Introduction to Financial Management: A Contemporary Approach

INTRODUCTION TO FINANCIAL MANAGEMENT: A CONTEMPORARY APPROACH

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First published in 2024 by The University of Queensland

DOI: 10.14264/4325b20

eISBN: 978-1-74272-386-0

Please cite as: Rekker, S. (2024) *Introduction to Financial Management: A Contemporary Approach.* The University of Queensland, DOI: 10.14264/4325b20

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The University of Queensland, St Lucia QLD, Australia

ACKNOWLEDGEMENT OF COUNTRY

We acknowledge the Traditional Owners and their custodianship of the lands on which this project originated. We pay our respects to their Ancestors and their descendants, who continue cultural and spiritual connections to Country. We recognise their valuable contributions to Australian and global society.

A Guidance Through Time by Casey Coolwell and Kyra Mancktelow © The University of Queensland

About the artwork

Quandamooka artists Casey Coolwell and Kyra Mancktelow have produced an artwork that recognises the three major campuses, while also championing the creation of a strong sense of belonging and truth-telling about Aboriginal and Torres Strait Islander histories, and ongoing connections with Country, knowledges, culture and kin. Although created as a single artwork, the piece can be read in three sections, starting with the blue/greys of the Herston campus, the purple of St Lucia and the orange/golds of Gatton.

The graphic elements overlaying the coloured background symbolise the five UQ values:

- The Brisbane River and its patterns represent our Pursuit of excellence. Within the River are tools used by Aboriginal people to teach, gather, hunt, and protect.
- Creativity and independent thinking is depicted through the spirit guardian, Jarjum (Child in Yugambeh language), and the kangaroo
- The jacaranda tree, bora ring, animal prints, footprints and stars collectively represent honesty and accountability, mutual respect and diversity and supporting our people.

Learn more about The University of Queensland's Reconciliation Action Plan.

PART I

FOUNDATIONS

1.

WHAT IS FINANCIAL MANAGEMENT?

1.1 Introduction

At the end of this chapter, you will be able to:

- identify the key financial decisions financial managers make
- identify the differences in the basic legal forms of business organisation and the implications for the financial manager
- evaluate various business purpose theories.

How do you manage your money? If you have any spare money, are you saving it in a separate savings account? Or are you investing it another way? Do you have enough in your access account when you need to pay a bill? Should you get a credit card? Should you work, or borrow money, to fund your studies?

No matter what you do – start your own business, be a stay-at-home parent, work for a large business, for the government, for a not-for-profit, or surf full-time for the rest of your life – knowledge of finance will help you make informed decisions in both your personal life and your work life.

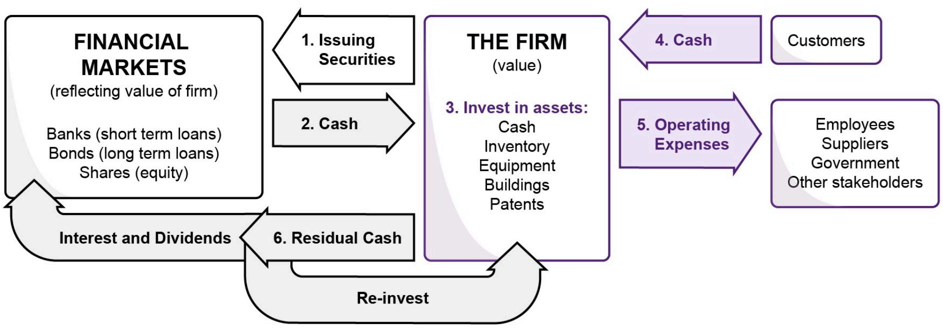
You may not realise it, but you are already making many financial decisions every day. In your own life, you will most likely spend money on things that you value. However, in a business, this can be a little bit different, as you have to consider what others value in order to stay in business. In this chapter, we will explore what types of important financial decisions have to be made in a business, what common business structures there are in Australia, and discuss different views of what the role of the company is in society.

1.2 Key Financial Decisions

Imagine you own a small coffee shop. You had saved a little bit of cash that allowed you to buy the equipment and furniture cheaply; some tables and chairs, two second-hand coffee machines, cups and mugs, cleaning items, etc. You have also hired a few employees to help, mainly for busy hours. In other words, you have invested in productive assets (e.g. the equipment and furniture) and human capital (e.g. your employees – and yourself, of course).

Through your investment, you are generating revenue by selling the goods (coffee) and services (making coffee!) your coffee shop provides. These are the very basic elements of any business, generating cash flows by investing in productive assets and human capital. Ideally, the generated cash inflows (through selling goods and services) are greater than the cash outflows (cost of goods sold, employee expenses, tax, etc.). If your coffee shop generates more money than the costs of running it, you can choose to do 2 things; you can cash in the money (for yourself, or in the case of a not-for-profit, for a purpose), or you could reinvest it in the business (by for example buying another coffee machine).

In the scenario above, you are the only provider of capital when starting the business. As companies grow or want to grow quickly, they often have to seek external financing through borrowing money or issuing shares to financial markets. These interactions of the firm with financial markets and other stakeholders are depicted in the figure below. Companies can raise money by issuing securities, which can be debt or equity (step 1). Debt securities are like loans, which require regular interest payments until the loan is paid back with interest. Equity securities work a little bit differently; they only receive cash in the form of dividends if the firm has any residual earnings that it decides to pay out. (Note that in your coffee shop, you are the sole equity holder and thus are entitled to all the residual cash.) When investors in financial markets buy these securities from the company, they provide capital to the firm (step 2), but of course, these investors expect a financial return on their investment (part of step 6). Ideally, a firm uses capital to invest in productive assets (step 3). Productive assets are assets that generate more money (revenues, step 4) than what they cost to generate (operating expenses, step 5). Investing in such assets increases the value of the firm.



Financial markets and the firm

When you own a small business, you will probably have to make all the financial decisions yourself. However, in a bigger business, there is usually a financial manager that manages the financial matters of the firm. Traditionally, the field of Corporate Finance is concerned with the financial aspects of running and managing a for-profit corporation. However, note that many of the principles can be applied to not-for-profits, social enterprises and other forms of business structures. When managing the finances of a business, there are three main questions that need to be addressed, each covered in the next three sections;

- What long-term investments should the business make? (Capital Budgeting)
- How will the business finance these investments? (Capital Structure)
- How will the business manage everyday financial activities? (Working Capital Management)

1.2.1 Capital Budgeting

The process of capital budgeting is concerned with deciding what long-term assets (plant and equipment, new products, etc.) a business should, or should not, invest in. It is about planning and managing the firm's long-term investments.

For example, if your coffee shop is doing well, you may want to consider upgrading your coffee machines (investing in long-term assets), or expanding the cafe to the place next door (investing in long-term assets). If some equipment is no longer needed, you may want to sell it as this is better than keeping the equipment in the cafe where it may not create any value.

> When deciding whether or not to invest in a new asset, the first step is to evaluate whether the value the asset creates is greater than the cost of buying the asset. This might occur when the cash inflows of the investment exceed the cost of undertaking the investment. However, the cash flows that the project generates usually occur in the future, after the initial investment has been made, and span over a period of time.
> And as you will learn in this course, not all cash flows can be valued equally. In short, you probably want to know if your investment generates more money than simply putting your money in a savings account at the bank (or if borrowing, more than you need to pay back your loan!).

Financial managers employ in-depth analyses that account for the following three items in regard to future cash flows:

- **Size**: what amount will you receive?
- **Timing**: when and how often will you receive them?
- **Risk**: what is the likelihood that you will receive the cash flow? E.g. a probability of 100.

That the size of the cash flow matters might be quite straightforward. The timing, however, is also crucial, it matters whether you will receive your first cash flow in the next year or only after 10 years and whether you receive them each year, or only once every 5 years. Finally, the risk of the cash flows is important too and can differ greatly amongst industries. A supermarket chain opening a supermarket in a new suburb might be more predictable in generating cash flows than a new pharmaceutical company developing a new drug.

Overall, in capital budgeting, we evaluate what are good decisions (i.e. increasing the value of the firm), and bad decisions (i.e. decreasing the value of the firm). Long-term assets might require a significant amount of capital and cannot easily be reversed, so it is important to make an informed decision. In Chapter 7, we are going to learn in more detail how we can evaluate whether a certain project is worth undertaking or should be avoided.

1.2.2 Capital Structure

The capital structure of a firm is the mixture of financing (debt and equity) a firm uses to finance its operations. Deciding on a capital structure involves questions such as; how and where should the financial manager raise money? What is the least expensive source of funds for the firm?

In the example of the coffee shop above – you purchased all the assets from your own savings and are the sole owner of the business. If you have not borrowed any money, you own all of the capital in the firm.

Large businesses that have been undergoing expansions with large capital expenses often source capital externally through issuing debt and/or equity securities. Deciding on an optimal capital structure is a complex process. In this course, we will learn the pros and cons of issuing debt and/or equity securities and learn how financial markets value such securities.

1.2.3 Working Capital Management

Working capital is the capital within a business that is used in its day-to-day operations. Good management of current assets, such as cash, accounts receivable, and inventory; and current liabilities such as accounts payable, ensure that the firm can operate efficiently with minimal disruption. For example, if your coffee shop does not have enough coffee beans or milk in stock your customers will be unhappy, and you might need to close your shop for a few days. On the other hand, if you have too much milk in your inventory it may spoil and lose value. Particular matters of importance to working capital management are;

Cash and inventory: How much cash and inventory should we hold?

Too much cash can be unproductive as there is an opportunity cost (measured as the return on the next best alternative). That is, you could invest your excess cash in more equipment, staying open extra hours or expanding the business, which would increase the earnings of the business. Holding cash does not produce value to the firm. On the other hand, too little cash is not good either because you need to be able to pay your creditors to avoid getting in trouble.

Accounts receivable: Should we sell on credit to our customers?

Selling on credit to customers may cause you to make more sales, but there are two risks involved; 1) some customers may default (i.e. not pay you what they owe) and 2) you need to have enough cash to pay your suppliers/creditors.

Accounts payable: What short-term financial options do we have, and should we use them?

If your supplier lets you pay in 3 months (which is equivalent to lending you money), should you pay then or now? It depends, as often there are costs to these short-term financing options, sometimes with very high interest rates.

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https://uq.pressbooks.pub/introduction-financial-management/?p=33#h5p-2

1.2.4 Summary Key Financial Decisions

In this section, we have looked at the very basics of what a business does and the types of (financial) questions it commonly encounters.

Later in this course, we will cover in detail how to conduct capital budgeting analyses (Chapter 7, 8, and 9), explain how both debt and equity are valued (Chapters 5 and 6) and learn techniques that allow you to make sound financial decisions. In the next section, we are going to look at different business structures and explain their key differences.

1.3 Basic Legal Forms of Business

In Australia, there are four main legal forms of business:

- Sole trader (called sole proprietorship in the US)
- Partnership
- Corporation and
- Trust.

The differences between these business forms are mostly surrounding their tax liabilities, asset protection, and ongoing administrative costs. Businesses may change their business structure over time. Many companies start as sole traders and progress to other structures as the business grows. The Australian Tax Office (ATO) has a video on Choosing your business structure that explains the different structures in more detail.

Note that there are many different types of organisations, with different objectives, including not-for-profits and charities. Such organisations exist to achieve a social or environmental mission, but of course it is important for them to manage their finances effectively to maximise impact, and much of your traditional finance knowledge will be useful for these organisations. In the remainder of this chapter, we assume for-profit corporations when we talk about companies and corporations.

1.3.1 Sole Trader

For a small coffee shop that you started with your own money, a sole trader may be the best option for your business. A business as a Sole Trader is extremely **easy to set up**; it takes you about an hour to apply online on the ATO website for an Australian Business Number (ABN) (note that you do need a separate bank account for the business!). It is also the **least regulated**, saving you a lot of paperwork and time and money compared to other business structures that are more regulated.

In terms of tax liabilities, you are taxed once as personal income – the business itself does not actually pay tax. Any losses your business makes can offset your other income. For example, if you have a paid job in addition to running your coffee business, you can often deduct any business losses from your income and pay less tax as a result.

Whilst you get to keep all the profits if the firm makes money, you are subjected to **unlimited liability**. As the sole equity holder, this means that you are fully personally liable for any debts, so if you go bankrupt and are unable to pay your debt, you may owe your creditors money until it is paid off in full or creditors may be able to seize your personal assets. Note that banks may be reluctant to lend you any money in the first place and will often decide how much to lend based on how many personal assets you own.

Main advantages and disadvantages of organising as a sole trader are listed below:

Advantages	Disadvantages
• Easiest to start • Least Regulated • Single owner keeps all the profits • Taxed once as personal income • Losses can offset other income • Owner has control of all decisions	• Equity capital limited to owner's personal wealth • Unlimited liability • May be difficult to raise capital

1.3.2 Partnership

A partnership is a business that is **owned by two or more people** and is still relatively easy to start. Whilst not required, it is important to set up a **partnership agreement** at the start to help prevent misunderstandings or disputes later on. The tax structure is very similar to that of a sole trader – tax is paid by the partners on their individual tax returns, not by the partnership.

A partnership has the advantage of having **more capital available** than a single person, but it may still be limited in raising any external capital. A general partnership consists of general partners only who all face **unlimited liability** just like a sole trader. However, in a **limited partnership**, there are also one or more general partners that have unlimited liability, but there are also one or more limited partners, who do not actively participate in the business and whose liability only extends to the amount they have put into the business.

Transferring ownership is difficult in a partnership. Usually, a partnership dissolves if one of the partners dies or wants to sell. Advantages and disadvantages are listed below:

Advantages	Disadvantages
• More capital available than for sole trader • Relatively easy to start • Income taxed once as personal income • Losses can offset other income • Can have limited partners with limited liability	• Unlimited liability • Difficult to transfer ownership • Hard to raise capital • Partnership dissolves when one partner dies or wishes to sell

1.3.3 Corporation

A corporation is a very unique business structure. It is an "incorporated" organisation, a legal separate entity, that is governed by law. It can sue and be sued, it can own and be in debt, very similar to a legal person, but born only on paper. A corporation is also the most complex business structure, requiring substantial paperwork and compliance costs over its life. In return, it gives many advantages and has become a much-preferred business structure in the last century.

A corporation enjoys the ability to **raise capital more easily** than other business structures because it is able to issue shares to the financial market (privately if a private company or publicly if it is a public company). Especially when publicly traded, **transfer of membership** is easy given that shares can be bought and sold on the stock exchange (or privately). It is attractive to invest in for members (shareholders), as they enjoy **limited liability**; the only money members can lose is the money they paid for the shares, as they are not liable for the firm's debts in case of bankruptcy (and thus no-one can go after the member's personal assets!). This limited liability of members also extends to any fraudulent, negligent or reckless acts that any directors or employees engage in. Directors and employees are personally liable for any of those acts. Further benefits include that the life of a business is not bound to that of any of the members; its life does not have a limit.

Apart from increased costs, there are some disadvantages of incorporating a business. If you move from a sole trader or partnership to a corporation, and you are not the majority shareholder, then you may lose control of what will happen with the business. Also, a corporation pays tax over its profits, which may cause members to pay tax twice (as they may have to pay tax whenever any dividends are paid out).

For a small company with a few members, it may be the case that those who are a member of the company are also managing it. Or at least, they would make decisions for the business together. This becomes more difficult when there are many members. When the company has dispersed members (many different shareholders), the members are often not involved in the daily operations and management of the company (for many reasons). This is both a blessing – members can invest without having any knowledge of running a business – and a curse – the managers may not act in the member's best interest. Members therefore elect a board of directors to oversee the managers who are employed to manage the daily operations of the business, and receive voting rights for the Annual General Meetings where important matters for the business are decided.

Advantages	**Disadvantages**
• Separation of members (shareholders) and management • Unlimited life • Limited liability • Transfer of ownership is easy • Easier to raise capital • Directors and employees are personally liable for fraudulent, negligent or reckless acts	• Separation of members (shareholders) and management • Possible loss of control • Taxation of company profits • Costs more to set up • Higher compliance costs

Check Your Knowledge

Joe and Annie have developed StudyApp to help students organise their notes for optimal study.

Joe has used his web marketing skills to promote StudyApp, while Annie has used her programming skills to incorporate tons of user suggestions, making the StudyApp very popular among local students. Joe and Annie would like to expand the usage of their app to other universities in other states, but this will require both of them to quit their current jobs and focus full time on StudyApp. One of their friends from uni is now working at a textbook publisher, and they have been exploring a deal with the publisher to expand distribution of StudyApp.

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https://uq.pressbooks.pub/introduction-financial-management/?p=33#h5p-3

Concept Check

What are the advantages and disadvantages of each of these possible business forms for StudyApp? (drag and drop each grey box to a relevant column)

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https://uq.pressbooks.pub/introduction-financial-management/?p=33#h5p-4

1.3.4 Summary

We have learnt the basics of three commonly occurring business structures; sole trader, partnership and corporation. All the structures have advantages and disadvantages, which one suits best depends on your situation. In the next section, we are going to discuss different theories of business purpose.

1.4 Theories of Business Purpose

We have talked a little about how a firm can be structured, but what is the purpose of a firm in society? What should a business value?

First, let's have a look at what you value yourself, using the Sustainable Development Goals (SDGs). The SDGs are a set of 17 goals, with 169 targets, that are *"**a blueprint to achieve a better and more sustainable future for all**"*.[1] All 193 countries have committed to these goals that are to be achieved by 2030. Below are the 17 goals:

Source: United Nations, Public domain, via [Wikimedia Commons](https://commons.wikimedia.org).

To simplify the goals, we can divide them into environmental (biosphere), social (society) and economic.

1. United Nations. (n.d.). *Sustainable Development Goals*. https://sdgs.un.org/goals

Source: Azote for Stockholm Resilience Centre, Stockholm University, CC BY 4.0, via Wikimedia Commons.

For societies and economies to thrive long term and be sustainable, we need a highly functioning natural environment and healthy, equitable social systems to support them.

Polls:

Poll 1:

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Poll 1 results:

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Poll 2:

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Poll 2 results:

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1.4.1 Sole Traders and Partnerships

As a sole trader, you own the business all by yourself. As a partnership, you own the company with your partners. In both those cases, **you have direct control** over what happens in the company and the consequences are yours as well. You make the decisions by yourself or with your partners. For example, you can choose how you treat your employees, and you'll probably realise that you have to create some value for them if you want to retain them. Do you give them part of the profits when you have had a good month? Or do you keep it to yourself?

Let's consider your coffee shop. You can decide whether you give a discount on takeaway cups, if you sell fair-trade coffee only, etc. Let's say the cost of a "common" discount is $0.5 for customers using a takeaway cup, but a disposable cup only costs you $0.05. Should you offer the "common" discount? From a purely financial perspective, you may say no, but the reality is that most coffee places now offer this discount. Some may argue that considering the environment (through reducing the billions of coffee cups ending up in landfill) is either "good business", as you enhance your reputation and customers might be more loyal, whereas others do it simply because it is "the right thing to do".

1.4.2 The Corporation

To what extent should companies consider the social and environmental impacts of their business? How should they be balanced with financial impacts? This question has been long debated, some are set in law and regulation, others in culture, and can differ across and within countries.

The 20th century gave something unique, which was the rise of **the corporation,** a separate entity from both its owners and management, which for the first time allowed companies to **have dispersed equity ownership.**

> Before companies started raising capital from the public, companies were closely controlled by those who owned them. However, when the industrial revolution started and production ramped up, owners of companies had to increasingly hire managers to help manage the company's operations. And in the 20th century, when companies went to the public for finance more and more often, there started to be an **increased separation between those that are shareholders of the company and those who manage the company.**
>
> Managers are often seen as employees ("agents") of the company that are hired by the shareholders ("principals") to run the firm in their best interest. To make sure that the agents act in the best interest of principals, and not for example in their own self-interest, the shareholders elect a board of directors to oversee the company. Moreover, shareholders often receive voting rights with their shares, where they can vote on the board of directors and other important matters at the Annual General Meeting.

In most textbooks, you will often see the following argument: shareholders "own" the company (residual claimants of the firm) → management and directors have to do what the shareholders want → shareholders want maximum wealth (as a measure of value) = maximum share price; *thus the role of the financial manager is to maximize the value of the shares (share price)*. This argument was mostly instigated by Milton Friedman (1970), the father of **shareholder theory.** His idea was further enhanced by Jensen and Meckling (1976) in their work the "Theory of the Firm"[2], one of the most cited and influential works in finance literature, which discusses **the main challenge that needs to be addressed in corporate governance is that the managers and directors act to maximize shareholders' wealth**. This view is discussed in more detail next.

1.4.3 The Shareholder Theory (Friedman, 1970)

Milton Friedman, a Nobel prize-winning economist, wrote an article in the Financial Times in 1970

2. Jensen, M. C., & Meckling, W. H. (1976). Theory of the firm: Managerial behavior, agency costs and ownership structure. *Journal of Financial Economics*, *3*(4), 305-360. https://doi.org/https://doi.org/10.1016/0304-405X(76)90026-X

entitled " The Social Responsibility of Business". In this article, he writes about the notion that businesses may have a responsibility beyond just making a profit; a responsibility to achieve some "social goals". He strongly disagrees with this and quotes from his book "Capitalism and Freedom" (1962) in which he argues:

> *"There is one and only one social responsibility of business – to use its resources and engage in activities designed to increase its profit as long as it stays within the rules of the game, which is to say, engages in open and free competition without deception or fraud."* [3]

And

> *"In a free-enterprise, private-property system, a corporate executive is an employee of the owners of the business. He has direct responsibility to his employers. That responsibility is to conduct the business in accordance with their desires, which generally will be to make as much money as possible while conforming to their basic rules of the society, both those embodied in law and those embodied in ethical custom."*

Thus, Friedman concludes that there is one and only one responsibility of a business, which is to increase profits for shareholders. Note, however, that **he does not believe that this should occur at all costs**; the actions to achieve these profits have to be **legal and conform to ethical custom**. His main concern about a business manager pursuing anything other than profits is that the manager is spending someone else's money:

> *"In each of these cases, the corporate executive would be spending someone else's money for general social interest. Insofar as his actions in accord with his "social responsibility" reduce returns to stockholders, he is spending their money. Insofar as his actions raise the price to customers, he is spending the customers' money. Insofar as his actions lower the wages of some employees, he is spending their money."*

Friedman was not against giving money to any charitable organisation or helping out friends, he just

3. Friedman, M. (1962). *Capitalism and freedom*. University of Chicago Press.

believed that if **anyone wanted to give money to charity or anyone that this should be with their own money**. A manager sponsoring the local ballet, soccer club or the Red Cross with corporate funds may be something the shareholders do not want to spend money on. Shareholders may want to spend the proceeds of the businesses' money on other pursuits. Both shareholders and managers themselves are free to give money to charity as well, but with their own money. Friedman also argued that if managers would spend money on charitable organisations or any other "social" goal, **the managers would be acting as a regulator as they are effectively imposing a tax and deciding where the proceeds of the tax would go to**, and this should be determined through a democratic process, not a corporate executive.

Concept Check

In September 2019 there were so called "Climate Strikes" across the world to demand regulatory action on climate change. There were a large number of businesses that expressed their support and encouraged their employees to take the afternoon off (paid) to join the strike.

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https://uq.pressbooks.pub/introduction-financial-management/?p=33#h5p-6

Let's go back to your coffee shop for a little bit.

While running the business, you will be both impacted by, and impact, a number of entities in society. Take your customers for example your customers impact whether or not you can stay in business, and at the same time, your service and the quality of the coffee have an impact on the wellbeing of the customers. Your suppliers have an impact on the quality and availability of your coffee, whilst you also impact their ability to be in business. Entities that both affect the firm, and are affected by the firm, are what we call **stakeholders.** In reality, stakeholders have an impact on the success of a business.

Shareholder theory does not deny this but rather proposes that stakeholders are a means to an end (maximising wealth for the shareholders, also called shareholder primacy). So for example, if wages can be cut to generate a profit, they should be cut. If dumping waste in a river is cheaper than treating it, the waste should be dumped in the river. If paying liability suits for a defective product is cheaper than making the product safe, then it is best to make the defective product and pay for the lawsuit. The following video shows a debate between Friedman and a student at Cornell University in 1978.

VIDEO: [Milton Friedman on Self-Interest and the Profit Motive (YouTube, 6m56s)]

One or more interactive elements has been excluded from this version of the text. You can view them online here: https://uq.pressbooks.pub/introduction-financial-management/?p=33#oembed-1

Friedman proposes that perhaps the car company should have put a disclaimer on the product saying "this product is $13 cheaper and therefore has an increased chance of x% of exploding under y situation". Do you think companies should do this? Do you think they do? **Do you think people are really "free" if they do not have information on the possible impacts of products on individuals/society when buying a product?** Who has a responsibility for providing this information?

1.4.3.1 Enlightened Friedmanite

There is much criticism of Friedman's view (shareholder primacy), particularly as it is often used to justify focusing on short-term valuations. If managers are putting profit in the next year first, does that mean they are maximising profit for the next 5 years? 10 years? 50 years? Are higher current profits necessarily in the best interest of shareholders who may hold their investment for years or decades? "Enlightened" Friedmanites take a longer-term perspective. Is it in the best interests of shareholders to clear-cut a forest and maximise current production, without replanting it? Or to sustainably manage the forest resource so that it provides a moderate level of output for decades to come? This long-term perspective can lead to the same result as managing for stakeholders (discussed next), but there is a difference in motive.

1.4.4 Stakeholder Theory (Freeman, 1984)

One of the leading alternatives to shareholder theory is stakeholder theory, proposed by Edward Freeman in 1984.[4] Stakeholder theory asserts that a manager's goal should not be to maximise shareholder wealth as a primary purpose, but rather to create value for all stakeholders. Freeman intentionally used the word "value" instead of "wealth," as value includes (but is also broader than) financial outcomes. It includes human well-being, benefits from collaboration, etc.

4. Freeman, R. E. (1984). *Strategic management: A stakeholder approach*. Pitman.

> One of stakeholder theory's premises is the "responsibility principle," which says that people want to and should consider how their actions impact others. Applying this principle to corporations means that a manager needs to consider how the firm's actions can impact others, and manage the firm accordingly. Stakeholder theory sees business as a set of relationships between groups that have a stake in a firm's activities, and the manager's job is therefore to manage, and create value for, these relationships. Freeman defines a stakeholder as "any group or individual that can affect or be affected by the realization of an organization's purpose".[5] Practically, some stakeholders will have a stronger claim on the firm than others.

Freeman[6] classifies five primary (most important) stakeholders and their stakes are as follows:

- Financiers (shareholders and debtholders) have a financial stake in the firm and expect a financial return from the firm
- Employees provide human capital to the firm and are impacted by the firm in terms of working conditions. Employees may also be decision-makers in the firm (e.g. if they are managers), or they can also be financiers (e.g. via employee stock options)
- Suppliers and customers have a stake in the firm in terms of exchanging products and services for resources (money)
- Communities grant firms the "right to operate" and can be impacted by the firm's operations e.g. provision of local services or dumping hazardous waste

There can also be secondary stakeholders.

5. Ibid.

6. Ibid.

Source: Adapted from R. Edward Freeman, Jeffrey Harrison, and Andrew Wicks, *Managing for Stakeholders* (New Haven: Yale University Press, 2007)

There may be conflicting interests between groups of stakeholders and the manager's job is not to trade-off these conflicts, **but to work out a way to create value for all parties.** Stakeholder theorists, therefore, argue that managing for stakeholders is simply good business practice. If all stakeholders are managed well this will result in a profitable, well-run firm.

CONCEPT CHECK: What is happening in the real world?

The Business Roundtable is an organisation that consists of Chief Executive Officers (CEOs) of more than 181 major companies in the United States. The organisation has been issuing statements on the Purpose of the Corporation since 1978, and since 1987 it has defined the purpose of the corporation to be to serve shareholders first and foremost.

In August 2019, "the Business Roundtable" has changed its statement to:

We commit to:

- *Delivering value to our customers. We will further the tradition of American companies leading the way in meeting or exceeding customer expectations.*
- *Dealing fairly and ethically with our suppliers. We are dedicated to serving as good partners to the other companies, large and small, that help us meet our missions.*
- *Supporting the communities in which we work. We respect the people in our communities and protect the environment by embracing sustainable practices across our businesses.*
- *Generating long-term value for shareholders, who provide the capital that allows companies to invest,*

grow and innovate. We are committed to transparency and effective engagement with shareholders.

- *Each of our stakeholders is essential. We commit to delivering value to all of them, for the future success of our companies, our communities and our country.*

Concept Check

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The example above demonstrates that there is a change in business sentiment. CEOs are increasingly realising that creating long-term value for shareholders requires creating value for its stakeholders. Through innovative thinking many co-benefits can be created. In some regions like Europe, there is also increasing regulation on requiring company of their social and environmental impacts, so there is more information and transparency for people to make informed decisions.

1.4.5 Shareholder Value Myth (Stout, 2012)

Cornell Professor of Corporate Law, Lynn Stout wrote a book entitled *The shareholder value myth*[7] in which she discusses the history of the role of companies in society and several inaccuracies about shareholder theory. Watch the video below (for more info here is an article too).

The shareholder value myth | Lynn Stout, Cornell University (YouTube, 12m43s):

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7. Stout, L. A. (2012). *The shareholder value myth*. Berrett-Koehler Publishers. https://scholarship.law.cornell.edu/cgi/viewcontent.cgi?article=2311&context=facpub

view them online here: https://uq.pressbooks.pub/introduction-financial-management/?p=33#oembed-2

Concept Check

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1.4.6 Shareholder Welfare not Wealth (Hart)

Lynn Stout's last point regarding shareholders having pro-social concerns is very similar to Oliver Hart's thesis below.

In the video below, Oliver Hart (winner of the 2016 Nobel Prize in economics) discusses the shareholder theory in the economic field and provides a new perspective on what the goal of the firm should be. In his paper, "Shareholders Should Maximize Shareholder Welfare not Market Value (PDF, 674 KB)"[8], he argues that firms should maximise the welfare of shareholders, which is much broader than wealth. Shareholders are all participants in society and have a range of social and environmental preferences. When a company engages in actions that maximize profits but create externalities that go against a shareholders' ethical preferences, it is suboptimal to engage in these actions and let the shareholders "mitigate" the externalities with their own money. Firms should therefore actively seek shareholders' preferences and values, and act consistently with those. Watch the video below.

Shareholders Care about more than just profits (YouTube, 4m12s)

8. Hart, O., & Zingales, L. (2017). Shareholders should maximize shareholder welfare not market value. *Journal of Law, Finance, and Accounting*, *2*, 247 -274. https://scholar.harvard.edu/files/hart/files/108.00000022-hart-vol2no2-jlfa-0022_002.pdf

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Case Study: Gun Control

Oliver Hart uses the example of Dick's Sporting Goods, which changed its policy on gun control.

Dick's Sporting Goods could generate money by selling assault rifles. Friedman would have argued that, if it is a profitable strategy to sell high-powered guns, then the company should do it, pay shareholders the extra dividend, and they might decide individually to support gun control organizations. However, spending money by shareholders to "reverse" the actions of the company would be very inefficient and suboptimal for the shareholders.

Hart argues that it is more efficient than the company refrains from selling guns in the first place. Shareholders are humans, who have pro-social concerns, and it is assumed that if someone is not only interested in the bottom line, they would prefer to invest in companies who are also interested in issues beyond the bottom line. Oliver argues that if a CEO and managers want to show loyalty to their shareholders, their individual concerns should be taken into consideration.

In other words, instead of making money at the expense of all, the pro-social concerns of shareholders should be accounted for when building a strategy.

TEST YOUR KNOWLEDGE: Child labour

Many companies in the fashion industry operate in developing countries, where labour is cheap and regulations on working conditions and education possibilities are poor. Whilst most of these countries do not legally allow child labour, regulations are not often enforced, as the low wages make it difficult for parents to miss out on the extra income their children can bring in. The CEO of "M&H", a company known for its cheap apparel, says "Our duty is to maximize value for shareholders, this means we have to minimize our costs, and after all, our consumers want the cheapest products." He further says that "without us, our employees would not have any income at all." He does say that he cares about education a lot, and that he personally donates 5% of his income to education initiatives in developing countries. He argues that it would be wrong to donate money with the companies' funds, reasoning that this is the money that belongs to shareholders, who if they wanted to, could donate this themselves.

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Discussion on Edge: Case Study: Merck

Watch this video: Merck & co will pay $4.85 billion to end thousands of lawsuits over its painkiller Vioxx (YouTube, 2m7s)

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Discussion

Assume you were Merck's CEO and you were aware that Vioxx had possible dangerous side effects;

Lawsuits for dangerous side effect and deaths = $ -5 billion

Net Revenue from selling Vioxx = $ 10 billion

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1.5 Business Ethics

In this chapter we have touched upon ethics. Ethics is concerned with what is ethically the "right" thing to do and what is "wrong" or "not right". Many may consider *"Do unto others as you want them to do unto you"* as a general ethical principle to live by. In business, sometimes it seems that different ethical rules apply to everyday ethics and a "dog-eat-dog" attitude is acceptable. Billionaire Jeremy Grantham argues the following:

> *"Capitalism has this strange ability to kind of paralyse the altruistic part of humans. So at the weekends, they're altruistic, they love their grandchildren. Then during the week they take on the character of the corporation whose only job description, says Milton Friedman, is to maximize short term profits. If a human being does nothing except maximize their self interest, they're a sociopath. That's how it's defined. So during the week you behave like a sociopath and as if you have no grandchildren-or as if you hate the ones you have. And then at the weekend you become a loving grandfather again. That is apparently what capitalism does to us, based on the evidence."*

This demonstrates the importance of **business culture,** it determines the way people behave and make decisions. Different businesses will have different cultures, and you may want to think about what kind of business culture you want to be part of, or want to create when you have the power to do so.

Evidence shows however that lapses in ethics can also be very costly to both shareholders, managers and the general public. For example, the Global Financial Crisis in 2008/09 has caused devastating losses to many through unethical behaviour of a small group of people. Scandals can cause companies to go bankrupt, such as Enron, whilst others cause major losses for shareholders, the general public's health and loss of trust, such as Volkswagen. In 2018, the big banks in Australia all suffered big share declines as a result of an investigation by the Royal Commission, as they all had been involved in fraudulent and highly unethical practices.

1.6 Summary

In this first chapter, we covered **key financial decisions, different forms of business organisations and different business purpose views.**

- **Key financial decisions** a manager has to make include 1) capital budgeting (what long-term assets should I invest in?) (covered further in Chapters 7-9), 2) financing decisions (how do I finance my operations?) (covered further in Chapters 5 & 6), and 3) working capital management (how do I manage my current assets and liabilities?)
- **There are different forms of business organisations**, which differ in several important aspects, such as control, tax, ease of set-up and liability of members. We discussed 1) Sole Trader (one owner), 2) Partnership: two or more owners of a business, with general – and sometimes also limited – partners and 3) Corporation: an entity separate to its members. Try to list the advantages and disadvantages of each structure and if unsure, revise the respective section. It is also important you are comfortable recommending a business structure in a particular scenario.
- Finally, we discussed **four different views on what the role of a business in society is**. Philosophizing what the role of a corporation in society *ought to be* is a question of business ethics. A very influential, but possibly outdated, the view is that of Friedman (1970) who proposed that the only responsibility of a business is to maximize profits for its shareholders (without deception or fraud, adhering to the law and ethical custom). This theory is referred to as Shareholder Theory. Later theories criticise this view and propose alternatives: stakeholder theory (Freeman), shareholder welfare (Hart and Zingales) and "satisficing" one or more objectives (Stout). In the tutorial, we collect ideas from the different theories in miro. This will be a great tool to revise the theories for the workshop (where we will apply the theories to a case) and your final exam.

Before continuing with the course, we would like to point out that the concepts that are going to be learnt in this course can be applied to any organisation (for-profit, not-for-profit, and everything in between!).

Decisions are often complex and we encourage you in this course to consider both financial and non-financial factors before arriving at a final decision.

2.

THE FIVE PRINCIPLES OF FINANCE

2.1 Introduction

At the end of this chapter, you will be able to:

- explain why money has a time value
- explain the trade-off between risk and return
- explain why cash flows are the source of value
- explain why market prices reflect information
- explain the implications of the fact that Individuals respond to incentives
- apply the five principles of finance to financial decisions.

You may be familiar with "AfterPay", a product of the Australian listed company AfterPay Touch Group Ltd. AfterPay is a financial product that allows consumers to "buy now and pay later", with no financing costs.

Don't just pay later. Pay Better. Choose Afterpay (YouTube, 15s):

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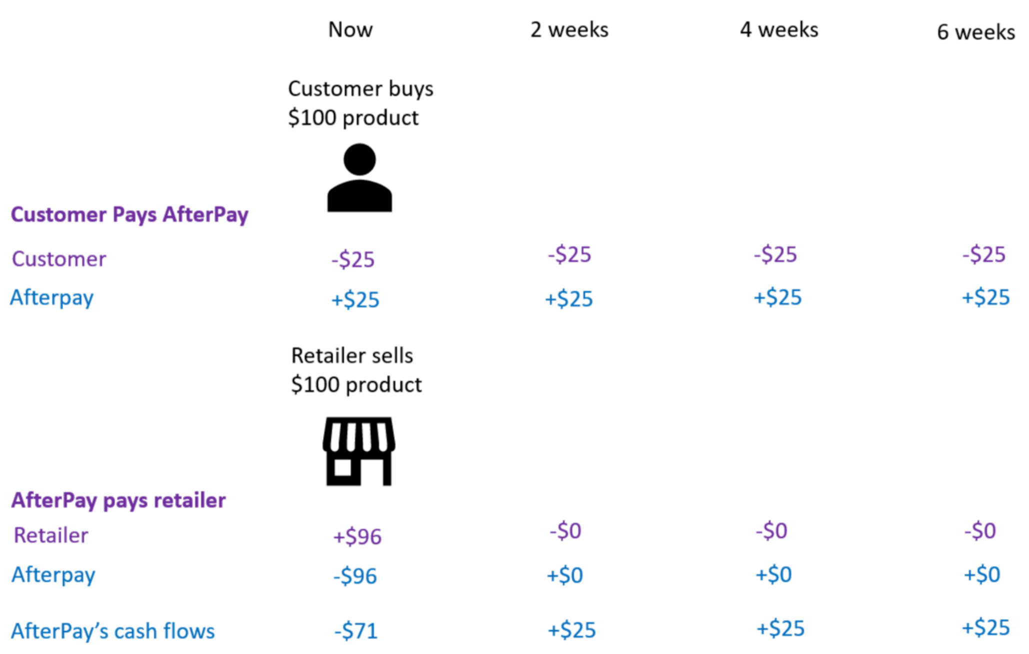
Did you ever wonder how AfterPay Touch makes money from AfterPay?

Or why retailers participate?

2.1.1 How the AfterPay business model works



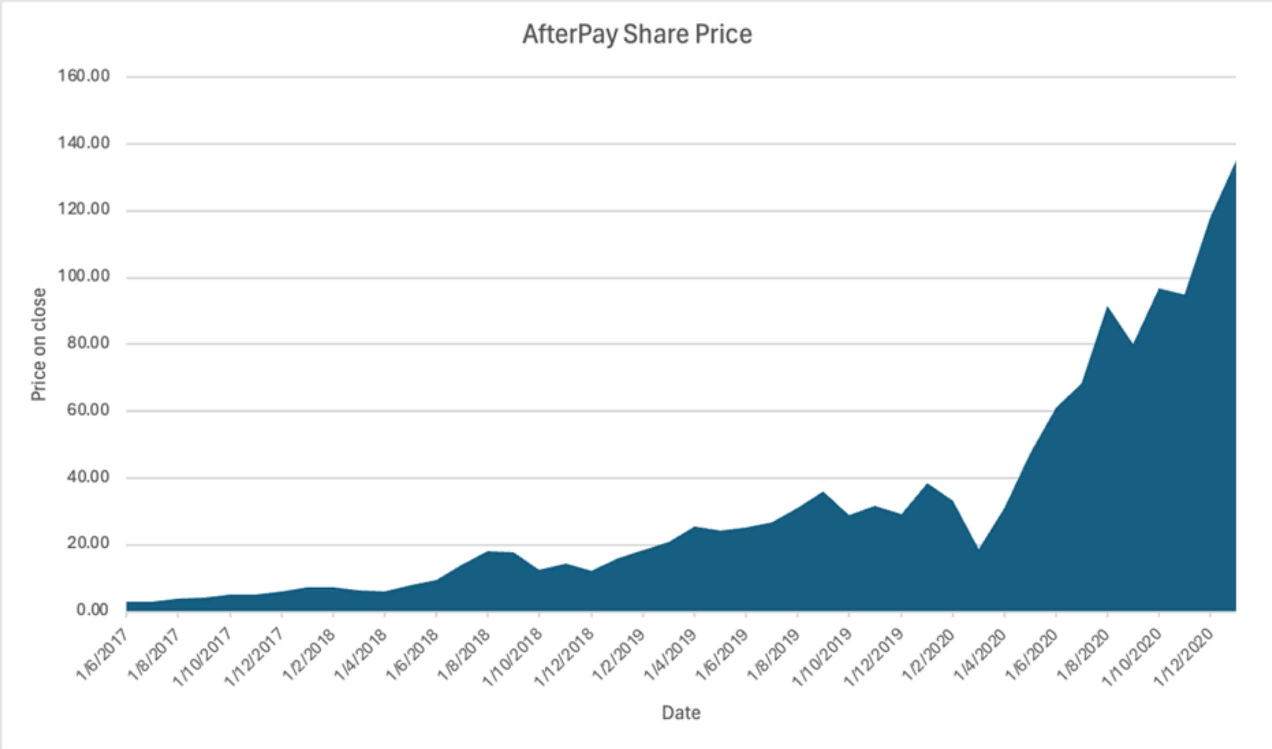
How Afterpay works

Here's how AfterPay works from the customer's perspective, buying a product of $100 using AfterPay:

You pay ¼ (=$25) of the price when you buy your item(s) from a participating retailer, and ¼ more every fortnight for a total of 4 payments (now, in 2 weeks, in 4 weeks and the final payment in 6 weeks). No fees or charges as long as your payments are all on time. Late fees start at $10, with a maximum of up to $68 (depending on the amount of your purchase).

And this is what it looks like for the retailer: The participating retailer receives 96% of the purchase price on the day of purchase. That is, they essentially pay AfterPay 4% of the purchase price for the ability to offer AfterPay to their customers. On a $100 purchase, AfterPay is out-of-pocket $71 on the day of purchase (they pay the retailer $96 and receive $25 from the purchaser), and receive three fortnightly payments of $25. Based on the computations we'll learn later in the course, this equates to a 2.8% return per fortnight for AfterPay (you will learn how to calculate this in Chapter 4), and an annualised return of over 100%.

Of course, AfterPay has many costs to pay out of that return, so the net return to AfterPay Touch shareholders is significantly less than this. Even so, 26 months after listing on the ASX, the share price had risen from under $3 to over $30, meaning investors have great confidence in AfterPay's future. This confidence has continued, with AfterPay's share price at $135.87 on the 1st of Feb 2021 (simply google AfterPay stock and you can see the share prices).



So, as a financial manager, how would **you** analyse the business model of AfterPay?

One way to organise your analysis is to consider the five principles that underlie all financial decision making:

- Money has a time value.
- There is a trade-off between risk and return.
- Cash flows are the source of value.
- Market prices reflect information.
- Individuals respond to incentives.

In this chapter, we will explore each of these principles and what they imply with regard to the financial behaviour of individuals and businesses.

2.2 Why Money Has a Time Value

Would you rather have $100 today or $100 a year from now?

Most people would rather have the money now rather than later. So, to induce people to defer receipt of money to the future, more money must be offered in the future than today. How much more will depend on what you can do with the money in the interim. Most would prefer $200 in one year to $100 today, but is a guaranteed $105 in one year enough for you to be willing to give up $100 today?

Watch the following video for an explanation of how money has a time value.

VIDEO: [Time Value of Money Explained (YouTube, 2m48s)]

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The fact that money has a time value means that timing is an important attribute of cash flows. You can only compare cash flows directly if they occur at the same point in time.

If cash flows are at different points in time, then they must be adjusted using the time value of money formulas to move them all to a single point in time. This concept underlies most of the computations we will do in this course, from figuring out the value of shares to evaluating new products and other financial projects.

When considering the AfterPay business model, the proposition to the customer depends heavily on time value of money – the customer is able to defer payment for up to 6 weeks at no cost. As you will learn in this course, the option to delay payment is generally beneficial to the customer, assuming the customer has an opportunity cost of greater than 0%.

We'll learn more about the time value of money in Chapters 3 and 4.

2.3 Trade-Off Between Risk and Return

Source: Bunch of vintage dice by Lynn Friedman via flickr under a CC BY-NC-ND 2.0 licence.

Imagine you're a contestant on a TV game show. You must choose between two boxes – one box has $1000 in it and one is empty, but you don't know which is which. Before you choose, what is your "expected" outcome – that is, what is the average amount that you will receive?

Your expected outcome is $500 because you have a 50% chance of receiving $1000 and a 50% chance of receiving nothing. Mathematically, your expected outcome is the sum of each possible outcome multiplied by the probability of that outcome:

$$\$500 = 50\% \times \$1000 + 50\% \times 0$$

Does that mean that you will get $500? No. You'll get either $1000 or zero. This is a risky outcome. In other words, you don't know how much you'll receive, but on average you'll get $500.

All business investment involves risk.

You might have a great idea for a new business venture, but there are no guarantees that it will be successful. In order to get the business off the ground, you, and everyone providing funding for the venture, must be prepared to take some risk.

Concept Check

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Say the price of both investments is $450. Now which one would you buy?

- Investment A
- Investment B

Investment A has more risk than Investment B, but the expected outcome of the two investments is the same:

Investment A: $1000 \times 50\% + 0 \times 50\% = \$500$

Investment B: $450 \times 50\% + 550 \times 50\% = \$500$

This means Investment B is a more attractive investment, as most investors are risk averse, and your expected outcome for Investment B is not higher to compensate for the extra amount of risk.

Most investors are *risk-averse*.

This means that for a given return or expected outcome, they will choose the less risky option. In order to encourage investors to take risks (and not just hide their money in a mattress!), riskier investments have to offer higher average returns (or have lower prices). That is, there's a trade-off between risk and return. Riskier investments will have higher returns, on average, and safer investments (like bank deposits) will have lower returns.

Different borrowers pay different interest rates – large banks can borrow at the RBA Cash Rate, which was below 1% p.a. (per annum, or annual) in mid-2019; home loan rates at the same time were around 3-5% p.a., and credit card rates were 13-20%p.a. These different rates reflect the risk that the amount lent will not be repaid.

How does this trade-off between risk and return figure into the AfterPay business model?

One way is through the effective interest cost that AfterPay is able to earn: 2.8% per fortnight. This is a very high return, much higher than credit card interest rates which would be equivalent to approximately 0.8% per fortnight. Part of the reason AfterPay can command this higher return is due to the services provided to both retailers and customers. **But part of the return is due to the risk of non-payment.** At the same time, investors will value AfterPay's shares depending on the risk of the cash flows (e.g. dividends) they expect to receive.

Of course, some investors are more risk-averse than others. This may have to do with the amount of time they have to recoup any losses. Your grandfather may be retired or near retirement. If he loses half of his money from a bad investment, it will affect his ability to support himself in retirement. On the other hand, a 20-year-old has plenty of time to save for retirement. If they invest their super in high-risk/high-growth assets like shares over the 45+ years until retirement, the higher average/expected return on risky investments means that a year of negative returns will be balanced by high returns in subsequent years.

There are other factors that determine how risk-averse an investor is, such as personal investing history, cultural differences, financial literacy, and occupation.

How risk averse are you?

Take the Investment Risk Tolerance Assessment based on academic research and developed by the University of Missouri.

Investment Risk Tolerance Assessment

Concept Check

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2.4 Cash flows are the Source of Value

In finance, cash is king!

Cash can be invested in new products or equipment, or distributed to the company's investors. You might think that profit is more important because profit is what is reported in the company's financial statements, but can we spend profit?

There are some significant differences between profit and cash flow. The most obvious difference has to do with the way accountants treat **investment in fixed assets** – things like buildings and machinery. Even though the equipment purchase will probably require a cash outlay immediately, the accountants will spread the costs over the useful life of the equipment. First, the equipment will be recorded on the balance sheet as an asset rather than showing it as an expense on the income statement. Then, over the useful life of the equipment there will be an **annual expense for depreciation**. However, the firm does not actually spend anything at that point in time. To account for such discrepancies between when cash flows occur and when they are included in profit, **we will learn in Chapter 8 how to convert the company's profit to cash flow.** One adjustment we have to make is to add back any depreciation expense and subtract the cash paid for new purchases of equipment.

Cash flow and profit measure different things.

Profit is an assessment of the economic gain to investors from company activity. When the company is liquidated it can sell assets, pay off liabilities, and whatever is left goes to shareholders. If the economic gain is what you're measuring, then purchasing equipment or land does not represent a loss to the company, and shouldn't go directly onto the income statement as an expense. But, equipment or land won't help the company pay next week's payroll or dividend distributions to shareholders. To continue in business a company must have cash. In finance, we're measuring the value of a business a bit differently to how accountants measure value. Accountants focus on historical cost and verifiable numbers. In finance we focus on cash flow and when the company has access to cash that can be distributed to shareholders. Cash flow determines the market value of the assets a company owns and ultimately the market value of the company as a whole.

What are the cash flows that create value for AfterPay?

When a customer buys a $100 item, AfterPay pays the retailer $96. AfterPay receives 4 payments of $25 from the customer, earning $4 over the six weeks between the purchase and the final $25 payment. Out of that $4, AfterPay must pay its operating expenses, which would include app programming and maintenance; advertising costs, the cost of tracking customer accounts, financing costs, and salaries of the managers and owners of the business. AfterPay's profit will not be the same as the net cash flow for several reasons. For instance, AfterPay would be paying cash currently to develop the app and other software tools that create a large part of the value of the business. As this software will provide value for more than the current year, AfterPay does not treat software development as a current expense. Instead, much like physical assets, the value of the software goes onto the balance sheet as an asset and is amortised (equivalent to depreciation but for intangible assets) over the useful life of the software. But, cash is what is needed to pay creditors, salaries, and merchants. Therefore, any computation of the value of AfterPay to investors will focus on cash flow rather than profit.

Exercise

Which are cash flows?

Which of the following amounts represent cash flows?

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2.5 Market prices Reflect Information

If cash flows are a source of value, how does that relate to the share market?

For listed companies, the company shares trade on share markets constantly when the market is open. You may be familiar with Woolworths grocery stores. Woolworths Group Limited is traded on the Australian Securities Exchange (ASX). It would not be unusual to see 3 million Woolworths shares change hands during a single day of trading on the ASX. Each investor who buys or sells Woolworths shares must think they are getting a fair price for the shares; if a purchaser thought the market price was too high, they wouldn't buy; and if a seller thought the market price was too low, they would hold the shares until they thought the market price was fair. That is, each investor has an idea of the value of Woolworths shares (note that the estimated value need not be identical for every market participant). The share market acts as an auction system and transactions occur when buyers and sellers can agree on the value of the shares.

Where does that idea of value come from?

Professional share analysts estimate the value of companies using a variety of methods, but all of them are based on a knowledge of the business. Often the analyst will forecast the cash flows of the business to determine value. Note that the analyst will be using all three of the previous principles of finance in this process:

1. Future cash flows will be discounted to take **time value** into account;
2. The **risk** of the business will be factored into the **return** required (used as the interest rate to compute a current (present) value);
3. **Cash flows** will be used as a source of value.

To make an accurate forecast, the analyst needs one other ingredient: information about the company, its plans, the market it faces, and the overall economic environment. When valuing Woolworths, the cash flow model will incorporate the effects of competition from Coles and others; consumer confidence in the Australian economy; releases of financial results from Woolworths and its competitors; company announcements about acquisitions, store closures, and many other factors. **When any of these inputs change**, the estimated value of Woolworths will change. As investors incorporate new information into their assessment of the value of Woolworths, the amount they are willing to pay for Woolworths shares (or the amount they are willing to accept if they are selling) will change – and the market price will change.

On Friday 28 June 2019, AfterPay Touch shares dropped as much as 15% in afternoon trading on the back of news that credit card company VISA was planning to enter the buy now pay later market. News of an unexpected large competitor would have caused shareholders and analysts to reconsider their forecasts of the growth in AfterPay's market share, which would, in turn, have reduced the forecast cash flows used to value the shares. The entry of such a large player into the market may also have caused analysts to adjust their estimates of the risk or volatility of those cash flows. As we learned earlier, higher risk means higher required returns. Changing the risk assessment will also affect the value as shareholders will pay more for safer cash flows.

So, in general, announcements bring new information to the market and can cause shareholders and analysts to re-evaluate the value of the business. **The relevant information is anything that is a surprise.** If we expected profit to rise by 5% and profit does rise by 5%, then there's nothing new to incorporate into our forecasts, and share price should not change. On the other hand, if we expected profit to rise by 5% and it only rises by 3%, then we need to adjust our forecast cash flows downward, and our estimate of the value of the company will fall. There are many relevant pieces of information when it comes to valuing a company, so there are many types of announcements that could change the value of a company.

Exercise

Match the events to outcomes

Match the following events to one of three outcomes:

1. Share price likely to **RISE**

2. Share price likely to **FALL**

3. **NO IMPACT** on the share price.

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2.6 People Respond to Incentives

The final principle in this chapter is that people respond to incentives. You know from your own life that incentives are powerful (e.g. if you study hard, you will likely get a good job). Incentives come in many forms. You probably work because you get paid (financial incentive), but you may also volunteer at your local sports club because you gain joy from doing so. In a work context, employee incentives can often be categorised as financial and non-financial incentives.

As we discussed in Chapter 1, there are four major theories about what the goal of the company should be, but let's focus on Shareholder and Stakeholder theory here. **Shareholder Theory** says the firm exists to benefit only the shareholders, while **Stakeholder Theory** says the firm should benefit all stakeholders. We'll cover these theories in more detail in Chapter 12, but for now we want to consider *HOW* the board of directors (and by extension the shareholders and stakeholders) ensure that the firm is managed to provide value for shareholders first and foremost, or for all stakeholders. What stops managers from managing the company to benefit the managers themselves *first and foremost*, at a possible cost of the value for others?

> Let's step back a minute and remember how a corporation is structured.
>
> Shareholders provide equity capital for the firm – they each own shares in the firm. The company is a separate legal entity that owns the assets (and is liable for the debts) of the firm.
>
> Shareholders, however, are not involved in the daily business decisions of the firm. The shareholders elect a board of directors (one share = one vote); the board of directors hires the management team (Chief Executive Officer (CEO), Chief Financial Officer (CFO) and others as needed); and the managers are responsible for overseeing the daily operation of the firm.

This question of how to ensure that managers are managing towards the correct goal is an example of a "*principal-agent problem*". This problem originates from Shareholder Theory.

Under this theory, managers should be running the firm to maximise the overall benefit to shareholders. Shareholders in this instance are the *principals* – that is, shareholders are the ones who provided the capital to start the firm and are, through the board of directors, hiring managers to act as their *agents* in running the firm. But, shareholders don't know the precise details of how the firm runs, what its plans and strategies are, and what needs to be done on a daily basis to keep the firm not only afloat, but thriving. So, there's an *information asymmetry* between shareholders and managers – managers have much better information about their task than shareholders.

How do shareholders make sure that managers don't take advantage of their better information to steer benefits to themselves rather than shareholders?

The conflict that arises when there is information asymmetry between principals and agents is known as the **principal-agent problem**. And the solution to this problem lies in our fifth principle – providing the appropriate incentives to managers. What is appropriate depends on what theory of the firm is adopted.

Exercise

POLL: IMAGINE YOU ARE A MANAGER OF A PUBLIC COMPANY. WHAT JOB ASPECTS DO YOU CARE ABOUT?

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In answering this question, you needed to reflect on how you would respond to incentives. There are clearly no right or wrong answers – different people respond differently. But what is clear is that you do respond to incentives, and the way the incentives are structured will affect how you respond.

Tim Cook, Apple CEO by Austin Community College, CC BY 2.0 via Wikimedia Commons.

When Tim Cook took over as CEO of Apple in 2011, the board of directors granted him 1 million restricted shares in the company. Under the original deal (modified in 2013), the restrictions would lapse on half of the shares in 2016, and on the other half in 2021 (and Cook would be able to sell the shares).

What incentives does this provide?

With such a large portion of his personal wealth invested in Apple, the idea is that such large share ownership would align his incentives with shareholders. For Tim Cook, these shares are in addition to his annual cash compensation of $15 million in 2018 (PDF, 1.73 MB). Famously, Cook's predecessor, Steve

Jobs, received an annual salary from Apple of $1. As the largest individual shareholder, Jobs' compensation for running the company consisted entirely of the increase in his wealth as the share price rose.

CEOs have not always been paid such lofty sums. This podcast from Planet Money, When CEO Pay Exploded, looks at the history of CEO pay and one reason (partly tax-related) that CEO pay exploded in the 1990s.

When a manager's pay is based on accounting measures, then the incentive is for the manager to maximise those measures. If pay is in the form of shares, then the incentive is to maximise share price. So, pay incentives need to be crafted carefully so that the company is incentivising the behaviour that it wants to see.

Most of the discussion so far has been focused on incentives for managers to act in the shareholders' best interest (=increasing the value of the company). However, as businesses adopt a stakeholder perspective, incentives for managers need to be adjusted accordingly, to ensure value for all stakeholders is created. This is exactly what has been happening in recent years, with Australia now leading the world in ESG (environmental, social & governance)-related pay. Thus, pay is increasingly linked to non-financial outcomes such as benefits to the environment and broader society.

Multiple Choice: Shell

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https://uq.pressbooks.pub/introduction-financial-management/?p=41#h5p-18

2.7 Summary: Applying the Five Principles

In this chapter we have explored five principles that underlie all financial decisions:

1. Money has a time value
2. There is a trade-off between risk and return

3. Cash flows are the source of value
4. Market prices reflect information
5. Individuals respond to incentives

To wrap up the chapter, let's consider how all five of these principles apply to something that will be relevant to your personal financial decision making: superannuation.

1. Money has a time value

As we will see in the next two chapters, the time value of money means that the longer you save, the greater the impact of compound interest on the value of your savings. The earlier you start saving, the greater your balance at retirement. This is the principle behind the policy to require employers to contribute 9.5% of your salary to a superannuation fund.

2. There is a trade-off between risk and return

Higher risks lead to higher returns. In deciding which investment option to choose for your superannuation, you will be making a trade-off between risk and return. You could choose to invest your superannuation in government bonds, but to get the returns required to grow your savings, you will need to take greater risks. Fortunately, with 40+ years until you retire, your investment has plenty of time to recover from a loss.

3. Cash flows are the source of value

As you will learn in Chapters 5 and 6, the value of the investments in your superannuation will be based on the cash flows generated by those investments – dividends for share investments, and interest for bond investments. And the value of superannuation to you is the cash flows you will receive to support yourself during retirement.

4. Market prices reflect information

Information about future cash flows – or about trends and regulations that will affect future cash flows – will be an input into the valuation of the investments in your superannuation account.

5. Individuals respond to incentives

A major goal of superannuation is to reduce the reliance of retirees on the Age Pension. To do this, the government needs to convince people to save enough to support themselves in retirement. In addition to requiring employers to make contributions to superannuation, the government provides tax concessions to incentivise individuals to make voluntary additional contributions. These incentives include a 15% tax rate on both contributions and earnings inside superannuation (as compared to a progressive tax rate on individual income that ranges from 19% to 45%) and the ability to withdraw income from superannuation after age 60 without paying additional tax. Individuals have responded to these tax incentives so that superannuation investments now total A$2.9 trillion.

PART II

VALUATION AND CAPITAL BUDGETING

3.

TIME VALUE OF MONEY (PART 1)

3.1 Introduction

At the end of this chapter, you will be able to:

- **visualise** cash flows using **timelines**
- **explain** the concept of **time value of money**
- **apply time value computations** to present and future values
- explain how **compounding** applies to **non-financial contexts**
- **calculate comparable interest rates** regardless of how they are quoted.

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Click the accordion to access the text of the video (you can skip this if you watched the video)

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3.2 Timelines

We can make our lives much easier by visualising the concept of time value of money using **timelines.** A timeline allows you to visually present cash flows, most importantly, the *timing* of the cash flows as well as their nature as either inflows or outflows. This helps you better understand an investment project, an event, or any other forms of financial transactions.

3.2.1 Timelines Introduction

NOTE!

We adopt the following conventions in setting up timelines:

- Cash flows occur at the **end** of each time period (unless otherwise stated)
- Cash **outflows** are entered as **negative** (-ve) values
- Cash **inflows** are entered as **positive** (+ve) values
- The start of the time period we are evaluating is represented by n = 0

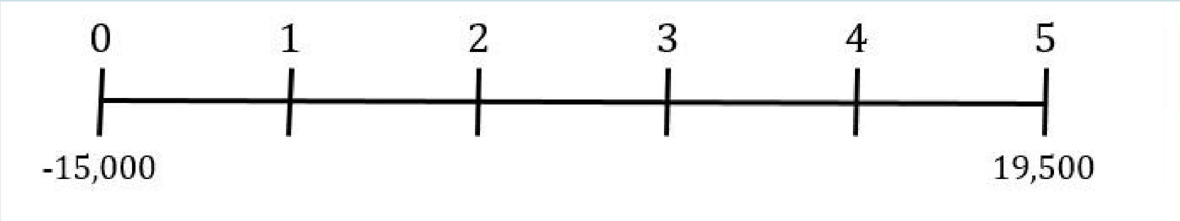
Exercise

Concept check: Part A

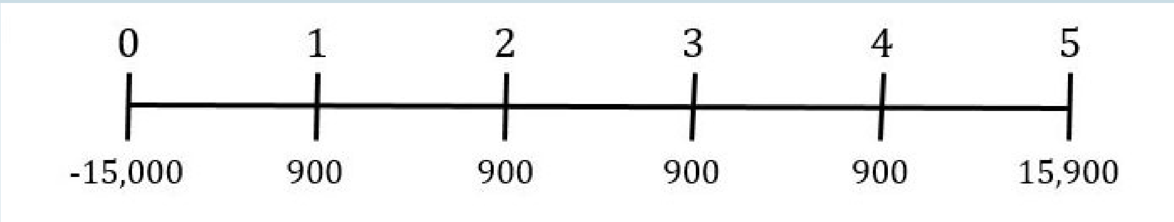
Michael is investing $15,000 in a 5-year bank term deposit that pays a 6% annual interest ($900) at the end of each year. After five years, Michael will receive his $15,000 back.

Which of these timelines correctly represents the resulting cash flows from Michael's perspective?

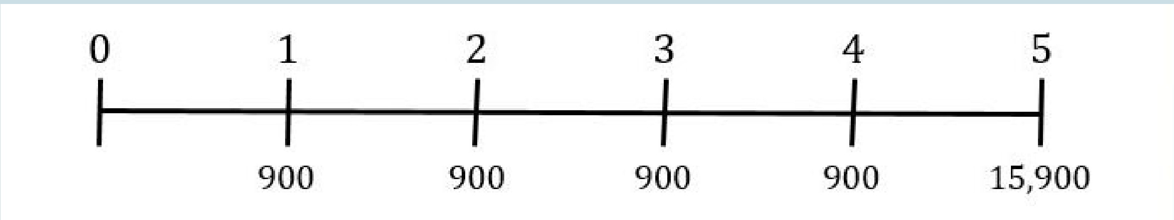
A.



B.



C.



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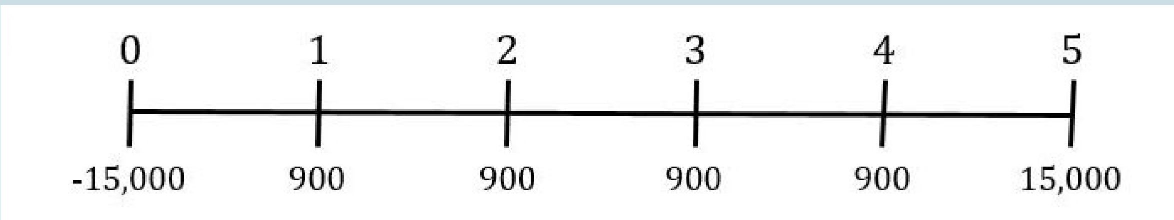

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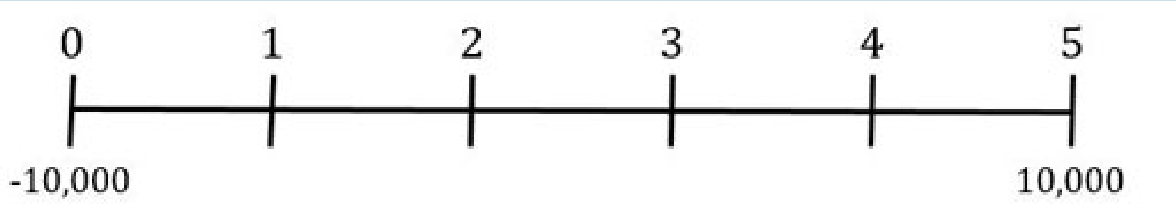
Concept check: Part B

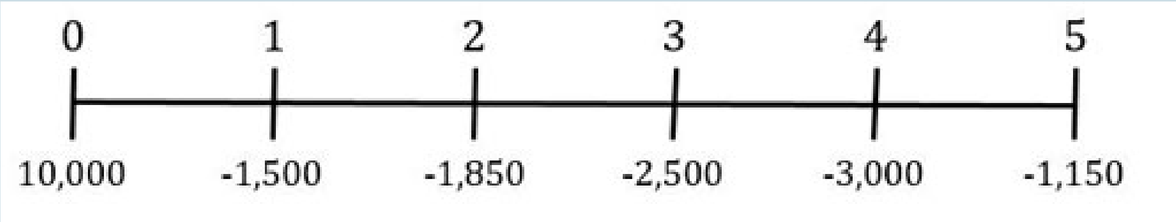
Your brother has asked you for a $10,000 loan and promised to pay back over a 5 year period. He has agreed to pay $1,500 at the end of the first year, $1,850 at the end of the second year, $2,500 at the end of the third year, $3,000 at the end of the fourth year, and $1,150 at the end of the fifth year.

