	-	4.00
Duration (in years)		**4.00**		

Period	Year 1	Year 2	Year 3	Year 4
Bond Y	€ 10	€ 10	€ 10	€ 110
PV of payment	9.09	8.26	7.51	75.13
Relative value	0.09	0.08	0.08	0.75
Weight of maturity	0.09	0.17	0.23	3.01
Duration (in years)		**3.49**		

- Bond X with no coupon must have a duration of 4.00 years
- In contrast, Bond Y with a 10% coupon rate has a lower duration (3.49 years)
- In other words, Bond Y has a shorter effective maturity than Bond X
- **Hence, bonds with higher durations are more sensitive to interest rate changes**
- **In other words, duration can show the sensitivity of a bond to interest rate risk**

Topic 6: Free Cash Flows

What Are Free Cash Flows

Cash flows are a crucial component for capital budgeting

Premise

- At the beginning of the course, we saw that capital budgeting – the process of identifying, planning and managing a firm's long-term investments – is one of the 3 key concerns in corporate finance

Examples

- In December 2001, Peugeot announced the project of building a new manufacturing plant in Kolin, Czech Republic. This represents a €1.5 billion investment partnered with Toyota. The plant is expected to be operational in 2005 to produce 300,000 vehicles a year
- Curitel Mobile, a specialist in the production of components for small electronic devices, is considering purchasing a new machine. This piece of equipment will replace the existing one to allow increase in production and decrease in marginal production cost

- To evaluate whether a project is value-creating, we can discount cash flows
- So, we need to understand what cash flows are and how they are determined

But first, it is necessary to note that cash flows and earnings are different …

Premise

- Financial managers must be concerned not only with how much cash they expect to receive, but also with when they expect to receive it and how likely they are to receive it
- Evaluating the size, timing, and risk of future cash flows is the essence of capital budgeting
- But it must be noted that cash flows are different from earnings (accounting profits)

- Cash flow is a term that refers to the amount of cash being received and spent by a business during a defined period of time, sometimes tied to a specific project
- It is necessary to note that corporate finance generally focuses on cash flows, whereas financial accounting generally stresses income or earnings
- Hence, when performing capital budgeting calculation, always discount cash flows, and *never* earnings
- At the end of the day, investors care about the ability of companies to generate cash for profit and to keep the company/project going

… because cash flows: 1) take into account net investment …

Example
- While the future earnings for these 2 firms are identical…

- … their cash flows (and hence the value of the company) can be different

Earnings

	Year 1	2	3	4	5
GL	£ 100	£ 105	£ 110	£ 116	£ 122
Songsam	£ 100	£ 105	£ 110	£ 116	£ 122

Cash flows

GL

	Year 1	2	3	4	5
Earnings	£ 100	£ 105	£ 110	£ 116	£ 122
Net investment	(25)	(26)	(28)	(29)	(30)
Cash flow	£ 75	£ 79	£ 83	£ 87	£ 91

At 10% discount rate, PV of cash flows is £311

Songsam

	Year 1	2	3	4	5
Earnings	£ 100	£ 105	£ 110	£ 116	£ 122
Net investment	(50)	(53)	(55)	(58)	(61)
Cash flow	£ 50	£ 53	£ 55	£ 58	£ 61

At 10% discount rate, PV of cash flows is £208

- In this case, we can see that net investment makes the cash flows from the 2 firms different

… 2) do not count depreciation as monetary flow …

Financial analysts do *not* count depreciation and amortisation as flow

	Year 0	1	2
Cash flow		£ 1,500	£ 500
Cash outlay	£ 2,000		
NPV@10%	(£ 223)		

Accountants, on the other hand, treat depreciation and amortisation as flow

	Year 0	1	2
Cash flow		£ 1,500	£ 500
Depreciation		1,000	1,000
Accounting income		500	(500)
NPV@10%	£ 41		

- Note that the results are different
- There are 2 important conclusions
  1. Depreciation and amortisation are not ‘taken out’ when calculating cash flow in corporate finance. Therefore, when converting from earnings to cash flows, D&A must be ‘added back’
  2. Make sure cash flows are counted only when they occur. Rather than spreading the cash outlay across the years, cash flow represents the money is spent/gained in the time period

… and 3) include change in working capital

Premise
- Working capital is usually defined as the difference between current assets and current liabilities

- Current assets mostly include:
  - Accounts receivable (sales are made *now* but customers pay their bills *later*)
  - Inventories (depending on the products and inventory management)
- Current liabilities mostly include:
  - Accounts payable (buy *now* from the suppliers and pay them *later*)
- It must be noted that the shorter period of accounts receivable, the better for the firm because less cash is tied-up. The same go with inventories. The lower the level of inventories, the less cash is tied up
- On the other hand, it is better cash-wise for a firm to have a high level of accounts payable
- As detailed below, it is the *change* in working capital from one year to another that impacts the cash flow calculation
- It must be note that technically the difference between the current assets and current liabilities should be called *net working capital* because there is a subtraction operation. However, in practice, people use the term *net working capital* and simply *working capital* interchangeably

Before putting a cash flow analysis together, let us examine five considerations when determining cash flows

