CHAPTER 1

INVESTMENT APPRAISAL – NET PRESENT VALUE

1. Investment decisions

When News Corporation bought Myspace for $580 million in 2006, it (Myspace) was one of the hottest companies on Earth. When News Corporation sold Myspace for $35 million in 2012, it had the marketability and popularity of a mouldy potato. This was a bad investment decision.

Investment decisions are just one part of corporate financial strategy, along with financing and dividend decisions. Let's take a look at these three types of decision more closely.

Financing decisions

Businesses need funding to invest in capital (e.g. equipment, machinery, buildings, etc.), **to pay expenses and for working capital** (e.g. salaries, inventories, utilities, etc.).

Financing decisions relate to the decisions about where this money comes from, and is primarily about balancing. This money can generally come from:

- **Equity** - Investment from owners/shareholders
- **Debt –** Money from lenders such as banks or bonds
- **Retained earnings** – Unspent/accumulated profits from prior periods

Investment decisions

Once raised, the money needs to be invested, and investment decisions help the organisation decide where to invest this money to repay debt (and interest payments) and achieve a good rate of return for shareholders.

Strategic options are generated as part of the business strategy-setting process. As part of the evaluation of the strategic options, investment decisions can be made using techniques such as:

- **Net present value** (**NPV**) – This is **the difference between the present value of cash inflows and the present value of cash outflows for a project**. The present value aspect is useful for projects that last several years, since it takes into account elements such as inflation.

- **Internal rate of return** (**IRR**) – **This looks at an investment in terms of the optimal rate of return for the company, rather than the net value.** Higher rates of return are generally preferable.

- **Payback period –** This is **the length of the time taken for an investment to make a return on the initial expenditure** (e.g. a £50 investment with a £25 annual payback would have a two-year payback period).

- **Return on capital employed** (**ROCE**) – **This compares a company's capital with its earnings** to measure how efficiently capital has been used to make money.

Dividend decisions

Assuming investments were well made, **funds can be returned to shareholders in the form of dividend payments**. The directors have to balance the payment of dividends with retention of cash in the business to allow for future investment and growth.

2. Net present value (NPV)

Imagine that it is 2005 and you are the finance manager at Apple Inc. Your research and development team come to you with two ideas: one is a hand-held device with a touch screen that makes phone calls, sends emails and plays music. The other is a new phone modelled on an existing phone on the market with a unique design.

The first is, of course, far more costly than the second, and obviously more risky too, since it will be a novel idea. The second option would be safer and more likely to bring a guaranteed return.

But, you are the financial manager, and you need to approach this more analytically and with numbers. But where do you start with a project like this? Is there a way to input some data and have a simple 'yes' or 'no' output?

Well, while we don't have anything quite that simple yet, **we do have NPV.**

Net present value (NPV) is a project appraisal technique which uses **relevant net cash flows** generated by a project over its total lifetime to calculate a project's net contribution to an organisation. Basically, NPV tells us whether it's worth doing a project or not.

Therefore, **NPV calculates an organisation's change in wealth** if it undertakes a particular project. **A positive NPV is an increase in the total value of the company from doing the project, while a negative NPV is a decrease in total value of the company from doing the project.**

Traditionally, therefore, a negative NPV for a project would suggest that it should not be undertaken as it would not bring any profit for a business or investor. Likewise, a positive NPV would bring profit so should be undertaken. However, there are **other factors that should be considered when making these decisions such as the company strategy and business model. These may outweigh a decision based purely on the NPV**.

Therefore, if a project has a **positive NPV, but undertaking it would, for example, undermine the principles of the business**, investors and customers may react negatively. If it was felt that this would significantly damage the business, the project shouldn't be undertaken.

A project with a **negative NPV shouldn't be ruled out either. Sometimes, if undertaken, such a project may build a foundation for future profitable projects**.

In summary, **a project shouldn't be automatically accepted just because it has a positive NPV or rejected just because it has a negative NPV**.

Discounting and the time value of money

NPV takes account of the time value of money by 'discounting' future cash flows so the further they are away the less value they have. To put this into context, the same amount of money received in one year's time will not be as valuable as money that is received now. One reason for this is because in one year, you will not be able to purchase as much of a product with the same funds due to inflation. Another way of thinking about this is that those funds, if invested now, will be worth more in one year as they would have earned interest in that year.

To take you through the process of calculating NPV, we'll use an example company: Buzzing Batteries (BB), a mobile phone and MP3 lithium battery manufacturer. The company is UK-based, profitable and has been in business since 1999.

Given that any company needs to achieve a percentage return equivalent to the cost of capital to satisfy investors, **the effective rate used is the cost of capital.**

For BB the cost of capital is 10%. This means that £110 received in one year's time has a present value of £110/1.1 = £100, or in other words, the investor would need £110 in 1 year to give them a 10% return on £100 now.