Which of these timelines correctly represents the resulting cash flows from your perspective?

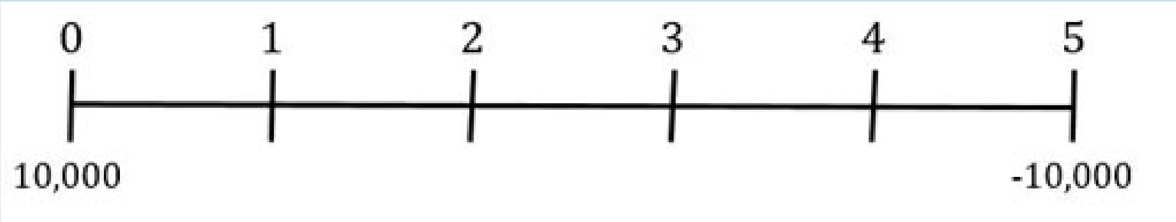
A



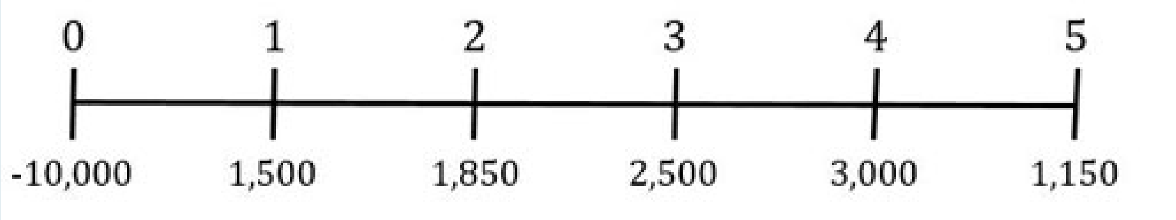
B



C



D



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https://uq.pressbooks.pub/introduction-financial-management/?p=67#h5p-22

3.2.2 Comparing Cash Flows

3.2.2.1 The Basic Concept

Let's have a look at a simple example. Assuming you can earn interest of 5% per annum in a bank savings account, let's compare:

(A) receiving payment of $100 today

(B) receiving a payment of $100 next year.

Which option is better?

3.2.2.2 Comparing Cash Flows

Whichever computation you use, Option A, receiving $100 today is always worth more! The key to this answer is that if you were to receive $100 today, you could earn 5% interest on that sum for one year. If the interest rate were higher, the difference between the value of Option A and Option B would be even greater!

Based on this example, we can make several generalizations:

- The value of a dollar invested at a positive interest rate grows over time. Thus, the further in the future you receive a dollar, the less it is worth today.
- The trade-off between money today and money at some future date depends in part on the rate of interest you can earn by investing. The higher the rate of interest, the more likely you will elect to invest your funds (assuming no additional risk of this higher interest rate).

Note that especially when we have multiple cash flows (Chapter 4) it will be important to draw a timeline. The video below explains this in more detail.

VIDEO: [Tips for Time travel (YouTube, 2m15s)]

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3.3 Time Value of Money Basics

3.3.1 Definitions and Mechanics of Time Value

Calculations

With the use of a timeline, you should be able to correctly identify cash flows, and their respective timing, and do some simple calculations by compounding or discounting cash flows. To do simplify our calculations, it would be handy to name the five variables involved in every time value of money problem.

Video: Time Value of Money – Definitions

3.3.1.1 Time Value of Money – Definitions

1. **Present value (*PV*)** – While present value can refer to the value today of a cash flow in the future, it can be helpful to think of present and future as relative terms. Whenever we are moving a cash flow backwards in time we will be using present value (discounting) computations. So, computing the value in 2025 of a cash flow promised in 2030 is a present value computation; it tells us what we will be willing to pay in 2025 for the promised cash flow in 2030.
2. **Future value (*FV*)** – Value of a cash flow at some specific future time – it is the money you have in your hand at a point in time in the future. Again, future is a relative term. Whenever we are moving a cash flow forwards in time we will be using future value (compounding) computations. So, computing the value in 1990 of a cash flow we expected to receive in 1985 is a future value computation; it tells us what that cash invested in 1985 was worth in 1990.
3. **The number of periods (*n*)** – This is the number of compounding periods (interest computation periods) during the investment. It is usually measured in years, but it could be any scale of time such as quarterly, monthly, or even daily.
4. **Interest rate (*r*)** – This is the growth rate of your money over the lifetime of the investment. This is also called the rate of return, discount rate, interest rate or growth per period.
5. **Cash flows (*CF*)** – These are a series of either single, equal, or mixed, evenly-spaced or irregular cash flows. Cash flows can be positive or negative. If we're receiving money (cash inflows) we use positive numbers, if we're paying money (cash outflows) we use negative numbers. As every investment has two sides (borrower/lender; company/shareholder; bank/depositor), each side will be looking at a mirror image of what the other side sees.

The variables are illustrated for the example we saw previously of $100 received today, earning 5% per annum, and solving for the value at year 1.

3.3.1.2 Future Value (FV)

Future Value and Compounding

Future Value (FV) of an investment is what the investment will be worth after earning interest for one or more time periods. The process of converting the initial amount into a future value is called compounding.

NOTE: If you were to invest a certain dollar amount today, it would grow to a larger (hopefully!) value at some point in the future. The value at a future point in time is called the future value. In order to calculate the future value, we must know the principal amount of investment, the rate at which the investment will grow, and the length of time that the investment will be held.

- Present value = Principal amount of investment in this problem is the $100 that is invested today.
- Rate at which the investment will grow is referring to interest rate (*r*) of 10% per annum.
- Length of time that the investment will be held is referring to the number of periods (*n*), usually measured in years.

VIDEO: [Future Value Formula (YouTube, 4m17s)]

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The video has derived the Future Value formula as follows:

$$FV_n = PV \times (1 + r)^n$$

Where:

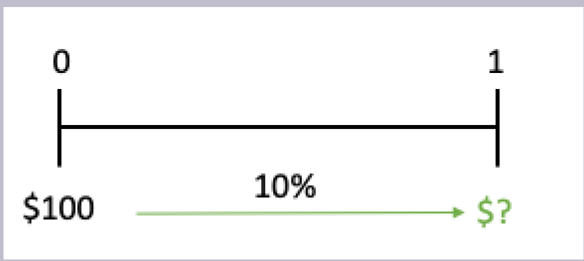
1. PV is how much you have at the start of the time period you are evaluating
2. r equals the interest rate you are earning on the investment
3. n equals the number of periods you are putting the money away
4. FV equals how much you have at the end of the period you are evaluating, the future value
5. The term $(1+r)^n$ is the future value interest factor, often also known as the future value factor.

Examples

Single-period investment

Suppose you place $100 in a bank savings account that pays interest at 10% per year, and expect to hold the investment for one year. How much will the investment be worth at the end of this period? In other words, what is the future value?

Step 1) Draw a timeline



Step 2) Identify the variables you have and need

PV = $100

r = 0.10 (When doing any time value of money calculations, always express interest rate in decimal format)

n= 1

FV= ?

Step 3) Calculate your unknown variable

FV=PV*1+rn
FV=$100*1+0.101
FV=$110

Thus, you would have $110 dollars in 1 year time.

Concept Check

Two-period investment

Now, suppose that at the end of the first period, you decide to hold the investment for another year. At that point, your principal (present value) will be $110 and it will grow for another year at 10%. How much money would you have at the end of the second year? (Input the number without the dollar sign)

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https://uq.pressbooks.pub/introduction-financial-management/?p=67#h5p-23

Think about this...

From the previous example we see that $100 invested at 10% per year for 2 years will grow to $121. Notice that in the second year, you earned $11 in interest as compared to only $10 in the first tear. Where did the extra $1 come from?

That is the interest that you earned on the $10 interest from year 1 ($10 × 0.10 = $1). In other words, the extra interest came from the process of compounding!

NOTE: a two-period investment is simply two single-period investments back-to-back. After the first period, interest accrues on the original investment (principal) and on the interest earned in preceding periods. The future value of $121 at the end of year 2 consists of three parts:

The initial investment of $100.

The $20 ($10 + $10) of simple interest earned at 10% for the first and second years.

The $1 interest earned during the second year on the $10 of interest from the first year ($10 × $0.10 = $1). This is called interest on interest. The total amount of interest earned is $21 ($10 + $11), which is called compound interest.

The Power of Compound Interest

The concept that interest compounds – that is, that you earn interest on the interest earned in previous periods – is very powerful. To see the effect of compounding, compare the compound interest to the amount of interest you would earn without compounding. We call interest computed without compounding "simple interest", and it's computed as the interest rate times the original principal. For one period it's the same as compound interest:

$$FV_{1\ simple} = PV + PV \times r = PV \times (1 + r)$$

But for subsequent periods it's quite different:

$$FV_{2\ simple} = PV + PV \times r + PV \times r = PV \times (1 + r \times 2)$$

and

$$FV_{n\ simple} = PV \times (1 + r \times n)$$

Exercises

Anna received a $6000 inheritance from her great Aunt at the start of 2005, which she deposited immediately. She now wants to use it for her wedding, taking place at the start of 2022. If her bank pays 3% interest per year, how much will she have for her wedding?

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https://uq.pressbooks.pub/introduction-financial-management/?p=67#h5p-24

3.3.2 Re-arranging the FV formula

In the previous sections, you learned everything that you need to know in order to solve time value of money problems. That is quite a bold statement, but it is true! The key is that we derived basic time value of money formula to solve for future value:

$FV_n = PV \times (1 + r)^n$

From this formula, we can easily derive other formulas for solving for any of the variables in a time value problem:

$$FV = PV\,(1 + r)^n$$

Rearranging the variables, we can develop equations to calculate the Present Value , Interest Rate, and Time.

$$PV = \frac{FV}{(1 + r)^n} \qquad r = \left(\frac{FV}{PV}\right)^{\frac{1}{n}} - 1 \qquad n = \frac{\ln(\frac{FV}{PV})}{\ln(1 + r)}$$

Note that the mathematical re-arranging is the "easy" part, the more difficult part is to figure out from a problem which variable you need to solve for. But don't worry, your timelines and practice will help you!

3.3.3 Present Value (PV)

Present Value and Discounting

When calculating the Present Value **(PV)** of an investment, we calculate the value of a cash flow at an earlier point in time. This can be useful to understand for many reason, such as how much you need to save to achieve a desired outcome in the future.

In the video below we demonstrate an example for the following present value problem: After finishing his apprenticeship, Joe wants his own food truck. He has 2 years to save $1800 for the deposit. He knows his bank pays 6% interest, but how much does he need to deposit now to have $1800 in 2 years' time?

VIDEO: [Present Value Formula (YouTube, 2m26s)]

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The process of converting the future cash flows into present value is called discounting. The present value formula is:

$$PV = \frac{\mathrm{FV}_n}{(1+r)^n}$$

Remember that *n* is the number of periods in the future that the future cash flow is located (relative to the present value). Note that as we are dividing the future value, the present value will always be less than the future value (at a positive interest rate). Accordingly, the present value can be thought of as the current value of a future cash flow that has been discounted at the appropriate discount rate.

Just as we have a future value factor (1+*r*), we also have a present value factor, which is more commonly known as the discount factor. The discount factor, which is $\frac{1}{(1+r)}$ is the reciprocal of the future value factor. This expression may not be obvious in the equation above, but note that we can write that equation in two ways:

$$PV = \frac{\mathrm{FV}_n}{(1+r)^n}$$

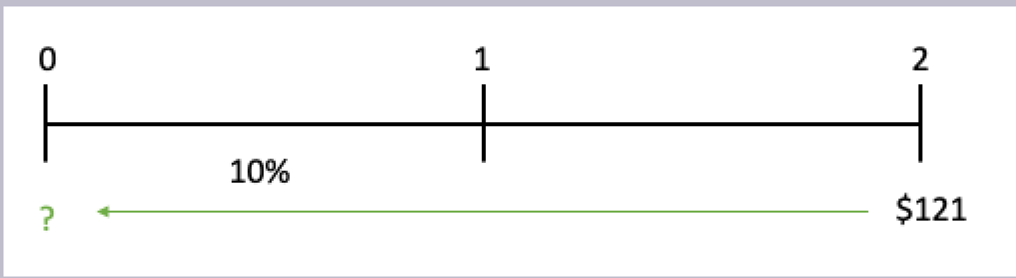
$$PV = \mathrm{FV}_n \times \frac{1}{(1+r)^n}$$

Example

Two-period investment – Example

Suppose your mother gives you a 10% term deposit. The term deposit matures in two years and pays $121 at maturity. The term deposit cannot be redeemed until maturity. Being a student, you want the money now and would like to sell the term deposit. What would be the fair price if you sell the term deposit today?

Step 1) Draw a timeline



Step 2) Identify the variables you have and need

FV = $121

r = 0.10

n= 2

FV= ?

Step 3) Calculate your unknown variable

$$PV = \mathrm{FV}_n \times \frac{1}{(1+r)^n}$$

$$PV = \frac{\$121}{(1+0.10)^2}$$

PV=$100

Thus, a fair price would be $100. This is because if you sell it for $100, the other party will receive a 10% return each year on this investment.

Test Your Knowledge...

Xiao is a student at UQ and is very excited about the newest Tesla car. Unfortunately, she is a student and cannot afford to buy one. She estimates that a second-hand Tesla will cost $20,000 in 6 years' time. Her parents say that they will make a deposit now into an account earning 4% per year, which she will receive in 6 years if she graduates. How much do her parents have to deposit so that she can buy the Tesla in 6 years?

An interactive H5P element has been excluded from this version of the text. You can view it online here:
https://uq.pressbooks.pub/introduction-financial-management/?p=67#h5p-25

3.3.4 Interest Rate (r)

There are times where we know the cash flows that occur at different points in time, and would like to know what the interest is that is earned on the investment. For this, we would need to use our re-arranged FV formula for r:

$$r = \left(\frac{FV_n}{PV}\right)^{\frac{1}{n}} - 1$$

Take the previous example where you received a term deposit from your mum. Let's say you didn't know the interest rate of this deposit, but you know that if you would currently sell it you receive $100 (the present value), whilst the value in two years would be $121, what would be the interest rate you earn if you held this investment for two year? Intuitively you may say 10%, but as calculations become more tricky it would be handy toknow the formula that can give you an answer every time.

Using the formula above, we see that a term deposit with a future value of $110, a present value of $100, and 1-year time period, gives a discount rate of 10%:

$$r = \left(\frac{121}{100}\right)^{\frac{1}{2}} - 1$$

$$r = 0.1 \; or \; 10\%$$

Example

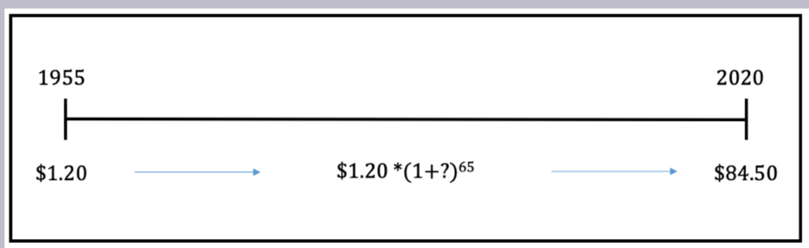
Calculating returns

Your great grandfather bought a share in a company for $1.20 in 1955, and this share currently sells in the market for $84.50. If he sells his share now, what is the return he earned on this investment?

Note: When asked about calculating a return, we often refer to the interest rate.

Step 1) Draw a timeline

In this question, we have the following timeline



Step 2) Identify the variables you have and need

PV = $1.20

N=65 (2020-1955)

FV= $84.50

r=?

Step 3) Solve for your unknown variables

$$r = \left(\frac{FV_n}{PV}\right)^{\frac{1}{n}} - 1$$

$$r = \left(\frac{\$84.50}{\$1.20}\right)^{\frac{1}{65}} - 1$$

$$r = 0.0676 \; or \; 6.76\%$$

Thus, your great grandfather made an annual return of 6.76% on his investment

Exercise

UQ has an iLab program, which helps UQ entrepreneurs (students and staff) put their business ideas into reality. During the program, several investors offer financing to the businesses. One investor offers the following, "I will invest $200,000 into your business, if you pay me $1,000,000 back in 3 years.". What is the annual return on investment this investor asks for?

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https://uq.pressbooks.pub/introduction-financial-management/?p=67#h5p-26

3.3.5 Number of periods (n)

Being able to calculate the number of periods can come in useful if you, for example, want to know how long it would take to save for a holiday if your money is sitting in the bank.

Again, for the term deposit example, you may say answering the following would be easy: if a term deposit pays 10% p.a., costs $100 now, and pays $110 at maturity, how many years until the term deposit matures?

The answer is quite straightforward after going through the example a few times now: it would be one year. The formula we re-arranged for n however is useful when problems become more complex (which they almost always are!).

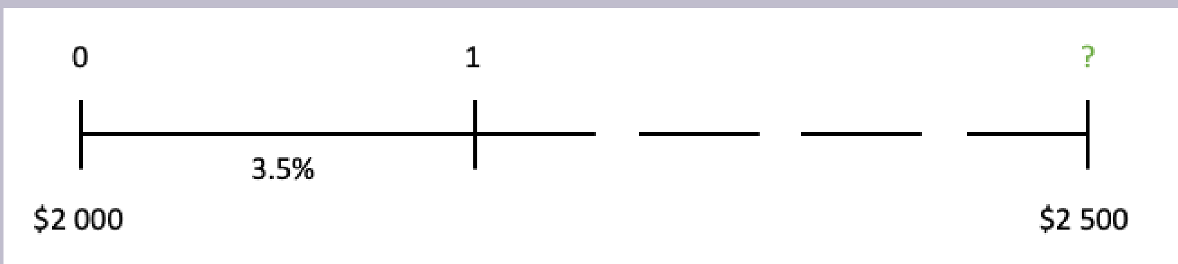
$$n = \frac{ln\left(\frac{\mathrm{FV}_n}{PV}\right)}{ln\ (1+r)}$$

Example

Solving for n

Imagine Paul just received a gift of $2000 from his great Aunt. He would like to use this to go on a holiday after he graduates, and estimates will cost $2500. Earning 3.5% interest p.a., how long will it take until Paul has enough money for his holiday?

Step 1) Draw a timeline



Step 2) Identify the variables you have and need

$PV = 2000$
$FV = 2500$
r=3.5%=0.035
$n = ?$

Step 3) Solve for your unknown variable

$$n = \frac{ln\left(\frac{FV_n}{PV}\right)}{ln(1+r)}$$
$$n = \frac{ln\left(\frac{2500}{2000}\right)}{\ln(1+0.035)} = 6.4864\ years$$

If Paul plans to graduate in about 4 years, he will not have enough for his holiday from his Aunt's funds alone.

Test Your Knowledge…

Adriana just turned 22 and just received a big pay-out from her job. She decides to make an extra contribution of $1000 towards her superannuation. She hopes that when she retires, she can use it to hire someone to build a nice garden for her, estimating to cost $10,000. If her superannuation fund pays a return of 5.5% p.a., how old will she be when she has enough for her garden?

An interactive H5P element has been excluded from this version of the text. You can view it online here:
https://uq.pressbooks.pub/introduction-financial-management/?p=67#h5p-27

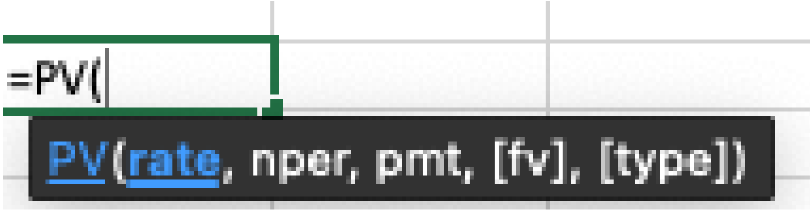
3.3.6 Using Excel

In Excel, the variables we have used so far are named as follows:

- PV = PV (so, the same!)
- FV = FV (so, the same!)
- r = rate

- n = nper

When solving for e.g. PV, you simply type "=PV(" and it will automatically guide you through the process:



You can follow the same process for solving for n: "=nper(...)" etc.

You also see a variable "pmt" and "[type]". With a single cash flow, which is what we worked with in this chapter, you should leave the variable "pmt" at zero. You will learn in Chapter 4 when we can use the "pmt" function/variable. You can close the bracket after filling out your FV, as we use the default function for "[type]".

Exercise

1. What is the difference between *compounding* and *discounting*?

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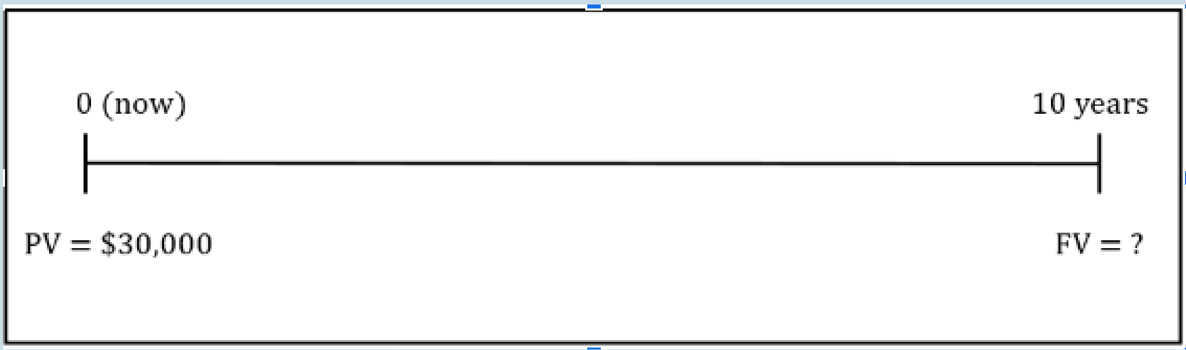
https://uq.pressbooks.pub/introduction-financial-management/?p=67#h5p-28

2. You are planning to invest $30,000 today in an investment fund that will provide a return of 11% each year. What will be the value of the investment in 10 years?



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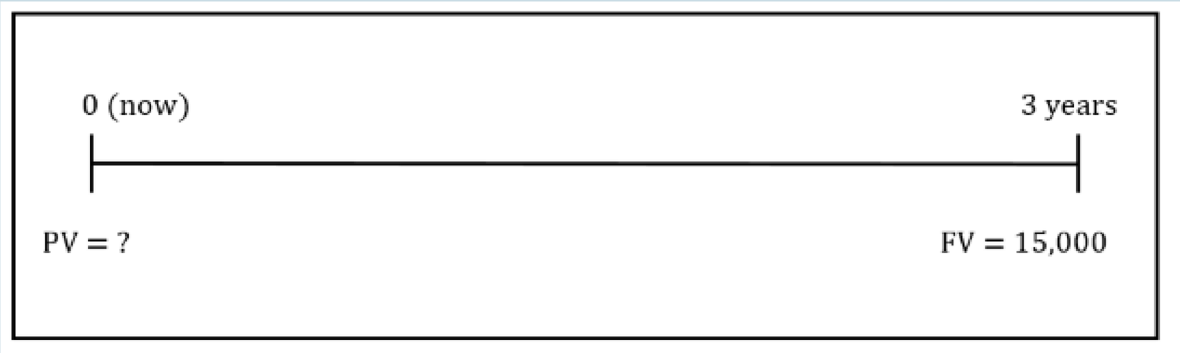
https://uq.pressbooks.pub/introduction-financial-management/?p=67#h5p-29

3. Your sister has asked you for a loan and has promised to pay back $15,000 at the end of 3 years. If you normally invest to earn 6% per annum, how much will you be willing to lend to your sister?



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https://uq.pressbooks.pub/introduction-financial-management/?p=67#h5p-124

4. Simon decided to invest in his favourite stock Tesla on 30 December 2016, when the share price was 42.73USD. Exactly 4 years later, the stock price was 694.78 USD. If Simon sold his share after 4 years, what would be the annual return he earned?

An interactive H5P element has been excluded from this version of the text. You can view it online here:
https://uq.pressbooks.pub/introduction-financial-management/?p=67#h5p-30

5. Your uncle bought his home for $85 000 a long time ago. Its current value is $500 000 (assume January 2020). He says to you "Buying my house was a great investment, so far I've made a return of 8% p.a." Assuming yearly compounding, in what year did your uncle buy the house?

An interactive H5P element has been excluded from this version of the text. You can view it online here:
https://uq.pressbooks.pub/introduction-financial-management/?p=67#h5p-31

3.4 Compounding in Non-Financial Settings

The concept of compounding is not restricted to money. Any number that grows over time, such as the population of a city or the number of frogs in a pond, could grow at some compound growth rate. Compound growth occurs when the initial value of a number increases or decreases each period by a factor (1+ growth rate). As we go through the course, we will discuss many different types of interest rates, such as the discount rate on capital budgeting projects, the yield on a bond and the internal rate of return on an investment. All of these "interest rates" can be thought of as a growth rate (g) that relates future values to present values.

When we refer to the compounding effect, we are really talking about what happens when the value of a number increases or decreases by $(1 + growthrate)^n$. Does this sound familiar? If we want, we can rewrite the future value equation in a more general form as a compound growth rate formula, substituting g, the growth rate, for r, the interest rate.

$$FV_n = PV \times (1 + g)^n$$

Where:

Future value of the economic factor, such as sales or population, at the end of period n.

PV = Original amount or present value of economic factor

g = Growth rate per period

n = Number of periods; a period may be a year but can also be a quarter, month, week, day, minute, or any other length of time.

How do we apply this equation in a non-financial setting?

Suppose, for example, that Jessica, a management student, is writing an assignment and needs an estimate of how fast the world population is growing. In her research, she finds that the world's population was an estimated 7 billion people in 2011. The United Nations estimates that the population could reach 11 billion people in 2050. Calculate the annual growth rate implied by these numbers. At that growth rate, what was the world's population in 2017?

We first find the annual rate of growth through 2050 by applying the above equation for the 39-year period 2011-2050. For the purpose of this calculation, we can use the estimated population of 7 billion people in 2011 as the present value, the estimated future population of 11 billion people as the future value, and 39 years as the number of compounding periods (*n*). We want to solve for *g*, which is the annual compound growth rate over the 39-year period. We can then plug the 39-year population growth rate in the equation and solve for the world's population in 2017 (FV_6).

To find the growth rate;

$$FV_n = PV \times (1+g)^n$$

$$11 = 7 \times (1+g)^{39}$$

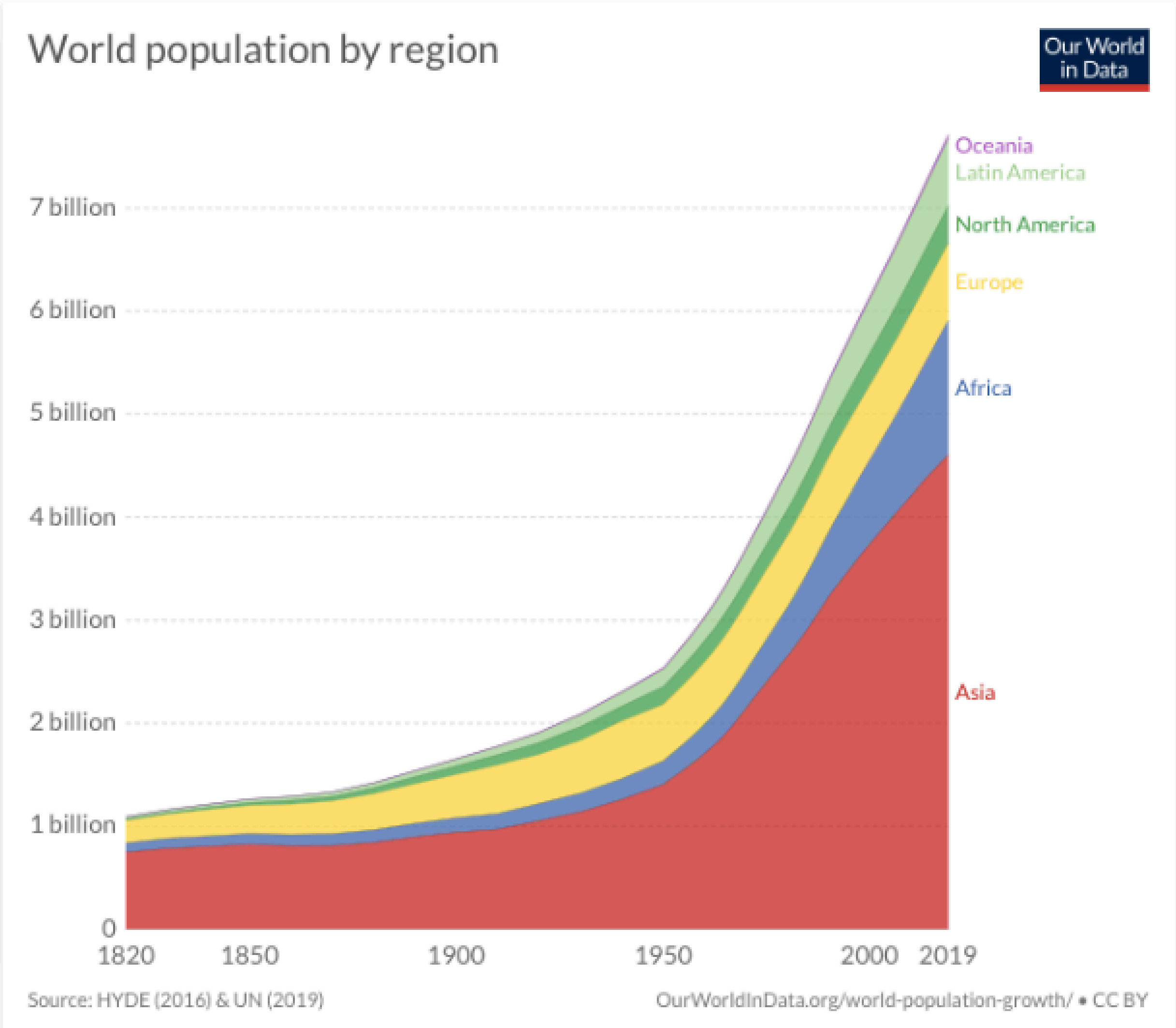
$$\frac{11}{7} = (1+g)^{39}$$

g=\left(\frac{11}{7}\right)^\frac{1}{39}-1=1.0117-1=0.0117\:or\:1.17%

The world's population in 2017 is therefore estimated to be:

$$FV^6 = 7 \times (1+0.0117)^6 = 7 \times 1.0723 = 7.506\ billion\ people$$

The following graph shows how different world regions have grown since 1820.



World population by region by Our World in Data, CC BY 4.0

Since the 1950's the world has seen unprecedented and exponential growths in population and wealth, which have gone paired with numerous socio-economic changes such as energy use and fertiliser consumption for food production. These changes have made our lives a lot better and more comfortable. In turn, these anthropogenic (=human caused) changes are affecting our earth system in unprecedented ways, such as increasing the concentration of greenhouse gases in the atmosphere and the altering of land from forests to farms or domesticated land, causing a loss of biodiversity on a global scale.

Read this article on Acceleration by the International Geosphere Biosphere Program. This will show you the implications of exponential growth in population and the increase in GDP.

For additional materials on the topic, you can view the following video on The Exponential Function where, decades ago, physics professor Albert Bartlett argued that "The greatest shortcoming of the human race is our inability to understand the exponential function"

VIDEO: [Dr. Albert Bartlett: Greatest Shortcoming of Human Race and the Exponential Function (YouTube, 2m4s)]()

One or more interactive elements has been excluded from this version of the text. You can view them online here: https://uq.pressbooks.pub/introduction-financial-management/?p=67#oembed-4

Question: Do you think GDP can grow indefinitely in a world where GDP goes paired with negative environmental impacts and with finite resources?

3.5 Interest Rates: Compounding Period and Interest Rate

Each of the time value formulas contains an interest rate, r, and a number of time periods or payments, n. For each problem or investment, interest is compounded at a given frequency – this could be annual, quarterly, monthly, etc. Compounding frequency depends on the facts given. If you borrow money from a bank, the contract will state how frequently interest will be compounded. We care about compounding frequencies for 2 main reasons:

- Interest rate, r, have to match with the frequency of the payments n.
- Interest rates with different compounding periods cannot be compared (next section)

The problems we've dealt with so far have all involved annual compounding. In that case, the compounding period is a year, and the appropriate interest rate is the annual rate itself. Things are a little more complicated with non-annual compounding periods.

3.5.1 Annual Percentage Rates (APR)

Banks and other credit providers disclose to consumers what is called an **annual percentage rate** (APR).

The APR, otherwise known as the nominal rate, is the annualised interest rate using simple interest (thus without compounding!).

Let's say you observe an interest rate of 10% on your bank's website for a credit card. This observed rate is what we call the quoted rate, or APR (it is required to be disclosed by law). Does this mean you pay 10% per year? Not necessarily. It depends on the compounding frequency. You find out that the interest rate is compounded monthly. This means you have actually only been provided with a monthly rate, which you have to calculate. How does that work??

VIDEO: Interest rates (YouTube, 2m20s)

One or more interactive elements has been excluded from this version of the text. You can view them online here: https://uq.pressbooks.pub/introduction-financial-management/?p=67#oembed-5

To convert the APR into the variables for time value formulas, APR is divided by the number of compounding periods per year to get the "periodic" interest rate, or the interest rate per compounding period to get r for the PV or FV formula. And the number of years is multiplied by the number of compounding periods per year to get the n for the time value formulas.

Let's consider quarters as an example:

Suppose we have a time value problem that runs for five years and has an APR of 12%, compounded quarterly. If we have quarterly cash flows that run for 5 years, what is our r and n?

The r rate for that period is 12%/4=3%. The time dimension (=n) of the problem is 20 quarters rather than five years (5 years x 4 quarters/year = 20 quarters). Hence r and n for the problem should be 0.03 and 20, respectively.

Exercise

Match the APR and compounding frequency to r and n :

An interactive H5P element has been excluded from this version of the text. You can view it online here:
https://uq.pressbooks.pub/introduction-financial-management/?p=67#h5p-32

Example

Your bank offers you a "special" student loan to buy your new $1400 laptop for your studies. The interest rate is 8% p.a. compounded weekly. You plan to pay back the loan in full, in one payment, in 5 years time. How much do you owe the bank then?

This question is asking about the future value of your loan. The present value is $1400, your interest rate per period (weeks) *r* is 0.08/52, and your total number of periods (weeks) *n* is 5*52.

$$FV^n = PV \times (1+r)^n$$
$$FV^{5*52} = \$1400 \times \left(1 + \left(\frac{0.08}{52}\right)\right)^{5*52}$$
$$FV^{260} = \$2,087.91$$

Thus, you owe the bank $2087.91 in 5 years time.

3.5.1.1 More examples of compounding periods and interest rates

VIDEO: Compounding frequencies (YouTube, 2m20s)

One or more interactive elements has been excluded from this version of the text. You can view them online here: https://uq.pressbooks.pub/introduction-financial-management/?p=67#oembed-6

3.6 Equivalent Interest Rates

3.6.1 Working with Different Compounding Frequencies

Often we need to compare different investments, and as we've seen, not all interest rates are quoted the same way. Compounding frequency matters. For a 12% APR, would you rather borrow with quarterly compounding or fortnightly compounding? How would you compare?

Let's consider the credit card from the last section. Remember that the APR is 12% and compounding is monthly. You charge $100 on the card at the beginning of the year. At the end of the year, you go to pay off the credit card balance as planned. It seems reasonable to assume that with an APR of 12%, your credit card balance at the end of one year would be $112 (1.12 × $100 = $112). Is that right? Wrong! The bank is actually charging you 1% per month, meaning that the bank will compound your credit card balance monthly, 12 times over the year. The bank's calculation for the balance due is $112.68 ($\$100 \times 1.01^{12} = \$112.68$). The bank is actually charging you 12.68% per year, and the total interest paid for the 1-year loan is $12.68 rather than $12. This simple example raises a question: What is the correct way to annualise an interest rate?

VIDEO: Introduction to EAR (YouTube, 3m3s)

One or more interactive elements has been excluded from this version of the text. You can view them online here: https://uq.pressbooks.pub/introduction-financial-management/?p=67#oembed-7

3.6.2 Computing the Effective Annual Interest Rate

Given the credit card example above, we can conclude that when interest on your investment or loan is paid more frequently than once a year, you may in fact be earning (or paying) a higher rate of interest on your savings than the quoted rate given to you by your financial institution. Every interest rate quoted has a compounding frequency associated with it. If this is not stated explicitly confusion can (and often does) arise about exactly what that interest rate means.

VIDEO: [Calculating the EAR (YouTube, 2m40s)]

One or more interactive elements has been excluded from this version of the text. You can view them online here: https://uq.pressbooks.pub/introduction-financial-management/?p=67#oembed-8

The Effective Annual Interest Rate (EAR) is an important tool that allows the evaluation of the true return on an investment or true interest rate on a loan. More specifically, EAR is defined as the annual growth rate that takes compounding into account. Mathematically, the EAR can be stated as follows:

$$EAR = \left(1 + \frac{APR}{m}\right)^m - 1$$

where

m = the number of compounding periods during a year

APR = quoted or nominal interest rate

The EAR conversion formula accounts for the number of compounding periods, and thus effectively adjusts the annualised quoted interest rate for the time value of money. In the case of compounding more frequently than once per year, the EAR is always higher than the stated annual interest rate. Because EAR is the true cost of borrowing and lending, it is the rate that should be used for comparing different investment options. Note however that simply converting the APR to the EAR does not take fees into account which should be considered when deciding between investment options (more on this in Chapter 4!).

We will use our earlier bank credit card example to illustrate the EAR equation. Recall that the credit card has an APR of 12% (1% per month). The APR is the quoted interest rate, and the number of compounding periods per year (m) is 12. Applying the EAR equation, we find that the effective annual interest rate is:

$$EAR = \left(1 + \frac{APR}{m}\right)^m - 1$$

$$= \left(1 + \frac{0.12}{12}\right)^{12} - 1$$
$$= (1.01)^{12} - 1$$
$$= 1.1268 - 1 = 0.1268 \; or \; 12.68\%$$

The EAR of 12.68% is the true cost of borrowing the $100 on the bank credit card for one year. The calculation adjusts for the effects of compounding and, hence, the time value of money.

Finally, notice that interest rates are quoted in the marketplace in three ways:

1. The quoted interest rate (APR). This is an interest rate that has been annualised by multiplying the rate per period by the number of compounding periods per year.
2. The interest rate per period (periodic interest rate). The bank credit card rate of 1% per month is an example of this kind of rate. You can find the interest rate per period by dividing the quoted interest rate by the number of compounding periods per year.
3. The effective annual interest rate (EAR). This is the interest rate actually paid (or earned) over a year, which takes compounding into account. Sometimes, it is difficult to differentiate a quoted interest rate from an EAR. Generally, however, an annualised consumer rate is an APR rather than an EAR.

Example

Suppose you are the Chief Financial Officer (CFO) of Infigen Energy. Your firm is planning a $1 billion solar farm expansion and will finance it by borrowing money for 5 years. Three banks have submitted interest rate quotes, all are APRs:

- **Westpac:** 10.40% compounded monthly
- **Commonwealth Bank**: 10.90% compounded annually
- **ANZ:** 10.50% compounded quarterly

Although all the loans have the same maturity, the loans are not comparable because the APRs have different compounding periods. To make adjustments for the different time periods, we apply the EAR equation to convert each of the APR quotes into an EAR:

Westpac:

$$EAR = \left(1 + \frac{0.1140}{12}\right)^{12} - 1$$

$$= (1.0087)^{12} - 1$$
$$= (1.1091) - 1$$
$$= 0.1091,\ or\ 10.91\%$$

Commonwealth:

$$EAR = \left(1 + \frac{0.1090}{1}\right)^{1} - 1$$
$$= (1.1090) - 1$$
$$= 0.1090,\ or\ 10.90\%$$

ANZ:

$$EAR = \left(1 + \frac{0.1050}{4}\right)^{4} - 1$$
$$= (1.0263)^{4} - 1$$
$$= (1.1092) - 1$$
$$= 0.1092,\ or\ 10.92\%$$

As shown, Commonwealth Bank offers the lowest interest cost at 10.90%.

Notice the shift in rankings that takes place as a result of the EAR calculations. When we initially looked at the APR quotes, it appeared that Westpac offered the lowest rate and Commonwealth had the highest. After calculating the EAR, we find that when we account for the effect of compounding, Commonwealth actually offers the lowest effective interest rate.

Another important point is that if all the interest rates are quoted as APRs with the same compounding frequency, such as monthly, the interest rates are comparable, and you can select the correct rate by simply comparing the APRs. That is, the lowest APR corresponds with the lowest cost of funds. Thus, it is correct for borrowers or lenders to make economic decisions with APR data as long as interest rates have the same maturity and the same compounding period. To find the true cost of the loan, however, it is still necessary to calculate the EAR.

Exercise

Test your knowledge: Rank the best interest rate

You have $5,000 to invest for five years. You have the following alternatives (all are for a 5 year period and have the same level of risk). Rank the investment based on return.

An interactive H5P element has been excluded from this version of the text. You can view it online here:
https://uq.pressbooks.pub/introduction-financial-management/?p=67#h5p-33

An interactive H5P element has been excluded from this version of the text. You can view it online here:
https://uq.pressbooks.pub/introduction-financial-management/?p=67#h5p-34

3.7 Summary

This chapter has introduced the basic principles of a very important concept in finance: *the time value of money*. The basic equations for present value and future value equations are two of the most fundamental relationships in finance and will be applied throughout the remainder of this course.

- Timelines are a critical first step in organizing cash flows in a financial problem.
- There are three rules of time travel:
- Only cash flows that occur at the same point in time can be compared or combined.
- To move a cash flow forward in time, you must compound it.
- To move a cash flow backward in time, you must discount it.

We also learnt that the concept of compounding does not only occur in financial settings. A variable growing at a constant rate (=compounding) occurs in many different settings, and thus we can use the same formula to find out, for example, at what rate a population has been growing. It was shown how our socio-economic systems have been growing exponentially over the past 50 years has caused rapid changes in our natural environment.

Finally, we discussed the importance of interpreting interest rates appropriately. Interest rates are often quoted as Annual Percentage Rates (APRs), compounded at a certain frequency. From this information we can find: 1) *r and n for* our time value of money calculations and 2) the **EAR** for comparing different interest rates with different compounding frequencies.

In this chapter we applied the time value of money concept to a single cash flow, next chapter we will apply the concept to multiple cash flows.

Note that the "discount rate" can also be used to compound.

3.7.1 Key Formulas

$$FV = PV\,(1+r)^n$$

Rearranging the variables, we can develop equations to calculate the Present Value , Interest Rate, and Time.

$$PV = \frac{FV}{(1+r)^n} \qquad r = \left(\frac{FV}{PV}\right)^{\frac{1}{n}} - 1 \qquad n = \frac{\ln(\frac{FV}{PV})}{\ln(1+r)}$$

where:

- **Future Value (FV):** the value at the end of a specific period
- **Present Value (PV):** the value of the beginning of a specific period
- **Number of periods (n):** the number of periods.
- **Interest rate (r):** the interest/growth rate per period.

NOTE: In each time value of money problem, it is important to first draw a timeline. This will help you to identify which variable you are trying to solve for and what the values are for each of the other variables. Both the Present Value and Future value are also a Cash

Flow, where the present value is the Cash Flow at time 0 and the Future Value is the Cash Flow at time n.

$$EAR = \left(1 + \frac{APR}{m}\right)^{m} - 1$$

Where:

m **=** the number of compounding periods during a year

APR = quoted or nominal interest

4.

TIME VALUE OF MONEY (PART 2)

4.1 Introduction

At the end of this chapter, you will be able to:

- explain why cash flows occurring at different times must be adjusted to reflect their value as of a common date before they can be compared
- calculate the present value and future value for multiple cash flows
- identify an annuity, calculate the present value and future value of an ordinary annuity
- identify a perpetuity and calculate the present value of an ordinary perpetuity
- apply time value of money concepts to common financial decisions.

Have you ever thought about taking out a mortgage in a few years? Or maybe heard your parents talk about their retirement goal? For retirement, as people are living longer, we need to save more to fund those extra years in retirement. While we can estimate what retirees of today need in superannuation, it is difficult to project the amount needed for those retiring in 10, 15 or even more years, as there are too many variables relating to how the economy and investment world is likely to perform.

The value of a retiree's superannuation fund largely depends **on its earnings** over a long holding period and **how much is invested** on an ongoing basis. It is important for individuals to adequately plan for retirement by keeping an eye on the value of their superannuation and making adjustments if it appears to be inadequate to meet their future needs.

This topic discusses the discounting and compounding **of multiple cash flows** and provides the tools that should help you to make informed financial decisions that involve multiple cash flows such as your retirement.

4.2 Comparing Multiple Cash Flows – Theory

4.2.1 Time Value of Multiple Cash Flows

In the previous chapter, we introduced the concept of the time value of money. To recall, time value of money concept refers to money today is more valuable than the same amount of money to be received in the future. We have also developed the basics that stem from this concept, such as simple interest, compound interest, present value and future value calculations. Note that this was all done in the context of a single cash flow.
The concepts we covered last week are summarised in the following video.

VIDEO: [Time Value of Money Explained (YouTube, 2m48s)]()

One or more interactive elements has been excluded from this version of the text. You can view them online here: https://uq.pressbooks.pub/introduction-financial-management/?p=94#oembed-1

In this chapter, we consider the value of multiple cash flows. Most business or even personal decisions involve **a series of cash flows over time**.

Imagine you own a pizza shop in Indooroopilly Shopping Centre. You are considering adding a production line and your accountant told you that the decision will require an analysis of the project's expected cash flows over a number of periods. Initially, there will be **large cash outlays** to build and get the new line operational. **Thereafter,** the project should **produce cash inflows** for many years. Because the cash flows occur over time, the analysis must consider the time value of money, discounting each of the cash flows by using the present value formula we discussed in the previous topic. We also learnt that to compare cash flows, we have to convert them to the *same point in time*.

We begin our discussion of the time value of multiple cash flows by calculating the future value and then the present value of multiple cash flows. These calculations are nothing more than applications of the techniques from the previous topic.

4.2.2 Future Value of Multiple Cash Flows

In the previous topic, we worked through some examples that involved the future value of a lump sum of money invested in a savings account that paid a certain interest per year. But suppose you are investing more than one lump sum?

Let's say you put $1000 in a bank savings account today and **another** $1000 one year from now. If the bank pays 8% interest per year, how much money will you have at the end of 2 years? If you add another $1000 at the end of 3 years, how much will you have in three years?

To solve this, we can use the future value equation:

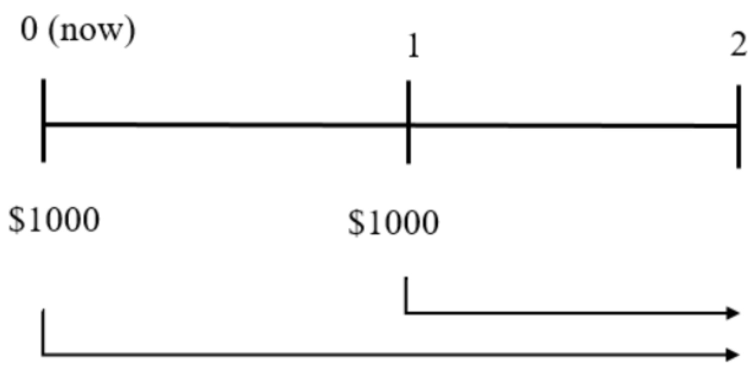
$$FV_n = PV \times (1+r)^n,$$

separately for each of the two $1000 deposits.

VIDEO: [Future Value of Multiple Cash Flows (YouTube, 2m39s)]()

One or more interactive elements has been excluded from this version of the text. You can view them online here: https://uq.pressbooks.pub/introduction-financial-management/?p=94#oembed-2

First, let's look at a timeline so that we can see the magnitude and timing of the cash flows.



There are two cash flows into the savings plan. The first cash flow is invested for 2 years and compounds to a value that is calculated as follows:

$$FV_2 = PV \times (1+r)^2$$
$$= \$1000 \times (1+0.08)^2$$

$= \$1000 \times 1.1664$
$= \$1166.40$

The second cash flow earns simple interest for a single period only and grows to:

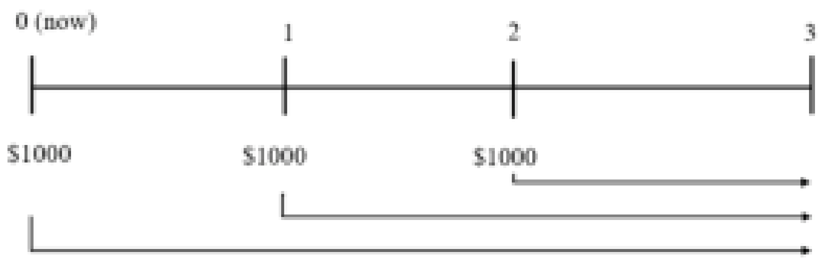
$$FV_2 = PV_1 \times (1 + r)$$
$$= 1000 \times (1 + 0.08)$$
$$= \$1000 \times 1.08$$
$$= \$1080$$

Therefore, the total amount of money in the savings account after 2 years is the sum of these two amounts, which is:

$$\$2246.40 \;\times (\$1166.40 \;+\; \$1080)$$

Now suppose that you expand your investment horizon to 3 years by investing \$1000 today, \$1000 a year from now, and another \$1000 at the end of 2 years. How much do you have at the end of 3 years?

Let's draw a timeline to correctly identify the time period of each cash flow.



Now, we can calculate the future values of each of the individual cash flows.

$$FV_3 = PV_2 \times (1 + r) = \$1000 \times (1 + 0.08) = \$1000 \times 1.08 = \$1080$$
$$FV_3 = PV_1 \times (1 + r)^2 = \$1000 \times (1 + 0.08)^2 = \$1000 \times 1.1664 = \$1166.40$$
$$FV_3 = PV0 \times (1 + r)^3 = \$1000 \times (1 + 0.08)^2 = \$1000 \times 1.2597 = \$1259.71$$

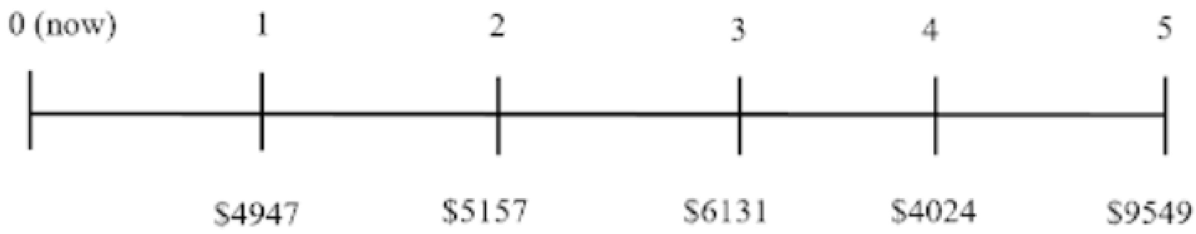
Adding up the future values, the total is \$3506.11.

Our example suggests that instead of earning 8% simple interest on each \$1000 investment, you are also earning interest on interest for the first and second interest received. To summarise, solving future value problems with multiple cash flows involves a simple process:

1. Draw a timeline to ensure each cash flow for its time period are correctly identified.
2. Calculate the future value of each cash flow for its time period.
3. Add up the future values.

Let's use this process to solve a practical problem. Suppose you have an investment that will pay you the following cash flows over the next five years: $4947, $5157, $6131, $4024, and $9549. If you invest these cash flows at an expected rate of 8.25% annually over the five years, what is the future value of your investment's cash flows at the end of 5 years?

Step (1) Draw a timeline



Step (2) Calculate the future values of each cash flow

$$FV5 = 4947(1.0825)^4 + 5157(1.0825)^3 + 6131(1.0825)^2 + 4024(1.0825)^1 + 9549$$

Step (3) Add up all the future values

$$FV5 = 4947(1.0825)^4 + 5157(1.0825)^3 + 6131(1.0825)^2 + 40244(1.0825)^1 + 9549 = 6792.87 + 6541.55 + 7184.34 + 4355.98 + 9549$$

$$= \$34,423.74$$

At the end of the fifth year, you will have **$34,423.74.**

Exercise

An interactive H5P element has been excluded from this version of the text. You can view it online here:
https://uq.pressbooks.pub/introduction-financial-management/?p=94#h5p-35

4.2.3 Present Value of Multiple Cash Flows

In many situations, we need to calculate the **present value of a series of future cash flows**. We do this, for example, to determine what we have to save every year to be able to withdraw at certain amount at a future date. This can be used to find the market price of a bond (Chapter 5), to decide whether to purchase a new machine or to determine the value of a business.

Solving present value problems involving multiple cash flows is similar to solving future value problems involving multiple cash flows:

First, we prepare a timeline to identify the magnitude and timing of the cash flows.

Second, we calculate the present value of each individual cash flow using

$$PV_n = \frac{FV}{(1+r)^n}$$

Finally, we add up the present values. The sum of the present values of a stream of future cash flows is their current market price, or value. There is nothing new here!

Let's work through some examples to see how we can use **present value equation** to find the **present value of multiple cash flows**.

VIDEO: [Present Value of Multiple Cash Flows (YouTube, 3m5s)]

One or more interactive elements has been excluded from this version of the text. You can view them online here: https://uq.pressbooks.pub/introduction-financial-management/?p=94#oembed-3

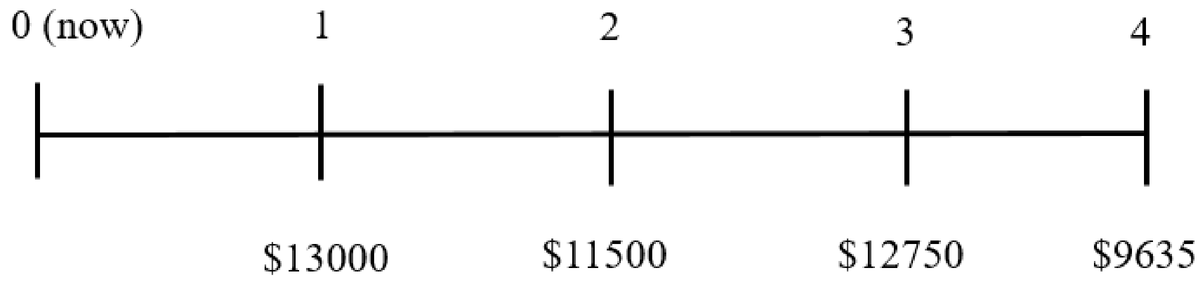
Now, let's consider another example:

Suppose you have an opportunity to buy a small business while you are at university. The business involves selling sandwiches, home-made kombucha and snack foods to students from a truck that you drive around campus. The annual cash flows from the business have been predictable. You believe you can expand the business, and you estimate that cash flows will be as follows: $13,000 the first year, $11500 the second year,

$12750 the third year, and $9635 the fourth year. You did some research at the university and found that an 8% discount rate would be appropriate.

How much should you pay for the business?

Step (1) Draw a timeline



Step (2) Calculate the present values of each cash flow

$$PV_0 = \frac{13000}{(1.08)} + \frac{11500}{(1.08)^2} + \frac{12750}{(1.08)^3} + \frac{9635}{(1.08)^4}$$

Step (3) Add up all the present values

$$\begin{aligned} PV_0 &= \frac{13000}{(1.08)} + \frac{11500}{(1.08)^2} + \frac{12750}{(1.08)^3} + \frac{9635}{(1.08)^4} \\ &= 12037.04 + 9859.40 + 10121.36 + 7082.01 \\ &= \$39,099.81 \end{aligned}$$

This calculation tells us that the value of the business is **$39,099.81**. If you pay $39,099.81 for the business, you will earn a return of exactly 8%. Of course, you should buy the business for the lowest price possible; however, you should not pay more than $39,099.81. If you do, you will be paying more for an investment than it is worth.

Let's test your knowledge before you go on.....

Exercises

1. What is the key economic principle involved in calculating the present value and future value of multiple cash flows?

An interactive H5P element has been excluded from this version of the text. You can view it online here:
https://uq.pressbooks.pub/introduction-financial-management/?p=94#h5p-36

2. What are the steps involved in calculating the future value when you have multiple cash flows?

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https://uq.pressbooks.pub/introduction-financial-management/?p=94#h5p-37

3. Explain why cash flows occurring at different times must be adjusted to reflect their value as of a common date before they can be compared, and calculate the present value and future value for multiple cash flows.

An interactive H5P element has been excluded from this version of the text. You can view it online here:
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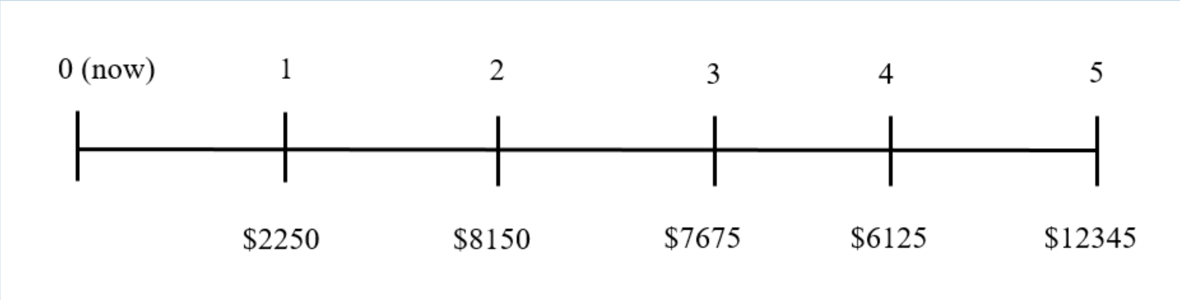
4. Your grandmother has agreed to deposit a certain amount of money each year into an account paying 7.25 per cent annually to help you go to university. Starting next year, and for the following 4 years, she plans to deposit $2250, $8150, $7675, $6125, and $12 345 into the account. How much will you have at the end of the 5 years?

The timeline for the cash flows and their future value is as follows:



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4.3 Annuities – Present Value

4.3.1 Present Value of an Annuity

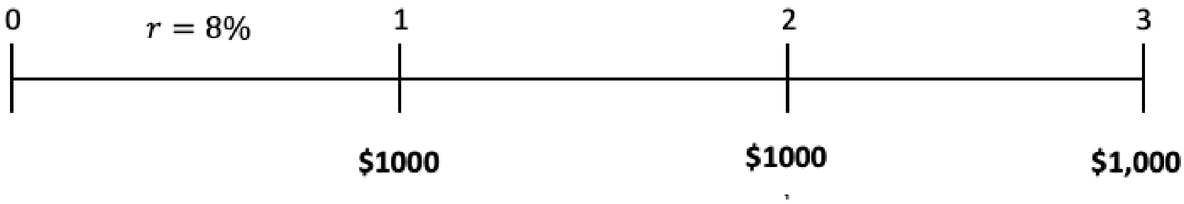
4.3.1.1 Motivation

We often encounter contracts that call for the payment of **equal amounts of cash over several time periods**. For example, most business loans and insurance policies require the holder to make a series of equal payments, usually monthly.

Similarly, nearly all consumer loans, such as car, personal, and home loans, call for equal monthly payments. Let's define some terms:

- Any financial contract that calls for equally spaced and level cash flows over a finite number of periods is called an **annuity.**
- If the cash flow payments continue forever, the contract is called a **perpetuity.**
- Most annuities are structured so that cash payments are received at the end of each period. Because this is the most common structure, these annuities are often called **ordinary annuities.**

We frequently need to find the present value of an annuity (PVA). Suppose, for example, that a financial contract pays \$1000 at the end of each year for 3 years and the appropriate rate is 8%. The timeline for the contract is:



What is the most we should pay for this annuity? Using our usual present value equation of ...

$$PV_0 = \frac{FV}{(1+r)^n}$$

...all we need to do is calculate the present value of each individual cash flow (CF_n) and add them up.

Simply do as follows,

$$\begin{aligned} PV_0 &= \frac{FV}{(1+r)^1} + \frac{FV}{(1+r)^2} + \frac{FV}{(1+r)^3} \\ &= \frac{\$1000}{(1+0.08)^1} + \frac{\$1000}{(1+0.08)^2} + \frac{\$1000}{(1+0.08)^3} \\ &= \$925.93 + \$857.34 + \$793.83 \\ &= \$2577.10 \end{aligned}$$

This approach to calculating the present value of an annuity works as long as the number of cash flows is relatively small. In many situations that involve annuities, however, the number of cash flows is large, and doing the calculations by hand would be tedious. For example, a typical 20-year home loan has 240 monthly payments (12 months x 20 years = 240 months).

Fortunately, our problem can be simplified because the cash flows (CF_n) for an annuity are all the same. ($CF_1 = CF_2 = CF3_{=} \ldots = CF_n = CF$). Thus, the **present value of an annuity (PVA)** with *n* equal payments at interest rate *r* is the sum of the individual present value calculations:

$$PVn = CF(1+r)^1 + CF(1+r)^2 + \ldots\ldots\ldots + CF(1+r)^n$$

Note that each $< em >< strong > CF < /strong >< /em >$ is essentially a future value that is being discounted to its present value.

With some mathematical manipulations that are beyond the scope of this course, we can simplify this equation to yield the present value of an annuity formula:

$$PVA_n = CF \times \left[\frac{1 - \frac{1}{(1+r)^n}}{r} \right]$$

Where:

PVA_n=present value of an n period annuity

CF = level and equally spaced cash flow

r= discount rate, or interest rate

n= number of periods (often referred to as the annuity's maturity)

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https://uq.pressbooks.pub/introduction-financial-management/?p=94#h5p-40

Let's apply the PVA equation to the example involving a 3-year annuity with a $1000 annual cash flow at 8%. To solve for PVA_n, we simply plug our values into the equation:

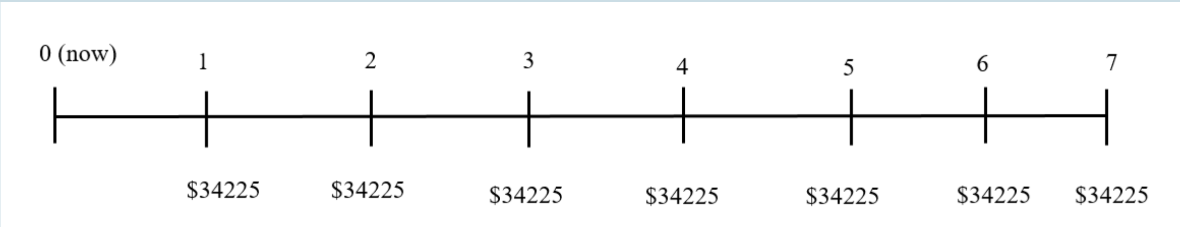
$$PVA_n = CF \times \frac{1 - \frac{1}{(1+r)n}}{r}$$
$$= \$1000 \times \frac{1 - \frac{1}{(1.08)^3}}{0.08}$$
$$= \$1000 \times 2.5771$$
$$= \$2577.10$$

This is equal to the **$2577.10** we calculated by hand earlier.

Exercises

Let's test your knowledge

UQ Ltd is expecting annual interest income of $34,225 for the next 7 years from long term notes receivable. What is the present value of this annuity if the discount rate is 8.5%?



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4.3.2 Re-arranging the PVA Equation

The formula for the present value of an annuity has four variables:

1. Present value (PVA)
2. Amount of each annuity payment (CF)
3. Interest rate (r), and
4. Number of annuity payments (n)

Thus, if you know three of these variables, the remaining unknown variable can be easily computed. The video below shows how to rearrange the PVA equation to solve for monthly or yearly payments (CF), interest rate (r) , and the number of payments (n).

Present Value of an Annuity (PVA):

$$PVA = C * \left(\frac{\left(1 - \frac{1}{(1+r)^n}\right)}{r}\right)$$

$$C = \frac{PV * r}{\left(1 - \frac{1}{(1+r)^n}\right)}$$

$$n = \frac{\ln\left(\left(1 - \frac{PV * (r)}{C}\right)^{-1}\right)}{\ln(1+r)}$$

VIDEO: [Re-arranging the PVA formula (YouTube, 2m)]

One or more interactive elements has been excluded from this version of the text. You can view them online here: https://uq.pressbooks.pub/introduction-financial-management/?p=94#oembed-4

4.3.3 Solving for an Annuity Payment (CF)

4.3.3.1 Finding monthly or yearly payments

A very common problem in finance is determining the payment schedule for a loan on a consumer asset such as a car or a house that was purchased on credit. Nearly all consumer credit loans call for equal payments, e.g. monthly, fortnightly or weekly.