Aspects	Description
1 **Count only incremental cash flows**	• Incremental cash flows are the changes in the firm's cash flows that occur as a direct consequence of accepting the project • In other words, we are interested in the difference between the cash flows of the firm *with* the project and the cash flows of the firm *without* the project

2 **Include incidental effects**	• Incidental effects are spillover or side effects that a new project can cause on the company's future cash flows
	  - *Erosion* occurs when a new project reduces the sales, and hence, the cash flows of existing projects
	  - *Synergy* occurs when a new project increases the cash flows of existing projects

3 **Forget sunk costs**	• A cost that has already occurred. Given that sunk costs are in the past, they cannot be changed by the decision to accept or reject a project

Before putting a cash flow analysis together, let us examine five considerations when determining cash flows (cont'd)

Aspects	Description
4 Include opportunity costs	• If an asset is used in a new project, potential revenues from alternative uses are lost. These lost revenues can be meaningfully viewed as costs or opportunity costs because, by taking up the project, the firm foregoes other opportunities for using the assets
5 Beware of allocated costs	• Frequently, a particular expenditure benefits a number of projects. Accountants allocate this cost across the different projects when determining income • However, for capital budgeting purposes, this allocated cost should be viewed as a cash outflow of a project only if it is an incremental cost of the project

Topic 6: Free Cash Flows

Free Cashflows Calculations

There are many methods to calculate cash flow. But we only focus on the method that accrues all value to both the share- and debt-holders of the firm

- There are many ways to calculate cash flows
- For instance, there is a method that considers the cash flows going to equity shareholders only and there is another that focuses on the cash flows to the firm as a whole (hence, all security holders)
- In this course, we are only concerned with the latter method of cash flow calculation named Free cash flow to firm or FCFF

- But regardless of the methods chosen, cash flows are made up of 3 major components and briefly discussed above

The basic rule is that to calculate the cash flow for a specific time period, you must consider the following three 3 major components that may occur in a single period

1 **Cash flow from operations** + 2 **Capital investment** + 3 **Investment in working capital** = **Cash flow in one period**

Also called:

- Operating cash flow

Also called:

- Capital spending
- Capital expense
- Net investment
- Net capital expense
- Capital expenditure (Capex)

Also called:

- Change in net working capital (ΔNWC)
- Change in working capital (ΔWC)

Cash flow from operations is the amount of income produced by a project

Components	Description
1 Cash flow from operations	• This refers to the cash that a project generates • It takes into account all the cash inflows, such as revenues, outflows, costs and taxes • To calculate this, we will first calculate net operating profit after taxes (or NOPAT): $$NOPAT = EBIT \times (1 - t)$$ • Also, as discussed above, since neither depreciation (D) nor amortisation (A) are cash items, both of them must be added back to complete the calculation • Therefore, the calculation of cash flow from operations (or CFO) can be: $$CFO = NOPAT + D + A$$ • Depreciation can be calculated by either the straight-line or accelerated method

Any major expenditures, whether it is cash inflow or outflow, impact on the cash flow of the project/firm

Components	Description
2 Capital investment	• The investments that are made at any time during the project, such as investments in plants, equipment, R&D, marketing, etc. • In this case, capital investment is *negative* cash flow because it represents a cash outflow from a firm • However, there are occasions in which a firm/project receive cash. For example, if an asset (e.g. a machine) can be sold when the project winds down or is completed (i.e. salvage), the sales price represents a *positive* cash flow to a firm • In this case, if a machine is sold at the end of a project, the money from selling it will represent a cash inflow

Investment in working capital takes into account the short-term financing needs

Components

Description

3 **Investment in working capital**

- It is important to stress that it is *not* the absolute amount of working capital that is important here. Instead, it is the *change* in working capital between 2 periods that really matters
  - Think about it this way: if this year you need more working capital, you should consider only the increase between the previous year and this year. Conversely, if you need less working capital for this period, you only count the amount decreased this year
- In the following example, when you are considering the accounts receivable (A/R) in Year 2, the impact to cash flow is not $910m because it is the absolute amount of A/R for Year 2. Instead, you should count only the increase from year 1 to year 2, which is $30m

	Year			
(in $ millions)	1	2		Change
Accounts Receivable	880	910	+	30
Accounts Payable (-)	550	605	+	55
(Net) working capital	330	305	-	25

Investment in working capital takes into account the short-term financing needs (cont'd)