Taking account of the time value of money and all relevant cash flows (both incoming and outgoing) means NPV is considered **a superior project appraisal technique compared to others such as ARR, payback periods and IRR** (but we'll come to these later on!)

The timing of cash flows

When completing NPV calculations, it is vital that the timing of cash flows is clearly recorded, as amounts received at later times need to have a greater discounting factor applied to them. Therefore it is important that a standardised approach is used in these calculations, including a standard NPV proforma.

You will need to become familiar with the following approximate proforma for NPV calculations:

	Year 0	Year 1	Year 2	Year 3	Year 4
Sales receipts		X	X	X	
Costs		(X)	(X)	(X)	
Sales less costs		X	X	X	
Taxation based on net income		(X)	(X)	(X)	(X)
Capital expenditure	(X)				
Scrap value				X	
Working capital	(X)			X	
Tax benefit of tax depreciation		X	X	X	X
Net cash flow	(X)	X	X	X	(X)
Discount factors @ post tax cost of capital	X	X	X	X	X
Present value	(X)	X	X	X	(X)

This is a lot to take in visually, but having this proforma will really help you in the exam! The good news is that you should have seen plenty of NPV calculations by then. There are also some key points that it's worth noticing about the presentation of an NPV:

- **Cash outflows that occur at the beginning of a project occur now** (Year 0), meaning that these outflows are already at their nominal value.

- **Cash outflows or inflows that occur during any particular year are all treated as if they occurred at the end of that financial year.** For instance, revenue will be earned over a full 12-month period, but for the purpose of NPV calculations we treat revenue as if it occurred all in month 12. This assumption is used to keep calculations straightforward.

If you are specifically told that a cash outflow or inflow occurs at the start of a year, include it as the end of the previous year. For instance, a cash flow received at that start of Year 2 is deemed to have occurred at the end of Year 1 and should be included in Year 1 cash flows in your calculation.

Again this is an understood assumption that ensures consistent treatment of inflows/ outflows across different NPV calculations.

Example – basic NPV

Buzzing Batteries is looking to expand operations by opening up three retail shops selling batteries directly to the public. It has decided upon a company policy of acquiring all of its store locations. The following cash flows are forecast:

	Year 0 £'000	Year 1 £'000	Year 2 £'000	Year 3 £'000	Year 4 £'000
Land and buildings	(4,225)				
Fittings and equipment	(910)				
Gross revenue		2,340	3,250	3,640	3,900

Cost of capital is 12%, so we can now calculate the NPV.

We start by completing a table over a number of years (which will look like the one above), and also find the net cash flow for each year:

	Year 0 £'000	Year 1 £'000	Year 2 £'000	Year 3 £'000	Year 4 £'000
Land and buildings	(4,225)				
Fittings and equipment	(910)				
Gross revenue		2,340	3,250	3,640	3,900
Net cash flow	(5,135)	2,340	3,250	3,640	3,900

Next use the discount tables, (which can be found at the end of this study text), to look up the relevant discount factors to use. Add a row to your table to note the discount rate of 12%:

	Year 0 £'000	Year 1 £'000	Year 2 £'000	Year 3 £'000	Year 4 £'000
Land and buildings	(4,225)				
Fittings and equipment	(910)				
Gross revenue		2,340	3,250	3,640	3,900
Net cash flow	(5,135)	2,340	3,250	3,640	3,900
Discount factor	1.00	0.893	0.797	0.712	0.636

Next up is the calculation of the present value of each year, to do this we multiply the discount factor by the net cash flow for the relevant year. So for example:

To find the present value for Year 1:

2,340 x 0.893 = 2,089.62

Here, the number is rounded to the nearest thousand for ease of calculation. Continue to find the present value for all years.

	Year 0 £'000	Year 1 £'000	Year 2 £'000	Year 3 £'000	Year 4 £'000
Land and buildings	(4,225)				
Fittings and equipment	(910)				
Gross revenue		2,340	3,250	3,640	3,900
	(5,135)	2,340	3,250	3,640	3,900
Discount factor	1.00	0.893	0.797	0.712	0.636
Present value	(5,135)	2,090	2,590	2,592	2,480

Finally, we simply add up all of these present values to create the net present value:

(5,135) + 2,090 + 2,590 + 2,592 + 2,480 = 4,617

Therefore, £4,617,000 is the projected revenue of Buzzing Batteries over the four years. As you can see, the NPV of the project is a positive figure. This means it will give investors a return above the 12% cost of capital, and so the opening of the new shops should be undertaken.

It's also worth noting that effectively this is saying that doing this project increases the total value of the company by £4,617,000. If the stock market was efficient, as soon as the announcement of the project was made to the market, BB share prices would increase!

Example – NPV including relevant costs and scrap value.

Using the same BB example we can add in additional factors to demonstrate other concepts you will need to be familiar with when completing NPV calculations. Here we introduce a range of other costs (some of which are relevant and some which are not) and scrap value.