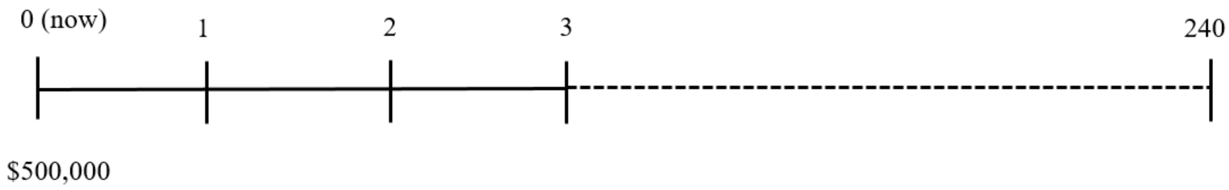
Scenario 1: Suppose that you have just purchased a $550,000 apartment in Southbank. You were able to provide a deposit of $50,000 and obtain a 20-year home loan at 8% for the balance. How much should you pay per month?

From the example, we know that the present value of the annuity is $500,000. It is the price of the apartment less the deposit made ($550,000 – $50,000), which is how much you have to borrow. We also know the number of payments – since the payments will be made monthly for 20 years, you will make 240 payments in total (12 months x 20 years).

***Because the payments are made monthly, both the interest rate and maturity must be expressed in monthly terms*.**

This step is essential to ensure a consistent time horizon is applied throughout the computation. To get the monthly interest rate, we simply divide the annual quoted interest rate by 12. Thus, the monthly interest rate equals 0.6667% (8% / 12 months = 0.6667% per month). What we need to calculate is the monthly cash payment (CF) over the loan period.

Start by drawing a timeline to help visualise the problem:



To find monthly payments, we plug all the data into the present value of annuity formula (PVA).

$$CF = \frac{PVA_n * \ r}{\left(1 - \frac{1}{(1+r)^n}\right)}$$

$$CF = \frac{\$500\ 000 * 0.006667}{1 - \frac{1}{(1.006667)^{240}}}$$

$$CF = \frac{\$3\ 333.50}{0.797189}$$

$$= \$4182.20$$

Therefore, your home loan repayment will be **$4182.20** per month.

(Note that this is a very large monthly amount that most people would be unable to afford. The deposit put in is also less than 10% of the total value of the house. This makes it unlikely that a bank will let you take out this loan)

Exercise

Suppose that you are thinking about installing solar panels on your roof. You are looking to purchase panels at a cost of $5,000. You have been offered a loan for the entire amount of the purchase by your bank. The loan has an annual 7% interest rate, a lifespan of 5 years, and monthly repayments (12 per year). What are the monthly repayments on this loan?

An interactive H5P element has been excluded from this version of the text. You can view it online here:
https://uq.pressbooks.pub/introduction-financial-management/?p=94#h5p-42

4.3.4 Solving for Annuity Payment (CF) – Amortisation Schedule

4.3.4.1 Finding monthly or yearly payments using a loan amortisation schedule

Once you understand how to compute a monthly or yearly loan payment, you are ready to prepare a **loan amortisation schedule**. The term amortisation describes the way in which the **principal (*the amount borrowed*)** is repaid over the life of a loan. With an amortising loan, **some portion** of each month's loan repayment **goes to reducing the principal**. When the final loan payment is made, the unpaid principal is reduced to zero and the loan is paid off. The **other portion** of each loan payment **is interest**, which is payment for the use of outstanding principal (*the amount of money still owed*). Thus, with an amortising loan, each loan payment contains some repayment of principal and interest payment. Nearly all loans to consumers are amortising loans.

A **loan amortisation schedule** is just a table that shows the loan balance at the beginning and end of each period, the payment made during that period, and how much of that payment represents interest and how much represents repayment of principal. To see how a loan amortisation schedule is prepared, consider an example as follows.

Scenario 2: Suppose that you are thinking about buying the new Tesla Truck that currently retails for $60,000. To purchase the car, you will need to take out a loan for the full amount. The dealer kindly offers you a loan to purchase. The loan has an annual 9% interest rate, a lifespan of 5 years, and semi-annual repayments (2 per year).

Prepare a loan amortisation schedule to show:

1. What is the amount of your semi-annual repayments?
2. Calculate the outstanding balance on the loan after 3 years, assuming you have made all standard repayments.

First, we calculate the loan repayment. For consumer loans, the amount of the loan payment is fixed, hence all payments are identical in amount. Therefore, we first solve for CF:

$$CF = \frac{PVA_n * \ r}{\left(1 - \frac{1}{(1+r)^n}\right)}$$

$$CF = \frac{\$60\ 000 * \frac{0.09}{2}}{\left(1 - \frac{1}{\left(1+\frac{0.09}{2}\right)^{10}}\right)}$$

$$CF = \frac{\$2\ 700}{0.356072} = \$7,582.73$$

Hence, to answer the question (a), the amount of your semi-annual repayments is $7,582.73.

To calculate the outstanding balance on the loan after 3 years, you will need to look at a loan amortisation schedule. For the first year, the values are determined using steps as follows:

1. The **amount borrowed**, or the beginning principal balance is $60,000.

2. The **semi-annual loan payment,** as calculated earlier, is $7,582.73.

3. The **interest payment** for the first payment is $2,700, calculated as follows:

$$Interest\ payment = r \times \ P_0$$

$$= 0.09/2 \times \$60,000$$

$$= \$2,700$$

4. The **principal paid** for the year is $4,882.73, calculated as follows:

$$Principal\ paid = Loan\ payment - Interest\ payment$$

$$= \$7,582.73 - \$2,700$$

$$= \$4,882.73$$

5. The **ending principal balance** is $55,117.27, calculated as follows:

$$Ending\ principal\ balance = Beginning\ principal\ balance - Principal\ paid$$

$$= \$60000 - \$4,882.73$$

$$= \$55,117.27$$

Note that the ending principal balance for the first year becomes the principal balance for the second period, which in turn is used in calculating the interest payment for the second period.

$$Interest\ payment = r \times P_0$$

$$= 0.09/2 \times \$55,117.27$$

$$= \$2,480.28$$

Putting these computations into a table gives us the entire amortisation schedule for the loan:

Payment No.	Beginning Balance	Interest Payment	Principal Payment	Ending Balance
0				60,000.00
1	60,000.00	2,700.00	4,882.73	55,117.27
2	55,117.27	2,480.28	5,102.45	50,014.82
3	50,014.82	2,250.67	5,332.06	44,682.76
4	44,682.76	2,010.72	5,572.01	39,110.75
5	39,110.75	1,759.98	5,822.75	33,288.01
6	33,288.01	1,497.96	6,084.77	27,203.24
7	27,203.24	1,224.15	6,358.58	20,844.65
8	20,844.65	938.01	6,644.72	14,199.93
9	14,199.93	639.00	6,943.73	7,256.20
10	7,256.20	326.53	7,256.20	–

VIDEO: Constructing an amortisation schedule in excel (YouTube, 9m10s)

Download the Excel template (XLSX, 14KB)

Download the Solution (XLSX, 15.3KB)

These calculations make sense because each loan payment includes some principal repayment. This is why the interest in column 3 declines each year. We repeat the calculations until the loan is fully amortised, at which point the principal balance goes to zero and the loan is paid off. Therefore, to answer the question (b), the outstanding balance on the loan after 3 years (6 payments) is $27,203.24.

Note that the amount of interest and principal that are paid each year change over time. Interest payments are the greatest in the early years of an amortising loan because much of the principal has not been repaid. However, as the principal balance is reduced over time, the interest payments decline and more of each periodic payment goes toward paying down the principal. The final loan payment repays just enough principal to pay off the loan in full.

4.3.5 Solving for Number of Annuity Payments (n) Given PVA

4.3.5.1 Finding the number of payments (n)

Another important calculation is determining the number of payments for an annuity. By re-arranging the PVA formula for n we found:

$$n = -\frac{ln\left(1 - \frac{PV \times r}{CF}\right)}{\ln\left(1 + r\right)}$$

The number of payments tells us for example the time required on an annuity contract to repay a debt. Suppose you currently owe $3450 on a car loan. If you are charged 11.6% per annum, how long will it take you to pay off the loan assuming you are making $600 annual repayments.

$$n = -\frac{ln\left(1 - \frac{PV \times r}{CF}\right)}{\ln\left(1 + r\right)}$$

$$n = -\frac{ln\left(1 - \frac{\$3\ 450 \times 0.116}{\$600}\right)}{\ln\left(1 + 0.116\right)}$$

$$n = \ -\frac{ln\left(3.003003\right)}{ln\left(1.116\right)}$$

$$n = 10\ payments$$

$$n = 10\ years$$

Solving this problem as shown above, we find that it will take 10 payments for you to pay off this loan. Since you are making annual payments, this equals 10 years.

Using excel to solve for n

If you'd like to use excel, you can use the function "=nper()", however, you must enter either pmt of pv as a negative, as excel looks at it from the perspective from one side of the transaction.

For the example above you would enter:

```
=NPER(0.116, 600,-3450)
NPER(rate, pmt, pv, [fv], [type])
```

We close the bracket after our PV, because we do not have an additional payment occurring at the end of our time period (i.e. no PV). When hitting enter, you should get the same value of 10 years.

Exercise

Test your knowledge.

Your parents invested in a little studio apartment in St Lucia when you started your studies for $250,000. They paid a deposit of $50,000 and borrowed the remaining amount. They can afford to make loan repayments of $350 a week. How long will it take them to repay the loan in full? The interest rate on the loan is 2.6% per year, compounded weekly.

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https://uq.pressbooks.pub/introduction-financial-management/?p=94#h5p-43

An interactive H5P element has been excluded from this version of the text. You can view it online here:
https://uq.pressbooks.pub/introduction-financial-management/?p=94#h5p-44

4.3.6 Solving for Interest Rate (r)

4.3.6.1 Finding interest rate (r)

Another important calculation is determining the interest rate, or discount rate for an annuity. The interest rate tells us the rate of return on an annuity contract. For example, suppose your parents are getting ready to retire and decide to convert some of their superannuation into an annuity that guarantees them a fixed annual income. Their superannuation fund manager asks for $350,000 for an annuity that guarantees to pay them $50,000 a year for 10 years. What is the rate of return on the annuity?

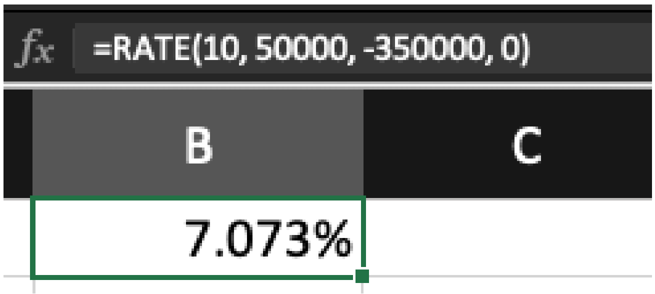
As we did in the previous section when finding annual payment, we can insert these values into PVA formula.

$$PVA_n = CF \times \frac{1 - \frac{1}{(1+r)n}}{r}$$

$$350,000 = \$50,000 \times \frac{1 - \frac{1}{(1+r)^{10}}}{r}$$

To determine the rate of return for the annuity, we need to solve the equation for the unknown value r. Unfortunately, it is not possible to solve the resulting equation for r algebraically. The only way to solve the problem manually is by trial and error. Fortunately, with the aid of technology, we can also solve this kind of problem using excel. To illustrate how to find the interest rate for an annuity using excel, the function =RATE() is used as illustrated below:

When you hit enter it will show 7.073%



Note that the interest rate is 7.073%. Notice that we have used negative sign for the present value of the annuity, representing a cash outflow, and a positive sign for the annuity payments, representing cash inflows. Using the present value formula, you must always have at least one inflow and one outflow. If we had entered both the PV and PMT amounts as positive values (or both as negative values), the calculator would have reported an error since the equation cannot be solved. As we have mentioned before, we could have reversed all the signs – that is, made cash outflows positive and cash inflows negative, and still find the correct answer. Finally, the FV was entered as zero to make sure that the register was cleared.

Exercise

Easy Finance lets you borrow money very easily. You are looking at buying a new washing machine for $1000 and they quote you the following to borrow the $1000, to be repaid in weekly instalments over a year (52 weeks): "Only $40 a week". What is the interest rate Easy Finance charges you?

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https://uq.pressbooks.pub/introduction-financial-management/?p=94#h5p-45

An interactive H5P element has been excluded from this version of the text. You can view it online here:
https://uq.pressbooks.pub/introduction-financial-management/?p=94#h5p-46

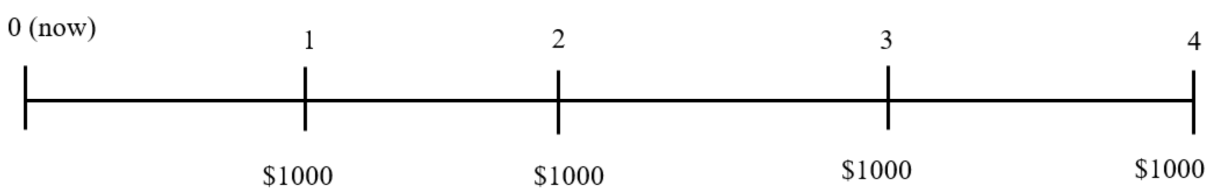
4.4 Annuities – Future Value

4.4.1 Future Value of an Annuity

Generally, when we are working with annuities, we are interested in calculating their present value. On occasion, though, we need to calculate the **future value of an annuity (FVA).** Such calculations typically involve some type of saving activity, such as a monthly savings plan. Another application is calculating terminal values for retirement or superannuation plans with constant contributions. We will start with a simple example:

Scenario: Suppose that you plan to save $1000 at the end of every year for 4 years with the goal of buying a motorcycle that costs around $4500. If your bank pays 8% interest a year, will you have enough money to buy the bike at the end of 4 years?

To solve this problem, we can first lay out the cash flows on a timeline.



We can then calculate the future value for each cash flow using the future value equation $FV_n = PV \times (1+r)^n$. Finally, we can add up all the cash flows. Given that the total future value of the four payments is $4506.11, you should have enough money to buy the bike.

The **year 1** deposit earns interest for three years: $\$1000 \times (1.08)^3 = \$1259.71$

The **year 2** deposit earns interest for two years: $\$1000 \times (1.08)^2 = \$1166.40$

The **year 3** deposit earns interest for one year: $\$1000 \times (1.08)^1 = \$1080.00$

The final, **year 4**, deposit is placed in the account at the same time as it is withdrawn, so it earns no interest: $\$1000 \times (1.08)^0 = \$1000.00$

Adding these up, total future value = **$4506.11.**

Similar to PVA, one way to simplify these computations is by using a future value of annuity formula (FVA).

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https://uq.pressbooks.pub/introduction-financial-management/?p=94#h5p-47

The Future Value of an Annuity formula is

$$FVA_n = CF \times \frac{(1+r)^n - 1}{r}$$

Where...

FVA_n= Future value of an annuity at the end of n periods
PVA_n = Present value of an n period annuity
CF = Level and equally spaced cash flow
r= Discount rate, or interest rate
n = Number of periods

Using the above equation to calculate FVA for the motorcycle example is straightforward. The calculation and process are similar to those we developed for PVA problems. We plug our values into the equation and yield:

$$FVA_n = CF \times \frac{(1+r)^n - 1}{r}$$

$$= \$1000 \times \frac{(1+0.08)^4 - 1}{0.08}$$

$= \$1000 \times 4.50611$

$= \$4506.11$

This value is the same as the one we calculated previously using a series of future value calculations.

Exercise

Let's test your knowledge before you go on...

You are saving up to buy a new computer, and hope to have saved $4,000 at the end of 12 months. After looking at your budget, you decide to deposit $325 per month into an account that pays 3% per year compounded monthly (0.25% per month). How much will you have in the account in 12 months?

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https://uq.pressbooks.pub/introduction-financial-management/?p=94#h5p-48

4.4.2 Rearranging the FVA Equation

The formula for the future value of an annuity has four variables:

1. Future value (FVA)
2. Interest rate (r)
3. Number of annuity payments (n), and
4. Amount of each annuity payment (CF).

Thus, if you know three of these variables, the remaining unknown variable can be easily computed. In the following sections, we show how to rearrange the FVA equation to solve for monthly or yearly payments (CF), interest rate (r), and the number of payments (n).

Future Value of an Annuity (FVA):

$$FVA = C * \left(\frac{((1+r)^n - 1)}{r}\right)$$

$$C = \frac{FV * r}{((1+r)^t - 1)}$$

$$n = \frac{\ln\left(\left(\frac{FV * r}{C} + 1\right)\right)}{\ln(1+r)}$$

Handout: Re-arranging the FVA formula (optional- click on the link below):

Handout (PDF, 50.9KB)

4.4.3 Solving for Annuity Payment (CF)

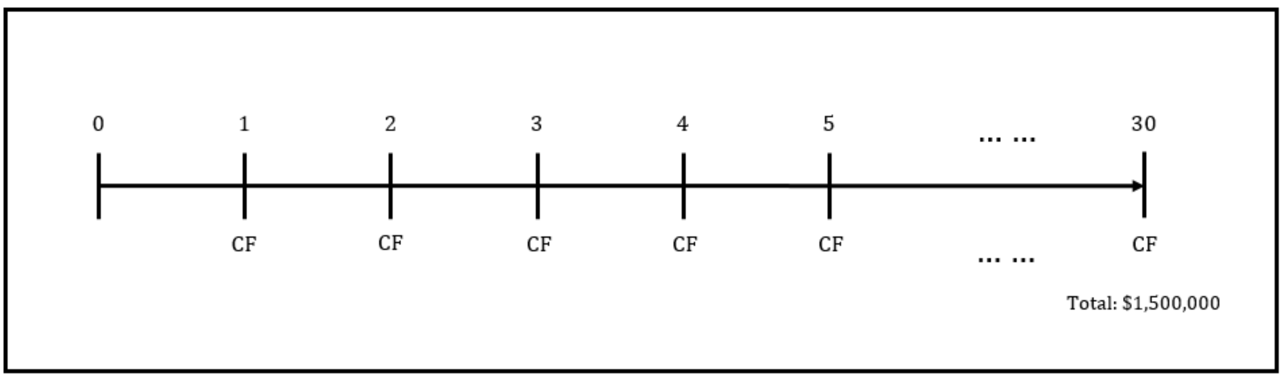
A common problem of financing is determining the value of the payments needed to achieve a certain goal at a future date. For example, saving for retirement through superannuation is usually done through a number of equal payments, e.g. \$1000, over a predetermined set of time, e.g. 30 years, at a regular time-interval, e.g. annually.

To find the value of these equal payments we can use our re-arranged FVA formula for CF:

$$CF = \frac{FVA_n \times \; r}{(1+r)^n - 1}$$

Scenario 1: Let's say you are planning on buying a beach-front property in Byron Bay when you retire in 30 years. Your real estate agent has agreed to sell you this property in 30 years for \$1,500,000. You are guaranteed an annual return on your savings of 6%. How much should you put aside every year, for the next 30 years, to reach this goal?

Start by drawing a timeline to help visualise the problem:



From this timeline we can see that we know all but one input (CF).

Future Value of Annuity (FVA): $1,500,000

Number of Payments (n): 30

interest-rate (r): 6%

CF: **unknown.**

$$CF = \frac{FVA_n \times\ r}{(1+r)^n - 1}$$

$$CF = \frac{1500000 \times 0.06}{(1+0.06)^{30} - 1}$$

$$CF = 18973.36$$

Answer: Therefore, in order to reach your goal of buying the property in 30 years you must save **$18,973.36 every year for the next 30.**

Test your knowledge...

Suppose that you are thinking about buying the new Tesla Truck. The truck currently retails for $60,000. Due to your poor credit rating, you have not been approved for a loan. You will have to save up for the truck over the next four years. The truck will cost $60,000 in 4 years. Your bank offers you 8% annual interest rate compounded semi-annually (4% every 6 months) for your savings account. To meet this, what will you need to save every semi-annual period for the next four years?

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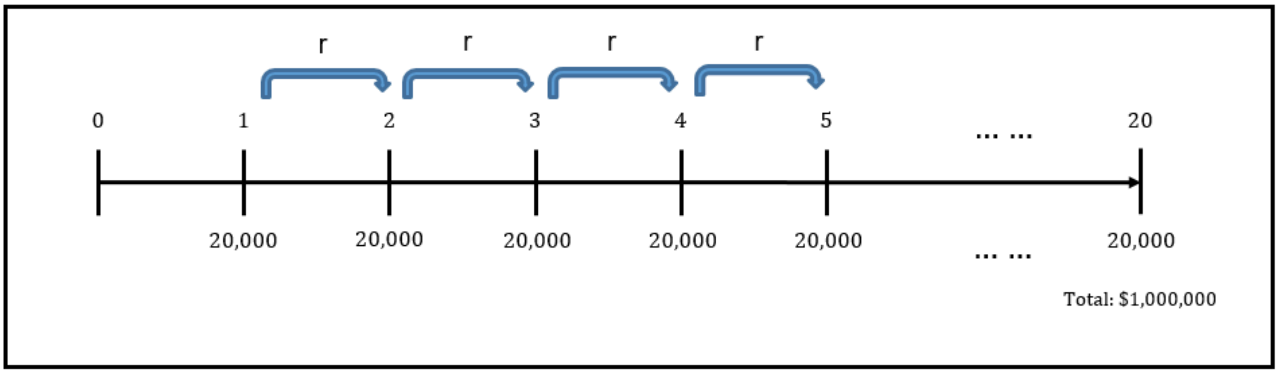
4.4.4 Solving FVA Equation for Interest Rate (r)

Often in many of these cases, people have i) a savings goal in mind, ii) a time-span in mind, iii) and the amount of money they can contribute to that goal each period. However, many do not consider that the interest rate has a big influence on achieving their goal. The interest rate you receive affects the CF you are required to save. Conversely, the CF you choose to save affects the rate you require to achieve a certain goal.

Scenario 3: You want to retire in 20 years as a millionaire (having $1 million dollars in your savings account). You can save $20,000 a year towards this goal. What rate of return (r) would you require to reach this goal exactly

Let's **draw a timeline**.



From this example, **we know all but one input** (interest rate).

FVA = $1,000,000

CF = $20,000

n= 20

r= **unknown**.

Now, let's **use the FVA** to solve for r.

$$FVA_n = CF \times \frac{(1+r)^n - 1}{r}$$

$$1000000 = 20000 \times \frac{(1+r)^{20} - 1}{r}$$

However, as you may have noticed, we can not solve this equation algebraically (with pen and paper). We need to use a computer to solve for r. This can be done via i) Microsoft Excel or ii) a financial calculator.

i) Solving via Microsoft Excel:

To find the interest-rate use the 'RATE' function.

The RATE function takes in the following arguments:

Inputs		
Argument	**Variable**	**Input**
nper (number of payment periods)	n	20
pmt (The payment made each period)	CF	-20000
pv (present value)	PV	0
fv (future value)	FVA	1000000

For this example we calculate '=RATE(20, -20000,0,1000000)' .The rate = 8.8%.

ii) Solving via a Financial Calculator, the steps are:

Enter	20		0	-20000	1000000
Key	N	I/Y	PV	PMT	FV
Solve for		8.8			

Note: Using the future value annuity formula, you must always have at least one inflow and one outflow. If we had entered both the FV and PMT amounts as positive values (or both as negative values), the calculator would have reported an error since the equation cannot be solved. As we have mentioned before, we could have reversed all the signs – that is, made cash outflows positive and cash inflows negative, and still find the correct answer. Finally, the PV was entered as zero to make sure that we started investing at $0.

Exercise

Your employer contributes a portion of your salary to your superannuation fund every fortnight. When you retire in 40 years, you would like to have $1,000,000. Assuming the contributions to superannuation are constant at $400, what fortnightly return is required to meet your goal?

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4.4.5 Solving for Number of Annuity Payments (n)

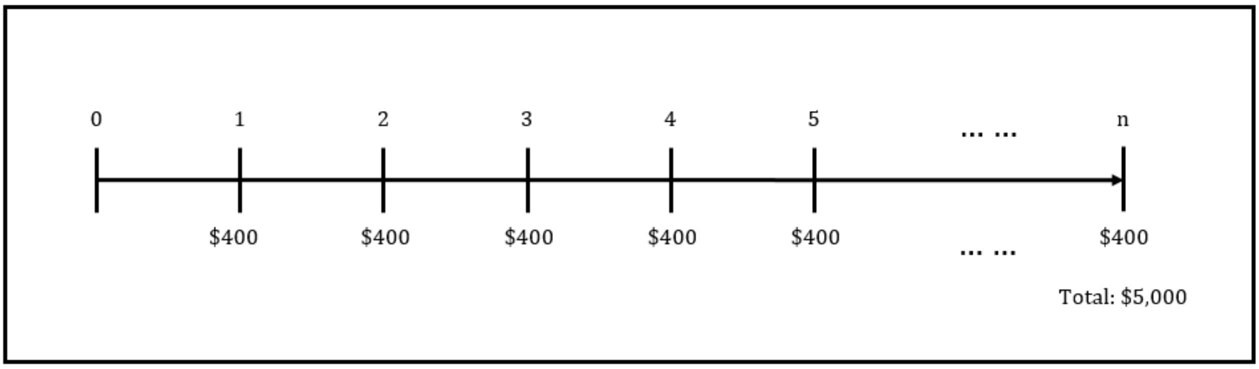
Previously we re-arranged the FVA formula to solve for n:

$$n = \frac{ln\left(1 + \frac{FVA_n \times r}{CF}\right)}{ln(1+r)}$$

Note: You can choose to use log rather than ln. The answer will be identical.

Scenario 4: You are trying to save up for a trip to Coachella. The trip is estimated to cost $5,000 in total. You are able to save $400 every 6-months for the trip. You can earn 6% per year compounded semi-annually (3% every 6 months) on these savings. How many years will it take to save up for this trip?

Start by drawing a timeline to help visualise the problem:



From this timeline we can see that we know all but one input (n).

FVA = $5,000

CF = $400

r = 3%

n (number of semi-annual periods) = **unknown.**

$$n = \frac{ln\left(1 + \frac{FVA_n \times r}{CF}\right)}{\ln\left(1 + r\right)}$$

$$n = \frac{ln\left(1 + \frac{5000 \times 0.03}{4000}\right)}{ln(1.03)}$$

$$n = \frac{ln\left(1.375\right)}{ln\left(1.03\right)}$$

$$n = 10.7736$$

$$years = \frac{10.7736}{2} = 5.3867$$

Or excel you enter: =NPER(0.03, 400, 0, -5000) (remember that Excel assumes you are on one side of the transaction, you either receive 400 every semi-annual and then pay 5000 at the end (the bank's perspective) or you pay 400 every semi-annual and then receive 5000 at the end (your perspective). The answer of course will be the same.

Multiple Choice

Remember the example in the previous section: Your employer contributes a portion of your salary to your superannuation fund every fortnight. When you retire in 40 years, you would like to have $1,000,000. Assuming the contributions to superannuation are constant at $400, what fortnightly return is required to meet your goal? The answer was 0.15% per fortnight. If you expect the rate to be 0.2% per fortnight, how long will do you expect it will take you to reach your retirement goal?

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4.5 Perpetuities

4.5.1 Level Cash Flows: Perpetuities

A perpetuity is a constant stream of cash flows that goes on forever. Perpetuities in the form of bonds were used by the British Treasury to pay off the debt incurred by the government to the Napoleonic wars. These perpetual bonds, called consols, have no maturity date and are still traded in the international bond markets today. They will only be retired when the British Treasury repurchases them all in the open market.

In the corporate world, perpetuities are widely used by companies to compute a value for investments with no fixed ending date, such as stocks. Payments from these investments theoretically never stop, making a perpetuity a stream of cash flows that has no end limit.

From the PVA equation, we can calculate the present value of perpetuity by setting **n**, which is the number of periods, equal of infinity (**∞**). When that is done, the value of the term $\mathbf{1/(1+r)^{\infty}}$ approaches 0,

and thus…

$$PVP = \frac{CF}{r}$$

Where…

PVP = Present value of perpetuity
**CF = ** Amount of constant cash flow received every period
**r = ** Interest rate or required rate of return.

As you can see, the present value of a perpetuity is the promised constant cash payment (**CF**) divided by the interest rate (**r**). A nice feature of the equation is that it is algebraically very simple to work with since it allows us to solve for **r** directly rather than by trial and error.

For example, suppose you became a successful entrepreneur and decided to give back to your university by creating or endowing a scholarship fund to finance students. The goal of the fund is to provide the university with $100,000 of financial support for finance students each year forever. If the interest rate is 8%, how much money will you have to give the university to provide the desired level of support? Using the PVP equation, we find that the present value of the perpetuity is:

$$PVP = \frac{CF}{r}$$

$$= \frac{100,000}{0.08}$$
$$= \$1,250,000$$

Thus, a gift of $1.25 million will provide a constant annual payment of $100,000 to the university forever.

There is a subtlety that you should be aware of. In the above computations, we made no adjustment for inflation. If the economy is expected to experience inflation, which is generally the case, the real value of the scholarships you are funding will decline each year.

Before we finish our discussion of perpetuities, we should point out that the **present value of a perpetuity is typically not very different from the present value of a very long annuity.** For example:

> Suppose that instead of funding the scholarship forever, you plan to fund it for 100 years. If you calculate the present value of a 100 year annuity of $100,000 using an interest rate of 8%, you will find that it equals $1,249,431.76, which is only slightly less than the $1250,000 value of the perpetuity; making a gift a perpetuity would only cost you an additional $568.24. This is because the present value of the cash flows to be received after 100 years is extremely small. The key point here is that cash flows that are to be received far in the future can have very small present values.

Let's test your knowledge before you go on…..

Knowledge Check

1. What is the difference between a perpetuity and an annuity?

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2. Calculate the present value of a perpetuity of $1250 per year when the interest rate is 7% per annum.

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4.6 Summary & Key Formulas

4.6.1 Summary

This chapter has applied the time value of money to multiple cash flows. We cannot compare cash flows occurring at different points in time, so we need to convert them to one common point in time:

- **Step 1:** prepare a time line to identify the magnitude and timing of the cash flows.
- **Step 2:** calculate the value of each cash flow as a common point in time, i.e. PV or FV.
- **Step 3:** add up present or future values.

If our cash flows are equal in magnitude, equally spaced, and finite, then the stream of cash flows is called *annuity* and we can use a short-cut formula, the *annuity formula* to calculate the PV or FV. Payments can be any frequency (e.g. monthly, annual). Examples of annuities are loans and retirement savings. Like the FV formula in Chapter 3, the annuity formula's for PVA and FVA can also be re-arranged to find *CF and n*. Solving for *r* requires a financial calculator or excel. Which formula you need to use depends on the question, so always draw a timeline to make this easier! Finally, when computing present or future value of an annuity, the n is the number of payments, and r is expressed as the interest rate per period (per month for monthly payments, per year for annual payments, etc.).

If our cash flows are equal in magnitude, equally spaced and **in**finite, then the stream of cash flows is called a *perpetuity* and we can use the *perpetuity* formula (the easiest formula you'll learn in finance!)

We also constructed amortisation schedules to show how loans work and how our formulas work in practice.

4.6.2 Key Formulas

Present Value of an Annuity (PVA):

$$PVA = C * \left(\frac{\left(1 - \frac{1}{(1+r)^n}\right)}{r}\right)$$

$$C = \frac{PV * r}{\left(1 - \frac{1}{(1+r)^n}\right)}$$

$$n = \frac{\ln\left(\left(1 - \frac{PV * (r)}{C}\right)^{-1}\right)}{\ln(1+r)}$$

Future Value of an Annuity (FVA):

$$FVA = C * \left(\frac{((1+r)^n - 1)}{r}\right)$$

$$C = \frac{FV * r}{((1+r)^t - 1)}$$

$$n = \frac{\ln\left(\left(\frac{FV * r}{C} + 1\right)\right)}{\ln(1+r)}$$

Perpetuity:

Present Value: amount the perpetuity is worth today.

Payment: The amount paid at each interval

$$PV = \frac{CF}{r}$$

Interest Rate

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5.

VALUING DEBT

5.1 Introduction

At the end of this chapter, you will be able to:

- explain the difference between debt and equity
- identify different types of bonds and their features
- distinguish between a bond's coupon rate and yield to maturity, and use these to calculate the value of a bond
- explain the relationship between bond prices, interest rates, and default risk.

Debt has been a feature of human society for thousands of years. In Book 1 of Plato's Republic, Socrates discusses the issue of debt with Cephalus, a wealthy businessman, and Polemarchus, a fellow Athenian philosopher. Cephalus claims that justice may be defined as speaking the truth and repaying one's debts. As a counter-argument, Socrates presents the following case:

"Suppose that a friend when in his right mind has deposited arms with me and he asks for them when he is not in his right mind, ought I to give them back to him?"

In reply, Polemarchus points out that repaying debt can be interpreted as giving each what they are owed, and that what one owes a friend is quite distinct from what they owe an enemy.

Putting ethical considerations aside, in today's lesson we will try to put a more concrete value on debt using the **time value of money concept** we learned in the previous chapter.

5.2 Debt vs Equity

From a company perspective, financing a new investment or to maintain its current operations can come from either internal or external resources. If a company has residual cash available, it might use this to fund their investment internally. Alternatively, a company could raise the capital needed from investors by issuing **debt** or **equity**.

From an investor perspective, he/she can purchase debt or equity in a company. When an investor does this, he/she is purchasing a bundle of rights. For equity, these rights include a claim to the company's residual cash flows and the ability to vote for the board of directors. Equity is also known as "shares", and the price you pay for those shares is the amount you believe best represents the current value of the share, which is a function of the future cash flows you will receive from holding those shares. We will discuss equity in detail in the next chapter (Chapter 6).

In this chapter, we will focus on **debt**.

When you purchase debt, the rights you receive include the right to a specified series of future cash flows, plus other rights that might be negotiated. For example, for convertible bonds, bondholders have the right to convert debt into equity. Issuing debt is a way to borrow money. A company can seek a loan from a bank or sell bonds to investors. In either case, the company will have to compensate the holders of their debt by paying interest. The essential difference between debt and equity is that the interest payments to lenders (debt) are generally fixed upfront and compulsory, while the payments to shareholders are only a residual, and are paid entirely at the discretion of the company.

There is an important distinction between **equity** and **debt** in terms of the potential upside and downside for investors. For debt holders, their upside is limited to the agreed-upon interest payments, even if the company becomes significantly more profitable as a result of issuing the debt. The flip side of this is that the debt holders are protected somewhat from the risk that the company becomes insolvent (i.e. defaults) through debt covenant and collateral requirement agreements.

The differences between debt and equity are summarised in the table below:

Debt	**Equity**
Rights include the right to a specified series of future cash flows, plus other rights that might be negotiated. For example, for convertible bonds, bondholders have the right to convert debt into equity.	Rights include a claim to the company's residual cash flows and the ability to vote for the board of directors
Issuing debt is a way to borrow money. A company can seek a loan from a bank or sell bonds to investors. In either case, the company will have to compensate the holders of their debt by paying interest.	Also known as "shares", and the price you pay for those shares is the amount you believe best represents the current value of the share, which is a function of the future cash flows you will receive from holding those shares.
The interest payments to lenders (debt) are generally fixed upfront and compulsory	Payments to shareholders are only a residual, and are paid entirely at the discretion of the company
In this chapter, we will focus on **debt**.	We will discuss equity in detail in the Chapter 6

Additionally, debt holders have first priority in receiving payments:

1. Interest payment to Debt holders needs to be settled first before dividend can be paid to Equity holders are never, and

2. If the company goes bankrupt the debt holders have a first claim on the company's cash flows and assets. In other words, they have a senior position with regards to claims on the company's residual cash flows from liquidation. Equity holders, by contrast, have an unlimited upside potential but do face the possibility of losing the entire value of their investment if the company goes bankrupt.

5.3 Bond Types and Features

A bond is a type of negotiable debt instrument which sets forth an agreement between two parties: an issuer and a holder. Companies and governments can issue debt securities to raise capital from investors who will hold the debt. Bonds are generally used for the purpose of long-term borrowing (i.e., greater than one year).

Some key terms relating to bonds are summarised in the table below:

Principal amount or Face Value or par value	The payment
Maturity Date of the Bond	Date at which the payment is made
Coupons	• Issuer may decide to make periodic payments, which are a fixed percentage of the principal amount (I.e. Interest Payments). • Made at fixed intervals (typically every 6 months) • Coupon payment does not change throughout the life of the bond. • The holder can pass along ownership of the bond (e.g. sell the bond) to another party who will then hold the rights initially granted to the original holder.
Trust Deed	The principal and the coupon, and the magnitude and timing, are set at the time the bond is issued in this contract

The issuer of the bond agrees to deliver an agreed-upon payment to the holder at an agreed-upon date. The payment is referred to as the **principal** amount, face value, or par value. The date at which the payment is made is called the **maturity date** of the bond. Additionally, the issuer may decide to make periodic payments, which are a fixed percentage of the principal amount (i.e. interest payments). These payments are known as **coupons** and are made at fixed intervals (typically every 6 months). Accordingly, the amount of the coupon payments is determined by the **coupon rate** and fixed when the bond is issued. It is important to note that both the principal and the coupon, and the magnitude and timing, are set at the time the bond is issued in a contract called the Trust Deed. Thus, the coupon payment does not change throughout the life of the bond. The holder can pass along ownership of the bond (e.g. sell the bond) to another party who will then hold the rights initially granted to the original holder.

We next introduce different types of bonds commonly issued.

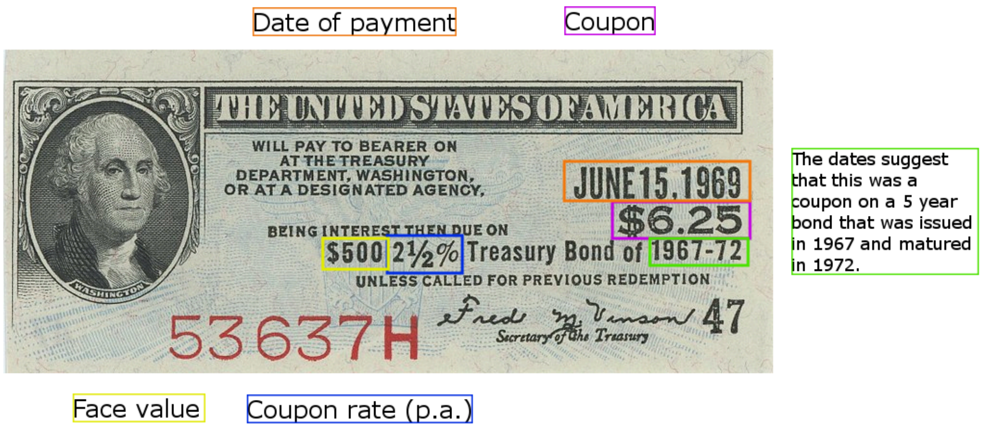
5.3.1 Zero-Coupon Bonds

Bond issuers need not necessarily offer coupon payments. Instead, they can issue zero-coupon bonds. In this case, the only cash flow that the holder of the bond receives is the face value at the maturity date. Of course, the price at which a zero-coupon bond sells is much lower than the face value, given investors want to be compensated for taking on the risk of the investment. This is easy to understand as the price of the bond would be equal to the present value of its expected cash flow. As you might imagine then, the discount rate used in this present value calculation will play a large part in determining the price.

5.3.2 Coupon Bonds

As with zero-coupon bonds, the issuer of a coupon bond agrees to repay the face value of the debt at maturity. In addition, they agree to make periodic coupon payments.

Below is a coupon from a U.S. treasury bond that paid interest (coupon) payments twice per year. Why is the coupon worth $6.25?



Treasury Bond coupon by the United States Department of the Treasury, Public domain

Here is a video introducing the concept of bonds, focusing on coupon bonds which are the most common type of bond. It will help you answer the question above.

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Answer:
Because $6.25 represents half a year's interest on $500 at 2.5%.
That is: $500 * 0.025/2 = $6.25
As we can see from the above example, the coupon payment is a fixed amount. However, there are also bonds that have coupon payments fluctuate with interest rate. We call this type of bond floating rate bond. The adjustment to the coupon payment is typically tied to an interest rate benchmark.

5.3.3 Convertible Bonds

Sometimes companies will issue securities that take on both the features of bonds we have described above and those of equity shares. These convertible bonds allow the holder to convert the value of the bond into shares of the issuing company at a predetermined ratio.

In this way, the holder of the convertible bond is able to take advantage of the upside if the value of the company (and thus the value of its shares) increases but also are protected against the downside by the debt covenants and collateral requirements mentioned earlier.

Because the holders of convertible bonds have this advantage over holders of ordinary bonds, the former is willing to pay a premium for their security over that paid by the latter.

5.4 Calculating Bond Value

In Chapters 3 and 4 we have learnt that we can value assets by converting the future cash flows to that asset into the same point in time (often the "present"). The value of an asset (i.e. its price), therefore, is the present value of all its future payments. In the case of a bond, it is the sum of the present value of the face amount and the present value of the coupon payments (if it's a coupon bond).

As we have seen, the present value of a cash flow is calculated by discounting the cash flow at an appropriate rate. This appropriate discount rate is in turn determined by the market (it is a function of the risk that investors associate with the expected cash flow). In the case of a bond, we have to be careful. While the issuer of the bond is offering a coupon rate to potential lenders, this is not the market-determined discount rate. The discount rate, or interest rate, on a bond required by the market is known as the bond's **yield to maturity**. Unlike the coupon rate, the bond's yield to maturity can change over the life of the bond as the market continuously evaluates the risk associated with the investment.

To calculate the value of a bond we will need both the coupon rate and the yield to maturity. The coupon rate will determine the amount of the coupon payments promised to the bondholder, and the market yield will determine the rate that we use to compute the present value of those promised payments.

$$PV(\text{ coupons }) = C \times \left[\frac{1-[1/(1+r)^n]}{r}\right]$$

where C is the coupon payment, r is the yield to maturity **expressed as a periodic interest rate**[1] and n is the number of periods to maturity or the number of coupon payments remaining. Note that the coupon payment is calculated using the coupon rate and the bond's face value:

$$C = \frac{\text{coupon rate}}{\text{number of coupons per year}} \times \text{Face Value}$$

1 Bond yields are quoted as Annual Percentage Rates (APRs) with compounding at the same frequency as the coupon payments. If the yield is quoted as 5% and there are 2 coupons per year, then the r in the present value equations will be $5\% \div 2 = 2.5\%$ or 0.025.

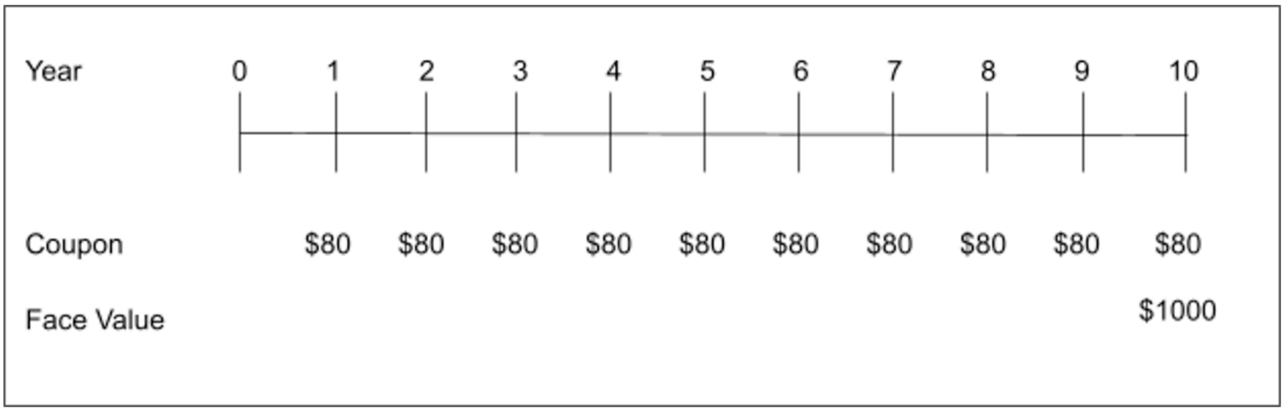
Apart from receiving coupon payments, bond holders will also receive the face value of the bond on the maturity date. We need to calculate the present value of the face amount:

$$PV(\text{ Face Value }) = \frac{\text{Face Value}}{(1+r)^n}$$

Therefore, the value of the bond should be the sum of the present value of all future coupon payments and the present value of face amount.

$$BondValue = PV(coupons) + PV(FaceValue) = C \times \left[\frac{1-[1/(1+r)^n]}{r}\right] + \frac{\text{Face Value}}{(1+r)^n}$$

We can illustrate the cash flows of the bond using a timeline, as shown below.



The present value of the principal repayment (face value) in year 10 is:

$$PV_{\text{Face}} = \$1000 \div (1+0.08)^{10} = \$463.19$$

The present value of the coupon payments is

$$PV_{\text{coupon}} = \left(\left(0.08 \times \frac{\$1000}{1}\right) \times \left[\frac{1-\left[1/(1.08)^{10}\right]}{0.08}\right]\right) = \$536.81$$

The value of the bond, the price at which it will sell today, will be the sum of the above two present values:

$$\text{Bond Value} = \$463.19 + \$536.81 = \$1000$$

In this case, the bond is selling at exactly its face value. This is sometimes referred to as **selling at par** or par value (where par is another word for face). The reason for this is that the market rate and the coupon rate are exactly the same – which means that an investor is receiving exactly the interest that they require every time period (as determined by the market rate) through the coupon payment.

But what happens when the coupon rate and the market rate are not the same? To illustrate, let us suppose that a year after Stark Industries' bond is issued, interest rates have increased from 8% to 10%. What will the value of the bond be now? Again we calculate the present value of the principal repayment

$$PV_{\text{Face}} = \$1000 \div (1 + 0.10)^9 = \$424.10$$

(note that since a year has passed, there are only 9 years and 9 coupon payments remaining).

And the present value of the coupon payments

$$PV_{\text{coupon}} = (\$1000 \times 0.08) \times \left[\frac{1 - \left[1/(1+0.10)^9\right]}{0.10}\right] = \$460.72$$

Then the total value of the bond is:

$$\text{Bond Value} = \$424.10 + \$460.72 = \$884.82$$

...or approximately \$885. The bond is selling at a discount to its face value. This is because the bond is offering a coupon rate which is less than the available market rate. Investors could easily get a 10% return for a similar risk investment, so why should they pay full price for an asset that offers them less than 10% in interest payments. The bond is said to be priced to yield 10% at \$885.

The difference between the face value and the present value of the bond in year 1 is \$115. This \$115 represents a gain over the initial amount paid (i.e. \$885) that the investor will receive when the bond matures. This gain is meant to compensate the investor for the below-market rate being offered by the coupon payments.

Another way to understand this discount of \$115 is to compare Stark Industries bond, which now has 9 years left to maturity, to a new bond issued to sell at par that also has 9 years to maturity and has a face value of \$1000. To sell at par, this bond would need to have a coupon rate of 10%. Therefore, Stark Industries' bond would have coupon payments which are \$20 less than that of the new bond. This difference in coupon payments can be valued as annuity. At a 10% discount rate, the present value of the annuity is:

$$PV_{\text{lost}} = (\$20) \times \left[\frac{1 - \left[1/\left(1.10^9\right)\right]}{0.10}\right] = \$115.18$$

Not surprisingly, this is the amount below face value at which Stark Industries' bond is selling.

To summarize we have that the value of a bond is given by

$$\text{Bond Value} = C \times \left[\frac{1 - [1/(1+r)^n]}{r}\right] + \frac{F}{(1+r)^n}\text{ , where } C = \frac{\text{coupon rate}}{\text{number of coupons per year}} \times F$$

So far we have used annual coupon payments, but often coupons are paid semi-annually (or perhaps even more frequently). If this is the case, we always assume that the required return by the investors (r) is an APR compounded at the frequency that the coupons are paid. For example, if coupons are paid semi-annually, we have 2 coupons per year, and thus we assume that the rate we have been given is an APR compounded semi-annually and we need to divide the APR by 2 to compute the semi-annual rate, and our n will have to be defined as the number of semi-annual coupons paid over the remaining life of the bond.

5.4.1 Calculating Bond Value – Worked Example

What is the price of a seven-year 8% coupon bond paying semi-annual coupons with a face value of $1000, if the current market yield is 9%?

VIDEO: [Calculating the bond value (YouTube, 8m42s)]

For the example above, you also could have used EXCEL using the PV() function:

Exercise

Q1. What if the interest rate stays the same?

If the interest rate had stayed at 8% after one year (when there are 9 years remaining), what would the value of Stark Industries' bond have been?

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https://uq.pressbooks.pub/introduction-financial-management/?p=103#h5p-56

Q2. What if the interest rate decreased?

What if the interest rate had decreased to 6% after one year (when there are 9 years remaining)?

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Q3. How much more?

How much more? What is the price of the bond at a 6% market yield?

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Test Your Knowledge

Q1. Bluechip Ltd issued a 10-year zero-coupon bond. The face value of the bond is $1,000 and yield to maturity is 5%. What was the issuance price?

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Q2. Goodfield Foods has an outstanding bond that has 7 years to maturity and a coupon rate of

6%. The coupon is paid annually. The bonds have a face value of $1000. What is the bond price if the current yield to maturity is 5%?

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Q3. Rio Tinto issued a 15-year bond one year ago at a coupon rate of 4.8%. The bonds have a face value of $100 and pay coupons semi-annually. If the current yield to maturity on these bonds are 5%. What is the current bond price?

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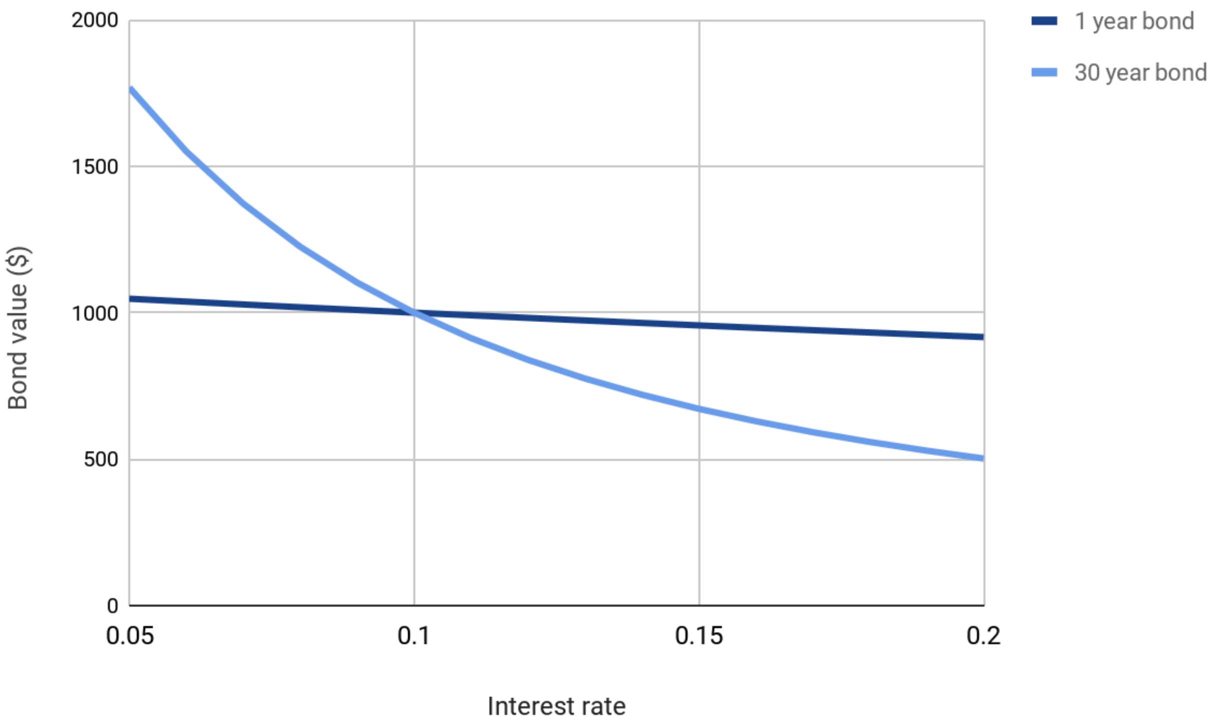
5.5 Relationship Between Price, Interest Rate & Default Risk

5.5.1 Interest Rate Risk

From our previous discussion in 5.3, you might have noticed that bonds carry a certain amount of interest rate risk. That is, the value of the bond is sensitive to changes in the interest rate. That means bond carries interest rate risk.

As we will explain in this section, the degree of sensitivity to the interest rate is not the same for every bond; all else equal, the interest rate risk is greater for bonds with longer maturity dates, and for bonds with lower coupon rates. The following chart illustrates how interest rate risk increases for bonds of longer maturity.



We have plotted the values of two bonds against a changing yield to maturity (interest rate). Apart from their maturity, the bonds are exactly the same (same face value and same coupon rate). As you can see the slope of the line is much steeper for the 30 year bond compared to the 1 year bond. This indicates that small changes in the interest rate will have a proportionately larger effect on the price of the longer maturity bond compared to the price of short maturity bond.

> The reason why longer maturity bonds carry a larger interest rate risk stems from the fact that for any bond, the repayment of the principal makes up a large portion of its value. For a 1 year bond, using different rates to discount this repayment to its present value will not greatly affect the outcome because the payment of face value is only one year away — that is, there is only one year for compound interest to work its magic. However, over 30 years, the effect of different discount rates can become quite significant.

All else equal, bonds with higher coupon payments are subject to a lower interest rate risk than bonds with lower coupon payments. This is because the total value of a bond with a lower coupon rate is proportionally more dependent on the face value than that of a bond with a higher coupon rate because the lower the coupon rate, the lower the proportion of total cash flows that come from those coupon payments. Since principal repayment occurs at maturity, more of the value of the bond with the lower coupon rate is subject to discounting compared to that of the bond with the higher coupon rate.

Exercise

Q1. Bond A and Bond B both have coupon rate of 5%, paid annually. Bond A has a maturity of 5 years while the maturity of Bond B is 10 years. Assume the face value of both bonds are $100 and the current yield to maturity is 5%.

Before doing any calculation, which bond will experience greater price percentage change if yield to maturity increases by 1%?

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What is the percentage price change in Bond A if yield to maturity increases by 1%? (Note: please answer using numbers only)

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What is the percentage price change in Bond B if yield to maturity increases by 1%? (Note: Please answer using numbers only)

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5.5.2 Default Risk

Apart from interest rate risk, bond also carries default risk, especially for corporate bonds.

As we have seen, when a company or government issues debt, they are obliged to both repay the face value of that debt at the time of maturity, and, for non-zero-coupon bonds, make periodic interest payments to the debt holders. Failure to meet this obligation, or violate an agreed-upon debt covenant, results in default. Default may, in turn, result in bankruptcy, a legal process whereby creditors work with authorities to manage the finances of a firm that has defaulted. Default represents a risk to investors in bonds and, as is the case with any marketable security, the investors will adjust their required return to compensate for this risk.

Credit rating agencies such as Fitch, Moody's, and Standard & Poor's specialise in measuring default risk and sell this data to investors (see table below). The credit ratings generally range between triple A (minimal default risk) to D (in default with little chance of recovery). The terms "investment grade" and "speculative grade" are often used to describe if a company is subject to low to moderate credit risk (investment grade) or substantial to very high credit risk (speculative grade).

Moody's	S&P	Fitch	Rating description	
Aaa	AAA	AAA	Prime	
Aa1	AA+	AA+		
Aa2	AA	AA	High grade	
Aa3	AA−	AA−		
A1	A+	A+		
A2	A	A	Upper medium grade	Investment-grade
A3	A−	A−		
Baa1	BBB+	BBB+		
Baa2	BBB	BBB	Lower medium grade	
Baa3	BBB−	BBB−		
Ba1	BB+	BB+		
Ba2	BB	BB	Non-investment grade speculative	
Ba3	BB−	BB−		
B1	B+	B+		
B2	B	B	Highly speculative	
B3	B−	B−		
Caa1	CCC+		Substantial risks	Non-investment grade AKA high-yield bonds AKA junk bonds
Caa2	CCC		Extremely speculative	
Caa3	CCC−	CCC		
Ca	CC		Default imminent with little prospect for recovery	
	C			
C		DDD		
/	D	DD	In default	
		D		

Table: Adapted from Bond credit rating, via Wikipedia.

Exercise

All else equal, are investors willing to pay more or less for an investment-grade bond compared to a bonds of speculative grade?

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5.5.3 Yield to Maturity

Investors require a certain yield to maturity and this yield is, in general, determined by four factors:

1. The real interest rate,
2. Expectations about the future rate of inflation,
3. The interest rate risk premium (the compensation investors require for bearing the risk associated with changes in the interest rate),
4. The default risk/credit risk premium (the compensation investors require for bearing risk associated with default).

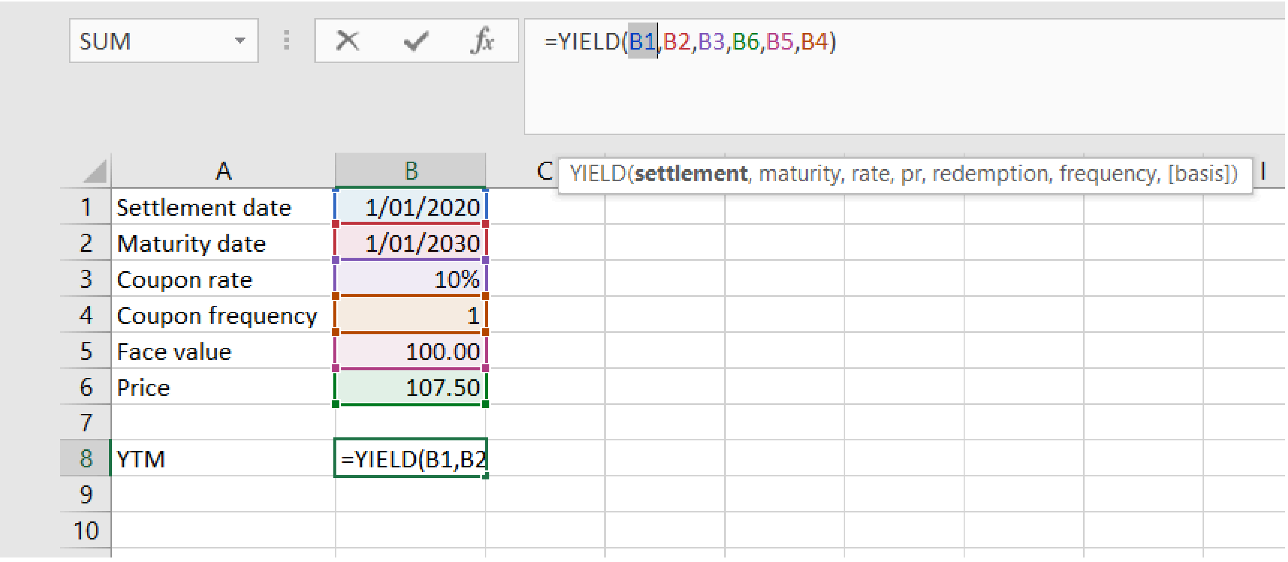
An interesting problem occurs in trying to determine the yield to maturity of a bond for which you know the face value, coupon rate, and maturity.

You might guess that if r were the unknown value, you would not be able to solve for it explicitly using the bond value equation. Interestingly, bond prices are usually what are observed in the market, and from this we can infer what the interest is that the market requires on the bond. It is not so easy to calculate the yield to maturity (YTM), and the easiest way to solve for the YTM is using a financial calculator or the YIELD function in excel.

The yield to maturity can be also be found manually using trial and error or by approximation. These methods are included in the Appendix (we will not require you to employ either of these two methods in the exam, but having a look at these two methods can enhance your understanding).

In Excel, you can also use the YIELD function to solve for Yield to Maturity. Assume we have the following bond outstanding

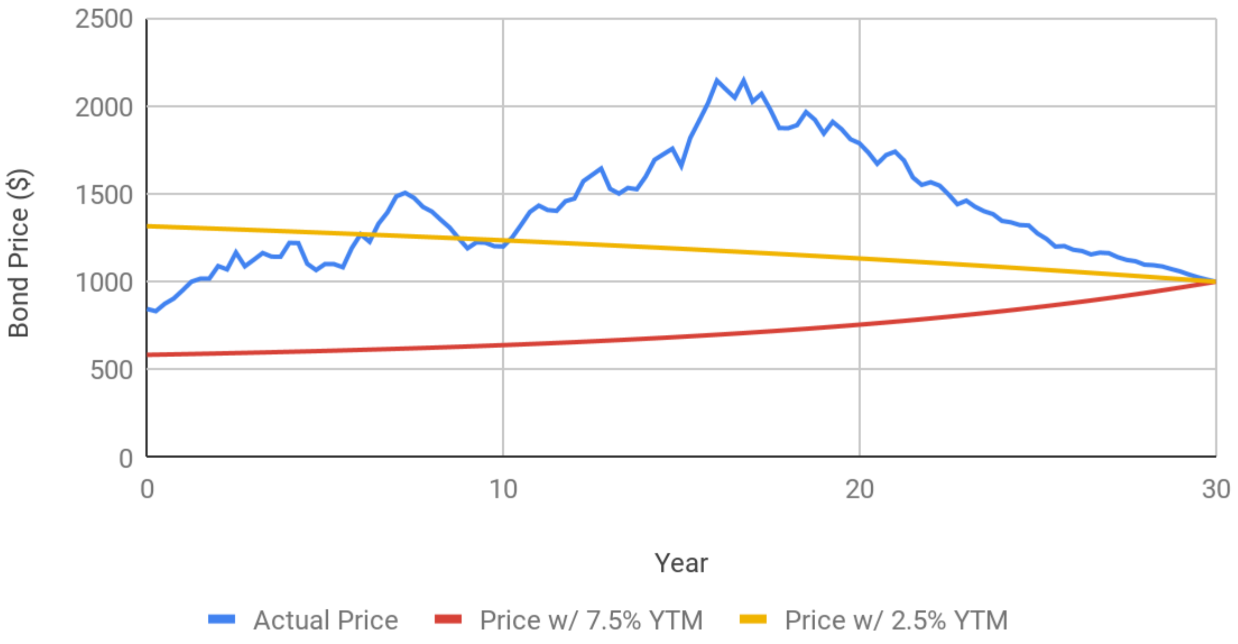
- 10-year maturity (assume today is 1/1/2020)
- A coupon rate of 10%, paid annually
- Face value of $100
- Current price is $107.5



For this simple example, the Yield to Maturity is 8.84%

5.5.3.1 Graphing Bond Price vs Yield to Maturity

The following chart show how the price of a bond can fluctuate over time according to the yield to maturity and the time to maturity. In this example we are looking at a 30 year, $1000 face value bond with a coupon rate of 4%. The bond makes quarterly coupon payments. The blue line shows how bond prices may actually fluctuate in the market. The graph also shows how the price of two bonds with different constant YTM's (2.5% and 7.5%) change over time and eventually converge to their face value. Note that in real life, it is extremely unlikely that a bond's yield to maturity stays constant throughout its life.



5.5.4 Want to Know More?

The trial and error method involves calculating the hypothetical price of the bond for various yield to maturity values to find which yield results in the true market price. So for example, suppose Wayne Enterprises issues a 10-year bond with a face value of $1000 and a coupon rate of 8.25%. If this bond is selling for $1165.60, what is its yield to maturity?

To answer this question we can construct the following table

Coupon Rate	n	YTM	Face Value	PV(face)	PV(coupon)	Price
8.25%	10	1.00%	$1,000	$905.29	$781	$1,686.67
8.25%	10	1.50%	$1,000	$861.67	$761	$1,622.50
8.25%	10	2.00%	$1,000	$820.35	$741	$1,561.41
8.25%	10	2.50%	$1,000	$781.20	$722	$1,503.24
8.25%	10	3.00%	$1,000	$744.09	$704	$1,447.84
8.25%	10	3.50%	$1,000	$708.92	$686	$1,395.04
8.25%	10	4.00%	$1,000	$675.56	$669	$1,344.71
8.25%	10	4.50%	$1,000	$643.93	$653	$1,296.73
8.25%	10	5.00%	$1,000	$613.91	$637	$1,250.96
8.25%	10	5.50%	$1,000	$585.43	$622	$1,207.28
8.25%	10	6.00%	$1,000	$558.39	$607	$1,165.60
8.25%	10	6.50%	$1,000	$532.73	$593	$1,125.80
8.25%	10	7.00%	$1,000	$508.35	$579	$1,087.79
8.25%	10	7.50%	$1,000	$485.19	$566	$1,051.48
8.25%	10	8.00%	$1,000	$463.19	$554	$1,016.78
8.25%	10	8.50%	$1,000	$442.29	$541	$983.60
8.25%	10	9.00%	$1,000	$422.41	$529	$951.87

Coupon Rate	n	YTM	Face Value	PV(face)	PV(coupon)	Price
8.25%	10	9.50%	$1,000	$403.51	$518	$921.52
8.25%	10	10.00%	$1,000	$385.54	$507	$892.47

We can see that a yield to maturity of 6% results in the correct price. The yield to maturity may also be approximated by the following formula:

$$YTM \text{ approx.} = \left(C + \frac{F-P}{t}\right) \div \left(\frac{F+P}{2}\right)$$

where C is the coupon payment, F is the face value, P is the market price of the bond, and t is the time to maturity. Now, the yield to maturity is essentially a rate of return and so it should be calculated by something that looks like

$$\frac{\text{Final Value - Initial Value}}{\text{Initial Value}}$$

Here the numerator represents a gain and the denominator allows this gain to be expressed as a proportion of the initial investment. If we compare this with our approximation formula we can see that the numerator does resemble a gain: it considers the annual coupon payment and the average annual capital gain (or loss). **The denominator is an estimate of the average investment**. So the approximation for the yield to maturity resembles a rate of return, as it should.