Components

Description

3 **Investment in working capital**

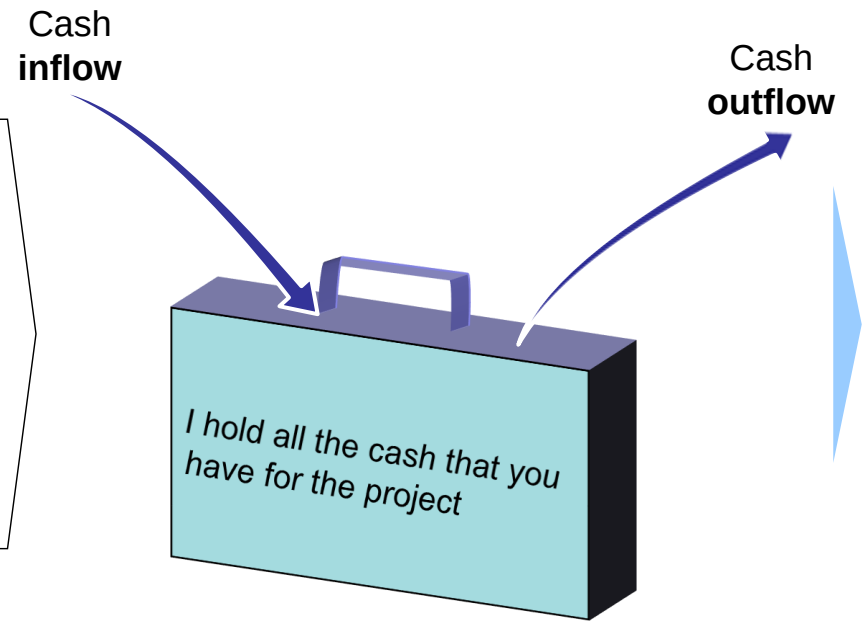
- Following the same line of thinking, when calculating accounts payable (A/P), it should be the change in A/P ($55m) and not the A/P for Year 2 ($605m) that you should be counting as part of the cash flow calculation that year
- Not shown here, the same logic applies to inventory and any other working capital components
- Working capital is then calculated by totalling all the cash inflow and outflow. In this case, A/R is an inflow whereas A/P is an outflow
- Therefore, the change in working capital (ΔWC) for Year 2 is -$25m
- This can be shown by the following formula:

$$\begin{array}{l} \text{Change in current assets} \\ \underline{-\ \text{Change in current liabilities}} \\ \text{Change in working capital} \end{array}$$

- So, when ΔWC is negative, it releases tied-up cash and increases the cash flow of the firm. If a firm has a positive ΔWC, more cash will be tied-up and decreases the cash flow of the firm

The key to "getting it right" with the calculation of free cash flow is to ask yourself whether the cash flow represents inflow or outflow

- It is important to ask whether a cash flow is going in or coming out of the "briefcase"



- It is important to apply the signs – "plus" and "minus" – that represent the inflow and outflow in a consistent fashion throughout the free cash flow calculations

Example of building a free cash flow analysis

Aspect	Description

Problem	• *You just discovered that there is a market for mini plastic Big Ben models and this market will last for 3 years. You also have the following project to manufacture them with the following details:*
	  ◦ *Sales price = £5 per unit*
	  ◦ *Number of units produced and sold per annum = 10,000*
	  ◦ *Cost of Goods Sold = £3 per unit*
	  ◦ *SG&A = £5,000 per annum*
	  ◦ *Initial outlay = £21,000*
	  ◦ *Depreciation = straight-line*
	  ◦ *Working capital = 20% of annual sales*
	  ◦ *Tax rate is 34%*
	  ◦ *Required rate of return = 20%*
	• *Is this project worth undertaking?*

Example of building a free cash flow analysis (cont'd)

Aspect | **Description**

Solution

- There are 5 steps to solve this problem

1. Calculating the cash flow from operations for each year

Sales	**£ 50,000**
COGS	(30,000)
SG&A	(5,000)
EBITDA	15,000
Depreciation	(7,000)
EBIT	8,000
NOPAT	5,280
Add back: Depreciation	7,000
CFO	**£ 12,280**

2. Calculation of capex

	Year			
	0	1	2	3
Net investment	(£ 21,000)			

Example of building a free cash flow analysis (cont'd)

Aspect | **Description**

Solution (cont'd)

3. Calculation of the change in working capital

	Year			
	0	1	2	3
ΔWC	(£ 10,000)	-	-	£ 10,000

- Since there are only changes in the working capital in Year 0 and Year **3**, the change in working capital in years is both 1 and 2 is zero

4. Calculation of free cash flow

	Year			
	0	1	2	3
CFO	£ -	£ 12,280	£ 12,280	£ 12,280
Capex	(21,000)	-	-	-
ΔWC	(10,000)	-	-	10,000
Free cash flow	**(£ 31,000)**	**£ 12,280**	**£ 12,280**	**£ 22,280**

5. Calculation of NPV

$$NPV = -£31{,}000 + \frac{£12{,}280}{1.2} + \frac{£12{,}280}{1.2^2} + \frac{£22{,}280}{1.2^3}$$

$$= £655$$

- Since NPV > 0, this project should be accepted

Exercise

Aspect	Description
Problem	• *Krekonite is considering a 3-year project that provides €200,000 per year. It has an annual cost of goods sold of €125,000 and annual SG&A of €12,000. It uses the straight-line depreciation method. The initial working capital is €20,000 and will remain unchanged over the life of the project. If tax rate is 34%, initial investment is €90,000 and cost of capital is 20%, is this project worth undertaking?*

Topic 6: Free Cash Flows

Equivalent Annual Cost

When comparing two projects with unequal lifespan, you can use equivalent annual cost

Aspect	Description
Use of equivalent annual cost	• Suppose a firm must choose between 2 machines, A and B. Both machines can do the same job, but they have different operating costs. They also have different operating lives • A simple PV calculation suggests taking the machine with the costs that have lowest PV. However, this might be a mistake because machine A, which has a lower cost, may need to be replaced before machine B • So, how do you solve this problem? The answer is to transform an investment today into an equivalent stream from cash flows – hence the name equivalent annual cost • Equivalent annual cost is therefore the cost per year of owning and operating an asset over its entire lifespan • The formula for calculating equivalent annual cost:

$$Equivalent\ annual\ cost = \frac{PV\ of\ costs}{Annuity\ factor}$$

$$PV\ of\ an\ annuity = C \times \left[\frac{1}{r} - \frac{1}{r(1+r)^t}\right]$$

When comparing two projects with unequal lifespan, you can use equivalent annual cost (cont'd)

Example

- Consider the following two machines that can do exactly the same job.
- Which one is the cheapest to own?

