



## Investment Banking Manual

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## About CFI's Investment Banking Manual

The following eBook's purpose is to outline all the necessary technical skills needed to succeed in a career in investment banking. The three-part guide will walk you through fundamental accounting analysis, valuation techniques, and Excel modeling skills. Produced after hours of research and planning by current and former professionals in the investment banking industry, you will become familiar with applicable knowledge that will allow you to thrive in all your future analyst positions.

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At various points in the manual a number of financial analysis issues are examined. The financial analysis implications for these issues, although relatively standard in treatment, remain an opinion of the authors of this manual. No responsibility is assumed for any action taken or inaction as a result of the financial analysis included in the manual.

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**PART 01**

# Accounting



01

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# Introduction

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This section aims to provide investment bankers with the required level of accounting knowledge necessary to:

- Interpret, understand and adjust the numbers within a set of financial statements
- Create meaningful and appropriate forecast financials.

**The intention of this manual is to furnish investment bankers with a thorough grounding in accounting and its impact on analysis.**

Accounting rules provide the guidance and requirements for accountants when they prepare the financial statements of organisations. Although accounting rules still vary across the globe, the vast majority of companies now report under either International Financial Reporting Standards (IFRS – formerly International Accounting Standards, IAS) or United States Generally Accepted Accounting Principles (US GAAP).

At the time of writing (early 2009) there is a concerted effort to bring IFRS and US GAAP closer together, and there are many joint projects considering how to improve the rules in a way that eradicates the remaining differences. There is early talk of complete convergence to one set of global accounting rules by 2014.

There are still many differences between IFRS and US GAAP, however most of them are rather obscure and technical, and often don't actually result in different financial reporting. There are however a smaller number of differences which are important and may have a significant impact on how the performance or position of an enterprise is reported.

This manual generally avoids talking specifically about IFRS or US GAAP rules, but instead refers simply to the accounting rules. Where this is the case, the reader can assume that the rules are effectively the same. Where the differences do arise, the page splits into two, with each set of rules explained separately.

### Accounting effect on key metrics

The focus of the manual is the analysis impact of accounting issues. Set out below are the key issues which will be covered, whether these issues have an impact on key metrics and where in the manual they will be discussed.

	Impact on						
	FCF	EBITDA	EBIT	EPS	Equity	Net Debt	EV
<b>Balance sheet items</b>							
<i>Current vs. non-current</i>							
<i>Tangible assets</i>							
Depreciation	√		√	√	√		
Impairment tests and write downs			√	√	√		
Revaluation			√	√	√		√
Capitalisation of interest		√	√	√	√		
<i>Intangible assets</i>							
Goodwill – group / individual entity level					√		
Amortisation periods			√	√	√		
Tax deductibility	√			√	√		
Impairment tests and write downs			√	√	√		
Revaluations			√	√	√		
Research and development		√	√	√	√		
Other internally generated intangibles	√	√	√	√	√		
Capitalisation of software cost	√	√	√	√	√		
Brands, licenses, copyrights	√	√	√	√	√		
<i>Liabilities</i>							

Net debt definitions					✓	✓	✓
Leasing – finance / capital and operating	✓	✓	✓	✓	✓	✓	✓
Sale and leaseback transactions	✓	✓	✓	✓	✓	✓	✓
<i>Provisions</i>							
Obligation vs. prudence		✓	✓	✓	✓	✓	✓
Deferred retirement benefits		✓	✓	✓	✓	✓	✓
Deferred tax				✓	✓		
<i>Capital instruments</i>							
Debt vs. equity	✓			✓	✓	✓	✓
Preference shares	✓			✓	✓	✓	✓
<b>Incomes statement items</b>							
Revenue recognition		✓	✓	✓	✓		
Events after the balance sheet date		✓	✓	✓	✓		
Discontinued operations	✓	✓	✓	✓			
Exceptional items	✓	✓	✓	✓			
Extraordinary items	✓	✓	✓	✓			
Treatment of capitalised costs	✓	✓	✓	✓	✓		
Share based payments		✓	✓	✓	✓	✓	✓
Foreign exchange rates		✓	✓	✓	✓	✓	✓
Hyper inflations		✓	✓	✓	✓	✓	✓
The 2 <sup>nd</sup> income statement				✓			
EPS – basic/diluted				✓			
<b>Cash flow statements</b>							
Cash definitions	✓					✓	
Categories of cash flows	✓						
Free cash flows	✓						
<i>Mergers and acquisitions</i>							

Associates – equity method	✓	✓	✓	✓	✓	✓	✓
Joint ventures – equity method/proportional consolidation	✓	✓	✓	✓	✓	✓	✓
Purchase/acquisitions accounting	✓	✓	✓	✓	✓		
Control	✓	✓	✓	✓	✓	✓	✓
Consideration	✓			✓	✓	✓	✓
Goodwill/fair value accounting		✓	✓	✓	✓		
Negative goodwill			✓	✓	✓		
Minority interests	✓			✓	✓		✓
Demergers	✓	✓	✓	✓	✓		
Special purpose entities	✓	✓	✓	✓	✓	✓	✓

### Impact on analysis

The derivations of key metrics are subject to accounting issues that may undermine their analysis. The appendices include a table indicating the sort of adjustments which could be made.

As ever with analysis, the key is to ensure consistency of treatment of like items throughout. Consequently, not all adjustments are appropriate at the same time and when some adjustments are made, others become inappropriate for the same category.

For example, if joint ventures (JVs) are deemed to be core to the business' activities, then it is not good enough to merely include the results of the JV in EBIT – if the sales figure does not include the JV's sales then margins will be inconsistent; if interest does not include the JV's interest then coverage ratios will be inconsistent; if net debt doesn't include the JV's net debt then enterprise value will be inconsistent, etc.

More information is available on each adjustment in the relevant section in the manual.

# Accounting and analysis fundamentals

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## Accounting framework

Underlying most international accounting is a conceptual framework. Without knowledge of this framework, the full implications of the accounting we shall discuss in the later sections may not be fully appreciated.

## Reporting elements

Although this may seem a very basic way to commence an accounting manual, it is a necessary step. As more complicated areas of accounting are examined, such as mergers and acquisitions, it is the basic understanding of the fundamentals of accounting that often let people down.

As a starting point we shall briefly examine the basic components of financial statements. This basic framework provides an approach to discussing more complicated

Asset	Liability
Past event → present control → future benefit	Past event → present obligation → future outflow
Expense	Income
Benefit used up	Benefit earned

accounting later.

There are four key reporting elements:

***Balance sheet components*****Assets**

An asset is a resource that is:

- Controlled by a company
- Expected to result in future economic benefits.

Typically, this would be something owned by the company, such as a machine or cash, or another financial asset created by a loan but there are many different types of asset that will be covered in this chapter.

**Liabilities**

- A liability is a present obligation:
- Arising from past events

In respect of which economic benefits are expected to flow from the company.

Typically these are amounts of money owed to third parties as a result of some kind of contract.

**Equity**

Equity is the residual interest in the assets of the entity after deducting all its liabilities. Equity can be thought of as the residual interest that the owners have in the business, or the owner's claim on the residual assets.

The two principal elements of equity are:

- The equity (or shares) that have been issued to the owners of the business
- The retained earnings of the company since it started.

Every year, the total profit or loss from the income statement is transferred into retained earnings. So retained earnings represent the cumulative retained profits and losses of the company since day one.

### Recognition criteria

Assets and liabilities are only recognised if:

- There is sufficient evidence of existence
- The monetary amount can be measured with sufficient reliability.

For example, a contingent asset such as a possible cash inflow resulting from a legal action will not be recognised as an asset in the financial statements if there is significant uncertainty over the outcome, or the amount cannot be reliably measured.

In assessing whether an item meets the definition of an asset, liability or equity, attention needs to be given to its underlying substance and economic reality and not merely its legal form.

### ***Income statement components***

It is important to understand the differences between incomes and expenses that appear on the income statement, and cash inflows and outflows that appear on the cash flow statement. Neither of the income statement components has any direct recognition relationship with cash or cash equivalents.

#### Income

Income is recognised in the income statement when an increase in future economic benefits related to an increase in an asset or a decrease of a liability has arisen that can be measured reliably.

This means income recognition occurs simultaneously with the recognition of increases in assets or decreases in liabilities.

For example, if an investment increases in value by \$100, then not only has the asset increased in value, but an income will often be recognised (even though there is no cash inflow).

#### Expenses

Expenses are recognised in the income statement when a decrease in future economic benefits related to a decrease in an asset or an increase of a liability has arisen that can be measured reliably.

So similar to the example above, if the investment falls in value by \$100, then the decrease in value of the asset may be accompanied by the recognition of an expense in the income statement (even though there is no cash outflow).

### **Cash flow statement**

The cash flow statement is a record of cash flows over an accounting period. At its simplest it is a list of cash inflows and cash outflows, and it explains the difference between opening and closing cash on the balance sheet.

For ease of interpretation, cash flows are categorised as operating, investing or financing. This distinction is explained further later in this chapter.

## Accounting mechanics

An understanding of the relationship between the income statement and the balance sheet is essential before moving on to the analysis and interpretation of financial statements.

### Balancing balance sheet

The balance sheet of a company will always balance:

$$\text{Assets} = \text{Liabilities} + \text{Equity}$$

Part of the reason for this has been touched upon above, the fact that changes in assets and liabilities are often accompanied by incomes or expenses in the income statement, which flow through to retained earnings within equity.

In fact, whatever happens at a company, there will always be two equal and opposite effects in the financial statements, maintaining the equilibrium.

### Dual effect

When accountants talk about double-entry bookkeeping and debits and credits they are referring to the fact that there is always a dual effect whenever anything impacts a set of financial statements.

This is best illustrated with some examples. The table illustrates, for a number of events, the impact on assets, liabilities, income and expenses:

Company borrows money from the bank	Cash (asset) ↑	Loan (liability) ↑
<i>Equal and opposite movements on the balance sheet</i>		
Company buys a vehicle	Cash (asset) ↓	Vehicle (asset) ↑
<i>Equal and opposite movements on the balance sheet</i>		
Company pays staff wages	Cash (asset) ↓	Wages (expense) ↑

*The expense will reduce retained earnings (equity) which will match the fall in assets*

Company sells goods      Cash (asset)↑10      Sales (income)↑10  
(cost \$6) for cash of \$10    Inventory (asset)↓6    Cost of sales (expense)↑6

*Balance sheet assets increase by 4 which matches the 4 increase in retained earnings*

This basic interaction between the income statement and the balance sheet underpins all of accounting. Regardless of what has just happened at a company, the accounting for it will always be represented by one or more of these dual effects.

### **Presentation of financial statements**

The exact content and presentation of financial statements will vary widely depending on the regime (IFRS or US GAAP) and the particular requirements and needs of the preparers and the users of the statements. Both IFRS and US GAAP have a minimum requirement for presentation on the face of the balance sheet, income statement and cash flow statement but, beyond this minimum, practice varies considerably.

Presented here are typical examples of IFRS (Tesco) and US GAAP (WalMart) income statements, balance sheets and cash flow statements for comparison purposes. In addition there is an IFRS Statement of Recognised Income and Expense, and the US equivalent, the Statement of Shareholders Equity. Although there are many differences in presentation, there are many similarities. The similarities have been highlighted.

**Presentation of primary statements****Tesco Group Income Statement (IFRS)**

year ended 23 February 2008	2008 £m	2007 £m
Continuing operations		
Revenue (sales excluding VAT)	47298	42641
Cost of sales	(43668)	(39401)
Pensions adjustment – Finance Act 2006	–	258
Impairment of the Gerrards Cross site	–	(35)
Gross profit	3630	3463
Administrative expenses	(1027)	(907)
Profit arising on property-related items	188	92
<b>Operating profit</b>	<b>2791</b>	<b>2648</b>
Share of post-tax profits of joint ventures and associates (including Enil on property-related items (2006/7 – £47m gain))	75	106
Profit on sale of investments in associates	–	25
<b>Finance income</b>	<b>187</b>	<b>90</b>
<b>Finance costs</b>	<b>(250)</b>	<b>(216)</b>
Profit before tax	2803	2653
<b>Taxation</b>	<b>(673)</b>	<b>(772)</b>
Profit for the year from continuing operations	2130	1881
Discontinued operation		
Profit for the year from discontinued operation	–	18
Profit for the year	2130	1899
Attributable to:		
Equity holders of the parent	2124	1892
Minority interests	6	7
	2130	1899
Earnings per share from continuing and discontinued operations		
Basic	26.95p	23.84p
Diluted	26.61p	23.54p
Earnings per share from continuing operations		
Basic	26.95p	23.61p
Diluted	26.61p	23.31p
Non-GAAP measure: underlying profit before tax		
Profit before tax (excluding discontinued operation)	2803	2653
Adjustments for:		
IAS 32 and IAS 39 'Financial Instruments' – Fair value remeasurements	(49)	4
IAS 19 Income Statement charge for pensions	414	432
'Normal' cash contributions for pensions	(340)	(321)
IAS 17 'Leases' – impact of annual uplifts in rent and rent-free periods	18	–
Exceptional items:		
Pensions adjustment – Finance Act 2006	–	(258)
Impairment of the Gerrards Cross site	–	35
Underlying profit before tax	2846	2545

Source: Tesco Annual Report

**Wal-Mart Consolidated Statements of Income (US GAAP)**

	Fiscal Year Ended January 31		
	2008	2007	2006
(Amounts in millions except per share data)			
<b>Revenues:</b>			
Net sales	\$ 374,526	\$ 344,992	\$ 308,945
Membership and other income	4,273	3,658	3,156
	378,799	348,650	312,101
<b>Costs and expenses:</b>			
Cost of sales	286,515	264,152	237,649
Operating, selling, general and administrative expenses	70,288	64,001	55,739
	21,996	20,497	18,713
<b>Operating income</b>			
<b>Interest:</b>			
Debt	1,863	1,549	1,171
Capital leases	240	260	249
Interest income	(305)	(280)	(242)
Interest, net	1,798	1,529	1,178
<b>Income from continuing operations before income taxes and minority interest</b>	20,198	18,968	17,535
<b>Provision for income taxes:</b>			
Current	6,916	6,276	5,932
Deferred	(8)	89	(129)
	6,908	6,365	5,803
<b>Income from continuing operations before minority interest</b>	13,290	12,603	11,732
<b>Minority interest</b>	(406)	(425)	(324)
<b>Income from continuing operations</b>	12,884	12,178	11,408
<b>Loss from discontinued operations, net of tax</b>	(153)	(894)	(177)
<b>Net income</b>	\$ 12,731	\$ 11,284	\$ 11,231
<b>Net income per common share:</b>			
Basic income per common share from continuing operations	\$ 3.17	\$ 2.92	\$ 2.73
Basic loss per common share from discontinued operations	(0.04)	(0.21)	(0.05)
<b>Basic net income per common share</b>	<b>\$ 3.13</b>	<b>\$ 2.71</b>	<b>\$ 2.68</b>
Diluted income per common share from continuing operations	\$ 3.16	\$ 2.92	\$ 2.72
Diluted loss per common share from discontinued operations	(0.03)	(0.21)	(0.04)
<b>Diluted net income per common share</b>	<b>\$ 3.13</b>	<b>\$ 2.71</b>	<b>\$ 2.68</b>
<b>Weighted-average number of common shares:</b>			
Basic	4,066	4,164	4,183
Diluted	4,072	4,168	4,188
<b>Dividends declared per common share</b>	<b>\$ 0.88</b>	<b>\$ 0.67</b>	<b>\$ 0.50</b>

Source: Wal-Mart Annual Report

**Tesco Group Balance Sheet (IFRS)**

	2008 £m	2007 £m
<b>Non-current assets</b>		
Goodwill and other intangible assets	2,336	2,045
<b>Property, plant and equipment</b>	<del>19,787</del>	<del>16,976</del>
Investment property	1,112	856
Investments in joint ventures and associates	305	314
Other investments	4	8
Derivative financial instruments	216	-
Deferred tax assets	104	32
	<b>23,864</b>	<b>20,231</b>
<b>Current assets</b>		
Inventories	2,430	1,931
Trade and other receivables	1,311	1,079
Derivative financial instruments	97	108
Current tax assets	6	8
Short-term investments	360	-
Cash and cash equivalents	1,788	1,042
	<b>5,992</b>	<b>4,168</b>
Non-current assets classified as held for sale	308	408
	<b>6,300</b>	<b>4,576</b>
<b>Current liabilities</b>		
Trade and other payables	(7,277)	(6,046)
Financial liabilities		
Borrowings	(2,084)	(1,554)
Derivative financial instruments and other liabilities	(443)	(87)
Current tax liabilities	(455)	(461)
Provisions	(4)	(4)
	<b>(10,263)</b>	<b>(8,152)</b>
<b>Net current liabilities</b>	<b>(3,963)</b>	<b>(3,576)</b>
<b>Non-current liabilities</b>		
Financial liabilities		
Borrowings	(5,972)	(4,146)
Derivative financial instruments and other liabilities	(322)	(399)
Post-employment benefit obligations	(838)	(950)
Other non-current payables	(42)	(29)
Deferred tax liabilities	(802)	(535)
Provisions	(23)	(25)
	<b>(7,999)</b>	<b>(6,084)</b>
<b>Net assets</b>	<b>11,902</b>	<b>10,571</b>
<b>Equity</b>		
Share capital	393	397
Share premium account	4,511	4,376
Other reserves	40	40
Retained earnings	6,871	5,693
<b>Equity attributable to equity holders of the parent</b>	<b>11,815</b>	<b>10,506</b>
<b>Minority interests</b>	<b>87</b>	<b>65</b>
<b>Total equity</b>	<b>11,902</b>	<b>10,571</b>

Source: Tesco annual report

**Wal-Mart Consolidated Balance Sheet (US GAAP)**

	January 31 2008	2007
<b>Assets</b>		
<b>Current assets:</b>		
Cash and cash equivalents	\$ 5,569	\$ 7,767
Receivables	3,654	2,840
Inventories	35,180	33,685
Prepaid expenses and other	3,182	2,690
	<b>47,585</b>	<b>46,982</b>
<b>Property and equipment, at cost:</b>		
Land	19,879	18,612
Buildings and improvements	72,533	64,052
Fixtures and equipment	28,026	25,168
Transportation equipment	2,210	1,966
Property and equipment, at cost	122,648	109,798
Less accumulated depreciation	(28,773)	(24,408)
Property and equipment, net	93,875	85,390
<b>Property under capital lease:</b>		
Property under capital lease	5,736	5,392
Less accumulated amortization	(2,594)	(2,342)
Property under capital lease, net	3,142	3,050
Goodwill	16,071	13,759
Other assets and deferred charges	2,841	2,406
	<b>163,514</b>	<b>151,587</b>
<b>Liabilities and shareholders' equity</b>		
<b>Current liabilities:</b>		
Commercial paper	\$ 5,040	\$ 2,570
Accounts payable	30,370	28,484
Accrued liabilities	15,799	14,675
Accrued income taxes	1,016	706
Long-term debt due within one year	5,913	5,428
Obligations under capital leases due within one year	316	285
	<b>58,454</b>	<b>52,148</b>
<b>Long-term debt</b>		
Long-term obligations under capital leases	29,799	27,222
Deferred income taxes and other	3,603	3,513
Minority interest	5,111	4,971
	<b>1,939</b>	<b>2,160</b>
<b>Commitments and contingencies</b>		
<b>Shareholders' equity:</b>		
Preferred stock (\$0.10 par value; 100 shares authorized, none issued)	—	—
Common stock (\$0.10 par value; 11,000 shares authorized, 3,973 and 4,131 issued and outstanding at January 31, 2008 and January 31, 2007, respectively)	397	413
Capital in excess of par value	3,028	2,834
Retained earnings	57,319	55,818
Accumulated other comprehensive income	3,864	2,508
Total shareholders' equity	64,608	61,573
	<b>163,514</b>	<b>151,587</b>

Source: Wal-Mart Annual Report

**Tesco Group Cash Flow Statement (IFRS)**

	2008 £m	2007 £m
Cash flows from operating activities		
Cash generated from operations	4099	3532
Interest paid	(410)	(376)
Corporation tax paid	(346)	(545)
<b>Net cash from operating activities</b>	<b>3343</b>	<b>2611</b>
Cash flows from investing activities		
Acquisition of subsidiaries, net of cash acquired	(169)	(325)
Proceeds from sale of subsidiary, net of cash disposed	–	22
Proceeds from sale of joint ventures and associates	–	41
Purchase of property, plant and equipment and investment property	(3442)	(2852)
Proceeds from sale of property, plant and equipment	1056	809
Purchase of intangible assets	(158)	(174)
Increase in loans to joint ventures	(36)	(21)
Invested in joint ventures and associates	(61)	(49)
Invested in short-term investments	(360)	–
Dividends received	88	124
Interest received	128	82
<b>Net cash used in investing activities</b>	<b>(2954)</b>	<b>(2343)</b>
Cash flows from financing activities		
Proceeds from issue of ordinary share capital	138	156
Proceeds from sale of ordinary share capital to minority interests	16	–
Increase in borrowings	9333	4743
Repayment of borrowings	(7993)	(4559)
New finance leases	119	99
Repayment of obligations under finance leases	(32)	(15)
Dividends paid	(792)	(467)
Dividends paid to minority interests	(2)	–
Own shares purchased	(775)	(490)
<b>Net cash from/(used in) financing activities</b>	<b>412</b>	<b>(533)</b>
Net increase/(decrease) in cash and cash equivalents	801	(265)
Cash and cash equivalents at beginning of year	1042	1325
Effect of foreign exchange rate changes	(55)	(18)
Cash and cash equivalents at end of year	1788	1042

Source: Tesco annual report

**Wal-Mart Consolidated Statements of Cash Flows (US GAAP)**

	(Amounts in millions)	Fiscal Year Ended January 31	
	2008	2007	2006
<b>Cash flows from operating activities:</b>			
Net income	\$ 12,731	\$ 11,284	\$ 11,231
Loss from discontinued operations, net of tax	153	894	177
Income from continuing operations	12,884	12,178	11,408
Adjustments to reconcile income from continuing operations to net cash provided by operating activities:			
Depreciation and amortization	6,317	5,459	4,645
Deferred income taxes	(8)	89	(129)
Other operating activities	601	1,039	613
Changes in certain assets and liabilities, net of effects of acquisitions:			
Increase in accounts receivable	(564)	(214)	(466)
Increase in inventories	(775)	(1,274)	(1,761)
Increase in accounts payable	865	2,132	3,031
Increase in accrued liabilities	1,034	588	1,002
<b>Net cash provided by operating activities of continuing operations</b>	<b>20,354</b>	<b>19,997</b>	<b>18,343</b>
Net cash used in operating activities of discontinued operations	—	(45)	(102)
<b>Net cash provided by operating activities</b>	<b>20,354</b>	<b>19,952</b>	<b>18,241</b>
<b>Cash flows from investing activities:</b>			
Payments for property and equipment	(14,937)	(15,666)	(14,530)
Proceeds from disposal of property and equipment	957	394	1,042
(Payments for) proceeds from disposal of certain international operations, net	(257)	610	—
Investment in international operations, net of cash acquired	(1,338)	(68)	(601)
Other investing activities	(95)	223	(67)
<b>Net cash used in investing activities of continuing operations</b>	<b>(15,670)</b>	<b>(14,507)</b>	<b>(14,156)</b>
<b>Net cash provided by (used in) investing activities of discontinued operations</b>	<b>—</b>	<b>44</b>	<b>(30)</b>
<b>Net cash used in investing activities</b>	<b>(15,670)</b>	<b>(14,463)</b>	<b>(14,186)</b>
<b>Cash flows from financing activities:</b>			
Increase (decrease) in commercial paper	2,376	(1,193)	(704)
Proceeds from issuance of long-term debt	11,167	7,199	7,691
Payment of long-term debt	(8,723)	(5,758)	(2,724)
Dividends paid	(3,586)	(2,802)	(2,511)
Purchase of Company stock	(7,691)	(1,718)	(3,580)
Payment of capital lease obligations	(343)	(340)	(245)
Other financing activities	(334)	(227)	(349)
<b>Net cash used in financing activities</b>	<b>(7,134)</b>	<b>(4,839)</b>	<b>(2,422)</b>
Effect of exchange rates on cash	252	97	(101)
Net (decrease) increase in cash and cash equivalents	(2,198)	747	1,532
Cash and cash equivalents at beginning of year <sup>(1)</sup>	7,767	7,020	5,488
Cash and cash equivalents at end of year <sup>(2)</sup>	\$ 5,569	\$ 7,767	\$ 7,020

**Supplemental disclosure of cash flow information**

Income tax paid      \$ 6,299.00      \$ 6,665.00      \$ 5,962.00

Interest paid            1,622            1,553            1,390

Capital lease obligations incurred    447            159            286

(1) Includes cash and cash equivalents of discontinued operations of \$221 and \$383 million at January 31, 2006 and 2005.