Using the approximation formula we can find the yield to maturity for Wayne Enterprises' bond above:

$$YTM \text{ approx.} = \left(\$82.5 + \frac{\$1000 - \$1165.60}{10}\right) \div \left(\frac{\$1000 + \$1165.60}{2}\right) = 6.09\%$$

...which is a pretty good approximation to what we found using the trial and error method. Often, the approximate formula can help to inform the range of yield to maturity values that you will use in the trial and error.

For further details please see Griffith, R and Chandy, P.R. A Note on Yield-to-Maturity Approximations. Interfaces, Volume 16, No 3, pp 90-97. 1986E

5.6 Summary & Key Formulas

5.6.1 Summary

In this chapter, we focus on how to value debt, in particular, bond. We have learnt different type of bonds and their key features. More importantly, we know that the value of bond equals the present value of future coupon payment plus the present value of face value. In calculating bond value, it is important to distinguish between coupon rate and yield to maturity. While coupon rate is set at the issuance and does not change over the life of the bond, yield to maturity fluctuates day to day reflecting investor's risk assessment on the bond.

There are two key risks involved in bond investment, and reflected in the yield to maturity. First, as we have seen from this chapter, there is an inverse relationship between bond price and interest rate, which means bond carries **interest rate risk**. Second, the promised payment (coupon or face value) may not eventuate. That is, companies may default on their bonds outstanding. For this reason, corporate bond carries **default risk**. Higher default risk is reflected in higher yield to maturity, and hence, lower bond price.

5.6.2 Key Formulas

Bond value formula:

$$BondValue = C \times \left[\frac{1-[1/(1+r)^n]}{r}\right] + \frac{\text{Face Value}}{(1+r)^n},$$

$$where\ : C = \frac{\text{coupon rate}}{\text{number of coupons per year}} \times FaceValue$$

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6.

VALUING SHARES

6.1 Introduction

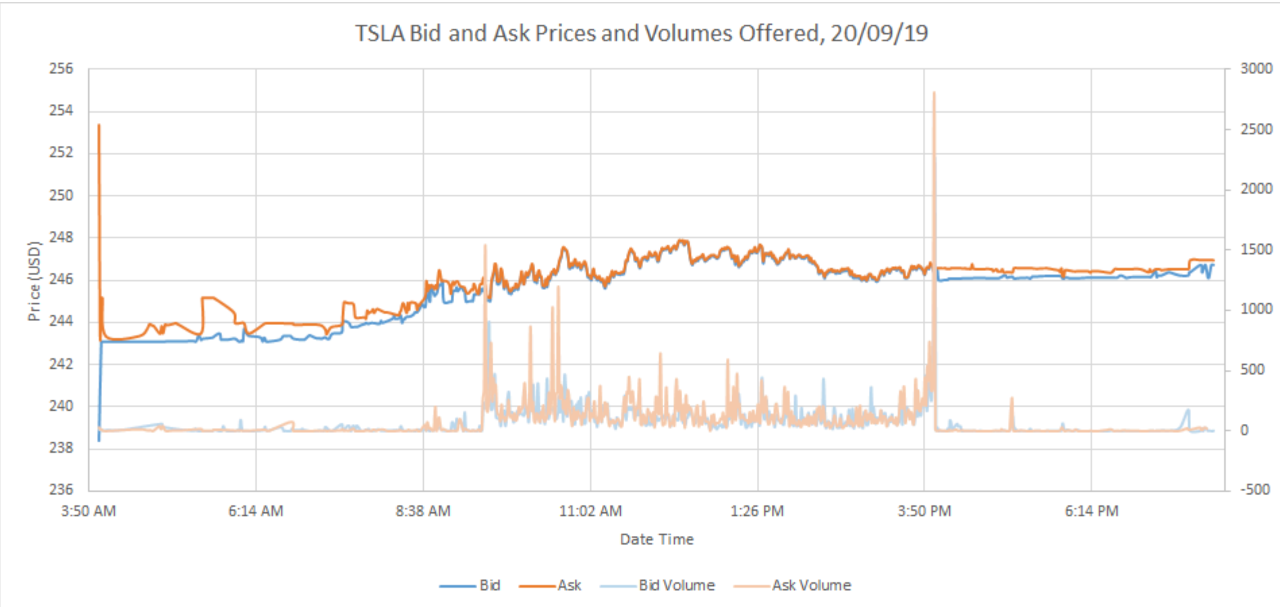
At the end of this chapter, you will be able to:

- explain what determines market prices (information, efficient markets)
- describe how the general dividend valuation model values a share
- discuss the assumptions that are necessary to make the general dividend valuation model easier to use
- use the general dividend valuation model to calculate the value of a company's shares
- critically evaluate the models of share valuation, including their limitations.

Dice by Steve A Johnson via flickr under a CC BY 2.0 licence.

When a company wants to take on a new investment opportunity, they will often need to look for external sources of capital. We saw last week that one way for a company to do this is to take out a loan or issue a bond (debt). Another way is for that company to issue shares. Investors may agree to purchase a company's shares because they expect that holding those shares will allow them to make claims on the future cash flows of the company. These potential shareholders will be willing to pay a price for the shares that is based on both the information that they have about the company (and thus its expected value), and the level of risk they are willing to take (how much uncertainty around the expected future values they are willing to accept).

In a large stock market, many investors, each having different beliefs and preferences around risk, will come together and trade shares. They might buy shares that are being offered or sell shares that they hold. As more and more market participants come together to trade on a particular share, a clearer picture of the "true" value of the share emerges. We can see how this works by looking at a typical day of trading on the stock market. The figure below shows the prices at which market participants were willing to buy (the bid price) and willing to sell (the ask price) shares in Tesla Motors on 20/09/2019. The figure also shows the amounts of shares investors were willing to buy (the bid volume) and willing to sell (the ask volume) at the given prices at the given times.



The main thing to notice about this plot of stock prices is how the discrepancy between bid and ask prices **decreases as the amount of trading increases**. This makes sense as more trading implies that more investors are sharing their information (beliefs and preferences) with the market (through the price they offer to buy or sell at) and market participants are better positioned to arrive at a consensus value for Tesla's share price.

In this chapter, we will look at some particular models that individual investors might use to estimate a share price that takes into account their beliefs and preferences.

Note:

1. No one really knows the true value of a share because the future is unpredictable. We can though come to a consensus on share value through stock market activities. The "true" value here refers to the market value.
2. Tesla shares are traded on the NASDAQ stock exchange. NASDAQ has pre-trading hours from 04:00 to 09:30, trading between 09:30 and 16:00, and after-market hours between 16:00 and 20:00. All times are for the US Eastern Time.

6.1.1 Where Do Prices Come From?

We saw in the previous topic, **Valuing Debt**, that when a company requires financing, they may look to their residual cash flows (internal financing), or may seek to raise capital by issuing debt or equity. We also learned what determines the value of debt and how this may be calculated. In this lesson we will answer similar questions about equity: what determines equity value and how can share prices be calculated?

So, where do share prices come from? To answer this we could begin by recalling the determinants of the bond price: the face value and coupon payments (i.e. promised cash flow), the time to maturity, and the interest rate required by the market. For the bond, the values for these determinants of the price are easily obtained. This is not the case for shares. Shares do not necessarily have promised cash flows as it is not compulsory for companies to pay dividends, there is no set maturity date, and due to the high degree of volatility, market required returns (risk-adjusted interest rates) are difficult to observe.

Nevertheless, the present value of a share's cash flows, and thus its price, can be estimated. Investors would have an expectation about the dividend payments they will receive from owning a share, and these dividend payments, like coupon payments for bonds, could occur at regular intervals. So we may be able to get around our first difficulty in valuing shares. What about the maturity date and the discount rate? We will see that assumptions can be made about these determinants as well.

Have a look at this Netflix video: The stock market has been booming. That doesn't mean the economy is too. This explains what the stock market is **actually** measuring.

6.2 General Dividend Valuation Model

Let's imagine that you buy a share today and have an expectation that you will be able to sell this share in one year for \$9. You also expect that you will receive a dividend of \$1 at the end of the year, just before you sell your share. Finally, suppose that, as an investor, you require a rate of return of 10%. What is the most you would pay for this share? Well, the most you would be willing to pay would have to be equal to the present value of the cash flows you expect to receive discounted at your required rate of return (to account for your opportunity cost!), that is

$$\text{Present Value} = \frac{(\$1 + \$9)}{(1+0.1)^1} = \$9.09$$

Thus, if you require a 10% return on your investment, you would be willing to pay \$9.09 now for receiving \$9 + \$1 in one year. We can generalise the formula used above as follows:

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

where P_0 is the price of the share today, D_1 and P_1 are, respectively, the dividend paid and the price of the share in one year from now, and r is the rate of return. Now, you might be saying that what we have done so far does not really help us to answer the general question of how to determine share prices. In our example we have essentially replaced the problem of determining the price of the share today with that of determining the price of the share in the next period (and we assumed what the latter would be!). But determining the price of the share in the next period is at least as difficult as determining the price today. So how can we proceed?

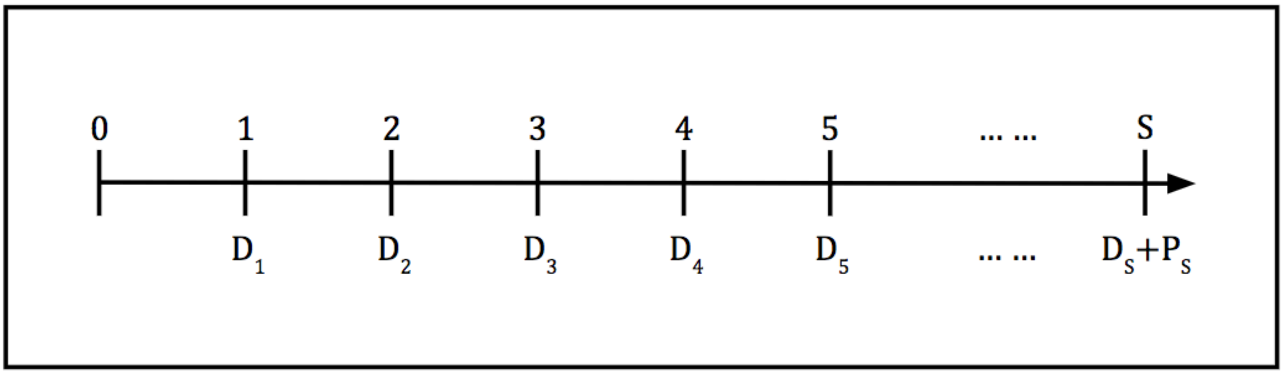
Using our general formula (1) we can say that if we know the share price in period 2, then we can figure out the share price in period 1

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

Plugging this into equation (1) we have:

$$\begin{aligned} P_0 &= \frac{D_1}{(1+r)^1} + \frac{P_1}{(1+r)^1} \\ &= \frac{D_1}{(1+r)^1} + \frac{D_2 + P_2}{(1+r)^1} \times \frac{1}{(1+r)^1} \\ &= \frac{D_1}{(1+r)^1} + \frac{D_2 + P_2}{(1+r)^2} \\ &= \frac{D_1}{(1+r)^1} + \frac{D_2}{(1+r)^2} + \frac{P_2}{(1+r)^2} \end{aligned}$$

But what if we do not know the share price in period 2. Well we could calculate the price in period 2 if we knew the price in period 3, and we could calculate this latter if we knew the price in period 4, etc. You might begin to recognise a pattern. We can replace the problem of knowing the share price today with one of knowing the share price sometime in the future. If we put the expected cash flows on a timeline, it would look like this:



Therefore we can estimate the price of a share today using the following formula:

$$P_0 = \frac{D_1}{(1+r)^1} + \frac{D_2}{(1+r)^2} + \frac{D_3}{(1+r)^3} + \frac{D_4}{(1+r)^4} + \frac{D_5}{(1+r)^5} + \ldots + \frac{D_S + P_S}{(1+r)^S}$$

Equation (2) is often referred to as the **General Dividend Discount Model**. The subscript S in the last term refers to the last period for which we make estimates of the future dividend and share price. We could imagine that period S refers to the point at which the shareholder expects to sell their share (and realise a capital gain). However, we should not make the mistake in thinking that the share price today, P_0, is affected by the shareholders' expectations regarding when they will sell. The share price estimated by the General Dividend Discount Model is not affected by the choice of S. In other words, the period in which the investor expects to sell is arbitrary. The investor could sell in the next period or in 10 years (or perhaps never sell). Regardless, when they do sell, the share will likely still be valuable (P_S) and that value may be estimated by the future cash flows (dividend payments) as well. To understand this, think about how the purchaser at time S will value the share.

So how many dividend payments will we need to determine? Theoretically, there could be an infinite number. Obviously this would render Equation (2) practically useless. Even if the number of dividend payments is finite, how do we determine what they will be? Can we make any inferences based on our expectations? As we will see, we can make assumptions about the pattern in dividend payments that make the General Dividend Discount Model easier to use and allow us to more readily estimate the share price.

Concept Check…

Let's put a few numbers to the General Dividend Discount Model.

You own one share of Silly Putty Ltd. The consensus forecast is that Silly Putty Ltd. will pay a dividend of $1 one year from today and a dividend of $2 two years from today. You expect to be able to sell the share for $10 immediately after receiving the second dividend. If you require a return of 10% on your investment, how much is the share of Silly Putty Ltd. worth today?

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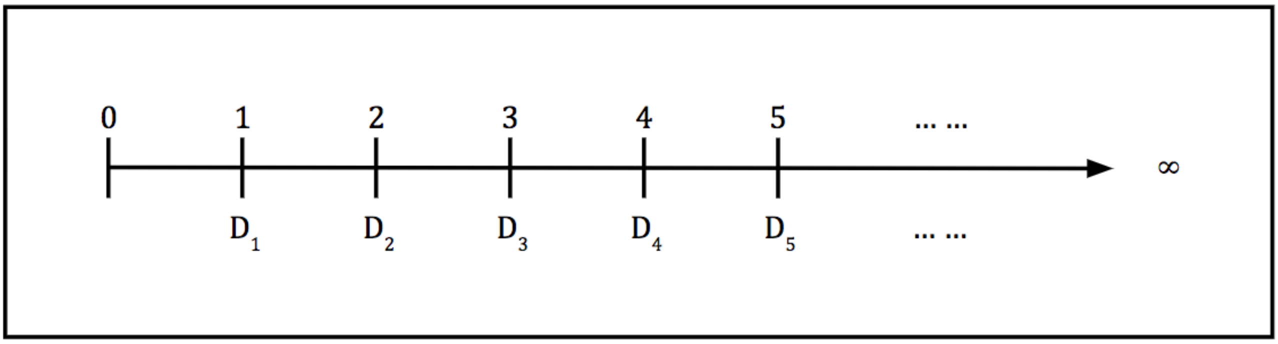
6.3 Assumptions

6.3.1 Constant Dividend Model

The General Dividend Discount Model may be simplified by making assumptions regarding the pattern in dividend payments. These assumptions will allow us to make use of formulas that we have already encountered in our discussion of Present Value methods.

The case of zero growth should be familiar. If dividend payments do not grow over time, they will remain fixed. We can visualise this on a timeline:



Note that all dividends are the same amount, so no subscripts (indicating time t) are needed. The price of a share with constant dividend payments will be given by:

$$P_0 = \frac{D}{(1+r)^1} + \frac{D}{(1+r)^2} + \frac{D}{(1+r)^3} + \frac{D}{(1+r)^4} + \frac{D}{(1+r)^5} + \dots \infty$$

This may be simplified. We have already seen how to calculate the present value of periodic fixed cash flows paid out in perpetuity: the perpetuity formula. If we apply this to the case of perpetual dividend payments we have

$$P_0 = \frac{D}{r} \qquad (3)$$

Where, D is the constant dividend, and r the require rate of return. Why is the value of something that pays an infinite number of payments not infinite? Remember that the further away a cash flow occurs, the less it is worth today because there are many years your money could earn interest over. For example, if I promise you $3 in 50 (100) years, and you require a return of 5%, you would be willing to pay me only $0.26 ($0.023) now. As our time horizon moves towards infinity, the present value moves towards zero and the infinite sum converges to a finite number.

Concept check…

Georgia Lighting Ltd. pays an annual dividend of $5 per share. This dividend is expected to be constant for the forseeable future. If you require a return of 8%, what would you be willing to pay for one share of Georgia Lighting Ltd.?

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https://uq.pressbooks.pub/introduction-financial-management/?p=114#h5p-67

6.3.2 Constant Growth Model

If a company is growing and we expect it to continue to do so, we may want to assume that dividends also keep growing for the foreseeable future. To keep it simple, we often assume that dividends grow at a certain fixed rate g. Using this assumption, we can estimate the value of future dividends using past dividends. For example, if D_0, the dividend in period 0 (i.e. the dividend that has just been paid), is expected to grow at the rate g, we could easily calculate the value of D_1, the dividend in period 1:

$$D_1 = D_0 \times (1 + g)$$

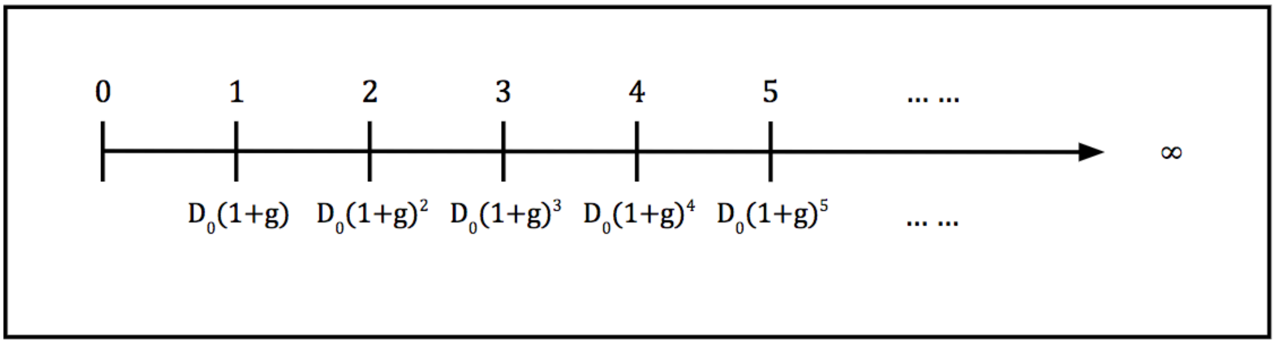
Similarly, the dividend in period 2 would be:

$$D_2 = D_1 \times (1+g) = [D_0 \times (1+g)] \times (1+g) = D_0 \times (1+g)^2$$

We can generalise the above as follows (equation (4)):

$$D_t = D_0 \times (1+g)^t \qquad (4)$$

The pattern of dividends will be:



The assumption of constant growth in dividend payments allows us to simplify our share price calculation. Instead of having to determine the dividends paid in each period (as in Equation 2), we only have to know the value of the dividend that has just been paid and the growth rate. We can write out the price of the share explicitly:

$$\begin{aligned} P_0 &= \frac{D_1}{(1+r)^1} + \frac{D_2}{(1+r)^2} + \frac{D_3}{(1+r)^3} + \frac{D_4}{(1+r)^4} + \frac{D_5}{(1+r)^5} + \dots \\ &= \frac{D_0(1+g)^1}{(1+r)^1} + \frac{D_0(1+g)^2}{(1+r)^2} + \frac{D_0(1+g)^3}{(1+r)^3} + \frac{D_0(1+g)^4}{(1+r)^4} + \frac{D_0(1+g)^5}{(1+r)^5} + \dots \end{aligned}$$

As long as the growth rate is less than the rate of return (and the rate of return is positive) we can write the present value of this series of cash flows as

$$P_0 = \frac{D_0(1+g)}{r-g} = \frac{D_1}{r-g} \qquad (5)$$

Notice that if the growth rate is zero, we have the same result as equation (3) where dividends are constant, and thus have zero growth. Furthermore, if the growth rate were larger or equal to the rate of return, the explicit sum above would go to infinity as the number of periods went to infinity. In this case, we would not be able to simplify to equation (5).

Equation (5) is known as the Gordon Growth Model, after the author who first published it in 1956. We may generalise this formula to find the share price in any period t.

$$P_t = \frac{D_t(1+g)}{r-g} = \frac{D_{t+1}}{r-g} \qquad (6)$$

As we will see, this generalisation is particularly helpful in situations where a company experiences non-constant or supernormal growth.

Concept Check...

Great Toys Inc. (GTI) just paid a dividend of $0.20 per share. Analysts are forecasting that GTI dividends will grow at a constant rate of 3% per year in perpetuity. If the market requires a return of 10% on GTI shares, how much are the shares worth today?

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So far, we have assumed that the rate of return r is given. This may not always be the case and certainly estimating the required return for an investor is a complex task. Nevertheless, from our discussion of the Gordon Growth Model (Equation 5) we can make some inferences about the rate of return required by the investor. Rearranging Equation (5) we have equation **(7):**

$$r = \frac{D_1}{P_0} + g \qquad (7)$$

This tells us that the rate required by an investor has two components:

1. D_1/P_0, we can call the **dividend yield**. This is the expected cash dividend in the next period divided by the current share price.

2. growth rate, g. If the dividend grows at a constant rate and the required return is fixed, then the share price must grow at the same rate as the dividend. Therefore, we can call this second component of the required rate the **capital gains yield.** That is, the rate at which the value of the investment grows.

Concept Check…

Earlier, you answered this question:

Great Toys Inc. (GTI) just paid a dividend of $0.20 per share. Analysts are forecasting that GTI dividends will grow at a constant rate of 3% per year in perpetuity. If the market requires a return of 10% on GTI shares, how much are the shares worth today?

You computed that the current price of GTI was $2.94.

What do you expect the price of GTI to be in 5 years?

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6.3.3 Valuation using PE Ratio

As mentioned previously, estimating the value of a share can be difficult. In the previous section, we used the General Dividend Discount model to estimate the value of a share. Due to its inherent assumptions, this method can not be readily applied to companies that do not currently pay dividends and have no intention to do so in the near future. What if the company does not pay out a dividend? Does this mean that the share price would be zero? Not necessarily. Many young firms do not pay out dividends, instead choosing to reinvest their retained earnings in profitable growth opportunities. For example, Microsoft famously did not pay dividends for its first 17 years of operation. Microsoft had its initial public offering in March 1986 and paid out its first dividend in January 2003. As we can see from Figure 1 below, MSFT shares certainly had a value before dividends were paid out. More recently, Tesla has rarely made a profit since it was listed on the share market in 2010, yet its share price has increased from around $17 a share in 2010 to over $100 in 2013, then to $383 in 2017. In early 2021, the share price for Tesla has reached all-time high of over $4,500 (share split re-adjusted), with a market value over $850 billion. Importantly, Tesla has yet to pay a cent of dividend.

One way of estimating the share price for a company that does not pay out dividends is to utilise the company's historical **p**rice **e**arnings ratio (PE) and the current **e**arnings **p**er **s**hare (EPS). PE is defined as the ratio of a company's share price to its EPS over the previous year, that is, the ratio of Price to Earnings. Therefore, it is possible to estimate share price if we know a company's EPS and have a benchmark PE:

$$P_T = \text{ Benchmark } PE \times EPS_t \ \ (8)$$

This benchmark PE may be taken to be an average or median of current PEs from similar companies, or the average historical PE from the company whose share you want to value. Utilising benchmarks is particularly useful for estimating the share price of non-dividend paying companies, however the technique need not be limited to just these types of companies. Benchmarking can also be used in conjunction with the General Dividend Discount Model to obtain a better share price estimate for dividend paying companies.

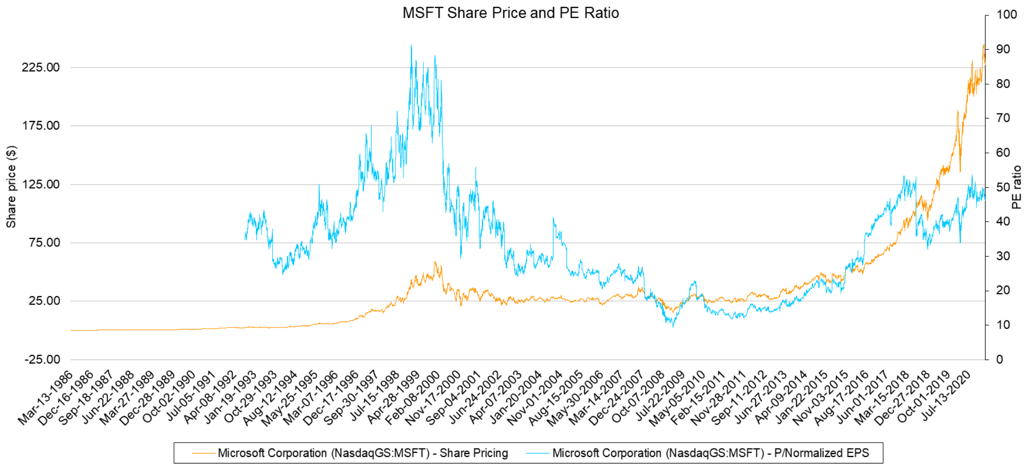

Figure 1: Microsoft's share price (USD) from March 1986 to March 2021. Prices are adjusted to take into account stock splits and other financial factors. Source: Adapted from S&P Capital IQ

Concept Check…

The Price Earnings (PE) ratio is inherently a rough, "back of the envelope" computation. Which of the following would describe limitations of using PE ratios as your sole method of valuing a company?

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6.3.4 Optional Extension

The assumptions that dividend payments are either held constant or grow at a constant rate are nice but not always reasonable. We can easily allow for fluctuations in the growth rate (and even growth rates that exceed the discount rate) in the short term if we assume that the growth rate will eventually settle to a fixed value which is less than the discount rate. To see how this works, let us write out the share price explicitly

$$\frac{D_1}{+r)^1} + \frac{D_2}{(1+r)^2} + \ldots + \frac{D_N}{(1+r)^N} \quad (9)$$

where P_N, the price of the share in period N, is given by:

$$P_N = \frac{D_N(1+g_N)}{r-g_N} \qquad (10)$$

and g_N is the constant growth rate that can be applied to the dividend payments beginning in period N (note that g_N could be zero).

Now, we can split the task of calculating the share price in Equation (9) into two pieces:

1. Finding the present value of the dividend payments up to period N, and

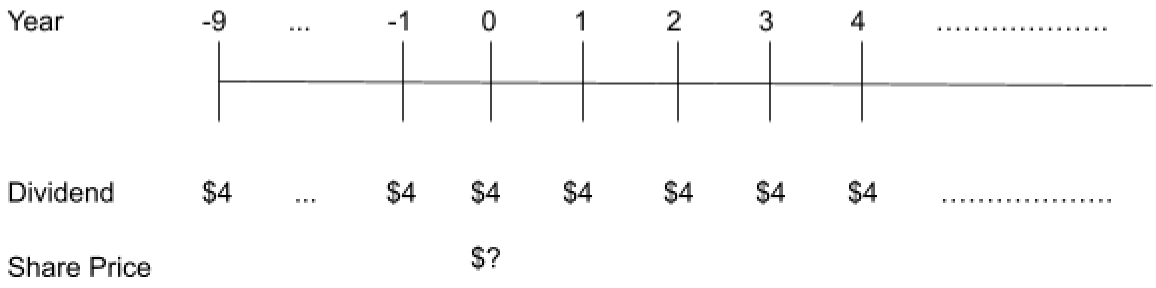
2. Calculating the present value of the dividend payments that occur after (i.e. the P_N term). **This is called the terminal value.**

Obtaining the first of these two present values will be straight forward if you know all the dividend payments. For the second part, we can use the growing perpetuity formula, to estimate the share price at year N, and then discount it back to year 0.

6.4 Calculate Share Value

Let us make use of our share price models with some examples. Consider the Nakatomi Corporation, which has been paying out dividends of $4 p.a. consistently for the past 10 years. The company's earnings are stable and they have no plans to change their dividend policy in the foreseeable future. What might their share price be?

First, note that due to Nakatomi's consistency with regards to earnings and dividend payout policy, investors may make the reasonable assumption that dividend payments will remain fixed in perpetuity. Therefore, we have the following timeline of cash flows.

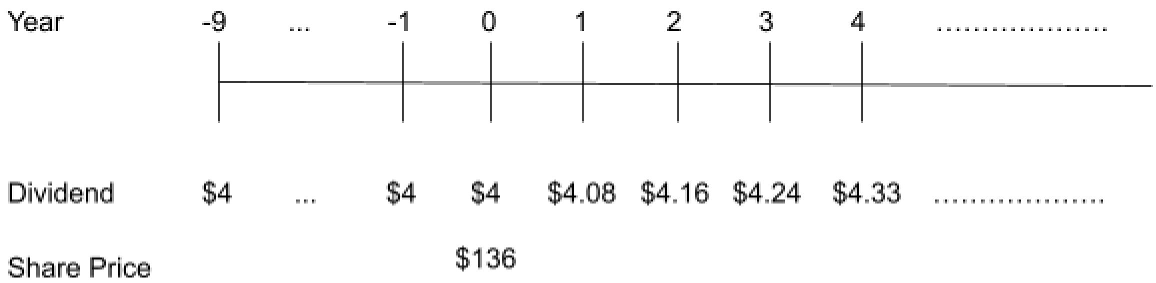


The timeline shows that the firm has paid a constant dividend of $4 every year for the past 10 years, and that it is expected to continue to pay this dividend in perpetuity. The share price at time 0 has been calculated using the perpetuity formula, Equation 3 above. We assume that investors require a return of 5% so that

$$P_0 = \frac{D}{r} = \frac{\$4}{0.05} = \$80$$

(Note that this would be the price *after* the dividend at time 0 has been paid, otherwise it would be $80+$4=$84)

Simple enough. Now let us imagine that Nakatomi, due to some good news about their current investments, announces that they plan to pay out a dividend of $4.08 next year, $4.16 the following year, $4.24 the year after, $4.33 in four years, and so on. How might an investor value Nakatomi's shares now? To begin, let us draw a timeline:



It seems that Nakatomi now plans to pay an increasing dividend every year. By how much is the dividend increasing year on year? We can calculate this easily using the dividend values in year 1 and today:

$$g = \frac{D_1 - D_0}{D_0} = \frac{\$4.08 - \$4}{\$4} = 0.02 = 2\%$$

So, it seems that Nakatomi plans to increase its dividends at a steady rate of 2%. This value is consistent with the dividend payments in years 2, 3, and 4 as well. Note that this growth rate in dividends is also lower than the required rate of return, 5%. Therefore, we can use the Dividend Discount Model, Equation (5), to price Nakatomi's share:

$$P_0 = \frac{D_0(1+g)}{r-g} = \frac{\$4(1+0.02)}{0.05-0.02} = \frac{\$4.08}{0.03} = \$136$$

It makes sense that the share is more valuable now if investors believe that they will receive growing dividend payments. This example also illustrates the impact of growth rate assumption on share price. **Share price is very sensitive to growth rate assumption**, with growth rate increases from 0% to 2% in this example, the share price could have increased by 70%.

Concept Check...

It's 31 December 2020. Persimmon Inc. paid the following dividends in the last five years:

$4.50 in 2016

$4.59 in 2017

$4.68 in 2018

$4.78 in 2019

$4.87 in 2020

If dividend growth remains constant, what dividend do you expect for 2021?

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Concept Check…

Following on from the previous problem…

What price do you expect Persimmon Inc shares to sell for now (just after the 2020 dividend has been paid)? Assume that the market requires a return of 8% on these shares.

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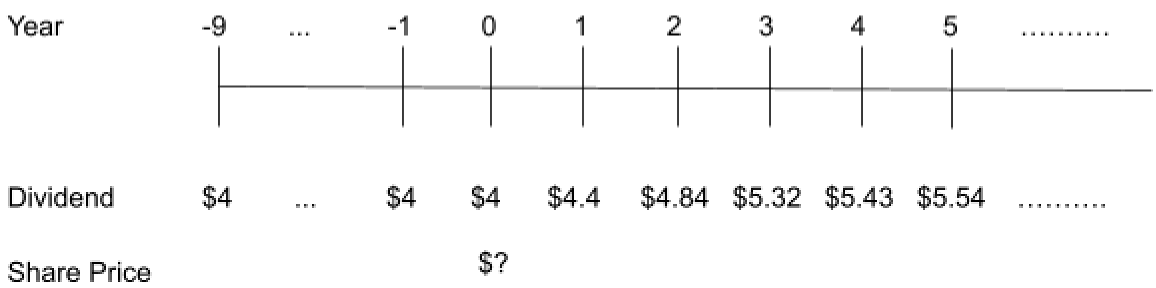
6.4.1 Extend Your Knowledge (optional)

Now suppose that Nakatomi has received even better news about its current investments and now plans to pay a dividend of $4.4 next year, $4.84 the following year, $5.32 the year after, and then settle to the steady growth rate of 2% from their previous announcement. How much will investors be willing to pay for Nakatomi's shares now? Let's first draw a timeline:



The timeline shows that, as in the previous two cases, Nakatomi has paid an annual dividend of $4 for the past 10 years. It now plans to pay large dividends for the next 3 years and then settle down to dividends that grow at a small but steady rate of 2%. Clearly, the dividend payments are growing at a higher rate than 2% in years 1 through to 3. We can easily see that there are non-constant dividends in the first 3 years. Now we can use the mixed dividend growth model in Equations 7 and 8 with g_N=2% as shown here…

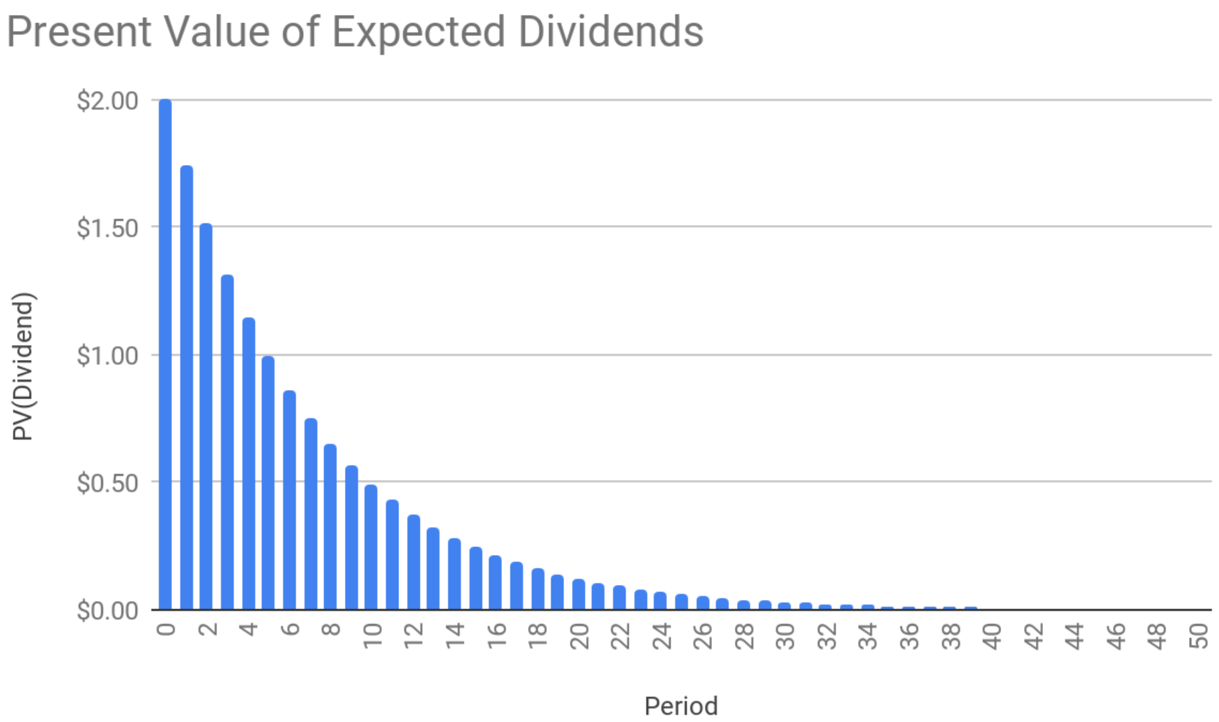
$$
\begin{aligned}
P_0 &= \frac{D_1}{(1+r)^1} + \frac{D_2}{(1+r)^2} + \ldots + \frac{D_N}{(1+r)^N} + \frac{D_N\,(1+g_N)}{r-g_N} \times \frac{1}{(1+r)^N} \\
&= \frac{\$4.4}{(1+0.05)^1} + \frac{\$4.84}{(1+0.05)^2} + \frac{\$5.32}{(1+0.05)^3} + \frac{\$5.32(1+0.02)}{0.05-0.02} \times \frac{1}{(1+0.05)^3} \\
&= \$13.18 + \$156.37 = \$169.55
\end{aligned}
$$

...which is the share price shown in the timeline. Again, the share price has increased on the expectation about the growth in dividend payments.

6.5 Critical Evaluation

The models we have discussed above allow estimation of the value of a share. These models rely on particular assumptions about the cash flows one expects to receive from holding the share. The share price estimated using the General Dividend Discount Model (Equation 2) relies, first and foremost, on the assumption that the company who issues the share makes dividend payments to their shareholders. As we saw with the early years of Microsoft, it is not necessarily the case that companies pay dividends and it is certainly not required that a company pay dividends in order for their shares to be valuable to investors. Even if a company does pay dividends, the information that investors receive about the company's dividend policy can really only be used to estimate future dividend payments. So, the **General Dividend Discount Model relies on expected values of future dividends.**

It is also worth noting that the majority of share value comes from dividends paid over the next 10 or 20 years. Consider the following chart. We have taken the present value of expected dividend payments over time (assume $2 dividend each year) using a discount rate of 15%.



Clearly the further we go in time, the less of an impact a dividend paid at that time will have on the present value of holding the share (and thus the share price). In fact, about 75% of the present value comes from the dividends paid out in the first 10 years, and the next 10 years contributes about another 20%. This means that for a long term investor who plans to hold their share indefinitely, the majority of the value in today's dollars will be recovered in the next 20 years. **The further away the dividend is expected to be paid, the less it is worth today.**

A further assumption of the general dividend model allows us to estimate the share price for a company that we expect will grow. If the growth occurs at a constant rate, then we can apply the Gordon Growth Model (Equation 5). Explicitly we are assuming a constant growth rate and this rate, much like the future dividend values in the other models, is an expectation based on the available information we have on the company. Implicitly we are assuming that expected growth will translate to growth in dividends. Again, looking at the early years of Microsoft, growth in company value does not necessarily result in growing dividend payments.

In general, companies face a tradeoff when it comes to growth. To see this look at the rate of return formula we derived from the Gordon Growth Model (Equation 8). We can see that a company's share price increases with the expected dividend, D_1, and the expected growth rate, g. Therefore, in order to maximise value, a company might wish to increase both D_1 and g. However, **increasing growth will likely require investment and if the firm spends money on new investments, they have less money available to pay dividends. The firm must find a balance between these two components of the rate of return in order to grow sustainably.**

Remember that in the General Dividend Discount model, we make the assumption that the investor plans to hold the share indefinitely. In other words, the model will take on the form of an infinite sum of dividend payments. We explained that this is a reasonable assumption to apply to the model. Consider an investor planning to sell shares after 5 years, the selling price at year 5 will be the present value of all future dividends beyond year 5. At the same time, the investor would have collected the first 5 years' dividends. Although the investor will not hold the shares infinitely, the investor will still effectively collect all the future dividends associated with the share. **As a result, it is reasonable to assume the infinite sum of dividend payments.**

6.6 Summary & Key Formulas

6.6.1 Summary

In this chapter, we focus on share price valuation. Similar to bonds, share price today equals the present value of all future cash flows (dividends) investors will receive. There are two key inputs: the expected dividends and the discount rate. Investors form expectation of future dividends based on current information available. At the same time, the discount rate depends on investors' assessment of the risk associated with those dividends.

With this basic concept in mind, we introduced the General Dividend Discount Model. We further explored the two special cases of the General Dividend Discount Model. They are the constant dividend model and the constant growth model. As an optional extension, we also discussed how to deal with companies with fluctuations in the growth rate.

For companies that do not pay dividends or have no intention to do so in the near future, we also introduced share valuation using PE ratio. The benchmark PE ratio can be calculated with reference to similar companies or from the historical PE ratios of the company itself. This is particularly useful for young firms such as Microsoft in the 1990s and Tesla today.

6.6.2 Key Formulas

General Dividend Discount Model

$$P_0 = \frac{D_1}{(1+r)^1} + \frac{D_2}{(1+r)^2} + \frac{D_3}{(1+r)^3} + \frac{D_4}{(1+r)^4} + \frac{D_5}{(1+r)^5} + \cdots + \frac{D_S + P_S}{(1+r)^S}$$

Constant Dividend Model

$$P_0 = \frac{D}{r}$$

Constant Growth Model

$$P_0 = \frac{D_0(1+g)}{r-g} = \frac{D_1}{r-g}$$

PE Ratio Valuation

$$P_T = \text{ Benchmark } PE \times EPS_t$$

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7.

CAPITAL BUDGETING METHODS

7.1 Introduction

At the end of this chapter, you will be able to:

- explain the importance of capital budgeting decisions
- explain the net present value (NPV) as a capital budgeting method
- calculate the NPV for a project
- explain the payback period as a capital budgeting tool, including its limitations
- calculate the payback period for a project
- explain the internal rate of return (IRR) as a capital budgeting tool
- calculate the IRR for a project using either Excel or a Financial Calculator.

In both your career and your personal life, you are likely to encounter situations where you have to make investment decisions. For example, you may need to decide whether to purchase a property or to keep renting instead. Or, you may decide to become an entrepreneur and need to make decisions on which business opportunities to invest in.

Remember the scenario in which you owned a little coffee-shop? Starting the coffee-shop with your savings was an investment decision, but when running the business and things are going well, you will face more decisions on what to invest in:

- An extra coffee-machine?
- A small baking section?
- A couple of bean bags?
- Another cafe?

Making decisions about what fixed assets to invest in is what we call **capital budgeting**.

Whether it is a personal or a business investment decision, you would have to conduct some sort of analysis to find out whether it is worthwhile to undertake the investment. Logically, you may say that a financial decision is a good decision if the benefits from the investments exceed the costs incurred. In this chapter, we will discuss capital budgeting tools that can be used to evaluate whether a particular investment adds value to a business or not. That said, the concepts taught here may come in very handy in your own personal investment decisions as well.

You may remember from Chapter 1 that the three main types of financial decisions a manager has to make are: working capital management decisions, capital structure decisions and capital budgeting decisions (summarised in Figure 7.1).

Working capital management decisions answer questions such as how much short-term resources are needed to keep business running, capital structure decisions deal with questions of how companies raise capital from debt and equity investors, and capital budgeting decisions are related to questions such as which projects or products to invest in to maximise value to shareholders or stakeholders.

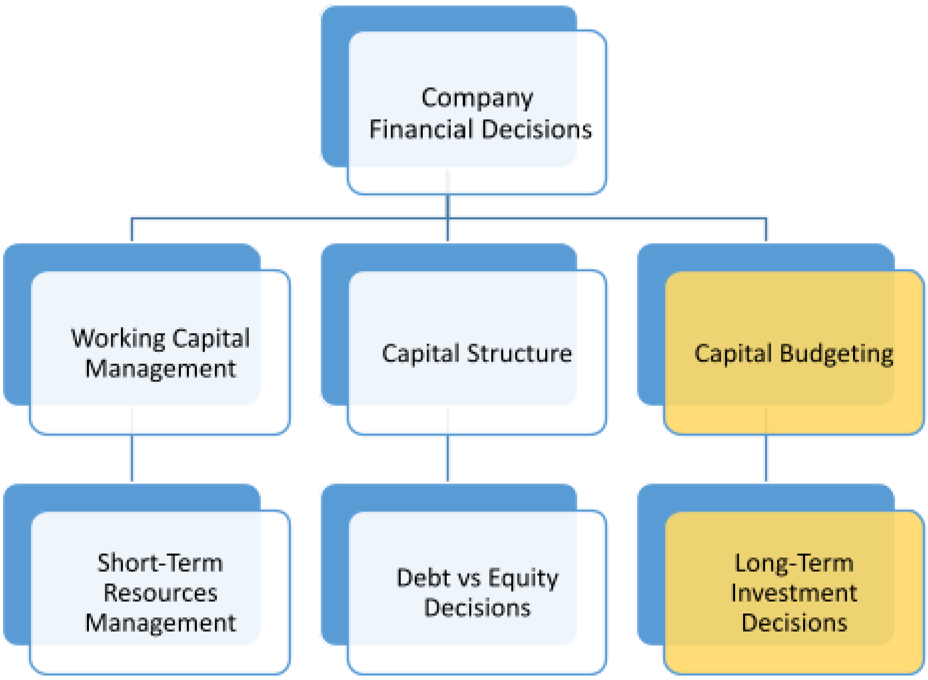

Figure 7.1

This chapter is an introduction to capital budgeting. Capital budgeting is the process of planning and managing company's long-term investment. Capital budgeting decisions may be driven by several **motives**.

- One of the motives may be to **maintain the current operating capability** of the company. Decisions related to this motive include the renewal and replacement of the company's current production facilities. With this type of investment, companies may operate more efficiently and potentially reduce their costs.
- Another motive for capital budgeting may be to **expand the current size** of the company. The expansion may include building new production facilities, choosing new projects or introducing new business lines or products. Expansion of the existing business activities may potentially enhance

revenues.

- Also, companies may engage in capital budgeting decisions in **responding to stakeholders' demands** such as mandatory projects required by government regulations or projects related to corporate social responsibility. While these types of investments may not be related to cost reduction or revenue enhancement, they are still required to keep the business running.

In this chapter, we will focus our discussion on the expansion investments as these are revenue-enhancing, involve more uncertainty and may affect companies more significantly. A similar analysis can be performed for any outlay that provides future benefits to the firm over a period exceeding one year. For some types of decisions, the future benefits may be hard to quantify (such as the goodwill and reputation effects of a principled stand on sustainability), or may be very uncertain or far in the future (such as the benefits derived from reducing the company's carbon footprint). So, while we will teach you quantitative analysis methods in this chapter, any real-world decision must also consider qualitative and non-quantifiable costs and benefits.

7.1.1 Importance of Capital Budgeting

Capital budgeting decisions are the company's most fundamental decisions for many reasons:

- **Company value** – capital budgeting decisions will increase or decrease company value, depending on whether or not the present value of all future cash flows generated from the projects exceed the costs incurred by the project.
- **Competition** – decisions to take new projects or launch new products/services are necessary for companies to remain competitive. Companies may have little chance of survival without finding new business opportunities and capital budgeting helps to measure the effectiveness of each investment relative to the opportunities available.
- **Costs** – capital budgeting decisions may involve large cash outlays which are difficult and costly to reverse. Also, given the large amount of resources that might be used in a particular project, accepting one project reduces the company's opportunity to invest in other projects (opportunity costs).
- **Capitalisation** – capital budgeting projects often make up the non-current asset portion of the balance sheet. Therefore, these decisions may a have long-term impact on the company.

Concept Check...

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7.1.2 Project Classifications

7.1.2.1 Decision Rules

The decision rules we use for capital projects will depend on the relationship of the projects to other investment opportunities the company may have. Project relationships can be classified into the following types:

Independent projects: The decision to accept or reject one project does not directly affect the decision on other projects. This means that if we have enough capital, we could undertake multiple projects as they are independent of each other.

Examples:

- Samsung introducing a new smartphone and the replacement of machinery for a ship building business line. Assuming that Samsung is not capital constrained, accepting the smartphone project will have no effect on the replacement project.
- The establishment of fuel stations and the introduction of online channel for sales (e-commerce) in Walmart. With Walmart's financing capacity, acceptance of the fuel stations project does not exclude the e-commerce project from consideration.

Mutually exclusive projects: The decision to accept one project prevents the acceptance of other projects. In other words, two or more projects cannot be undertaken at the same time.

Examples:

- Qantas' decision of purchasing aircraft from either Airbus or Boeing for its longest range flights. The acceptance of aircraft from Airbus will preclude the acceptance of aircraft from Boeing, or vice versa.
- Sony's decision to locate its largest LCD TV factory either in Europe or in Asia. Once Sony has selected Europe as the factory location, the other possible location is ruled out.

Contingent projects: The decision to accept/reject one project is dependent on the decision to accept or reject one or more other projects. Contingent projects are usually projects that support the success of other projects or become a prerequisite of other projects. Contingent projects may be combined and analysed as a single project.

Examples:

- BHP Billiton also builds facilities such as roads and houses when the company starts its new mining project in a remote area. The project for building the facilities will be accepted only if BHP decides to do the mining project in the area.
- Microsoft's decision to invest in a data centre was contingent upon the decision of starting its cloud computing business. Investment in data centre is one of the prerequisites for Microsoft's cloud computing project.

Check Your Understanding...

Match the projects to the project types independent, mutually exclusive and contingent:

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Financial managers use project evaluating tools to decide on which project(s) to undertake. These tools include the Net Present Value (NPV), Payback Period, Internal Rate of Return (IRR), Profitability Index and Average Accounting Return (AAR). This chapter will discuss the three most common tools employed by financial managers: NPV, Payback Period, and IRR.

7.2 Net Present Value (NPV)

As stated previously, project evaluation requires cost-benefit analysis. Costs usually occur at the start, when we invest. Benefits from undertaking a project occur after the initial investment has been made. Remember that in finance, cash flows are key, so we measure the project's future net cash flows (usually estimated to be positive) generated by the project and compare it to the cash outflows from the initial cost (outlay).

NPV compares the future net cash flows and the initial cost by taking into account the time value of money. If, for one reason or another, we do not have to generate a return on our investment, we could just add up the benefits (cash inflows) from a project and deduct the initial cost. However, there is cost associated with using capital. Investors require a return on their investment and even the company has an opportunity cost of investing (and earning a return) elsewhere if it does not need external financing. To account for the time value of money, the net present value evaluates the difference between the present value of the project's future net cash flows and its current cost (outlay), to understand if the future benefits outweigh the initial costs.

NPV = PV(Future Net Cash Flows) – Initial Cost

NPV = – Initial Cost + PV(Future Net Cash Flows)

When the present value of the future net cash flows generated from the project is greater than the project's initial cost, then the NPV will be positive. Positive NPV projects generate more than the required return on capital and will thus increase the value of the company and therefore, should be accepted. The present value of future cash flows is computed by discounting the future cash flows at the opportunity cost of capital. This means that if NPV is zero, then the project earns exactly the return that investors (providers of capital) require to take on the risk of the project.

On the other hand, if the present value of the project's future cash flows are less than the initial cost, then the project will have a negative NPV. Negative NPV projects have a return lower than the investor's requirement and should be rejected as they decrease the value of the company and consequently, reduce shareholders' wealth.

NPV Decision Criteria:

NPV > 0 → Accept Project

NPV < 0 → Reject Project

Remember how we computed the value of shares in Chapter 6? The value of a company is measured as present value of future cash flows at an opportunity cost that reflects the risk of those cash flows. Therefore if NPV is positive, the company is earning more than the required return on the project, increasing the present value of the company's future cash flows and increasing the value of the company and its shares.

NPV is considered the best project evaluation tool as it considers the time value of money and is a direct measure of how much the company's value will increase or decrease by undertaking a particular project.

Note that the NPV decision rule is solely based on the value creation for shareholders. In reality you may consider the value to other stakeholders as well when making a final decision on whether or not to undertake a project.

Concept Check...

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7.3 Calculating NPV for a Project

NPV is determined using the discounted cash flow method in which the project's future net cash flows (cash inflows – cash outflows) are discounted to year 0 and the initial project cost is subtracted from the computed present value of future net cash flows.

$$NPV = -CF_0 + \sum_{n=1}^{N} \frac{CF_n}{(1+r)^n}$$

CF_0 = initial cost (including discounted project costs after year 0)
CF_N = net cash flow in period n, where n = 1, 2 ,3, ... N
r = the discount rate (cost of capital)
n = the project's estimated life

7.3.1 NPV Components

In calculating NPV, we need to estimate the initial cost of the projects, the timing and the amount of future cash flows as well as the cost of capital of the project as the discount rate.

- **Initial costs** – a project's initial costs are usually incurred in year 0 (upfront) and therefore, the cash outflows are already at present value. For projects with initial costs extend beyond year 0, costs should all be discounted to year 0.
- **Future net cash flows** – the future net cash flows include cash inflows from revenue generated from the project minus related expenses. In some projects such as replacement projects, the future net cash flows may be cost reductions resulting from the project.
- **Discount rate** – the discount rate reflects the opportunity cost of the project. That is, the minimum required rate of return of the project given the risk and duration of the project. When a project is relatively risky, the company may require a higher discount rate.

Example

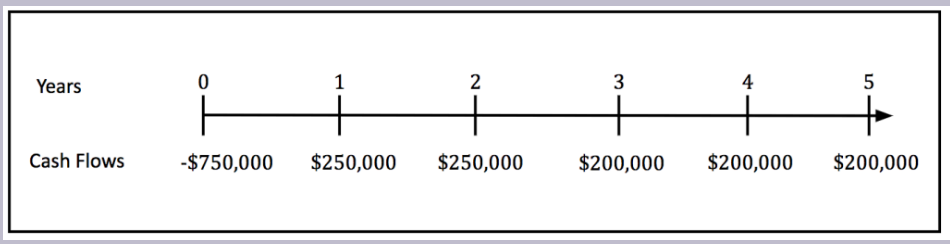
Samsung example

Samsung is considering the launch of 2 different smartphones: smartphone A and smartphone B. Smartphone A will require an initial outlay of $750,000 and is expected to generate after-tax cash flows of $250,000/year for the first 2 years and $200,000 in each of year 3, year 4 and year 5. On the other hand, smartphone B will require an initial outlay of $950,000 and the expected after-tax cash flows generated from smartphone B are $600,000 in year 1, $300,000 in each of year 2 and year 3, $250,000 in year 4 and $100,000 in year 5. Samsung faces an opportunity cost of capital of 10%. If smartphone A and smartphone B are independent projects, should Samsung proceed with any of them? If both projects are mutually exclusive, which project should Samsung choose? (hint: use NPV as the decision criteria).

Solution

Smartphone A

Solving capital budgeting questions can be made much easier by drawing the project's timeline. The timeline for smartphone A cash flows over its expected life is the following:



Timeline over 5 years with -$750000 at year zero, $250000 for years 1 and 2 and $200000 for years 3 to 5

Since this question uses the NPV as the decision criteria, we will use the following formula:

$$NPV = -CF_0 + \sum_{n=1}^{N} \frac{CF_n}{(1+r)^n}$$

The present value of future cash flows is determined by discounting the expected after-tax cash flows from year 1 until year 5. The cost of capital (10%) is used as the discount rate when determining the present value of future cash flows since it is the opportunity cost that reflects the risk of those cash flows. In other words, the project needs to generate at least a 10% return to be a worthwhile undertaking.

Further, the initial cost of the project ($750,000) is deducted from the present value of future after-tax cash flows to get the NPV of the project.

$$NPV = -\$750,000 + \frac{250,000}{(1+0.1)^1} + \frac{250,000}{(1+0.1)^2} + \frac{200,000}{(1+0.1)^3} + \frac{200,000}{(1+0.1)^4} + \frac{200,000}{(1+0.1)^5}$$

$$= -\$750,000 + \$227,272.73 + \$206,611.57 + \$150,262.96 + \$136,602.69 + \$124,184.26$$

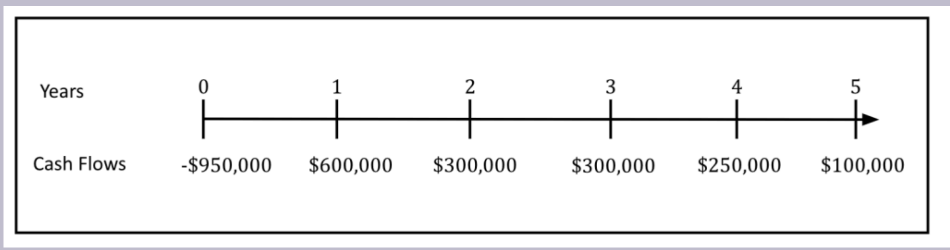
$$= -\$750,000 + \$844,934.21$$

$$= \$94,934.21$$

As the present value of future cash flows ($844,934.21) exceeds the initial cost ($750,000), the project has a positive NPV ($94,934.21). This means this project provides a higher return than what is required (>10%) and the value of the firm increases by $94,934.21 if the project is undertaken.

Smartphone B

Smartphone B project's timeline is the following:



Timeline – 5 years with -$950,00 in first years and $600,000 for year 1, $300000 for years 2 and 3 , $250000 for year 4 and $100000 for year 5.

Using the same step as discussed in smartphone A project, the NPV of smartphone B project is as follows:

$$NPV = -CF_0 + \sum_{n=1}^{N} \frac{CF_n}{(1+r)^n}$$

$$NPV = -950,000 + \frac{600,000}{(1+0.1)^1} + \frac{300,000}{(1+0.1)^2} + \frac{300,000}{(1+0.1)^3} + \frac{250,000}{(1+0.1)^4} + \frac{100,000}{(1+0.1)^5}$$

$$= -\$950,000 + \$545,454 + \$247,933.88 + \$225,394 + \$170,733.36 + \$62,092.13$$

$$= -\$950,000 + \$1,251,62.35$$

$$= \$301,628.35$$

Smartphone B also generates positive NPV ($301,628.35) since the present value of the future cash flows of the project ($1,251,628.35) is greater than its initial outlay of $950,000.

If projects smartphone A and smartphone B cash flows are not related (independent), then Samsung should proceed with both projects as both NPVs are positive. This is because when projects are independent, the company can run the projects at the same time (assuming no capital constraint). So as long as the NPVs of the projects are positive, then undertaking the projects is expected to increase the company's value.

However, if both projects are mutually exclusive (Samsung can choose either smartphone A *or* smartphone B due to insufficient demand for both), then Samsung should choose smartphone B as it provides greater NPV ($301,628.35) than smartphone A ($94,934.21). By choosing smartphone B, Samsung will increase the value of the firm more than choosing smartphone A.

Video: [Samsung 7.3 (YouTube, 4m35s)]

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Summary

A firm can measure how much value a project adds to a company's value by estimating the net present value (NPV) of a project. Net present value refers to the difference between the present value of the project's future net cash flows and its initial cost (outlay). The project generates a positive NPV if the sum of discounted future cash flows exceeds the initial cost and vice versa. The discount rate is the cost of capital that takes into account the risk of the future cash flows that are expected from an investment. Selecting positive NPV projects also means that the company is earning more than the required return on the project.

7.3.2 Worked Example

Zenzo Inc is considering two energy storage systems for their solar panels. Projects are mutually exclusive. Projected cost and energy savings are displayed below:

Year	Flow System	Turbo System
0	-$2,450,250	-$1,766,475
1	$810,150	$656,253
2	$718,742	$501,368
3	$687,543	$423,036
4	$554,358	$394,358
5	$935,521	$604,375

The company uses 13.56% to discount such project cash flows. The video below demonstrates computation of NPV and the application of the NPV decision rule.

Video: Worked example (YouTube, 7m34s) (Zenzo Inc part 1)

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Video: Worked Example 7.3 in Excel (YouTube, 3m58s) (Zenco Inc Part 2)

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Download the Excel template (xlsx, 72KB)

Concept check

You are a financial consultant for Equinox and have been asked for some advice. Equinox Ltd is planning to use marketing services from a digital marketing company. The contract with the digital marketing company requires Equinox to pay an upfront cost of $450,000. Equinox expects that this new marketing strategy will result in additional cash flows of $150 250, $250 650, and $175 000 over the next 3 years.

What is the NPV if the discount rate is 12%?

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https://uq.pressbooks.pub/introduction-financial-management/?p=121#h5p-79

What if the discount rate is 16%?

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https://uq.pressbooks.pub/introduction-financial-management/?p=121#h5p-80

Explain how the choice of discount rate influences the NPV and the capital budgeting decision.

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https://uq.pressbooks.pub/introduction-financial-management/?p=121#h5p-81

7.4 Payback Period – What does it Measure?

How many years does it take to recover my initial investment?

This is what the **payback period** measures: it is the number of years required for a project to recover its initial cost through future net cash flows. This figure may be useful to understand about your project, but sometimes management selects (sometimes arbitrary) cut-off times, e.g. three years. In that case, all projects that recover their initial cost within the three-year period are accepted while all those that require longer than three years to recover their initial cost are rejected.

Payback period is relatively simple and easy to understand once the cash flows have been estimated. In addition, it is favourable for small businesses as the payback period tends to select projects that generate cash flow more quickly. The small businesses may have fewer resources and need the cash back on their investment to use for other purposes. Another advantage of payback period is that it increases the certainty of the cash flows. This is because the method generally favours projects with a shorter payback period. The longer it takes for the project to recover its initial investment, the greater the uncertainty or risk of the project not providing enough benefits.

Despite its positive features, the payback period has some disadvantages.

- **First,** it ignores the time value of money, i.e. it treats cash flows equally even though they occur at different points in time. Unlike the NPV that discounts future net cash flows, the payback period simply calculates the sum of the future net cash flows (violating the rule learned in the Time Value of Money module that cash flows can only be compared at the same point in time).
- **Second,** the cut-off point (eg. three years) is arbitrarily set by the management. Hence, the cut-off point for the decision rule will be highly influenced by judgement rather than an objective basis.
- **Third,** it ignores cash flows after the cut-off date. This limitation is especially relevant when the payback period is used to compare two projects or more. Payback period tends to choose project with faster initial cost recovery, regardless of the project's cash flows after the cut-off date compared to other projects.
- **Fourth**, as payback period favours projects that generate cash inflows sooner than later, it may reject long-term projects such as research and development projects.

Payback Period Decision Criteria:

Payback period < cut-off year → Accept Project

Payback period > cut-off year → Reject Project

Exercises

An interactive H5P element has been excluded from this version of the text. You can view it online here:
https://uq.pressbooks.pub/introduction-financial-management/?p=121#h5p-82

7.5 Calculating the Payback Period for a Project

Similar to the NPV, payback period calculation requires initial cost and future net cash flow estimates. The payback period can be calculated using the following formula:

$$\text{Payback Period} = \text{Years before cost recovery} + \frac{\text{Remaining cost to recover}}{\text{Cash flow during the year}}$$

How this formula works may be best explained with a simple example. Suppose a company proposed a project that requires an initial cost of $50,000. The project is expected to generate cash flows of $15 000, $20 000, $30 000 and $45 000 in the next four years. In this case, the cumulative cash flow after 2 years is $35,000 ($15,000 + $ 20,000) while the cumulative cash flows after 3 years is $65,000 ($15,000+$20,000+$30,000). Hence, the project pays back the initial cost of $50,000 sometime in the third year and the number of years before cost recovery is 2 years.

After 2 years, the project has paid back $35,000, leaving $15,000 to be recovered ($50,000-$35,000), which we call the remaining cost to recover. Further, we need to determine the fractional year when the initial cost is fully recovered by dividing the amount to be recovered ($15,000) with the cash flow in year 3 ($30,000), which is referred to as the cash flows during the year in the formula above. This $15,000 is $15,000/30,000= ½ of the third year cash flow. Assuming that the $30,000 cash flow is paid uniformly throughout the year, the project's payback period will be 2.5 years.

$$\begin{aligned}\text{Payback Period} &= 2 + \frac{50,000 - 35,000}{30,000} \\ &= 2.5 \text{ years}\end{aligned}$$

Whenever a project is estimated to have equal future cash flows each year, let's say $15,000 for the next four years, then the formula can be simplified into:

$$\text{Payback Period} = \frac{\text{Project Cost}}{\text{Yearly Cashflows}}$$

If the project above was expected to generate cash flows of $15,000 for 4 years with an initial cost of $50,000, then the payback period would be:

$$\text{Payback Period} = \frac{50,000}{15,000} = 3\frac{1}{3} \text{ years.}$$

7.5.1 Worked Example

Let's analyse the Samsung case again. What is the payback period for smartphone A and smartphone B. Which project should Samsung choose if it sets the 3 years as the cut-off year?

Year	**Smartphone A** Cash Flows	Cumulative Future Net Cash Flows	**Smartphone B** Cash Flows	Cumulative Future Net Cash Flows
0	-750,000	-750,000	-950,000	-950,000
1	250,000	-500,000[1]	600,000	-350,000
2	250,000	-250,000[2]	300,000	-50,000
3	200,000	-50,000	300,000	250,000
4	200,000	150,000	250,000	500,000
5	200,000	350,000	100,000	600,000

[1] -750,000 + 250,000

[2] -500,000 + 250,000

Video: [Samsung 7.4 example (YouTube, 3m36s)]

One or more interactive elements has been excluded from this version of the text. You can view them online here: https://uq.pressbooks.pub/introduction-financial-management/?p=121#oembed-3

7.5.1.1 Solution to Worked Example

Smartphone A Payback Period

$$\text{Payback Period} = \text{Years before cost recovery} + \frac{\text{Remaining cost to recover}}{\text{Cash flow during the year}}$$

We can find out the number of years before the initial cost is recovered by identifying the year after which the cumulative cash flows turn positive. For Smartphone A, this is year 3. In year 3, only $50 000 is left to recover the initial cost and in the fourth year, a cash flow of $200 000 is expected. Thus the expected payback period is:

$$\text{Payback Period} = 3 + \frac{50,000}{200,000} = 3.25\text{years}$$

Smartphone B Payback Period:

With the same logic, the payback period for smartphone B will be between 2 and 3 years. The exact payback period is:

$$\text{Payback Period} = 2 + \frac{50,000}{300,000} = 2.17\text{years}$$

Smartphone B payback period (2.17 years) is shorter than the cut-off year (3 years). So smartphone B should be accepted. On the other hand, smartphone A should be rejected as the payback period (3.25 years) exceeds the cut-off year. Therefore, based on the payback period criteria, Samsung should only proceed with project B. In this case, the decision is the same regardless of whether the projects are independent or mutually exclusive.