	Costs (£)				
Machine	**Year 0**	**Year 1**	**Year 2**	**Year 3**	**PV at 10%**
A	+15,000	+4,000	+4,000	+4,000	24,947
B	+10,000	+6,000	+6,000		20,413

It is important to remember that the investment in year 0 is positive because you are dealing with cost *only*

We cannot simply compare these 2 figures because they have different longevity

When comparing two projects with unequal lifespan, you can use equivalent annual cost (cont'd)

	Costs (£)				
Machine	**Year 0**	**Year 1**	**Year 2**	**Year 3**	**PV at 10%**
Machine A	15,000	4,000	4,000	4,000	24,947
Equivalent annual cost		10,800	10,800	10,800	24,947

**The annuity factor in this case is 2.49*

	Costs (£)				
Machine	**Year 0**	**Year 1**	**Year 2**	**Year 3**	**PV at 10%**
Machine B	10,000	6,000	6,000		20,413
Equivalent annual cost		12,223	12,223		20,413

**The annuity factor in this case is 1.67*

- Machine A is better than machine B because it costs less on a *per year basis* to own and operate

Topic 7: Investment Criterion

NPV as Investment Criterion

NPV is considered to be an excellent tool for deciding whether an investment/project/asset should be accepted. This is because it takes into account…

Reasons	Description
1 **Time value of money**	• NPV considers the fact that a pound in the future is worth less than a pound today and that distant cash flow is worth less
2 **Cash flow and cost of capital**	• NPV relies on DCF, which in turn, concentrates on the forecasted cash flow from a project and the (opportunity) cost of capital • This is important because it focuses only on cash flow (which can increase shareholders' value) and not on accounting profit
3 **Compatibility**	• Since PV are all measured in today's pounds, they can be added up • This has an important implication because if you have two projects, they can be combined • *NPV of Project A and Project B = NPV (Project A) + NPV (Project B)*

NPV is considered to be an excellent tool for deciding whether an investment/project/asset should be accepted. This is because it takes into account… (cont'd)

Reasons	Description
4 **Recuperation**	• The NPV approach allows the investors to know when they will be able to recuperate their investments
5 **Value creation**	• The NPV approach enables one to learn how much value is created (or destroyed) as a result of undertaking a project • This is important when there are 2 or more projects

Example

Aspects	Description
Problem	• *A pharmaceutical company wants to develop a new drug. The company envisages two potential strategies:* 1. *Invest $1 billion now and sell the drugs starting next year. In this case, the company will receive $500 million, $400 million and $300 million in the first, second and third year, respectively* 2. *Invest $200 million now and in the first year to develop the drug at a slower pace. The company will receive $300 million in each of the second year and the third year* • *Which is a better strategy if the discount rate is 5%?*
Solution	• By calculating the cash flows:

(in €000s)		Year 0	Year 1	Year 2	Year 3
Strategy 1	Cash flows	-1,000	500	400	300
	DCF	-1,000	476	363	259
Strategy 2	Cash flows	-200	-200	300	300
	DCF	-200	-190	272	259

NPV $_{\text{Strategy 1}}$= € 98.2

NPV $_{\text{Strategy 2}}$= € 140.8

• Strategy 2 is therefore a better option because it creates more value

Topic 7: Investment Criterion

Payback, Internal Rate of Return and Economic Value Added

In addition to NPV, there are several alternatives to approach investment decisions. One of them is Payback

Aspects	Description
How it works	• The payback rule is the length of time a project needs to recover an investment (i.e. "how long will it take to get my money back?") • The rule states that a project should be accepted if its payback period is less than a pre-determined cut-off period
Problem	• *An investment in a new machine will cost you £50,000. Once installed, you will be able to save £20,000 in the first year, £30,000 in the second and £10,000 for the subsequent years. Should you accept or reject this investment using the payback method?*
Solution	• You will be able to recover the entire investment in 2 years (i.e. the project "pays for itself" in two years) • In this case, £20,000 in year 1 and £30,000 in year 2 = £50,000, which is exactly the amount of the initial cash outlay • If your cut-off period is 2 years or greater, then this project should be accepted (i.e. this is a good project) • Conversely, if your cut-off period is under 2 years, you should not accept it • It is necessary to note that time value of money is *not* considered here

While the payback method is easy to use, it can lead to poor decisions

- Examine the following project using the payback method

Example

Project	Cash flows				Payback period (in years)	NPV at 10%
	Year 0	Year 1	Year 2	Year 3		
A	(£2,000)	£1,000	£1,000	£10,000	2	£7,249
B	(£2,000)	£1,000	£1,000	£0	2	(£264)
C	(£2,000)	£0	£2,000	£0	2	(£347)

Initial cash outlay

While the payback method is easy to use, it can lead to poor decisions (cont'd)

- Which of these projects will you accept?