(2) Includes cash and cash equivalents of discontinued operations of \$221 million at January 31, 2006.

Source: Wal-Mart Annual Report

**Tesco Group statement of recognised income and expense**  
year ended 23 February 2008

	2008 £m	2007 £m
Loss on revaluation of available-for-sale investments	(4)	(1)
Foreign currency translation differences	38	(65)
Total gain on defined benefit pension schemes	187	114
Gains/(losses) on cash flow hedges:		
Net fair value gains/(losses)	66	(26)
Reclassified and reported in the Group Income Statement	(29)	(12)
Tax on items taken directly to equity	123	12
Net income recognised directly in equity	381	22
Profit for the year	2130	1899
Total recognised income and expense for the year	2511	1921
Attributable to:		
Equity holders of the parent	2500	1920
Minority interests	11	1
	<b>2511</b>	<b>1921</b>

Source: Tesco Annual Report

**Wal-Mart Consolidated Statements of Shareholders' Equity (US GAAP)**

	Number of Shares	Common Stock	Excess of Par Value	Accumulated Other Comprehensive Income		
				Capital in Excess of Par Value	Retained Earnings	Total
Balance – January 31, 2005	4234	\$ 423	\$ 2,425	\$ 2,694	\$ 43,854	\$ 49,396
Comprehensive income:						
Net income					11231	11231
Other comprehensive income:						
Foreign currency translation					(1691)	(1691)
Net changes in fair values of derivatives					(1)	(1)
Minimum pension liability					51	51
Total comprehensive income						9590
Cash dividends (\$0.60 per share)						(2511)
Purchase of Company stock	(74)	(7)	(104)			(3469)
Stock options exercised and other	5	1	275			276
<b>Balance – January 31, 2006</b>	<b>4165</b>	<b>\$ 417</b>	<b>\$ 2,596</b>	<b>\$ 1,053</b>	<b>\$ 49,105</b>	<b>\$ 53,171</b>
Comprehensive income:						
Net income						11284
Other comprehensive income:						
Foreign currency translation					1584	1584
Net changes in fair values of derivatives					6	6
Minimum pension liability					(15)	(15)
Total comprehensive income						12859
Adjustment for initial application of SFAS 158, net of tax					(120)	(120)
Cash dividends (\$0.67 per share)						(2802)
Purchase of Company stock	(39)	(4)	290			(1769)
Stock options exercised and other	5	1	290			290
<b>Balance – January 31, 2007</b>	<b>\$ 4,131</b>	<b>\$ 413</b>	<b>\$ 2,834</b>	<b>\$ 2,508</b>	<b>\$ 55,818</b>	<b>\$ 61,573</b>
Comprehensive income:						
Net income						12731
Other comprehensive income:						
Foreign currency translation					1218	1218
Net changes in fair value of derivatives					(1)	(1)
Minimum pension liability					138	138
Total comprehensive income						14087
Cash dividends (\$0.88 per share)						(3586)
Purchase of Company stock	(166)	(17)	(190)			(7484)
Stock options exercised and other	8	1	384			385
Adoption of FIN 48						(160)
<b>Balance – January 31, 2008</b>	<b>\$ 3,973</b>	<b>\$ 397</b>	<b>\$ 3,028</b>	<b>\$ 3,864</b>	<b>\$ 57,319</b>	<b>\$ 64,608</b>

Source: Wal-Mart Annual Report

***Non-recurring items***

When analysing financial statements, it is important to be able to distinguish between the normal, core, recurring performance of the business and the impact of any non-recurring one-off items, such as the sale of a company, or a significant write-off of an asset.

Accounting rules require that the impact of non-recurring items should be presented separately in the financial statements if not doing so would make the accounts misleading.

IFRS	US GAAP
Non-recurring items (often referred to as "exceptional items") should be presented separately in the income statement before operating profit/EBIT	Highly unusual items (often referred to as "extraordinary items") should be presented net of taxes in a separate section of the income statement below operating profit/EBIT

***Discontinued operations***

Discontinued operations are those that have been disposed of by the year-end or are planned to be sold or discontinued during the next year. Accounting rules require that the results of such operations be presented separately on the face of the income statement. Similarly the balance sheet must show separately the amounts relating to assets and associated liabilities held for sale at the balance sheet date.

On the day that assets are classified as held for sale they cease to be depreciated, and, if required, are immediately written down to their fair value less costs to sell.

## Balance sheet issues

Items are presented on the balance sheet in order of liquidity, in other words, closeness to cash. Liquid items are close to cash and can be converted to cash quickly and cheaply, like short-term deposits, or receivables that are expected to be paid shortly. Illiquid items are difficult to convert to cash, for example land and buildings.

The terminology used on the balance sheet is "current", for items expected to be settled in cash within 12 months and "non-current" for items not expected to settle within 12 months.

### Assets

#### ***Current assets***

##### *Cash and equivalents*

Often the first item on the balance sheet is the most liquid, which is cash and cash equivalents. This section normally includes all cash held at the bank or on deposit, and any short-term investments that can quickly and cheaply be converted into cash.

##### *Receivables*

Receivables are amounts of money that are owed to the company by others. The only accounting issue here is that accountants are required to be prudent or cautious so must ensure that the balance sheet value of receivables does not exceed the expected recovery.

From time to time, doubts may be raised about whether a particular third party will be able to pay their debt, and the receivable may need to be written down, or completely written off. The accountants estimate how much will be recovered, reduce the receivable by the appropriate amount, and recognise a corresponding expense in the income statement.

##### *Inventory*

Inventory is defined as items used by a company that represent or contribute to the finished goods that are eventually sold to customers.

**Cost**

Inventory sits on the balance sheet at cost. This includes all costs of purchase, conversion and other costs incurred in bringing inventories to their present location and condition. This would include the wages of production staff and even some allocation of overheads such as utilities or property rentals.

In the same way that receivables can require write-downs, inventory can "go bad" from physical damage, deterioration, or obsolescence. The accounting treatment is the same: the balance sheet asset falls with a corresponding expense in the income statement.

**FIFO, LIFO or weighted average?**

A systematic method must be used to model the flow of inventory through the production process. "Cost of sales" in the income statement is the cost to the company of the goods that have been sold in the period. This can be difficult to determine where there are complex flows of inventory throughout the process and the purchase cost of raw materials is changing all the time. Consider the following example:

A sugar manufacturer buys 100 tonnes of unrefined sugar in April at \$1,000/ton and a further 200 tons in September at \$1,200/tonne. In November they sell 250 tonnes of refined sugar. What should the "cost of sales" number be?

There is no right or wrong answer to this question. The answer depends on how the flow of sugar is modeled through the process.

**First In First Out (FIFO)**

Cost of sales =  $(100 \times 1,000) + (150 \times 1,200) = \$280,000$

**Last in First Out (LIFO)**

Cost of sales =  $(200 \times 1,200) + (50 \times 1,000) = \$290,000$

**Weighted Average**

Cost of sales =  $250 \times ((100 \times 1,000) + (200 \times 1,200)) / 300 = \$283,334$

The Finance Director will select the policy that is most appropriate to the business. This choice of accounting policy will be disclosed in the notes to the financial statements and is generally not permitted to be changed over time.

IFRS	US GAAP
LIFO is not permitted as a costing method	All appropriate methods are permitted including LIFO

### ***Considerations for investment banking: Current assets***

Write downs of current assets such as receivables and inventory are non-cash charges to the income statement hence it is important to adjust for them when deriving a cash flow number from a profit number. This is often part of a "changes in working capital" adjustment along with other components of working capital such as current liabilities.

When comparing profit metrics from one company to another it is important to ensure (if inventory is a material number in the accounts) that the inventory costing models are comparable. Where one company uses FIFO and the other uses a weighted average, adjustments may need to be made to make the numbers more comparable.

### ***Non-current assets***

Non-current assets are those that the company expects to benefit from over a longer time in the future, typically greater than 12 months. A vehicle, or a piece of plant or machinery would be classified as a non-current asset as the company would expect to be using the asset for an extended period of time.

#### ***Tangible non-current assets***

Tangible non-current assets are those that have physical form or substance. In other words, you can touch them. You can touch a vehicle, so it is a tangible asset, as opposed to a trademark which has no physical form and is not a tangible asset.

A tangible non-current asset is initially measured at cost. Cost comprises:

Purchase price

- Any costs directly attributable to bringing the asset to the location and condition necessary for it to be operational
- The initial estimate of the costs of dismantling and removing the item and restoring the site on which it is located.

Directly attributable costs would typically include:

- Costs of employee benefits arising directly from the construction or acquisition of the asset
- Costs of site preparation
- Initial delivery and handling costs
- Installation and assembly costs
- Costs of testing whether the asset is functioning properly
- Professional fees.

IFRS	US GAAP
IFRS provides a choice of two methods for the ongoing measurement of tangible non-current assets after initial recognition; the cost model or the revaluation model. Although this is a free choice for the finance director, it must be made by class of asset. In other words, if a decision is taken to adopt the revaluation model for a property, then all properties will need to be revalued.	US GAAP permits only the cost model

***Cost model***

After recognition, the tangible non-current asset is carried at its cost less any accumulated depreciation and any accumulated impairment losses.

***Depreciation***

With the exception of goodwill, land and other assets with infinite useful economic lives (rare), all assets are depreciated through the income statement over their useful economic life. This is the matching of the cost of the asset to the time periods which benefit from the use of the asset. The dual effect is asset down on the balance sheet, and depreciation expense up in the income statement.

Assets should be depreciated in a manner that reflects the pattern in which the benefits of the asset are consumed over time. For simplicity, this is often “straight-line” over the life of the asset with an equal proportion of the cost of the asset being depreciated each year. Another common method is accelerated depreciation, where a constant percentage of book value is charged each period, resulting in higher expenses in the early years to reflect the fact that a greater proportion of the benefit arises when the asset is new.

***Revaluation model***

IFRS	US GAAP
<p>If the revaluation model is chosen, then after recognition the tangible non-current asset is carried at a revalued amount, being its fair value at the date of the revaluation less any subsequent accumulated depreciation and subsequent accumulated impairment losses.</p> <p>Movements in value over time are not reflected in the income statement, but in a separate component of equity called the revaluation reserve. This avoids the income statement becoming misleading as the gain or loss is not yet realised.</p> <p>Assets must be revalued with sufficient frequency to ensure that the carrying value is kept up to date (no requirement for annual revaluation).</p>	Revaluation model not an option.

***Capitalisation of borrowing costs***

The standard treatment for borrowing costs is to recognise interest expense in the income statement. However, the accounting rules require an alternative treatment where the financing is specifically for the purpose of buying or constructing an asset. A company must treat the cost in the same way as all other direct costs of the asset, and capitalise the amounts as part of the asset itself. This has the consequence of improving net income in the short term with a corresponding reduction in net income in the future when the additional depreciation will need to be recognised.

**Illustration – interest capitalisation**

Tesco capitalise interest paid on funds specifically related to financing of assets under the course of construction. The impact is to remove an interest charge from the income statement and capitalise it into fixed assets. This is purely an accounting policy decision and does not change the amount of cash interest paid in the period.

**BORROWING COSTS** Borrowing costs directly attributable to the acquisition or construction of qualifying assets are capitalised. Qualifying assets are those that necessarily take a substantial period of time to prepare for their intended use. All other borrowing costs are recognised in the Group Income Statement in the period in which they occur.

Source: Tesco Annual Report

From the accounting extract below, £103m has been capitalised from net interest payable into fixed assets. This has reduced the net interest payable from £262m to £159m; the interest cover (as illustrated = EBIT ÷ Net interest payable) is reduced from 17.5x to 10.6x.

Capitalised interest will subsequently hit the income statement through the depreciation charge. There is generally no tax effect of capitalising interest either at the time of capitalising or at subsequent expensing

**NOTE 5 Finance income and costs**

2008 £m

Finance costs	
Interest payable on short-term bank loans and overdrafts repayable within five years	(47)
Finance charges payable under finance leases and hire purchase contracts	(13)
4% 125m GBP unsecured deep discount loan stock 2006	-
6% 150m GBP Medium Term Note (MTN) 2006	-
0.7% 50bn JPY MTN 2006	-
7.5% 258m GBP MTN 2007	(8)
6% 125m GBP MTN 2008	(7)
5.25% 500m EUR MTN 2008	(18)
5.125% 192m GBP MTN 2009	(10)
6.625% 150m GBP MTN 2010	(10)
4.75% 750m EUR MTN 2010	(25)
3.875% 500m EUR MTN 2011	(13)
4% RPI GBP MTN 2016(b)	(20)
5.5% 850m USD Bond 2017	(12)
5.5% 350m GBP MTN 2019	(19)
5% 415m GBP MTN 2023	(18)
3.322% LPI GBP MTN 2025(c)	(19)
6% 200m GBP MTN 2029	(12)
5.5% 200m GBP MTN 2033	(11)
1.982% RPI GBP MTN 2036(d)	(11)
6.15% 1,150m USD Bond 2037	(18)
5% 300m GBP MTN 2042	(15)
5.125% 600m EUR MTN 2047	(21)
5.2% 500m GBP MTN 2057	(13)
Other MTNs	(13)
Capitalised interest	103
<b>Total finance costs (on historical cost basis)</b>	<b>(250)</b>

Source: Tesco Annual Report

## Considerations for investment banking: Tangible non-current assets

The following will impact capital employed (and equity), depreciation and profit or loss:

- PPE can be revalued under IFRS
- All assets with a finite useful life must be depreciated
- Interest should be capitalised during the construction of an asset.

## *Intangible non-current assets*

Intangible non-current assets have no physical form or substance such as patents, licenses, trademarks, brands, and rights to do certain things. They generally take the form of a contract.

### *Purchased intangibles*

Purchased intangibles such as telecoms licenses, or rights to explore for oil and gas, are treated in the same manner as tangible assets. They are recognised on the balance sheet at cost and depreciated (or amortised) over their useful economic lives.

IFRS	US GAAP
There is an option to revalue purchased intangible assets, but only if there is an active market for the asset, which is unusual.	No option to revalue

### *Goodwill*

Goodwill is a particular type of purchased intangible asset that arises in the financial statements of a group that has acquired a company. It is the excess of the consideration for the acquisition over and above the fair value of the identifiable net assets acquired. Goodwill is not amortised but must be tested

for impairment every year. Goodwill is covered in more detail in Accounting and analysis for mergers and acquisitions.

### ***Internally generated intangibles***

Reputation, knowledge, experience and human capital are all examples of intangible assets that are generated internally rather than acquired. They are not recognised on the balance sheet and any expenditure on developing these is expensed through the income statement.

### ***Research and development***

Speculative research is always treated as an expense in the income statement.

IFRS	US GAAP
<p>Development expenditure on particular projects should be capitalised in specific circumstances, where the company can demonstrate all of the following:</p> <ul style="list-style-type: none"><li>• The technical feasibility of completing the project resulting in a product that will eventually be available for use or sale</li><li>• Its intention to complete the project and use or sell the product</li><li>• Its ability to use or sell the product</li><li>• How the project will generate probable future benefits</li></ul>	<p>Development expenditure is generally expensed as incurred, with the exception of certain costs associated with the development of internal use software and websites.</p>

- Its ability to reliably measure the expenditure attributable to the project.

This treatment is often adopted for drugs companies or high tech industries that invest large amounts of money on the development of products that will bring benefits in the future.

### ***Amortisation***

Amortisation is depreciation for intangible assets. However, the two words, depreciation and amortisation are increasingly used interchangeably.

***Considerations for investment banking: Intangible non-current assets***

The following will impact capital employed (and equity), amortisation and profit or loss:

- Purchased goodwill is capitalised and reviewed annually for impairment rather than amortised as it was in the past
- Intangibles acquired as part of an acquisition of a business should be capitalised separately from goodwill – see Accounting and analysis for mergers and acquisitions
- Intangibles arising from development must be capitalised if they fulfil the IFRS criteria.

In order to ensure cross-border comparability between European and US companies, bankers may need to:

- Re-define EBITDA, EBITA, EBIT, EPS and adjusted equity and capital employed (adjusted for intangibles) to account for the differing impacts of intangibles
- Focus on EBITDARD (earnings before interest, tax, depreciation, amortisation and research and development) in certain sectors, such as pharmaceuticals.

**Impairment**

Prudence dictates that assets on the balance are not overstated (that they don't exceed the value of the future economic benefits). Where an asset is carried on the balance sheet at a higher value than the recoverable amount of the asset, the asset will need to be written down or impaired.

**Impairment indicators**

An enterprise assesses at each balance sheet date whether events or changes in circumstances indicate that an asset has become impaired. Indicators of impairment would include:

- Current period operating loss
- Significant decline in market value
- Obsolescence or physical damage

- Significant adverse changes in business, market, statutory environment, regulatory environment or indicator of value used to measure fair value on acquisition
- Commitment to significant reorganisation
- Significant change in market rates of return likely to affect recoverable amount.

IFRS	US GAAP
No quantitative test to indicate whether an impairment test is required or not.	Impairment test not required where gross (undiscounted) value of future cash flows exceeds carrying value of the asset.

### ***Recoverable amount***

The recoverable amount (RA) of an asset is the higher of its net realisable value (NRV) and its value in use (VIU). An impairment test determines the recoverable amount of the asset and if that is lower than the balance sheet carrying value then the asset is impaired and will be written down to the recoverable amount.

Net Realisable Value: Selling price, less directs costs of selling the asset

Value in Use: Present value of the future cash flows directly attributable to the asset

### ***Income statement impact of impairment losses***

If the asset is held on the balance sheet at historic cost then any impairment loss is taken to the income statement. If the asset has been revalued upwards in the past then the impairment loss will reduce the revaluation reserve down to nil, with any additional impairment creating an income statement expense.

**Impairment testing illustration**

Circumstances have indicated that the asset outlined below has suffered impairment. The details of the impairment review and test are outlined below.

<b>Impairment testing</b>	
Carrying value of asset	\$180,000
Net selling price	\$150,000
Remaining useful life	5 years
Appropriate discount rate	c. 7.00%
<b>Forecasted future cash flows</b>	
Year 1	56,000
Year 2	45,000
Year 3	36,000
Year 4	27,000
Year 5	19,000
<b>Undiscounted future cash flows</b>	<b>183,000</b>
<b>Discounted future cash flows</b>	<b>155,173</b>
<b>Required impairment charge (IFRS)</b>	<b>24,827</b>
<b>Required impairment charge (US)</b>	-

IFRS will determine that an asset is impaired by comparing the carrying value of the asset to the recoverable amount. In the case outlined above, the recoverable amount (the higher of the value in use [\$155,173] compared to the net selling price of the asset [\$150,000]) of \$155,173 indicates that the asset requires an impairment adjustment of \$24,827 [\$180,000-\$155,173]. This impairment adjustment will be charged directly to the income statement.

*Note: There would be no such impairment under US GAAP as an asset is deemed not to be impaired if the sum of the future cash flows (undiscounted) is higher than the carrying value of the asset.*

*Reversals of impairment losses*

IFRS	US GAAP
Where the indicators of impairment have reversed, past impairments should potentially be reversed for all assets apart from goodwill.	Impairments never reversed.

***Considerations for investment banking: Impairment***

In the same way that write downs of current assets are a non-cash expense, so are impairments of non-current assets. Care is needed when analysing historic impairment charges or even considering the likelihood of future impairments. Impairment testing by its very nature is subjective as both NRV and VIU often rely on inputs and assumptions that can be difficult to validate.

**Liabilities**

Similar to assets, liabilities are presented as either current (falling due within 12 months of the balance sheet date) or non-current (falling due after more than 12 months following the balance sheet date).

**Debt**

Debt comes in a wide range of forms but the accounting for it has a number of consistent themes.

***Debt vs. equity***

Financial instruments issued by a company must be classified for accounting purposes as either debt or equity. It is usually quite clear whether the instrument represents debt or equity:

- Ordinary shares issued for cash are clearly equity as there is no obligation to deliver cash (pay a dividend)

- A bank loan is clearly debt, as there is a contractual obligation to deliver cash (pay interest).

However there are certain instruments which exhibit characteristics of both debt and equity.

### ***Preference shares and redeemable securities***

Legally, a preference share is a share of the company that gives some kind of guaranteed return to the investor, and hence exhibits debt like characteristics. Whether preference shares are presented as debt or equity on the balance sheet (and the servicing as interest or dividends in the income statement) depends on the exact features of the instrument, but many preference shares are treated as debt due to the guaranteed payout.

IFRS	US GAAP
Redeemable securities where the holder has the option to ask for their investment back are typically presented as debt.	Redeemable securities typically presented as part of equity or, for SEC registrants, mezzanine equity.

### ***Considerations for investment banking: Debt vs. equity***

The debt vs. equity issue can have a significant impact on the financial statements of a company that is moving from one accounting regime to another. For example, in the period when a European company transitions from its local GAAP to IFRS, it may find that some of its issued instruments (redeemable preference shares) that have been presented as equity in the past need to be moved into the debt category. This can result in a significant change to the shape of the balance sheet and the reader might be fooled into thinking that something real has happened at the company, when nothing actually has happened. The company is simply reporting under different accounting rules.

### **Convertible debt**

IFRS	US GAAP
Debt that is convertible to equity shares at the option of the holder is split into a debt element and an equity element on the balance sheet of the issuer. It is treated as a vanilla debt instrument with an equity conversion option.	Convertible debt is generally treated as entirely debt unless there is a beneficial equity conversion feature that exists at the inception of the instrument.

### **Effective interest rate**

Accounting for interest payments on simple loans is straightforward. When a payment of interest is made there is a cash outflow and a corresponding interest expense in the income statement.

Difficulties arise when the interest cash flows do not match the interest expense suffered over an accounting period. Consider an extreme example, where all the interest is rolled up into the loan and not paid until a later date. In the future there will be interest on interest and there is a method of dealing with this in the financial statements called the effective interest rate method.

The effective interest rate (or internal rate of return) of an instrument is the discount rate that discounts all the cash flows to a zero net present value and can be determined in straightforward examples by:

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

FV = future value

PV = present value

r = discount rate

n = number of time periods

It is this effective interest rate that drives the accounting for these instruments, as illustrated in the following example.

A company borrows €100,000 on 1 January from a bank. The bank agrees that the interest can be rolled up into the loan and repaid on 31 December four years later along with the capital. The total repayment on that day will be €120,000.

How does the company reflect this arrangement in its financial statements over the 4 year term of the loan?

### 1 Jan accounting

The company would reflect an increase in cash of €100,000 and an increase in liabilities of €100,000.

### Ongoing accounting

The ongoing accounting would be determined by the effective interest rate:

$$\begin{aligned} FV &= PV(1+r)^n \\ 120,000 &= 100,000 (1+r)^4 \\ 1.2 &= (1+r)^4 \\ 4\sqrt{1.2} &= 1+r \\ 1.047 &= 1+r \\ r &= 4.7\% \end{aligned}$$

The company is suffering interest at 4.7%, but only paying it at the end of the loan. The annual accounting entries for the 4 years would come from the following table.

Operating loan balance	Interest expense at 4.7%	Cash flow	Closing loan balance
100,000	4,700	0	104,700
104,700	4,921	0	109,621
109,621	5,152	0	114,773
114,773	5,227	0	120,000

The balance sheet liability grows from €100,000 to €120,000 over the 4 year period, with corresponding entries as interest expense each year.

This “effective interest rate” method must be applied to all such arrangements in order to determine the accounting treatment.

### **Net debt**

Net debt comprises debt less (the aggregate of) cash and cash equivalents.

#### *Debt*

Debt comprises:

- Borrowings (instruments issued as a means of raising finance which are classified as liabilities)
- Obligations under finance/capital leases.

#### *Cash equivalents*

Cash equivalents (or liquid resources) are short-term, highly liquid investments which are readily convertible to cash and subject to insignificant changes in value.

Money market deposits and certificates of deposit are likely to meet this requirement.