Previously we calculated the NPV for two energy saving projects Zenzo Inc is considering:

Year	Flow System	Turbo System
0	-2,450,250	-1,766,475
1	810,150	656,253
2	718,742	501,368
3	687,543	423,036
4	554,358	394,358
5	935,521	604,375

The following video shows how to calculate the payback period for the Flow System.

Video: Zenzo Inc example 7.4 – Payback of the flow system (YouTube, 5m53s)

One or more interactive elements has been excluded from this version of the text. You can view them online here: https://uq.pressbooks.pub/introduction-financial-management/?p=121#oembed-4

7.5.1.2 Worked example PDF

Please download the Zenzo Inc Payback Period for the Flow System (PDF, 718KB) worked example.

Concept Check

What is the payback period for the Turbo System?

An interactive H5P element has been excluded from this version of the text. You can view it online here:

https://uq.pressbooks.pub/introduction-financial-management/?p=121#h5p-83

Which system should Zenzo choose based on the payback period, if the cut-off is 3.5 years? (remember the projects are mutually exclusive!)

An interactive H5P element has been excluded from this version of the text. You can view it online here: https://uq.pressbooks.pub/introduction-financial-management/?p=121#h5p-84

Exercise

Should Melrose Ltd purchase new machinery?

Melrose Ltd is considering to purchase new machinery to increase its production capacity. The cost of the new machinery is $7,270 and the additional cash flows generated from adding the production capacity over the four years are projected to be $2,600, $3,350, $2,850 and $1,150. The company imposes a payback cut-off of 3 years for this project.

If Melrose Ltd uses the payback period as their decision criteria, should it accept this project?

Solution:

The payback period of this project is calculated as follows:

Year	Smartphone A Cash Flows	Cumulative Future Net Cash Flows
Year 0	-7,270	-7,270
Year 1	2,600	-4,670
Year 2	3,350	**-1,320**
Year 3	2,850	1,530
Year 4	1,150	2,680

The cash flows are going to be recovered somewhere between year 2 and year 3, given that there is \$1,320 left to recover in year 2, and the cash flows in year 3 are larger than what is needed to recover the investment in full. The exact payback period is calculated as follows:

$$\text{Payback Period } = 2 + \frac{1320}{2850} = 2.46 \text{ years}$$

Since the payback period of the project (2.46 years) is less than the cut-off year (3 years), the company should proceed with the project.

7.6 Internal Rate of Return (IRR)

7.6.1 What is the Internal Rate of Return (IRR) and What does it Measure?

The internal rate of return (IRR) is a commonly used capital budgeting method, and is the discount rate when NPV = 0. The IRR tells us what return the project is expected to generate. The IRR is intuitively very easy to understand, and we will learn in this chapter how and when we can use it to make capital budgeting decisions.

To solve for IRR, we can use the NPV formula discussed previously and set NPV to zero:

$$NPV = -CF_0 + \sum_{n=1}^{N} \frac{CF_n}{(1+r)^n}$$
$$0 = -CF_0 + \sum_{n=1}^{N} \frac{CF_n}{(1+IRR)^n}$$

(Remember, N is the life of the project and n refers to each year in turn)

Similar to the yield to maturity in bond valuation, IRR cannot be solved directly. We can use the trial and error approach or spreadsheet function to determine IRR.

The example below illustrates an example of estimating the IRR using trial and error. Suppose a company has a three-year project with an initial cash outlay of \$500,000. The company projects future cash inflows to be \$100 000, \$200 000, and \$300 000 for year 1, year 2 and year 3, respectively. The IRR of the project can be estimated using trial and error. With this method we estimate the IRR by trying a discount rate, and then adjust it, until NPV = 0.

Let's try a discount rates of 7%:

$$r = 7\%, NPV = -500,000 + \frac{100,000}{(1+0.07)^1} + \frac{200,000}{(1+0.07)^2} + \frac{300,000}{(1+0.07)^3}$$
$$= \$13,035.05$$

A discount rate of 7% results in a positive NPV. We are trying to find out at which discount rate NPV is zero, therefore we have to increase our discount rate (this will decrease NPV). So let's try a discount rate of 9%.

$$r = 9\%, NPV = -500,000 + \frac{100,000}{(1+0.09)^1} + \frac{200,000}{(1+0.09)^2} + \frac{300,000}{(1+0.09)^3}$$
$$= -\$8,265.84$$

Now the NPV is negative, this means our estimated discount rate is too high. Now, if we adjust it to 8% and keep making adjustments, we will find that 8.21% is the rate that makes NPV equal to 0.

$$r = 8.21\%, NPV = -500,000 + \frac{100,000}{(1+0.0821)^1} + \frac{200,000}{(1+0.0821)^2} + \frac{300,000}{(1+0.0821)^3}$$
$$= -\$18.36 \approx 0 \text{ (the discount rate rounded from } 8.2082635\%)$$

We can also find the IRR (more easily!) by using a spreadsheet.

VIDEO: Calculating IRR using Excel (YouTube, 58s)

One or more interactive elements has been excluded from this version of the text. You can view them online here: https://uq.pressbooks.pub/introduction-financial-management/?p=121#oembed-6

7.6.2 IRR Decisions

IRR calculates the rate of return earned by a particular project. It computes the compound annual rate of return generated by an investment. A project with an IRR that exceeds its required rate of return should be accepted as this implies a positive NPV.

Decisions made using IRR are generally consistent with the decisions based on NPV, but only if we are evaluating independent projects and those projects have conventional cash flows. IRR should not be used in the following cases:

- Non-conventional cash flows

- Ranking mutually exclusive projects

7.6.2.1 Non-Conventional Cash Flows

Non-Conventional Cash Flows are cash flows that have more than one sign change. Thus far, we have had a cash outflow at the start (minus sign) and only cash inflows after (plus sign), which is what we call conventional cash flows. To illustrate non-conventional cash flows, let's analyse a mining project with the following cash flows. Unlike a project with conventional cash flows that has an initial cash outflow followed by future cash inflows, this project has a cash outflow in year 4 (-$2,250,000). The negative cash flows at the end of the project could be the result of major site restoration.

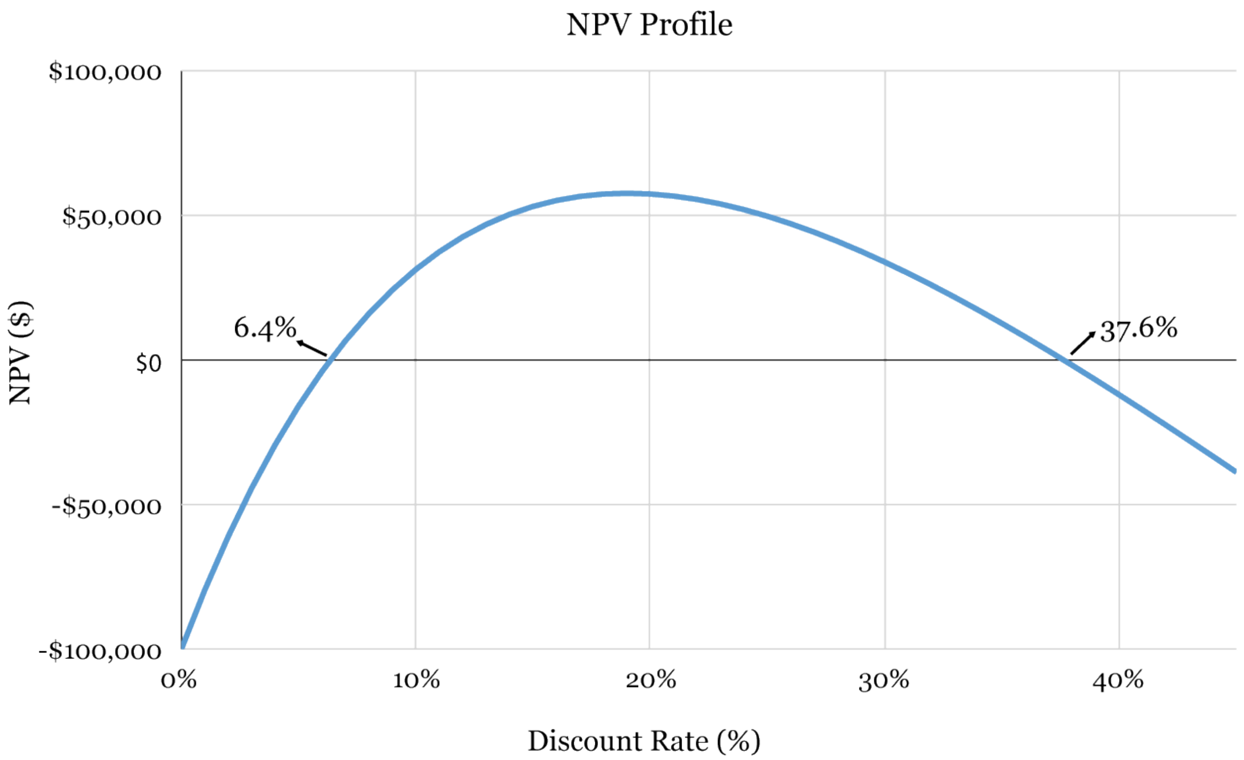
Year	**Cash Flows**
0	-$1,000,000
1	$800,000
2	$1,000,000
3	$1,350,000
4	-$2,250,000

To understand the effect of the cash flows, we will determine NPVs at various discount rates as follows:

Discount Rate	**NPV**
5%	-$15,965.57
15%	$52,997.95
20%	$57,291.67
30%	$33,787.33
40%	-$12,078.30

As shown above, as the discount rate increases from 5% to 15%, NPV changes from negative (-$15,965.57) to positive ($52,997.95). Later, the NPV becomes smaller and turns into negative number again when the discount rate is 40% (-$12,078.30).

The NPV profile below shows that the line crosses the x-axis at two points. In other words, there are two discount rates that make NPV = 0. One at 6.4% and the other at 37.6%. In this situation, there is no correct answer for IRR as we have **multiple IRRs**.



The number of IRRs in a project is equal to the number of cash flows sign changes (positive to negative or vice versa) in the project. In our example, we had two IRRs as we have two sign reversal in the cash flow streams (from -$15,965.57 to $52,997.97 and from $33,787.33 to -$12,078.30).

Ranking Mutually-Exclusive Projects

Another problem with IRR is related to mutually exclusive investment decisions. In this case, IRR and NPV may result in a different decision. This is due to the fact that projects are likely to **have different scales**. Suppose a company is considering whether to utilise its land by either building an apartment or building a shopping centre. The expected cash flows from this mutually exclusive projects are the following:

Year	Apartment	Shopping Centre
0	-$3,000,000	-$4,000,000
1	$800,000	$900,000
2	$900,000	$1,000,000
3	$900,000	$1,500,000
4	$850,000	$1,100,000
5	$800,000	$1,000,000

The IRRs of the projects are the following:

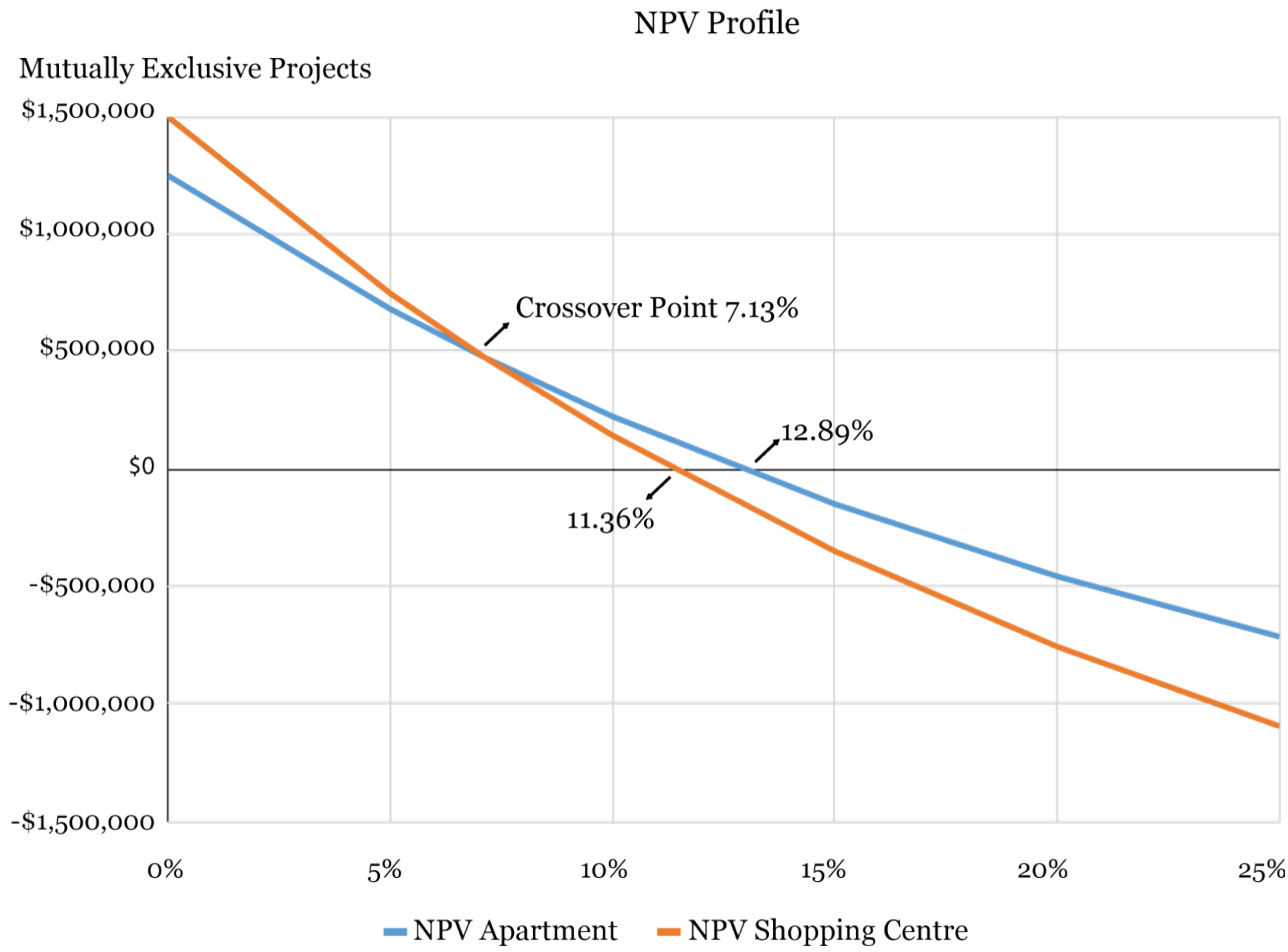
- IRR_\text {Apartment} : 12.89%
- IRR_\text {Shopping Centre}: 11.36%

If we use IRR as the decision criteria, then we will choose the apartment project because it has a greater IRR (12.89%) compared to the shopping centre project (11.36%). However, if we use NPV, then we may choose the shopping centre project for some discount rates as it has a greater NPV.

Again, to understand the effect of the cash flows from these projects, we will determine NPVs at various discount rates as follows:

Discount Rate	$NPV_{\text{Apartment}}$	$NPV_{\text{Shopping Centre}}$
0%	$1,250,000.00	$1,500,000.00
5%	$681,803.17	$748,427.62
7.13%	$475,171.16	$475,171.16
10%	$224,556.20	$143,836.42
15%	-$148,322.27	-$348,867.98
20%	-$456,082.82	-$755,144.05

As shown above, the NPVs for the shopping centre are greater than the NPVs for the apartment project when the discount rates are below 7.13% (the crossover point). Therefore, when the discount rate is below the crossover point, the project's ranking based on IRR and NPV are in conflict.



Generally, the IRR Decision rule is as follows:

IRR Decision Rule:

IRR > Required rate of return → Accept Project

IRR < Required rate of return → Reject Project

But remember that the IRR cannot be used to rank mutually exclusive projects or when cash flows are non-conventional.

Video: [IRR 7.6.2 (YouTube, 8m13s)]

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Exercises

Concept check

Kathmandu Ltd has the following three independent projects. The company's required rate of return for the projects is 15%. Determine the IRR for each project based on the cash flows listed below and decide which project(s) should be accepted.

Year	Project A	Project B	Project C
0	-$35,000	-$50,000	-$60,000
1	0	$15,000	$20,000
2	$15,000	$15,000	$20,000
3	$20,000	$20,000	$25,000
4	$20,000	$20,000	$20,000
5	$10,000	0	$10,000

What is the IRR for Project A based on the cash flows listed above?

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https://uq.pressbooks.pub/introduction-financial-management/?p=121#h5p-86

What is the IRR for Project B based on the cash flows listed above?

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https://uq.pressbooks.pub/introduction-financial-management/?p=121#h5p-87

What is the IRR for Project C based on the cash flows listed above?

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https://uq.pressbooks.pub/introduction-financial-management/?p=121#h5p-88

Which projects should be accepted based on the companies required return rate of 15%?

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An interactive H5P element has been excluded from this version of the text. You can view it online here:
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7.7 Summary and Conclusion

7.7.1 Summary

Capital budgeting is one of the most fundamental decisions for modern corporations. Deciding on the right projects to invest in can have profound impact on the company performance, given the capital investment typically involves large amount of resources and not reversible once the investment is made. There are three different types of projects, namely, independent projects, mutually exclusive projects and contingent projects.

In this chapter, we have learnt three common methods in evaluating capital investment projects. The first method is NPV, which compares the future net cash flows and the initial cost by taking into account the time value of money. The decision rule is to accept projects with positive NPVs if they are independent. When projects are mutually exclusive, then the project with highest NPV should be accepted.

The second method we have learnt is payback period, which measures the number of years required for a project to recover its initial cost through future cash flows. The decision rule is to accept projects with payback periods less than the cut-off times set by the management. For mutually exclusive projects, the project with shortest payback period should be accepted. The drawbacks of payback period includes the omission of time value of money, the arbitrary cut-off point, the omission of cash flows after the cut-off date, and the rejection of long-term projects such as research and development projects.

The third method is the IRR, which calculates the discount rate that makes the NPV equal to 0. The IRR tells us what return the project is expected to generate, and we should projects with IRRs higher than the hurdle rates set by the management. For mutually exclusive projects, the project with the highest IRR should be accepted. However, IRR should not be used when there is non-conventional cash flows or when ranking mutually exclusive projects with different scales.

7.7.2 Key Formulas

NPV Formula:

$$NPV = -CF_0 + \sum_{n=1}^{N} \frac{CF_n}{(1+r)^n}$$

$CF_0 =$ initial cost (including discounted project costs after year 0)

$CF_n =$ net cash flow in period n, where n $= 1, 2, 3, \ldots$ N

r$=$ the discount rate (cost of capital)

$n =$ the project's estimated life

Payback period formula:

$$\text{Payback Period} = \text{Years before cost recovery} + \frac{\text{Remaining cost to recover}}{\text{Cash flow during the year}}$$

IRR Formula:

$$0 = -CF_0 + \sum_{n=1}^{N} \frac{CF_n}{(1+IRR)^n}$$

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8.

NPV – RELEVANT CASH FLOWS

8.1 Introduction

At the end of this chapter, you will be able to:

- explain why only incremental after-tax free cash flows are relevant in evaluating a project
- identify the relevant (incremental) cash flows for a capital budgeting project
- explain why tax computations are relevant to capital budgeting and how depreciation affects after-tax free cash flows (FCF)
- calculate the after-tax FCF for a project
- identify and calculate any initial and final year after-tax cash flows from capital transactions and changes in working capital
- compute NPV and IRR using Excel.

In Chapter 7, we discussed three commonly used project evaluation tools: Net Present Value (NPV), Payback Period, and Internal Rate of Return (IRR). Those three methods have one thing in common: all methods use cash flows arising from the project in their analysis. But, which cash flows should we use? Are they the same cash flows as presented in the annual "cash flow statements"? Are all projected cash flows relevant for capital budgeting?

In this chapter, we focus on the "cash flows" part of capital budgeting. In particular, we discuss which projected cash flows are relevant and how these cash flows differ from the accounting cash flow statement.

8.1.1 The Importance of Incremental After-tax Free Cash Flows (FCF) in Capital Budgeting

In capital budgeting, we are interested in something called the *incremental after-tax free cash flows*. What are the "incremental after-tax free cash flows" for a project? The term will be explored as follows:

- **Incremental cash flows:** The incremental cash flows refer to any net additional future cash flows generated by a company as a direct consequence of adopting a project. Incremental cash flows are often also referred to as relevant cash flows. This concept also means that cash flows that would exist regardless of whether or not the project is adopted are not relevant in project evaluation.
- **Free cash flows:** The free cash flows refers to the cash flow available to the debtholders and shareholders after all operating expenses have been paid and necessary investments in working capital and fixed assets have been made.
- **After-tax:** As a consequence of the free cash flows concept, we also need to take into account the cash outflow from tax payments to the government that will be applied to the profit or gain generated from the project. We will discuss later in this chapter that a project may generate a profit or gain from selling the fixed assets at the end of the project, which is a taxable transaction.

Incremental after-tax free cash flows are important because they represent the cash flows that can be paid out to creditors and shareholders. By discounting these cash flows at the cost of capital, we are essentially measuring how much the acceptance of a project would add to (or subtract from) the value of the company in today's dollars. While the value of a company must equal the total value of both debt and equity (**remember assets = liabilities plus equity**), the value of debt is capped at the present value of the promised cash flows. Any increase in the value of a company will, therefore, go to shareholders. This means that the present value of the incremental after-tax free cash flows from a project is a way of measuring how much the project increases (or decreases) shareholder wealth.

Investors care more about cash flows than accounting income. If you invest in a company, you care more about how much dividend you will receive each year, because that determines the cash flows you receive. Having that cash flow, you can choose to consume or invest. On the other hand, you care less about the accounting profit or loss (unless this impacts the cash flow to you). This is because you cannot consume or invest that profit if you don't receive the dividend. Also, accounting income can be distorted by non-cash items in revenues and/or expenses, such as credit sales, accrued expenses and depreciation expenses.

In this chapter, we are going to learn how to identify relevant cash flows for project evaluation.

8.2 Identifying Incremental Cash Flows in Capital Budgeting

8.2.1 Identifying Incremental Cash Flows

Project Evaluation	Accounting Statement
• Focuses on **future cash flows**	• Focuses on historical cash flows.
• Considers only cash flows from operating and investing activities, and accounts for any financing cost using the discount rate.	• Includes cash flows from financing activities such as cash inflows from issuing shares or bonds, or cash outflows for dividend payments.
• Only includes cash flows that have an impact on the company's **overall cash flows**.	• Includes all cash flows irrespective of their impact on the company's overall cash flows

Not all cash flows related to a project are relevant and will be used in the capital budgeting analysis. Failure to include all relevant cash flows or including non-relevant cash flows in the NPV analysis will result in the NPV being overstated or understated and can lead to an incorrect capital budgeting decision. When determining whether a cash flow is incremental, the key question to ask yourself is whether the cash flow would occur if the project **were not accepted** (if the answer is yes, the cash flow is not incremental).

This section outlines some guidelines in identifying relevant cash flows. The most important types of cash flows are discussed in the next section.

8.2.1.1 Cash flow categories

In this course, we cover five major categories of cash flows:

1. Sunk Cost
2. Opportunity Cost
3. Side Effects
4. Financing Costs
5. After-Tax Cash Flows

A sunk cost is a cost that has incurred or is already committed to, and is thus a cost that will occur regardless of whether the company accepts or rejects the project. A sunk cost is not incremental with respect to the decision to undertake the project and should not be included in the analysis. Capital budgeting is related to future investment and any costs that were incurred in the past are not relevant.

Example: Walt Disney

Walt Disney conducts a preliminary survey and hires a consultant to help estimate demand and cash flows for a potential new park and resort. The consultant's report will be used to generate cash flow forecasts for the computation of NPV so that Disney can decide whether to proceed with the new park and resort. The fee for the consultant should not be included in the initial outlay for NPV calculation because the company will still have to pay the fee for the consulting work performed, whether or not it decides to build the new park and resort. In other words, the consultation fee is not an incremental cash flow when evaluating whether the new park should be built.

When assets already owned by the company are used in a new project, the use of these assets represents an "**opportunity cost**". By deciding to use the asset for the new project, the company is giving up the opportunity to use that asset for another project (or the opportunity to sell the asset). Opportunity costs are measured as the value of the next-best alternative use of the asset (often the market value of the asset). Opportunity costs are not necessarily out-of-pocket costs or costs that require a cash payment. We include and add the opportunity costs as a cost at the time they occur, if the resources used in the project could be used for alternative value-creating activities.

Example: Merlo

Merlo is considering whether to expand. It is looking at opening a new store in a shop already owned by Merlo but is currently rented out for $75,000 per year. If Merlo does not launch the new store, they will receive rent of $75,000 per year. If Merlo does launch the new store, they will not receive rent. The lost rent must be included in the cash flow computation for the new store because it represents a lost opportunity or opportunity cost.

Side effects or the impact of the project on the sales of another existing product line should be included in the cash flows relevant to the new project. The impact can be good or bad as launching a new product can increase or decrease cash flows generated from the existing products. When the impact is a loss of sales in another product line, we call it "erosion" or "cannibalized sales". Not all lost sales are side effects, though. Often sales will be lost to competitors if updated products are not launched. So the appropriate consideration when measuring a side effect is the difference between projected revenue from the old product once the new product is launched and projected revenue without the new product.

Another common side effect occurs when expansion results in economies of scale or cost savings in other product lines. This is often called synergies. For example, a product that doubles the number of packing boxes needed to ship products may qualify the company for a volume discount on all packing boxes, not just those used for the new product.

Example: DVD Rent Co

DVD Rent Co is investigating an online streaming project that enables their customers to subscribe to videos online rather than using DVDs. The new project will reduce the DVD rental revenue relative to projected revenue without the online streaming product. Should this reduction of the DVD rental revenue be included in the incremental cash flows for the online streaming project? YES. DVD Rent Co's cash flows as a whole will be reduced by the erosion of the DVD rental revenue.

In capital budgeting decisions, interest expense or any other **financing costs** such as dividends are not included in the cash flows. The rationale is that the project should be judged on its own, not on how it will be financed. Interest costs to the company are included in the interest rate used to compute present value (discount rate) and NOT the cash flows.

Example: Soulara

Soulara is a plant-powered nutrition program which includes meal-delivery service, using sustainable and local ingredients in composing the meals. Thus far, they have focused on meals for lunch and dinner only. They are deciding whether or not to also start offering breakfast options. If they undertake this new project, they will need to take on debt to finance the initial investment into a new large kitchen facility. Should the interest payments be included when evaluating the new project?

NO, financing costs such as interest expenses are not included in capital budgeting. They are considered by discounting the incremental cash flows at the *cost of capital.*

Taxes that have to be paid (or received) as a consequence of undertaking the project should be included in a project analysis, and therefore we consider **after-tax cash flows** in capital budgeting. The tax effects in a project may come from the taxes that are applied on the additional taxable income generated by the project as well as on the gain/loss of selling the fixed assets when the project is concluded or terminated. After-tax cash flows represent what is available to distribute to investors as dividends or interest. Because the project will generate additional taxable income for the company, the relevant tax rate is the rate that applies to the next dollar of income (also known as the marginal tax rate). In Australia, the company tax rate of 30% applies to large companies (turnover in excess of $50m) and 26.0% (25.0% from FY22) applies to small companies. Unless the project pushes total company turnover across the $50m threshold, you can just use these rates as the marginal rate.

Example: Sea World

Sea world is a marine animal park in the Gold Coast, Queensland, which promotes conservation through education and the rescue and rehabilitation of sick, injured or orphaned wildlife. It also offers a range of attractions such as rides and animal exhibits. It is currently considering adding another ride to the park, which is estimated to generate an additional EBIT of $5 million per year. If the company has an annual turnover of $150 million, what tax rate should Sea World use to calculate after-tax cash flows for the new ride?

30%, as the company is considered large (>$50m threshold).

Exercises

Check your understanding of cash flow:

An interactive H5P element has been excluded from this version of the text. You can view it online here: https://uq.pressbooks.pub/introduction-financial-management/?p=135#h5p-90

8.3 Calculating After-tax FCF for a Project

8.3.1 Calculating After-tax Free Cash Flow (FCF)

In calculating the after-tax FCF, we need to consider the yearly incremental operating cash flows that result from the project. Additionally, after-tax FCF includes any incremental capital expenditures as well as any addition to working capital that are required for the project.

After-tax FCF calculation adopt a stand-alone principle which means that we evaluate each project's investment, revenue and expenses independent from the company that owns that project.

A project's FCF is calculated as follows:

Formula	
Revenue	XXX
Less: Operating Expenses	(XXX)
Earnings before interest, tax, depreciation and amortisation (EBITDA)	XXX
Less: Depreciation/Amortisation Expenses	(XXX)
Earnings before interest and tax (EBIT)	(XXX)
Tax (EBIT x tax rate)	XXX
Net operating profit after tax (NOPAT)	(XXX)
Add: Depreciation/Amortisation Expenses	XXX
Operating Cash Flows	XXX
Less: Capital Expenditures	(XXX)
Less: Additions to working capital	(XXX)
After-tax FCF	XXX

This video will talk you through the steps involved in calculating after-tax FCF.

Video: [FCF Calculation 8.3.1 (YouTube, 10m3s)]

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As shown in the formula above, the After-tax FCF calculation involves six steps:

Step 1: Compute earnings before interest, tax, depreciation and amortisation (EBITDA) by subtracting operating expenses from revenue. Include all incremental revenue and operating expenses. Be sure to include opportunity costs and side effects, and to exclude sunk costs!

Step 2: Earnings before interest and tax (EBIT) is computed as EBITDA less depreciation/amortisation expenses. There are several depreciation methods allowed in accounting such as straight-line, diminishing-balance or units of production methods, but the only applicable method used on the tax return is relevant for the capital budgeting analysis. This is because we include depreciation in the analysis only due to its tax implication. In this course, all depreciation computations will be computed as the straight line depreciation with zero salvage value:

$$Depreciation = \frac{Initial\ Cost}{Useful\ Life}$$

Depreciation is computed on tangible assets that have a useful life in excess of one year. For intangible assets (such as patents) the cost is spread over the useful life in the same manner. This is called amortisation.

Step 3: Net operating profit after tax (NOPAT) is computed as EBIT less tax. You compute tax by multiplying EBIT by the appropriate corporate tax rate. It is important to note here that interest expense is not deducted from EBIT when we calculate NOPAT. As discussed in section 8.2, financing costs such as interest expense are not relevant and should be excluded from the analysis. As discussed above, the financing expense is incorporated in the discount rate when we determine NPV later (we will discuss how to determine the relevant discount rate in Chapter 11).

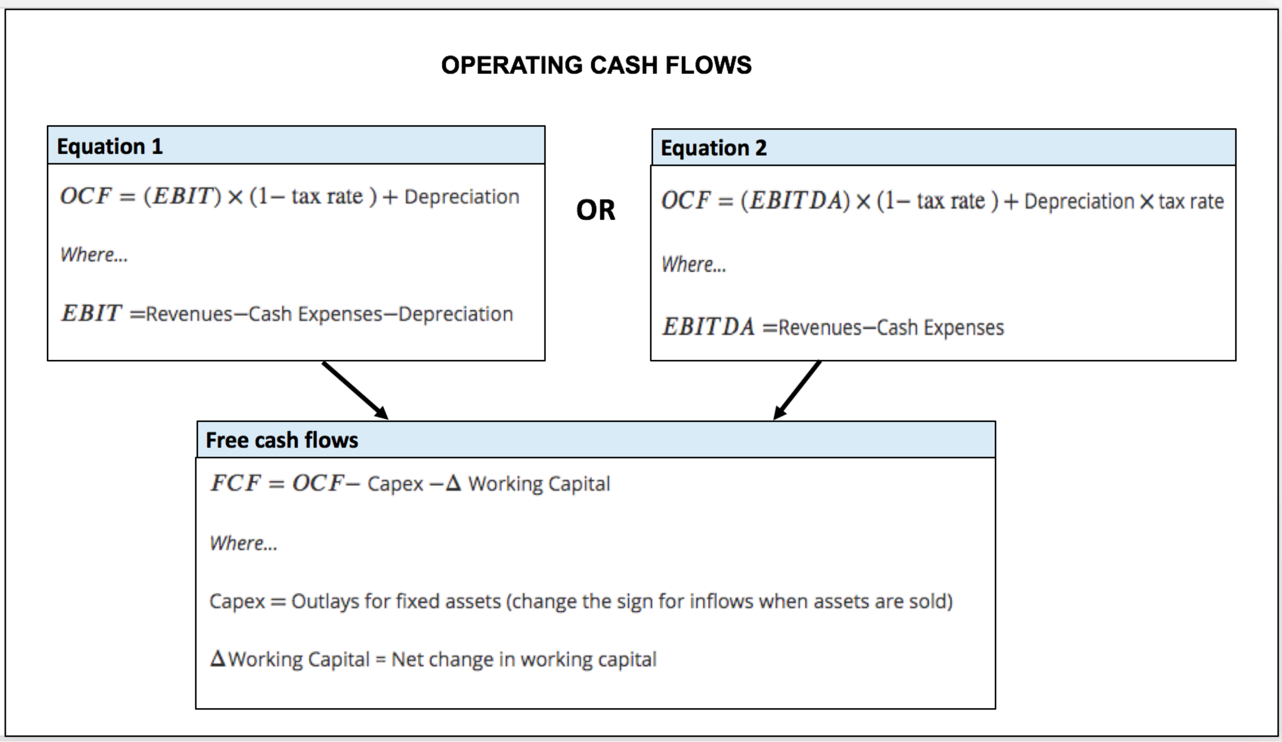
Step 4: Add back the depreciation/ amortisation to get operating cash flows. This step may seem strange – up in step 2 we deducted the depreciation/amortisation, so why add it back now? Depreciation and amortisation are not cash flows, but they do reduce the amount of tax payable and tax is definitely a cash flow item! So, we need to deduct depreciation and amortisation to compute tax properly but add them back to compute cash flows. When we calculate NOPAT, depreciation/amortisation is included because the expense is deductible in calculating tax. However, we need to add back the depreciation/ amortisation expense to NOPAT to get cash flow from operations. In other words, depreciation produces tax savings (tax shield) for the company.

Step 5: Subtract the incremental capital cash flows related to the project. Capital cash flows occur when we purchase or sell fixed assets that are required for the project. Typically, the company will purchase equipment or facilities at the beginning of the project, generating a large cash outflow (negative number) at the start of the project (at year zero on our timeline). The company may also sell equipment or facilities when the project ends, resulting in a cash inflow in the final year. It is important to compute this final year cash flow on an after-tax basis. We'll talk more about the initial and final year cash flows in section 8.4.

Step 6: Subtract any addition to working capital. Launching a new product may require an investment in inventory, which will show up on the balance sheet and not in the income statement. Opening a new retail outlet will also require inventory as well as cash in the till. These balance sheet items aren't free – they require a cash outlay. So, if the project requires an increase in current assets, we need to consider that investment in working capital when computing the free cash flows available. For a complex project, working capital may change every year as demand for the product changes. However, for this course, we will consider only simple projects where the amount of working capital required is constant over the life of the project. We'll discuss working capital in more detail in section 8.4.

8.3.2 Formula for Operating Cash Flows (OCF)

The formula for operating cash flows (OCF – the result of step 4) can be written out algebraically in a few ways. Feel free to choose whichever method (the previous table or either of these equations) that makes the most sense to you. Once we have Operating Cash Flows (OCF), Free Cash Flows (FCF) is computed as shown below.



Note: Equation 2 is called the “tax shield” method because it explicitly computes how much tax the company saves due to depreciation.

8.3.2.1 After-tax Operating Cash Flows Example

To illustrate the after-tax operating cash flow calculation, let’s go through the following example.

Radiant Ltd is considering launching a new lighting product that requires an initial investment in machinery and facilities of $300,000. These fixed assets will be depreciated straight-line to zero over their five-year useful life.

Radiant spent $10,000 for market research to help estimate demand for the new lighting. The project is estimated to generate $1,500,000 in annual sales for five years with annual cost of sales (materials and direct labour) of $1,000,000. The project will also require five additional employees in Radiant’s sales team, which will increase the company’s salaries and wages expenses by $250,000 per year. Also, production of the new product will take place in a warehouse that is currently being rented out for $30,000/year.

If the tax rate is 30%, what is the annual operating cash flow (OCF) for the first year of this project? (Since the question asks about year 1 only, you can ignore initial and final year cash flows).

View the following video on Operating Cash Flows and download the PDF handout if you wish to work alongside the example.

Video: [After-tax operating cash flows (YouTube, 9m16s)]

One or more interactive elements has been excluded from this version of the text. You can view them online here: https://uq.pressbooks.pub/introduction-financial-management/?p=135#oembed-2

Handouts

Download Module 8 Example 1 Template and Solution (PDF, 871KB)

8.4 Initial and Final Year After-tax Cash Flows from Capital Transactions and Changes in Working Capital

8.4.1 Cash Flows – Incremental Capital Expenditures

In the previous section, we have focused the discussion mainly on the after-tax *operating cash flows* part of the after-tax *free cash flows*. As we have seen, operating cash flows correspond with items we might see in an income statement.

However, to convert operating cash flows to free cash flows, we need to adjust for changes in items on the balance sheet: fixed assets and working capital.

In this section, we will discuss in further detail how to compute:

1. the after-tax cash flows related to the incremental capital expenditures, and,
2. the addition to working capital that may be required for the project.

Many projects will require the purchase of facilities or equipment that will last for more than one year. A hotel considering adding a new restaurant to its facilities will need to purchase kitchen appliances, furniture and other fixed assets. These assets will be carried on the balance sheet rather than being treated as an immediate expense. Then, each year the book value of the asset will be reduced through the annual depreciation expense.

Finally, when the restaurant is no longer viable, the remaining fixed assets will be sold or scrapped. Remember that "cash is king". The cash flows that result from these transactions are called "capital expenditures" or capex for short.

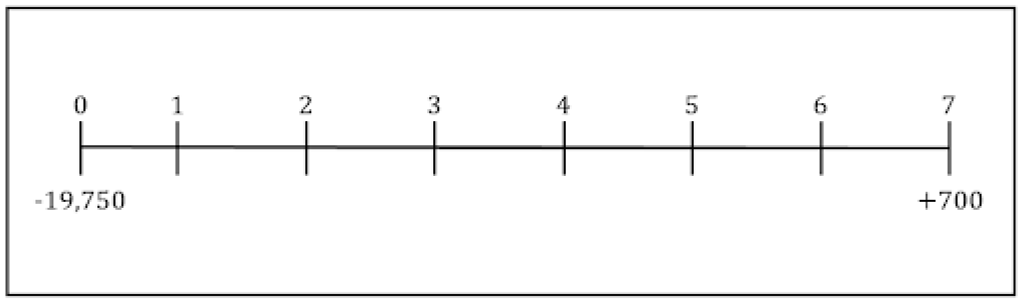
As with operating cash flows, only incremental cash flows are relevant. If the project uses assets the company already owns, the original cost of those assets is a sunk cost – no cash flow is required today. However, we need to consider what the alternative use is for those assets (that is, the opportunity cost).

We've already seen that when the alternative use is to rent out an existing warehouse, the rent we give up is considered an opportunity cost and is included in computing operating cash flow. Sometimes the next best option for existing assets is to sell them. In that case, deciding to proceed with the project means we're giving up the opportunity to receive the value of the asset in cash today (that is, the opportunity to sell the asset), which must be taken into account as an opportunity cost in the form of an increase to capital expenditure.

Let's Work Through an Example

Fiji Resorts is deciding whether to open a coffee kiosk in the lobby. The space where the kiosk would be built currently contains furniture that cost $2,000 and could be sold for an after-tax cash flow of $250. The kiosk fitout will cost $20,000 and can be depreciated straight-line over a 7 year useful life. After 7 years the kiosk will be obsolete. The used equipment can be sold after 7 years for $700 (net of tax). What are the relevant capital expenditure cash flows?

In year zero (now) Fiji Resorts will spend $20,000 for the kiosk fitout and receive $250 from selling the furniture for a net out flow of $19,750. The $2,000 cost of the furniture is not a current cash flow – it's a sunk cost. In 7 years, Fiji Resorts will receive a net cash flow of $700 from selling the used equipment. On a timeline:



Check Your Knowledge

Fortitude, Inc. is planning to set up a new factory. The factory will be built on a land that was bought 5 years ago for $6 million. When the land was purchased the company had planned to build an office building, but they were unable to complete that project. The land is currently vacant and has been on the market for six months.

A prospective buyer recently offered $10 million for the land. The costs for building the factory is $28 million. The land requires grading before it is suitable for construction and the grading cost is $1.5 million.

What is the proper cash flow amount to use as the initial investment in fixed assets when evaluating this project?

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https://uq.pressbooks.pub/introduction-financial-management/?p=135#h5p-91

8.4.2 Calculating Final Year Cash Flow

Incremental cash flows related to capital expenditures can also take place at the final year of the project due to the residual value or the salvage of the fixed assets. Buildings or equipment used in a project often have some residual value at the end of the project, even if these assets have been depreciated down to zero. When evaluating a project, we need to take this residual value into account — but, we need to be careful to include only the actual cash we will get to keep from selling the asset.

When an asset is sold, we need to determine whether that sale generates any taxable income and thus related tax liability. Clearly, if you buy an asset for $1,000 and sell it for $1,500, you have made a profit – and the (Australian) tax office will want its share. Your profit is $500 (=$1,500-$1,000), and tax at 30% would be $150.

> What is your cash flow from selling the asset?

You have received $1,500 in cash, but you owe a tax of $150 – so your after-tax cash flow from the sale is $1,500 – $150 = $1,350.

But how does that work when an asset has been depreciated? Think back to the accounting entries that are made when depreciation is recorded. One side of the entry is the depreciation expense and the other side of the entry is an accumulated depreciation account on the balance sheet. This accumulated depreciation account offsets the book value of the asset. If we buy an asset for $1,000 and have accumulated depreciation of $200, the net book value of the asset (i.e. cost less accumulated depreciation) will be $800.

> Now, what happens when we sell the asset for $1,500?

When you make the sale you receive $1,500 in cash. At the same time, you are selling it for more than what it is worth on the books, and that is what you need to pay tax on. The gain on your sale is the sales proceeds (=$1500) minus the book value of the asset (=$800), which is $700. Since this is recorded as a profit on our income statement, tax will increase by $210 (30% of $700).

> Now, what is your net after-tax cash flow from selling the asset?

You've received $1,500, but you owe the ATO $210, so your net after-tax cash flow is $1,500-$210=$1,290.

More generally, the after tax cash flow on the sale of fixed assets is equal to the sales proceeds (cash received) less any tax due on the gain (or loss). The tax due on gain (or loss) is computed as gain (or loss) times the applicable tax rate. Gain or loss is computed as sales proceeds less book value. And book value is computed as original cost less accumulated depreciation.

Net Salvage Cash Flow = Proceeds – (Proceeds – Net Book Value) x tax rate

where, Net Book Value = Cost of asset – accumulated depreciation

Now, what if the asset is sold at a loss?

In this case a profitable company will get a tax benefit from the loss. The loss will offset some of the company's other taxable income and reduce the company's tax liability relative to what it would have paid if the asset had not been sold. In this case the after-tax cash flow will actually be greater than the cash received for the asset.

Continuing with our previous example, assume you now sell the asset for $500 instead of $1,500. Given the book value of the asset is $800, you will make a loss of $300, which can be used to offset other taxable income. The tax savings is $90 (30% of $300). As a result, the net after-tax cash flow is $500 + $90 = $390.

8.4.3 After-tax Salvage Cash Flows – Worked Example

Inada Mining requires a heavy duty truck for a planned 5-year project. The cost of the truck is $140,000 and the useful life of the truck is 7 years. That is, tax regulations allow depreciation to be computed on a straight-line basis down to a zero salvage value over 7 years, even though Inada only plans to own the truck for 5 years. At the end of five years, the company expects to sell the truck for $50,000. If the company faces a 30% tax rate, what is the after-tax cash flow from selling the truck?

Solution: The cost of the truck is $140,000. Since the truck must be depreciated over 7 years, the depreciation expense for the truck is $20,000/year ($140,000/7 years). The book value of the asset is calculated as follows:

Cost of truck	$ 140,000
Accumulated depreciation ($20,000 x 5 years)	($ 100,000)
Net book value	$40,000

As shown above, the net book value of the truck is $40,000. Further, the sales proceeds of the truck after 5 years is $50,000. The net after-tax cash flow from selling the truck after 5 years is calculated as follows:

$$Net\ Salvage\ Cash\ Flow = Proceeds - (Proceeds - Net\ Book\ Value) \times tax\ rate$$

$$= 50,000 - (50,000 - 40,000)\times 0.3$$

$$= 47,000$$

Exercise

Calculate net salvage cash flow Fantastic Frogs

Fantastic Frogs has decided to purchase a new chocolate frog molding machine.

The machine costs $150,000 and tax regulations require that it be depreciated straight-line to zero over a ten year life. Fantastic Frogs expects to sell the machine for $60,000 after seven years when their new high volume chocolate frog molding technology is ready for production.

What is the after-tax cash flow that Fantastic Frogs will receive when the machine is sold in seven years? The relevant tax rate is 30%.

An interactive H5P element has been excluded from this version of the text. You can view it online here:
https://uq.pressbooks.pub/introduction-financial-management/?p=135#h5p-92

8.4.4 Addition to Working Capital

Launching a new product may require an investment in inventory, which will show up on the balance sheet and not in the income statement. Opening a new retail outlet will also require inventory as well as cash in the till. These balance sheet items aren't free – they require a cash outlay. So, if the project requires an increase in non-cash current assets (or decrease in current liabilities), we need to consider that investment in working capital when computing the free cash flows available.

For a complex project, working capital may change every year as demand for the product changes. However, for this course we will consider only simple projects where the amount of working capital required is constant over the life of the project.

So, how do we determine the cash flow from working capital?

Cash is required to fund changes in working capital only. If we need to have $2,000 in the cash registers over the life of the project, then that means we have to put $2,000 aside at the beginning of the project (at time zero on our timeline). After all, the cash needs to be available in the cash register before we can start selling our product.

We needed zero additional working capital before starting the project, and $2,000 in working capital when the project begins – a change of +2,000 in working capital and a cash flow of -2,000. Each subsequent year, we still need $2,000 in the cash register. There's no change in the level of working capital required, so there's no additional cash flow.

At the end of the project, we no longer need to have cash in the cash register, so the $2,000 will come back into the general bank account and can be used for other investments (or to pay dividends). So, at the end of the final year, we have a change in working capital requirements of -2,000 and a cash flow of +2,000.

Generally, if the working capital requirement is constant over the life of the project there will be a negative cash flow (outflow) in year zero and an equal positive cash flow (inflow) in the final year of the project.

Remember from your accounting course that working capital is defined as current assets less current liabilities. Therefore, the change in working capital can be determined as the changes in the company's cash and cash equivalents, accounts receivable, inventories and accounts payable that are required by the project.

Working capital (WC) is calculated as follows:

$$WC = Cash\ and\ Cash\ Equivalents + Accounts\ Receivable + Inventories - Accounts\ Payable$$

Test Your Knowledge: Working Capital

Amazing Androids Pty Ltd is opening a new retail outlet. It estimates that the new outlet will require the following investment in working capital:

Cash float of $1,000

Investment in inventory of $30,000

Increase in accounts payable to suppliers of $3,000

Increase in accounts receivable from customers of $5,000

What is the cash flow amount to be included in year zero when evaluating Amazing Androids' new retail outlet?

An interactive H5P element has been excluded from this version of the text. You can view it online here:
https://uq.pressbooks.pub/introduction-financial-management/?p=135#h5p-93

8.5 Tying it all Together

8.5.1 NPV Relevant Cash Flows-Extended Example

So far, we have discussed relevant free cash flows that consist of 1) incremental after-tax operating cash flows, 2) incremental capital expenditures and 3) an addition to working capital as the consequences of undertaking the project. In this section, we will analyse a more comprehensive example that ties all the concepts above and relates those concepts with the NPV and IRR calculation discussed in **Chapter 7**.

- **BMX Ltd**., a car manufacturer is currently evaluating a proposal to introduce a new hybrid car model that is more environmentally and economically friendly. The project's duration is expected to be 5 years and after 5 years the project will be terminated since the company will run a new fully electric car project. An intensive feasibility study costing $250,000 has already been completed. Based on the feasibility study, the company expects to sell 500 units of the new hybrid car per year. Annual revenue is estimated at $17,500,000 for the next 5 years. The company estimates that the direct cost for each car is $22,000/unit. The marketing and support expenses will be

$5 million per year. If the new hybrid car is introduced, EBITDA from the existing cars will fall by $1 million per year.

- **The production of the new car** will be conducted in a new plant to be built on land already owned by the company. The land was purchased 10 years ago for $750,000 and has been used for a commercial car park. The annual EBITDA generated from the car park is $70,000. The cost to build the plant will be $1,000,000 and the building value is expected to fall to $300,000 after 5 years. For tax purposes, the building must be depreciated straight line over a 20-year life with no salvage value. The plant also needs equipment for the manufacturing process that costs $200,000. It is expected that the equipment will be depreciated straight-line to zero in 5 years. At the end of the project, the equipment will be sold for $50,000. The new project requires $150,000 of working capital starting immediately.

- **The working capital** will be recovered at the end of the 5 years. An additional financing cost of $750,000 per year will be required to help fund this project. The corporate tax rate is 30%. BMX plans to use a cost of capital of 8% to evaluate this project.

With the above information, consider the following:

- What is the NPV of the project?
- What is the IRR?
- Should the company proceed with the project?

Video: [FINM1416_22 Relevant Cash Flows-Extended Example Part 1 (YouTube, 11m51s)]

One or more interactive elements has been excluded from this version of the text. You can view them online here: https://uq.pressbooks.pub/introduction-financial-management/?p=135#oembed-3

Video: [FINM1416_23 Relevant Cash Flows-Extended Example Part 2 (YouTube, 4m58s)]

One or more interactive elements has been excluded from this version of the text. You can view them online here: https://uq.pressbooks.pub/introduction-financial-management/?p=135#oembed-4

Video: FINM1416_24 Relevant Cash Flows-Extended Example Part 3 (YouTube, 8m21s)

One or more interactive elements has been excluded from this version of the text. You can view them online here: https://uq.pressbooks.pub/introduction-financial-management/?p=135#oembed-5

8.6 Computing NPV and IRR in Excel

8.6.1 NPV and IRR Extended Example

The video below demonstrates how to calculate NPV and IRR for the extended example in section 8.5 using Excel.

Video: Extended example Excel 8.6.1 (YouTube, 10m22s)

One or more interactive elements has been excluded from this version of the text. You can view them online here: https://uq.pressbooks.pub/introduction-financial-management/?p=135#oembed-6

If you prefer to read instead of watching the video, please read the below between the lines.

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The table below shows how to solve for NPV and IRR for the extended example in section 8.5 using Excel. Excel has a specific function for determining NPV and IRR:

NPV : =NPV(discount rate, range of cash flows) + Initial Investment

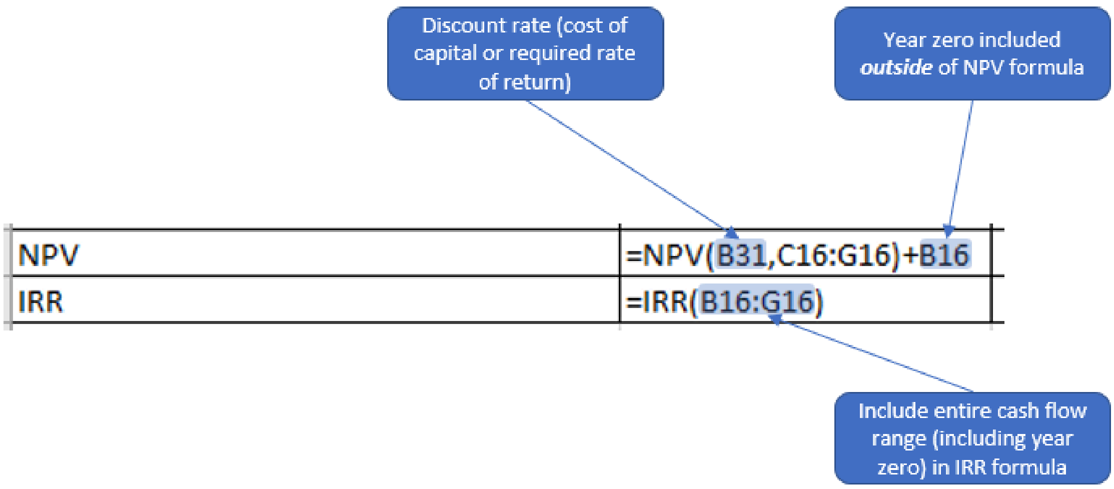
IRR : =IRR(range of cash flows)

It is important to note here that the range of cash flows in the NPV formula using excel excludes year 0 cash flow (initial investment). The year 0 cash flow is added separately. However, in determining IRR, all cash flows including year 0 cash flow are included in the IRR formula.

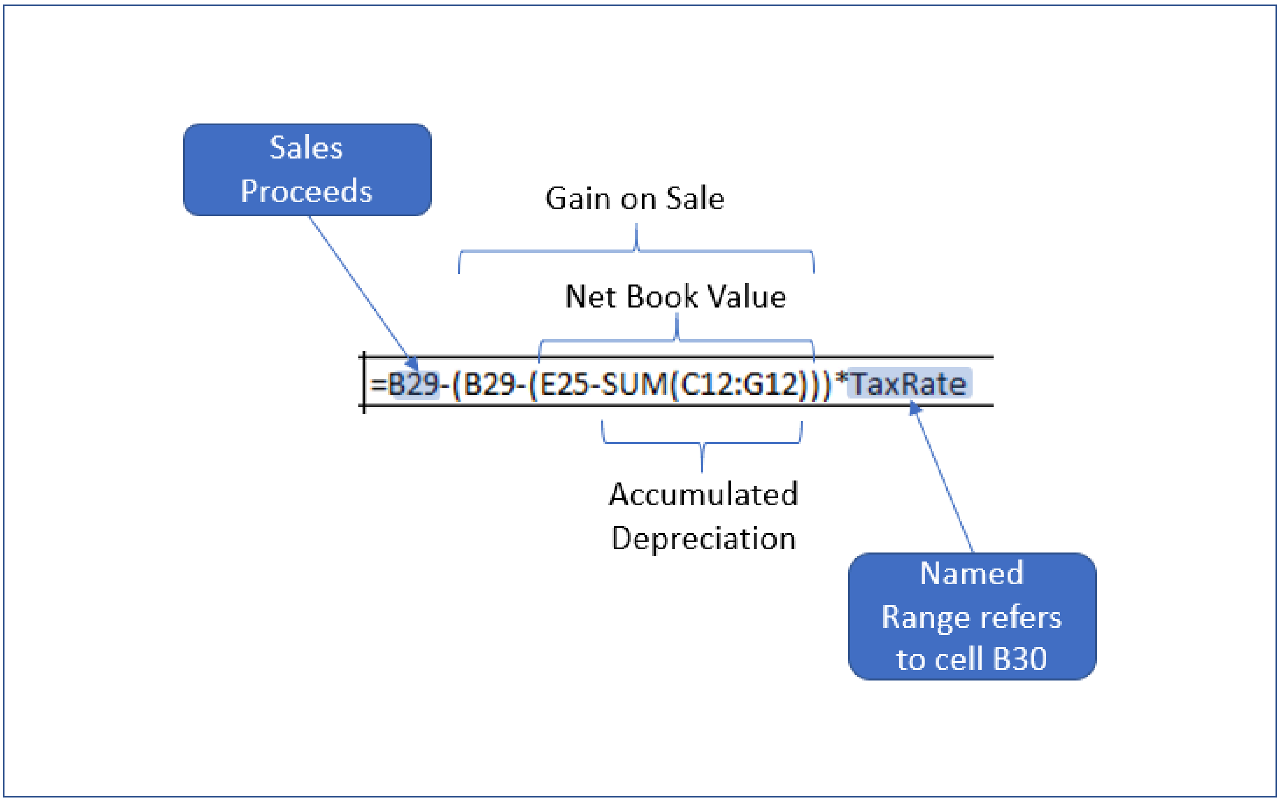
	A	B	C	D	E	F	G
1		**Year 0**	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Year 5**
2	Revenue		17,500,000	17,500,000	17,500,000	17,500,000	17,500,000
3	Direct costs		-11,000,000	-11,000,000	-11,000,000	-11,000,000	-11,000,000
4	Marketing and support expenses		-5,000,000	-5,000,000	-5,000,000	-5,000,000	-5,000,000
5	Side effect-EBITDA erosion		-1,000,000	-1,000,000	-1,000,000	-1,000,000	-1,000,000
6	Lost parking revenues		-70,000	-70,000	-70,000	-70,000	-70,000
7	EBITDA		430,000	430,000	430,000	430,000	430,000
8	Depreciation expense		-90,000	-90,000	-90,000	-90,000	-90,000
9	EBIT		340,000	340,000	340,000	340,000	340,000
10	Tax		-102,000	-102,000	-102,000	-102,000	-102,000
11	NOPAT		238,000	238,000	238,000	238,000	238,000
12	Add depreciation expense		90,000	90,000	90,000	90,000	90,000
13	Cash flow from operations		328,000	328,000	328,000	328,000	328,000
14	Capital Expenditures	-1,200,000					470,000
15	Additional working capital	-150,000					150,000
16	After-Tax Free Cash Flows	-1,350,000	328,000	328,000	328,000	328,000	948,000
17							
18	NPV	381,570.47					
19	IRR	16.5127%					
20							
21	**Inputs**			**Depreciation**			
22	Annual incremental revenue	$ 17,500,000		Capital expenditures	Cost	Useful life	Depreciation Expenses
23	Units of hybrid car sold	500		Building	$ 1,000,000	20	$ 50,000
24	Direct costs/unit	$ 22,000		Equipment	$ 200,000	5	$ 40,000
25	Marketing and support expenses/year	$ 5,000,000		Total capital expenditures	$ 1,200,000		$ 90,000
26	Lost EBITDA from existing cars	$ 1,000,000					
27	Lost parking revenues	$ 70,000					
28	Additional working capital	$ 150,000					
29	Sale of Equipment and Building in year 5	$ 350,000					
30	Tax rates	30%					
31	Cost of capital	8%					

Further, as shown above, it is recommended to list all the inputs that will be used in the calculation separately. By doing this, we can change any of the inputs (assumptions) used such as units of hybrid car sold or the direct costs/unit and see how the change affect NPV and IRR. This is especially important when we want to perform sensitivity analysis, scenario analysis or goal seek analysis for a particular project. These analyses will be discussed in **Chapter 9**.

	A	B	C	D	E	F	G
1		Year 0	Year 1	Year 2	Year 3	Year 4	Year 5
2	Revenue		=$B$22	=$B$22	=$B$22	=$B$22	=$B$22
3	Direct costs		=-$B$23*$B$24	=-$B$23*$B$24	=-$B$23*$B$24	=-$B$23*$B$24	=-$B$23*$B$24
4	Marketing and support expenses		=-$B$25	=-$B$25	=-$B$25	=-$B$25	=-$B$25
5	Side effect-EBITDA erosion		=-$B$26	=-$B$26	=-$B$26	=-$B$26	=-$B$26
6	Lost parking revenues		=-$B$27	=-$B$27	=-$B$27	=-$B$27	=-$B$27
7	EBITDA		=SUM(C2:C6)	=SUM(D2:D6)	=SUM(E2:E6)	=SUM(F2:F6)	=SUM(G2:G6)
8	Depreciation expense		=-$G$25	=-$G$25	=-$G$25	=-$G$25	=-$G$25
9	EBIT		=SUM(C7:C8)	=SUM(D7:D8)	=SUM(E7:E8)	=SUM(F7:F8)	=SUM(G7:G8)
10	Tax		=-C9*$B$30	=-D9*$B$30	=-E9*$B$30	=-F9*$B$30	=-G9*$B$30
11	NOPAT		=SUM(C9:C10)	=SUM(D9:D10)	=SUM(E9:E10)	=SUM(F9:F10)	=SUM(G9:G10)
12	Add depreciation expense		=-C8	=-D8	=-E8	=-F8	=-G8
13	Cash flow from operations		=C11+C12	=D11+D12	=E11+E12	=F11+F12	=G11+G12
14	Capital Expenditures	=-E25					=B29-(B29-(E25-SUM(C12:G12)))*TaxRate
15	Additional working capital	=-B28					=B28
16	After-Tax Free Cash Flows	=SUM(B13:B15)	=SUM(C13:C15)	=SUM(D13:D15)	=SUM(E13:E15)	=SUM(F13:F15)	=SUM(G13:G15)
17							
18	NPV	=NPV(B31,C16:G16)+B16					
19	IRR	=IRR(B16:G16)					
20							
21	**Inputs**			**Depreciation**			
22	Annual incremental revenue	17500000		Capital expenditures	Cost	Useful life	Depreciation Expenses
23	Units of hybrid car sold	500		Building	1000000	20	=E23/F23
24	Direct costs/unit	22000		Equipment	200000	5	=E24/F24
25	Marketing and support expenses/year	5000000		Total capital expenditures	=SUM(E23:E24)		=SUM(G23:G24)
26	Lost EBITDA from existing cars	1000000					
27	Lost parking revenues	70000					
28	Additional working capital	150000					
29	Sale of Equipment and Building in year 5	350000					
30	Tax rates	0.3					
31	Cost of capital	0.08					



The year 5 capital expenditures excel formula is explained below. Notice how the named range “TaxRate” makes the formula easier to read.



———END OF TEXT VERSION———-

Download

Download [Excel Template (xlsx, 24KB)]()

8.7 Summary and Conclusion

8.7.1 Summary

In this chapter, we mainly focus on the calculation of incremental after-tax free cash flow in evaluating a project. When determining whether a cash flow is incremental, the key question to ask is whether the cash flow would occur if the project were not accepted. If the answer is yes, then the cash flow is not incremental.

We also discussed five major categories of cash flows:

- Sunk cost
- Opportunity cost
- Side effects
- Financing costs
- After-tax cash flows

It is important to understand how each of these cash flows is treated in calculating the free cash flow for a project. Lastly, in calculating the final year cash flow, we need to be careful to include only the actual cash we will receive from selling the asset, which means we need to consider the tax implications. If an asset is sold for higher price than the book value, then the gain on sale is taxable and tax should be deducted from the cash proceeds.

8.7.2 Key Formulas

Operating cash flow:

$$OCF = EBIT \times (1 - taxrate) + Depreciation$$

where...

$$EBIT = Revenues - Cash\ Expenses - Depreciation$$

Or

$$OCF = EBITDA \times (1 - tax\ rate) + Depreciation \times tax\ rate$$

where...

$$EBITDA = Revenues - Cash\ Expenses$$

Free cash flow:

$$FCF = OCF - Capex - \Delta Working\ Capital$$

where...

$$Capex = Outlays\ for\ fixed\ assets$$
$$\Delta Working\ Capital = Net\ change\ in\ working\ capital$$

Final year cash flow:

$$\text{Net Salvage Cash Flow} = \text{Proceeds} - \ (\text{Proceeds - Net Book Value}) \times \ \text{tax rate}$$

$$\text{Net Book Value} = \text{Cost of asset} - \text{accumulated depreciation}$$

One or more interactive elements has been excluded from this version of the text. You can view them online here: https://uq.pressbooks.pub/introduction-financial-management/?p=135

9.

NPV – MODELLING AND ANALYSIS

9.1 Introduction

At the end of this chapter, you will be able to:

- estimate the sensitivity of an output to a change in an input
- estimate the NPV break-even point for a project
- explain sensitivity analysis, scenario analysis, and simulation analysis and describe how they are used to evaluate the risks associated with a project
- construct a capital budgeting analysis in Excel
- evaluate a proposed capital budgeting project.

In the previous two chapters we learnt how to identify relevant cash flows to use in project analysis, and how to use capital budgeting tools. When calculating the NPV we relied on (well-informed) estimations of what the cash flows would be if we undertook the project. We were given estimations on how much sales a new project would generate, what the costs would be, what the tax rate would be, and so forth. But how sure are we of these estimations? Is it possible to accurately estimate all variables? Do you think that any project's cash flows are estimated 100% correctly? Probably not. In reality, the estimations are almost certainly going to be different from what actually occurs. So does this mean our analysis is useless? Or is there some way we can account for this uncertainty?

Of course, our analysis so far has not been useless – the estimations we made are based on information available to us at the time, and are our "best guess". It is a baseline for us to understand the viability of a project.

In this chapter, we are going to learn how **different modelling and analysis techniques** can help us understand how changes to our estimations could impact our initial estimation of NPV, payback or IRR.