Exercise

	Cash flows				
Project	**Year 0**	**Year 1**	**Year 2**	**Year 3**	**Year 4**
D	(€100)	€30	€40	€50	€60
E	(€200)	€40	€20	€10	
F	(€200)	€40	€20	€10	€130
G	(€200)	€100	€100	(€200)	€200
H	(€50)	€100	(€50,000)		

Initial cash outlay

While the payback method is easy to use, it can lead to poor decisions (cont'd)

Aspects	Description
Pros	• Is easy to understand • Allows efficiency in making decisions • Adjusts for the uncertainty incurred by the later cash flows • Favours liquidity • Comes in handy when it is difficult to estimate the cost of capital
Cons	• Ignores time value of money • Requires an arbitrary cut-off point • Ignores cash flows beyond the cut-off date • Is biased against long-term projects, such as R&D • Arguably, you can use the payback method *and* taking time value of money into consideration to make the method more rigorous. But it still suffers from neglecting the cash flows after the cut-off date (see project A in the previous slide)

Another investment decision criterion is Internal Rate of Return (IRR)

Aspect	Description
How it works	• With this method, we try to find a single rate of return that summarises the merits of a project • This rate of return should be an 'internal' rate in the sense that it depends only on the cash flows of a particular investment, not on rates offered elsewhere • The IRR is the discount rate at which a NPV calculation will equal to zero • Hence, an investment should be accepted if the IRR exceeds the required return. It should be rejected if the IRR is smaller than the required return

Another investment decision criterion is Internal Rate of Return (IRR) (cont'd)

Aspect

Problem

- *We covered this question in our first session. You are thinking about recommending your client invest in a piece of land that costs £85,000. You are certain that next year the land will be worth £91,000, representing a sure gain of £6,000. Given the discount rate is 10%, should your client undertake this investment?*

Solution

- *As opposed to calculating the NPV, some of you looked the rate of return instead. Specifically,*

$$\text{NPV} = 0 = \text{-£85,000} + \frac{\text{£91,000}}{(1+\text{IRR})}$$

$$85{,}000 + 85{,}000 \times \text{IRR} = 91{,}000$$

$$\text{IRR} = \frac{6{,}000}{85{,}000}$$

$$= 7.06\%$$

- *Since your cost of capital (or required return) is 10%, it is greater than the internal rate of return of the project of 7.06%. Therefore, the project should be rejected*

- It can be seen that the IRR signifies the minimum rate of return that a project can generate on its own
- The fact that the IRR is simply the discount rate that makes NPV equal to 0 is important because it tells us how to calculate the returns on more complicated investments (i.e. more than one cash flow)

Another investment decision criterion is Internal Rate of Return (IRR) (cont'd)

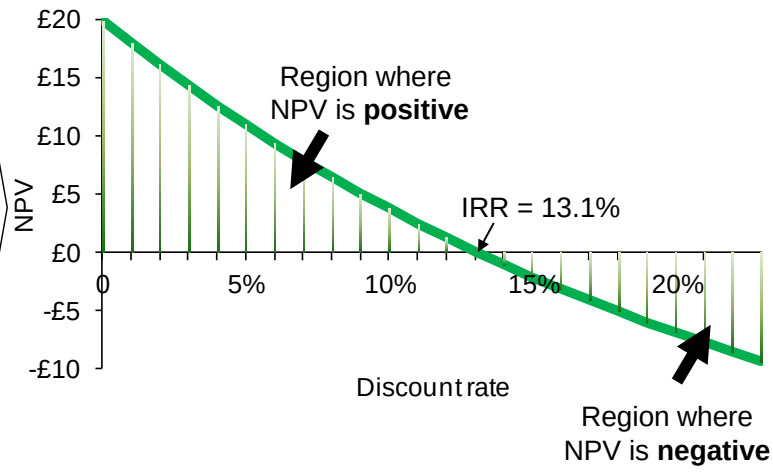
Example
- What is the IRR of this series of cash flows?

Project	Cash flows		
	Year 0	Year 1	Year 2
I	(£ 100)	£ 60	£ 60

- We can decide whether this project is worth undertaking by asking:
  - If your cost of capital is less than the IRR, then you should accept it investment
  - If it exceeds the IRR, then you should reject it
- The IRR of this project is 13.1%

Another investment decision criterion is Internal Rate of Return (IRR) (cont'd)

Example
- Given that IRR is the rate at which NPV equals 0, it is the point where NPV turns from positive to negative
- The example can be graphed as such:



- As displayed in the diagram, if the cost of capital is lower than the IRR of 13.1%, NPV will be positive
- Indeed, the lower the cost of capital, the higher the NPV
- Conversely, if the cost of capital is higher than the IRR (in English, when the project cannot generate more return than what is required), the project is value-destroying
- Note that this implies that NPV and IRR are ***negatively*** related