**NOTE 19 Borrowings****Current**

	Par value	Maturity year	2008 £m
Bank loans and overdrafts		2008	1,458
Loan from joint venture (note 28)		2008	10
7.5% MTN	£258m	2007	-
6% MTN	£125m	2008	130
5.25% MTN	€500m	2008	392
Other MTNs		-	43
Finance leases (note 32)		-	51
			2,084

**Non-current**

	Par value	Maturity year	2008 £m
Finance leases (note 32)	-	-	215
6% MTN	£125m	2008	-
5.25% MTN	€500m	2008	-
5.125% MTN	£192m	2009	191
6.625% MTN	£150m	2010	153
4.75% MTN	£750m	2010	592
3.875% MTN	€500m	2011	387
4% RPI MTN <sup>(a)</sup>	£238m	2016	254
5.5% USD Bond	\$850m	2017	455
5.5% MTN	£350m	2019	350
5% MTN <sup>(b)</sup>	£415m	2023	417
3.322% LPI MTN <sup>(c)</sup>	£241m	2025	255
6% MTN	£200m	2029	194
5.5% MTN	£200m	2033	192
1.982% RPI MTN <sup>(d)</sup>	£204m	2036	212
6.15% USD Bond	\$1,150m	2037	604
5% MTN	£300m	2042	305
5.125% MTN	€600m	2047	451
5.2% MTN	£500m	2057	499
Other MTNs	-	-	135
Other loans	-	-	111
			5,972

**NOTE 17 Cash and cash equivalents**

	2008 £m
Cash at bank and in hand	1,542
Short-term deposits	246
	1,788

Net debt components may be spread around the balance sheet in:

- Liabilities > 1 year
- Liabilities <1 year
- Cash at bank and in hand
- Current asset investments.

Users may have to calculate net debt manually from the information in the notes to the accounts, although some corporates may produce net debt disclosures

Net debt for Tesco 2008:

Borrowings	
Current	2,084
Non-current	5,972
Less: Cash and equivalents	(1,788)
<b>Net debt</b>	<b>6,268</b>

Source: Tesco Annual Report

**Where is net debt used?**

- As a component of enterprise value:

Equity value	X
Add: net debt	X
Add: minority interest	X
Less: JVs & associates	(X)
Capital Employed	X

And so used in most multiples and needed to derive equity value from DCF valuations.

- As a component of capital employed:

Equity shareholders' funds	X
<b>Add: net debt</b>	<b>X</b>
Add: minority interest	X
Less: JVs & associates	(X)
<b>Capital Employed</b>	<b>X</b>

And so used in most returns analysis (return on capital employed, etc.) and either on its own or as part of capital employed in credit analysis:

- Returns analysis (e.g. return on capital employed)
- Credit analysis
- Net debt to EBITDA multiples
- Gearing ratios
- Net debt to funds from operations multiples
- Total coverage ratios.
- In the breakdown from enterprise value to Equity value:

Enterprise value	X
Less: net debt	(X)
<b>Less: minority interest</b>	<b>(X)</b>
Add: JVs & associates	X
<b>Equity value</b>	<b>X</b>

## Leases

If a company needs a particular non-current asset, the obvious course of action would be to buy it. If the company does not have the cash to do this then it could consider borrowing the money required. However, there is an alternative which is to lease the asset from a lessor company. Where a company is leasing an asset, the accounting treatment is driven by the economic substance of the arrangement rather than its legal form.

### Lease classification

For accounting purposes, leases fall into one of two categories. Operating leases are held off balance sheet and finance (or capital) leases are held on balance sheet. Whether any particular leased asset is on or off balance sheet is determined by consideration of a number of criteria. The exact criteria are slightly different under IFRS and US GAAP but the following list highlights typical factors that would indicate a finance lease under both regimes:

- The lease transfers ownership of the asset to the lessee by the end of the lease term
- The lessee has the option to purchase the asset at a price which is expected to be sufficiently below fair value at the date the option becomes exercisable such that, at the inception of the lease, it is reasonably certain that the option will be exercised
- The lease term is for the major part of the economic life of the asset even if title is not transferred
- At the inception of the lease the present value of the minimum lease payments amounts to substantially all of the fair value of the leased asset

- The leased assets are of a specialised nature such that only the lessee can use them without major modifications being made.

The distinction between operating and finance lease is a matter of judgement and is based on the factors above.

### **Operating lease accounting**

Lease payments under an operating lease are recognised as an expense in the income statement on a straight line basis over the lease term (unless another systematic basis is more representative of the time pattern of the user's benefit). The payments are treated as operating cash flows in the cash flow statement.

For operating leases there is a requirement for the company to disclose in its financial statements the operating lease expense for the year, and the lease payments it is committed to making in future years. These operating lease commitments disclosures are useful for bankers needing to capitalise operating leases (see *Operating lease conversion*).

### **Finance lease accounting**

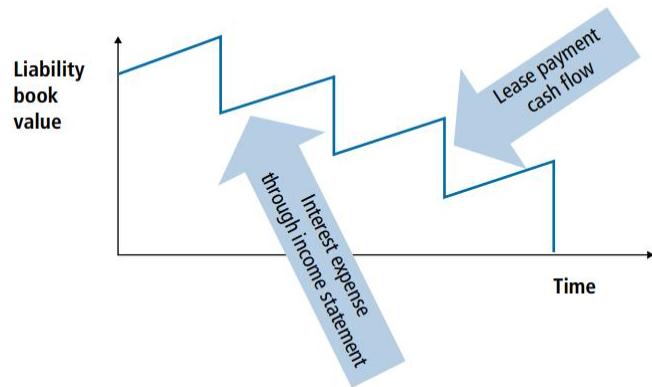
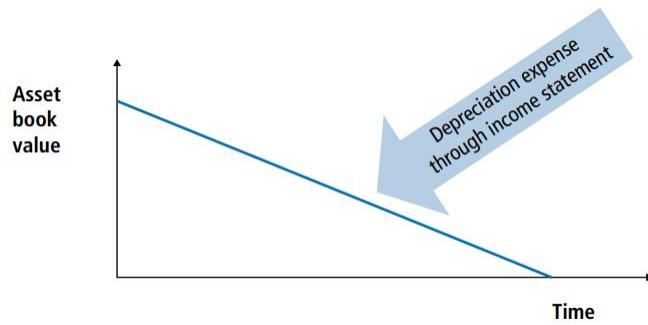
The accounting for an asset held under a finance lease is similar to that if the company had borrowed money to buy the use of the asset. A depreciating asset and an amortising liability are recognised on the balance sheet.

#### ***Balance sheet***

At the inception of the lease an asset and a matching lease obligation are recognised on the balance sheet at the present value of the future lease payments, usually measured at the company's incremental borrowing cost.

The asset depreciates as normal over the term of the lease, usually straight line.

The liability increases over time as interest accumulates but then decreases with the lease payment, which not only pays off the notional interest but also pays off some of the capital. This continues for the duration of the lease until the outstanding obligation has reduced to nil.



#### *Income statement*

The lease payments are not treated as an expense in the income statement. The income statement is impacted in two ways. Operating profit is reduced as a result of the depreciation expense and profit before tax is reduced further because of the interest expense.

#### *Cash flow statement*

The lease payments are treated as partly repayment of interest and partly repayment of capital. The repayment of capital element is always treated as financing in the cash flow statement but care is needed with the interest element, which may be presented as operating, investing or financing.

**Illustration**

A company enters into a 7 year lease to acquire the use of an asset.

The interest rate implicit in the lease is  $8\frac{1}{2}\%$  (approximately).

The present value of the minimum lease payments is \$614m. At the end of the first year of the lease, the financial statements would show:

**Balance sheet impact****Finance lease**

	<i>Inception</i>	<i>Depn</i>	<i>Int</i>	<i>Cash</i>	<i>End</i>
PPE	614	(88)			526
Cash				(120)	(120)
	614	(88)	–	(120)	406
Debt	614		52	(120)	546
PL		(88)	(52)		(140)
	614	(88)	–	(120)	406

**Operating lease**

	<i>Inception</i>	<i>Depn</i>	<i>Int</i>	<i>Cash</i>	<i>End</i>
PPE					–
Cash				(120)	(120)
	–	–	–	(120)	(120)
Debt					–
PL				(120)	(120)
	–	–	–	(120)	(120)

**Income statement impact**

<i>Earning metrics</i>	<i>Finance</i>	<i>Operating</i>
EBITDAR	–	–
Rentals	–	(120)
EBITDA	–	(120)
Depn	(88)	–
EBIT	(88)	(120)
Interest	(52)	–
*Earnings	(140)	(120)

\* Ignores the tax impact

## Operating lease conversion

When comparing the performance or position of one company with another, it is important to ensure that the impact of different accounting treatments in the two companies is neutralised as much as possible. Where one of the companies has a number of operating lease arrangements (off balance sheet) and the other has a number of on balance sheet finance leases, adjustments can be made to bring the two into line with each other. Generally the operating leases are capitalised or the financial statements are adjusted as though the leases had always been treated as finance leases.

There are two approaches used to complete this adjustment:

- The discounted cash flow approach
- The multiple approach.

### ***The discounted cash flow approach***

Information required:

- An interest rate to apply to the future lease commitments
- The future lease payments
- The lease term.

#### *Interest rate*

- Use a benchmark interest rate (e.g. 10 year government gilt rate) and add a credit risk premium or
- Examine the notes to the accounts and use the interest rate disclosed in either:
  - The pensions note (used by the actuaries to calculate the present value of the pension scheme benefit obligations) or:

Discount rate	6.00%
Projected future remuneration increases	2.75%
Projected future pension increases	1.75%

Source: Bayer Annual Report

- The financial instruments note:

Short term borrowings (excluding the short-term portion of debentures) amounted to €2.0 billion with a weighted average interest rate of **6.2 percent**. The Bayer Group's financial obligations are primarily unsecured and of equal priority.

Source: Bayer Annual Report

It would seem that using a pre tax interest rate of about 6.00% to discount the future lease commitments would be appropriate.

#### *Lease term and commitments*

Identifying the lease term and the future cash flow commitments on the operating leases can be a more involved process due to the quality of disclosure in the accounts.

The operating lease extract below is typical. With this information, once an interest rate has been identified, discounting the first 5 years of cash flows is straightforward.

**Minimum non-discounted future payments** relating to operating leases total €478 million. The respective payment obligations mature as follows:

Maturing in	€ million
2004	124
2005	93
2006	76
2007	64
2008	55
2009 or later	66
	478

Source: Bayer Annual Report (reporting under IAS)

In the case of Bayer, 66m of the total operating lease commitment arises after year 5. Given that the annual commitment for years 4 & 5 were €64m and €55m respectively, it would be fair to say that the term of the lease commitment beyond year 5 is limited.

An example of a present value calculation of the future cash flow commitment for the Bayer operating leases:

Bayer operating lease conversion				
Discount rate		6.00%		
		Payments €m	Discount factor	PV €m
1	2004	124	<u>0.943</u>	117.0
2	2005	93	<u>0.890</u>	82.8
3	2006	76	<u>0.840</u>	63.8
4	2007	64	<u>0.792</u>	50.7
5	2008	55	<u>0.747</u>	41.4
6	2009	66	<u>0.705</u>	46.5
PV of the future operating lease commitments				<u>401.9</u>
Sum of discount factors				4.917

Given the assumptions made above, the present value of the operating lease commitments for Bayer is €402m.

The charge in arriving at operating profit for operating lease payments reflected in the income statement of Bayer was €124m. If the leases are now treated as finance leases this charge needs to be restated as interest and depreciation. Depreciation is charged above the operating profit line and interest below.

By applying a 6% interest rate to the €402m, a notional pre-tax interest charge can be calculated as €24m.  
Operating profit can be restated by adding back €24m

<b>Bayer income statement adjustments</b>			
	Operating lease	Lease charges	Finance lease reclassified
EBITDAR	-	-	-
Operating lease charge	(124)	124	-
EBITDA	(124)	-	-
Depreciation	-	(100)	(100)
Operating profit	(124)	-	(100)
Interest on finance leases	-	(24)	(24)
Profit before tax	(124)	-	(124)

A similar issue needs addressing for the cash flow statement.  
The operating lease cash payment is classified as an operating cash outflow. As a finance lease, the cash outflow is split into a

<b>Cash flow adjustments</b>			
	<u>Operating lease to finance lease</u>	<u>Finance lease to acquired asset</u>	
	Operating lease cash flow	Finance lease reclassified	Finance lease cash flows
Operating cash flow	(124)	100	(24)
Investing cash flow	-	-	-
Free cash flow	(124)	-	(24)
Financing cash flow	-	(100)	(100)
Net cash flow	(124)	-	(124)

\* Assume borrowed 402 to finance acquisition of asset

repayment of principal (a financing cash flow) and a servicing of finance (interest as an operating cash flow in the following illustration).

An alternative approach to the cash flow adjustment would be to treat all leases as if they were acquired assets. In this case, any new leases would be treated as capital expenditure financed by new borrowings. It is only by this adjustment that we have consistency of treatment of all assets used by the business.

### ***The multiple approach***

The discounted cash flow approach to converting operating leases to finance leases is an academic resolution to the conversion issue. However, its use is to provide a theoretical foundation to the commonly used multiple approach to operating lease conversion.

The multiple approach assumes that the operating lease commitment is an annuity (a series of equal annual cash flows). The present value of an annuity is calculated using the annuity factor equation below.

#### **Annuity calculation**

Number of time periods (n)                    6 periods

Discount rate (r)                              6.00%

Annuity factor                                   $\frac{1}{r} \left(1 - \frac{1}{(1+r)^n}\right)$                             **4.917**

Note: this is the same result as the sum of the discount factors in the present value calculation for the Bayer operating lease conversion.

Inputs required:

- The number of periods of the annuity
- An interest rate.

The annuity, therefore, reflects the expected length of the operating lease commitment and the risk of that commitment.

Rating agencies have standard multiples that they will apply in this calculation. (See ratings agencies' operating lease adjustments table.) The annuity factor should then be applied to the expected annuity.

(Most rating agencies will apply the annuity factor to the gross

**Annuity calculation**

Number of time periods (n)      6 periods

Discount rate (r)      6.00%

Annuity factor       $\frac{1}{r} \left(1 - \frac{1}{(1+r)^n}\right)$       **4.917**      A

Assumed cash flow annuity

(average of cash flow commitment  
(2004-2009))      79,7      B

PV of the future operating lease  
commitments (€)      391.7      (AXB)

income statement operating lease rental charge, however different models will provide varying estimates for the appropriate figure to be used – see ratings agencies' operating lease adjustments table).

An example of the multiples approach is outlined below for Bayer:

Ratings agencies' operating lease adjustments			
Lease adjustments	STANDARD &POOR'S	Moody's Investor Service	Fitch Ratings
<b>Debt adjustment</b>	NPV of future minimum, non cancellable leases (at 10% discount rate) added to debt (alternatively 5X multiple of net income statement charge)	8X gross income statement charge added to debt  * Subject to note below	8X gross income statement charge added to debt
<b>Interest adjustment</b>	Interest component of rents (10% of NPV result, or $\frac{1}{3}$ of net income statement charge) added to EBIT, EBITDA and interest	$\frac{1}{3}$ gross income statement charge added to EBIT and interest	$\frac{1}{3}$ gross income statement charge added to interest
<b>Depreciation adjustment</b>	Depreciation component (remaining amount or $\frac{2}{3}$ of net income statement charge)	$\frac{2}{3}$ gross income statement charge  Full rent expense added to EBITDA (becomes EBITDAR)	$\frac{2}{3}$ gross income statement charge  Full rent expense added to EBITDA (becomes EBITDAR)

\* The multiplier of 8 is derived using a standard interest rate of 6% on an asset with a 15-year useful life. This is not appropriate for all leases and Moody's varies the multiplier depending on the industry. Some of these are presented here:

Industry	Multiplier
Technology	5
Telecommunications	5
Housebuilding	5
Aerospace/defence	6
Automotive	6
Chemicals	6
Healthcare	6
Transport services	6

### Considerations for investment banking: Leasing arrangements

Metric comparability: Operating leases can be termed a source of off-balance sheet financing. Where comparability is required across companies which have financed their assets through outright acquisition, finance leases and operating leases, it may be necessary to adjust the financials so that the metrics are calculated on a consistent basis. Capitalising all operating leases will treat all assets as if they have been acquired/finance leased.

Operating lease conversion – metrics impacted:

- EBITDA
- EBIT/operating profit
- Depreciation
- Interest
- Operating cash flow

- Financing cash flow
- Free cash flow
- Funds from operations
- Net debt.

## Provisions

The word “provision” has two meanings in the accounting world:

1. A decrease in an asset such as a provision against a receivable where it is believed that the full amount will not be collected
2. An increase in a liability such as a litigation where there may be a payout in the future

The common feature here is uncertainty. The extent of the decrease in asset or increase in liability is not known exactly so an estimate must be made. Provisions against assets have already been covered in this chapter. Provisions as liabilities with uncertainty are covered here.

### Definition and recognition

A provision is a liability with uncertainty. For a provision to be recognised there must be a present obligation (legal or constructive) as a result of a past event that will probably result in an outflow of resources, and can be reliably measured.

There must be a past event that has triggered the provision. It is not possible to simply book provisions for events that may or may not happen in the future. For example, if a company has potentially been negligent in the past, and is being taken to court, then there is a past event to trigger a provision. However, a company cannot simply book provisions every year to cover them for the eventuality that they may be taken to court.

The accounting treatment for provisions depends on the level of certainty of the future outflow, as follows:

Probable	Recognise a provision
Possible	No provision recognised. However, the existence of a "contingent liability" would need to be disclosed
Remote	No accounting or disclosures required

When a provision is recognised, a liability and resultant expense are created. In the future when the payment is made, there is a decrease in cash with a corresponding decrease in the liability. If the provision doesn't exactly match the cash outflow then there will be a gain or loss recognised in the income statement representing the difference between the two.

IFRS	US GAAP
Where the effect of discounting is material, provisions should be measured at the discounted present value of the future cash flow.	Provisions generally undiscounted.

### Common types of provision

The common types of provision include:

- **Restructuring:** A restructuring provision may only be booked where the company is fully committed to the restructuring programme by the balance sheet date
- **Litigation:** In recognition of a probable future payout as a result of a legal action
- **Environmental:** Future clean-up costs of pollution and other environmental damage

- **Decommissioning:** A particular kind of environmental provision, with specific accounting rules, explained below.

### Decommissioning provisions

Decommissioning provisions recognise the cost of taking heavy infrastructure assets out of service at the end of their lives. They arise on assets such as power stations and oil platforms.

The estimated costs of decommissioning are:

- Provided for when stations are constructed
- Capitalised as part of the cost of construction
- Depreciated over the same lives as the stations.

Due to the typically lengthy timeframes involved, the effect of the time value of money is often material and the amount of the decommissioning provision is usually the present value of the expenditures expected to be required to settle the obligation. When discounting is used, the carrying amount of the provision increases in each period to reflect the passage of time. This increase is reflected as a borrowing cost.

## Illustration

6 years ago, a radioactive facility was commissioned. Future decommissioning costs to be incurred 25 years after construction are estimated at £800m at future prices. The nominal rate of interest which reflects the risks specific to the liability is 5.987%.

Balance sheet		Income statement		Cash flow statement
	£m		£m	£m
Decommissioning asset - cost	187	Operating expenses (dep'n)	(8)	
- acc dep'n	(45)			
- NBV	142			
Provision s	(265)	Finance charges	(15)	

## Workings

### Decommissioning asset

On commissioning of facility	£187
£800m ÷ (1.05987) <sup>25</sup>	m
Annual depreciation charge	£8m
£187m ÷ 25	
Accumulated depreciation to date	£45m
£7.5m ÷ 6	

### Decommissioning provision

At beginning of current period	£250
£800m ÷ (1.05987) <sup>20</sup>	m
Unwinding of discount in period	£15m
£250m x 5.987%	
At end of period	£265
£800m ÷ (1.05987) <sup>19</sup>	m

**Considerations for investment banking: Provisions**

Metric comparability: Provisions are estimates of future, probable economic outflows. They can also be used to manipulate profits from one period to another. Financial analysis needs to attempt to ascertain whether the provision is genuine or not. This is not an easy task.

Careful monitoring of balance sheet provision movements and the reconciliation of operating profit to operating cash flow are key watch areas. Also consider the timing of these provision movements with the income statement performance. Typical profit smoothing with provisions will be cyclical with income statement performance.

***Deferred tax*****Introduction**

Deferred taxation is an area of accounting that is much maligned and misunderstood. The accounting is technical and requires detailed calculations and forecasting. However, the idea is reasonably straightforward. Accountants like to be prudent (that is, they like to anticipate potential future losses when applicable and probable) and accountants also love to match (again, they like to account for items in the period that they relate to).

Deferred tax applies these concepts by accounting in the current period for future tax implications of transactions in the current period. Hence a deferred tax liability is exactly what it states it is – a probable tax outflow (liability) that is deferred until a later date.

**Definitions*****Deferred tax liabilities***

Deferred tax liabilities are the amounts of income taxes payable in future periods in respect of taxable temporary differences.

***Deferred tax assets***

Deferred tax assets are the amounts of income taxes recoverable in future periods in respect of:

- Deductible temporary differences

- Carryforward of unused tax losses
- Carryforward of unused tax credits.

### ***Recognition***

#### **Temporary differences**

Temporary differences are differences between the amount at which an asset or liability is recognised in financial statements and its tax base. The tax base is the amount that will be deductible or taxable in respect of the asset or liability in the future.

The rationale for recognising deferred tax on temporary differences is that the entity should provide for the unavoidable tax consequences of recovering the carrying values of assets or settling liabilities at the amounts shown in the accounts. It is inherent in the carrying value of an asset that it will generate (pre-tax) cash flows at least equal to that carrying value. Any tax payable on generating those cash flows is inherently a liability of the entity.

#### ***Taxable temporary differences***

A deferred tax liability is recognised for all taxable temporary differences, unless the deferred tax liability arises from:

- Goodwill for which amortisation is not deductible for tax purposes
- The initial recognition of an asset or liability in a transaction which is not a business combination and, at the time of the transaction, affects neither accounting profit nor taxable profit.

#### ***Deductible temporary differences***

A deferred tax asset is recognised for all deductible temporary differences to the extent that it is probable that taxable profit will be available against which the deductible temporary difference can be utilised, unless the deferred tax asset arises from:

- Negative goodwill
- The initial recognition of an asset or liability in a transaction which is not a business combination and, at the time of the transaction, affects neither accounting profit nor taxable profit.

### ***Unutilised tax losses***

A deferred tax asset is recognised for the carry forward of unused tax losses (and unused tax credits) to the extent that it is probable that future taxable profit will be available against which the unused tax losses (and unused tax credits) can be utilised.

### **Measurement**

Deferred tax assets and liabilities are measured at the tax rates expected to apply to the period when the asset is realised or the liability is settled, based on tax rates that have been enacted or substantively enacted by the balance sheet date.

Deferred tax assets and liabilities are not discounted.

### **Considerations for investment banking: Deferred tax**

Deferred tax balance sheet numbers are often removed from financial analysis. Cases can arise where deferred tax provisions do not reverse and do not lead to an actual cash outflow. This is often the case with entities that have aggressive capital expenditure forecasts. The impact is that the provisions become bookkeeping entries that do not lead to a cash flow impact, and merely reduce balance sheet equity. Treating deferred tax provisions as quasi equity and reinstating the provision as an equity number is a relatively common adjustment for analysis using capital employed or equity numbers.

### **Pensions**

Accounting for company pension schemes is a complex area but important for bankers to understand, as the numbers can be big and can have a significant impact on the value of a company.

This section covers the accounting treatments for the two main types of scheme, defined contribution and defined benefit.

#### **Defined contribution schemes**

These are simple schemes where in addition to regular salaries, the company pays an additional amount (often a percentage of salary) to the employee, to be invested for the benefit of the employee when they retire. Essentially the employee has a

personal pension pot which grows over time and helps fund the retirement years.

From the perspective of the company, this is simply treated as a little extra benefit paid out to staff, so the accounting for each payment is a decrease in cash and a corresponding income statement expense.

### ***Defined benefit schemes***

Defined benefit schemes are very different to defined contribution schemes. A defined benefit scheme is essentially a promise. The employer promises to pay a pension to the employee in retirement, the size of which is typically related to the number of years service and the salary of the employee during the years of service.