We are looking at different types of risks, with the aim to understand how the change in an input (i.e. assumption) affects the feasibility of a project. If the change in an input has a great impact on the attractiveness of the project, then more time should be spent investigating the variables' expected outcome.

This chapter will cover three common forms of risk analysis:

- Sensitivity analysis
- Scenario analysis
- Simulation analysis

9.1.1 Practical example – YoGo Technologies

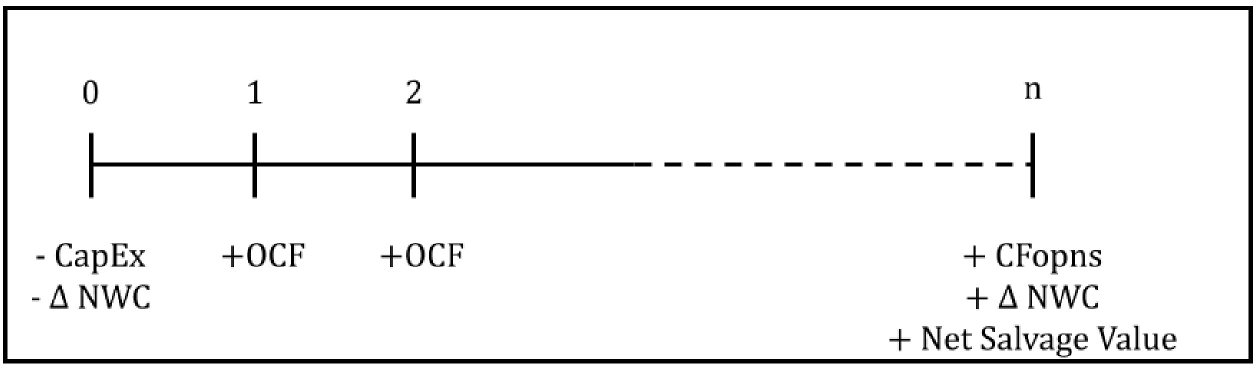
This section revises the computation of NPV in detail. Having completed **Chapter 8, you should try to do the NPV analysis yourself, then check against the solution**. This is a good test to see if you have understood Chapter 8.

The problem: YoGo Technologies is investigating a potential new product that will generate a net revenue of $20 per unit. The expected sales are 5,000 units per year, for 5 years. Production equipment will cost $200,000 and will be depreciated straight-line over 5 years, to 0. After 5 years the equipment will be sold for $50,000. The company tax rate is 30%, and the required return is 10%. What is the NPV of the project?

Below provides a recap on calculating NPV, if you have been keeping up you probably do not need it. After the text solution, there's a video of the solution as well – jump there if that's how you prefer to learn.

9.1.1.1 RECAP – calculating cash flows

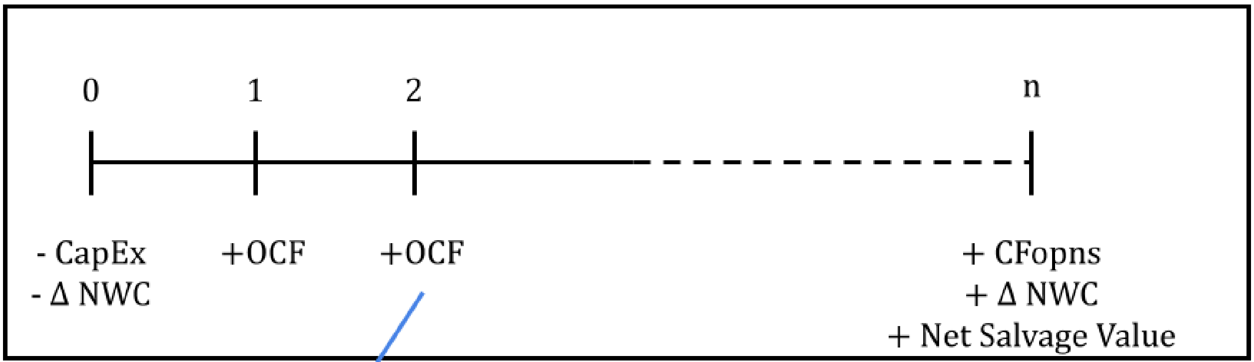
As you may recall, typically the timeline of a project's cash flows looks like this:



We start with the capital expenditure or initial cost. This is the initial outlay (–CapEx), reflecting that we made an investment into something. Sometimes we also have to invest in additional net working capital (- Δ NWC). Then, if all goes well, we start receiving cash flows from operations (+OCF) for the life of the project. For example, when we start selling products, we will have cash inflows. We continue having these cash flow from operations for the life of the project. At the end of the project, at year 'n', we usually recover the investment in net working capital if we made any (+Δ NWC). Sometimes, we are able to sell the equipment at the end, which will also return a cash inflow. In this case, we have to calculate the net cash inflow from this sale, which is indicated as the net salvage value.

Let's start with the cash flows from operations. As we did in Chapter 8, we use a **basic income statement** to identify the cash flows.

Step 1: Cash flows from operations



Net Revenue ($20 x $5,000)	$100,000
EBITDA	$100,000
Depreciation & Amortization ($200,000 / 5)	-$40,000
EBIT	$60,000
Tax	x(1 - 0.3)
NOPAT	$42,000
Add back depreciation	+$40,000
Cash Flow Operations	=$82,000

In this exercise, we have the net revenue per unit sold, which is the revenue minus the costs of goods sold, and this gives us the gross profit per unit. To calculate the total net revenue, we multiply the net revenue per unit, which is $20, by the number of units we are selling, which is 5,000 units; $20 x 5,000 = $100,000. Note that here we already counted the costs of goods sold and we do not have any other expenses remaining. In general, we could have some fixed costs to be calculated, which would add up to EBITDA. In this simple example, the $100,000 is the EBITDA. What comes after EBITDA? We have to calculate the depreciation and amortisation. In this example, we only have depreciation, but no amortisation. Depreciation is calculated as the initial cost divided by useful life of the equipment you are investing in. In this case, this is $200,000 divided by 5, which is $40,000. This is our annual depreciation.

Focusing on the annual cash flow, we will calculate the EBIT, which is $100,000 minus the $40,000, so it is $60,000. Next, we have to consider interest and tax. It is important to note that even if we had an interest expense, we would not include it in this statement because it is not an operating cash flow and it does not affect the amount of tax we have to pay. In this example, we do have a tax rate of 30%. We can find the Net Operating Profit After Tax (NOPAT), by multiplying the EBIT amount by '1 minus the tax rate', so (1 – 0.3), giving us $42,000.

Do we have the cash flows from our operations? Not yet! We still need to add back depreciation and amortisation. This is $42,000 plus the depreciation of $40,000, adding up to $82,000, which are the cash flows from operations. This amount is the actual cash we generate each year, where we are undertaking this project. This is step 1.

Now we move on to Step 2.

Step 2: Identifying the cash flows at the start of the project.

There is no investment in net working capital, but we do have an initial capital expenditure that we have to spend to start the project. In this example, it is $200,000.

Step 3: Identifying the cash flows at the end of the project.

In step 3, there is no net working capital recovery as we didn't invest in any, but we do receive a cash flow from selling our production equipment. To find out exactly how much we calculate the net salvage value;

$$Net\ Salvage\ Value = Sales\ proceeds - \underbrace{(Sales\ Proceeds - NBV)}_{\text{Gain on Sale}} * tax\ rate$$

To unpack this equation, let's start by calculating the net book value (NBV). In this case, this will be 0, because we depreciated it to 0. We then have the proceeds, which is the amount we are receiving from selling the assets. In this example, this will be the re-sale value of $50,000. In other words, this is the cash we are receiving, but we have to make an adjustment for the tax we may have to pay. Combining everything together, we are receiving $50,000 on our book value, which is worth 0, meaning that we are making a gain on sale of $50,000, over which we still have to pay 30% tax. Therefore, we multiply the $50,000 by the tax rate of 30%. Overall, the net cash we are receiving from selling this asset is $35,000.

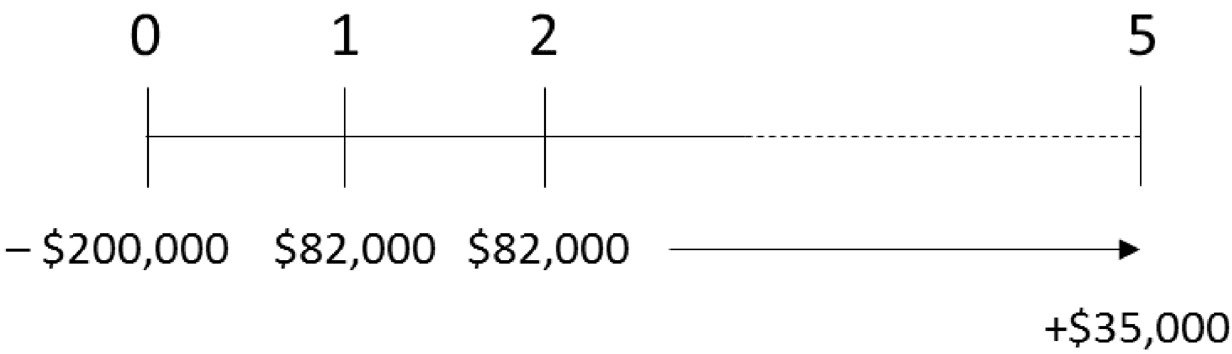
$$= 50{,}000 - \underbrace{(50{,}000 - 0) \times 0.3}_{\text{Tax on Gain}}$$

$$= \$35{,}000$$

In other words, we receive $50,000, but we have to pay $15,000 worth of tax, which is the tax on gain. What happens if you make a loss on sale? This means you would get tax back. This is because the loss on sale can be used to offset other taxable income, reducing the tax payment. Effectively, we are getting some tax back in addition to our sales proceeds.

Now that we have calculated these values, we can redraw the timeline with specific numbers.

At time 0, we have -$200,000 and we have an expected cash flow of $82,000 for 5 years. In addition to that, at the end, we will also receive the $35,000 from selling the asset.



Combining this together, we will calculate the NPV. We hope you remember what NPV tells us – if the NPV is positive, it means that the project adds value to the firm, so the company increases in value. In other words, the project generates a higher return than the cost of capital we are discounting at. In this example, we are using the discount rate of 10% to calculate the present value. Therefore, if the NPV is positive, it means that the project is generating more than 10% and thus adds value to the firm.

Firstly, remember the formula from Chapter 8?

$$NPV = -CF_0 + \sum_{n=1}^{N} \frac{CF_n}{(1+r)^n}$$

For the OCF we can use the annuity formula, resulting in:

$$
\begin{aligned}
\text{NPV} &= -\$200,000 + \$82,000 \times \left(\frac{1 - \frac{1}{1.10^5}}{0.10} \right) + \frac{\$35,000}{1.10^5} \\
&= -\$200,000 + \$332,576.76 \\
&= \$132,576.76
\end{aligned}
$$

This can also be done in excel, below the solution is a link for the Excel template and video to solve this way.

By using either the manual calculation or excel, we will get an NPV of $132,576.76. This means that if the company proceeds with the project, it will make more than 10% of what is required and will add $132,576.76 to the value of the business.

The following two videos go through this solution in detail, first using a pen and calculator, and second using a spreadsheet program.

Video: NPV Calculation (YoGo) (YouTube, 13m19s)

Download the Excel template (XLSX, 11.6KB).

Video: NPV Calculation in Excel (YoGo) (YouTube, 10m38s)

Everything so far was covered in **Chapter 8**, and now we are ready to start conducting a Sensitivity Analysis in the next section.

We are looking to answer: What happens if the net revenue changes? How would that affect the NPV? How much can net revenue change for the project to be still beneficial?

9.2 Sensitivity analysis

Sensitivity analysis is the simplest, most basic form of risk analysis, which shows how sensitive an output variable is to a change in an input variable. With respect to capital budgeting, we are often interested in examining the sensitivity of the output from an analysis, such as the NPV estimate, to changes in the input variables.

$$
\text{Sensitivity (slope)} = \frac{\Delta NPV}{\Delta Input}
$$

Where "input" can be any variable or assumption that has an impact on NPV, such as sales volume, interest rates, or production costs.

An analyst might look at how a project's NPV changes if there is a decrease in the value of individual cash inflow assumptions or an increase in the value of individual cash outflow assumptions. For example:

- What happens if the sales of a company decrease?

- How will it affect the NPV?
- Or what happens if the costs increase?
- How much can the costs increase before it becomes unattractive to take on the project?

We can calculate this by looking at how a certain change in a given input will affect NPV. With sensitivity analysis, we're looking at how a single input variable affects NPV.

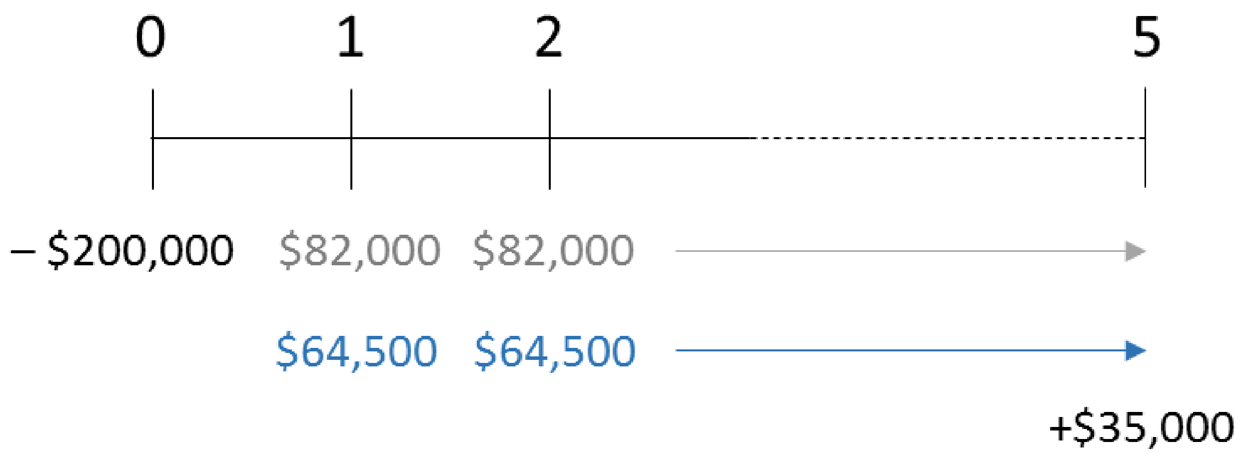
9.2.1 Calculating sensitivity

Calculating the sensitivity of NPV from changes in net revenue gives us an exact number of how much NPV changes when net revenue changes by one unit. We can simply re-calculate the new NPV if net revenue goes up by one, or we can pick any new number of net revenue and the sensitivity formula gives us the same result (unless there is a non-linear relationship).

To see how this works, let's assume the new net revenue is $15 dollars per unit. The new cash flows from operations calculation with this input would look like this resulting in $64,500.

Net Revenue ($15 x 5,000)	$75,000
EBITDA	$75,000
Depreciation & Amortization ($200,000 / 5)	- $40,000
EBIT	$35,000
Tax	x (1 – 0.3)
NOPAT	$24,500
Add back depreciation	+ $40,000
Cash Flow Operations	**= $64,500**

This means that with a net revenue of $15 per unit, we would have an annual cash flow of operations of $64,500. In comparison with the original timeline, the initial capital expenditure and the net salvage value will stay the same, but the cash flow operations each year will need to be updated. Under the new scenario, the timeline will look like this. Overall, the **only value that changes is the cash flows from operations**.



What is the NPV under this new scenario?

$$\text{NPV} = -\$200,000 + \$64,500 \times \left(\frac{1-\frac{1}{1.10^5}}{0.10}\right) + \frac{\$35,000}{1.10^5}$$

By using either the manual calculation or excel, our equation would be: minus (-) $200,000, plus (+) the $266,237.99, which gives us the present value of **$66,237.99**.

What does this mean for the project? In this new scenario, although we are making less money per unit sold, the NPV is still positive, and it is still worth undertaking this project.

Similarly, we can compute NPV for various changes in assumptions. Here are the results of those computations:

Variable of Interest	Value	NPV
Base Case		132,576.76
Net Revenue per unit	$15	66,237.99
Units sold	4,000	79,505.75
Equipment salvage value	$45,000	13,403.54

Note: the numbers in the table have been computed by changing each variable **in isolation**. So, for the computation with Units Sold = 4,000, net revenue per unit is still $20 and salvage value is still $50,000, just like in the base case.

While these numbers are informative, it would be even better to be able to answer the question "How much does a 1 unit change in input change NPV?" This is the purpose of sensitivity analysis. It helps us see which inputs make the greatest difference to the profitability of a project. This next video demonstrates the computation of sensitivity.

$$\text{Sensitivity (slope)} = \frac{\Delta NPV}{\Delta Input}$$

In the sensitivity analysis, we calculate the change in NPV per unit change in the inputs. The aim of the sensitivity analysis is to analyse how the NPV changes from the change in net revenue per unit (S1 = Scenario 1 and S2 = Scenario 2).

$$\text{Sensitivity} = \frac{NPV_{S1} - NPV_{S2}}{NR_{S1} - NR_{S2}}$$

The change in net present value is calculated as the old NPV, $132,576.76 minus the new NPV value of $66,237.99, divided by $20 per unit minus $15 per unit. This calculation will give us the result of $13,267.75.

$$\text{Sensitivity} = \frac{NPV_{20} - NPV_{15}}{NR_{20} - NR_{15}} = \frac{\$132,576.76 - \$66,237.99}{\$20 - \$15} = \$13,267.75$$

What does this number mean? This number shows us that if our net revenue per unit goes up by $1, our NPV will increase by $13,267.75. It is a positive relationship, meaning that if our net revenue per unit increases, the NPV also increases. Similarly, if the net revenue per unit decreases by $1, then the NPV also decreases by $13,267.75. On the contrary, focus on costs would most likely deliver a negative relationship, meaning that a $1 increase in cost would decrease the NPV by a certain percentage.

Following this logic...

What happens if the net revenue per unit (=dollar) decreases by $7?

In this case, the NPV would **decrease** by 7x the amount of **$13,267.75**, so by **$92,874.28**.

We can also use the **sensitivity figure** to find out by how many dollars our net revenue can change before we "break-even" (NPV = 0), meaning changing it any further would make the project unfeasible.

Our original estimate of a net revenue of $20 resulted in an NPV of $132,576.76. We can divide the NPV by the sensitivity to find net revenue break-even point;

$$\begin{aligned}\text{Breakeven net revenue } &= \text{net revenue}_{20} - \frac{NPV_{20}}{\text{Sensitivity }_{netrevenue}} \\ &= \$20 - \frac{\$132,576.76}{\$13,267.75} \approx \$10.01\end{aligned}$$

This means that at a revenue of $10.01, the project has an NPV of 0 and breaks even. If net revenue is any lower than $10.01, the project will reduce the value of the firm.

Understanding the meaning of the process and the number gives you the ability to interpret how a certain output would change as a result of an input change. Remember that inputs in a project are only estimations and are affected by a number of internal and external factors. It becomes essential to understand how a certain variable change will influence the whole project, as this is an indication of risk. This means that the higher the sensitivity to a certain change in input, the more it is exposed to significant risk from this input changing. So, the higher the sensitivity of NPV to a given input, the more important it will be to estimate that input accurately.

$$\text{Sensitivity (slope)} = \frac{\Delta Output}{\Delta Input}$$

The generic formula of sensitivity analysis provides a way to interpret what happens to variable X in the case of a change in variable Y. We used NPV in the previous sensitivity analysis, but we could also be interested in what happens to the Operating cash flows given a certain input change. It is dependent on the context of different scenarios to decide which variable change is best to assess the impact on another important variable. It is common to analyse what happens to the NPV as a result of an input change because, ultimately, **this is the method that shows whether a project is worthwhile or not**.

In the next video, we will show how to compute the NPV numbers in the table above using Excel. You can use the spreadsheet you created in the previous unit, or you can use this spreadsheet: YoGo-Template – Sensitivity.xlsx. **Note: there is a small mistake in the video, it should be; there is a positive relationship between salvage value and NPV (if salvage goes up, NPV goes up)"**

Video: Sensitivity analysis (YoGo)

9.3 Scenario Analysis

With sensitivity analysis, we were looking at each input in isolation. However, in the real world, several inputs are subject to change and input are often related to each other. For example, if we raise the price of our new product, this will often result in a decrease in demand for the product.

Analysing price separately from the number of units sold doesn't really make sense. For scenario analysis, we create various "scenarios", which are combinations of several inputs or assumptions. We might have a high price scenario that includes higher than expected prices, but lower than expected demand.

The expected or most likely combination of inputs is called the **base case scenario**. Once we have a **base case**, we can consider the risk of alternative scenarios. We might define a **best-case scenario** that includes expected inputs in the event that the economy is booming, or demand for our new product exceeds expectations. And we might define a **worst-case scenario** with values we would expect if the economy were to fall into recession or if our new product were to be particularly unpopular.

When evaluating the various scenarios, it is important to consider the likelihood of each scenario actually occurring.

The following example provides an overview of an automated vertical food production system, under three different scenarios; strong, expected and weak economic conditions (see table below). It compares the unit sales, unit prices, unit variable costs and NPV in each scenario. For example, you could assume to be selling more at a higher price in strong economic conditions, but also pay higher costs, and vice versa in a weak economy.

Economic Conditions	Unit Sales	Unit Price	Unit Variable Costs	NPV
Strong	38,500	$240	$110	$272,853
Expected	35,000	$220	$95	$153,688
Weak	28,000	$190	$90	$(117,523)

Considering the numbers, with NPV being negative under the worst-case scenario, whether one would undertake this project depends on the person's risk aversion and the probability for each of the scenarios. It is a matter of question to evaluate how likely it is that the project would deliver the **worst-case scenario** results. Therefore, utilising the knowledge of this data, the decision becomes dependent on one's subjective assessment of the probability and risk preference.

9.3.1 Conducting a Scenario Analysis in Excel

Assume that YoGo has identified the following scenarios:

Inputs	Base Case	Best Case	Worst Case	Low Demand	High Demand
Net Revenue	$20	$22	$18	$19	$21
Sales (units)	5,000	7,500	2,500	3,500	6,500
Initial Cost	$200,000	$200,000	$200,000	$200,000	$200,000
Useful Life	5	5	5	5	5
Salvage	$50,000	$65,000	$10,000	$50,000	$50,000
Tax rate	30%	25%	35%	30%	30%
Discount rate	10%	9%	11%	10%	10%

The first step of conducting a scenario analysis is to calculate the NPV under each scenario. This can be done manually, but is a lot easier in excel. If you want to practice calculating NPV's manually, it would be a useful exercise to calculate the NPV under each scenario and then check with the spreadsheet calculations if you have done it correctly.

The following video will show how to conduct the scenario analysis in excel.

Video: Scenario Analysis in Excel (YouTube, 7m13)

If you have followed the previous videos and have been amending your spreadsheet according to the instructions, you can continue using your spreadsheet. Alternatively, you can use this spreadsheet: YoGo-Template – Scenario (XLSX, 52KB)

9.4 Simulation Analysis

Previously we looked at Scenario and Sensitivity analysis. We have seen that scenario analysis is a more comprehensive analysis than sensitivity analysis because it considers the relationships between the input variables. What it doesn't explicitly consider is the probability of any given scenario occurring. If we really want to get an idea of the risk of a project, it would be useful to be able to generate a probability distribution for NPV. This is what simulation analysis aims to do. The idea is to look at the probability distributions of the underlying inputs as well as the relationships between those inputs (correlation in statistics). These inputs are fed into a computer to generate a probability distribution for the output, or NPV. The computer uses random number generators to create thousands of equally probable sets of input variables. NPV is computed for each set of inputs to get thousands of equally probable NPVs. The mean (average) and dispersion (standard deviation) of those NPVs gives us an idea of the risk of the project.

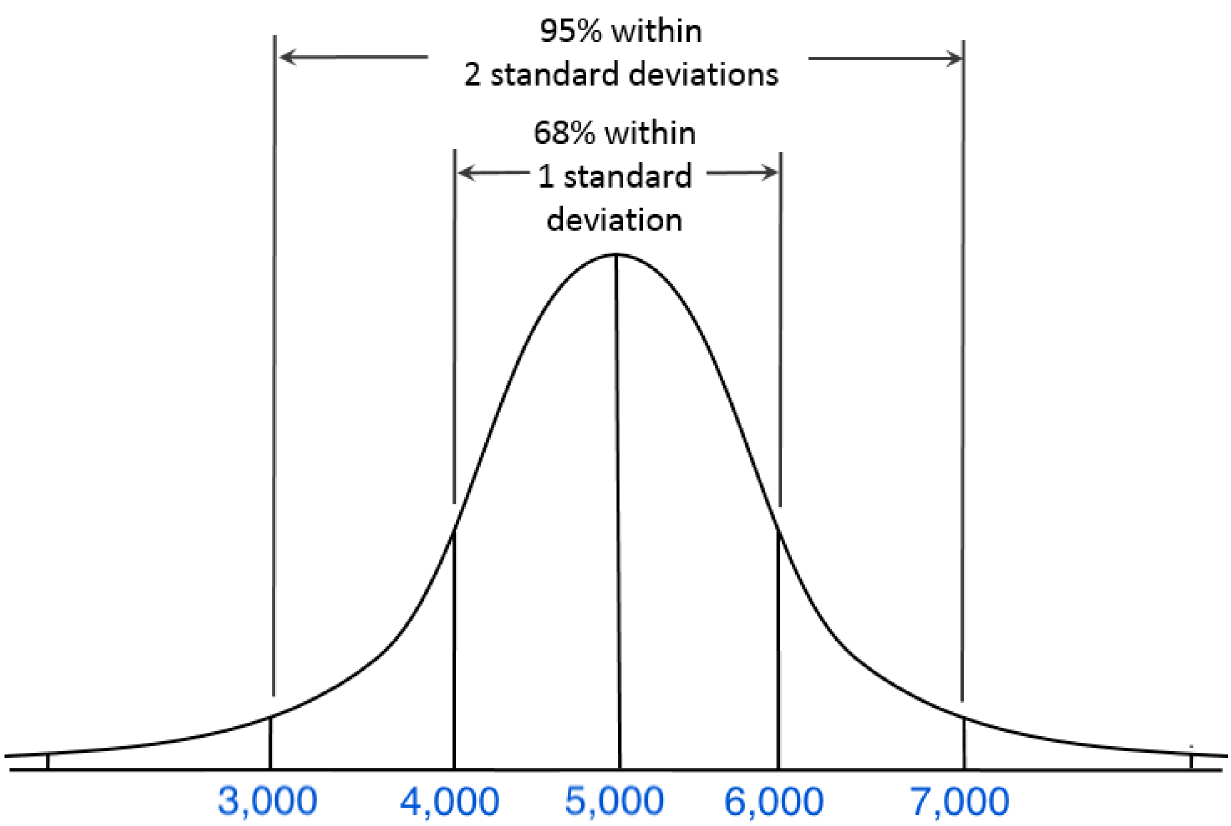
9.4.1 Conducting Simulation Analysis in Excel

9.4.1.1 YoGo technologies simulation analysis

The first step in conducting a simulation analysis is **simulating what our inputs are likely to be.** When simulating the input variables, we usually assume a normal distribution. That is, it is equally likely that a variable is "x" higher or lower than expected. The basic process is to identify the best estimate of your input variable, and then identify the likelihood of your input being different. The best estimate is what we refer to as the mean, and the standard deviation is an estimate of how much we think the variable may be different to our best estimate. This is best illustrated with an example:

Let's say our best estimate of the units sold is 5,000 (the mean) and we estimate a standard deviation of 1,000 units. This means that we estimate that there is a 68% chance that our sales will be 1,000 units higher or lower than 5,000 and a 95% that it will be two standard deviations away (1,000 x 2= 2000) from the mean. Basically we estimate that the distribution of our unit sales looks like this:

DISTRIBUTION UNIT SALES



We can tell Excel that the distribution looks like this, and then Excel can simulate possible outcomes based on this function.

Second, we can indicate the distribution of another variable of interest, such as net revenue. We can also tell Excel how the variables impact each other by including a correlation variable: there is generally a strong negative relationship between the two variables (if net revenue goes up because of a higher price, sales usually go down). Note that in the next chapter (Chapter 10) we will spend a little bit more time on standard deviations and correlations, for now it is just important to understand intuitively how the simulation analysis works and how it can help making informed decisions.

The following video shows how to conduct a simulation analysis in Excel.

Video – Simulation analysis YoGo.

If you have followed the previous videos and have been amending your spreadsheet according to the instructions, you can continue using your spreadsheet. Alternatively, you can use this spreadsheet: YoGo-Template – Simulation (XLSX, 480KB)

9.5 Summary and Conclusion

9.5.1 Summary: Comparing Risk Analysis Methods

The table below compares all the risk analysis methods.

?	Sensitivity Analysis	Scenario Analysis	Simulation Analysis
Input	Change assumption for one variable at a time	Combinations of inputs, where the values are expected to be related (e.g. price and volume)	Random draws from probability distribution of input(s), where inputs may or may not be related
Output	Sensitivity output (e.g. NPV or cash flow) to changes in one variable	What IF – how output (e.g. NPV or cash flow) will change IF a given scenario eventuates	Frequency distribution of output (e.g. NPV or cash flow)
What Do We learn?	Which forecasts to refine – or which assumptions drive value	If we can choose scenario: which is best. If scenarios are based on external environment: gives us an idea of risk.	Expected value and/or risk (variation) in output (e.g. NPV or cash flow)

The sensitivity analysis changes the assumption for one variable at a time and it looks at the sensitivity of the output to changes in one variable. It gives a basic understanding of which forecasts to refine or which assumptions drive value. For example, if your NPV is the most exposed to the number of products a company sells, then it becomes a relevant factor to analyse.

In scenario analysis, there is a combination of inputs that change, where the values are often related, for example, the price, the volume and the tax. Essentially, it is a 'what if' analysis, referring to certain situations and showing what would happen to the NPV, in the **best-case scenario**, for example. Sometimes these scenarios are based on economic conditions or other external factors and conditions that are outside of the company's control. This analysis provides an idea of the risks a project could be exposed to, should the external conditions change.

Lastly, **simulation analysis uses a random number from the probability distribution, where inputs may or may not be related and the output delivers a frequency distribution of outputs**. This shows how the NPV would change in the thousands of different cases. In other words, we can predict the expected value of the NPV, which would be represented in a sequence of different values.

9.5.2 Key Formulas

Sensitivity analysis:

$$\text{Sensitivity (slope)} = \frac{\Delta\ Output}{\Delta\ Input}$$

One or more interactive elements has been excluded from this version of the text. You can view them online here: https://uq.pressbooks.pub/introduction-financial-management/?p=146

PART III

RISK AND RETURN

10.

RISK AND RETURN

10.1 Introduction

At the end of this chapter, you will be able to:

- explain the relationship between risk and return
- distinguish between, and calculate, holding period return and expected return
- explain why standard deviation of returns is especially useful in finance (risk measure)
- explain the concept of diversification
- distinguish between systematic and unsystematic risk
- explain the Capital Asset Pricing Model (CAPM)
- evaluate the adequacy of expected return using CAPM
- critically evaluate CAPM.

In our discussions thus far regarding time value of money, we have used a given discount rate to bring cash flows to a common point in time. Recall that this discount rate is the return required by an investor for taking on a risky investment. We have also referred to it as the cost of capital, as entities borrowing money will have to pay a return to investors.

Although we now have a good sense of the importance of the required return in the valuation of financial assets, we have not yet explored fully how investors arrive at a value for this return. This is the topic of this week's chapter.

10.2 Risk and Return

10.2.1 Concepts of Risk and Return

In finance, the concepts of risk and return are very much related. For now, we can think of the return on an asset, such as a stock, as the change in the asset's value over a given time. To get a sense of how returns for different stocks may vary we have plotted the 1 year returns (September 2018 to September 2019) of the

50 largest (by market capitalisation) stocks on the Australian Securities Exchange (ASX), this is shown in Figure 1 below.

The return on the ASX50 index is also plotted as a reference[1]. As we can see, most stocks had a return that was fairly close to that of the index (around 11%), but some had returns that were much less (even negative) or much more. Looking at these companies with the benefit of hindsight, one would have done best to invest in Fortescue Metals Group Limited (FMG), the company with the highest return. Likewise, an investment in Cimic Group Limited (CIM) stock, which had the lowest return (a negative return in fact), would have turned out poorly. Based on this information, would it be wise to invest in FMG today? What about CIM?

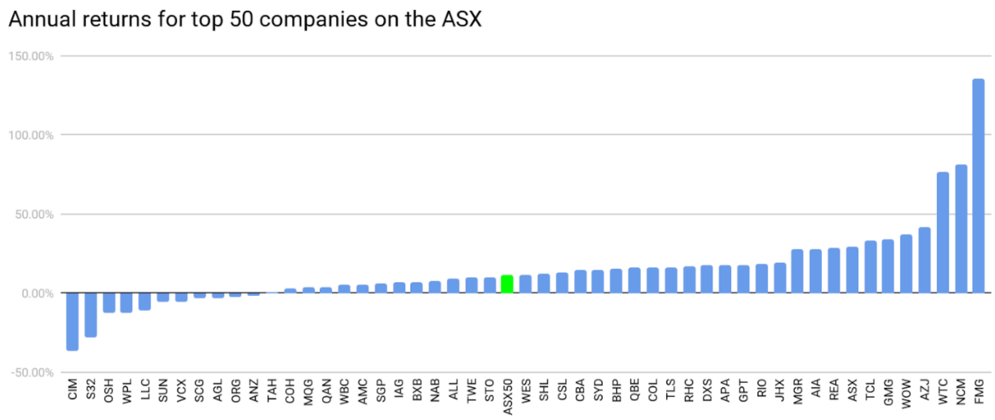


Figure 1: Annual returns for ASX50 companies. Data source: [Market Index](#)

Let's take a closer look at the two extreme cases: CIM and FMG. Figure 2 below plots the daily returns for these two stocks. Apart from a couple of outlying values, the plot of returns looks fairly similar for both companies. The average daily return for both stocks is close to 0% and rarely do the daily returns exceed plus or minus 4% for either company.

> Looking at this plot we can begin to get a feel for the concept of risk.
>
> To start with, we can think of risk on a stock as its chance to being much higher or lower than its expected value. We can take the expected value to be the mean or average value.

1. The ASX 50 is an index that represents the large-cap component of the Australian stock market. It contains the ASX top 50 companies by way of float-adjusted market capitalisation and accounts for 63% (March 2019) of the Australian equity market. https://www.marketindex.com.au/asx50

From our discussion so far we can say that the daily returns for both FMG and CIM have an expected value of around 0%[2].

To measure how far from expectations the return might move, we can employ the standard deviation measure. The standard deviation quantifies the amount of variation in a set of values. A low standard deviation indicates that values in the set tend to be close to the mean, while a high standard deviation indicates that the values are more spread out.

It turns out that the standard deviations for FMG and CIM are 2.65% and 2.14% respectively. This means that the daily returns on FMG were more spread out over the year when compared to CIM, thus making FMG a riskier stock. With this new information, would you rather invest in FMG or CIM today?

This question is complex and we still require a few more pieces to answer it. For one, how long do you plan to hold the stock? Also, will you be investing in the stock on its own or adding it to a portfolio of assets? We will explore these questions in the following sections.

2. We will see later that the historical means, or expected values, of FMG and CIM daily returns are not exactly 0. For our purposes here we can assume that the means are relatively close to 0.

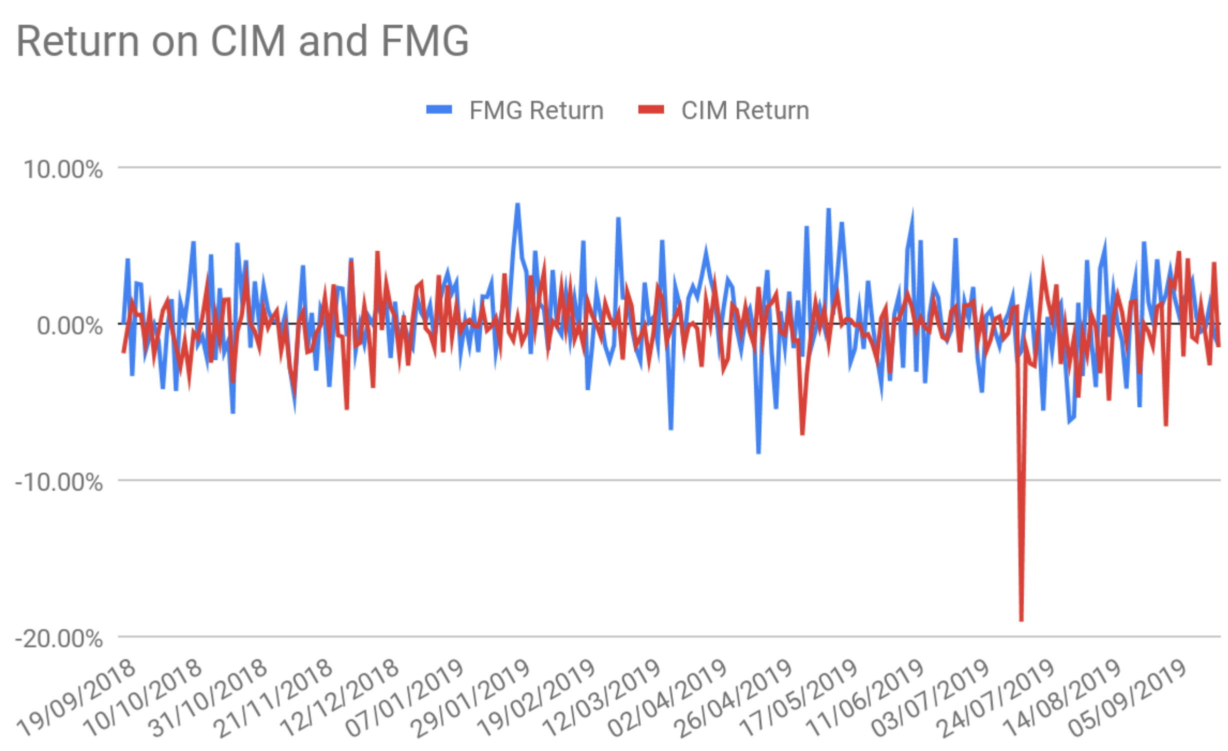


Figure 2: Daily returns on CIM and FMG (September 2018 -September 2019). Data sources: Yahoo Finance

10.2.2 Holding Period and Expected Return

Previously, in Figures 1 and 2 we showed the returns on different stocks. How did we arrive at these values?

We stated earlier that the return on a stock can be thought of as the change in the stock's value over a given time. So, let's say you purchased a share of FMG stock in September 2018. You would have paid $3.79 per share. If you sold that stock in September 2019 you would have sold at a price of $8.92. Therefore you would have made…

$$\$8.92 - \$3.79 = \$5.13$$

…over the year. This increase in value from buying the stock at a low price and selling at a higher price is known as the capital gain. Similarly, if you had purchased a share of CIM stock in September 2018 for $51.27 and sold in September 2019 for $31.83 you would have received a capital gain of…

$$\$31.83 - \$51.27 = -\$19.44$$

which is a capital loss of $19.44.

A stock's return comes not only from the capital gain or loss, but also from the dividends received. In the case of our two stocks, dividends paid between September 2018 and September 2019 were…

FMG		CIM	
Date	Dividend	Date	Dividend
02 Sept 2019	$0.24	11 Sept 2019	$0.71
22 May 2019	$0.60	13 June 2019	$0.86
28 Feb 2019	$0.19		

Table 1: Dividend dates and amounts for FMG and CIM stock between 09/2018 and 09/2019.

So an investor in FMG stock would have received a total of $1.03 in dividends and an investor in CIM would have received $1.57. Knowing both the capital gain/loss and dividends paid we can now compute the *Total Dollar Return* (TDR) for these two stocks.

$$\text{TDR} = \text{Dividend Income} + \text{Capital gain/loss}$$
$$\text{TDR}_{\ FMG} = \$1.03 + \$5.13 = \$6.16$$
$$\text{TDR}_{\ CIM} = \$1.57 - \$19.44 = -\$17.87$$

Calculating total dollar returns gives some information about the stocks but it does not allow us to compare across stocks. For example, if two stocks offer a total dollar return of $10 but one has a price of $10 while the other has a price of $100, which would you rather invest in?

To compare across stocks, we should normalise the returns in some way. This could be done by taking *holding period returns*, which measures the return relative to the initial price, and is calculated as follows:

$$\text{Holding period return} = \text{Total dollar return}/\text{Price}_{\text{t-1}}$$
$$\text{Holding period return}_{\text{FMG}} = \$6.16/\$3.79 = 1.635 \text{ or } 163.5\%$$
$$\text{Holding period return}_{\text{CIM}} = -\$17.87/\$51.27 = -0.349 \text{ or } -34.9\%$$

This holding period return is the return received from holding an asset over a certain period of time. A useful exercise would be to understand how much of the holding period return stems from the dividend and how much from the capital appreciation[3].

$$\textit{Holding period return} = \underbrace{\textit{Dividend yield}}_{=\frac{D_{t+1}}{P_t}} + \underbrace{\textit{Capital yield}}_{=\frac{P_{t+1}-P_t}{P_t}}$$

$$= \frac{D_{t+1}}{P_t} + \frac{P_{t+1} - P_t}{P_t}$$

...where t is the period the stock was purchased P refers to the price of the stock at time t, and D refers to the dividend. Note that this is a simplified 1-period model only.

Applying this to our stocks FMG we see that...

\begin{equation} \begin{aligned} \text { Holding Period Return}_{F M G}=\frac{D_{t+1}}{P_{t}}+\frac{P_{t+1}-P_{t}}{P_{t}} \\=& \frac{$1.03}{\$ 3.79}+\frac{\$ 8.92-\$ 3.79}{\$ 3.79} \\ &=0.272+1.354 \\ &=1.635 \text { or } 163.5 \% \end{aligned} \end{equation}

$$\begin{aligned} \text{Holding Period Return}_{FMG} = \frac{D_{t+1}}{P_t} + \frac{P_{t+1}-P_t}{P_t} \\ = \frac{\$1.03}{\$3.79} + \frac{\$8.92-\$3.79}{\$3.79} \\ = 0.272 + 1.354 \\ = 1.635 \text{ or } 163.5\% \end{aligned}$$

FMG had a holding period of 163.5% which is composed of a 135.4% capital gain yield and a 27.2% dividend yield.

Concept Check

What is the dividend yield for CIM?

An interactive H5P element has been excluded from this version of the text. You can view it online here:
https://uq.pressbooks.pub/introduction-financial-management/?p=162#h5p-94

Remember that CIM started the year at $51.27, ended the year at $31.83 and paid dividends totalling $1.57 per share.

What is the capital gains yield for CIM?

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https://uq.pressbooks.pub/introduction-financial-management/?p=162#h5p-95

Remember that CIM started the year at $51.27, ended the year at $31.83 and paid dividends totalling $1.57 per share.

What is the holding period return for CIM?

An interactive H5P element has been excluded from this version of the text. You can view it online here:
https://uq.pressbooks.pub/introduction-financial-management/?p=162#h5p-96

What is the cause of the negative holding period return?

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https://uq.pressbooks.pub/introduction-financial-management/?p=162#h5p-97

10.2.3 Average Returns

Another bit of information an investor might want to know is how their stock did on average during the holding period. Thus, they could calculate the mean return during the holding period:

$$\bar{x} = \frac{1}{t}\sum_{i=1}^{t} x_i = \frac{x_1 + x_2 + \cdots + x_t}{t}$$

...where t is the number of periods for which the stock was held, x_i refers to the return for the i^{th} period, and $\bar{x}$ is the average, or arithmetic mean. In the case of FMG and CIM, the mean daily returns (around 260 observations) during the period from September 2018 to September 2019 were...

$$\overline{\text{return}}_{FMG} = 0.43\%$$
$$\overline{\text{return}}_{CIM} = -0.15\%$$

So, on any given day during this period, an investor in FMG stock could have expected to receive a return of 0.43% over the previous day and an investor in CIM could have expected to receive a return of -0.15%. Of course these values are arrived at with the benefit of hindsight. An investor in September 2018 could not have known with certainty that these would be their actual returns.

10.2.4 Expected Return

The expected return is a return that can be estimated by calculating the probability-weighted average of the possible returns from an investment. The probability weights are based on information that an investor has at the time.

$$E\left[R_i\right] = \sum_{j=1}^{n} p_j R_{ij} = p_1 R_{i,1} + p_2 R_{i,2} + \cdots + p_n R_{i,n}$$

where n is the number of possible states (possible returns) R, and p_j is the probability assigned to state R_j .

Let's say we know the probability of different states of the economy and regulations concerning our product, and what the expected returns would be in each of these states. See estimates for the stock returns of FMG under different scenarios in the table below.

State (i)	pi	E(RFMG,i)
1 – Recession & unfavourable regulation	0.10	-20%
2 – Recession & favourable regulation	0.15	-10%
3 – Normal & unfavourable regulation	0.20	-5%
4 – Normal & favourable regulation	0.30	10%
5 – Good & unfavourable regulation	0.10	15%
6 – Good & favourable regulation	0.15	25%

Note that the sum of all of the probabilities (p_i) must be 1.00 or 100%.

Here we can see that the worst outcome of a recession combined with unfavourable regulation has a 10% probability of occurring and would result in a 20% loss. On the other hand, the most favourable scenario of a booming economy paired with favourable regulation would result in a 25% return and has a 15% chance of occurring. We can calculate the expected return as follows:

$E\left[R_{FMG}\right] = \sum_{j=1}^{n} p_j R_{i,j} = p_1 R_{FMG,1} + p_2 R_{FMG,2} + p_3 R_{FMG,3} + p_4 R_{FMG,4} + p_5 R_{FMG,5} + p_6 R_{FMG,6}$
$E\left[R_{FMG}\right] = \sum_{j=1}^{n} p_j R_{i,j} = (0.1 * -0.2) + (0.15 * -0.1) + (0.2 * -0.05) + (0.3 * 0.1) + (0.1 * 0.15) + (0.15 * 0.25)$
$E\left[R_{FMG}\right] = 0.0375 \text{ or } 3.75\%$

Thus, based on the estimations above, the expected return on FMG is 3.75%. Note that in reality it is very hard to estimate the probability of certain states occurring and the accompanying return if this state occurs. Therefore, we will give you this information.

Concept Check

The following table shows the probabilities of different states of the economy and corresponding expected returns for Goldio Ltd (GLD).

State (i)	Pi	RGLD,i
1 – Severe Recession	10%	30%
2 – Recession	15%	20%
3 – Neutral	50%	0%
4 – Mild Boom	15%	-10%
5 – Large Boom	10%	-20%

What is the expected return for Goldio Ltd?

An interactive H5P element has been excluded from this version of the text. You can view it online here: https://uq.pressbooks.pub/introduction-financial-management/?p=162#h5p-98

10.3 Measuring Risk

In this video, you will see a first introduction to risk. In this section we look at how exactly we can measure risk.

Video: Relationship between risk and return (YouTube, 3m8s)

One or more interactive elements has been excluded from this version of the text. You can view them online here: https://uq.pressbooks.pub/introduction-financial-management/?p=162#oembed-3

10.3.1 Introduction to Measuring Risk

10.3.1.1 A First Introduction to Risk

To understand risk we can start by making frequency distributions of the returns on our two stocks, FMG and CIM. To construct a frequency distribution from a data set first divide the data into bins of equal size that cover the range of values in the data set. Then count the number of values from the data set that fall into each bin.

There is a video at the end of this session explaining measuring risk, if you prefer to watch, you can skip ahead to the video.

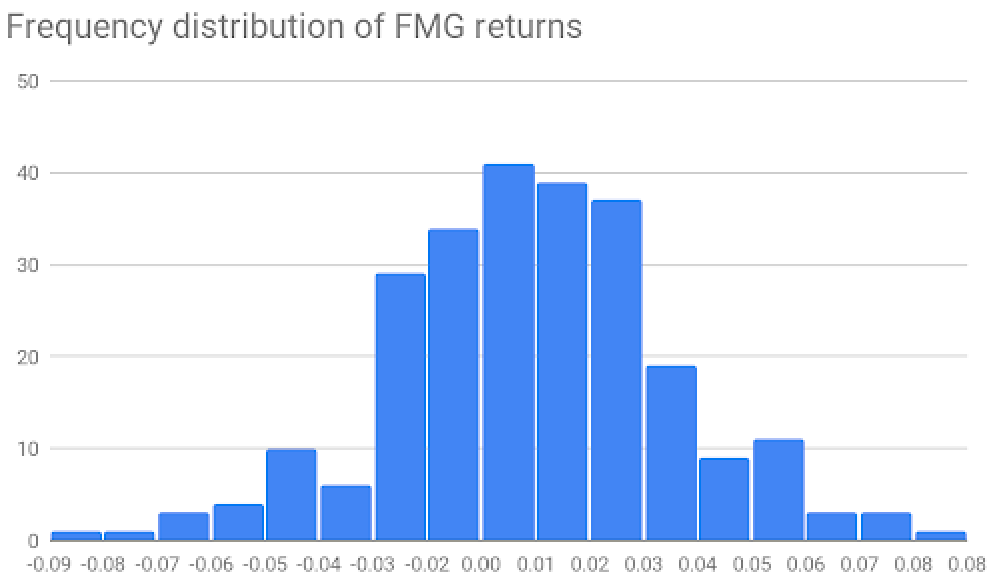


Figure 3: Frequency distribution of FMG daily returns (09/2018 – 09/2019). Data source: Yahoo Finance

For example, in our frequency distribution of FMG daily returns (shown in Figure 3), we have created bins that are 0.01 units wide each. The bins cover the range from -0.09 to 0.08, which is sufficient to categorise the range of return values in our FMG return data set. We can see by the height of the tallest bin that there are 41 occurrences of FMG daily stock returns within the range of 0 and 0.01. This makes sense as the mean value of FMG returns is 0.0043 (0.43%). We can also see that there are very few occurrences of returns at the far ends of the range covered by the distribution. Overall, about 72% of the values lie within the range of -0.03 and 0.03.

We can compare the frequency distribution of FMG returns with that of CIM (Figure 4). The tallest bin contains 63 occurrences of returns within the range -0.01 and 0.01 and, not surprisingly, the mean return on CIM is -0.0015 (-0.15%). You'll also notice that CIM has one outlying return in the range of -0.19 and -0.18. This corresponds to what we saw in Figure 2. Apart from this extreme case, however, most of the returns, around 78%, lie within the range of -0.02 and 0.02. This means that, when compared to FMG, CIM returns exhibit smaller deviations away from their mean value.

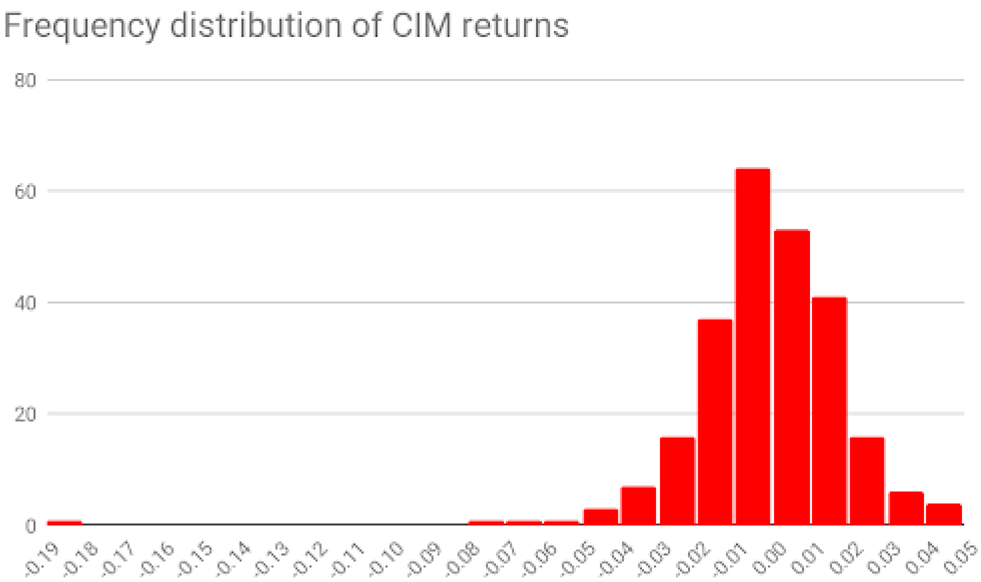


Figure 4: Frequency distribution of CIM daily returns (09/2018 – 09/2019). Data source: [Yahoo Finance]

We have already mentioned that the standard deviation (also known as the volatility[4]) is a measure of dispersion or risk. The standard deviation (represented by the symbol σ) of returns is calculated as follows...

[4] To be precise, volatility in finance refers to the standard deviation of logarithmic returns.

$$\sigma = \sqrt{\frac{1}{t-1}\sum_{i=1}^{t}(x_i - \bar{x})^2} = \sqrt{Var} = \sqrt{\sigma^2}$$

...where t is the number of periods for which the stock was held, x_i refers to the return for the i^{th} period, and $\bar{x}$ is the mean return. The last two equalities tell us that the standard deviation is the square root of the variance (Var or σ^2). The variance measures the squared deviations from the mean. You will not be expected to compute variance from raw data in this course. The purpose of going through the computation here is to give you an idea of what factors lead to large levels of volatility or risk.

To see how to calculate the standard deviation, we can look at the monthly returns for FMG and CIM between September 2018 and September 2019. In Table 2 below we have listed the monthly stock prices for FMG and CIM during this time[5]. We have calculated the mean of the monthly returns and used this to calculate the deviation of each month's return from the mean. We then take the square of these values and divided them by the number of observations (12) minus 1. Finally, we take the square of this value to arrive at the standard deviation.

[5] We have taken the monthly stock price to be the price on the 1st of the month. The prices in this table have been adjusted to include dividends.

Date	Price		Return		Deviation (xi-x̄)		Squared Deviation $(xi\text{-}\bar{x})^2$	
Month	FMG	CIM	FMG	CIM	FMG	CIM	FMG	CIM
09/ 2018	$3.33	$49.18						
10/ 2018	$3.41	$44.80	2.40%	-8.91%	-6.76%	-5.69%	0.46%	0.32%
11/ 2018	$3.56	$41.28	4.40%	-7.86%	-4.76%	-4.64%	0.23%	0.22%
12/ 2018	$3.63	$40.91	1.97%	-0.90%	-7.19%	2.32%	0.52%	0.05%
01/ 2019	$4.17	$42.90	14.88%	4.86%	5.72%	8.08%	0.33%	0.65%
02/ 2019	$5.58	$47.29	33.81%	10.23%	24.65%	13.45%	6.08%	1.81%
03/ 2019	$6.17	$47.77	10.57%	1.02%	1.41%	4.23%	0.02%	0.18%
04/ 2019	$7.01	$47.50	13.61%	-0.57%	4.45%	2.65%	0.20%	0.07%
05/ 2019	$8.35	$44.72	19.12%	-5.85%	9.95%	-2.63%	0.99%	0.07%
06/ 2019	$8.46	$44.39	1.32%	-0.74%	-7.84%	2.48%	0.62%	0.06%
07/ 2019	$8.44	$35.75	-0.24%	-19.46%	-9.40%	-16.25%	0.88%	2.64%
08/ 2019	$7.43	$30.71	-11.97%	-14.10%	-21.13%	-10.88%	4.46%	1.18%
09/ 2019	$8.92	$31.83	20.05%	3.65%	10.89%	6.87%	1.19%	0.47%

Date	Price	Return		Deviation $(xi-\bar{x})$	Squared Deviation $(xi-\bar{x})^2$	
	Mean	9.16%	-3.22%	Standard Deviation	9.16%	-3.22%

Table 2: Calculation of standard deviation of monthly returns for FMG and CIM stock.

Note that the standard deviation for monthly returns of CIM stock is much smaller than that of FMG stock. **We do not require you to be able to calculate the standard deviation**, but rather understand what the standard deviation tells us.

To further our understanding of frequency distributions, means, and standard deviation as a measure of risk we can compare the distributions plotted in Figures 3 and 4 to the normal distribution. The normal distribution gives the probabilities across a range that a normally distributed random variable will occur at a given point within that range. Variables are generated by selecting a mean value and standard deviation. Then the random variables will occur with highest probability at and close to the mean value and the probability of occurrence will start to decrease the farther you are from the mean. In Figure 5 we have again plotted the distribution of daily FMG returns (this time with bins that are 0.005 units wide) and overlaid this with a normal distribution that has the same mean and standard deviation as that of the FMG returns[6]. As you can see, the normal distribution is a good approximation for the distribution of FMG returns[7]. The same can be said for CIM returns.

[6] Note that the FMG distribution and normal distribution have been scaled appropriately for comparison. Specifically, we have plotted the density distribution, which means that each frequency value in the given series has been divided by the sum of all frequencies in that series in order to arrive at density values. In this way, the sum of densities is equal to 1.

[7] In practice, the normal distribution is used to approximate the distribution of logarithmic returns. Economists believe that stock returns are log-normally, as opposed to normally, distributed.

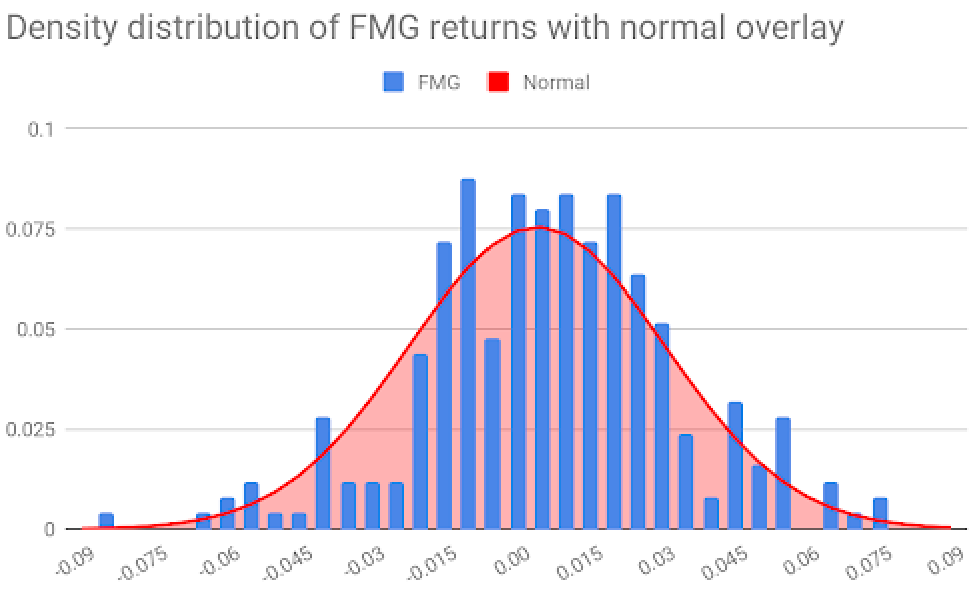
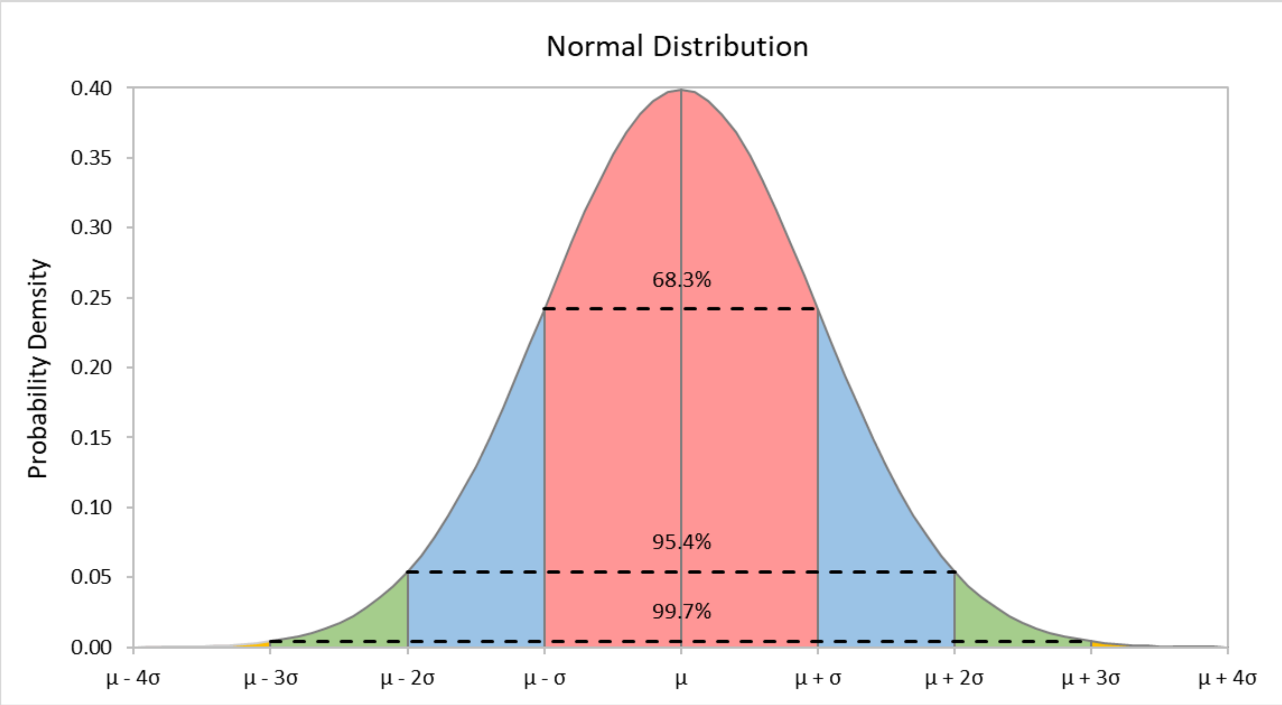


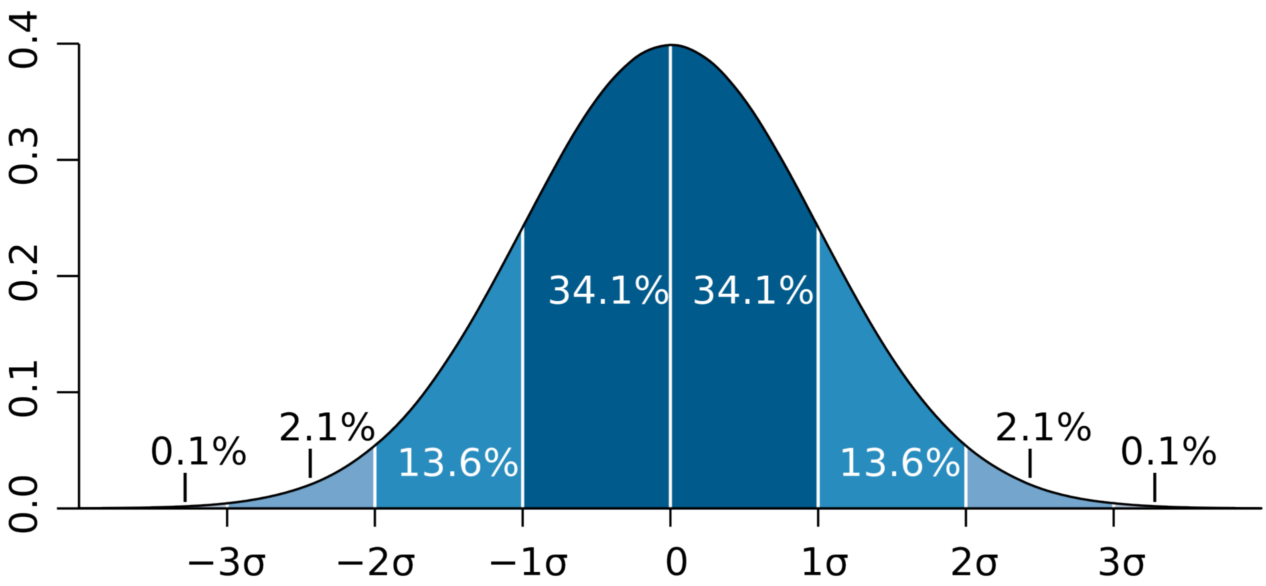
Figure 5: Density distribution of FMG daily returns and its normal approximation. Data source: Yahoo Finance

The normal distribution is useful because of its simplicity and its wide applicability. Using just the mean and standard deviation calculated from historical return data, the normal distribution allows us to approximate the probability of achieving a particular return in the future. Moreover, the more historical data you use to compute your mean and standard deviation, the better will be your approximation. If you expect your future returns are normally distributed then there is a 68% probability that you will receive a return that is within 1 standard deviation away from the mean, a 95% probability that you will receive a return that is within 2 standard deviations away from them mean, and less than 1% probability that your return will be greater (or less) than 3 standard deviations away from the mean.



Normal Distribution

For example, using FMG daily return data we have a mean of 0.43% and a standard deviation of 2.65%. If we approximate future FMG daily returns to be normally distributed with this mean and standard deviation then there is a 68% probability that the future daily return will be between -2.22% and 3.08%.