Unfortunately, IRR has several pitfalls. One of the them is that there can be more than one rate of return

- What is the IRR of this series of cash flows?
- Try 25% and 33.3%

Project	Cash flows		
	Year 0	Year 1	Year 2
J	(£ 60)	£ 155	(£ 100)

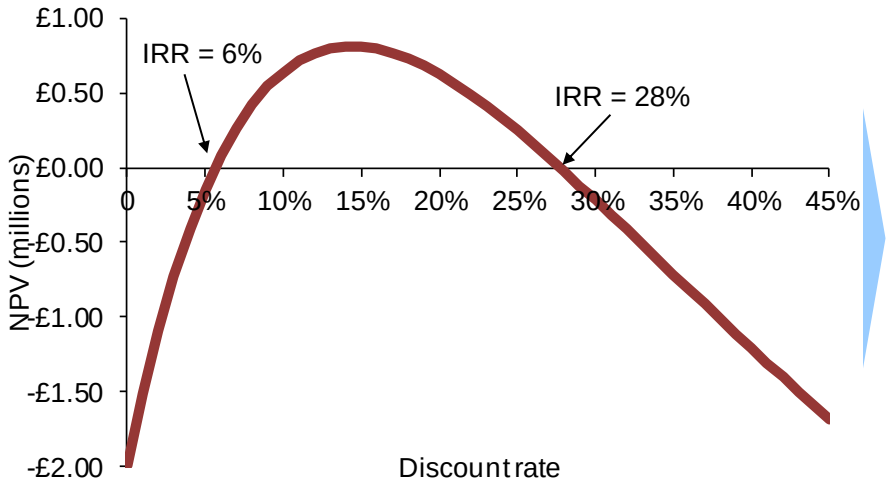
Unfortunately, IRR has several pitfalls. One of the them is that there can be more than one rate of return (cont'd)

- What is the IRR of this series of cash flows?

Project	Cash flows					
	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5
K	(£ 22)	£ 15	£ 15	£ 15	£ 15	(£ 40)

Unfortunately, IRR has several pitfalls. One of the them is that there can be more than one rate of return (cont'd)

- Graphing the previous series of cash flows, it can be seen that the curve reaches zero at 2 points:



- When there are changes in the sign of the cash flows, the IRR rule will potentially fail to work
- In contrast, the NPV method always works

The second pitfall is that it may lead to wrong investment decision

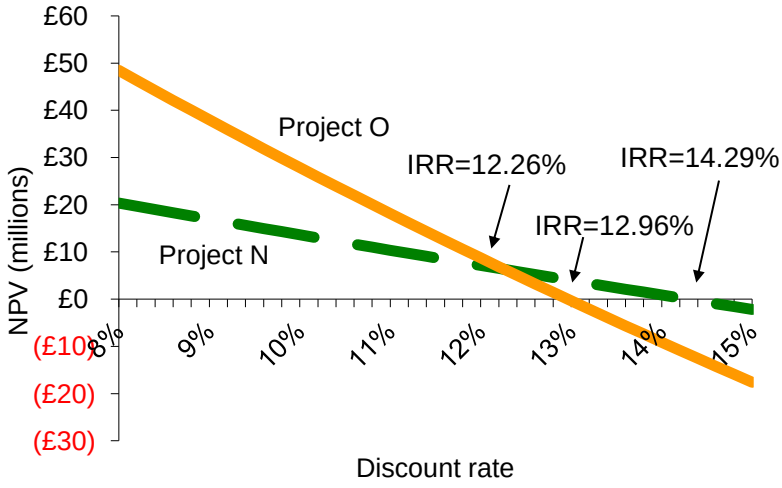
Case 1

- You can select *only* one of these two projects (and hence called mutually exclusive investment opportunities)
- Which one would you take?

Project	Cash flows				IRR	NPV
	Year 0	Year 1	Year 2	Year 3		
N	(£ 350)	£ 400			14.29%	£ 24
O	(£ 350)	£ 16	£ 16	£ 466	12.96%	£ 59

The second pitfall is that it may lead to wrong investment decision (cont'd)

- In the previous series of cash flows,
- Project N has a higher IRR but lower NPV, whereas project O is the exact opposite
- Graphically, it is presented as such:



- The problem here is that when IRR is above 12.26%, Project N will have a higher NPV than Project O
- So, which project to accept?
- The answer is the one that creates the most value (NPV) and not necessary the one with the highest rate of return (IRR)

The second pitfall is that it may lead to wrong investment decision (cont'd)

Case 2

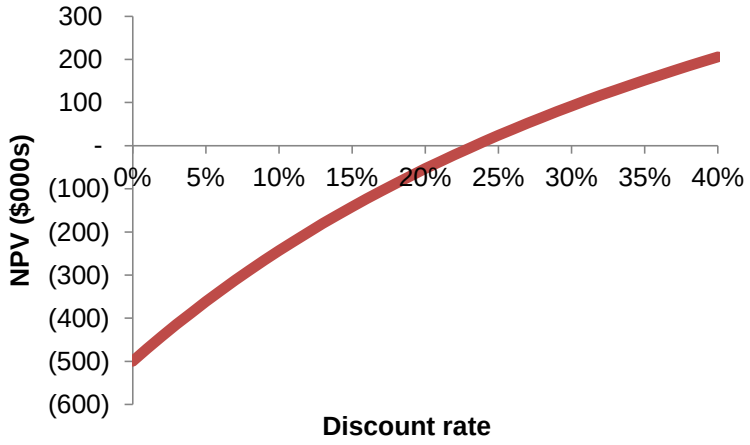
- A CEO receives $1 million upfront if he agrees to write a book about his experiences
- He estimates that it will take him 3 years to write the book, which will cause him to forgo alternative sources of income amounting to $500,000 a year
- The estimated cost of capital is %10
- Hence,