This promise immediately creates an obligation for the company which needs to be recognised on the balance sheet as a liability. There are two types of defined benefit scheme:

- Funded: company ring-fences some financial assets to help settle the obligation in the future
- Unfunded: no ring-fenced assets but usually a regulatory requirement to take out insurance against company bankruptcy.

The explanations that follow relate to a funded scheme. The same rules would apply for an unfunded scheme but the application would be simpler as there would of course be no pension assets on the balance sheet.

For a funded scheme there would be both a pension asset and a pension liability on the balance sheet. Understanding the accounting for these schemes starts with an understanding of how the asset and the liability move over time and then considering the dual effect of those movements.

### ***Pension asset***

The pension asset on the balance sheet is the fair value of the pool of assets at the balance sheet date. There are three main reasons why the pool of financial assets might move over time.

#### *Actual return on assets*

The ring-fenced pension assets are essentially a pool of investments, held for the long-term benefit of the employees.

Those investments, whether they are cash, debt or equity, will hopefully grow in line with market movements. The pool may increase when markets are rising, but may also fall in line with a slump.

#### *Employer contributions*

From time to time, or possibly even on a regular basis, the company may top up the pool of assets with its own cash. This maybe to fill a deficit and increase the pension asset to bring it into line with the pension obligation or it may just be a regular contribution.

The employer is usually prohibited from taking money out of the pool but this will be governed by the law and regulations that apply to the scheme.

#### *Payments*

There will be regular payments out of the scheme to ex-staff now in retirement. There may also be one-off payments out to transfer the value of an individual's benefit to their next of kin in the event of death. These payments represent a continual outflow of assets from the pool.

#### ***Movement in pension obligation***

The pension obligation is the present value of the future cash flows that have been earned by the balance sheet date. The liability is the result of an actuarial calculation with a number of inputs such as mortality rates, salary rates and other economic assumptions.

There are four main reasons why the pension obligation might move over time.

#### *Service cost*

The service cost is the increase in the obligation over time as a result of staff working for the year. Another year worked means the value of the promise increases as the pension is directly linked to number of years served.

#### *Interest cost*

The company does not actually suffer interest on the liability but there is a notional interest cost as the discount unwinds as time passes. Each year, all else being equal, the future cash flows are

discounted over a shorter period (one year less) than the previous year so the present value will increase.

#### *Changes in actuarial assumptions*

If the actuaries change their assumptions for the actuarial calculation, such as mortality rates, then there will be a change in the value of the obligation. These changes could increase or decrease the size of the obligation.

#### *Payments*

In the same way that payments to retired people decrease the pension asset, they will also decrease the pension obligation, because as soon as a payment is made, that amount is no longer owed to the individual.

#### ***Dual effects and the income statement***

So there are seven reasons why the net pension position (asset minus liability) might move over time. Each of these must have a dual effect if the balance sheet is to balance. These are explained below:

Movement	Dual effect
<b>Asset</b>	
Actual return on assets	The full amount of the movement here is not taken to the income statement as it could introduce unwanted volatility. A long term expected return on assets is taken to the income statement as a gain (one would never expect to make losses in long term) and any difference between expected and actual is treated as an actuarial gain or loss (see Actuarial gains and losses)
Employer contributions	Company cash falls and the pension asset increases by the same amount. These are both balance sheet movements so no impact on the income statement

Payments	The pension asset falls and the pension liability falls by the same amount so no impact on the income statement.
<b>Obligation</b>	
Service cost	As the obligation increases there is a matching expense recognised in the income statement.
Interest cost	As the obligation increases there is a matching expense recognised in the income statement.
Changes in actuarial assumptions	Treated as an actuarial gain or loss (see Actuarial gains and losses)
Payments	The pension obligation falls and the pension asset falls by the same amount so no impact on the income statement.

So the three movements included in the income statement pension expense are:

Service cost	S
Interest cost	I
(Expected return on assets)	(E)
Pension expense	P

### ***Actuarial gains and losses***

There are two remaining movements that are not immediately reflected in the income statement that must be accounted for if the balance sheet is to balance. The difference between actual and expected return on assets and the impact of changes in actuarial assumptions are referred to as actuarial gains and losses.

There is a choice of how any actuarial gains or losses can be accounted for. The options are covered here, along with their applicability to both IFRS and US GAAP.

	IRFS?	US GAAP?
Option 1: Take any actuarial gains or losses directly to equity. In other words, simply increase or decrease retained earnings (without passing through the income statement) by the amount of the gain or loss. This avoids any income statement impact and results in a balance sheet that shows the true pension position at the balance sheet date	✓	x
Option 2: Leave some actuarial gains or losses unrecognised. In other words, pretend they never happened. The rationale for this being a permitted treatment is that in the long run actuarial gains will offset any actuarial losses so, in the interests of short term smoothing, pretending they never occurred in the first place is acceptable. Actuarial gains/losses can only remain unrecognised within specified limits (the corridor). Once they exceed these limits they must be recognised systematically through the income statement. This avoids any income statement impact but it does result in a misleading balance sheet position, as the reported position is the position had the actuarial gain or loss not happened (even though of course it did happen). The true pension position can always be determined through a careful review of the pension note but the balance sheet itself will often be misleading.	✓	x
Option 3: As option 2 but recognise all actuarial gains/losses eventually through the income statement. In other words, defer any gains/losses outside the corridor in equity and amortise systematically through the income statement over time.	✓	✓
Option 4: Recognise all actuarial gains/losses systematically thorough the income statement	✓	✓

Presented below is an extract from the pension note of Tesco's 2008 financial statements. The way that Tesco has presented the information is useful for the reader, as it is clear where items have been recorded in the income statement. Service cost has been charged to operating profit and both expected return on assets and interest have been recorded in finance income. It is also possible to see the items recognised outside the income statement in the statement of recognised income and expense.

**Note 24 Post-employed benefits continued**

The amounts that have been charged to the Group Income Statement of Recognised Income and Expense for the year ended 23 February 2008 are set out below:

2008  
£m

**Analysis of the amount (charged)/credited to operating profit:**

Current service cost	(461)
Past service gains	-
Total charge to operating profit	(461)

**Analysis of the amount credited/(charged) to finance income:**

Expected return on pension schemes' assets	301
Interest on pension schemes' liabilities	(254)
Net pension finance income (note 5)	47
Total charge to the Group Income Statement	(414)

**Analysis of the amount recognised in the Group Statement of Recognised Income and Expenses:**

Actual return less expected return on pension schemes' assets	(465)
Experience losses arising on the schemes' liabilities	(21)
Currency gain/(loss)	1
Changes in assumptions underlying the present value of the schemes' liabilities	672
Total gain/(loss) recognised in the Group Statement of Recognised Income and Expense	187

Source: Tesco Annual Report

## Considerations for investment banking: Pensions

### Cleaning up the income statement

There are two main income statement issues:

- Some of the pension cost may be in the wrong part of the income statement
- There are some questionable items included in the income statement.

The issues arise with the treatment and location of:

- Interest costs
- Expected gains or losses on plan assets
- Actuarial gains and losses.

An additional problem associated with the income statement impact of pensions is that most companies preparing their accounts only disclose a detailed breakdown of the income statement charges in the annual report. It is, therefore, difficult for analysts to examine the income statement impact of these charges in the quarterly results.

### EBIT and EBITDA

The pension service cost represents the present value of the additional pension entitlement earned by an employee working for another year for his/her organisation.

This is clearly an operating cost and is treated as such by the accounting rules and gets charged to EBITDA.

The most appropriate approach to adjusting the EBITDA metrics is to strip out all other pension accounting – interest costs, expected gains/losses on plan assets and actuarial gains and losses which are financial in nature.

The problem is that the accounting rules don't specify exactly where in the income statement these items should be presented. Hence some companies will present all items as part of operating profit (EBIT) and others may present the interest cost and the expected return on assets as part of interest (see Tesco example above). Sometimes it is possible to determine how the items have been presented by carefully studying the pensions note, but it can often be difficult.

The financial items MUST be taken below the EBITDA line

**Illustration****Income statement \$**

	<b>Unadjusted</b>	<b>Adjusted</b>
Interest cost (100)	(100)	100
Current service cost	(130)	(130)
Expected return on plan assets	120	(120)
<b>EBIT(DA)</b>	<b>(110)</b>	<b>(130)</b>
Interest cost	-	(100)
Expected return on plan assets	-	120
Net financial income	-	20
<b>Profit before tax</b>	<b>(110)</b>	<b>(110)</b>

**Cleaning up the balance sheet**

As has been explained, the net pension liability recognised on the balance sheet may be distorted by the accumulation of actuarial gains or losses. These accumulated actuarial gains or losses add no value to the company and merely distort any analysis of the balance sheet.

Another approach is to ignore the balance sheet number and examine the funding status of the plan, usually disclosed in the notes to the accounts.

Most analysts will treat a pension deficit as a debt item. Therefore the post-tax pension deficit is often included in calculations of:

- Adjusted net debt
- Enterprise value
- Total capital employed.

However, when examining a pension asset it is generally inappropriate to treat the asset as a cash item, as shareholders usually will not have access to the funds.

## Adjusting free cash flow

Free cash flow metrics should be net of the pension service charge, as this reflects the normal operating cost of running the pension. The issue arises as to whether the charge to the free cash flow line is the income statement service cost or the cash paid.

In most circumstances, analysts will adjust free cash flow with the income statement service cost. Identifying the cash flow impact of the service cost is likely to be impractical due to the availability of information and the complexity of the calculation.

Therefore the most common strategy to overcome this issue is to assume over the long run that the service cost will approximate to the underlying pension contribution.

There will be differences in the numbers used. However, the difference should be immaterial reflecting the time value impact of the timing of the income statement service cost and the actual contribution.

Ratings agencies' pension adjustments			
Pension adjustments	STANDARD &POOR'S	Moody's Investor Service	FitchRatings
<b>General approach</b>	Under-funded pension schemes treated as debt items	Deficits in funded plans are viewed as debt Liabilities of unfunded plans are assessed on a case by case basis	Deficits in funded plans viewed as debt-like
<b>Debt adjustment</b>	Post-tax net deficit added to total debt	Funded schemes: pre-tax deficit added to debt Unfunded schemes: split into debt and equity according to company's unadjusted debt / capital ratio	Funded schemes: post-tax deficit added to debt
<b>Income statement adjustment</b>	All pension costs, except for service costs, are added back to EBIT and EBITDA, if reported above the operating line		All pension costs, except for service costs, are added back to EBIT and EBITDA, if reported above the operating line

## Income statement issues

Many of the areas covered so far have impacted both the balance sheet and the income statement. There are a small number of issues that relate primarily to the income statement only, and they are covered here.

### Revenue recognition

The question here is when should revenue (sales) be recognised in the income statement and how much revenue should be recognised. For many businesses this is a straightforward matter. A supermarket recognises a sale at the time the customer pays for the item at the checkout. However, for more complex business models, the question is not so simple.

Consider a building company that takes a deposit from customers before building a property for them. Recognising revenue in line with cash receipts doesn't make sense as the timing of the cash flows may be arbitrary and may not reflect the performance of the work.

### Basic concepts

Revenues are considered to have been earned when the entity has substantially accomplished what it must do to be entitled to the benefits represented by the revenues.

In the case of a service provider, revenue should be recognised to the extent that the service has been provided and the revenue has been earned.

In the case of the provision of goods, revenue should be recognised when the customer has assumed the risks and rewards of ownership.

### Long term contracts

Specific guidance is provided where the provision of goods or services covers a time period greater than one accounting reference period. In a large-scale construction project such as that outlined above, the financial statements would be misleading if no revenue were recognised until the project was complete. Hence revenue is recognised to the extent that the

project will be profitable and in proportion to the stage of completion.

Hence where a project is 30% complete, 30% of total revenues will be recognised and matched to 30% of total expected costs. Where it becomes apparent that a project may be loss making then the losses need to be recognised immediately.

### **Bundling and unbundling**

Difficulties arise where the provision of one service is dressed up to look like separate elements or, alternatively, where the provision of a number of services is dressed up to look like one arrangement.

A health club that takes a non-refundable joining fee from the customer would need to consider what the joining fee represents. If the upfront fee simply represents a prepayment for future services then it should not be recognised as revenue on day 1 but spread over the term of the contract. This would result in a liability (deferred income) where the cash has been received but the service not yet provided.

Similarly, a high street retailer that gives out “free” mobile handsets if the customer signs up to a line rental contract would need to consider if the provision of the handset on day 1 was an element that would need to be accounted for separately. This would result in an asset (accrued income) where the service has been provided but no cash yet received.

### **Principal vs. agent**

The issue here is one of income statement presentation. A website might be selling holidays on behalf of a holiday company. What should the income statement of the website look like?

Website as principal	Website as agent
Sales	100
Cost of sales	(60)
Profit	40

The following would be indicators that the intermediary (website) should be treated as principal:

- Website sets the ultimate selling price
- Website submits fixed amount to holiday company
- Customer deals with website in the event of a problem with the holiday
- Customer has no direct contact with holiday company.

Although the bottom line profit number is of course the same, the presentation can have a significant impact on profit margins and sales multiples.

### Illustration

lastminute.com

#### *Memorandum sales*

On the face of its income statement lastminute.com discloses total transaction value of £34.2m. It discloses that this amount does not represent statutory turnover, but represents the total price at which goods and services have been sold over the company's website, and that, in the majority of transactions, the company only acts as an agent or cash collector and earns a commission.

#### *Sales*

The income statement also discloses that turnover for lastminute.com is actually £3.7m.

### Considerations for investment banking: Revenue

If the top line is inconsistent ...

The revenue recognition policy is a key policy. Where businesses have different revenue recognition criteria then the top line, and all subsequent operating numbers, may vary particularly in times of rapid growth (or decline).

The timing of revenue and cost recognition may vary (and so will profit metrics) but the cash flows will remain unaffected –

when reconciling from profit to cash flows, the working capital adjustments are likely to be more significant.

## Employee share options

Employees are increasingly being rewarded for their services through shares and share options in addition to more traditional methods such as cash. Share option schemes can vary significantly in nature but the accounting for them is determined through some basic principles.

### **A typical share option scheme**

A typical share option scheme would have an employer grant options to staff, that may be exercised at some time in the future if certain performance targets have been achieved.

For example, on 1 January 2009 (grant date) staff may receive options to buy shares in the company for €1.00 per share (strike price, or exercise price) on 31 December 2010 (vesting date) if, at that time, they are still employed by the company, and the company share price is greater than €2.00 (performance conditions). The share price on 1 January 2009 is €1.50.

There is clearly value in the options. On grant date the difference between the exercise price and the market value of the share is €0.50. This is referred to as the intrinsic value of the option. The options also have a fair value, which will be higher than the intrinsic value as there is the possible upside of share price rises over the vesting period. The fair value of the option could be determined with an option pricing model such as Black-Scholes or binomial and is needed for the accounting.

The accounting treatment for these schemes is separated into what happens over the vesting period and what happens at the exercise date. It is important to keep the two separate and not try to relate them to each other.

They are independent of each other.

### ***Accounting treatment during the vesting period***

The accounting rules require an expense to be recognised in the income statement equal to the fair value on grant date of the options granted, spread over the vesting period.

Taking the example above, if the fair value of an option was €1.00 (derived from the option pricing model), then there would be an expense of €0.50 for each of the next two years.

The dual effect of the expense is an increase in equity (usually retained earnings) so the overall impact of this cosmetic expense in the income statement is nil on the balance sheet. Equity both increases as a result of the direct dual effect and decreases when the expense flows through to retained earnings.

The expense may be adjusted over time for non-market performance conditions such as staff leaving (options lapse) but is not adjusted for the likelihood of achieving market performance conditions such as the €2.00 share price target. The existence of the market conditions are built into the option pricing model on grant date and are not revisited over the vesting period.

#### ***Accounting treatment at exercise***

On exercise, any cash received by the company for the employee is treated in the same way as cash received when issuing ordinary shares. This will not impact the income statement of the company. There are never any gains or losses reflected in the income statement as a result of transactions in a company's own shares.

#### ***Cash settled schemes***

A cash settled share option scheme works in the same way as a traditional equity settled scheme (as above) but on exercise date the employee receives cash, equal to the difference between exercise price and market value of the share, rather than the share itself.

The accounting is similar in that an expense is recognised in the income statement over the vesting period but the dual effect is a genuine liability, as there is an obligation to pay cash in the future. The accounting for a cash settled scheme is, therefore, no different to the accounting for any discretionary long-term cash bonus. It is expensed in the income statement as it is earned and the liability extinguished when the cash is paid.

There are usually many pages of disclosures relating to share option schemes but it will always be possible to find the income statement charge for both equity and cash settled schemes. The Tesco presentation here is typical.

**Note 23 Share-based payments**

The total Group Income Statement charge for the year recognised in respect of sharebased payments is £228m (2007 - £209m), which is made up of share option schemes and share bonus payments. Of this amount £199m (2007 - £185m) will be equity-settled and £29m (2007 - £24m) cash settled.

Source: Tesco Annual Report 2008

***Considerations for investment banking: Share options***

Employee share options can cause difficulties when valuing a company using DCF techniques. The share option expense in the income statement is a non-cash charge and should be added back when determining the free cash flows to be discounted back to an enterprise value. Hence the EV is larger than that of an equivalent company that rewards its staff with cash rather than share options.

However, when adjusting from EV to equity value, in addition to deducting net debt, an additional deduction will be required in recognition of the fact that any in-the-money options will need to be funded somehow, which effectively reduces the value of the shares of the company. The deduction should be the difference between the share price at the balance sheet date and the exercise price of the options.

**Post balance sheet events**

When events happen after the end of the financial year, but before the approval of the accounts (post balance sheet events), the accounting rules require a distinction between those events that:

- provide additional evidence of conditions that existed at the balance sheet date (adjusting events)
- are indicative of conditions that arose after the year end (non-adjusting events).

Adjusting events must be adjusted for and the financial statement numbers will change. Non-adjusting event simply require disclosure with no changes to the numbers in the accounts.

### ***Proposed dividends***

For a proposed dividend to be recognised as a liability at the balance sheet date neither the directors nor the shareholders can have the ability to cancel it. Where dividends are proposed after the balance sheet date they are not recognised as a liability.

### **Cleaning up the income statement**

Operating profit and EBIT are not necessarily interchangeable metrics. Operating profit is an accounting metric, whereas EBIT is a metric used in analysis and can be adjusted to normalise the underlying profit.

The types of adjustments made to EBIT are for:

- Exceptional items such as:
  - Profit or losses from non-current asset disposals
  - Reorganisations/restructuring costs
  - Integration costs
  - Significant impairments of tangible and intangible non-current assets
- Operating profits of joint ventures and associates
- Goodwill impairments
- Discontinued operations and/or acquisitions
- Stripping out the non-service cost pension expenses

Depreciation differences are still likely to persist and prove difficult to identify whilst non-goodwill intangibles (and the consequent amortisation) are likely to be more conspicuous. The need for EBITDA still remains.

Additionally, other sector specific metrics may be appropriate such as EBITDAR (adjusting for rentals) and EBITDARD (adjusting for research and development) may be necessary to obtain sector comparability.

The illustration here shows some typical adjustments that may be required when cleaning up the income statement.

	2007 £m
<b>Continuing operations</b>	
<b>Revenue (sales excluding VAT)</b>	42,641
Cost of sales	-39,401
Pensions adjustment - Finance Act 2006	258
Impairment of the Gerrards Cross site	-35
<b>Gross profit</b>	3,463
Administrative expenses	-907
Profit arising on property-related items	92
<b>Operating profit</b>	2,648
Share of post-tax profits of joint ventures and associates (including £nil on property-related items (2006/7 - £47m gain))	106
Profit on sale of investments in associates	25
Finance income	90
Finance costs	-216
<b>Profit before tax</b>	2,653
Taxation	-772
<b>Profit for the year from continuing operations</b>	1,881
<b>Discontinued operation</b>	
Profit for the year from discontinued operation	18
<b>Profit for the year</b>	1,899
<b>Attributable to:</b>	
Equity holders of the parent	1,892
Minority interests	7
	1,899
<b>Earnings per share from continuing and discontinued operations</b>	
Basic	23.84p
Diluted	23.54p
<b>Earnings per share from continuing operations</b>	
Basic	23.61p
Diluted	23.31p

Source: Tesco Annual Report

**Tesco 2007**

	£m	£m	£m
Operating profit	2,648		
JVs and associates		106	
Sale of associates		25	
EBIT	2,648		2,779
Pension adjustments	(258)		(258)
Impairment Gerrards Cross	35		35
Property related items	(92)		(92)
Recurring EBIT	2,333		2,437

In this way, legitimate cases for EBIT ranging from £2,333 to £2,779 can be made. When making adjustments to metrics it is vitally important to ensure consistency of definitions when using metrics in ratio calculations.

For instance, if EBIT has been adjusted to include the operating profit from JVs and associates to be used in a return on capital employed calculation (or EV multiple), the capital employed (or EV) definition must include the capital employed (or market value) in relation to the JVs and associates.

## Cash flow statements

The cash flow statement is a summary of the cash flows of the business over a period of time.

Bankers generally prefer cash flow information over income statement information as it is not subject to the same differences in accounting policy choices. There is an argument that the finance director can cosmetically flex profit numbers by influencing the outcome of, for example, an impairment test; whereas nothing can be done by the accountants to influence the cash flows of the business. They are simply a consequence of the performance of the business.

### Cash flow definitions

**Cash flows:** inflows and outflows of cash and cash equivalents.

**Cash:** cash on hand and demand deposits.

**Cash equivalents:** short-term, highly liquid investments that are readily convertible to known amounts of cash and which are subject to an insignificant risk of change in value. This includes overdrafts and cash equivalents with short-term maturities (less than three months).

### Cash flow classification

Cash flows are classified and presented in one of three ways:

#### *Operating*

Operating activities are the principal revenue-producing activities of the entity and other activities that are not investing or financing activities.

Operating cash flows would typically include the cash flows associated with sales, purchases and other expenses.

There are two ways of presenting operating cash flows. The finance director has a free choice between the direct or indirect presentation.

#### **Direct presentation**

Operating cash flows are simply presented as a list of cash flows; cash in from sales, cash out for purchases, etc. This is a simple method for presenting operating cash flows, but in

practice it is rarely used. The indirect presentation is much more common.

### Indirect presentation

Profit	P
Depreciation	D
Amortisation	A
Impairment expense	I
Change in working capital	$\Delta WC$
Change in provisions	$\Delta P$
Interest Tax	(I)
Tax	(T)
<b>Operating cash flow</b>	<b>OCF</b>

Operating cash flows are presented as a reconciliation from profit to cash flow.

The items in this reconciliation are not cash flows but “reasons why cash flow is different to profit”. Depreciation expense reduces profit, but has no cash flow impact, hence it is added back. Similarly if the starting point profit is above interest and tax in the income statement, then interest and tax cash flows will need to be deducted if they are to be treated as operating cash flows.

There is no specific guidance on which profit number should be used in the reconciliation. Different companies use operating profit, profit before tax, profit after tax, or net income. Clearly the exact starting point for the reconciliation will determine the exact adjustments made to get down to an operating cash flow number.

### Investing

Investing activities are the acquisition and disposal of non-current assets and other investments not included in cash equivalents. Investing cash flows would typically include the

cash flows associated with buying or selling property, other non-current assets, and also financial assets.

### ***Financing***

Financing activities are activities that result in changes in the size and composition of the equity capital and borrowings of the entity. Financing cash flows would typically include the cash flows associated with borrowing and repaying bank loans, issuing and buying back shares. The payment of a dividend is also usually treated as a financing cash flow.

### ***Interest and tax***

IFRS	US GAAP
There are two common ways of presenting interest in the cash flow statement. Many companies present both interest received and interest paid as operating cash flows. Others treat interest received as an investing cash flow and interest paid as a financing cash flow. The finance director can choose which way to do this but it is usually possible to see which method has been chosen, simply by looking at the cash flow statement.	Interest paid and received are treated as operating cash flows.

Tax cash flows are usually presented as operating unless they are specifically associated with investing or financing activities.

### ***Free cash flow***

Bankers use different cash flow measures for different purposes. Free cash flow is a common measure used typically as an input to a discounted cash flow (DCF) model for valuation purposes.

Care is needed, however, as free cash flow has no definition as such and can be calculated and used in different ways.