We are looking to calculate the NPV of this project where cost of capital is 12% with the following information:

	Year 0 £'000	Year 1 £'000	Year 2 £'000	Year 3 £'000	Year 4 £'000
Land and buildings	(4,225)				
Fittings and equipment	(910)				
Gross revenue		2,340	3,250	3,640	3,900
Direct costs		(975)	(1,430)	(1,950)	(2,080)
Marketing		(220)	(325)	(260)	(260)
Office overheads		(165)	(165)	(165)	(165)

- The cost of land and buildings includes £100,000 which has been spent on legal fees
- 55% of the office overhead is a charge made for head office services
- BB anticipates selling the new stores at the end of year four for £4 million which includes £75,000 for fixtures and fittings

To find the NPV we need to first recognise which costs are relevant – you will have encountered how to distinguish between relevant and non-relevant costs earlier in your studies.

The legal fees are a sunk cost because they have already been paid whether the project to open the retail units goes ahead or not. We therefore reduce land and buildings fees by £100,000: 4,225 – 100 = 4,125. **Remember that this is a cost and must therefore be represented on the table as** (**4**,**125**).

The allocated overhead charge (that is calculated as 55% of the full cost) is also irrelevant to this project for the same reason; the head office will be maintained whether this project happens or not. **As such, we can adjust the given cost of office overheads accordingly**: 165 x 45% = 74.25.

We are told that BB can sell the new stores at the end of year 4 and this additional factor (£4 million) has also been included in the solution below as a gain. The net cash flow for each year can then be calculated:

	Year 0 £'000	Year 1 £'000	Year 2 £'000	Year 3 £'000	Year 4 £'000
Land and buildings	(4,125)				
Fittings and equipment	(910)				
Gross revenue		2,340	3,250	3,640	3,900
Direct costs		(975)	(1,430)	(1,950)	(2,080)
Marketing		(220)	(325)	(260)	(260)
Office overheads (45%)		(74)	(74)	(74)	(74)
Resale value					4,000
Net cash flow	(5,035)	1,071	1,421	1,356	5,486

We can then do exactly what we did in the previous example, which is to apply the discount factor based on a 12% cost of capital:

	Year 0 £'000	Year 1 £'000	Year 2 £'000	Year 3 £'000	Year 4 £'000
Land and buildings	(4,125)				
Fittings and equipment	(910)				
Gross revenue		2,340	3,250	3,640	3,900
Direct costs		(975)	(1,430)	(1,950)	(2,080)
Marketing		(220)	(325)	(260)	(260)
Office overheads (45%)		(74)	(74)	(74)	(74)
Resale value					4,000
Net cash flows	(5,035)	1,071	1,421	1,356	5,486
Discount factor	1.00	0.893	0.797	0.712	0.636
PV of future cash flows	(5,035)	956	1,133	965	3,489
Net present value	1,508				

We can see that the NPV is positive and so the project should be undertaken. A lot of the work with NPV calculations is about being methodical, ensuring that you cover all of the criteria and working through each factor carefully. While parts of an NPV calculation can become quite involved, there are also a lot of easy marks available in your exam!

3. NPV and working capital

Projects obviously require capital and you can be asked as part of an NPV calculation to build in working capital requirements. This means we need to have an understanding of how much it will cost in order to keep BB's new retail stores operational.

As we are only dealing with relevant cash flows, the full amount of working capital is recorded in Year 0 of your calculation and then only the incremental amounts are recorded in subsequent years. **At the end of the project the full amount invested will be released.**

Year 0 working capital requirements

You will often find that working capital requirements are given as a percentage of turnover. For example, in another retail project BB requires 20% of turnover as working capital:

	Year 0 £'000	Year 1 £'000	Year 2 £'000	Year 3 £'000	Year 4 £'000
Turnover		3,320	3,600	4,000	4,700

This means, for example, that the working capital requirement for Year 1 is £664,000 (£3.32 million x 20%).

A key point to remember is that working capital is required at the start of the year. Therefore the £664,000 goes in Year 0 in preparation for Year 1 and so on.

	Year 0 £'000	Year 1 £'000	Year 2 £'000	Year 3 £'000	Year 4 £'000
Turnover		3,320	3,600	4,000	4,700
Working capital	(664)	(720)	(800)	(940)	
Relevant cash flow	(664)	(56)	(80)	(140)	940

Mid-project working capital requirements

Relevant cash flows measure the incremental increases in working capital. Take a look. Between Year 0 and Year 1, working capital requirements went from £664,000 to £720,000.

Because the project has already had £664,000 invested, we simply calculate £720,000 – £664,000 to discover what extra investment is required to maintain the required working capital. So, £720,000 – £664,000 = £56,000, hence £56,000 extra is required in working capital.

Final year working capital requirements

As we can see, however, this isn't the case in the final year. In the last year of the project the full amount of working capital invested is released. In the above example Year 0-3 cash flows are added up to get £940,000 which is treated as an inflow in that final year. It's almost as if BB's new project stops after year 4 - they're able to reclaim that working capital.