	Cash flows (000s)			
	Year 0	Year 1	Year 2	Year 3
	$ 1,000	($ 500)	($ 500)	($ 500)

- The IRR would be 23.38%
- Since it is larger than the cost of capital of 10%, then this book deal is a good deal
- However, if NPV is calculated, then the answer would be -$243,426, which means this is not a good deal

The second pitfall is that it may lead to wrong investment decision (cont'd)

- Graphing the series of cash flows, it is can be seen that:



- Indeed, it can be seen that NPV is only positive if the cost of capital is greater than the IRR of 23.8%
- The problem is that by getting the cash upfront and the costs incurred later, it is as if receiving cash today in exchange for a future liability
- In other words, it is akin to financing
- Also, the graph implies that NPV and IRR are ***positively*** related when they should be negatively related

The third pitfall with IRR is that at times, it is impossible to determine the IRR

- What is the IRR for this series of cash flow?

	Cash flows		
	Year 0	Year 1	Year 2
Project P	(£ 200)	£ 600	(£ 500)

- It is simply impossible to calculate the IRR (because NPV will always be negative)

Redeeming qualities and pitfalls of IRR

Aspects	Description
Pros	• Is a simple way of communicating information about a proposal • Is closely related to NPV, often leading to identical decisions
Cons	• Produces multiple answers with non-conventional cash flows • Leads to incorrect decisions when comparing mutually exclusive investments • Fails to determine the IRR

Economic value added (EVA) is an estimate of true economic profit as it takes into consideration of the charges of the capital invested in the firm

- EVA makes the cost of capital *visible* to operating managers
- Managers can no longer therefore make money without taking into account the resources used while making the money

EVA = NOPAT – Capital charge

Cost of capital x Capital employed (which is the capital that is invested in a project or C_0)

- If EVA > 0, it can be said that value is created
- In short, it is the profits or returns the company must generate so as to satisfy all the investors who have 'rented' their capital to the company
- In other words, the cash generated is covering the cost of capital

Economic value added (EVA) is an estimate of true economic profit as it takes into consideration the charges of the capital invested in the firm (cont'd)

Example

- A manager can make $13m a year for a company on an investment of $100m
- The return on the investment is 13% ($13m/$100m)

If the cost of capital is 10%, then
EVA = $13m - (100 x 10%) = 3m

If the cost of capital is 13%, then
EVA = $13m - (100 x 13%) = 0m

If the cost of capital is 20%, then
EVA = $13m - (100 x 20%) = - 7m

- If the return on the investment cannot cover the cost of capital, then the investment project should be rejected – this is very similar to IRR
- EVA, on the other hand, allows the actual gain or loss to be visible – otherwise, it is too easy for a manager to say s/he is entitled to a corresponding reward because the project generates a return on investment of $13m

Topic 7: Investment Criterion

Capital Rationing and Profitability Index

So far, we have assumed that a firm has all the necessary capital to invest in value-creating projects. Nevertheless, our decision-making capacity will be reduced if capital is not always available

Aspects

Description

Capital rationing

- Limitations on the investment programme that prevent a company from undertaking all projects
- Such restrictions are either due to the shortage of funds (hard rationing) or deliberate actions to limit the funds available for investments (soft rationing)

Problem

- *You only have £20. Which of the following projects can give you the highest possible NPV within the budget?*

	Cash flows				
Project	**Year 0**	**Year 1**	**Year 2**	**PV at 10%**	**NPV**
Q	(£3)	£2.2	£2.4	£4	£1
R	(£5)	£2.2	£4.8	£6	£1
S	(£7)	£6.6	£4.8	£10	£3
T	(£6)	£3.3	£6.1	£8	£2
U	(£4)	£1.1	£4.8	£5	£1

Profitability index serves as an useful investment decision method when capital is rationed

Aspect

Description

Solution

- Pick the projects that give the highest NPV on a *per pound basis of investment*
- This is called the profitability index (PI) and can be calculated using the following formula:

$$\text{Profitability index} = \frac{\text{NPV}}{\text{Initial investment}}$$

- The profitability index for each of these projects are therefore:

Project	PV	NPV	Initial investment	Profitability index
Q	£4	£1	£3	1/3=0.33
R	£6	£1	£5	1/5=0.20
S	£10	£3	£7	3/7=0.43
T	£8	£2	£6	2/6=0.33
U	£5	£1	£4	1/4=0.25

But profitability index is not without problem

Aspects	Description
Problem	• The profitability index method breaks down when there is more than one resource to be rationed
Example	• *You can only raise £10 million for investment in each of years 0 and 1. Which project(s) would you accept?*