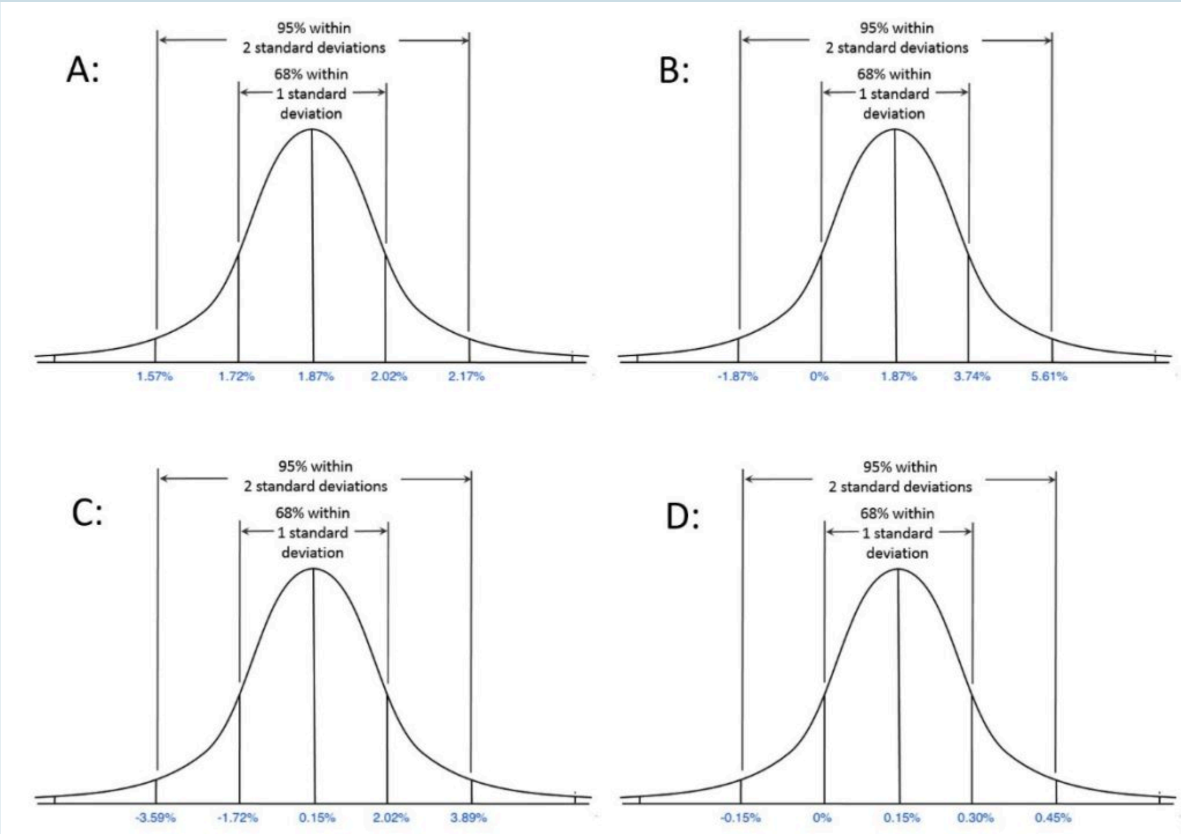
Standard deviation diagram by M.W.Toews, CC BY 2.5, via Wikimedia.

Video: Module 10 – Measuring Risk (YouTube, 14m49s)

Concept Check

Which of the following frequency distributions would be the most representative of CIM's future daily returns?

1 point possible (ungraded)



If we expect the daily mean (μ) for CIM to be 0.15% and the standard deviation (σ) to be 1.87%, and future returns to be normally distributed, which of the following frequency distributions would be the most representative of CIM's future daily returns?

An interactive H5P element has been excluded from this version of the text. You can view it online here: https://uq.pressbooks.pub/introduction-financial-management/?p=162#h5p-99

As a final visualisation, we have plotted in Figure 6 the normal distributions that were produced by using, respectively, the mean and standard deviation of daily FMG returns and that of daily CIM returns. Again, the two distributions have been scaled to allow for comparison[8].

[8] Note that the range of the x-axis in Figure 6 does not explicitly include the outlying negative value we saw for CIM returns in Figure 4. However, this value is accounted for in the lowest bin (-0.09 to -0.085) used here.

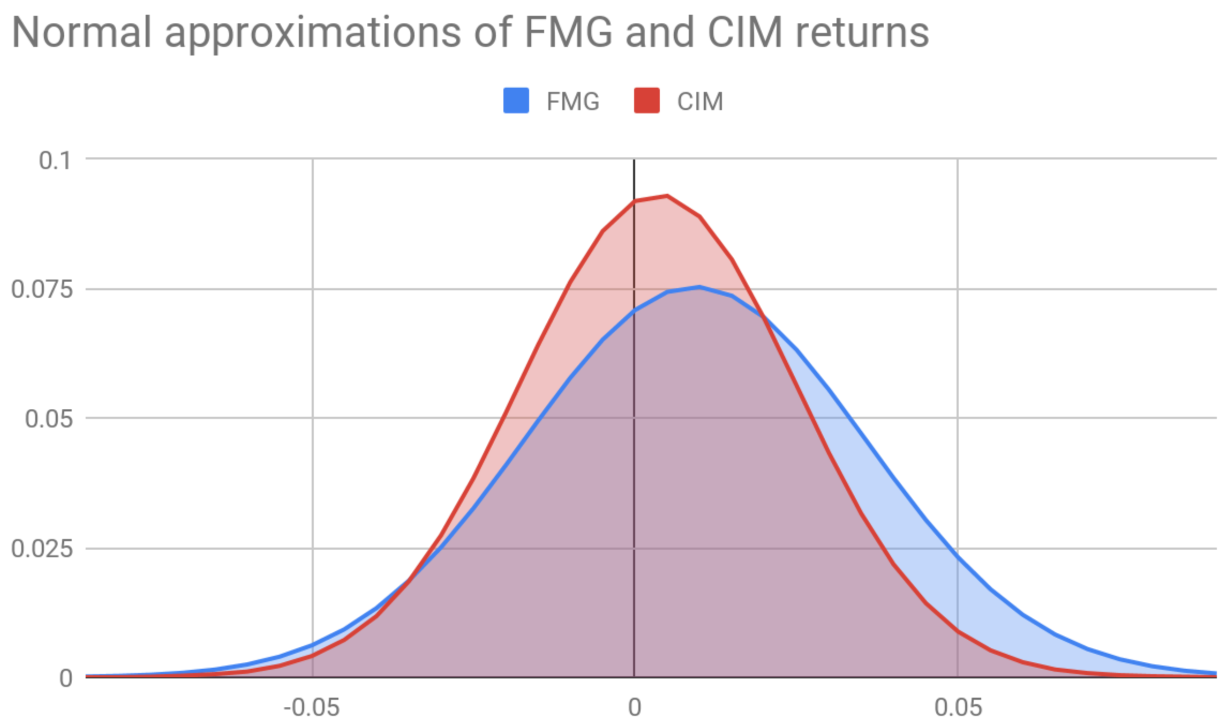


Figure 6: Normal approximations of FMG and CIM returns. Data source: [Yahoo Finance](#).

Note that the CIM normal distribution is taller and slimmer than that of FMG reflecting the fact that daily CIM returns have a smaller standard deviation. Also note the position of the peaks of the distribution. FMG stock has a higher average daily return than CIM.

Now that we have discussed both risk (as measured by the historical standard deviation) and expected return (as measured by the historical mean), we can begin to see a connection between these two quantities. Comparatively, FMG stock has the higher risk but it also has the higher expected return. The opposite is true of CIM stock, it has lower risk and lower expected return. It is often the case that a stock with a higher risk is expected to yield a higher return (otherwise no one would buy it!), however there are some risks that matter more than others; this is what we will learn in the next section.

10.4 Diversification

10.4.1 Expected Return of a Portfolio

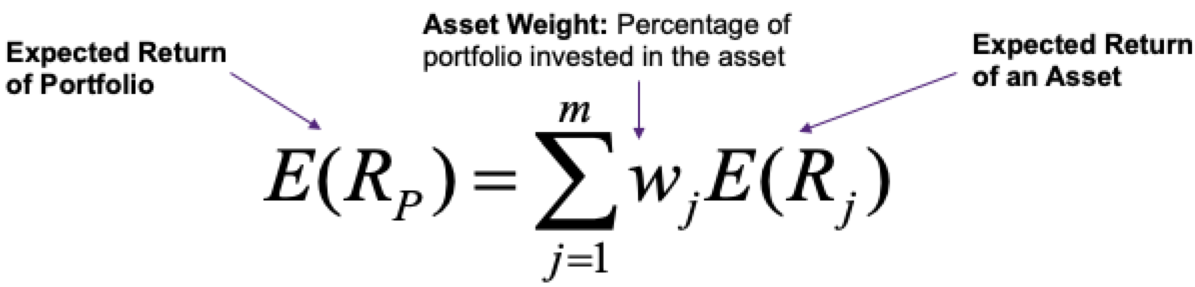
So far we have presented the question of investing in FMG and CIM stock as mutually exclusive. That is, we have asked if an investor would rather invest in FMG or CIM stock based on the information available on past returns. However, the investment decision does not have to be an either or. Typically, investors hold portfolios of many financial assets, which can include stocks, bonds, and cash, so that their wealth is allocated amongst different assets. That is, most investors have *diversified* holdings.

Expected return of a portfolio

As we have mentioned, an investor who holds a portfolio of stocks allocates their wealth among the different stocks in their portfolio. Let us imagine we want to construct a portfolio from our two stock FMG and CIM. If we have $100 to spend, we could spend a certain amount, lets say x dollars, buying FMG stock, and the rest, $\$100 - x$, buying CIM stock. It is better to work with percentages here so we can say that we place w percentage of our wealth on FMG stock and $1 - w$ percentage of our wealth on CIM stock. These values w and $1 - w$ are called the portfolio weights. Then our expected return on the portfolio will just be the weighted average of the expected returns on the individual stocks

$$E\left(R_p\right) = w \times E\left(R_{FMG}\right) + (1 - w) \times E\left(R_{CIM}\right)$$

Mathematically, this is the same formula we saw in Equation 4. In fact, we can generalise for the return on a portfolio of m assets…



Going back to our two stock portfolio, if we decide to allocate an equal amount of wealth between FMG and CIM stock we will have an expected daily portfolio return of…

$$\begin{aligned} E\left(R_p\right) &= w_{FMG} \times E\left(R_{FMG}\right) + \left(1 - w_{FMG}\right) \times E\left(R_{CIM}\right) \\ &= 0.5 \times 0.0043 + 0.5 \times (-0.0015) \\ &= 0.0014 \text{ or } 0.14\% \end{aligned}$$

Thus, the expected daily return is 0.14%.

Video: [Portfolio Return (YouTube, 1m13s)]

One or more interactive elements has been excluded from this version of the text. You can view them online here: https://uq.pressbooks.pub/introduction-financial-management/?p=162#oembed-1

Portfolio weights are calculated using market values, and are expressed as a percentage of the total portfolio value: if you invest $10,000 in BHP and $30,000 in CBA (and nothing else), your portfolio value is $40,000 and the weight in BHP is 10,000/40,000 = 0.25 and the weight in CBA is 30,000/40,000 = 0.75 (or 1 – 0.25).

Example – GoSun

You hold a portfolio that consists of 500 shares in GoSun worth $5 each and 300 shares in Enova worth $32 each. What are the portfolio weights of GoSun and Enova? If the expected return on GoSun is 10% and Enova is 6%, what is the expected return of your portfolio?

Download the working for the video below (PDF, 960KB).

Video: Worked example – Go Sun expected return on portfolio

One or more interactive elements has been excluded from this version of the text. You can view them online here: https://uq.pressbooks.pub/introduction-financial-management/?p=162#oembed-2

Concept Check (Advanced)

Your friend Jay decided to invest part of his Christmas bonus. He is a big fan of Apple and Tesla, and decides to invest in these two companies. The share prices, amounts bought, and expected return for each on the day he bought the shares are displayed below (Share prices are at 31 Oct 2019, expected returns are based on a 5 year historical average).

Company	Share Price	Number of Shares	E(R)
Apple	$243.26	20	21%
Tesla	$315.01	25	9%

1a) What are the portfolio weights for Apple in Jay's portfolio at the day he purchased the shares?

An interactive H5P element has been excluded from this version of the text. You can view it online here:
https://uq.pressbooks.pub/introduction-financial-management/?p=162#h5p-100

1b) What are the portfolio weights for Tesla in Jay's portfolio at the day he purchased the shares?

An interactive H5P element has been excluded from this version of the text. You can view it online here:
https://uq.pressbooks.pub/introduction-financial-management/?p=162#h5p-101

2) What is the expected return of the portfolio?

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https://uq.pressbooks.pub/introduction-financial-management/?p=162#h5p-102

10.4.2 Portfolio Risk

Just based on the expected return, the advantage of holding a portfolio of the two or three stocks as opposed to just investing in one stock is unclear. To understand the advantage we must look at portfolio risk.

Portfolio risk depends on three items:

1. Portfolio weights
2. Risk (standard deviation) of the individual assets
3. The relationship (correlation) between the assets

As you can see, the risk on a portfolio of stocks is not simply the weighted average of the risks of the individual assets. In fact, portfolio risk is less than the weighted average of the risks of the securities in the portfolio, and how much less depends on how strong the relationship is between the returns on the securities in the portfolio. The strength of a relationship between two variables can be measured by calculating the correlation coefficient. Correlation measures how much two random variables tend to move in the same direction or in opposite directions – it is a standardised measure and varies between -1 and +1 for all pairs of random variables, where;

- Correlation of +1 means the two variables always move in the same direction (also called perfectly positively correlated)
- Correlation of -1 means the two variables always move in opposite directions (also called (perfectly negatively correlated)
- Correlation of 0 means there is no relationship between the two random variables

Whenever we add assets to our portfolio that have a correlation of less than 1 to the assets in our portfolio something magical happens; the risk of the portfolio is less than the weighted average of the risk of the individual assets. In other words, some of the variation of the portfolio disappears!

This magical effect is what we call the **portfolio effect.**

Let's have a look at how this works.

It turns out that the correlation between daily FMG and CIM returns is 0.1084 (for calculations see the Appendix) meaning that the returns on the two stocks are slightly positively correlated. A possible reason for this weak correlation is that the two companies are in somewhat different businesses. CIM is large project developer which is involved in the telecommunications, engineering and infrastructure, building and property, mining and resources, and environmental services industries. FMG, on the other hand, concentrates on the mining, processing, and transportation of iron ore.

The weak correlation between the two stocks will allow us to create a diversified portfolio with a lower combined risk than that of the individual stocks. Generally, the weaker the correlation between the two stocks the greater the risk-lowering effect of diversification.

Why does lower correlation lead to lower risk in a portfolio?

Very roughly, you can think of correlation as the probability that the two stocks will move in the same direction. If you own two stocks that always move in the opposite direction (correlation is close to -1), then when one stock goes up, the other is likely to go down. This means that gains in one stock offset the losses in the other stock. When you add the returns of the two stocks together, they offset each other and are likely to be very near the average return. In other words, the risk or variability of your return will be low. On the other hand, if your two stocks have correlation close to +1, then they will, on average, move in the same direction. On a good day, both will go up and you'll have a very good return. On a bad day, however, both will go down and you'll have a very bad return. So, the closer the correlation is to +1, the closer the risk of your portfolio will be to the average risk of your two stocks. And as the correlation moves towards -1, the risk of the portfolio reduces to something that is much less than the average risk of your two stocks.

To see how this works, let us take our 50/50 portfolio in FMG and CIM. In the previous section, we already took step 1 of calculating portfolio expected return (daily):

For calculating portfolio risk, we need the portfolio weights (0.5 each), individual asset risk (FMG = 2.65% and CIM = 2.41%), and the correlation (0.1084). The resulting portfolio risk (see Appendix 2 for calculations) is 0.0179 or 1.79%.

This standard deviation of the daily returns on the portfolio with equal weights given to FMG and CIM stocks is significantly less than that of either stock separately. Taken together with the return calculated above, it might be that a risk averse investor prefers investing in this lower risk portfolio over an investment in solely the higher return, but higher risk, FMG stock.

Of course, our imaginary investor is not restricted to allocating equal amounts of their wealth to FMG and CIM. They could place different weights on these two stocks in their portfolio to arrive at a risk return profile that suits their needs. This is illustrated in Figure 7 below.

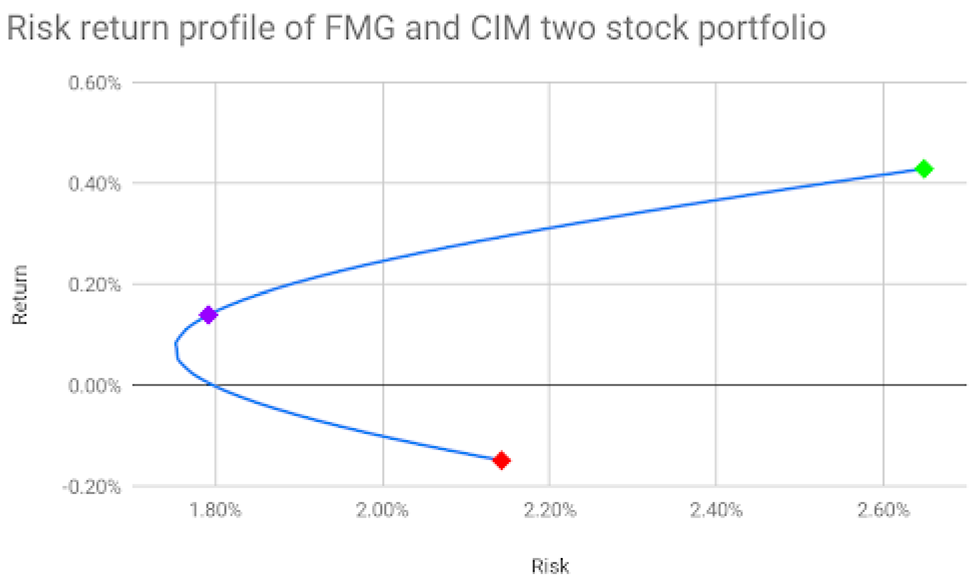

Figure 7: Risk return profile of FMG/CIM portfolio for different combinations of weights. The diamonds indicate three significant portfolios: the 100% FMG portfolio (green), the 100% CIM portfolio (red) and the equally weighted (50/50) portfolio (purple). Data source: [Yahoo Finance](https://finance.yahoo.com).

This plot is the result of calculating the portfolio mean (return) and standard deviation (risk) for different combinations of weights placed on the two stocks FMG and CIM. For any particular combination, the weights, given as percentages of the investor's wealth, have to add to 1. For example, the investor may place 70% of their wealth in FMG and 30% in CIM, resulting in a portfolio return of 0.26% and risk of 2.03%. Note that the "portfolio" of investing in just FMG and that of just investing in CIM are also plotted. It seems from the plot that if an investor seeks the least risky portfolio of FMG and CIM stock, they should place 40% of their wealth in FMG and 60% in CIM. This portfolio will deliver a positive expected return (although lower than that of just investing in FMG stock) but also benefit from the lower risk of CIM stock.

Concept Check

Which component impacts portfolio risk but not portfolio return?

An interactive H5P element has been excluded from this version of the text. You can view it online here:
https://uq.pressbooks.pub/introduction-financial-

management/?p=162#h5p-103

10.5 Systematic and Unsystematic Risk

In the previous section we found that portfolio risk reduces when we combine stocks with correlations that are less than perfectly correlated. How can this happen?

Video: Risk Diversification (YouTube, 3m18s)

As the video shows, there are two types of risk that are important to distinguish between.

First, let's take a step back. The risk from owning a stock comes from unexpected changes in the value of the stock. Therefore, we could think of the actual return received from holding a stock as having two components: the expected return and the unexpected return.

We have already spoken about the expected return component. The unexpected component comes from the fact that stocks are risky and this riskiness can result in unexpected changes in the value of the stock. These changes might be due to, for example, the central bank of a country unexpectedly increasing or decreasing the interest rate. They may also be due to the government releasing unexpected news about the country's GDP or inflation rate. You might imagine that these types of changes/announcements would affect all the companies that operate in that country. Take inflation: an unanticipated increase would likely affect wages and both the cost of goods that companies buy (accounts payable) and sell (accounts receivable).

There are other types of changes/announcements that would affect certain companies more than others. For example, the government might announce the imposition of tariffs on goods from a certain industry, or new regulations regarding certain environmental factors (e.g. the use of a waterway or limits on a particular source of pollution). Non-governmental action may also affect companies such as workers from a certain industry deciding to unionise or the discovery of new precious metal deposits. You could imagine that the discovery of a new iron ore deposit in Australia would affect FMG's value more so than CIM's. And some of these announcements may affect one company alone. The worst daily return for CIM came on the day that it announced its half-year earnings. Clearly, the market did not expect the reported 15% drop in profit.

What we are describing here is the difference between systematic and unsystematic risk. It is important to distinguish between these two sources of risk as an investor can themselves deal with one but not the other by using the diversification principle behind portfolio building. We will see also that this ability for an individual investor to diversify is also recognised by the market and thus affects the return that the investor expects to receive. For now, let us rewrite Equation 10 to account for these two components of unexpected returns…

So the total return on a particular company's stock includes the expected return, some unexpected return that is due to risk factors which affect the market as a whole, and some unexpected return that is due to risk factors that are more or less unique to the particular company[9].

[9] The distinction between systematic and unsystematic risk may be less than exact in practice. This is because of the interconnectedness of the market. Even the most particular piece of information about a specific company can have some small effect on the market as a whole.

Concept Check

Choose if the events are systematic or unsystematic risk:

An interactive H5P element has been excluded from this version of the text. You can view it online here:
https://uq.pressbooks.pub/introduction-financial-management/?p=162#h5p-104

10.5.1 Systematic and Unsystematic Risk in a Portfolio

As we have seen, by building a portfolio of stocks an investor can decrease their overall risk, particularly if the returns of the stocks in the portfolio are weakly correlated.

But, what type of risk is being reduced through diversification?

If we own a diversified portfolio, systematic risks will affect ***all*** of the companies in our portfolio to some extent, because systematic risks are those that affect the economy as a whole. Unsystematic risks, however, affect only a small number of companies in the economy. So in a diversified portfolio, these unsystematic risks would tend to cancel out. This means that the risk reduced through diversification is **unsystematic**.

For example, if we invest solely in FMG stock, we face the risk that our returns will decrease due to some negative shocks related to iron ore. We can reduce this risk by combining our investment in FMG with an investment in CIM, a company that is not as susceptible to risk factors due to iron ore. Of course, there will still be systematic risk factors that affect both companies. These risk factors can not be diversified away. What can be done is to eliminate as much unsystematic (or diversifiable) risk as possible by optimally diversifying your portfolio. This is illustrated in Figure 8 below.

We have plotted the total portfolio risk (as measured by the average standard deviation) for equally-weighted portfolios containing different numbers of stocks[10]. Notice the sharp reduction in unsystematic (diversifiable) risk that occurs with just a slight increase in the number of stocks in the portfolio. As the number of stocks increase the diversifiable risk will decrease so that the total risk (the sum of the unsystematic and systematic components) approaches the systematic risk only.

[10]For each portfolio of n number of stocks, a 100 sample portfolios are generated by selecting n stocks randomly from the top 50 stocks in the ASX200. From these 100 samples, an average standard deviation is computed.

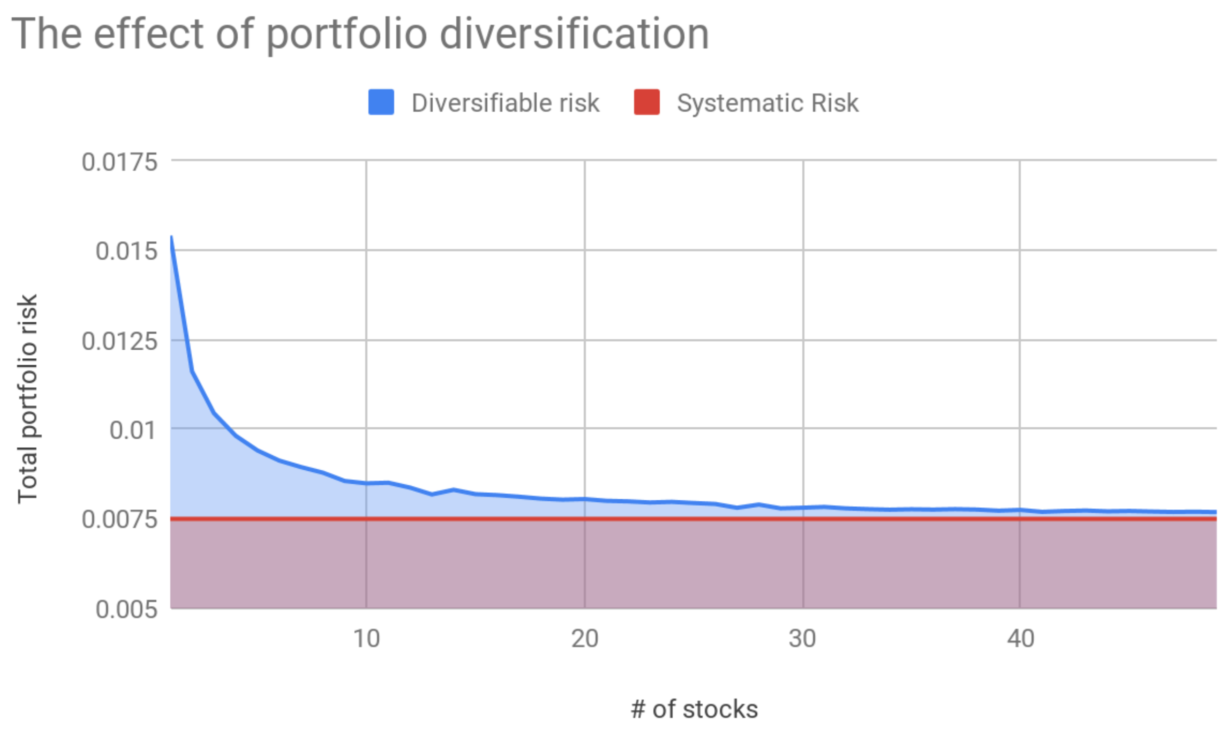

Figure 8: The effect of portfolio diversification on unsystematic (diversifiable) risk. Data source: Yahoo Finance.

Figure 8 may be a bit misleading. It suggests that all stocks have the same level of systematic risk. This is not exactly true. While all stocks are affected by systematic risk, some are affected more so than others. Changes to the inflation rate is certainly a systematic risk but some companies might be more susceptible to these changes than others. What Figure 8 shows as the systematic risk level is really an average level (the level of systematic risk an average company will have).

So this discussion has revealed two important points:

- unsystematic risk may be reduced through diversification so that large portfolios have almost no unsystematic risk.
- different stocks are affected by systematic risk in different ways.

This leads to the ***systematic risk principle***. The principle states that the expected return on a risky asset (such as a stock) depends only on that asset's systematic risk. In other words, because every individual investor has the ability to diversify their portfolio in such a way as to virtually eliminate unsystematic risk, the market will only reward the investor for the risk that they can not diversify away, i.e. systematic risk.

10.6 The Capital Asset Pricing Model

In the previous sections we explored the relationship between risk and return and discovered that an asset's expected return is determined by the systematic component of risk. Next we will quantify this systematic component and learn how we can use this to calculate a stock's expected return.

To begin we should first discuss the concept of the risk-free asset. As we have seen in previous lessons, the price of an asset may be calculated as the present value of future cash flows. Because future cash flows are risky, we discount them with some appropriate rate of return. The more risk we assign to the future cash flows, the higher the discount rate used. Now, if an asset were truly risk-free, what discount rate would we use? Would it be zero? In other words, if you invest $100 in the asset today, would we expect to receive $100 in the future?

So that there would be no discount (there would be a 0% rate of return)?

NO!

This is not what happens in practice.

We know that there is a time value of money and therefore there should be some minimal strictly positive discount rate. In finance, when we talk about a risk-free asset we do not mean that there is absolutely no risk. Instead, we mean the tradeable asset that has the least amount of risk. In practice, this is the government bond. We have seen that government bonds do have some rate of return, albeit low.

The return on this risk-free bond (also known as the *risk-free rate*) may be used as a benchmark to compare the return on risky assets. The return earned on a risky asset that is above that earned on the government bond is known as the excess *return*.

The principle of diversification discussed earlier tells us that the market will only reward an investor for the systematic risk they take on. The unsystematic risk borne by an investor is reduced as the number of stocks in their portfolio increases. If the portfolio contains a sufficient number of stocks, the unsystematic risk is virtually eliminated. We could imagine that a portfolio that contains all the tradable assets on the market would only be subject to systematic risk. Therefore the return on this portfolio would depend only on systematic risk. While it might be difficult to construct a portfolio that contains all tradable assets (including not only stocks, bonds, and options, but also real estate, collectibles, and precious metals), we can approximate such a portfolio using market indices such as the ASX200[11].

We now have the basic components to measure the systematic risk of a stock and thus its expected return. Essentially we want to compare how the excess return on the stock changes with the excess return on the market index, which contains only systematic risk. To do this we can run a simple linear regression on historical data. Linear regression is a statistical technique that fits a line to a scatter plot of data. In this case, we're plotting the excess return of the market (measured as index return less the risk free rate) against the excess return of a single stock (measured as the stock's return less the risk-free rate). We're subtracting the risk-free rate in both cases because we want to measure only that portion of the return that relates to the risk of the asset.

The slope of the regression measures how the return on the stock is affected by systematic risk and is called the stock's beta (β). A stock with a beta value of 1 is affected by systematic risk in the same way as is the market. By definition, the average stock on the market will have a beta of 1. Lower values of beta indicate the stock is less affected by systematic risk than the average stock on the market. Beta values greater than 1 indicate that systematic risk has a greater effect on that stock.

[11] The ASX200 is an index portfolio comprising of stocks from the top 200 companies listed on the ASX. Each stock is weighted according to its market capitalisation (= share price x shares outstanding). Together, these 200 companies account for about 82% of the total market capitalisation on the ASX. The ASX200 is widely used as a benchmark for the Australian market.

Video: [Risk Premium Systematic Risk Beta (Youtube, 3m47s)]

10.6.1 Using CAPM

The expected return of a risky asset consists of the return on the risk-free asset, plus the excess return determined by the asset's exposure to market risk.

$$E[r] = r_f + \text{ excess return}$$

The excess return is determined by how much systematic risk an asset is exposed $(beta)$ and the compensation per unit of systematic risk. Given the market has a $beta$ of 1, the market's return also determines the compensation per unit of systematic risk. Therefore, we can estimate the expected return of an asset as follows:

$$E[r] = r_f + \beta\left(E\left[r_m\right] - r_f\right)$$

...where $E[r]$ is the expected return on the stock, r_f is the risk-free rate, $E[r_m]$ is the expected return on the market index. The quantity $E[r_m] - r_f$ is called the *market risk premium*, it's the "premium" or excess return you earn from taking on the risk inherent in the market as a whole. This important equation is known as the *Capital Asset Pricing Model* or CAPM. It tells us that if we know the expected return on the market, the risk-free rate (i.e. the current yield on a government bond), and the stock's expected beta, we can calculate an expected value for the stock's return.

Video: [Capital asset pricing model (YouTube, 3m6s)]

Concept Check

If the risk-free rate for 10-year Australian government bonds is estimated to be 0.95%, the expected return on the ASX200 8.74%, and the beta for CIM is 1.40, what is the expected return for CIM?

An interactive H5P element has been excluded from this version of the text. You can view it online here: https://uq.pressbooks.pub/introduction-financial-management/?p=162#h5p-105

10.6.2 Does CAPM Work?

You may find that the actual return is much higher or lower than what is predicted by CAPM. However, this does not suggest that the CAPM is a poor model in general.

The first thing to realise is that the CAPM is a forward looking model. It tells us the future return that an investor might expect on a risky investment (e.g. an investment in stock) given the fact that the market is only willing to reward the investor for taking on systematic risk. The investor may end up realising a much greater or lower return, and this will likely be the case for investments in stocks with a large amount of total risk. However, there is no way to know beforehand that these abnormal returns will indeed occur, and certainly the market will not reward the investor preemptively for them. Therefore, the CAPM is really giving us a best guess at the expected return on a stock given all the information (e.g. historical data) we have at the time of investment.

The CAPM does this by using the beta, typically estimated using the stock's historical systematic risk vis-à-vis the market. The CAPM thus quantifies the relationship between risk and return: the larger the effect of systematic risk on a stock, the larger the return an investor expects to receive on that stock. We can visualise the CAPM's risk return relationship using the *Security Market Line* (SML). In Figure 9 we have plotted the SML for the expected annual returns on ASX200 stocks with different betas[12].

[12] Here we have annualised daily returns calculated using the CAPM. The daily CAPM returns were calculated in turn using betas generated from historical daily return data.

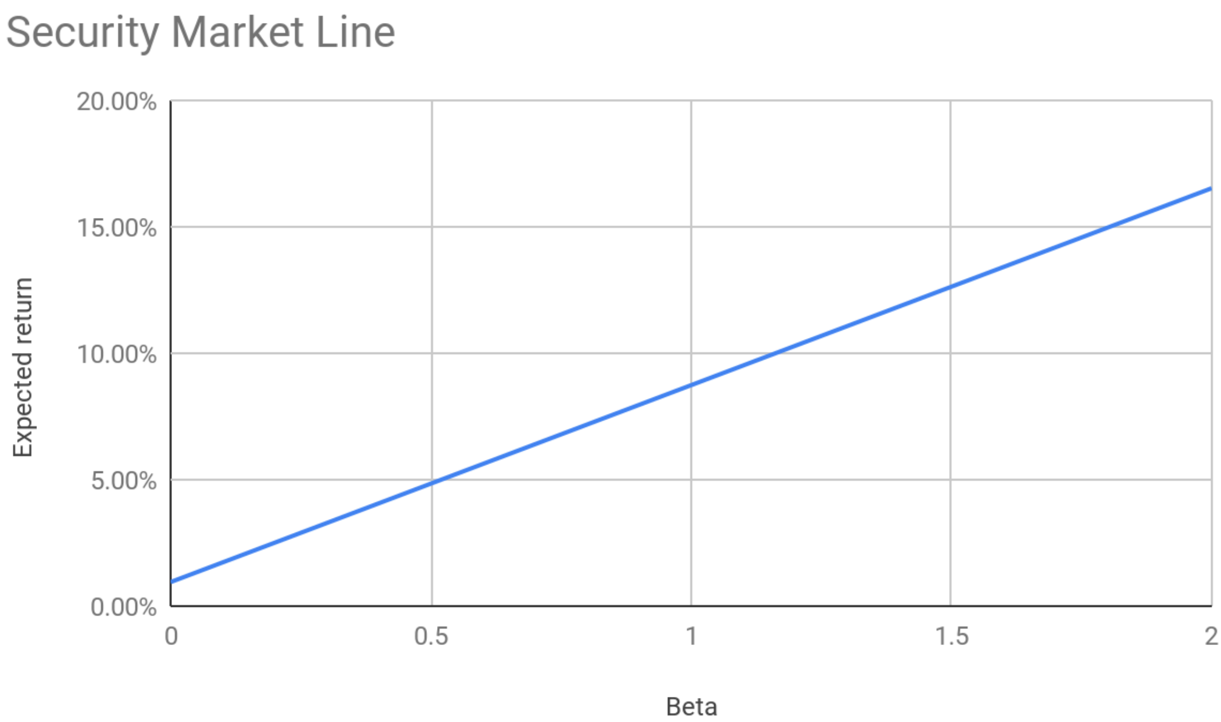

Figure 9: Security Market Line of annual expected returns for stocks on the ASX200.

10.7 Summary and Key Formulas

10.7.1 Summary

In this chapter we have covered different concepts related to both risk and return.

Hopefully you are now able to:

- Explain the relationship between risk and return
- Distinguish between, and calculate, holding period return and expected return
- Explain why standard deviation of returns is especially useful in finance (risk measure)
- Explain the concept of diversification
- Distinguish between systematic and unsystematic risk
- Explain the Capital Asset Pricing Model (CAPM)
- Evaluate the adequacy of expected return using CAPM
- Critically evaluate CAPM

which were the learning objectives outlined at the start of the chapter. See if you can write down a short paragraph on each of these questions. If you struggle, revise the chapter again and/or contact your tutor to book a consultation.

10.7.2 Key Formulas

Calculating Holding Period Return:

$$Holding\,Period\,Return = Dividend\,Yield + Capital\,Yield$$

$$Holding\,Period\,Return = \frac{D_{t+1}}{P_t} + \frac{P_{t+1} - P_t}{P_t}$$

Calculating expected returns: $E\left[R_i\right] = \sum_{j=1}^{n} p_j R_{ij}$

Calculating standard deviation (you will not be asked to calculate standard deviations of raw returns in the exam): $\sigma = \sqrt{\frac{1}{t-1}\sum_{i=1}^{t}(x_i - \bar{x})^2} = \sqrt{Var} = \sqrt{\sigma^2}$

Expected return of a portfolio: $E\left[R_p\right] = \sum_{j=1}^{m} w_j R_j$

CAPM: $E[r] = r_f + \beta\left(E\left[r_m\right] - r_f\right)$

Note: you need to be able to calculate portfolio weights, there is no formula for this in the chapter but it is explained.

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11.

COST OF CAPITAL

11.1 Introduction

At the end of this chapter, you will be able to:

- explain the Weighted Average Cost of Capital (WACC) and what it measures
- calculate the cost of individual sources of capital
- calculate capital-structure weights
- calculate the WACC
- explain the relationship between CAPM and the appropriate discount rate for a project
- critically evaluate the use of WACC as the discount rate of a project.

You may have wondered a few times by now: how do we determine the discount rate for a capital budgeting project?

We have hinted in a few places that the return required on the investment of capital (i.e. the discount rate) depends on **the risk** of the investment.

If you start a small business the discount rate may be quite straightforward. Let's say you start a martial arts gym and you have borrowed the initial cost of $5,000 from the bank at 10% p.a., compounded annually for the life of the project (estimated at 5 years). In that case, you will need to make **at least** 10%, given this is your **cost of capital in order to turn a profit**, and as such the discount rate you should use is 10%. However, it gets complicated for larger businesses and complicated projects. In this chapter we will learn how to estimate the appropriate discount rate for a project, which is determined by the **Weighted Average Cost of Capital (WACC).**

11.2 The Cost of Capital – Concepts

In **Chapter 10** we talked about the relationship between risk and return. Intuitively, it makes sense that a riskier investment will require a higher expected return. Consider these two alternative investments:

Investment	**A**	**B**
Initial Cost	$100	$100
Payoff at the end of one year	$105	Flip a coin – if it's heads you receive $120; if it's tails you receive $90

Investment A always pays $105, so it's expected payoff is $105.

Which Investment would you prefer?

Most people would say investment A because the two investments have the same expected payoff, but investment B involves risk.

Now, what if the payoff for investment B were $125 for heads and $95 for tails? Do you want a guaranteed $105, or the expected payoff of $110 from investment B? Your answer will depend on several factors:

- How much will it hurt you if you lose the coin flip?
- What other investments do you have, and are they correlated with investment B?
- Are there any non-financial reasons to object to either A or B? For example, ethical or environmental concerns.

The first factor – how much will it hurt you to lose – is essentially measuring your level of risk aversion; how much you like or dislike risk. If two investments have the same payoff a risk averse investor will always choose the investment with the least risk.

The second factor – your other investments – considers the impact of diversification on the risk you actually face. Say you also own investment C. The cost of investment C is $100. The payoff of investment C depends on the same coin flip as investment B. If the coin lands on heads, Investment C will pay $95, but if the coin lands on tails, Investment C will pay $125. Consider the payoffs to two possible combinations of investment: A & C or B & C (all owned in equal amounts):

Coin Flip	A&C	B&C	2A
Heads	\$105 + \$95 = \$200	\$125 + \$95 = \$220	\$105 × 2 = \$210
Tails	\$105 + \$125 = \$230	\$95 + \$125 = \$220	\$105 × 2 = \$210

Because B and C move in opposite directions, owning them together actually reduces your risk relative to owning either on it's own. Furthermore, since B and C both have a higher expected payoff than A, owning B and C together provides a higher return than investing in two units of A.

From this example, we can see that more risk requires a higher return, but not all risk is the same. In Chapter 10 we learned that there's systematic risk and unsystematic risk. We don't get compensated for unsystematic risk because we can eliminate it by diversifying. The lesson from all of this is that the appropriate return for a given investment depends only on its level of systematic risk – how highly correlated is the investment with all of the other investments in the economy? Furthermore, if we can find two investments with the same level of systematic risk, those two investments will have the same expected return.

How do we determine the appropriate level of risk for a project or investment? There are two main ways:

1) Measure its systematic risk (beta) OR

2) Find another investment with the same systematic risk.

Fortunately, the second approach is often fairly easy. If a company has a single line of business, then whatever return is required on that company's assets is the same as the return required to expand their operations in the same area. For example, if Myer Holdings Ltd (ASX code MYR) wanted to open a new Myer store, then the required return for that store will be the same as the required return on Myer's existing assets since the company owns only the one line of business. However, if Myer wanted to expand into the mining business, they would not be able to use this return. In this case they would have to estimate the systematic risk from the operations of a business that is already in the mining business, for example BHP.

How do we know what return is required on a company's assets?

Think about how you might buy a company's assets – you could buy the assets directly, or you could buy all of the debt and all of the equity in the company. After all, the company has purchased their assets using the debt (money they have borrowed) and equity (money owners have invested) that is on their balance sheets. This means that a portfolio of the debt and equity of a company must have the same expected return as the assets of that company: they are just two ways of buying the same investment. So, if we want to measure the expected return for a company's assets, we just compute the weighted average of the return on the company's debt and equity. This is known as the **Weighted Average Cost of Capital or WACC**.

Required Return is the return that the firm must earn to compensate investors for the capital they provide to finance projects. In other words, the required return is the return required to attract capital – that's why required return and cost of capital are just two names for the same concept.

Note: the cost of capital depends on the use of the funds, not the source. Whether we use debt or equity to finance the project doesn't matter and does not affect our decision to go ahead with the project or not.

Knowledge Check

AlphaBeta Ltd is evaluating the purchase of commercial real estate. Which of these factors will affect the required return?

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11.3 Weighted Average Cost of Capital (WACC)

A firm's assets are financed by a combination of long-term liabilities (debt) and shares (equity). Buying all of the debt and all of the equity of a firm is equivalent to buying all of the assets of the firm.

Remember the accounting identity: **Assets = Liabilities + Equity.**

The capital that finances the firm is a portfolio of the debt and equity of the firm. Therefore, the cost of capital is the weighted average of the return required on these two sources of capital. We have learnt how to compute the return on a portfolio – it's simply the weighted average of the returns on the investments in that portfolio, where the weights are based on market values. Therefore, a weighted average of the firm's cost of debt and equity will measure the required return for the firm's assets:

$$WACC = \frac{E}{V} \times E\left(R_{equity}\right) + \frac{D}{V} \times E\left(R_{debt}\right) \times (1 - \text{taxrate})$$

Where R_e is the expected return on equity, R_d the expected return on debt. There are a few things to note about this equation. First, the weights are computed based on market values. E is the market value of all of the shares and D is the market value of all of the debt.

$$V = D + E$$

Second, the debt term is multiplied by $(1 - \texttt{tax-rate})$. This is because the corporate tax rules treat debt different to equity. When a company pays interest on debt, they are allowed to deduct that interest from their taxable income. That means that \$100 of interest expense only costs the firm 100 $\times (1 - \texttt{tax-rate})$ or \$70 at a 30% tax rate. To account for this, we measure the cost of debt on an after-tax basis.

To measure WACC we need:

- Cost of equity R_e which is the required return on shares.
- Cost of debt R_d which is the market yield on the firm's debt.
- Market value of debt and equity to compute the weights.

11.4 Estimating Returns

11.4.1 Cost of Equity

The cost of equity is hard to observe. There are two methods we can use to estimate $E\left(R_{equity}\right)$: the dividend growth model and the Capital Asset Pricing Model (CAPM). To use the dividend growth model, we assume constant dividend growth and estimate the growth rate using historical dividend growth rates or analyst forecasts. Remember that the dividend growth model is $P_0 = \frac{D_1}{r - g}$. We can rearrange this to get $r = \frac{D_1}{P_0} + g$, which is what we need.

Let's apply this to some real numbers:

AGL Energy Ltd (AGL) is an Australian energy provider, that both produce energy (electricity, gas, solar) and provides retail distribution. Over the last ten years AGL has paid the following dividends:

Year	Dividend	Growth
2009	0.54	
2010	0.59	9.26%
2011	0.6	1.69%
2012	0.61	1.67%
2013	0.63	3.28%
2014	0.63	0.00%
2015	0.64	1.59%
2016	0.68	6.25%
2017	0.91	33.82%
2018	1.17	28.57%
2019	1.19	1.71%

Averaging ten years of growth rates, we get an average annual growth rate of 8.78%. The current share price of AGL is $19.66. If we assume that the 8.78% average growth rate will continue indefinitely, we can estimate the required return on equity for AGL:

$$E\left(R_{equity}\right) = \frac{1.19 \times 1.0878}{19.66} + 0.0878 = 0.1536 \text{ or } 15.36\%$$

(Why do we have to multiply the 2019 dividend by 1.0878? Because the formula needs next year's dividend – so we have to estimate the 2020 dividend. Since we're assuming that dividends grow at 8.78%, the 2020 dividend will be $1.19 \times 1.0878 = 1.29$)

Does this look realistic to you? 8.78% is a fairly high growth rate to be applying to a perpetuity. If we remove the two outliers (2017 and 2018 with >20% growth), the average growth rate becomes 3.18%, which is much more reasonable. At 3.18% growth,

$$E\left(R_{equity}\right) = \frac{1.19 \times 1.0318}{19.66} + 0.0318 = 0.0943 \text{ or } 9.43\%$$

The advantage of using this method to estimate the required return on equity is that it is fairly straightforward and the data is easy to obtain. However, this only works for companies that pay dividends, and the required return is very sensitive to the estimated growth rate. Additionally, we have not explicitly considered the riskiness of the return or the uncertainty of our forecasts.

The other method of estimating the required return on equity is to use the **Capital Asset Pricing Model (CAPM)**. Recall equation 12 from Chapter 10:

$$E[r] = r_f + \beta\left(E\left[r_m\right] - r_f\right)$$

This equation tells us that the expected return on any asset (including equities) is a function of the risk free rate, beta, and the expected return on the market portfolio (a portfolio of all assets available for investment).

Risk Free Rate: The appropriate risk free rate is the yield on a government bond that matches our expected investment horizon – this is often approximated with a 10-year government bond, which is currently around 1.1%.

Expected return on the market portfolio: This can be approximated by the average total return on the ASX – which has historically been around 8%.

Beta: Beta is computed using a linear regression on historical prices. For listed companies, you can often find beta on Yahoo Finance or similar services. At the time the data for this example was gathered, AGL had a beta of 0.90.

Applying these numbers to the CAPM equation, we can estimate the expected return on AGL shares as:

$$R_{equity} = E[r] = r_f + \beta\left(E\left[r_m\right] - r_f\right) = 0.011 + 0.9 \times (0.08 - 0.011)$$

$$= 0.0731 \; or \; 7.31\%$$

Since we're using CAPM to estimate the return on AGL shares, the resulting return is AGL's return on equity.

The advantages of using this method to estimate the required return on equity are that we are explicitly adjusting for risk and this method doesn't require steady dividend growth (or, indeed, any dividends at all). The CAPM method applies to projects, equity, and anything we can compute or estimate beta for.

However, we must estimate the expected return on the market, risk-free rate, and beta. In practice, this often means that we are relying on past data to predict the future.

11.4.2 Cost of Debt

The cost of debt is the return lenders require on new debt. The purpose of computing WACC is to determine the current required return for a company's assets – so we need to look at current market values and current interest rates or returns.

For **bank loans**, we should be looking at current bank interest rates.

For **bonds**, we should be looking at the current market yield for traded bonds.

If these rates are not easily available, then we can approximate the appropriate rate by looking at bonds of companies with similar credit ratings. Be sure to express any bond yield as an annually compounded interest rate (see Chapter 3 section 5 where we discussed the computation of Effective Annual Rates).

Exercises

Knowledge Check

You are computing the WACC for Barty Ltd. You have the following pieces of information:

- Barty Ltd. shares are traded on the ASX. You have estimated that the beta of Barty Ltd. shares is 1.3
- Assume that the risk free interest rate is 1.0% and the market risk premium is 7%.
- Barty Ltd is funded partially by debt in the form of bonds.
- Barty Ltd bonds have a coupon rate of 5%, pay annual coupons, and have 10 years remaining until maturity.
- Barty Ltd bonds have a BBB credit rating, but are not publicly traded.

Your research has shown that BBB bonds with the same maturity date as Barty Ltd bonds are currently being issued at a market yield of 4.5% p.a. with annual coupons.

Which of the following represents the best estimates of the cost of debt and equity for Barty Ltd.?

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11.4.3 Market Values

To compute WACC, we also need the weights. Remember,

$$WACC = \frac{E}{V}R_e + \frac{D}{V}R_d(1-t)$$

Computing E, D and V is fairly straight forward. We're computing WACC to measure what investors currently require as a return on the assets of the company. Since we want a current value, we need to use market values and current returns in the equation.

So, E is just the current market value of equity. This is also known as the "market capitalisation" and is computed as **the current share price times the number of shares on issue**. For public companies, market capitalisation is commonly reported. Take a look at Yahoo Finance and see if you can find the current market capitalisation of AGL (often abbreviated as "Market Cap"). In November 2019, AGL had a market capitalisation of around A$13 billion. WACC is often computed using the most recent financial statements – analysts can easily look up the share price and multiply by the number of shares on issue, as reported in the annual report.

D is computed as the current market value of debt. Many companies have both public and private debt, meaning it is not easy to compute the current market value of their debt. If all debt is in the form of bonds, then we can use the bond valuation formula and current market yield to compute market value. Most companies, however, have a combination of bank debt, public bonds, and private debt, and analysts outside of the company often do not have sufficient information to compute current market value. In this case, analysts tend to assume that the book value of debt (the original value) is a reasonable estimate of the market value of debt.

Once we have E and D, we have V as: $V = E + D$

Do you think it is reasonable to use book value as an estimate of market value for debt? Why or why not?

11.4.5 Putting it all Together

So, now we have all of the pieces we need to compute WACC:

- Cost of equity: R_e
- Cost of debt: R_d
- Market value of equity: E
- Market value of debt: D
- Market value of assets: $V = E + D$

The final variable is the corporate tax rate. For large Australian firms, this will be 30%.

As a share analyst, you have found the following facts about Pineapple Ltd:

- Market capitalisation is $650 million
- Beta of Pineapple shares is 1.3
- The risk free rate is 4%
- The expected return on the market portfolio is 9.5%
- Pineapple has $250 million in bank loans which have a variable interest rate that is currently 4.5% compounded annually
- Pineapple faces a 30% corporate tax rate

What is WACC for Pineapple Ltd?

$$E = \$650 \text{ million (market cap)}$$

$$D = \$250 \text{ million (estimate with book value)}$$

$$V = E + D = \$900 \text{ million}$$

$$E\left(R_{\text{equity}}\right) = 4\% + 1.3(9.5\% - 4\%) = 11.15\%$$

$$E\left(R_{debt}\right) = 4.5\% \text{(current bank rate)}$$

$$WACC = \frac{650}{900} \times 11.15\% + \frac{250}{900} \times 4.5\% \times (1 - 0.3) = 8.93\%$$

Exercise

Kumquat Ltd has asked for your assistance in computing WACC. Looking through the financial records they have provided, you find the following facts:

- Kumquat Ltd is not publicly traded, so a current share price must be estimated.
- Kumquat has 50,000 shares on issue
- Last year Kumquat paid dividends of $10.50 per share. Dividend policy is to increase the cash dividend by 3% per year indefinitely (you can assume that income projections and budgets support this policy)
- Based on Kumquat's business and capital structure, beta for Kumquat shares is estimated at 1.5.
- The current risk free interest rate is 2% and the expected return on the market portfolio is 8%.
- Kumquat's only debt is a private bond issue. A total of 2,000 bonds were issued with a face value of $1,000 per bond. The bonds pay annual coupons of 6%. Based on current market conditions, Kumquat's CFO estimates that the market yield for Kumquat bonds is 4%. These bonds have ten years remaining until maturity.
- Kumquat faces a corporate tax rate of 30%.

What is the WACC of the company?

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VIDEO: [Worked example: WACC Kumquat (YouTube, 21m22s)]

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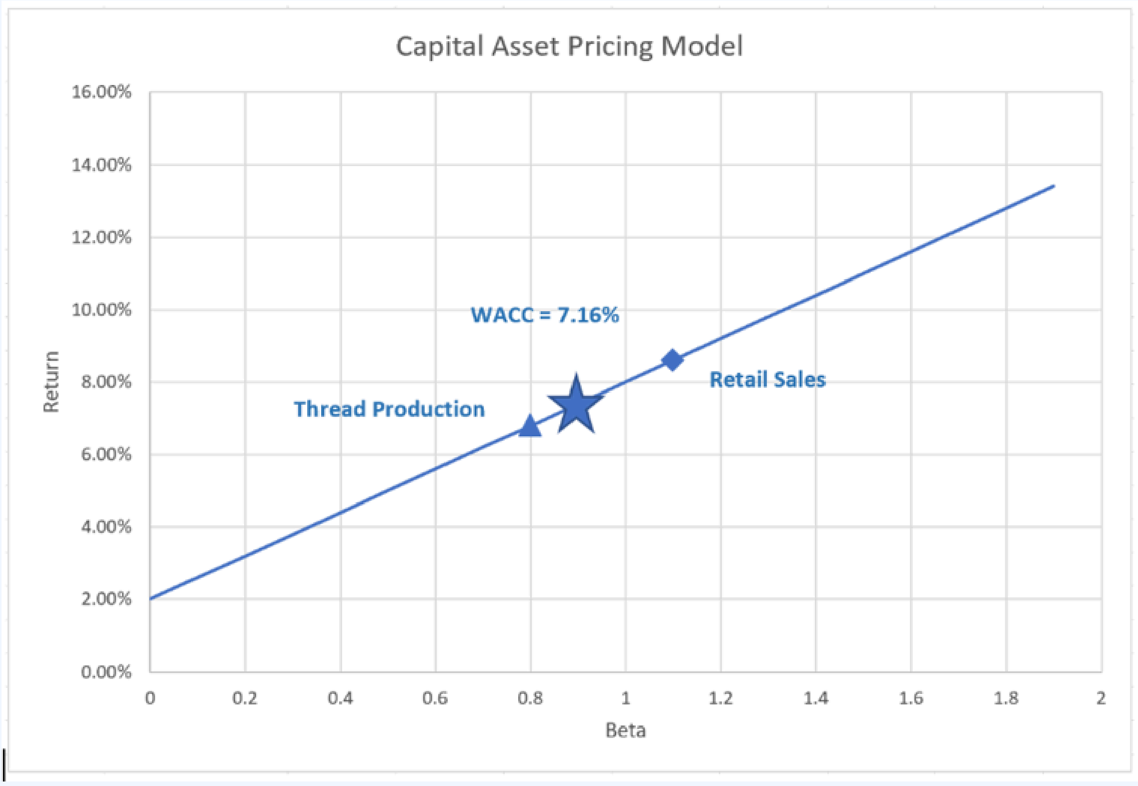
11.6 WACC and the Discount Rate for NPV

When computing WACC, we are using current market values and current market interest rates. Essentially, we're computing the expected return on a portfolio that consists of all of the firm's debt and all of the firm's equity. If we were to purchase all of the debt and equity of a firm, what would that entitle us to? What we would get is the net cash flows (incoming cash flows minus outgoing cash flows) from all of the firm's assets – because that's what firms use to pay interest and dividends to investors. And, if we own all of the firm's capital, we then control how the firm uses its assets – purchasing all the debt and equity should be equivalent to purchasing the firm's assets directly.

Therefore, WACC is measuring the return the market requires for the assets of the company. If a company's assets are all pretty much the same, then we can use WACC as an estimate of the required return on projects in the same line of business as the rest of the company. However, if a company has a variety of business lines, what WACC is measuring is the return on that portfolio of assets or businesses – not the return on any single asset or line of business.

From Chapter 10 we know that the required return depends on systematic risk. So, if WACC measures the return required on assets, it's also measuring the required return for any investment with the same systematic risk (beta) as the assets of the firm. When we determine the required return for a project (e.g. for computing NPV), what matters is the systematic risk of that project. Therefore, we can use WACC as the required return for NPV if (and only if) the systematic risk of the project we're evaluating is the same as the average systematic risk of the firm's assets. When is this likely to be true?

Consider Cottolin Exhibitions Ltd. (CEL) The company has two business lines – thread production and retail sales at craft shows. Thread production has wholesale clients and is a fairly steady business. CEL estimate that the beta of the thread production business is 0.8. The retail business, however, is highly dependent on the state of the economy. CEL estimate that the beta of the retail business is 1.1. Based on market value, 80 percent of CEL's business is in thread production and the other 20 percent is in the retail business. With these levels of systematic risk (and assuming a risk free rate of 2% and market risk premium of 6%), the required return for the thread production business is 6.8%, and the required return for the retail sales business is 8.6%. CEL's WACC will be 7.16%, which will be appropriate for neither business. Let's graph the returns as a function of systematic risk (beta):



Essentially, the measured WACC is just a weighted average of the required returns of CEL's two lines of business. It's not the appropriate return for either business. What happens if CEL decides to use WACC for all projects? Consider a project to expand thread production which has an IRR of 7%. If CEL (incorrectly) requires a return of 7.16%, this project will be rejected. But since the systematic risk of the project is only a beta of 0.8, a return of 7% is higher than the market required return and the project will add value to the firm. Using WACC in this instance results in rejecting a positive NPV project. Alternatively, consider a plan to expand retail sales that has an IRR of 8%. If CEL (incorrectly) requires a return of 7.16%, this project will be accepted. But, since the systematic risk of the project is a beta of 1.1, a return of 8% is lower than the market required return and the project will decrease the value of the firm. Using WACC in this instance results in accepting a negative NPV project.

Finally, note that the required return for a project depends on the systematic risk of the project, not the risk (or average return, or WACC) of the company.

When a company has only one line of business, then WACC is useful for determining the required return for projects in that line of business. Where a company has multiple lines of business, another approach must be taken. There are two common ways that conglomerate companies address this issue:

Pure Play Approach: Try to find companies that focus exclusively on the type of project we are valuing and use WACC from these companies as the cost of capital for our project.

Subjective Approach: Divide projects/divisions/ business lines into risk categories and apply a subjective adjustment to WACC for each category. Low systematic risk projects might be required to return 2% less than WACC and high systematic risk projects might be required to return 2% more than WACC.

Exercise

Mark each statement as either "appropriate" or "not appropriate".

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11.7 Summary and Key Formulas

11.7.1 Summary

Up until now, when doing capital budgeting questions, you have always been given the discount rate to use. This chapter taught you how to calculate that discount rate for yourself. The rate at which we discount cash flows is the required return for the project, which is the cost of capital for the firm, or the weighted average cost of capital (WACC).

When calculating WACC you need information on the sources of capital, meaning how much of your capital comes from borrowing money (debt) and how much comes from investors (equity).

- **E** stands for the amount of equity a company has. We can calculate this by multiplying the share price by the number of shares.
- **D** stands for the amount of debt a company has. We can find this by calculating the present value of all the debt (normally bonds) the company has issued.
- After we have calculated the amounts of E and D we have we then need to calculate the cost of these sources of capital.
- When it comes to the cost of equity, R_e, there are two ways that it can be calculated. If you are given information about a recent dividend and the dividend growth rate you can use the dividend discount model to do your calculation. If you are given information about the beta (systematic risk) of a company as well as the risk-free rate and expected return on the market (or market risk premium), you can use CAPM to calculate R_e.
- R_d is the market yield on the bonds the company has on issue. If they have more than one type of bond on issue you need to calculate the weighted average of the different yields.

After you have collected all of this information, as well as the tax rate, you can go ahead and calculate WACC.

You have to be able to decide if a particular WACC is appropriate for a project. For example, if a company is thinking about expanding into an area of business that is different from what it currently does, its current WACC would not be an appropriate discount rate. The two major ways of dealing with this problem are the Pure Play Approach and the Subjective Approach.

11.7.2 Key Formulas

$$WACC = \frac{E}{V}R_e + \frac{D}{V}R_d \times (1 - \mathrm{t})$$

$$\mathrm{V} = \mathrm{E} + \mathrm{D}$$

$$\text{E} = \text{Number of Shares} \times \text{Current Share Price}$$

$$\text{D} = \text{Present Value of Debt issued by the company}$$

$$\text{P V} = \frac{c}{r}\left(1 - \frac{1}{(1+r)^n}\right) + \frac{FV}{(1+r)^n}$$

$$R_e = r_f + \beta\left(E\left[r_m\right] - r_f\right)$$

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

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PART IV

SUSTAINABLE FINANCE

12.

CORPORATE SUSTAINABILITY & SUSTAINABLE FINANCE

12.1 Introduction

Upon completion of this chapter, you will be able to:

- evaluate the implications of the "challenges of the century" for business and finance
- describe different theories of the purpose of a firm and identify the differences between them
- critically evaluate theories taught in this course
- explain the concept of sustainability and how it is used in business and finance.

In this chapter, we will continue the discussion from Chapter 1 on theories of business purpose, and you will learn about the basis of corporate sustainability and sustainable finance. This chapter will also look at the objective of the firm in relation to sustainability.

Before we go into the sustainability in a business and finance context, we will first cover some major challenges humanity is facing today and in the future.

12.2 Challenges of the Century

In Chapter 1 we mentioned the 17 Sustainable Development Goals (SDGs), which identify a range of goals to achieve prosperity whilst protecting the planet. To jog your memory, they are depicted below in three categories; environmental (biosphere), social (society) and economic. For societies and economies to thrive in the long term, and thus can "sustain" (*sustainable)*, a highly functioning natural environment and healthy equitable social system is required.

Source: Azote for Stockholm Resilience Centre, Stockholm University, CC BY 4.0, via Wikimedia Commons.

Most of you agreed that all SDGs are important:

WHICH SDGS DO YOU THINK ARE IMPORTANT?
RESULTS

	1 = not important	2 = somewhat important	3 = important
Environmental	5%	10%	85%
Social	3%	23%	74%
Economic	8%	17%	75%

and that most parties in society play a role in achieving SDGs:

WHICH PARTIES DO YOU BELIEVE PLAY A ROLE IN ACHIEVING THE SDGS?
RESULTS

	Yes	No
Governments	98%	2%
Businesses	96%	4%
Individuals	91%	9%
Investors	82%	18%

Thus, most of you agree that financial markets (albeit less than other actors) and businesses play a key role in tackling challenges we face as a society.

In this first section of Chapter 12, we provide a brief history and overview of developments in different environmental and social systems and how they are connected, in particular we look at:

- Socio-economic trends
- Earth System trends

In this background section we draw information from other sciences, such as earth system and environmental science. Before continuing, here are a few questions to think about:

What are some of the challenges of the century?

What are some of the issues humanity has to deal with or has to face in the next century?

12.2.1 Socio-economic Trends

Since the Industrial Revolution, we invented machinery to replace manual tasks, and discovered new chemical processes and power sources (e.g. coal). Whilst these inventions led to an increase in population and economic development, the figure below demonstrates that a much more rapid growth occurred since the 1950s. There were unprecedented and exponential increases in our social and economic (socio-economic) systems.

The Anthropocene website contains more information on the major changes that have occurred in key trends since 1950.

Exercise

Go to the Anthropocene website and click on The Great Acceleration. What are some of the great accelerations we have seen in socio-economic systems? In our earth system?

Answer:

Socio-economic system:

- world population
- real gdp
- foreign direct investment

- urban populatin
- primary energy use
- fertilizer consumption
- large dams
- water use
- paper production
- transportation
- tele-communication
- international tourism

Earth system:

- carbon dioxide
- nitrious oxide
- methane
- stratospheric ozone
- surface temperature
- ocean acidification
- marine fish capture
- shrimp aquaculture
- coastal nitrogen
- tropical forest loss
- domesticated land
- terrestrial biosphere degradation

Of course these are just examples, and there are many more!

One of the most obvious challenges is related to the exponential increase of population. This is because people live longer and on average have more than 2 children. The human population has more than doubled in the past 50 years, from less than 3 billion to over 7 billion, resulting in humans exerting even more dominance over other species. However, it is expected that increased education and opportunities for women will result in a stabilisation of the global population in the future.

Economic growth (GDP) has also reached unprecedented levels since the 1950s, leading to substantially more wealth and higher levels of welfare. However, these increases are mostly concentrated in OECD countries. Economic systems have become global, where the wealth of countries is linked to other countries. We have collectively moved to cities, and many people have access to primary energy such as electricity and transport, allowing further economic development. We produce unprecedented levels of food which has led to the increased use of fertilisers and water. We travel more and have more electronic devices than ever before. Did you know that only 15 years ago one of the lecturers of the course had to select which message to delete when the number of messages on her Nokia phone reached the limit of 20 messages?

The Anthropocene website has more information on the socio-economic development.

Example: Mobile Phones and Telecommunications

In the 1950s, people were not using mobile phones yet, they only became part of our daily lives around the 2000s. This explains for example why telecommunications have risen significantly in the past 20 years. The same holds for tablets, laptops, and smart watches. These devices require energy to be produced, charged, and recycled, and have led to increased data use and storage. These devices are just one example of many aspects of our lifestyles that require large amounts of energy and resources. The way we currently produce, use and dispose our products has resulted in exponential changes in our environment. A great challenge is to decouple our social and economic growth from negatively impacting the life-support systems our planet is fortunate to have.