***At firm level***

Forecast free cash flow can be discounted (at the weighted average cost of capital or WACC) to give an enterprise value. Net debt is then deducted to give an equity value. As free cash flow here is at the firm level, it must be before interest. So here, free cash flow means:

Operating cash flow (pre-interest & tax)

Less: tax on operations

Less: capital expenditure (capex)

The capital expenditure number here is the capex required to maintain non-current assets to the level required to support the operating cash flow forecasts. This is often taken to be the annual depreciation expense.

***At equity level***

Forecast future free cash flow could be discounted at the cost of equity to give an equity value. Here free cash flow would have to be after interest.

Operating cash flow (pre-interest & tax)

Less: interest paid

Less: tax paid

Less: capital expenditure (capex)

# Accounting and analysis for mergers and acquisitions

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## Introduction

As merger and acquisition activity becomes more extensive and the complexity of the deals increases, it is essential that the accounting rules provide a robust framework for the financial reporting of the transactions. A working knowledge of the M&A accounting rules is an important requirement for investment bankers who need to:

- Assess the impact of potential transactions on the financial statements of the acquirer
- Determine whether a potential transaction is EPS accretive or dilutive
- Construct combination and merger models
- Analyze highly acquisitive companies to understand the extent of potential creative accounting impacts on the financial statements

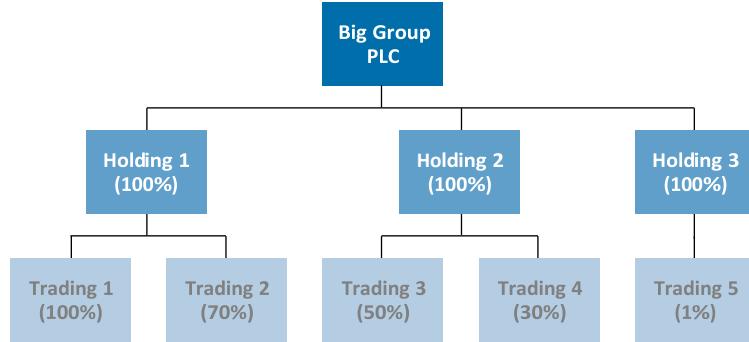
## Consolidation: the concept of the group

Most companies and other commercial organisations comprise a group of separate legal entities, related to each other through a structure of ownership and influence. A consolidated set of financial statements reports the performance and position of the entire group, rather than any particular legal entity within the group. When accountants “consolidate” the numbers, they are bringing together the results of all the related entities to create the group accounts.

## Extent of influence

The accounting rules provide different ways of consolidating the numbers from particular entities depending on the level of

influence exerted by the top parent company on that particular entity. Consider the group presented here:



The numbers relating to each of the entities within the group need to be consolidated, but how? The accounting rules provide three principal methods for doing this, and which method is appropriate for each entity depends on the extent of the ability of the top parent to influence the main operating and financial activities of the entity. The table here presents a summary of these three different approaches.

Extent of influence	Insignificant	Significant	Control
Guideline voting rights	<20%	20%<x<50%	>50%
Entity referred to as:	Investment or financial asset	Associate	Subsidiary
Method of accounting	See separate chapter	Equity accounting	Acquisition accounting

IFRS	US GAAP
<p>It is important to note that the guideline voting rights in the table above are only the starting point when determining the extent of influence. Other factors that would need to be considered when determining the level of influence would include:</p> <ul style="list-style-type: none"> <li>• % equity ownership (often the same as % voting rights, but not necessarily)</li> <li>• % beneficial interest (often the same as % voting rights, but not necessarily)</li> <li>• Shareholder agreements</li> <li>• Power to appoint members to the board</li> <li>• Potential voting rights such as: <ul style="list-style-type: none"> <li>• Share warrants</li> <li>• Share call options</li> <li>• Convertible debt</li> </ul> </li> </ul> <p>Hence a situation may arise where the parent holds only 45% of the voting rights but, because of one of the other factors above, is considered to control the company.</p> <p>IFRS has additional guidance on the application of the consolidation criteria rules to special purpose entities (SPE), but it is still the idea of influence and control that is at the heart of the accounting.</p>	<p>US GAAP has a more rigid set of rules to determine the most appropriate method for accounting for entities within a group.</p> <p>There is less emphasis on influence and control, and more on simply the voting % held. 49% would represent an associate and 51% would represent a subsidiary, without any further consideration of the other indicators of influence. Two particular types of entity are singled out for specific rules.</p> <p><b>Qualifying Special Purpose Entities (QSPEs)</b></p> <p>A QSPE is a trust or other legal vehicle:</p> <ul style="list-style-type: none"> <li>• which is demonstrably distinct from the transferor</li> <li>• whose permitted activities are significantly limited, were entirely specified when established and may be significantly changed only with the approval of a majority of the beneficial interests held by entities other than any transferor, its affiliates or agents</li> <li>• which may hold only certain (passive) financial assets, servicing rights related to financial assets held and cash</li> <li>• which can only dispose of financial assets in automatic response to certain specified events</li> </ul> <p>Such vehicles are typically set up to operate on autopilot to affect a securitisation arrangement and do not need to be consolidated.</p>

	<p><b>Variable Interest Entities (VIEs)</b></p> <p>VIEs have one or both of the following characteristics:</p> <ul style="list-style-type: none"><li>• The equity investment at risk is not sufficient to permit the entity to finance its activities without additional subordinated financial support from other parties, which is provided through other interests that will absorb some or all of the expected losses of the entity</li><li>• The equity investors lack one or more of the following essential characteristics of a controlling financial interest:<ul style="list-style-type: none"><li>• The direct or indirect ability to make decisions about the entity's activities through voting rights or similar rights</li><li>• The obligation to absorb the expected losses of the entity if they occur which makes it possible for the entity to finance its activities</li><li>• The right to receive the expected residual returns of the entity if they occur which is the compensation for the risk of absorbing the expected losses</li></ul></li></ul> <p>The primary beneficiary of a VIE is the party that absorbs a majority of the VIE's expected losses, receives a majority of its expected residual returns, or both, as a result of holding variable interests. The primary beneficiary of a VIE must consolidate the entity.</p>
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This chapter continues with an explanation of the mechanics and interpretation of both acquisition accounting for subsidiaries and equity accounting for associates. Accounting for investments (financial assets where no influence is exercised) is covered elsewhere.

## Acquisition accounting

### The acquisition accounting process

The process required to account for an M&A transaction can be broken down into a number of steps:

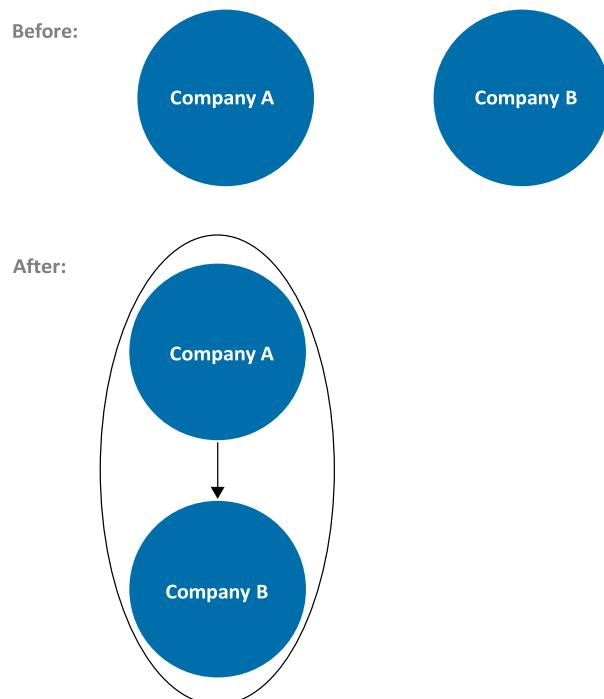
- Identify a business combination
- Identify the acquirer
- Measure the cost of the transaction
- Allocate the cost of a business combination to the identifiable net assets acquired and goodwill
- Account for goodwill

### Identify a business combination

#### *Definition*

A business combination is:

**"the bringing together of separate entities or businesses into one reporting entity."**



In most business combinations one entity, the acquirer, obtains control of one or more other businesses, the acquiree.

A business combination may be structured in a variety of ways for legal, taxation or other reasons:

- As an equity purchase
- As a purchase of the net assets of another entity
- As the purchase of some of the net assets of another entity that together form one or more businesses
- By the issue of equity instruments, the transfer of cash, cash equivalents or other assets, or a combination thereof
- Between the shareholders of the combining entities or between one entity and the shareholders of another entity; or
- By establishment of a new entity to control the combining entities or net assets transferred or the restructuring of one or more of the combining entities

The definition of a business combination should be broad enough to encompass all transactions or other events in which separate entities or businesses are brought together into one economic entity, regardless of the form of the transaction.

The acquisition method views a business combination from the perspective of the combining entity that is identified as the acquirer.

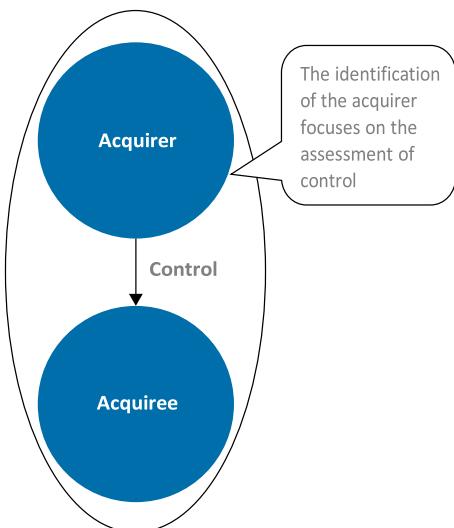
The acquirer purchases net assets and recognises the assets acquired and liabilities and contingent liabilities assumed, including those not previously recognised by the acquiree.

### **Identify the acquirer**

An acquirer must be identified for all business combinations. The acquirer is the combining entity that obtains control of the other combining entities or businesses.

As the acquisition method views a business combination from the acquirer's perspective, it assumes that one of the parties to the transaction can be identified as the acquirer.

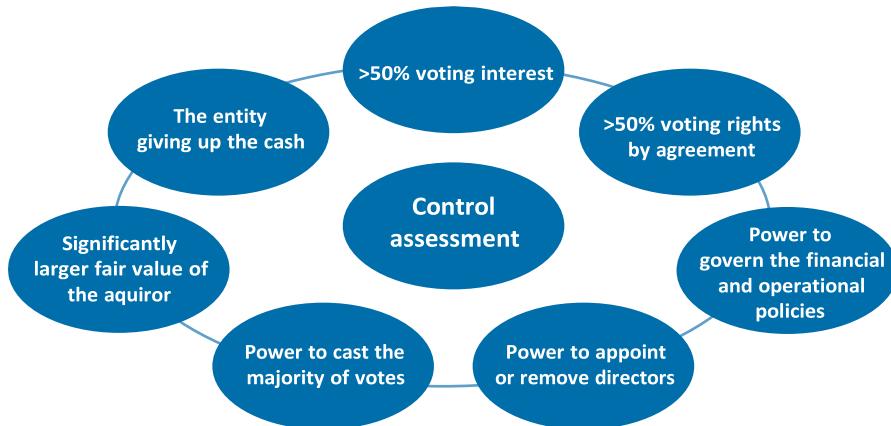
Control is the: "power to govern the financial and operating policies of an entity or business so as to obtain benefits from its activities."



A combining entity is presumed to have obtained control of another combining entity when it acquires more than one half of that other entity's voting rights, unless it can be demonstrated that such ownership does not constitute control.

Although sometimes it may be difficult to identify an acquirer there are usually indications that one exists. For example:

- If the fair value of one of the combining entities is significantly greater than that of the other combining entity, the entity with the greater fair value is likely to be the acquirer
- If the business combination is effected through an exchange of voting ordinary equity instruments for cash or other assets, the entity giving up cash or other assets is likely to be the acquirer; or
- If the business combination results in the management of one of the combining entities being able to dominate the selection of the management team of the resulting combined entity, the entity whose management is able so to dominate is likely to be the acquirer



In a business combination effected through an exchange of equity interests, the entity that issues the equity interests is normally the acquirer.

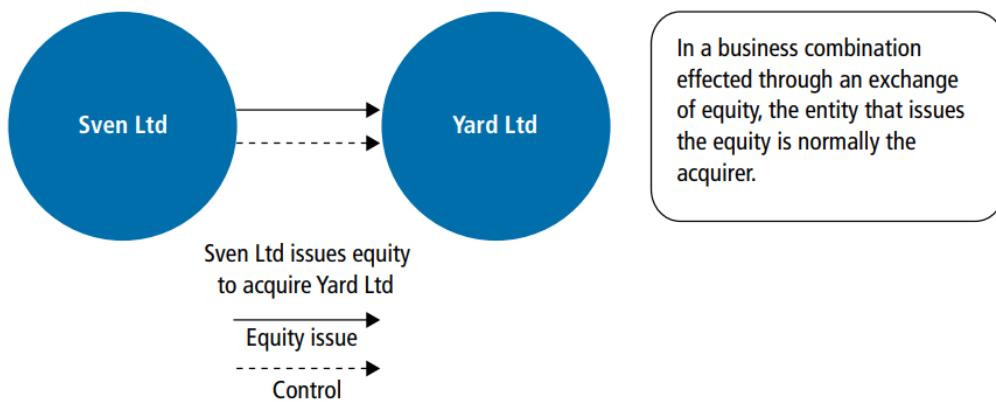
However, all pertinent facts and circumstances should be considered to determine which of the combining entities has the power to govern the financial and operating policies of the other entity (or entities) so as to obtain benefits from its (or their) activities.

In some business combinations, commonly referred to as reverse acquisitions, the acquirer is the entity whose equity

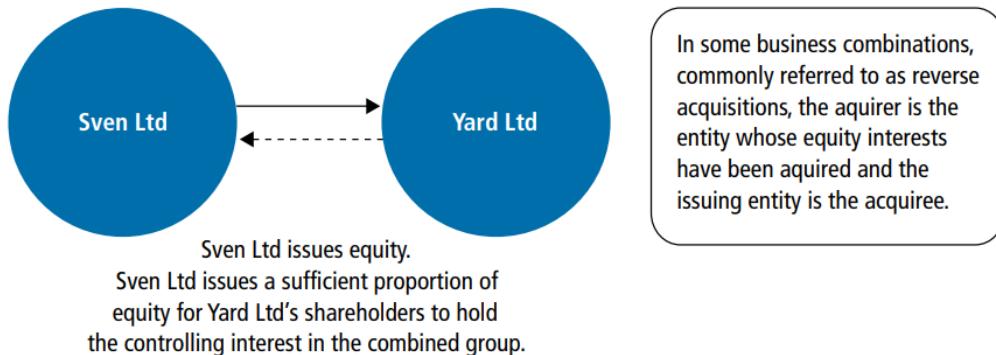
interests have been acquired and the issuing entity is the acquiree. This might be the case where, for example, a private entity arranges to have itself 'acquired' by a smaller public entity as a means of obtaining a stock exchange listing.

Although legally the issuing public entity is regarded as the parent and the private entity is regarded as the subsidiary, the legal subsidiary is the acquirer if it has the power to govern the financial and operating policies of the legal parent so as to obtain benefits from its activities.

#### Exchange for equity

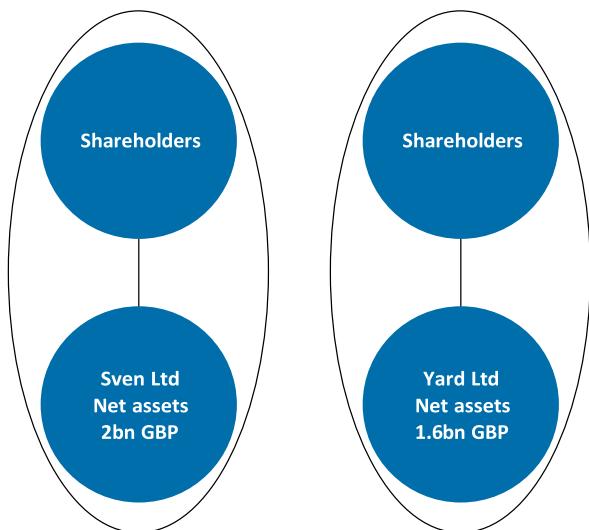


#### Exchange for equity (reverse acquisition)



Commonly the acquirer is the larger entity; however, the facts and circumstances surrounding a combination sometimes indicate that a smaller entity acquires a larger entity.

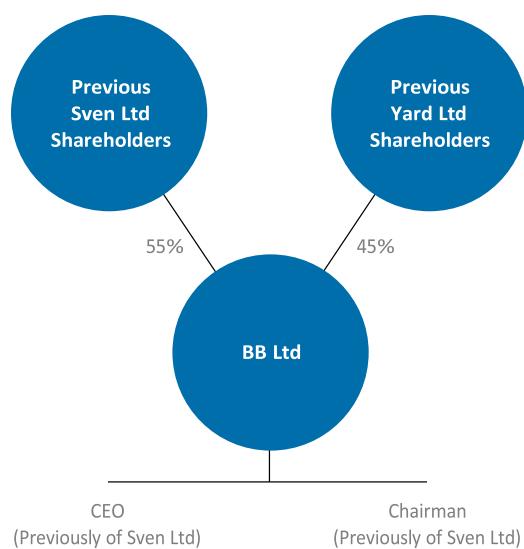
## Pre transaction



Sven Ltd and Yard Ltd enter into a business transaction. The combination is structured through a new entity, BB Ltd.

Previous shareholders of Sven Ltd will hold 55% of BB Ltd post transaction. The CEO and Chairman of Sven Ltd, will adopt these roles for the new entity, BB Ltd.

## Post transaction



Based on this information only, Sven Ltd would probably be deemed to be the acquirer – given the post transaction shareholdings and the board representation of its directors on the new board of BB Ltd. The net assets of Yard Ltd must be measured at fair value to be included in the group accounts of BB Ltd.

## Measure the cost of the transaction

The acquirer should measure the cost of a business combination as the aggregate of:

- The fair values, at the date of exchange, of assets given, liabilities incurred or assumed, and equity instruments issued by the acquirer, in exchange for control of the acquiree; plus
- Any costs directly attributable to the business combination. (Under the new accounting rules – see later – such costs are treated as expenses)

The acquisition date is the date on which the acquirer effectively obtains control of the acquiree.

Assets given and liabilities incurred or assumed by the acquirer in exchange for control of the acquiree are required to be measured at their fair values at the date of acquisition.

Therefore, when settlement of all or any part of the cost of a business combination is deferred, the fair value of that deferred component should be determined by discounting the amounts payable to their present value at the date of acquisition, taking into account any premium or discount likely to be incurred in settlement.

### Fair value guidance

The published price at the date of exchange of a quoted equity instrument provides the best evidence of the instrument's fair value and should be used, except in rare circumstances.

Other evidence and valuation methods should be considered only in the rare circumstances when the acquirer can demonstrate that the published price at the date of exchange is an unreliable indicator of fair value and that the other evidence and valuation methods provide a more reliable measure of the equity instrument's fair value.

The published price at the date of exchange is an unreliable indicator only when it has been affected by the thinness of the market.

If the published price at the date of exchange is an unreliable indicator or if a published price does not exist for equity instruments issued by the acquirer, the fair value of those instruments could, for example, be estimated by reference to their proportional interest in the fair value of the acquirer or by reference to the proportional interest in the fair value of the acquiree obtained, whichever is the more clearly evident.

#### ***Directly attributable costs of the business combination***

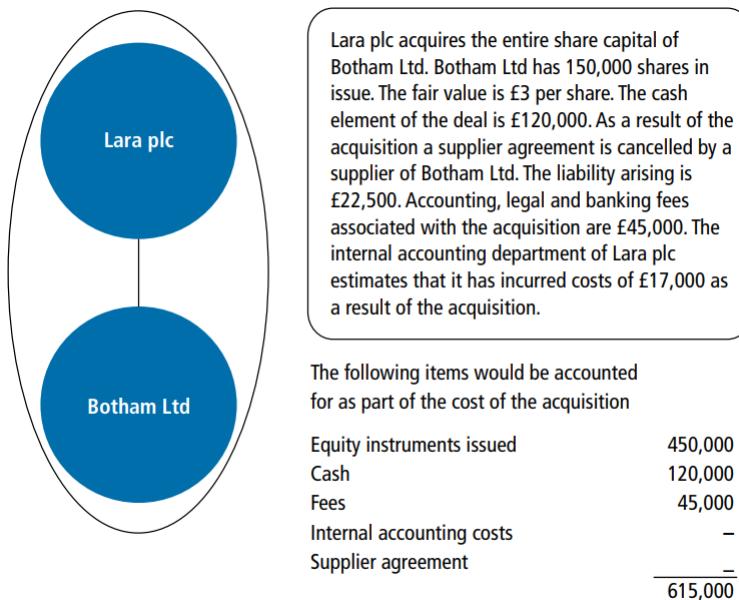
The cost of a business combination includes any costs directly attributable to the combination, such as professional fees paid to:

- Accountants
- Legal advisers
- Valuers and other consultants to effect the combination.

Under the new M&A accounting rules, these costs will be treated as expenses in the period in which the services are received. These rules are explained at the end of this chapter.

General administrative costs are recognised as an expense when incurred.

General administrative costs, including the costs of maintaining an acquisitions department, and other costs that cannot be directly attributed to the particular combination being accounted for are not included in the cost of the combination: they are recognised as an expense when incurred.



The costs associated with arranging and issuing financial liabilities are not included in the cost of a business combination.

These costs should be included in the initial measurement of the liability. Similarly, the costs of issuing equity instruments are an integral part of the equity issue transaction, even when the equity instruments are issued to effect a business combination, rather than costs directly attributable to the combination.

#### ***Deferred and contingent acquisition costs***

As was mentioned earlier, when settlement of all or any part of the cost of a business combination is deferred, the fair value of that deferred component should be determined by discounting the amounts payable to their present value at the date of exchange, taking into account any premium or discount likely to be incurred on settlement.

There are circumstances when the costs of the acquisition will not only be deferred but may also be contingent on future events. Often this type of acquisition cost is linked to the future profitability of the acquired business.

If this is the case, the contingency will be included in the cost of the acquisition if the payment is probable and can be reliably measured.

Deferred consideration is discounted back to present value to determine its fair value.

### Contingent cost of acquisition

Jenас plc acquires the entire ordinary share capital of Shearer Ltd. Shearer Ltd has historically been a profitable entity, with average net income per year of between £2,950,000 and £3,250,000 over the last 8 years.

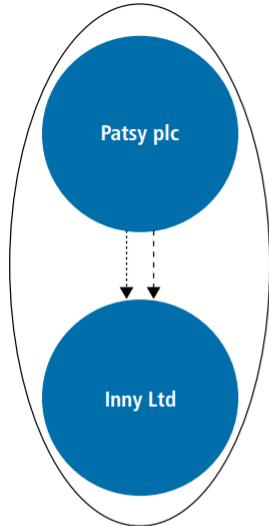
Jenас plc has agreed as part of the acquisition cost to pay an additional £1,000,000 to the previous owners of Shearer Ltd, if over the next 3 years the average profitability of Shearer Ltd exceeds £3,000,000 at the net income level.

Given the historical profitability of Shearer Ltd it is probable that the payment will be made in 3 years time. Therefore the deferred contingent consideration will be included in the cost of the acquisition at the acquisition date.

If at any stage there is evidence to suggest that the deferred contingent payment is unlikely to be paid (not probable), the cost of the acquisition should be adjusted with a subsequent amendment made to the goodwill figure.

There are important forthcoming changes to these rules which are explained at the end of this chapter.

From the shareholders of the acquiree's perspective, being acquired with equity issued by the acquirer carries its own risks. For instance, the acquiree faces the risk that the equity instruments issued as consideration for the purchase might fall in value post acquisition. Some acquisitions may be structured whereby the acquirer agrees to issue additional equity instruments to the acquiree if the fair value of the equity instruments given initially as consideration for the purchase falls below a pre-determined level.

**Consideration guarantees**

Patsy plc is a listed plc. It acquires the entire ordinary share capital of Inny Ltd. The purchase is effected by Patsy plc issuing 27,500 shares to the previous owners of Inny Ltd. Each share has a fair value of £10 each.

A clause has been entered into the acquisition agreement stating that Patsy plc will compensate the previous owners of Inny Ltd if the equity value is below £8 per share at the end of the 6 month period immediately following the date of acquisition.

Patsy plc will issue additional shares to the previous owners at the end of the 6 month period to ensure that the equity value of the Patsy plc shares, held by previous owners of Inny Ltd, does not fall below £220,000 ( $27,500 \times £8$  per share).