4. Tax in an NPV calculation

Much of the NPV calculations we've looked at so far should be familiar from your earlier studies. However, there is another element that needs to be considered: tax. In your exam it is important to read the question requirement very carefully when dealing with NPVs. This is because it's easy to be caught out by tax.

That said, **tax is usually a simple part of the NPV calculation and you will simply need to follow the instructions given.** You will be given a rate (e.g. 30%) and told if the tax is collected in the year in which it is due, or often you will be given scenarios where it is collected a year in arrears.

Example – NPV with working capital and tax

We're going back to BB and the opening of its new retail shops, only this time we're going to add in tax and working capital calculations.

	Year 0 £'000	Year 1 £'000	Year 2 £'000	Year 3 £'000	Year 4 £'000
Land and buildings	(4,125)				
Fittings and equipment	(910)				
Gross revenue		2,340	3,250	3,640	3,900
Direct costs		(975)	(1,430)	(1,950)	(2,080)
Marketing		(220)	(325)	(260)	(260)
Office overheads		(165)	(165)	(165)	(165)

- The cost of land and buildings includes £100,000 which has been spent on legal fees
- 55% of the office overhead is a charge made for head office services
- BB anticipates selling the new stores at the end of year four for £4 million which includes £75,000 for fixtures and fittings
- Working capital requirements are forecast to be 10% of revenue at the start of each year
- BB is charged corporation tax at 30%, It is collected one year in arrears

In the following table, let's start off with our cash flows. Land and buildings costs have been reduced by £100,000 to reflect that legal costs are sunk costs, whilst office overheads have been reduced by the 55% relating to head office.

We can see that the resale value of the shops (£4 million) has been calculated as part of Year 4. A year 5 column will eventually be added in order to accommodate tax (which will be collected one year after year 4).

	Year 0 £'000	Year 1 £'000	Year 2 £'000	Year 3 £'000	Year 4 £'000
Land and buildings	(4,125)				
Fittings and equipment	(910)				
Gross revenue		2,340	3,250	3,640	3,900
Direct costs		(975)	(1,430)	(1,950)	(2,080)
Marketing		(220)	(325)	(260)	(260)
Office overheads (45%)		(74)	(74)	(74)	(74)
Resale value					4,000

We're not done yet though. Next we need to calculate working capital, which is given in the question as 10% of revenue each year:

	Year 0 £'000	Year 1 £'000	Year 2 £'000	Year 3 £'000	Year 4 £'000
Gross revenue		2,340	3,250	3,640	3,900
Working capital (10%)	234	325	364	390	
Relevant cash flows	234	91	39	26	390

Remember, however, that working capital is required at the end of the previous year. We can therefore incorporate the relevant cash flows as follows, remembering that we effectively recoup working capital at the end of the project! This means we add up our cash flows and add this as a cash flow to year 4:

234 + 91 + 39 + 26 = 390

	Year 0 £'000	Year 1 £'000	Year 2 £'000	Year 3 £'000	Year 4 £'000
Land and buildings	(4,125)				
Fittings and equipment	(910)				
Gross revenue		2,340	3,250	3,640	3,900
Direct costs		(975)	(1,430)	(1,950)	(2,080)
Marketing		(220)	(325)	(260)	(260)
Office overheads (45%)		(74)	(74)	(74)	(74)
Resale value					4,000
Working capital	(234)	(91)	(39)	(26)	390
Net cash flows	(5,269)	980	1,382	1,330	5,876

See how the working capital requirement has slightly altered net cash flows.

We're nearly there! Finally we need to calculate tax. The notes tell us this is charged at 30% and collected the following year. **Remember that tax is charged against net income and not cash flows:**

	Year 0 £'000	Year 1 £'000	Year 2 £'000	Year 3 £'000	Year 4 £'000	Year 5 £'000
Gross revenue		2,340	3,250	3,640	3,900	
Tax (30%)			(321)	(426)	(407)	(446)

We can now add this to our calculations:

	Year 0 £'000	Year 1 £'000	Year 2 £'000	Year 3 £'000	Year 4 £'000	Year 5 £'000
Land and buildings	(4,125)					
Fittings and equipment	(910)					
Gross revenue		2,340	3,250	3,640	3,900	
Direct costs		(975)	(1,430)	(1,950)	(2,080)	
Marketing		(220)	(325)	(260)	(260)	
Office overheads (45%)		(74)	(74)	(74)	(74)	
Resale value					4,000	
Working capital	(234)	(91)	(39)	(26)	390	
Tax (30%)			(321)	(426)	(407)	(446)

We now have all of the relevant income and cost information we require, and can therefore calculate the net cash flows and present values as a result:

	Year 0 £'000	Year 1 £'000	Year 2 £'000	Year 3 £'000	Year 4 £'000	Year 5 £'000
Land and buildings	(4,125)					
Fittings and equipment	(910)					
Gross revenue		2,340	3,250	3,640	3,900	
Direct costs		(975)	(1,430)	(1,950)	(2,080)	
Marketing		(220)	(325)	(260)	(260)	
Office overheads (45%)		(74)	(74)	(74)	(74)	
Resale value					4,000	
Working capital	(234)	(91)	(39)	(26)	390	
Tax 30%			(321)	(426)	(407)	(446)
Net cash flows	(5,269)	980	1,061	904	5,469	(446)
Discount factor	1.00	0.893	0.797	0.712	0.636	0.567
Present value	(5,269)	875	846	644	3,478	(253)
Net present value	321					

And that's the end of our calculations! Overall the project of the new retail stores still has a positive NPV. This means we should still recommend that BB pursue the project.

Tax benefit

In some countries it is possible for an organisation to reduce its tax bill by deducting an allowance from the value of certain purchased items. In the UK this is known as a capital allowance**.** The value of this saving is specified through government-advised rates.

For example, in the UK a company car is an allowable capital allowance: the company gets money back to offset the car's depreciation in value. Capital allowance rates are usually 25%, but make sure you check the question to see if it gives a specific rate!

The question may also specify a certain item which the capital allowance refers to, for example, machinery; although *The Guardian* reported in 2015 that, in the UK, capital allowances had been extended to a range of objects including bowling alleys and fish tanks!

Finally, the annual amount claimed each year (**which is taken off the total asset value for the following year's balance**) **is called a** '**writing down allowance**'. For example, if BB (a UK-based business) has a £400,000 machine asset which is given a 25% allowance, it has a first year writing down allowance of £100,000. This leaves a balance of £300,000 to be recorded in Year 1 and claimed against in the following year.

Let's take a look at a slightly more complex example:

Example

Buzzing Batteries purchases a battery making machine for £1,000,000 and the capital allowance rate is 25%. The machine is sold for £100,000 in Year 4. We need to calculate the annual capital allowances.

We **start by calculating the year 1 capital allowance:**

Year 1 capital allowance: £1,000,000 x 25% = £250,000

Then we **work out the balance which has yet to be claimed against for tax:**

New balance = £1,000,000 - £250,000 = £750,000

We then **use £750,000 as the new starting figure and repeat the process for Year 2**:

Year 2 capital allowance: £750,000 x 25% = £187,500

New balance = £750,000 - £187,500 = £562,500

Getting the hang of it? We then **use £562,500 as the new starting figure and repeat for Year 4**:

Year 3 capital allowance: £562,500 x 25% = £140,625

New balance = £562,500 - £140,625 = £421,875

In the final year (**Year 4**), **the remaining balance can be charged for tax less any scrap value. This is called the balancing allowance**:

Year 4 balancing allowance: Current balance - scrap value

£421,875 - £100,000 = £321,875

This can therefore be summarised as follows, and the 30% tax allowance applied to it:

Year	Capital allowances	Tax savings (allowance x 30%)
1	£250,000	£75,000
2	£187,500	£56,250
3	£140,625	£42,188
4	£321,875	£96,563

That's the capital allowances calculated, whilst the annual tax savings would be recorded as a source of capital and incorporated into the NPV calculation. The annual capital allowances are then multiplied by the tax rate, which here we will assume is 30%, to give the actual annual tax savings which go into your NPV calculation.

When inputting these values into your calculation treat them on the same basis as you have been directed to treat your tax. In our earlier example, tax was charged the following year, so we would record capital allowances in this year.

To illustrate this, let's put the figures back into the example. Capital allowances have been calculated based on the £910k cost of fixture and fittings, at a written down allowance of 25% and against a corporation tax charge of 30%:

	Year 0 £'000	Year 1 £'000	Year 2 £'000	Year 3 £'000	Year 4 £'000	Year 5 £'000
Land and buildings	(4,125)					
Fittings and equipment	(910)					
Gross revenue		2,340	3,250	3,640	3,900	
Direct costs		(975)	(1,430)	(1,950)	(2,080)	
Marketing		(220)	(325)	(260)	(260)	
Office overheads		(74)	(74)	(74)	(74)	
		1,071	1,421	1,356	1,486	
30% Tax 1 year in arrears			(321)	(426)	(407)	(446)
Tax saved (W1 Cap Allow)			68	51	38	92
Resale/Scrap value					4,000	
Working capital (W2)	(234)	(91)	(39)	(26)	390	
Net cash flows	(5,269)	980	1,129	955	5,507	(354)
Discount factor @ 12%	1.000	0.893	0.797	0.712	0.636	0.567
PV of future cash flows	(5,269)	875	900	680	3,502	(200)
Net present value	488					

	Year 0 £'000	Year 1 £'000	Year 2 £'000	Year 3 £'000	Year 4 £'000	Year 5 £'000
Capital allowances (W1)		228	171	128	308	
Claims						
Balancing allowance (Cost £910K – scrap value – claims to date)					308	
Tax saved			68	51	38	92