Cash flows (millions)

Project	Year 0	Year 1	Year 2	NPV at 10%	Profitability index
V	(£10)	£30	£5	£21	2.1
W	(£5)	£5	£20	£16	3.2
X	(£5)	£5	£15	£12	2.4
Y	(£0)	(£40)	£60	£13	0.3

Topic 7: Investment Criterion

Analysing Projects

While the different investment criteria help you make appropriate decisions, we can engage in at least 3 activities to make us more informed. They include sensitivity analysis, break-even analysis and scenario analysis

Activities	Description
1 Sensitivity analysis	• To determine the percentage change of NPV as a result of a change in an 'input' variable (e.g. revenue) • In other words, it looks at these magnitudes that the NPV would change when an 'input' variable goes up or down
2 Break-even analysis	• To determine the minimum value to have a positive NPV • In a nutshell, it looks at what the 'floor' or 'ceiling' is for a variable (e.g. minimum revenue ['floor'] or per unit cost ['ceiling']) in order to maintain a positive NPV
3 Scenario analysis	• To attempt to develop possible scenarios as a result of changes of various inputs • In short, it looks at different possibilities of how and what NPV a project can generate

- All 3 mechanisms allow investors to examine the risk to which they are exposed

Let us use an example to illustrate these 3 activities

Example

- A pharmaceutical company is developing a drug for combating flu
- The project has the following data:

(in € millions)

Data

Initial investment	€ 160				
Sales	€ 900	or	€ 500	with a 50/50 chance	
Variable cost	€ 400	or	€ 200	with a 50/50 chance	
Fixed cost	€ 180				
Working capital	Negligible				
Duration of project	4 years				
Cost of capital	10%				

	Year 0	Year 1	Year 2	Year 3	Year 4
Income statement					
Potential revenue		€ 700	€ 700	€ 700	€ 700
Variable costs		300	300	300	300
Fixed costs		180	180	180	180
Depreciation		40	40	40	40
EBIT		180	180	180	180
Tax @ 34%		61	61	61	61
Net income		€ 119	€ 119	€ 119	€ 119
Cash flow analysis					
NOPAT		€ 119	€ 119	€ 119	€ 119
1. CFO		159	159	159	159
2. CAPEX	(160)	-	-	-	-
3. ΔNWC		-	-	-	-
Cash flows	(160)	159	159	159	159
DCF	(160)	144	131	119	108

NPV	**€ 343**

1 Sensitivity analysis can be used to determine the percentage change of NPV as a result of a change in an 'input' variable

- In this case, we would like to see what happens to the NPV if the potential revenue is only €600m instead of €700m

	Year 0	Year 1	Year 2	Year 3	Year 4
Income statement					
Potential revenue		€ 600	€ 600	€ 600	€ 600
Variable costs		300	300	300	300
Fixed costs		180	180	180	180
Depreciation		40	40	40	40
EBIT		80	80	80	80
Tax @ 34%		27	27	27	27
Net income		€ 53	€ 53	€ 53	€ 53
Cash flow analysis					
NOPAT		€ 53	€ 53	€ 53	€ 53
1. CFO		93	93	93	93
2. CAPEX	(160)	-	-	-	-
3. ΔNWC		-	-	-	-
Cash flows	(160)	93	93	93	93
DCF	(160)	84	77	70	63

NPV	**€ 134**

- The NPV drops from €343m to €134m

1 Sensitivity analysis can be used to determine the percentage change of NPV as a result of a change in an 'input' variable (cont'd)

- While revenue drops by 14.29% (600-700)/700, NPV falls by 60.93% (134-343)/134
- So, how sensitive is the NPV to a change in revenue?

$$\frac{-60.93\%}{-14.29\%} = 4.25\%$$

- In other words, a 1% drop in revenue equals to a 4.25% decrease in NPV

2 Break-even analysis shows the minimum value so as to generate a positive NPV

- Break-even is about changing variables such as revenue, volume, price, costs, so that NPV=0
- It is then possible to know the minimum revenue, volume, the highest costs acceptable, etc.
- In this case, we would like to know the minimum cash flow required to generate a zero NPV

$$NPV = 0 = -160 + \sum_{t=1}^{4} \frac{CF}{(1+0.1)^t}$$

$$CF = 50.5$$

- The investor will have to have a cash flow of €50.5m or more each year in order to make the project worthwhile
- In this way, the manager will be able to identify the minimum, say, revenue, so as to achieve a positive NPV

3 Scenario analysis makes is possible to develop various potential outcomes as a result of changes in various inputs

- The value of scenario analysis is that investors can anticipate how different figures or input would/could change and how the changes could affect the NPV
- To do so, we can build different "cases"

- **Best case:** *In the next 4 years, winter would be very cold and this would lead to a strong demand for the drug. In fact, the demand would outstrip supply and as a result the company would need to increase production and production capacities*
- **Base case:** *The scenario according to the considerations set out initially*
- **Worst case:** *In the next 4 years, winter would be very mild. Consequently, the demand for the drug would be below anticipation*

- The idea is not to predict the future but rather as a tool to initiate debates, which can lead to preparation for different potential outcomes