At the end of the 6 month period, Patsy plc shares have fallen in value to £6 per share. The equity value of the Patsy plc shares in the hands of previous owners of Inny Ltd is £165,000 ( $27,500 \times £6$  per share). Patsy plc, in order to guarantee the equity value, must issue 9,167 new shares ( $9,167 \times £6$  per share) = £55,000 to get back the guaranteed consideration value.

The new shares issued will be treated as an adjustment to equity. There will be no adjustment to the cost of the acquisition.

- Initial equity issue at the acquisition date
- - - - ► Additional equity issue to guarantee the value of the consideration

**Allocate the cost of a business combination**

The acquirer should, at the acquisition date, allocate the cost of a business combination by recognising the acquiree's identifiable assets, liabilities and contingent liabilities that satisfy the recognition criteria outlined below **at their fair values at that date**.

Any difference between the cost of the business combination and the acquirer's interest in the net fair value of the identifiable assets, liabilities and contingent liabilities so recognised should be accounted for as goodwill.

Sando plc acquires Port of Spain Ltd for £250,000. At the date of acquisition the assets and liabilities of Port of Spain are as follows:

Land and buildings	125,000	137,000
PPE	75,000	84,000
Inventories	4,520	4,265
Accounts receivable	12,450	11,205
Cash	7,580	7,580
Accounts payable	(12,450)	(12,450)
Other payables	(12,100)	(12,100)
<b>Fair value of net assets acquired</b>		<b>219,500</b>
<b>Total cost of acquisition</b>		<b>250,000</b>
<b>Goodwill</b>		<b>30,500</b>

Sando plc as the acquirer should, at the acquisition date, allocate the cost of a business combination by recognising the acquiree's identifiable assets, liabilities and contingent

liabilities that satisfy the recognition criteria at their fair values at that date.

For the purpose of allocating the cost of a business combination, the acquirer should use the following notes to determine fair value:

Allocation of acquisition cost	Fair value determination
Financial instruments traded in active market	Current market values
Financial instruments not traded in an active market	Use estimated values that take into consideration features such as price-earnings ratios, dividend yields and expected growth rates of comparable instruments of entities with similar characteristics
Receivables, beneficial contracts and other identifiable assets	Present values of the amounts to be received, determined at appropriate current interest rates, less allowances for uncollectability and collection costs, if necessary
Inventories of finished goods and merchandise	Selling prices less the sum of the costs of disposal and a reasonable profit allowance for the selling effort of the acquirer based on the profit for similar finished goods and merchandise
Inventories of work in progress	Selling prices of finished goods less the sum of <ul style="list-style-type: none"><li>• Costs to complete</li><li>• Costs of disposal</li><li>• A reasonable profit allowance for the completing and selling effort based on profit for similar finished goods.</li></ul>
Inventories of raw materials	Current replacement costs
Land and buildings	Market values

Plant and equipment	Market values  If there is no market-based evidence of fair value because of the specialised nature of the item of plant and equipment and the item is rarely sold, except as part of a continuing business, an acquirer may need to estimate fair value using an income, cash flow or a depreciated replacement cost approach
Intangible assets	Determine fair value: <ul style="list-style-type: none"><li>• By reference to an active market</li><li>• If no active market exists, on a basis that reflects the amounts the acquirer would have paid for the assets in arm's length transactions between knowledgeable willing parties, based on the best information available</li></ul>
Net employee benefit assets or liabilities for defined benefit plans	The present value of the defined benefit obligation less the fair value of any plan assets
Accounts and notes payable, long-term debt, liabilities, accruals and other claims payable	The present values of amounts to be disbursed in settling the liabilities determined at appropriate current interest rates.  However, discounting is not required for short-term liabilities when the difference between the nominal and discounted amounts is not material
Onerous contracts and other identifiable liabilities	The present values of amounts to be disbursed in settling the obligations determined at appropriate current interest rates
Contingent liabilities	The amounts that a third party would charge to assume those contingent liabilities. Such an amount should reflect all expectations about possible cash flows and not the single most likely or the expected maximum or minimum cash flow.

### ***Recognition criteria for acquired assets and liabilities***

The acquirer should recognise separately the acquiree's identifiable assets, liabilities and contingent liabilities at the acquisition date only if they satisfy the following criteria at that date:

The acquirer will only recognise the acquiree's net assets at the acquisition date if the recognition criteria are met

- In the case of an asset other than an intangible asset, it is **probable that any associated future economic benefits will** flow to the acquirer and its fair value can be measured reliably
- In the case of a liability other than a contingent liability it is **probable that an outflow of resources embodying economic benefits will** be required to settle the obligation and its fair value can be measured reliably
- In the case of an intangible asset or a contingent liability, its **fair value can be measured reliably.**

The acquirer's income statement should incorporate the acquiree's profits and losses after the acquisition date by including the acquiree's income and expenses based on the cost of the business combination to the acquirer.

For example, depreciation expense included after the acquisition date in the acquirer's income statement that relates to the acquiree's depreciable assets should be based on the fair values of those depreciable assets at the acquisition date, i.e. their cost to the acquirer.

### ***Acquiree's identifiable assets and liabilities***

Subject to the recognition criteria outlined above, the acquirer recognises separately, as part of allocating the cost of the combination, only the identifiable assets, liabilities and contingent liabilities of the acquiree that existed at **the acquisition date.**

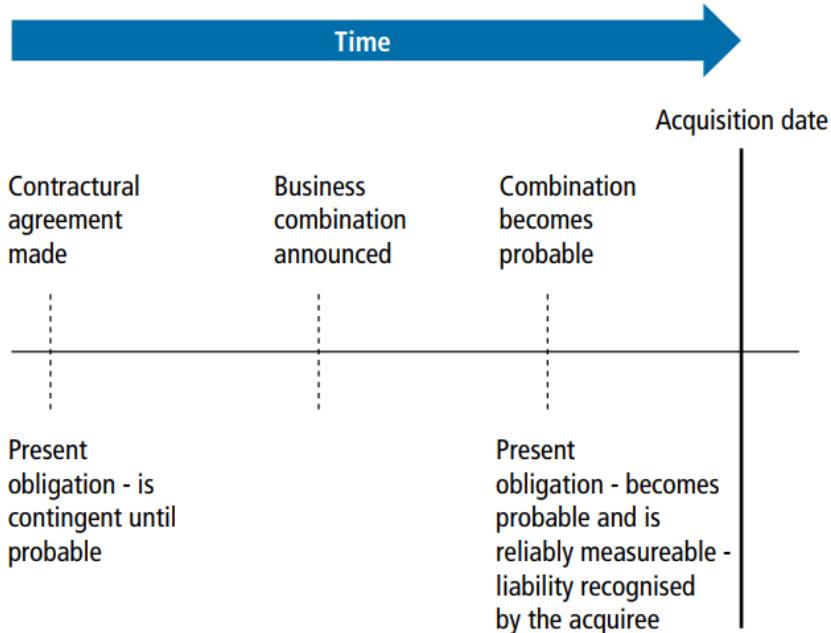
As a result the acquirer:

- Should recognise liabilities for terminating or reducing the activities of the acquiree as part of allocating the cost of the combination only when the acquiree has, **at the acquisition date, an existing liability for restructuring recognised in its accounts**
- When allocating the cost of the combination, **should not recognise liabilities for future losses or other costs** expected to be incurred as a result of the business combination

In the past SPK plc agreed contractually that it would make a payment to its employees and suppliers in the event that it was acquired in a business combination. This is a present obligation of the entity that is regarded as a contingent liability until it becomes probable that a business combination will take place.

The contractual obligation is recognised as a liability by the entity when a business combination becomes probable and the liability can be measured reliably.

Therefore, when the business combination is effected, the liability of the acquiree is recognised by the acquirer as part of allocating the cost of the combination. The liability is recognised as it is part of the acquiree's plan prior to the business combination. (See the following contrasting by the acquiree.



Wavy plc has acquired Beardy Ltd. As part of the business combination, Wavy plans to restructure the activities of Beardy Ltd. This will involve the termination of a number of employee contracts, a renegotiation of the supply chain and a systems integration exercise.

Wavy plc is unable to recognise the restructuring costs as an acquired liability as the effects of the plans were not a liability of the acquiree prior to the business combination. The restructuring is a post acquisition intention of the acquirer.

#### ***Acquiree's intangible assets***

An intangible asset should be recognised at cost on acquisition. The cost should be determined as part of the fair value exercise.

An acquirer should recognise separately an intangible asset of the acquiree at the acquisition date only if it meets the definition of an intangible asset:

- It is separately identifiable
- It is a resource that is controlled by the entity
- It is a probable source of future economic benefits
- Its fair value can be measured reliably

An asset meets the identifiability criterion in the definition of an intangible asset if it:

- Is **separable**, i.e. capable of being separated or divided from the entity and sold, transferred, licensed, rented or exchanged, either individually or together with a related contract, asset or liability; **or**
- **Arises from contractual or other legal rights**, regardless of whether those rights are transferable or separable from the entity or from other rights and obligations.

For identifiability, separability as well as contractual and legal rights are taken into account

This development to isolate more of an entity's intangible asset value is an attempt to reflect that in a modern economy more of an entity's equity value is reflected in its intangible asset worth.

Under previous accounting rules, the identifiability of separate net assets relied purely on the ability of the entity to identify an asset or liability separately and on that item being capable of separate disposal without curtailing the operations of the business. Where previously much of an entity's value could not be separated, this value became subsumed within the goodwill figure.

Current accounting rules examine the amount an acquirer is willing to pay for an acquisition (the cost of acquisition) and allocate it through a more thorough set of intangible asset recognition criteria.

When examining the elements of the acquisition, not all items that are deemed to add value to the entity in question should be recognised separately. This will usually be because the entity does not control the resource in question. The assembled workforce would be an example of this, as the skills or resource embodied in a particular group of people does not meet the intangible asset definition as the entity often has insufficient control over the actions of the group.

## Intangible assets recognition issues – illustrative examples

### The issue

CGT Ltd acquires PBB Ltd in a business combination on 31st March 2009.

PBB Ltd has a 3 year service agreement to supply training services to CTF Ltd. Both CGT and PBB believe that the service agreement will be renewed at the end of the current contract which comes to an end on 30th June 2010. The contract has already been renewed once in the past. The agreement is not separable in the sense that it is not capable of being separated or divided from the entity and sold, transferred, licensed, rented or exchanged, either individually or together with a related contract, asset or liability.

### The conclusion

The agreement to supply training services (a contractual right that is legally enforceable), irrespective of whether it is cancellable or not, meets the contractual-legal criterion for identification as an intangible asset. Therefore the asset will be recognised separately from goodwill, given that the fair value of the asset can be measured reliably.

If an entity establishes relationships with its customers through contracts, those customer relationships arise from contractual rights.

Therefore, customer contracts and the related customer relationships acquired in a business combination meet the contractual-legal criterion for identification as intangible assets. This will be the case even if confidentiality or other contractual terms prohibit the sale or transfer of a contract separately from the acquired entity or business.

Therefore in the case of CGT acquiring PBB, the customer relationship that PBB has with its customer will be recognised as a separate intangible asset subject to the fair value being measured reliably.

**The issue**

An investment bank decides to acquire a highly successful training company for the purpose of providing the bank's entire in-house and client training services. It seems like a fantastic idea. The investment bank takes into account a number of items that are not tangible assets of the company, when determining the purchase price of the training company:

- The skills and experience of the trainers working for the company
- The brand name of the company
- The company's client list
- The patent the company holds on an investment banking game it developed

**The conclusion**

The skills of the trainers and their respective experience cannot be recognised as a separate intangible asset as the investment bank does not have sufficient control over the trainers, their skills and experience to be considered an asset of the investment bank.

The brand name attached to training services provided by the company can be recognised subject to the fair value being reliably measured.

The patent on the investment banking game would be recognised as a separate intangible asset as it arises from legally enforceable rights.

**In process research and development**

IFRS	US GAAP
<p>On initial recognition as part of the transaction to acquire a business, the cost of an intangible asset should be measured at the fair value at the date of acquisition. There can be situations where this results in items, that are ineligible for recognition in the books of the acquiree, being recognised separately on acquisition in the books of the acquiring company.</p> <p>In-process research and development (IPRD) is a common example of this particular situation.</p> <p>Expenditure during the research phase (the search for new knowledge – pure research – and the noncommercial development of existing knowledge – applied research) of an IPRD project <b>must be expensed</b>.</p> <p>However, subsequent expenditure during the development phase of a project (the commercial development of existing research knowledge) can be capitalised post acquisition if the entity can demonstrate</p>	<p>Neither past expenditure on research nor on development is treated as a separable asset acquired as part of the acquisition. Where applicable a value is assigned to both and that amount is expensed through the group income statement on the date of the acquisition.</p>

<p>the features highlighted in the previous chapter.</p> <p>These criteria have the objective of determining whether a reliable economic benefit can be attached to the IPRD project in question.</p> <p>Pharma plc is a UK based pharmaceutical company. It has just completed the acquisition of a pharmaceutical research company. The research company has two major research projects. Project Ache is a development project taking a proven cure and developing it into a commercial product. Project Interest is a research project to examine and refine a potential medical cure for stupidity.</p> <p>On acquisition the projects are measured at their fair values and are recognised as assets acquired as part of the business combination.</p> <p>After the acquisition, any expenditure on Project Ache (the development project) can be capitalised if the project satisfies the recognition requirements outlined above. The subsequent expenditure incurred on Project Interest, because it is a research project and its future economic benefits are uncertain, will be written off immediately, until</p>	
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such time as the project can be classified as a development project that satisfies the criteria outlined above.

### Examples of separately recognised intangible assets

#### *Marketing related intangibles*

- Trademarks
- Brands
- Trade names
- Internet domain names
- Newspaper mastheads
- Non-compete agreements

#### *Customer related*

- Customer lists
- Order or production backlogs
- Customer contracts and related relationships

#### *Contract based*

- Licensing
- Royalty and standstill agreements
- Lease agreements
- Construction permits
- Franchise agreements
- Operating and broadcasting rights
- Employment contracts

#### *Technology based*

- Patented technology
- Computer software
- Unpatented technology

- Databases
- Trade secrets

## Accounting for goodwill

On the date of acquisition, the goodwill arising from the business combination should be recognised in the balance sheet of the acquirer as an intangible asset. The asset will be measured as the excess of the acquisition cost over the acquirer's interest in the fair value of the assets acquired and the liabilities assumed.

A detailed summary of the goodwill calculation is illustrated below:

### Goodwill

#### Fair value of consideration

Cash	300,000	<i>Fair value</i>
Ordinary shares of acquirer	675,000	<i>Fair value</i>
Debt	1,560,000	<i>Fair value</i>
Acquisition costs	23,350	<i>Included in the acquisition cost if directly attributable to the cost of the acquisition</i>
<hr/>		2,560,350

#### Fair value of net assets acquired

Book value of target	1,180,000	<i>Per balance sheet of target</i>
Fair value adjustments	12,000	<i>Adjustment to bring book values in line with fair values</i>
Fair value adjustments	13,500	<i>Adjustment to bring book values in line with fair values</i>
Intangible assets	175,000	<i>Recognition of intangible asset not recognized on target's balance sheet</i>
<hr/>		1,380,500
75% of target acquired	1,035,375	<i>% of target acquired in business combination</i>

#### Goodwill arising on the acquisition of target

1,524,975	<i>Goodwill arising (subsuming net assets not identifiable/separable as part of the business combination)</i>
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Alternatively, this could be presented as:

<b>Goodwill</b>		
<b>Fair value of consideration</b>		
Cash	300,000	<i>Fair value</i>
Ordinary shares of acquirer	675,000	<i>Fair value</i>
Debt	1,560,000	<i>Fair value</i>
Acquisition costs	23,350	Currently included in the acquisition cost if directly attributable to the cost of the acquisition
	<hr/> 2,560,350	
Minority interests: 25% x 1,380,500	345,125	
	<hr/> 2,905,475	
<b>Fair value of net assets acquired</b>		
Book value of target	1,180,000	<i>Per balance sheet of target</i>
Fair value adjustments	12,000	<i>Adjustment to bring book values in line with fair values</i>
Fair value adjustments	13,500	<i>Adjustment to bring book values in line with fair values</i>
Intangible assets	175,000	<i>Recognition of intangible asset not recognized on target's balance sheet</i>
	<hr/> 1,380,500	
<b>Goodwill arising on the acquisition of target</b>		
	<hr/> 1,524,975	Goodwill arising (subsuming net assets not identifiable as part of the business combination)
	<hr/>	

This presentation is useful in understanding the new M&A accounting rules presented at the end of this chapter.

The goodwill arising will sit as an intangible non-current asset on the balance sheet of the acquiring group. It is not amortised over its useful economic life, but tested for impairment on an annual basis.

***Discounts on acquisitions (previously referred to as negative goodwill)***

Negative goodwill arises when the acquisition cost of a business combination is less than the fair value of the net assets acquired. Consider the illustration below – the acquisition cost is significantly smaller than the fair value of the net assets acquired in the business combination.

	Book value	Fair value
Land and buildings	125,000	137,000
PPE	75,000	84,000
Inventories	4,520	4,265
Accounts receivable	12,450	11,205
Cash	7,580	7,580
Accounts payable	(12,450)	(12,450)
Other creditors	(12,100)	(12,100)
<b>Fair value of net assets acquired</b>		<b>219,500</b>
<b>Total cost of acquisition</b>		<b>180,000</b>
<b>Goodwill</b>		<b>(39,500)</b>

The first step required is to reassess the goodwill calculation, as discounts on acquisitions are rare and often negative outcomes are mistakes in the calculations rather than being a reflection of the actual goodwill position.

If after reassessing the goodwill calculation, the outcome is negative, the remaining negative excess is recognised immediately in profit or loss for the period. Given the information in the above example, if the initial calculation of the goodwill was deemed appropriate, the negative

goodwill would be written off and a gain would be recognised in the income statement.

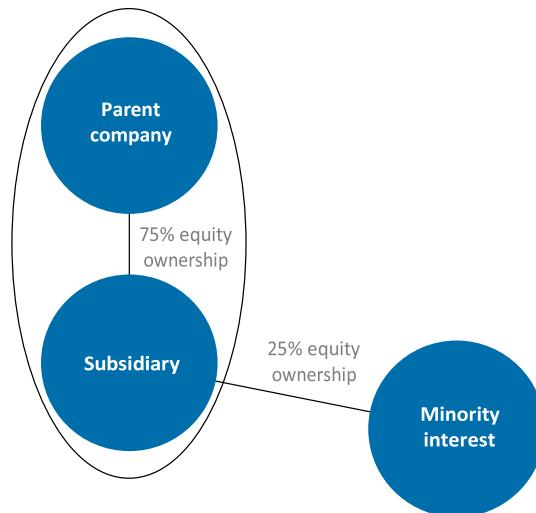
Negative excess is recognised immediately in profit or loss for the period.

### Minority interest

A minority interest is that portion of the profit or loss and net assets of a subsidiary attributable to equity interests that are not owned, directly or indirectly through subsidiaries, by the parent.

There are important forthcoming changes to these rules which are explained at the end of this chapter.

The group structure below illustrates a very straightforward minority interest. The parent company owns 75% of the equity voting share capital of the subsidiary. The rest of the voting share capital of the subsidiary is owned by parties external to the group shareholders.



The minority interest in the income statement represents the appropriation of profit that is owned by parties outside the group shareholder structure. The minority interest accounting arises because purchase accounting focuses on accounting for control in the income statement between the sales and profit after tax lines.

With group structures where the parent owns less than 100% of the voting share capital of the subsidiary, purchase accounting will consolidate 100% of the subsidiary results between sales and profit after tax, irrespective of the degree of ownership, thereby demonstrating control. However, this does overstate the degree to which the group has ownership of the profits or losses consolidated. The minority interest appropriation is therefore required to strip out the element of profit or loss the group does not own.

**Group income statement (minority interest illustration)**

Sales	X	P+S (100%)
Cost of sales	(X)	P+S (100%)
Operating expenses	(X)	P+S (100%)
Operating profit	X	
Interest	(X)	P+S (100%)
Profit before tax	X	
Tax	(X)	P+S (100%)
Profit after tax	X	
Minority interest	(X)	25% X Net Income of S
Net income	X	P+75% X S
<u>X/(X)</u>	Income and expenses under control of the parent	
<u>X/(X)</u>	Net income owned by the group after appropriating ownership to the MI	

The same argument can be applied to the balance sheet as purchase accounting demonstrates control by consolidating 100% of the net assets of the subsidiary into the group accounts. With structures where the parent owns less than 100% of the voting share capital of the subsidiary, a minority interest adjustment is required to appropriate this ownership.

### Group balance sheet (minority interest illustration)

Goodwill	X		
Tangible assets	X	P+S (100%)	
Intangible assets	X	P+S (100%)	
Inventories	X	P+S (100%)	
Receivables	X	P+S (100%)	
Cash	X	P+S (100%)	
Total assets	X		
Liabilities < 1 year	X	P+S (100%)	
Liabilities > 1 year	X	P+S (100%)	
Minority interest	X	25% X net assets of S	MI appropriation of group net asset ownership
Share capital	X	P	
Share premium	X	P	
Retained earnings	X	P+75%XS(post acqn)	
Total liabilities & shareholders equity	X		
<b>X/(X)</b>		Assets and liabilities under the control of the parent	
<u>X/(X)</u>		Net assets owned by the group after appropriating ownership to the MI	

### Comprehensive example

Mango plc is to acquire 100% of the shares of Steen plc. The consideration will comprise either:

- 2,700m in cash

- £3,100m of shares in Mango plc (comprising 1,525m shares with a fair value of 203½p each); or
- £2,250m of shares in Mango plc (comprising 1,107m shares with a fair value of 203½p each) and £750m in cash
- Both companies have the same year-end. The balance sheet of Steen reflects fair values. Goodwill is not to be amortised but is to be reviewed annually for impairment

Assume interest at 6% and corporation tax at 30%.

#### **Balance sheets immediately prior to transaction (£m)**

	<b>Mango</b>	<b>Steen</b>
Net operating assets	1,000	3,267
Net funds / (debt)	115	(1,133)
	1,115	2,134
Shares	172	984
Retained earnings	943	1,150
	1,115	2,134

#### **Forecast results for year following the transaction (£m)**

	<b>Mango</b>	<b>Steen</b>
Sales	4,384	8,969
Operating costs, excl dep'n	(4,017)	(8,336)
EBITDA	367	633
Depreciation	(109)	(190)
EBIT	258	443
Interest	14	(65)
Tax	(97)	(117)
Net income	175	261
Number of shares	1720m	
EPS	10.2p	

## Mango and Steen

The structure of the deal consideration has important implications, not only in terms of the capital structure of the group post transaction and potential credit ratings, but also in terms of whether the deal is EPS accretive or dilutive.

The all cash deal has created the highest level of accretion (84%), as the positive income statement earnings impact is realised without a corresponding increase in the average number of shares. Whether the group can sustain a £2,700m increase in net debt is questionable.

The other end of the deal consideration spectrum – an all equity deal produces EPS accretion (32%), but not as accretive as the cash deal. However, there is no additional pressure on the capital structure other than the acquired net debt of Steen Ltd.

Managing the capital structure & tax implications, the accessibility to the equity & debt capital markets and the EPS accretion / dilution targets of the acquirer are all important factors to examine when developing the deal consideration structure.

### Mango and Steen

Balance sheet	Mango	Steen	Cash Adj	Cash Group	Equity Adj	Equity Group	Mix Adj	Mix Group	Net assets under the control of the group
Goodwill	–	–	566	566	966	966	866	866	
Net operating assets	1,000	3,267	3,267	4,267	3,267	4,267	–	4,267	
Net funds / (debt)	115	(1,133)	(3,833)	(3,718)	(1,133)	(1,018)	(750)	(1,768)	
	1,115	2,134		1,115		4,215		3,365	
Shares	172	984	(984)	172	2,116	3,272	1,266	2,422	
Retained earnings	943	1,150	(1,150)	943	(1,150)	943	(1,150)	943	
	1,115	2,134		1,115		4,215		3,365	
<b>Elimination of pre-acquisition reserves</b>									
Income statement			Cash	Cash	Equity	Equity	Mix	Mix	
Sales	4,384	8,969	–	13,353	–	13,353	–	13,353	
Operating costs	(4,017)	(8,336)	–	(12,353)	–	(12,353)	–	(12,353)	
EBITDA	367	633	–	1,000	–	1,000	–	1,000	
Depreciation	(109)	(190)	–	(299)	–	(299)	–	(299)	
EBIT	258	443	–	701	–	701	–	701	
Interest	14	(65)	(162)	(213)	–	(51)	(45)	(96)	
Tax	(97)	(117)	49	(165)	–	(214)	14	(201)	
Net Income	175	261	(113)	323	–	436	(32)	405	
<b>Number of shares</b>	<b>1,720</b>			<b>1,720</b>		<b>3,245</b>		<b>2,827</b>	
<b>EPS</b>	<b>10.17p</b>			<b>18.76p</b>		<b>13.44p</b>		<b>14.31p</b>	
<b>Accretion / (Dilution)</b>				<b>84.34%</b>		<b>32.06%</b>		<b>40.63%</b>	

Additional interest paid on the cash element  
of the consideration and tax shield thereon.