Working capital (W2)	Year 0 £'000	Year 1 £'000	Year 2 £'000	Year 3 £'000	Year 4 £'000	Year 5 £'000
Turnover		2,340	3,250	3,640	3,900	

Working capital (10% of turnover)	(234)	(325)	(364)	(390)	
Relevant cash flows	(234)	(91)	(39)	(26)	390

5. NPV with inflation

Cash flows with inflation

There's a famous picture of a worker in 1920's Germany using bails of money to fuel his fire. This was due to horrible levels of hyperinflation because the money became worthless, and illustrates the dangerous impact inflation could have on an NPV. Okay, we probably won't be burning money in the near future, but if a project is taking place in a country with an unstable currency, inflation will have a huge impact on the project's profitability.

You may be given the cash flows in 'real terms', **known as real cash flows**. That's the amount that you would spend if you were to buy a product today.

Let's say the cost of a product in one year's time is £110, and inflation is 10%, that means that the product in 'real terms' costs £100.

The actual amount you will actually pay in one year is £110, and this is known as the **nominal cash flow**, and it's this cash flow that must be included in most NPV calculations.

Cost of capital with inflation

Another issue can be the use of real and nominal cost of capital figures.

If we are using real cash flows (no inflation), **then we will also be calculating real costs of capital** (no inflation).

If we're using nominal cash flows (with inflation) for our NPV, **however, we will also need to use nominal costs of capital** (with inflation).

To calculate the nominal cost of capital **we use the Fisher Equation** (named after American economist Irving Fisher) to calculate a nominal cost of capital:

(1 + real cost of capital) x (1 + general inflation rate) =
(1 + nominal cost of capital)

Or in algebraic form…

$(1 + r) \times (1 + i) = (1 + n)$

Where:

r = Real cost of capital

i = General inflation rate

n = Nominal cost of capital

Example

Here's a very quick, simple example using some random figures to demonstrate the process. The real cost of capital for a company is 8% and general inflation rate is 3%. What is the nominal cost of capital (that should be used in a typical NPV calculation?)

Nice and simple! We know that the Fisher equation is given as:

$(1 + r) \times (1 + i) = (1 + n)$

We also know that r is 8%, i is 3%, and n is the nominal cost of capital. Therefore:

$(1 + 0.08) \times (1 + 0.03) = 1 + n$

$1.08 \times 1.03 = 1 + n$

$1.1124 = 1 + n$

$0.1124 = n$

The nominal cost of capital is therefore 11.24%

NPV and Inflation

Now that we know how to calculate inflation, let's factor this into our running example of Buzzing Batteries:

	Year 0 £'000	Year 1 £'000	Year 2 £'000	Year 3 £'000	Year 4 £'000
Land and buildings	(4,125)				
Fittings and equipment	(910)				
Gross revenue		2,340	3,250	3,640	3,900
Direct costs		(975)	(1,430)	(1,950)	(2,080)
Marketing		(220)	(325)	(260)	(260)
Office overheads		(165)	(165)	(165)	(165)

- The cost of land and buildings includes £100,000 which has been spent on legal fees
- 55% of the office overhead is a charge made for head office services
- BB anticipates selling the new stores at the end of year four for £4 million which includes £75,000 for fixtures and fittings
- Working capital requirements are forecast to be 10% of revenue at the start of each year
- BB is charged corporation tax at 30%. It is collected one year in arrears
- BB's real cost of capital is 7.7% and there is currently inflation of 4%. Inflation has not been factored into the revenue generated or the costs accumulated

The first requirement is to calculate the nominal cost of capital as this should be used as the discount rate using the Fisher equation:

$(1 + r) \times (1 + i) = (1 + n)$

We also know that r is 7.7%, i is 4%, and n is the nominal cost of capital:

$(1 + 0.077) \times (1 + 0.04) = 1 + n$

$1.077 \times 1.04 = 1 + n$

$1.12008 = 1 + n$

$0.12008 = n$

The nominal cost of capital is therefore 12%. This is the rate already being used so there is no change needed!

However, the impact of inflation needs to be factored in. This impacts the costs and revenues. **The quickest way to calculate this is to multiply the total relevant cash flows by the inflation rate of 4%**. This is represented in the first year by 1.04 and in the second by 1.04^2 as this is two year's worth of inflation (1.04 x 1.04) and so on.