12.2.2 Earth System Trends

Our explosive socio-economic developments have led to large changes in our natural environment. That humans impact the natural environment is nothing new and has been documented since humans have wandered the earth. Now, however, it is happening at a much larger scale and is impacting some important life-supporting systems on regional, national and global scales.

The Great Acceleration figure above demonstrates **the effect human activities have had on various key environmental indicators**. Atmospheric concentrations of greenhouse gasses (carbon dioxide, nitrous oxide and methane) have exponentially increased, caused by, among other things, fossil fuel combustion for energy (carbon dioxide), increased deforestation (reducing the earth's uptake of carbon dioxide), agricultural processes including life-stock (nitrous oxide and methane), and other industrial processes. Ozone depleting gases have increased through the increased use of certain chemicals (e.g. CFC in refrigerators), which has led to ozone depletion. Strict regulation has stopped the use of these chemicals and has stabilised the amount of ozone depleting gases. Increased greenhouse gas emissions has led to ocean acidification. Our human activities have also led to increased over-fishing, tropical forest loss, and loss of species. This has dire ramifications not only for our environment, but also for those companies and small businesses that rely on the environment for the running of their business, namely in the sectors of agriculture and tourism. This New Scientist article describes how climate change is already affecting the tourism sector around the Great Barrier Reef.

12.2.3 The Great Acceleration

12.2.3.1 When did Humans Begin to Affect the Earth's Systems?

As we have seen, humans have moved from impacting the environment on a local scale to now becoming a geological force that is affecting the way the whole planet operates. Scientists are saying we have moved into a new geological epoch, the "Athropocene" – an epoch where humans are the driving force of changes in the environment. Some propose that this era started centuries ago, when we started smelting metals, traces of which we see in the Greenland ice core. Others argue that this started in the industrial revolution, when we dramatically increased our use of fossil fuels.

A TED talk on the "Anthropocene" (YouTube, 18m15s) by renowned earth system scientist Professor Will Steffen is available.

In geological terms, according to scientists, we now already live in the Anthropocene (instead of the Holocene), a geological epoch in which humans are the dominant force on the natural environment. In other words, humans are the primary cause of permanent planetary change. This epoch is characterised by the fact that planet is now outside of its natural limits. From sole participants, humans became the dominant creatures in the Earth, having an influence on the oceans, landscape, agriculture, and animals. Human activities have caused fundamental changes in the way the Earth is behaving, and it could be a full-scale catastrophic change.

Exponential growth in social and environmental changes has been evident since the industrial revolution. As we saw in the previous graphs however, a massive expansion of the human enterprise has occurred since the 1950s, and this phenomenon is what scientists call **the great acceleration**. It refers to the era in which human activities are changing environmental systems at unprecedented scales and levels.

One of the main inventions that have allowed us to "unleash" the human enterprise was the invention of "fossilised energy", also known as fossil fuels. These fossils that have been built up underneath the earth for millions of years, provide a cheap, powerful, reliable, and convenient energy when combusted. This energy source allowed humans to undertake economic activities more efficiently, such as:

- Converting and plowing land (globally, 85% of land has been impacted by humans in more than one way!)
- Manufacturing and transporting of products, many consuming energy themselves (e.g. cars, phones, laptops..)
- Construction,
- Cutting down trees at a faster rate (for example, 50% of Australian forests have been cut down since European settlement)
- Building enormous fishing boats (also trawling the seas with huge nets and systems),
- Reforming the coastal zones,
- Changing the Delta systems of rivers,
- Travelling large distances,

Think about the following example regarding oil.
What can 1 litre of oil provide to you? It allows you to drive for around 10-11kms, carrying

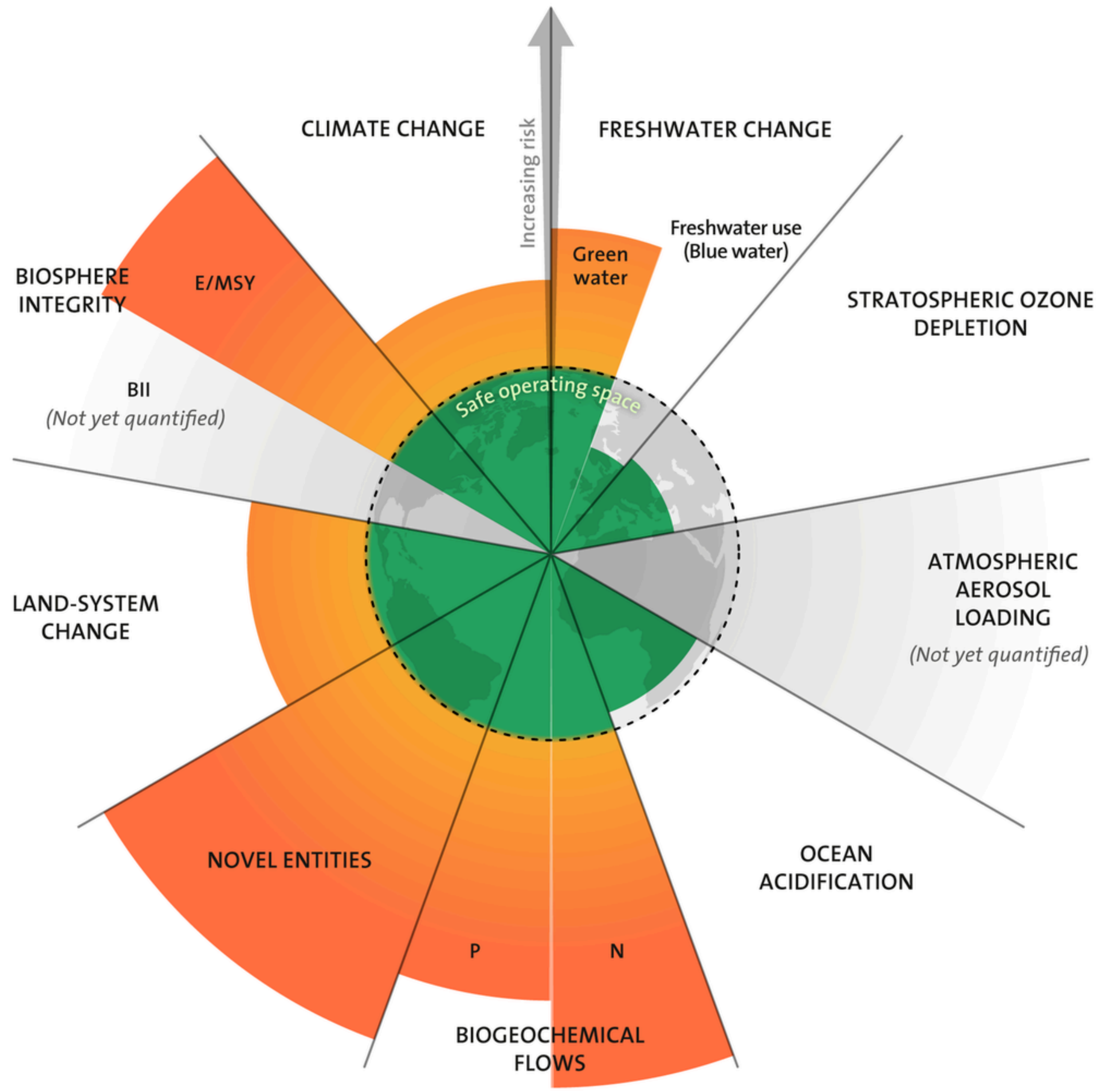
the weight of your car and propel it forward, even on steep hills. What would happen if you were to try and push the car yourself for 10-11 kms? It would be beyond difficult. This highlights the power of only 1 litre of oil. It is enormously condensed energy and one that has powered business and prosperity for a long period of time.

Unfortunately, there is a side effect. During the process of fossil fuel combustion, carbon dioxide (CO_2) is produced. CO_2 is a greenhouse gas, which traps heat in the atmosphere. Why is this a problem? There is a natural level of greenhouse gas emissions in the atmosphere that keeps the Earth warm, at exactly the right climate for humans to live and develop in. If humans are releasing CO_2 and other greenhouse gas emissions into the atmosphere every year, the concentration of greenhouse gases in the atmosphere increases, making the planet warmer. However, is a warmer planet bad for us?

A key question is – how bad is changing the natural environment for us? Which systems are important for our survival and how much can they be changed until the Earth becomes unsafe for humans to live on?

12.2.4 Planetary Boundaries

For humans it is important to know: "which earth systems are humans impacting? which systems are important in providing a "safe operating space for humanity"? How much can we change these systems before it becomes unsafe for humans?". The planetary boundaries framework aims to answer these questions based on the **most sophisticated scientific knowledge and evidence to date** (for example work that has been published in prestigious journals such as Nature and Science).



[Planetary boundaries diagram] by [Azote for Stockholm Resilience Centre], [CC BY-SA 3.0 Unported] via Wikipedia. Orange sections indicate "overshoot" of boundaries, green sections indicate a "safe" state within the boundaries (data for November 2022).

The framework identifies nine interlinked, but different, systems: climate change, novel entities, stratospheric ozone depletion, atmospheric aerosol loading, ocean acidification, biochemical flows, freshwater use, land-system change and biosphere integrity (see above figure). Humans are dependent on these systems and humans have an impact on these systems at the same time.

The framework concerns itself with the level of anthropogenic (human caused) changes that can occur, so that the risk of destabilisation of the Earth is likely to remain low. Generally, it is an indication of what a safe operating space is for global societal development and identifies the scientific limits to important planetary systems, which if transgressed, would pose a high risk of irreversible change in the Earth's stability, tipping it out of the safe Holocene state.

Crossing the identified limits is considered high risk because:

- Changes can be **extreme, rapid and irreversible** when tipping points are reached,
- It is **costly** for humans to adapt and,
- There are **limits** to how much change humans can **adapt** to.

For some systems we can have an idea of system limits, such as climate change. For other human impacts on the environment, we know that they pose a risk but we do not know the limit. For example, micro plastics or silicon fall into the category of novel entities. These materials do not naturally exist: they were created by humans. Although somewhat beneficial, the reverse effect of these materials depends on the level of their concentrations and usage. Now, there are over a hundred thousand man-made chemicals that do not naturally exist. We know that the too many novel entities poses a risk, but we do not know exactly how much is too much.

For other systems, such as biochemical flows (nitrogen and phosphorus cycles), which are mainly affected by the increasing level of agriculture and land use, we know how much is too much on a regional level. The heavy reliance on certain chemicals has already caused acidification of rivers (i.e. "dead-zones") on regional scales. Whilst all planetary boundaries are important, the two **core planetary boundaries are climate change and biosphere integrity.** The reason for this is that these two systems could tip the earth into a new, unsafe state and also have a significant impact on the other boundaries.

The two most important systems are biosphere integrity and climate change. These systems are also referred to as "core" planetary boundaries, because if limits are transgressed, the Earth could move into a different state (out of the safe Holocene state), which would induce irreversible and unsafe changes to our life-supporting earth system.

12.2.5 Case Study: Biosphere Integrity

Biosphere integrity refers to the quantity and quality of biodiversity. It is very similar to the concept of diversification that you learnt in this course. The more plant and animal species that inhabit the planet, and the better the quality ("function") of these species, the more resilient and better the health of our ecosystems is. Currently we are facing extinction rates that are 100-1000 higher than usual. We have thus exceeded the planetary boundary of limiting extinction rates to 10 extinctions per million species per years

(=10 times the usual rate). However, when making tough choices on which species are most important to concentrate our efforts on conserving, we need to look at the function of species in our ecosystems.

Black insect perched on pink petaled flower by Robert Thiemann on Unsplash

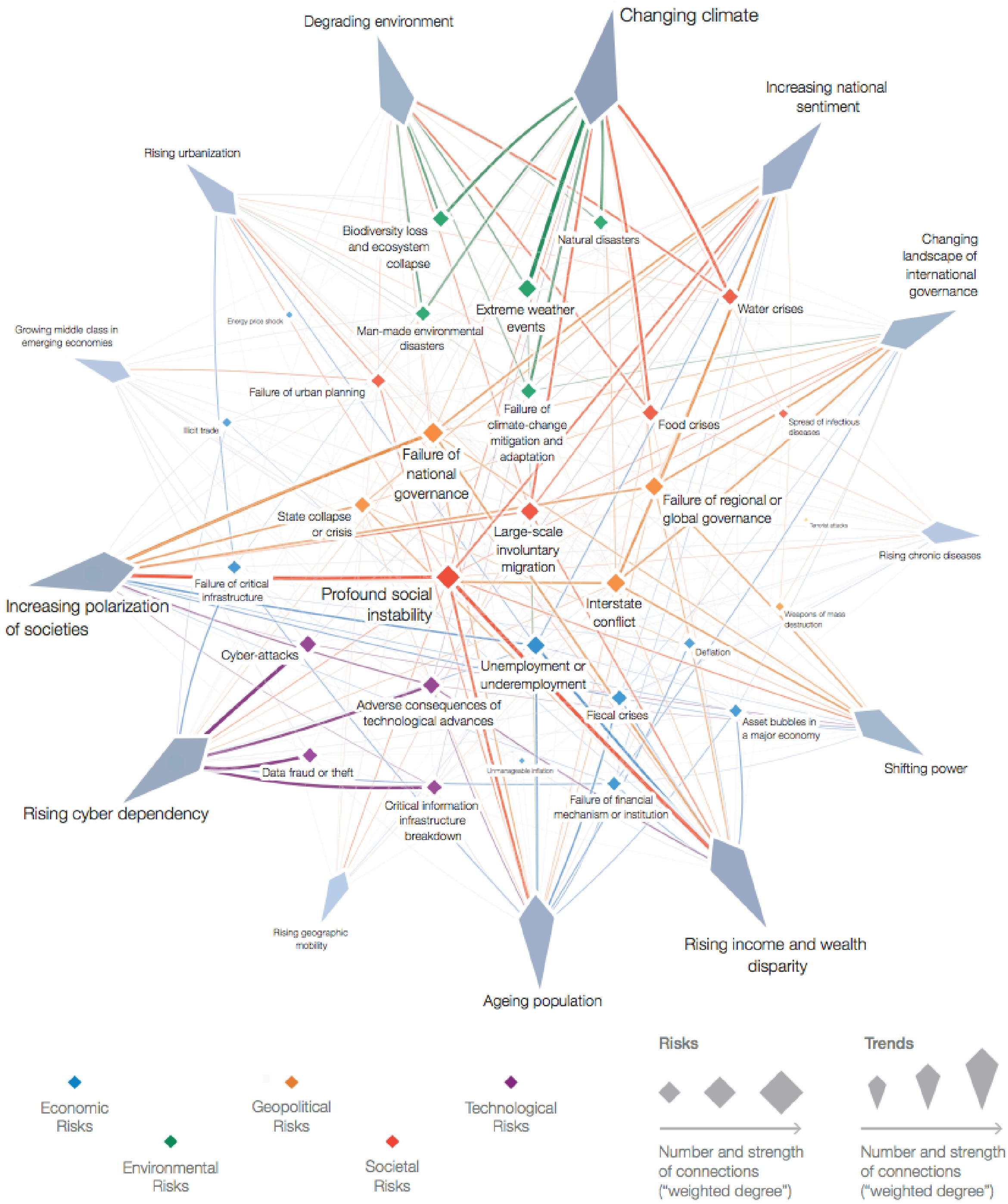
For example, bees would definitely be on our priority list! Bees pollinate about **70 percent of the world's food**. Although very small in size, bees are doing very important services for us (for free!!), and are highly functional. This means that if bees go extinct, unprecedented problems would occur. The functional diversity of specifies are different. This means that some species provide greater "function" to the ecosystem than others. Perhaps losing some types of mosquitoes might not be that bad though?

12.2.6 The World Economic Forum

So far, we have focused on socio-economic and environmental developments. This has provided you with an introduction of how **systems are vastly interrelated**. To understand and help solve challenges it is important to take a systems perspective that acknowledges complexity and interrelatedness, as not to "shift" challenges by creating a new one to solve another.

A useful demonstration of how challenges are related across different systems, and how to prioritise these challenges, can be found in the yearly 'global risks report' by The World Economic Forum. It reports the interrelatedness of risks, referring to economic, environmental, geopolitical, societal and technological risks. It details the number and strength of connections between different risks and trends. Environmental risks dominate global risks in terms of both impact and likelihood.

This figure below demonstrates the interlinkages between the different types of risks, and how one problem is connected to other problems. Consistent with the planetary boundaries framework, climate change is identified as a strong driver of increased environmental and social risks.



Source: The Risks-Trends Interconnections Map 2018 from the [The Global Risks Report 2018] by the World Economic Forum, shared under a [Creative Commons Attribution-NonCommercial-NoDerivatives 4.0 International Public License].

Whilst climate change has had an impact on several environmental issues, such as biodiversity loss, natural disasters (extreme weather events), it will increasingly lead to social issues such as food or water crisis, and large-scale immigration. It will also dramatically alter our economies and businesses, regardless of whether we rise to meet the challenge or not. **Thus, ultimately climate change is a long-term socio-economic issue that, if is not tackled, will have catastrophic implications for socio-economic systems.**

12.2.7 Challenges of the Century – Summary

In this section of Chapter 12, we have covered how recent rapid developments in socio-economic systems have led to unprecedented changes in important earth systems. This presents us with unique challenges for humanity in this century. One challenge is to decouple our socio-economic activities from negatively impacting planetary systems on which long-term human development depends. At the same time, there are social challenges such as poverty and income equality that are important to be considered. In the next section we focus in on the challenge of climate change.

12.3 Climate Change

12.3.1 Introduction

In this section of Chapter 12, we focus on the challenge of climate change. Climate change has increasingly been pushed up the agenda internationally given the urgency of the issue. As we learnt in the previous section, climate change is one of the key earth systems that can, on its own, push the earth into an undesirable state for humans to develop in. If climate change is not tackled, it could even lead to humans becoming extinct. Tackling the challenge will require many changes in the way we see and do business and finance. Mark Carney, prior governor of the Bank of England, said recently at the 26th Conference of Parties (COP, 2020) meeting on climate change:

"The objective for the private finance work for Cop26 is simple: to make sure that every private finance decision takes climate change into account. [..] Achieving net zero-emissions will require a whole economy transition – every company, every bank, every insurer and investor will have to adjust their business models".

If we act now, Mark Carney says it *"could turn an existential risk into the greatest commercial opportunity of our time"*. Note that what Mark Carney stated can be applied to any challenge: challenges can also be considered as opportunities, it depends on one's perspective as to how we approach them. What he is suggesting here is that if companies increase their investment in research and development that helps us transfer to a low carbon economy, they will most likely be rewarded with healthy bottom lines in the not-too-distant future.

12.3.2 Climate Change: Science

In this TEDxNASA (YouTube, 17m 21s) video, Bruce Wielicki gives an overview of some of the key facts and impacts of climate change.

12.3.2.1 How Does the Climate System Work?

The way the climate system works can be associated with simple budgeting. There is an income, and expenses, and the balance of the two.

In the climate system, there is sunlight, which is the incoming resource or energy that keeps heating up the planet. This energy leaves the system through infrared radiation – this is something that you do not see with your eyes, but it feels similar to fire, if you are close to it. At the same time, there are greenhouse gases (often expressed as a CO2-equivalent) blocking the heat from escaping, giving us a nicely habitable earth.

Thus, there is energy coming in, and energy leaving the system, which has a balance, and this is the energy budget of the planet. This determines the climate on the planet. Before the industrial revolution, the concentration of CO_2 in the atmosphere was 280 parts per million (ppm), but through our anthropogenic activities we kept adding greenhouse gases every year, increasing the amount of heat retained, and resulting in a concentration of 419ppm in October 2023.

Exercise

You can find historical carbon dioxide – and other greenhouse gas – levels on the NASA website.

What was the concentration of carbon dioxide in 1960?

Answer:

Around 320ppm.

Has the concentration of carbon dioxide changed since we wrote this pressbook?

Answer:

Yes. When checking again in January 2024 it had risen to 320ppm, so when you are checking now it will likely be higher.

The more carbon dioxide there is in the atmosphere, the more heat is trapped and the warmer the planet gets. The main sources of anthropogenic CO2 emissions are fossil fuel combustion, cement production and flaring.

Exercise

Here we are going to do our first exercise of looking up information provided by the IPCC. To make it easy we will give you the direct link to where you can directly see all the figures contained in the AR5 2014 synthesis report. Click on "graphics", and open Figure 1.5.

What is the other category of global anthropogenic CO_2 emissions?

Answer:

Forestry and other land use

Between 1750 and 1970, approximately how many $GtCO_2$ were emitted cumulatively for the two categories of anthropogenic CO_2 emissions?

Answer:

Forestry and other land use: around $500GtCO_2$

Fossil fuel combustion, cement production and flaring: around $400GtCO_2$

And between 1750 and 2011?

Answer:

Forestry and other land use: around $700GtCO_2$

Fossil fuel combustion, cement production and flaring: around $1300GtCO_2$

12.3.3 What is a Cloud Feedback?

Scientists were interested in the way climate change impacted the Earth's systems decades ago. The earliest climate models were built in the 1970s.

These models analysed cloud feedback, to see the impact of change in temperature. For example, if the global cloud cover is changed by 1 percent, it triggers dramatic changes in the sensitivity of the climate system (Note: Bruce Wielicki has been studying cloud feedback for the last 30 years!).

For a more accurate representation of this change, satellite data was analysed, in different wavelengths (or colour of light). This allowed scientists to compare the amount of green vegetation, the brown deserts, the snow, the ice and the clouds, and the thermal emission that is infrared up to space. This method contributed to a better understanding of the climate system and facilitated the prediction of future trends. There are many examples like this for the studying of oceans and other planetary systems.

As you saw in the video, there is a lot of mis-information and conspiracies out in the public domain. Academics and philosophers sometimes refer to this as “post-truth”, which is a recent phenomenon where the common standard for “facts” is no longer seen as needed to be obtained through scientific methods and enquiry. To find accurate information about topics always look at the source of information.

Some of the reliable sources to look at and find reliable information about climate change are:

- skepticalscience.com – common questions about climate change answered referencing peer-reviewed literature
- American Association for the Advancement of Science (AAAS) – established in 1848, gathering scientists around the world, spending hundreds of years on climate system questions.
- American Geophysical Union (AGU) – established in 1919, with 50,000 members in 137 countries.
- American Meteorological Society (AMS) – established in 1919, with 14,000 members.
- Intergovernmental Panel on Climate Change (IPCC) – group consists of thousands of scientists around the world, who are working to analyse how the climate system is changing and what the risks and occurring issues are.

Note: in academia, peer-reviewed articles are considered legitimate sources. Peer-reviewed articles have undergone significant criticism and questioning by other academics in the field, and are only published when all criticism and concern have been addressed to the highest standard.

12.3.4 Climate Change: Impacts

12.3.4.1 What are the Impacts of Climate Change?

Human activities are estimated to have caused 1.2C of global warming since pre-industrial levels. The impacts of climate change are already being felt around the world, we are already experiencing species extinction (flora and fauna slowly disappearing) and more extreme weather events (more frequent and more intense), just to name a few.

Exercises

The IPCC report summarizes the concerning impacts of climate change in their 5 reasons for concern. Particularly in the 2018 IPCC special report on 1.5C it outlines the differences in impacts of 1.5°C vs 2°C warming. We do not expect you to remember these impacts – this is merely to show you how a changing climate causes risks for socio-economic systems. Every country will be exposed to a different extent to these risks (More information on the impacts on Australia).

It is very useful to be able to find information in IPCC reports.

1. Go to ipcc.ch
2. Click on Reports, then click on “Global Warming of 1.5°C”.
3. In the section “summary for policy makers” click on “explore graphics”.
4. Click on “Figure SPM.2.”

What are the Five Reasons for Concern? Do the levels of impacts and risks associated with these reasons change from 1.5°C vs 2°C warming?

Answer:

- RFC1: Unique and threatened systems
- RFC2: Extreme weather events
- RFC3: Distribution of impacts
- RFC4: Global aggregate impacts
- RFC5: Large scale singular events

Yes, the risk levels increase for all of these impacts.

The bottom bars of the figure show the level of impacts and risks to various natural, managed and human systems. List them and identify those most at risk at 1.5°C.

Answer:

- warm water corals
- mangroves
- small-scale low-latitude fisheries
- arctic region
- terrestrial ecosystems
- coastal flooding
- fluvial flooding
- crop yields
- tourism
- heat-related morbidity and mortality

Risks are highest at 1.5°C for warm-water corals, small scale low-latitude fisheries , arctic region and coastal flooding.

12.3.5 What can be Done to Stop the Temperature Increase?

12.3.5.1 The Paris Agreement

Based on the overwhelming scientific evidence on climate change, most nations around the world have signed the “Paris Agreement”, which is a commitment to keep temperatures **well-below 2°C warming compared to pre-industrial levels**. Crossing 1.5°C-2°C will substantially increase the risk of setting off feedbacks that will lead to irreversible and catastrophic changes to our planet. For example, crossing 2°C would substantially increase the risk of melting the icecaps in Greenland, which if melted, will release huge amounts of methane (a strong greenhouse gas). The suddenly increased level of greenhouses gases would then accelerate climate change. As the earth is one big complex interconnected system, there are many such feedbacks.

Even though the Paris agreement has been signed by most nations, **current commitments to reduce greenhouse gas emissions are not sufficient to stay below the 2°C threshold.** In fact, current commitments will lead to warming of at least 2.6-3.1°C (Rogelj et al., 2016). Find out how on track your country is.

12.3.6 Climate Change: The Way Forward

12.3.6.1 Carbon Dioxide Emissions Pathways

To have a more than 50% chance of staying below 1.5°C, cumulative emissions need to be kept within 480 GtCO2 from 2018, which is also referred to as the "remaining carbon budget". Currently, we emit around 41 GtCO2 globally every year. This means that if we did not reduce emissions, we would **exceed the budget before 2030**.

Exercise

The IPCC outlines different pathways to reduce emissions society can follow, all resulting in net zero emissions by around 2060.

1. Go to ipcc.ch
2. Click on Reports, then click on "Global Warming of 1.5°C".
3. In the section "summary for policy makers" click on "explore graphics".
4. Click on "Figure SPM.3B."Have a look at the different pathways and their assumptions.

Which pathway has the highest use of Bioenergy with Carbon Capture and Storage (BECCS)? How much cumulative Carbon Capture and Storage needs to be used by 2100 in this pathway? How many bioenergy crops in 2050? How much land is this compared to, for example, China?

Answer:

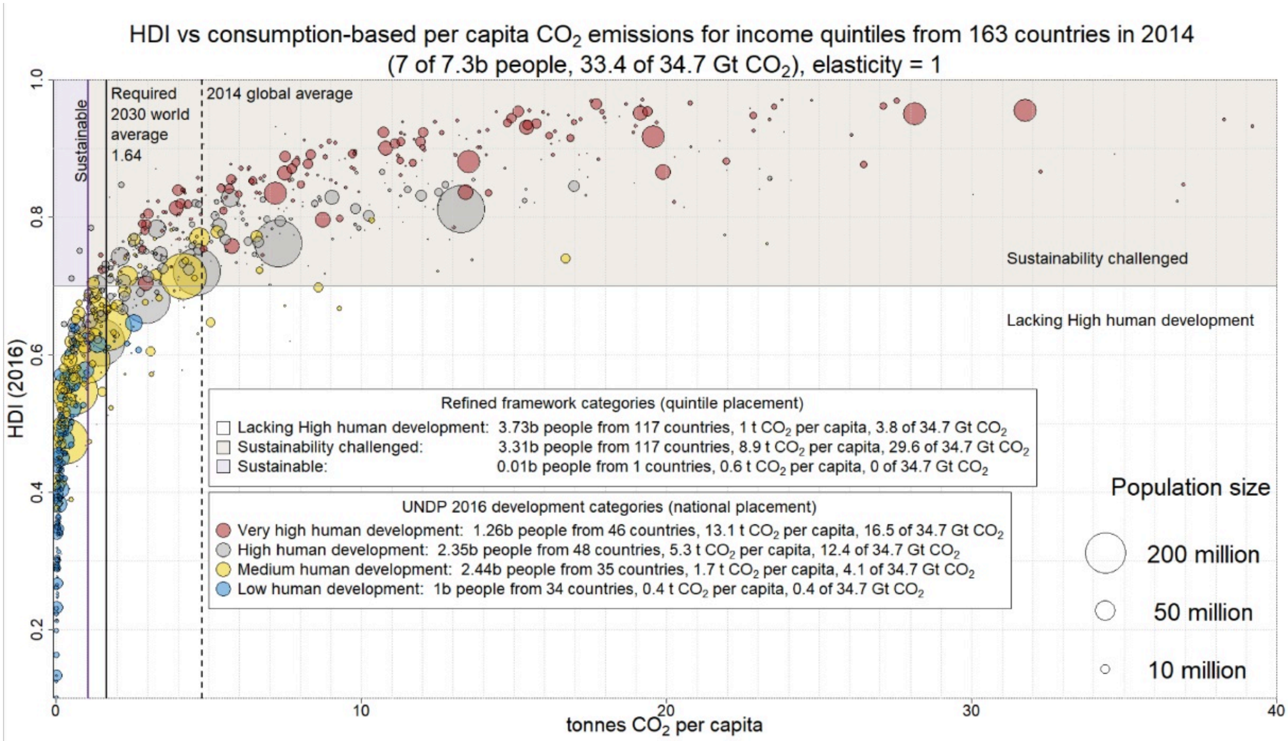
Pathway P4 requires the largest amount of BECCS, requiring cumulative CCS of 1218GtCO2 by 2100 of which 1191 GtCO2 being BECCS. This means that, on average, around 15GtCO2/yr needs to be captured and stored (compare this to annual anthropogenic emissions being around 40GtCO2 in 2020!!). This pathway requires 7.2 million km2 being used for bioenergy crops in 2050, this means a land size the equivalent of the majority of China being covered in crops (China's land area is about 9.6 million km2).

All scenarios require a fundamental shift in the energy sector away from fossil fuels, requiring large investments in renewable energy and storage solutions and a loss of value of existing fossil fuel assets. The scenarios also all rely on AFOLU (Agriculture, Forestry and Other Land Use) emissions to go to zero and turning negative using Carbon Dioxide Removal technologies such as afforestation (and perhaps increasing the population of whales?) that remove carbon from the atmosphere. Three of the four scenarios also include removal of carbon through Bioenergy with Carbon Capture and Storage (BECCS). **These technologies however have many limitations, one of which is a high cost.**

In the first scenario (P1), there is low population growth, with reduced energy demand and rapid decarbonisation, which is depicted by the rapid decrease of fossil fuels. In contrast, the last scenario (P4) depicts high population growth and high consumption patterns, where population remains reliant on fossil fuels. Although there is a reduction in the amount of fossil fuels (grey area), it still remains largely present for the next few decades. This scenario will need to rely heavily on technologies such as carbon capture and storage (CCS).

12.3.6.2 Human Development Index

The climate challenge can also be seen as a "dual-challenge". The figure below looks at the correlation between HDI (Human Development Index) and consumption-based per capita CO2 emissions, considering different income quintiles.



Source: Pascal, A., et al, 2020. Used with permission.

In the graph you can see a clear trend: the higher the development of a country, the higher the carbon emissions per capita. For example, if you live in Australia on an (relatively low) income of around

AUD$25,000 per year, then your carbon footprint is estimated to be around 13 tonnes of CO2. This amount can vary depending on a couple of factors, including one's travelling habits (e.g. international flights) and diet (e.g. vegetarian or meat-based diet).

If everyone in the world would get an "equal" carbon budget, how much would this be? In order to stay within a 2°C consistent carbon budget, everyone in the world would have 1.64 tonnes of CO2 allocated per person to emit in 2030. **The challenge for developed countries is therefore to maintain a high HDI, but decrease the emissions per capita**. For developing or underdeveloped countries the challenge is quite different, as they currently have very low CO2 levels per capita. Their challenge is to **increase their HDI** ***without*** **increasing their emissions**. An important element of the Paris Agreement is that there are **"common but differentiated responsibilities"**. **This means that because developed countries have emitted by far the largest portion of emissions, and have benefited from this greatly, they have a greater responsibility in mitigating climate change, including provide Climate Finance to poorer countries.**

12.3.6.3 Carbon Intensity Pathways of Sectors: How can we Decarbonise Different Sectors?

In order to contribute to the CO_2 reduction process, industries have to adopt significant transformations. Have a look at Table 2 of this Nature Climate Change article which provides a summary of the unit reduction certain industries have to achieve in order to achieve the sustainability targets.

For example, in the case of power generation, the global average was 591 g CO_2 per kWh 2011 and to stay within a global carbon budget consistent with staying below 2°C, this amount should be reduced to 28.7 by 2050. Power generation currently predominantly relies on the use of fossil fuels. Ways to decarbonise power generation can be achieved with renewable energy or nuclear power. However, both options carry certain risks or drawbacks. An increase in renewables has to be paired with investment in energy storage and smart systems. There is some exciting research ongoing by UQ researcher Dr. Jake Whitehead on using electric vehicles as portable energy storage systems, i.e. "battery-on-wheels".

12.3.7 Climate Change as a Tragedy of the Commons

Climate change is a classic example of a 'tragedy of the commons'. This occurs where a common pool of resources is overexploited. Globally, individual entities (each country, each company, and each individual) have a self-interest to consume or produce more than their 'fair share' of greenhouse gas emissions, which has led to a suboptimal state of our common climate. Think "why should I fly less when all my colleagues or friends don't? Why should I consume less energy when everyone else doesn't?" (for more information on the tragedy of the commons, please have a look at this science article).

Solving this issue requires collective action, and it is essential to recognise the importance of governance, ethical dimensions, equity, value judgments, economic assessments and diverse perceptions and responses to risk and uncertainty. Hardin (1969) argues that there is no technical solution to the tragedy of the commons. It requires the **education** of people, and a **sense of moral responsibility** to acknowledge the problem and to reduce the production of greenhouse gases.

Climate change was first addressed internationally as a major issue in the 1970s, in an IPCC report. Since then, there have been numerous international negotiations on how to solve it, mainly evolving around which country has to do what, which highlights this case as a collective action problem.

Did you know?

There is an increasing area of the law that deals with the rights of people in regards to climate change.

For example, in the Netherlands, there was a lawsuit brought by citizens, who sued their government for not taking enough action against climate change. They won the first case, which was appealed, and then they won again. This initiated an international breakthrough in terms of law, encouraging Courts to mandate that the Governments take the required actions.

What do you think about the role of educators, and universities? Do you believe they have a big influence in this case?

Overall, this section has put a lot of emphasis on climate change, as an example of one of the challenges of the century, but of course, we are facing many other environmental and social issues.

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Arguably, tackling Climate Change and other challenges require collective action (with a critical mass of actors taking action) and an extension of a moral responsibility by a multitude of actors. In the next sections, we briefly revise the different theories of the responsibilities of business in society. In section 12.3, we will discuss the limitations of some of the concepts that we have taught in the course, and discuss recent developments in both business and finance in relation to challenges of the century.

12.4 Theories of Business Purpose

12.4.1 Introduction

Let's Recap!

In Chapter 1 we introduced different theories of business purpose. Please go back to Chapter 1 if you need a refresher on the different theories. The theories are also summarised in short below:

12.4.1.1 Shareholder Theory (Friedman 1970)

Shareholder theory holds that the sole goal of a business is to maximise shareholder wealth, and that all corporate actions and investments should be evaluated on this basis. Friedman believes that it is not the corporate manager's role to pursue anything charitable, or incur costs for preventing environmental or social harm. However, Friedman does believe that profit maximisation should incur "while conforming to the basic rules of society, both those embodied in law and those embodied in ethical custom." and "without deception or fraud". Corporations are independent of political views, and one's individual views of morality ought to be expressed through the democratic system and supported by their own consumption decisions. Company profits should be given to shareholders as a dividend, who could then decide, individually, what charitable contributions to make, if any. This does not mean that charity was not important, rather that companies are not the appropriate vehicle as they do not have a comparative advantage in giving to charity.

Friedman's view on the shareholder theory has received a lot of criticism, highlighting that the idea of shareholder primacy and the "duty" to maximise profits is promoting an excessively short-term perspective, often at the long-term expense of the society, the economy and/or the company (see for example this article in the Financial Times). For the first time since 1987, the Business Roundtable, consisting of CEOs from the largest US corporations moved away from Friedman's view and refined the purpose of the corporation "to promote an economy that serves all Americans", which is consistent with Stakeholder Theory (next).

12.4.1.2 Stakeholder Theory (Freeman, 1984)

Freeman focuses on stakeholders, where stakeholders include any group/s that affect or are affected by the realisation of an organisation's purpose (Freeman, 1984).

According to stakeholder theory, the role of the manager is to maximise *value* for all stakeholders, so not only shareholders, but customers, employees, the broader community and others. In contrast with the shareholder theory, the stakeholder theory focuses on *value*, and not *wealth* (in this view, wealth is only part of the value). Businesses need to maintain a positive relationship with society and their environments in order to operate effectively. Failure to do so can destroy value for their stakeholders and ultimately affect a business's ability to operate in the long term.

Source: Adapted from R. Edward Freeman, Jeffrey Harrison, and Andrew Wicks, *Managing for Stakeholders* (New Haven: Yale University Press, 2007)

Stakeholders are employees, communities, suppliers, customers, the environment, shareholders, and the government. Most of them have contractual relationships with the firm. In general, the stakeholders should be viewed as equals, without no superiority or trade-offs.

This will lead to "good business" and long-term ***value*** creation for all stakeholders (including shareholders).

All stakeholders do not have the same influence on an organisation, which is why they are separated into these two categories. Primary stakeholders (orange pieces of the pie chart) are those individuals or groups who have a greater influence on the organisation and they are at utmost importance because the business relies on them for long-term survival. For example, what happens if customers stop buying the products?

Is there really a difference between Stakeholder theory and Shareholder theory? After all, maintaining a good reputation with society, customers and employees, and operating the business in an environmentally responsible manner could actually be consistent with maximising shareholder wealth. In fact, this is the conclusion of one school of thought known as "Enlightened Friedmanites" (that is, followers of Milton Friedman with an enlightened point of view). However, there is still a difference based on motive.

Proponents of Stakeholder theory have the motive of enhancing **value** for **all** stakeholders from an ethical standpoint, while Enlightened Friedmanites are still focusing on shareholder **wealth**.

12.4.1.3 Shareholder Value Myth (Stout, 2011)

Stout disagrees with Friedman but for reasons different from Freeman. She frames her discussion around managerial duty in a legal and historical context. She states that corporations are legal entities that own themselves and shareholders have contracts with the firm that gives them limited rights. Firms can pursue multiple objectives and aim to do at least sufficiently well at each rather than maximising only the wealth objective. Shareholders are different (i.e. there is no "single shareholder value"), all participate in society, and are likely to have social and environmental concerns. Thus, managers should be allowed to conduct the business in a socially and environmentally responsible way.

Stout also shows that since the late 1900's, the focus on shareholder wealth only (also called shareholder primacy) has actually led to a decrease in investment in R&D and financial returns, suggesting that a satisficing approach, which creates value on multiple fronts, may not only be better for shareholders, but for society as a whole.

12.4.1.4 Shareholder Welfare Theory (Hart and Zingales, 2016)

Hart and Zingales argue that corporations should maximise shareholder welfare rather than wealth.

They talk about three conditions necessary for shareholder welfare maximisation to be a superior business objective to shareholder market value maximisation. These are:

1. profit-making and damage-generating activities of companies are inseparable
2. government does not perfectly internalises externalities through laws and regulations
3. shareholders are pro-social

The authors also state that if shareholders pro-social preferences are sufficiently heterogeneous, then due to collective choice issues, market value maximisation may be a "second-best" objective.

12.4.2 Corporate Social Responsibility

12.4.2.1 CSR – The Big Questions

12.4.2.1.1 What is Corporate Social Responsibility (CSR)?

CSR argues that corporations are *responsible* for their actions, just like an individual. In other words, decisions made by managers (i.e. business decisions) are not exempt from ethics. It is similar to stakeholder theory in that it considers a wider responsibility than just to shareholders. However, CSR is different from stakeholder theory in *motivation*. CSR starts with the firm and looks outward to determine responsibility, whereas stakeholder theory starts with looking at the firm from outside to determine the relevant stakeholders and then work out how the firm should behave. For example, a firm may decide not to incur some extra costs to not pollute a river: did it do this not to harm stakeholders (stakeholder theory), or because it was the right thing to do (CSR)?

> CSR is conceptualised as the firm having a responsibility across three dimensions: environment (E), social (S), and sometimes governance (G). This has been the conceptual understanding for the past 20 years. Performance on environmental, social and financial measures is often referred to as the "triple bottom line" (financial performance is usually called the "bottom line").

12.4.2.1.2 How is CSR Reported Within a Company?

Every company that is currently operating and is familiar with trends and current societal expectations now issues a CSR or sustainability report. This trend is mostly caused by shareholders demanding transparency and information on a companies' CSR activities, recognising that engaging in environmental or social controversies can pose significant financial risks, whilst positive actions can increase reputation. However, **it is common for companies to engage in 'greenwashing', where "positive" actions are highlighted and negative impacts are not mentioned.** It may be, therefore, more interesting to ask "what is not being reported by the company?". This is why independent information on what the company is doing is very important. This has given rise to sustainability rating agencies that rate companies on a vast range of ESG indicators.

12.4.2.1.3 Is CSR Similar to Philanthropy?

A distinction that should be noted is that CSR is different from philanthropy. This is important to note because Friedman's thesis focused on charitable giving by companies. Philanthropy typically means donating money to a 'good cause', e.g. a charity, the arts or sports. However, while philanthropy can form part of a company's CSR strategy, **giving some money to charity is not the same as CSR.** Sometimes it can even be used as a distraction from the company's irresponsible activities. The firm's CSR activities need to be integrated into the firm's strategy and all of its activities. For example, do you believe that a retailer that knowingly purchases garments that were produced using child labour, and pollutes local rivers can be seen as "responsible" just because they donate 1% of their profits to clean energy projects? Or even when they support "related" project such as supporting an education project for children?

12.4.2.1.4 What is the Difference Between CSR and Stakeholder Theory?

Corporate social responsibility (CSR) is very similar to stakeholder theory, in that it emphasises the need to focus on both shareholder wealth maximisation and the firm behaving responsibly (ethically). It is likely that the eventual outcome from a decision will be the same under CSR or stakeholder theory.

CSR, however, is different from stakeholder theory in its motivation. CSR starts with the firm and says, "What is the right thing to do in this scenario?"; looking outward to determine responsibility, whereas stakeholder theory starts with looking outside the firm to determine the relevant stakeholders and then works out how the firm should behave.

CSR is concerned with what the right course of action to take is. When differentiating between stakeholder theory and CSR, question whether the company did something to not harm stakeholders, or because it was the right thing to do.

Exercise

GoodHealth Inc. has just found out that their baby food product still contains traces of the harmful chemical asbestos, which can, in some cases, harm a babies' health. In addition, its production facilities also often leach the chemical into a nearby lake in the small town in India where it operates. However, preventing the use of this chemical will require a new production process which is rather expensive. The financial manager of the company shows that keeping its current production processes is financially better than changing them, even considering a possible damage in reputation (who is going to find out anyway?) and paying for lawsuits. However, management decided that they were still going to change the production practices, because not doing so would substantially decrease value for its stakeholders. Is the firm applying CSR or stakeholder theory?

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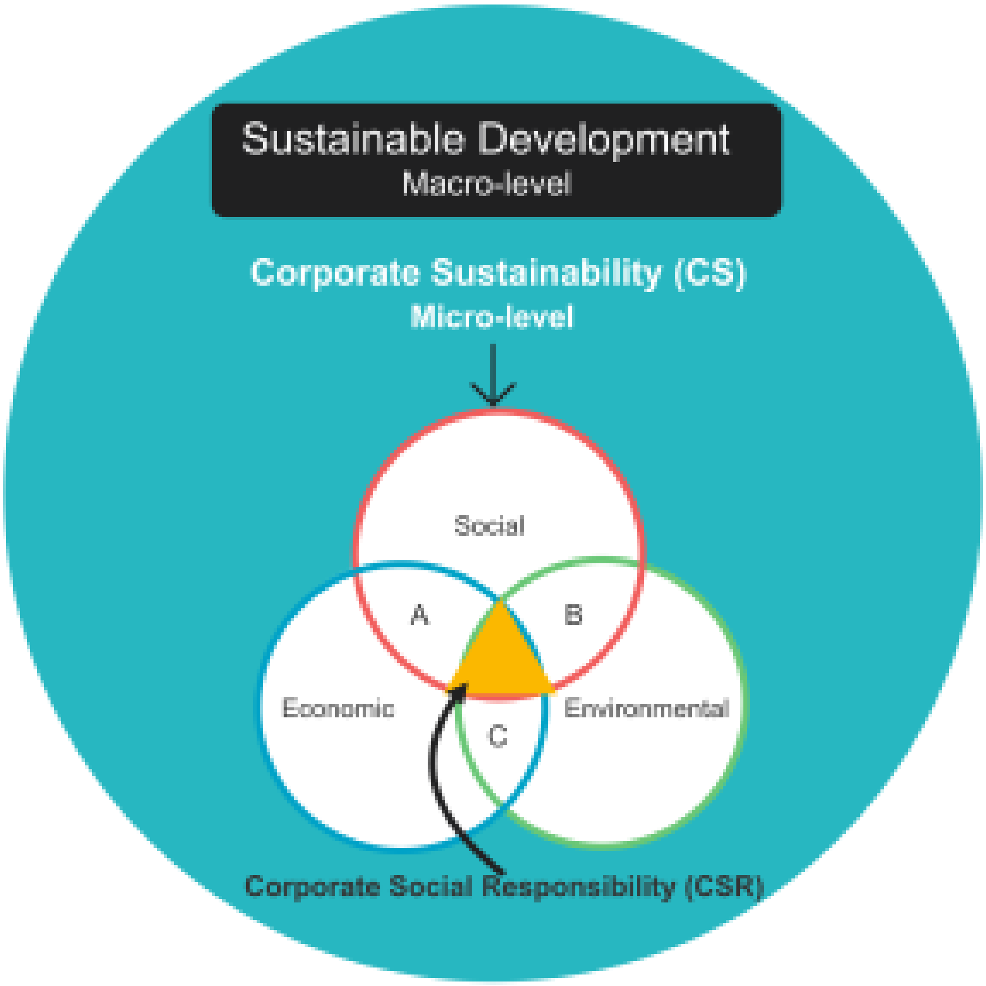
12.4.3 Corporate Sustainability

12.4.3.1 How are Corporate Sustainability and Corporate Social Responsibility Related?



Adapted from Ashrafi, M., Adams, M., Walker, T. R., & Magnan, G. (2018). How corporate social responsibility can be integrated into corporate sustainability: a theoretical review of their relationships. International Journal of Sustainable Development and World Ecology, 25(8), 671–681. https://doi.org/10.1080/13504509.2018.1471628

Corporate Sustainability and Corporate Social Responsibility are often used interchangeably. However, technically speaking corporate sustainability is one step further than corporate social responsibility, and it falls under the umbrella of sustainable development. **Sustainable development is defined as meeting the needs of the present without compromising the ability of future generations to meet their own needs.** This includes the need for economic, social and environmental sustainability. It views firms as playing an active positive role in staying within planetary boundaries and meeting the UN Sustainable Development Goals.

With corporate sustainability the question of: "is what I am doing consistent with this long-term goal?" is frequently asked. If it is, then you have a sustainable company. It may be useful to look at the planetary boundaries, or the Sustainable Development Goals, and identify whether your company is creating a positive impact, or at least not negatively impacting, the achievement of these goals.

Ashrafi, M. et al (2018)

12.4.4 Alternative Business Models

Whilst there seems to be an increased expectations and pressure for for-profit corporations to act socially responsibly, there has also been a rise in the number of social enterprises and not-for-profits.

What are Certified B Corporations? There is global growth in companies becoming certified B corporations. These corporations are legally required to consider the impacts of their decisions on their workers, customers, suppliers, community, and the environment. These are still for-profit, but have a clear commitment to creating value for all stakeholders first.

For example, have you heard about 'Ben and Jerry's? or 'Who Gives a Crap?' toilet papers?
'Who Gives a Crap?' is a Certified B Corp that pledges to spend a portion of revenue to build toilets in developing countries

What are not-for-profit organisations? Not-for-profit organisations exist to provide services for the community and measure their success in the social and environmental impact that they create. They do not exist to create a profit for their members. Many not-for-profit organisations (though not all), also apply for charitable status to provide a tax deduction for the individuals and companies that provide money to fund their charitable works.

Concept Check

In this section we have looked at different views of the firm's role in society. You have already applied several of the theories in the first Workshop. We apply the theories to another real world situation below.

Merchants of Doubt

Merchants of Doubt is a book co-written by Harvard Professor Naomi Oreskes, which refers to companies actively spreading doubt on science so that they can keep selling their product (another book on this topic was recently published in the Oxford University Press called "The Triumph of Doubt"). A common and well known example is the tobacco companies. When cigarettes first hit the market, the tobacco companies released statements saying that health reports stating that smoking was harmful were all incorrect or falsified, because smoking is good for you, and you should buy cigarettes. All advertising and promotions propagated this standpoint – that cigarettes were good for you. This means that doubt was created about the science, which allowed tobacco companies to keep selling their products.

The exact same occurrence is happening with climate change. There is ample evidence that shows that fossil fuel companies are funding fake reports and fake news. Realistically, it is less expensive (in the short term) to fund fake research and reports, as well as pay groups to lobby against carbon emission legislation, than it is to pay for the actual carbon emissions.

There are various groups online (these are called the merchants of doubt) who present climate change as a fiction, or some political agenda. They intend to feed this uncertainty to people about climate change and trigger doubtful thinking and question what is reliable or not.

What should a corporate manager working for a fossil fuel producer do under each of these different theories? What would you expect the companies to do?
"If funding climate change denial groups to create "doubt" of science to the public and lobby against carbon regulation is cheaper than having to pay for the damage caused by their carbon emissions, the corporate manager should..."

What should a corporate manager do under the shareholder theory?

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What should a corporate manager do under the stakeholder theory?

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What should a corporate manager do under corporate sustainability?

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What should a corporate manager do under the principles of CSR?

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12.5 Critical Thinking Regarding Concepts Taught in this Course

12.5.1 Introduction

We have covered different theories of business purpose in the previous section, thinking critically about what the purpose of a business should be in society. In this section, we ask you to reflect on the limitations of theories taught in the course and what alternative tools are available to create a positive impact on overcoming the challenges of the century.

How do we measure success?

What are the ethical and environmental impacts of seeking only financial profit?

This is an opportunity for you to weigh up and determine your position or values as a manager.

12.5.2 Modern Portfolio Theory (MPT)

12.5.2.1 Modern Portfolio Theory (Module 10)

In Module 10, we learnt that Modern Portfolio Theory suggests that everyone should hold a combination of the risk-free investment option and the market portfolio to get a maximum reward-to-risk independent of your risk preference. Investing in the market portfolio provides the most diversification of risk.

But what happens if we all invest in a market portfolio, for example, the S&P500 or ASX200? What if investing this way is consistent with e.g. a 4°C increase in temperatures compared to pre-industrial levels? Should we still be investing in the market portfolio? What if investing in the market portfolio is consistent with increasing income inequality? Should we still invest in the market portfolio?

Discussion: Do you think investors have a responsibility to consider societal impacts of their investments? Yes or No?

Consider the example of Tesla. They are a for-profit company with a mission to accelerate the world's transition to sustainable energy.

Tesla has been highly unprofitable, but what can it do to generate large sums of investment so that it can innovate and become more profitable? We are almost at the stage where renewables are overtaking fossil fuels, but we are not there yet.

What does this mean for Tesla? Who should help Tesla? Should the consumers or investors pay more for their product? For example, if consumers are willing to pay the price for Tesla, then Tesla will have more financial resources, and grow. Are the consumers the ones that should pay for an expensive car, or should investors also be willing to receive a lower return? Or should governments provide subsidies for green technologies? (and/or perhaps cut subsidies for polluting industries)?

Do you think that all stakeholders have a responsibility? Or do you think one group has more responsibility than another?

> If an individual sold their shares, this would have zero impact on the company.
> However, institutional investors such as banks and superannuation funds have a significant amount of money and power. They get to determine what is being invested in or not. This brings us back to concept of collective action – individuals together can impact what their financial institutions invest in and collectively have sufficient funds to steer corporate

actions and thus determine our common future.

The following question is debated heavily in the literature: **Is doing good also good for the bottom line?**

Considering hundreds of studies, there is no clear outcome. Why? Because elements of ESG can increase financial performance, whilst others may not. For example, reducing environmental impact can be a lot cheaper, such as energy efficiency, reduced resource use and less waste. Other products and services might require a larger investment upfront or cost more. For example, plastic cups are not environmentally friendly but are much cheaper than glass and requires less time washing up. Solar energy also requires a high upfront investment, and depending on government support (or subsidies for fossil fuels) might be financially attractive or not.

When contemplating investment options, the decision depends on what you value.

Limitations of Modern Portfolio Theory: Are investors rational?

Investors are assumed to be 'rational' and always aim for the highest return/risk combination. However, we know from Stout and Hart that most investors are pro-social and care about more than just wealth. **Increasingly investors are willing to consider ethical factors in investment decisions.**

Are there other forms of return? Increasingly, investors do not want their investments to be associated with "unethical" practices, and sometimes want a social and/or environmental return in addition, even at a compromise of financial returns.

Is there a consideration of (long-term) societal impact of collective investing according to the MPT? From research we know that "the market portfolio" is far from being aligned with staying within the agreed 2°C global warming limit. **In fact, a study showed examined an extremely well diversified portfolio of 30,000 publicly listed companies, and find it is currently aligned with a temperature of 3.4°C, well above the 2°C limit.** Should we still invest in the market portfolio?

12.5.3 Discount Rates

Discount Rates: Why do we discount the future/use a discount rate?

"If we used the share market's discount rate to value the lives of future Australians and if we knew that doing something would give lots of benefits now but would cause the extinction of our species in half a century, the calculations would tell us to do it." (The Garnaut Review, 2011)

As you would have learnt in this course, a core principle in finance is the "Time Value of Money" – we prefer money sooner rather than later because we could earn interest on it. To capture this "Time Value of Money" we use a discount rate to convert cash flows from the future in today's value. However, by using discount rates, an implicit assumption can be made on how much we value the future value:

1) The greater the discount rate, the less any future cost/benefits are worth today, and

2) The more distant positive or negative cash flows are, the less they are worth today.

12.5.3.1 Implications of Discount Rates on Climate Change

What do discount rates mean for the future in terms of climate change?

Tackling climate change would require large investments now, such that we still have a stable economy in the long-term. However, these long-term benefits are worth very little if we apply a discount rate, whilst the costs weigh very heavily as they would be incurred now. Vice versa, if we operate "business as usual" we would generate large profits now, but climate change will cause long-term costs in the future, which would be worth very little to us today.

By using the current market discount rate, there is an implicit assumption that, regardless of the investments we make as a society, the economy can keep growing at the same rate, i.e. current returns do not impact the ability to generate future returns. It thereby ignores the externalities and "the big picture" of how we are developing as an economy, and the consequences of this in the long term. In the case of climate change, the investments we make today have an impact on our ability to have a stable economy in the long-term. In a sense, using discount rates automatically values cash flows for future generations lower than those for present generations.

But can we use the market discount rate? Many economists argue that besides the need for pricing carbon, there is a need for a social discount rate for projects involving future economic damages caused by current actions. A survey shows that most economists suggest a discount rate of 2% for climate change related activities. Other economists, like Martin Weitzman, argue it would be worthwhile to go beyond economic analysis and that **catastrophic climate change should be avoided at all costs**.

Discount rates are important in climate discussions, as they determine what people should pay now per ton of carbon to pay for damages in the future. This is also referred to as the social cost of carbon. It is a question of economics and ethics, as physical science cannot answer this.

12.5.3.1.1 Example

To get a better understanding, assume that if we continue business as usual, climate damages at the end of the century will be $5 trillion (note: it will be much more, but for arguments sake, let's keep it at $5 trillion).

Applying a 1% discount rate, this is $\frac{5\ trillion}{1.01^{70}} = 3.67\ trillion$

Applying a 3% discount rate, this is $\frac{5\ trillion}{1.03^{70}} = 0.335\ trillion$

You can see that a slight difference in discount rate can have huge implications of how much we value climate damages. Let's say that taking no action on climate change generates a benefit in today's terms of 0.5 trillion, then the calculations for a 3% discount rate would tell us take no action on climate change. This is because the benefit of 0.5 trillion is more than 0.335 trillion – and our economic growth (expected at 3%p.a.) will generate more wealth in the future that it costs us to deal with these damages in the future.

Note that this example was greatly simplified, but it illustrates the sentiment of the quote at the start of the paragraph.

Estimates of the social cost of carbon vary widely. This study suggests the cost of carbon should be at least $125 per tCO2, whilst other estimates range from $34 – $1,079 per tCO2 for emissions in 2010, and from $77 – $1,875 per tCO2 for emissions in 2050. Using the $125 per tCO2, how much extra would you need to pay for a long-haul return flight from Brisbane to Europe (6t CO2) if you had to pay for the associated social cost? You would have to pay at least $125×6=$750.

Note: if the social cost of carbon is implemented, it does not necessarily lower emissions to 2°C. This should be done through a carbon price, aiming to induce behaviour change to reduce emissions to the levels agreed upon in the Paris Agreement.

12.6 Sustainable Finance

12.6.1 Sustainable Investing

We have talked about the role of business, but what is the role of investors in creating a sustainable socio-economic system? What do you find important when making financial decisions? What do you find important when investing? Do you consider ethics when choosing a bank account? Superannuation portfolio?

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KPMG (2019)'s Shareholder Values: Shareholder Value report released the following results from a survey they conducted.

Source: KPMG, 2019

Importance of Total Overall Factors (Extremely/Very Important)	Total	< 30 years old	31-40 years old	41-50 years old	51-60 years old	> 60 years old
Ethical Behaviour	54%	66%	57%	49%	51%	55%
Environmental Sustainability	40%	59%	51%	32%	38%	35%
Pays fair share of taxes to Australia	63%	65%	63%	57%	61%	68%
Treats employees well	55%	67%	57%	49%	51%	57%
Value beyond making a profit	52%	65%	55%	48%	46%	53%

According to the results presented, millennials in particular (highlighted in pink) find the majority of factors very important when making financial decisions.

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12.6.1.1 A Note on Banks

Also in the banking industry there is an increase in customers wanting their bank to act responsibly and to invest ethically. The Global Alliance for Banking on Ethical Values is an independent network of banks, using financial services to deliver sustainable economic, social, and environmental development (see for example this video on Triodos Bank – the Founder of the Alliance). The alliance started 30 years ago and they have 54 financial institutions as members, 50 million customers, and $163.4 billion USD assets under management. In Australia, Bank Australia is the only bank that is a member of this alliance.

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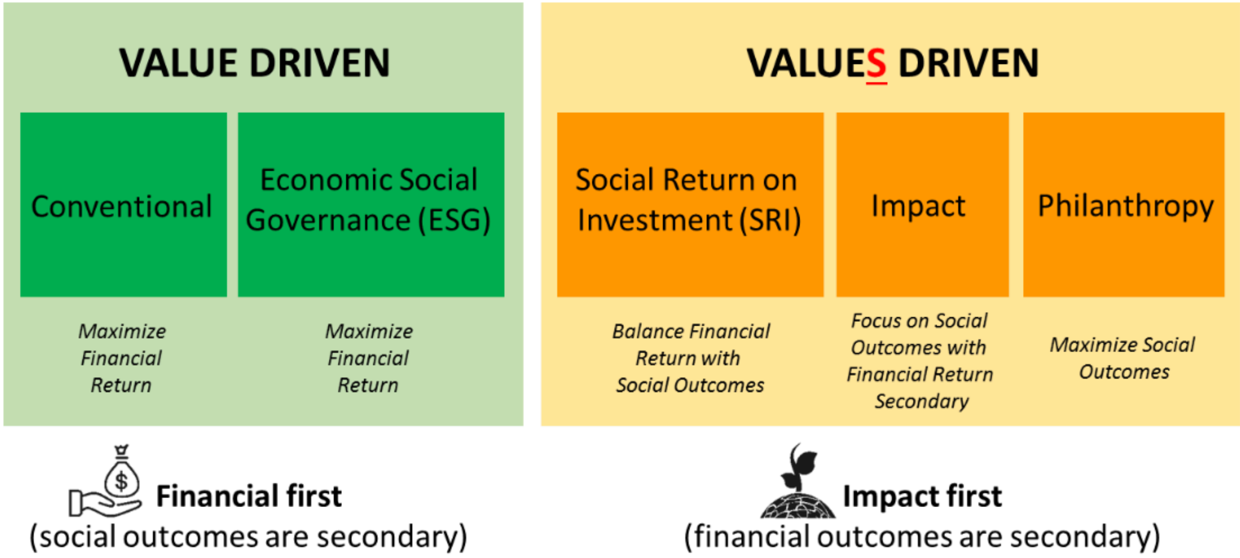
12.6.2 Sustainable Investing Framework and Tools

12.6.2.1 Sustainable Investment-Framework

Similar as with Corporate Social Responsibility and Corporate Sustainability, the terminology surrounding sustainable investment can be quite ambiguous and has become a new "buzz" word. In many cases, it is rather detached from our earlier definition of Corporate Sustainability. To provide clarity on the topic, different frameworks have been proposed. The difference lies in what is seen as "sustainable" and whether the investor is mostly values-driven or profit-seeking (value-driven). A useful framework to identify the different investment strategies can be found below.



Value driven investing is about putting financial returns first. Conventional finance is concerned with maximising financial returns, but investors are increasingly recognising that considering Environmental Social Governance (ESG) risks is important for generating long-term financial returns.

Values driven, in comparison, sees generating a social impact at least equally important as generating a financial return. SRI focuses on balancing financial returns with social outcomes, but impact investing (in the figure above) is about focusing on social outcomes with financial returns as secondary, whilst Philanthropy is about maximising social outcomes only, without seeking any financial return.

Impact investing has seen exponential growth in demand around the world and in Australia, where Australia's market has tripled in the last two years from $5.7 to $19.9 billion. A recent study also shows the growing appetite for impact investments is expected to grow more than 5 fold to $100billion over the next five years.

12.6.2.2 Sustainable Investing Tools

Common sustainable investment tools are:

- Negative screening: the exclusion of stocks based on social and/or environmental criteria. Many funds exclude, for example, firms deriving revenue from tobacco or selling firearms. It has also become common to exclude (divest from) fossil fuel companies.
- Positive screening: the selection of stocks based on positive social and/or environmental criteria. For example, a portfolio that invests in global environmental opportunities. This fund only select companies that meet certain environmental performance criteria.
- Shareholder Activism: Engagement of shareholders with companies on ESG factors. This tool is becoming increasingly common for shareholders, particularly in Europe.

Exercise

Multiple Choice

Recently 48.6% of shareholders backed a climate resolution that asked JP Morgan to describe its plans for aligning their financing with keeping global temperatures below 2 degrees (for more information, see Shareholders Urge JPMorgan Chase to Reduce Climate Impacts of Financing). What is this an example of?

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12.6.2.3 Sustainable Investment Boosts

Given the (long-term) financial success of SRI/Sustainable investment funds, and demand from clients, many funds now offer sustainable/responsible investment options (see e.g. Morgan Stanley). However, how responsible/sustainable are these investments?

Recent research by Rekker et al. (2019) (yes, the lecturer of your course) found that sustainability ratings, often used by investors to make sustainable investment decisions, do not measure how consistently a company is operating with e.g. meeting global climate goals (so how can we create climate-safe investment portfolios?). The role of sustainability rating agencies is to analyse the company data and provide independent assessments on their sustainability. The landscape is quickly changing however. Over the past few years there have been major developments in the required disclosure and action of companies on climate change. For more information see the recommendations by the Task-Force on Climate-Related Disclosures, the Science-based Targets initiative, and the Transition Pathway Initiative.

12.6.3 Regulation of Sustainable Finance

The European Union (EU) has emerged as the predominant player in leading the way on the topic of sustainable finance. Given the lack of clarity surrounding “sustainability” and the mis-use of terms in the financial sector, the European Commission has adopted an action plan, leading the development of regulation on creating a sustainable financial sector. Its key actions include:

- Establishing a clear and detailed EU classification system – or taxonomy – for sustainable activities. This will create a common language for all actors in the financial system, and facilitates sustainable investments. The taxonomy is a 400 page document, including criteria for 70 climate change mitigation and 68 climate change adaptation activities, including criteria for do no significant harm to other environmental objectives. **Companies and investors are expected to disclose sustainability information using the new taxonomy by the end of 2022.**
- Establishing EU labels for green financial products. This will help investors to easily identify products that comply with green or low-carbon criteria.
- Introducing measures to clarify asset managers' and institutional investor's duties regarding sustainability. Traditionally, institutional investors (e.g. banks) only had a fiduciary duty to inform clients about their financial products, but this new regulation will clarify the duties surrounding disclosing sustainability aspects of their investments.
- Strengthening the transparency of companies on ESG policies.
- Incorporating climate risks into bank's risk management policies and supporting financial institutions that contribute to fund sustainable projects.

Consider the knowledge based upon the content of this chapter: What investment strategies do you think are important to tackle some of the challenges of the century? What do you think is the role of business and the financial industry? Are your investments consistent with your values?

One or more interactive elements has been excluded from this version of the text. You can view them online here: https://uq.pressbooks.pub/introduction-financial-management/?p=187