## Accounting for associates and joint ventures

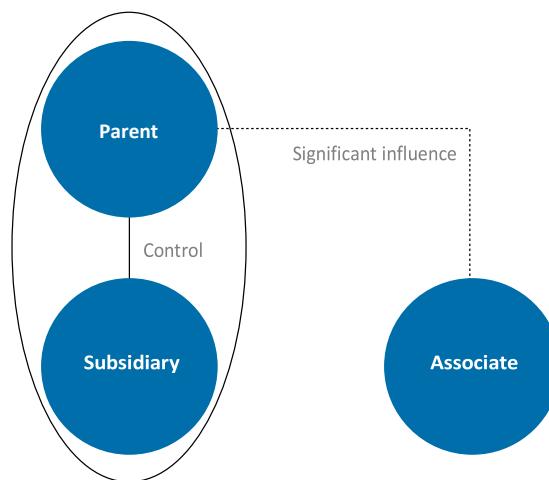
### Significant influence

An associate is an entity, including an unincorporated entity such as a partnership, over which the investor has significant influence and that is neither a subsidiary nor an interest in a joint venture.

If an investor holds, directly or indirectly (e.g. through subsidiaries), 20 per cent or more of the voting power of the investee, it is presumed that the investor has significant influence, unless it can be clearly demonstrated that this is not the case.

The existence of significant influence by an investor is usually evidenced in one or more of the following ways:

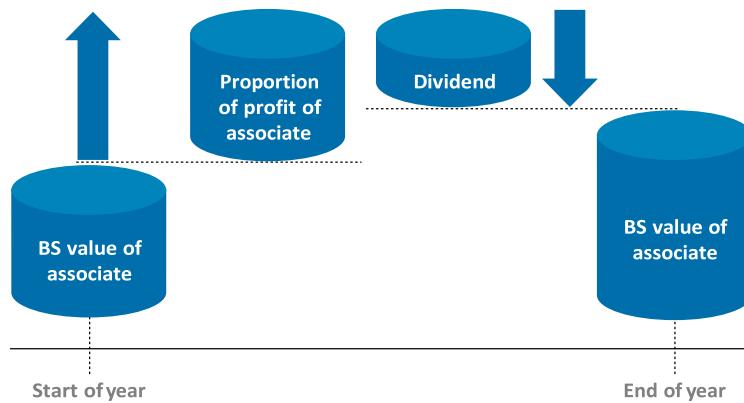
- Representation on the board of directors or equivalent governing body of the investee
- Participation in policy-making processes, including participation in decisions about dividends or other distributions
- Material transactions between the investor and the investee
- Interchange of managerial personnel
- Provision of essential technical information



## Equity accounting

Under the equity method the investment in an associate is:

- Initially recognised at cost
- Increased or decreased to recognise the investor's share of the profit or loss of the investee after the date of acquisition

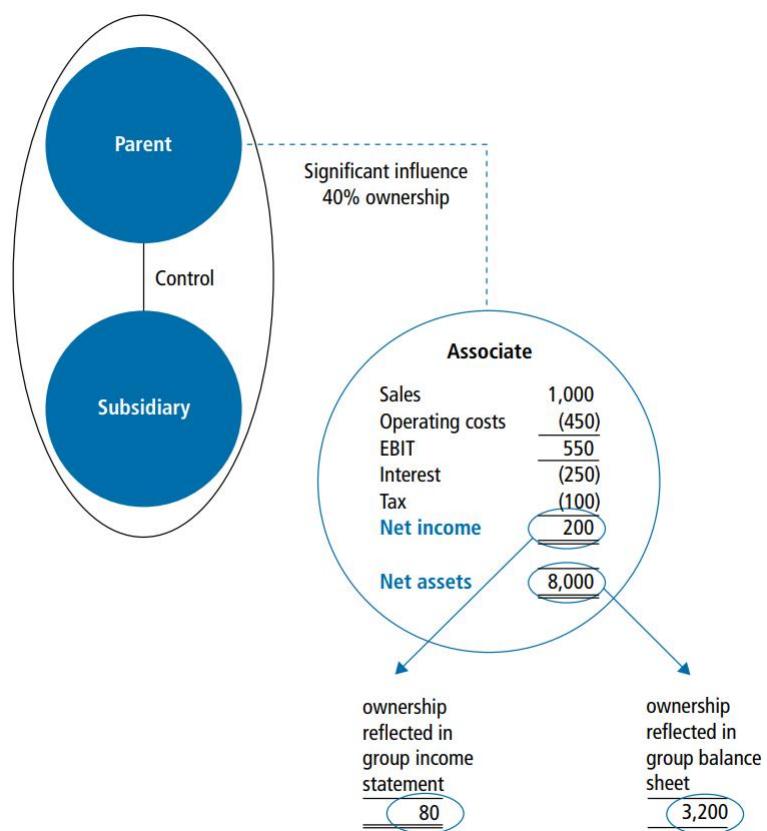


The investor's share of the profit or loss of the investee is recognised in the investor's profit or loss.

Distributions received from an investee reduce the carrying amount of the investment.

When potential voting rights exist, the investor's share of profit or loss of the investee and of changes in the investee's equity is determined on the basis of present ownership interests and does not reflect the possible exercise or conversion of potential voting rights.

Goodwill can arise on the acquisition of an interest in an associate investment in the same way as in the acquisition of a subsidiary.



### ***Considerations for investment banking***

#### **Equity accounting and the implications for adjusted net debt calculations**

The standard net debt calculation only includes the borrowings of the parent and its subsidiaries. Normally, lenders to an associate have no legal recourse to the group in respect of its debt and therefore there is an argument that the debt in the associate should be left outside the calculation.

However, for some companies their associates are so strategically important to the overall well being of the group, that if their associates did default on their debt (even if there was no recourse to the group) the consequences could call into question the financial position of the group. Therefore in some situations it may be necessary to adjust the net debt calculation to bring in the debt exposure embedded in the associates.

This is a situation Coca Cola Inc is exposed to. Below is an extract from their 10K:

"As of December 31, our long-term debt was rated "A+" by Standard & Poor's and "Aa3" by Moody's, and our commercial paper program was rated "A-1" and "P-1" by Standard & Poor's and Moody's, respectively.

In assessing our credit strength, both Standard & Poor's and Moody's consider our capital structure and financial policies as well as aggregated balance sheet and other financial information for the Company and certain bottlers including Coca-Cola Enterprises Inc. ("CCE") and Coca-Cola Hellenic Bottling Company S.A. ("CCHBC").

While the Company has **no legal obligation for the debt of these bottlers, the rating agencies believe the strategic importance** of the bottlers to the Company's business model provides the Company with an incentive to keep these bottlers viable."

Source: Coca Cola 10K

[“CCE” and “CCHBC” are both equity accounted investments of Coca Cola Inc]

**Income statement presentation****Nestlé SA annual report (IFRS)**

In millions of CHF

Sales to customers	<b>86,769</b>	87,979
Cost of goods sold	(36,146)	(37,583)
Distribution expenses	(7,045)	(7,104)
Marketing and administrative expenses	(31,195)	(31,081)
Research and development costs	(1,413)	(1,205)
EBITA	<b>10,970</b>	11,006
Net other income (expenses)	(2,268)	(2,105)
Profit before interest and taxes	<b>8,672</b>	8,901
Net financing cost	(699)	(594)
Profit before taxes	<b>8,003</b>	8,307
Taxes	(2,452)	(2,307)
Net profit of consolidated companies	<b>5,551</b>	6,000
Shares of profit attributable to minority interests	(422)	(380)
Shares of results of associates	<b>1,588</b>	593
Net profit	<b>6,717</b>	6,213

Source: Nestle annual report

IAS 28 requires the investor to recognise its share of the profit or loss of the equity accounted entity in the group income statement. This number is post interest and tax

**IFRA equity accounting**

IFRS requires that the group recognises its share of the associate's net income. IFRS is silent on where this number is then disclosed in the income statement. Commonly, the share of the associate's net income will be shown post tax, as in the Nestlé example above.

Both the equity accounting numbers from IFRS and US GAAP are net of interest and tax. However, the US GAAP disclosure that often brings the associate's income above the tax (and sometimes the interest line) can be very confusing

**Coca Cola Inc annual report (US GAAP)**

Year Ended December 31

(In \$millions except per share data)

Net operating revenues	<b>21,962</b>	21,044
Cost of goods sold	<b>7,638</b>	7,762
Gross profit	<b>14,324</b>	13,282
Selling, general and administrative expenses	<b>8,146</b>	7,488
Other operating charges	<b>480</b>	573
Operating income	<b>5,698</b>	5,221
Interest income	<b>157</b>	176
Interest expense	<b>196</b>	178
Equity income - net	<b>621</b>	406
Other income (loss) - net	(82)	(138)
Gains on issuances of stock by equity investees	<b>24</b>	8
Income before income taxes	<b>6,222</b>	5,495
Income taxes	<b>1,375</b>	1,148
Net income	<b>4,847</b>	4,347

Source: Coca Cola 10k

**US GAAP equity accounting**

US equity accounting will bring in the results of the equity accounted entities net of tax and interest. Surprisingly, this number is often disclosed in the income statement above the tax line.

## Accounting for joint ventures

A joint venture is defined as a contractual arrangement whereby two or more parties undertake an economic activity that is subject to joint control, where joint control is the contractually agreed sharing of control over an economic activity.

Joint ventures take many different forms and structures.

- Jointly controlled operations
- Jointly controlled assets
- Jointly controlled entities

A venturer should recognise its interest in a jointly controlled entity using either:

- Proportionate consolidation; or
- Equity accounting

Joint ventures are normally accounted for in the same manner as associates; equity accounting. There is an alternative which is occasionally used; proportional consolidation. An illustration of proportional consolidation is presented here.

The example below is an illustration of how a 50% joint venture would be proportionally consolidated into the group accounts. The joint venture is brought into the group accounts on a proportionate line by line basis between sales and net income

€'000s	Sven plc	Yard Ltd Joint venture	Prop Consol Yard Ltd	Sven plc Group
	(A)	(B)	(B) X 50% = (C)	(A) + (C)
Sales	15,000	8,000	4,000	19,000
Cost of sales	(6,000)	(3,200)	(1,600)	(7,600)
Operating expenses	(1,200)	(640)	(320)	(1,520)
Operating profit	7,800	4,160	2,080	9,880
Interest	(1,560)	(1,664)	(832)	(2,392)
Profit before tax	(1,560)	(1,664)	(832)	(2,392)
Tax	(1,640)	(646)	(323)	(1,963)
Net income	(3,200)	(2,310)	(1,155)	(4,355)
<b>Interest cover</b>	<b>5.00x</b>	<b>2.50x</b>		<b>4.13x</b>

## Considerations for investment banking

### Value will be harder to prove

Entities completing business combinations (accounted for as purchases) will look very different following the transaction. New assets and liabilities will be recognised on the combined balance sheet. Some existing assets and liabilities may be measured according to different conventions. It is possible that balance sheet items recognised prior to the acquisition may be derecognised in the post acquisition accounts.

These changes to the recognition and measurement requirements will make it a harder exercise to justify the accretion of post acquisition earnings.

### Goodwill

The accounting rules force acquirers to work hard to identify all of the assets they are acquiring, both tangible and intangible. As goodwill is the residual of these identifiable net assets, the goodwill number is often lower than would otherwise have been.

### The impact of goodwill impairment calculations on EBIT, EBITA and EBITDA calculations

In the past, the systematic amortisation of goodwill arising on the purchase of subsidiaries used to be charged in arriving at EBIT.

The removal of this amortisation charge will therefore increase EBIT numbers for companies with significant goodwill balances.

The impairment of goodwill, although not a systematic charge to EBIT, will be charged in arriving at the EBIT figure.

EBITA and EBITDA figures should still include adjustments for goodwill impairment charges and the amortisation of other intangible assets in arriving at the metric.

EBIT earnings volatility could increase as a result of the non-amortisation of goodwill. Previously, the systematic amortisation of goodwill provided a consistent charge to the

income statement with respect to the consumption of the economic benefit. Now with the introduction of impairment testing of goodwill, there is no regular charge to the income statement for goodwill. This could result in irregular income statement charges as and when impairments materialise.

### More amortisation

Goodwill amortisation has been replaced with the impairment model. This will have an earnings accretive impact. However, impairments of goodwill can still arise giving a more unpredictable dilutive impact to earnings. This is especially a concern for companies that made acquisitions at the top of the bull market. Companies with significant goodwill balances arising from acquisitions made during the mid 2000s bull run should assess the potential impact of the goodwill impairment reviews. Any significant goodwill impairments should be quantified and communicated to the market in order to manage any potential share price impact.

More intangible assets will be measured and recognised as part of the business combination. These intangible assets will be subject to the normal intangible asset amortisation rules. This may result in more amortisation in future years, mitigating the earnings accretion arising from the non-amortisation of goodwill.

### Tax deductibility of goodwill

As a general rule, goodwill is not considered tax deductible within most countries. The reason for this is that goodwill arising on the acquisition of equity is a group accounting adjustment and therefore only appears in the accounts at the group level. Tax is in most countries calculated at the single entity level, with the group tax charge merely reflecting the addition of the individual tax charges of individual group members. Thus goodwill adjustments / impacts rarely appear in the taxable profit calculation of a single tax reporting entity.

The exception to this basic rule relates to goodwill arising on the acquisition of an entity's net assets rather than its equity.

Goodwill arising from this type of business acquisition will appear in the accounts of an individual single entity. In some countries, amortisation of this goodwill is deductible for tax purposes.

### **Restructuring costs and the impact on post acquisition performance**

Unless the target entity was already committed to a restructuring prior to the acquisition, restructuring provisions are excluded from the goodwill calculation and must be charged directly to net income post acquisition. Under the old rules, there was more scope to include restructuring provisions in the goodwill calculation (as part of the allocated cost of an acquisition).

This will make it harder to demonstrate post acquisition earnings accretion.

### **Net debt implications**

The basic definition of net debt is detailed in the introductory accounting chapters. A basic definition of net debt =

$$\text{Borrowings} - (\text{Cash} + \text{Liquid Resources})$$

Given the nature of purchase accounting outlined in the previous pages, it is important to appreciate that the net debt calculation contained within an annual report includes borrowings, cash and liquid resources for the parent and its subsidiaries. It is important to realise that the standard net debt calculation does not include the debt exposure included in joint ventures and associates.

### **Past deals**

With the introduction of the goodwill impairment model, there may be significant write offs of goodwill required in respect of past deals. Consideration will have to be given as to how this information is communicated to the market. There is always the worry of an AOL-Time Warner situation where there was a \$53bn impairment write down on the intangible assets.

## Comprehensive example

### Business combinations

On 30th June 2007 Trevor plc acquired 75% of the ordinary shares of Simon Ltd. Both companies have a 31st December year end.

The consideration amounted to	2,750,000
Comprising:	
Cash	375,000
Ordinary share in Trevor plc (237,500 shares with nominal value of 1GBP)	475,000
Debt	1,900,000

The net assets of Trevor plc and Simon Ltd as at 30th June 2007 are:

	Trevor	Simon
Goodwill	800,000	–
PPE	2,165,000	350,000
Inventories	590,000	750,000
Receivables	450,000	600,000
Cash	497,000	100,000
<hr/>	<hr/>	<hr/>
Total assets	4,502,000	1,800,000
<hr/>	<hr/>	<hr/>
Liabilities	502,000	620,000
Ordinary shares (NV 1GBP)	600,000	100,000
Share premium	450,000	250,000
Retained earnings	2,950,000	830,000
<hr/>	<hr/>	<hr/>
Total liabilities and shareholders funds	4,502,000	1,800,000
<hr/>	<hr/>	<hr/>

The costs and fees associated with the business combination amounted to 27,500

An intangible asset was assessed to see if it met the recognition criteria and is to be included in the goodwill calculation at the date of acquisition of Simon Ltd – this intangible asset is not currently recognised on the balance sheet of Simon Ltd

Customer contracts	Fair value	175,000
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All other assets and liabilities on the balance sheet of Simon Ltd are at fair value

*Continued*

## Accounting for the business combination

### Goodwill

#### Fair value of consideration

Cash	375,000
Ordinary share in Trevor plc	475,000
Debt	1,900,000
Acquisition costs	27,500

2,777,500

#### Fair value of net assets acquired:

Fair value of Simon Ltd	
identifiable net assets	1,180,000
Intangible assets	175,000
	1,355,000

(1,016,250)

1,761,250

75% of Simon acquired

Goodwill arising on the  
acquisition of Simon Ltd

## Trevor Group plc – Balance sheet

	Trevor plc (A)	Simon Ltd	Adjustments Consideration acquired (B)	Adjustments Net assets Sheet (C)	Group Balance (A+B+C)
Goodwill	800,000	–		1,761,250	2,561,250
PPE	2,165,000	350,000		350,000	2,515,000
Intangibles	–	175,000		175,000	175,000
Inventories	890,000	750,000		750,000	1,640,000
Receivables	450,000	600,000		600,000	1,050,000
Cash	197,000	100,000	(375,000)	100,000	(78,000)
Total assets	4,502,000	1,975,000	(375,000)	3,736,250	7,863,250
Liabilities	502,000	620,000	1,927,500	620,000	3,049,500
<b>Minority interest</b>				338,750	338,750
Ordinary shares (NV 1 GBP)	600,000	100,000	237,500		837,500
Share premium	450,000	250,000	237,500		687,500
Retained earnings	2,950,000	1,005,000			2,950,000
Total liabilities and shareholders funds	4,502,000	1,975,000	2,402,500	958,750	7,863,250
Consideration			2,777,500		
Fair value of net assets acquired:				1,016,250	
Goodwill				1,761,250	

Continued

The income statements for Trevor plc and Simon Ltd for the year ended 31st December 2007 are outlined below, together with the income statement for Trevor plc group

	Trevor (A)	Simon	Simon 6 months	Group Income Statement (A+B)
Sales	375,000	105,000	52,500	427,500
Costs of sales	(210,000)	(42,000)	(21,000)	(231,000)
Operating expenses	(21,000)	(4,200)	(2,100)	(23,100)
Operating profit	144,000	58,800	29,400	173,400
Interest	(24,000)	(16,800)	(8,400)	(32,400)
Profit before tax	120,000	42,000	21,000	141,000
Tax	(31,200)	(12,600)	(6,300)	(37,500)
Minority interest				(3,675)
Net income	88,800	29,400	14,700	99,825

There was no impairment of goodwill for the year ended 31st December 2007

## New M&A accounting rules

In 2008 a revised set of rules for accounting for business combinations was published. The new rules provide a better reflection of the economics of business combinations and should provide the users of financial statements with more relevant information. When companies start using the new rules for the first time there will be a significant impact on the way transactions are reported and an early understanding of the new rules is useful for any investment banker.

### Application date

The new rules must be applied for accounting periods beginning on or after 1st July 2009. For companies with December year ends, the first accounting period when the new rules will apply will be the year ending 31st December 2010. However, companies can choose to apply the new rules early if they want to, so it is important to be aware of the changes as soon as possible.

The most important changes to the rules are explained here.

### Non-controlling interest and goodwill

The terminology is changing, in particular the concept of minority interest, which will be referred to in the future as non-controlling interest. There is a change to the way in which non-controlling interest can be measured, but in order to understand this, it is better to first consider the changes that are happening to goodwill.

There is no fundamental change to the way that goodwill is calculated (see earlier in chapter), however a slightly different approach will be required to calculate goodwill. Goodwill will be seen as:

Price paid plus	PP
Non-controlling interest	NCI
	X
(Fair value of 100% of separable net assets acquired)	(FV)
Goodwill	GW

The calculation is effectively the same as the traditional goodwill calculation, but grossed up on both sides by the non-controlling interest, resulting in the same answer as in the past.

IFRS	US GAAP
<p>The real change comes in the way non-controlling interest is measured. The new rules allow noncontrolling interest to be measured either as noncontrolling share of identifiable net assets (traditional approach), or at its full acquisition date fair value. The full acquisition date fair value of non-controlling interest will generally be higher than the share of net assets, as it will include any goodwill attributable to the non-controlling interest.</p> <p>If the choice is made to measure non-controlling interest at fair value, then the post-transaction group balance sheet will be grossed up, as both the noncontrolling interest and the goodwill number will be higher than otherwise would have been. The two numbers will be increased by the same amount so, of course, the balance sheet will still balance.</p> <p>If the Finance Director chooses to present the noncontrolling interest at fair value, then the question of the best way to measure that fair value becomes important. The new rules state that the fair value of non-controlling interest should be measured on the basis of market prices for equity shares not held by the acquirer or, if not available, by using a valuation technique such as discounted cash flows. This will not necessarily be the price paid for the acquisition, extrapolated across the non-controlling interest, as this will often not represent the true fair value of those shares.</p> <p>Where there is the intention to buy up the noncontrolling interest in the future, it makes sense to value non-controlling interest at its fair value. This will result in a balance sheet that better represents the future intention to buy up the remainder of the subsidiary and when this does eventually happen, there will be less of a negative impact on group net assets. However, the downside is the extra effort that may be required to value the non-controlling interest, particularly where there is no market for the shares.</p> <p>Bankers who are trying to model a particular transaction will need to be careful when applying the new rules. The selection of one of the methods for measuring the non-controlling interest should, in</p>	<p>The non-controlling interest must be measured at its full acquisition date fair value and not simply the noncontrolling share of the fair value of the separable net assets.</p> <p>The fair value of non-controlling interest should be measured on the basis of market prices for equity shares not held by the acquirer or, if not available, by using a valuation technique such as discounted cash flows. This will not necessarily be the price paid for the acquisition, extrapolated across the non-controlling interest, as this will often not represent the true fair value of those shares.</p>

theory, have no impact on the value of the target but it will impact the post acquisition balance sheet.

Merger models may need to incorporate a switch that enables both options to be modeled. Clearly the choice shouldn't impact the extent to which the deal is earnings accretive or dilutive but the size and shape of the group balance sheet may well be quite different depending on how the non-controlling interest is measured and this may impact the financing arrangements or related covenants.

### Contingent consideration

Many M&A transactions include an element of contingent consideration; a future adjustment to the price, often dependent on the performance of the acquired business. For a number of years after the acquisition there may be payments, either in cash or shares between buyer and seller to affect any "earn out". Existing accounting rules have required annual adjustments for changes in expectations of payments, with a corresponding adjustment to goodwill.

The new rules require that the adjustment be to the group income statement rather than goodwill. So volatility may be introduced to the group income statement in the years following the transaction as a result of changes in the estimates of the contingent consideration.

The most important implication of this rules change is that the post acquisition group income statement may be more volatile than before as the changes to the estimates of the contingent consideration move profits rather than goodwill. It will not be possible to eradicate this volatility altogether, but more care at the time of the first determination of the value will help reduce the extent of it. This additional complexity will also make the jobs of the bankers more difficult, and again the merger models will need to be adapted to be able to handle sensitivity analysis around the value of the contingent consideration. The bankers will need to focus more effort on forecasting the post acquisition performance of the target as the impact of their forecasts will be much more visible as a consequence of the new rules.

### Acquisition related costs

Existing accounting rules require that any costs directly associated with the acquisition are treated as part of the cost of the acquisition, in other words capitalised on the balance sheet as an increase in goodwill. These directly attributable costs would typically include the cost of investigating and valuing the target, any due diligence required, auditing the completion accounts, negotiating the price, and completing the deal.

The new rules require that such costs be expensed through the income statement in the same period the services are received, which will typically be around the transaction date.