	Year 0 £'000	Year 1 £'000	Year 2 £'000	Year 3 £'000	Year 4 £'000	Year 5 £'000
Land and buildings	(4,125)					
Fittings and equipment	(910)					
Gross revenue		2,340	3,250	3,640	3,900	
Direct costs		(975)	(1,430)	(1,950)	(2,080)	
Marketing		(220)	(325)	(260)	(260)	
Office overheads		(74)	(74)	(74)	(74)	
Real cash flows		1,071	1,421	1,356	1,486	
Inflation		1.04	1.04	1.04	1.04	
Nominal cash flows		1,114	1,537	1,525	1,738	
30% Tax 1 year in arrears (real cash flow)			(321)	(426)	(407)	(446)
Tax saved			68	51	38	92
Resale/scrap value					4,000	
Working capital	(234)	(91)	(39)	(26)	390	
Net cash flows	(5,269)	1,023	1,245	1,124	5,759	(354)
Discount factor @ 12%	1.000	0.893	0.797	0.712	0.636	0.567
PV of future cash flows	(5,269)	914	992	800	3,663	(200)
Net present value	900					

And that is how inflation can impact the total net present value of a project!

6. Perpetuities

After looking at all the figures, the management accountant at Buzzing Batteries has a thought. Yes, the project analysed throughout this chapter has a positive NPV (this means undertaking the project will have a positive impact on the value of the company). It does assume, however, that the company will sell the shops for £4,000,000 in year 4. If this £4,000,000 figure were removed from the NPV calculation above the NPV would be negative as it would dramatically reduce the present value of year 4.

However, what if the shops were to remain open and keep generating revenue? The shops, in theory, could remain open forever and keep generating revenue for Buzzing Batteries.

There is a problem though: How would an accountant calculate this value? They couldn't just sit there and calculate a present value for every year from now until forever… they'd be there, forever.

Luckily to for the accountant, there is a calculation they could perform to find the value of a project in perpetuity (over an infinite lifetime). A caveat to remember though, **a perpetuity calculation relies on a constant and consistent cash flow that continues forever.** This means that the cash flow (all incoming and outgoings) must be identical every single year. Any inconsistencies and it cannot be a perpetuity.

The present value (how much a future figure is worth in today's money when considering the time value of money – see section 2 for a recap if needed) of a perpetuity is found using the following formula:

$$\text{Present value} = \frac{\text{Cash flow}}{r}$$

Or

$$\text{Cash flow} \times \frac{1}{r}$$

Where

r = the interest rate

$\frac{1}{r}$ = the **perpetuity factor**.

Before we look at how perpetuities can help Buzzing Batteries to consider whether to keep its shops or not, let's work through a simple example to show how a perpetuity is used.

Example

You have just won £10,000,000 on the lottery – congratulations! Despite the appeal of spending it all on fast cars and an island in the Bahamas, you have wisely decided to put some of it away to give you a guaranteed yearly income.

You decide that £240,000 per year would be a nice amount for a comfortable lifestyle. After some research, you've found an account with a princely interest rate of 12%, how much would you need to deposit there to ensure an annual return of £240,000?

Solution

This question is asking us to find the amount we need to pay into that account today, in order to receive a set amount each year, forever. This means we have to find the present value, and we know that the formula for this is:

$$\text{Present value} = \frac{\text{Cash flow}}{r}$$

The cash flow (or the amount you want to receive per annum) is £240,000 and r or the interest rate is 12%. Let's put this all into our formula:

$$\text{Present value} = \frac{240{,}000}{0.12} = £2{,}000{,}000$$

As we can see here, if you wanted to receive £240,000 per annum it would require an initial investment of £2,000,000 into that account.

You've now got £8,000,000 left over from your winnings to spend on cars and houses. Lucky you!

So that's how it works for a lottery win for example, how can perpetuities translate to Buzzing Batteries's accounts to see if the company keeps the shops or not? Let's take a look at the figures:

The nominal discount rate is still 12% (this is the cost of capital the company uses to account for the time value of money – it is the same discount factor used throughout the running Buzzing Batteries example). As such:

$$\frac{1}{0.12} = 8.33$$

This is the perpetuity factor used when the discount rate is 12%. The default perpetuity factor assumes the perpetuity starts here and now (year 0) and continues over an infinite lifetime.

The management accountant at BB estimates that revenue and costs (cash flow) will remain consistent each year from year 4 (in the real world consistent cash flows are unlikely – but it is assumed they are for the purposes of this example) and there will be **no further working capital requirements or capital allowance after Year 5**.

What does this mean for the perpetuity? Perpetuities require a constant and consistent cash flow and the default perpetuity factor starts at year 0. Can this perpetuity begin at year 0? No, because cash flows are not consistent until year 4. Can it begin in year 4 or 5? No, because there are accounting adjustments in year 5 (working capital and capital allowance). This is known as a delayed perpetuity.

This example is only constant and consistent from year 6 onwards, so the perpetuity can only begin from this year. As such the perpetuity discount factor needs to be adjusted to take this into account.

This is because the start date is 6 years from now. Discount factors from years 1-5 cannot be included because this would provide a result from year 0 and give an overinflated present value for the perpetuity.

Looking back at the running example, the discount factors from years 1-5 at at a 12% rate are (from years 1 to 5) 0.893, 0.797, 0.712, 0.636 and 0.567 respectively. These discount are deducted from the perpetuity factor to provide the perpetuity factor from year 6:

8.333 – (0.893 + 0.797 + 0.712 + 0.636 + 0.567) = 4.728

Therefore, **4.728 is the perpetuity factor from year 6 to infinity**, so… Returning to the running example (see sections 2-5 if you need to refresh your memory) this year 6 to infinity factor can be added in. Note, the £4,000,000 resale value has now been removed as this resale value will not be received if the shops remain open.

	Year 0 £'000	Year 1 £'000	Year 2 £'000	Year 3 £'000	Year 4 £'000	Year 5 £'000	Year 6 to infinity £'000
Land and buildings	(4,125)						
Fittings and equipment	(910)						
Gross revenue		2,340	3,250	3,640	3,900	3,900	3,900
Direct costs		(975)	(1,430)	(1,950)	(2,080)	(2,080)	(2,080)
Marketing		(220)	(325)	(260)	(260)	(260)	(260)
Office overheads		(74)	(74)	(74)	(74)	(74)	(74)
		1,071	1,421	1,356	1,486	1,486	1,486
30% Tax 1 year in arrears			(321)	(426)	(407)	(446)	(446)
Tax saved			68	51	38	92	
Resale/scrap value							
Working capital	(234)	(91)	(39)	(26)			
Net cash flows	(5,269)	980	1,129	955	1,117	1,132	1,040
Discount factor @12%	1.000	0.893	0.797	0.712	0.636	0.567	4.728
PV of future cash flows	(5,269)	875	900	680	710	642	4,917
Net present value	3,455						

As the perpetuity is only active from year 6, the values between years 0-5 still need to be considered. In year 6 the consistent net cash flow '£1,040,000' is multiplied by the perpetuity value from year 6 to infinity '4.728' giving the perpetuity a present value of:

£1,040,000 x 4.728 = £4,917,000 (rounded to the nearest '000).

The £4,917,000 is then added to the other present values from years 0-5 providing a net present value of £3,455,000.

Meaning that undertaking this project and keeping a hold of the shops adds £3,455,000 in value to the company. Significantly more than the £789,000 added to the company by selling the shops at the end of year 4 (see running example from sections 2-5). So, provided that the cash flow remains constant and consistent, BB will generate more value by keeping hold of the shops!

This is an example of how using NPVs and perpetuities can help you (as the management accountant) make decisions that benefit the business you work for!

7. Annuities

Last but not least in this chapter on NPVs we talk about annuities. This is another method of calculating value over a period of time. Essentially an annuity is **a financial instrument which is purchased for an initial sum which then pays out the same amount each and every year until a definitive end date.**

For example, Emily purchases an annuity at a cost of £10,000 that pays her £1,000 per year, every year, for the next 20 years. By the time the annuity has finished she'll have received £20,000 from it (£1,000 x 20). Twice what she paid for it.

The payment will continue until the specified fixed period comes to an end or other additional conditions stipulated within the policy occur, e.g. death of the owner.

Example

Emily advises her friend Jemima to take out an annuity – but Jemima is not quite as good at maths as Emily and so is left feeling a little confused. There are two annuities available to her:

- Annuity A will pay out £4,000 each year for 12 years
- Annuity B pays out £3,200 each year for 20 years

Both will involve the same initial purchase price. The first payout will be at the end of the first year and it will continue regardless of whether she dies! If this unfortunate event occurs, the payout from the annuity will move on to her next of kin.

If the rate of interest is 7% which one should she choose?

Jemima has come up against the problem of trying to figure out which one is best for her. So, how do we compare them? We have another formula!

This is the cumulative discount factor formula:

$$\frac{1}{r}\left(1 - \frac{1}{(1+r)^{n}}\right)$$

Where:

r = interest rate

n = number of years the annuity will last for

Using this formula, we can help Jemima to compare both annuity options available to her.

Annuity A:

Adding the interest rate of 7% into the formula we get:

$$\frac{1}{0.07}\left(1 - \frac{1}{(1 + 0.07)^{12}}\right)$$

$$= 14.29 \left(1 - \frac{1}{(2.252)}\right)$$

= 14.29 x 0.556

= 7.945

Next we multiply this cumulative discount rate by the amount paid to calculate the NPV:

£4,000 x 7.945 = £31,780

So the NPV is of Annuity A is £31,780.

Annuity B:

Now we need to repeat the process to calculate the NPV of annuity B. Returning to the formula:

$$\frac{1}{r}\left(1 - \frac{1}{(1+r)\ n}\right)$$

$$\frac{1}{0.07}\left(1- \frac{1}{(1+0.07)^{20}}\right)$$

$$= 14.29\left(1- \frac{1}{(3.87)}\right)$$

= 14.29 x 0.741

= 10.594

£3,200 x 10.594 = £33,901

Therefore, based on the NPVs, Annuity B is the better option as it generates more of a return overall. However, Jemima could still choose Annuity A if she would prefer to have a larger annual payout for fewer years. She would receive less money overall selecting this option though.