Obvious implications of this rule change are lower goodwill numbers and lower group profits in the year of the acquisition. Bankers responsible for modeling the transaction will need to remember that these costs can no longer be capitalised as part of the purchase price and amend their models accordingly.

Note that there is **no** change to the accounting treatment of costs associated with **raising finance** for the transaction. These costs will continue to be deducted from the fair value of the instruments issued and amortised over the life of the instrument as part of the effective interest rate.

### Other changes

There are a number of other changes to the rules that are beyond the scope of this chapter but are mentioned here for completeness. The new rules cover the following areas:

1. Re-classification and re-designation of financial arrangements for accounting purposes on a business combination
2. Determination of what exactly is part of the exchange transaction as opposed to transactions that should be accounted for separately
3. Step acquisitions, where an existing stake is already held
4. Changes in ownership interest with no loss of control

**PART 02**

# Valuation



# Discounted cash flow techniques

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## Discounting fundamentals

Discounted Cash Flow (DCF) valuations are founded on the premise that:

Company value =

**value of the future cash flows generated by the company discounted at the required rate of return demanded by the investors**

A number of questions need to be answered:

- What is the cash flow?
- What is free cash flow (FCF)? How does it relate to FCF to firm and FCF to equity?
- How is the cash flow derived?
- What drives cash flow?
- How many years of cash flow forecasts must be produced to complete a valuation?

## Understanding the structure of DCF valuations

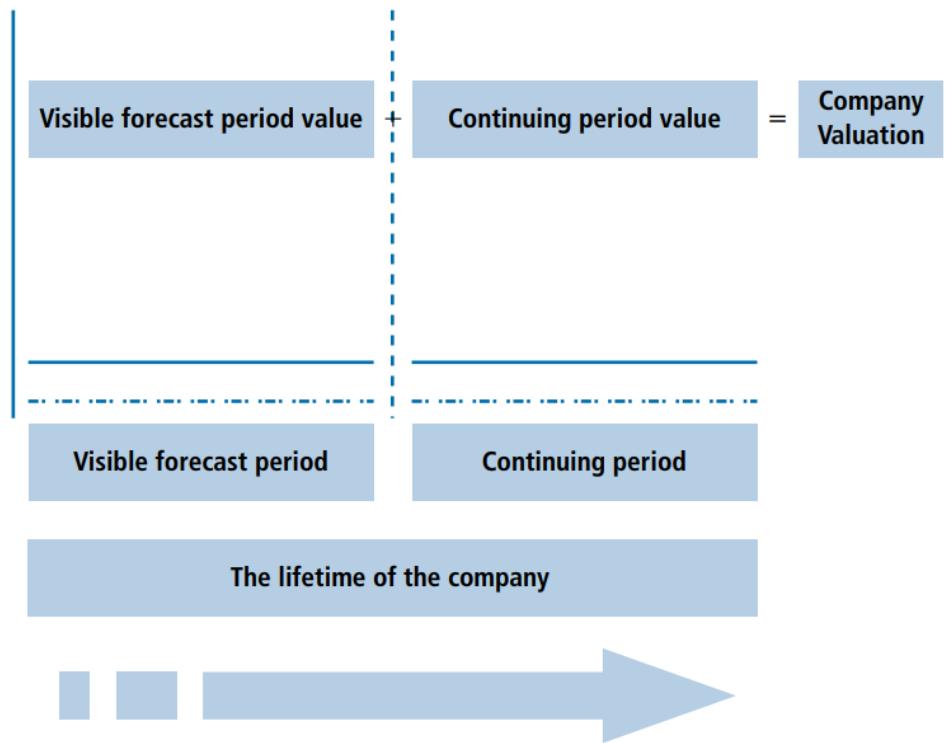
Realistically, it is difficult to forecast the entire cash flow profile of any company because of issues such as uncertainty:

- We do not know how long the company will exist and hence how many years to include in our cash flow forecast
- Forecasting is estimation. The further we predict into the future, the more prone to error our estimates become.

To address these issues many DCF models, whether estimating equity or firm value, will follow a two-stage approach to the forecasting of cash flows. The stages of a company's cash flow profile are split on the basis of:

- A visible forecast cash flow period

- A continuing period.



### The two-stage approach to DCF valuations

The two-stage approach to DCF valuations is a common solution to the problem of how we forecast the cash flow profile of a company. The approach is to forecast the cash flows of a company over a finite period of time, usually between 5 and 10 years. Analysts for some industrial groups (utilities and mining) may extend this period as far as 25 years, where cash flows tend to be contractual.

After this initial period of more detailed forecasting the remaining value of the company is captured by a terminal value, using either a perpetuity or multiple calculation (see above diagram – the continuing period value).

The valuation of the cash flows after the initial detailed forecasting period is often seen as a significant estimate or guess in the valuation process. The value estimated through the terminal value calculation can also be significant, relative to the full company valuation, and is very sensitive to its inputs.

However, the terminal value can be reviewed for reasonableness with respect to peers (cross sectional comparison) and the performance of the business itself (time series comparison).

The argument for using the terminal value calculation to capture the company's value post the visible forecast period is based on the premise that the company will hit a stage of maturity. Beyond this point, cash inflows to the company may grow with the rest of the economy and can be viewed as indefinite, if there is the necessary level of reinvestment back into the business. Capital expenditure, working capital and research and development will all have to be sustained to maintain the company's existing position.

The obvious benefit of the terminal value calculation is that we do not have to forecast cash flows forever. However, blind reliance on the terminal value calculation is a danger and is naïve.

### **The competitive advantage period (CAP)**

The CAP is the time period during which it is believed that the company is expected to generate returns on incremental investments in excess of the cost of capital.

Economic theories of the firm state that the generation of returns in excess of the cost of capital will attract competition. This competition will enter the market, providing barriers to entry are sufficiently low, and eventually force returns towards the cost of capital.

The issue for valuation lies in estimating the CAP to determine the visible forecast period. This is because the CAP will establish the length over which cash flows need to be estimated prior to the reliance on a terminal value calculation.

A number of strategic approaches have been developed to assist in determining the length of the CAP. Examples of such techniques are noted below:

- Porter's 5 forces
- Value chain analysis
- Product life cycle.

Using a combination of these tools, an estimate of the CAP can be determined. Generally, analysts will forecast between 5 and 10 years' cash flows before relying on a terminal value calculation to capture post CAP cash flows.

The determination of an appropriate CAP is obviously crucial for the valuation process, as it defines the use of the terminal value calculation and its impact.

## Estimating free cash flow for valuation purposes

We need cash flows to discount, in order to arrive at a valuation. We now have an idea of how we estimate a company's cash flow profile – we split the model into 2 stages – a visible forecast period and a terminal value period. We estimate cash flows during the visible forecast period and then capture subsequent future cash flows through a terminal value calculation.

### Why discount cash flows?

It seems obvious that a DCF valuation should focus on cash flows. However, there is clear reasoning why we focus on cash.

The alternative to using cash is to focus on some sort of earnings measure (as a number of the comps valuation techniques will do). The downside to an earnings measure is that it uses an earnings figure. Earnings can be manipulated in terms of revenue and cost recognition; it is affected by nonrecurring items and changes in accounting policy. Much of the work with comps valuation is spent trying to "clean" the earnings information prior to it being used in the valuation process.

At the end of the day....

**"Cash is fact – profit is an opinion"**

**The Economist 2<sup>nd</sup> August 1997**

A focus on earnings will also ignore a number of key considerations for the valuation process – such as:

- Risk considerations are ignored in accounting earnings
- Reinvestment needs are ignored
- The time value of money is ignored
- Earnings are historic, valuation is forward looking.

Cash flow is the energy of a business. Earnings do not pay bills, invest in capital expenditure or recruit new human resource – cash is required to partake in any of these activities. Hence a focus on cash flow is a focus on where a company generates future value for shareholders.

This statement that cash flow generates value to support shareholder returns finds support with empirical evidence. There has been a significant amount of economic research that has found that there is a weak statistical link between accounting based earnings and shareholder returns. However, the same types of studies presented using cash flow based measures have produced much stronger relationships between cash flow and shareholder returns.

### Which cash flows do we use?

Cash flow is a generic term and can refer to a number of different definitions.

The illustration below demonstrates the derivation of operating cash flow for accounting purposes:

Derivation of cash flow	
	£'000s
Sales	X
Operating costs	(X)
EBIT/Operating profit	X
Depreciation	X
Amortisation	X
EBITDA	X
Changes in working capital	X/(X)
Operating cash flow	X/(X)

This operating cash flow however does not go far enough for valuation purposes.

The illustration below outlines the basic derivation of cash flow:

**Derivation of accounting operating cash flow**

Sales	125,000
Operating costs	75,000
Increase in debtors (receivables)	12,000
Decrease in stocks (inventories)	9,000
Increase in creditors (payables)	7,500
Depreciation (included in operating costs)	2,300
Amortisation (included in operating costs)	750

**Derivation of accounting operating cash flow**

Sales	125,000
Operating costs	(75,000)
EBIT/Operating profit	50,000
Depreciation	2,300
Amortisation	750
EBITDA	53,050
Decrease in stocks (inventories)	9,000
Increase in debtors (receivables)	(12,000)
Increase in creditors (payables)	7,500
Operating cash flow	57,550

A major difference between accounting operating cash flow and the cash flow required for valuation purposes is that the latter will take into account the investment required to maintain existing cash flows and to support future cash flows.

### **FCF to firm vs. FCF to equity**

DCF valuation techniques focus on free cash flow (FCF). A basic definition of Free Cash Flow to the Firm (FCFF) is:

"the amount of cash that a company has left over after it has paid all of its expenses, but before any payments or receipts of interest or dividends, before any payments to or from providers of capital and adjusting tax paid to what it would have been if the company had no cash or debt".

The nature of the FCF measure will depend on the type of DCF valuation that is being performed. A FCF valuation which values the whole company (firm value) will focus on a different FCF to that which produces an equity valuation.

The FCF required to perform a valuation of equity is the potential cash claim equity shareholders will have after all expenses have been paid. This is known as the free cash flow to equity (FCFE).

The "cash left over" for a FCF valuation of the entire company (the firm value) will be the potential cash claims all providers of finance will have after all expenses have been paid. This is known as the free cash flow to firm (FCFF) and is defined above.

The main difference between FCFE and FCFF is the interest paid (net of tax) to debt finance providers. FCFF is before interest.

FCFE is also after the cash flows arising from debt repayments; one reason why it is difficult to use in practice.

The illustration below details the full breakdown of the accounting operating cash flow down to the FCFF and FCFE levels:

<b>Derivation of cash flow</b>	
	£'000s
Sales	X
Operating costs	(X)
EBIT/Operating profit	X
Depreciation	X
Amortisation	X
EBITDA	X
Changes in working capital	X/(X)
Operating cash flow	X
Tax paid (calculated on EBIT)	(X)
CAPEX	(X)
<b>Free cash flow (to firm)</b>	X/(X)
Interest paid (net of tax)	(X)
<b>Free cash flow (to equity)</b>	X/(X)

Note: the tax paid figure above should be a pre interest figure (unlevered) – calculated on EBIT or EBITA.

A FCFF DCF valuation will involve forecasting these cash flows over the visible cash flow period; cash flows post the visible cash flow period will be captured through a terminal value calculation.

The above breakdown of FCF gives an indication of how cash flows will be driven during the forecast visible cash flow period.

## The key value drivers of cash flow

Having examined the derivation of FCF at the equity and firm level, we can examine how we forecast and drive these cash flows. In order to forecast the cash flows of a company we need to have a sound understanding of the company's business model, its strategies and the markets the company operates in. Much of this knowledge can be analyzed using the strategic analysis tools we used in estimating the length of the visible cash flow period. However, there is no substitute for sector knowledge and experience.

The key drivers of FCFF cash flows are:

- Sales growth rates
- EBITDA margins
- Cash tax rates
- Fixed capital investment or capital expenditure
- Working capital requirements.

We shall examine in turn the influence each factor has on FCFF:

### Sales growth rates

The first driver of cash flow growth – without sales there is no company, no business, and therefore no cash. Obviously this is a crucial forecast driver.

The starting point of the sales analysis will be current sales activity. Consideration can then be given to recent investment activity at the capital expenditure and working capital levels to see if there is any foundation for future growth. Any expectations based on this level of analysis will have to be adjusted for:

- Market information
- Strategic considerations
- Pricing policy decisions
- Economic considerations
- Current and prospective competition (and barriers to entry).

### **EBIT and EBITDA margins**

Margins are useful for driving cash flow as they reflect the earnings after taking into consideration the normal costs of operations.

It is important to note that margins will depend on the nature of the business and the sales it makes. Commercially, the higher the capital expenditure and working capital requirements, the higher the margins must be to maintain a viable business.

When forecasting cash flows, margins allow valuation models to make an efficient jump from pure sales forecasts to profit figures.

### **Cash tax rate**

If a company is generating positive EBIT, it is likely that tax will have to be paid. The forecasting of tax to be paid is a more specialist area than forecasting sales. Consideration must be given to the tax legislation, the possibility of claiming relief for previously incurred tax losses and the impact of deferred taxation.

To circumvent unnecessary complications in the forecasting process, cash tax rates will generally be used and driven through EBIT or EBITA (treating the depreciation charge as an approximation to the allowed tax depreciation deduction), with effective cash tax rates adjusting for all other tax adjustments.

### **Fixed and working capital requirements**

As mentioned earlier the main difference between operating cash flow and cash flows for valuation purposes, is the investment necessary to maintain existing cash flows and support future cash flows.

Working capital requirements support current operations as well as supporting future growth. For instance, holding stocks (inventories) will satisfy current demand, as well as supporting future demand. For most business models, as sales grow, working capital investment will grow too.

Fixed capital requirements can be split into two elements:

- Maintenance capital expenditure – the replacement of the existing capital base, in order to satisfy existing demand and requirements
- Investment capital expenditure – the investment in new assets to meet forecast growth projections.

If a business model is forecasting growth, this growth must have a source. The source of longer term growth will be investment capital expenditure.

Higher capital expenditure should be reflected in higher sales growth in the short to medium term. As the company expands, working capital requirements should also expand in response.

## Calculating the terminal value

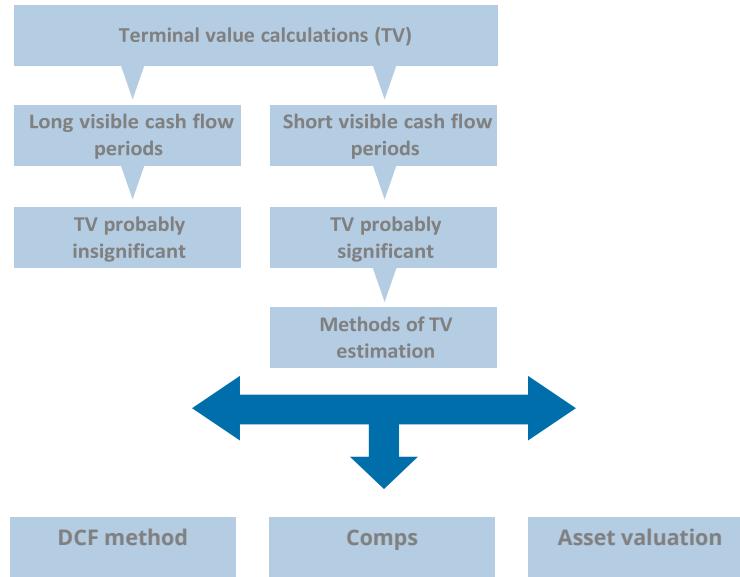
Earlier we introduced the structure of the standard DCF valuation – that is a two-stage valuation approach. Cash flows are forecasted during the visible cash flow period, with post visible cash flow period cash flows captured through a terminal value calculation. Most DCF valuation models will use a visible cash flow period between 5 and 10 years. This period would have been estimated using the strategic analysis tools mentioned earlier.

Some business models (for instance mining and utilities) will have visible cash flow period in excess of 20 years. Under these circumstances, the calculation of a terminal value at the end of a 20 year cash flow stream is often insignificant due to the impact of the time value of money and the residual value left in the business after 20 years. For this reason, DCF valuations with extended visible cash flow periods will often not calculate a terminal value as its impact on the total valuation is deemed to be immaterial.

For shorter visible cash flow period DCF valuations, the calculation of the terminal value is a crucial and sensitive element.

There are a number of steps required in order to calculate a terminal value:

- Select a terminal value calculation method
- Estimate the relevant parameters for the terminal value calculation
- Calculate the terminal value
- Convert the terminal value into present value terms.



The two most widely employed methods used to calculate a terminal value are:

- DCF method (cash flow perpetuity method)
- Comps.

### **DCF method (Cash flow perpetuity method)**

Initially we will concentrate on the FCFF valuation techniques. Subsequently we will compare and contrast FCFF vs. FCFE.

The DCF method for a FCFF terminal valuation works on the assumption that by the end of the visible cash flow period, FCFF will reach maturity and behave as a perpetuity. These perpetuities can assume no growth, constant positive growth or constant negative growth.

A simple DCF terminal value cash flow perpetuity calculation may assume zero cash flow growth. For a FCFF valuation this would involve dividing the terminal year FCFF by the WACC.

$$TV = \frac{CF_{11}}{WACC}$$

Where:

CF<sub>11</sub> The cash flow in period 11 (where year 10 is the last year of the visible cash flow period)

WACC The weighted average cost of capital

$$TV = \frac{CF_{11}}{WACC}$$

$$TV = \frac{\$125,000}{10\%}$$

$$TV = \$1,250,000$$

CF<sub>11</sub> The cash flow in period 11 (where year 10 is the last year of the visible cash flow period)

$$=\$125,000$$

WACC The weighted average cost of capital = 10%

Note: this terminal value calculation is expressed in time period 10 terms and will still require discounting back into present value terms.

A simple DCF cash flow perpetuity calculation, assuming no growth:

This method assumes there is no growth in the post visible cash flow period.

Most companies would argue that they would still grow during the post visible cash flow period, even if it was only at a low rate.

For terminal values calculated with an implied element of growth, the simple DCF cash flow perpetuity calculation must be modified.

$$TV = \frac{CF_{10}(1+g)}{WACC-g}$$

Where:

$CF_{10}$  The cash flow in period 10 (where year 10 is the last year of the visible cash flow period)

$g$  The perpetuity growth rate (expressed as a % age)

WACC The weighted average cost of capital

A DCF cash flow perpetuity calculation, assuming 2% growth:

$$TV = \frac{CF_{10}(1+g)}{WACC-g}$$

$$TV = \frac{\$125,000(1+2\%)}{(10\%-2\%)}$$

$$TV = \$1,593,750$$

$CF_{10}$  The cash flow in period 10 (where year 10 is the last year of the visible cash flow period)

$$=\$125,000$$

$g$  The perpetuity growth rate = 2%

WACC The weighted average cost of capital = 10%

Note: This terminal value calculation is expressed in time period 10 terms and will still require discounting back into present value terms.

As you can see the introduction of a 2% growth rate into the perpetuity equation has a significant impact on the terminal value calculation. The terminal value is very

sensitive to the growth rate applied to the perpetuity calculation.

Note also we must take great care when changing growth rates. Growth does not come from thin air. We must consider the capital injections required to create this growth and the impact of these capital injections on previous years' free cash flow.

The DCF cash flow perpetuity calculation must be used with caution because of the huge impact the growth rate assumption can have on the overall valuation. Estimating what the growth rate of a company will be in 5 or 10 years' time is tricky. Simple reality checks can prevent serious errors.

Such reality checks could be considering what sales would be in 20 years if the growth rate is applied to current sales. Can the market absorb this level of growth? What is the total market potential? What would competitive pressures be? At what rate is the economy growing? Is the growth rate sustainable? – All questions that need to be answered!

### **Key considerations when using the DCF method (cash flow perpetuity method)**

There are a number of issues to consider:

- The DCF method relies on the cash flow estimated in the final year of the visible cash flow period. Therefore, to use the DCF method, you must have faith in the visible cash flow period numbers and assumptions
- The reliance on the terminal value calculation as the main contributor to the overall valuation can be managed by extending the visible cash flow period. The benefit of this option is that the proportion the terminal value contributes to overall value will be lowered. The cost will be the increased speculation involved in forecasting cash flows over longer periods
- Be realistic when estimating the growth rate. Companies are not going to grow at 8% in perpetuity, when the GDP of the economy is growing at 2%.

The DCF cash flow perpetuity calculation is one option for terminal value calculations. Many practitioners will calculate the terminal value using several methods, as each method will give a unique insight into the terminal value.

### Value driver methodology

The problem with the above method is that it does not link the growth rate to capex or changes in working capital. For higher growth these will need to increase with a consequent fall in FCF.

For most valuations with a steady state GDP growth rate this is not critical, but as higher growth rates are incorporated into the model the problem can become more acute and the valuation is likely to be overstated.

The value driver formula below addresses the issue:

$$TV = \frac{EBIAT * (1 - \frac{g}{RONI})}{WACC - g}$$

TV = Terminal value

EBIAT = Earnings before interest after tax

g = growth rate

RONI = return on new investment

WACC = weighted average cost of capital

$$TV = \frac{1,500}{0.08 - 0.03} = £30,000$$

EBIAT is £2,000

g = 3%

RONI is 12%

Based on the rb model (RONI X proportion of funds reinvested X growth)

b (proportion of funds reinvested) = g/RONI = 3/12 = 25%

So £2,000 X 75% can be paid out

In the FCF model we would have exactly the same result using £1,500 as the free cash flow.

However if we increase the growth rate to 3.5% the value driver model will reduce the EBIAT to be distributed to £2,000 \* (1 - 3.5/12) whereas the FCF flow model will not automatically adjust for this.

In practice good sensitivity analysis should always triangulate results taking account of returns, proportions reinvested and growth rates.

### **Comps method of computing the terminal value**

In this approach the terminal value is calculated by applying a multiple to a consistent profit metric forecast as part of the DCF valuation. In a FCFF DCF valuation, we are attempting to estimate the terminal value at the firm level for the post visible cash flow period. Therefore the most appropriate multiples used are Firm Value (FV) multiples as these multiples will give a firm or firm level terminal value.

The attraction of this approach is its simplicity.

EBITDA (Terminal year t=10)	£125,000
EV/EBITDA multiple	10.00x
Terminal value in t=10 terms	£1,250,000

The terminal value in this example is calculated using an EV/EBITDA multiple. This multiple will be applied to the EBITDA in the last year (the terminal year) of the visible cash flow period. The estimated terminal value of £1,250,000 is expressed in time period 10 terms and will still need to be discounted back to present value.

### **Using an appropriate multiple**

The multiple used in the terminal value calculation has a significant effect on the final valuation and the choice of multiple used is a critical decision to be made. The main issue is how to arrive at an appropriate multiple.

The process focuses on maintaining a comparable universe of similar companies. The assumption underlying comps valuation is that the market on average prices companies fairly. Using the comparable universe information, applied to the company to be valued, should yield a suitable valuation.

Ideally the comps used should be from companies currently experiencing the growth pattern that our valuation target will be experiencing at the end of its visible forecast period.

For example fixed line operators were used as exit multiples when valuing the mobile phone companies (i.e. Telecom Italia reflects Orange as Orange will be in 15 years' time).

The use of multiples to compute a terminal value has the benefit of being able to 'reality check' the estimate against the rest of the comparable universe. However, some will argue that this contradicts the very nature of DCF valuation techniques – that DCF is an estimate of intrinsic value. Using comps to estimate the terminal value introduces a dangerous mix of relative or comparable valuation into an intrinsic valuation technique. Such inconsistency, some will argue, should be avoided.

Another issue of using comps determined terminal values is that all terminal values have an implied growth rate embodied in their calculation. The issue with comps is that the implied growth rate is not a transparent element of the terminal value calculation, whereas the growth rate ( $g$ ) forms part of the DCF cash flow perpetuity calculation. It is reasonably easy to use an inappropriate multiple embodying an excessive growth rate.

For cyclical companies, the terminal EBITDA and cash flow number should always be cycle average numbers (rather than taking a cycle peak or trough), on which we apply a cycle average multiple.

It is of course also very difficult to forecast the EV/EBITDA multiple for a peer group 10/15 years into the future.

### **Backing the implied growth rate out of the multiple**

The issue of using an inappropriate multiple embodying an excessive growth rate can be resolved by backing out the implied growth rate from the multiple used in the terminal value calculation. The implied growth rate can then be reviewed for reasonableness.

Backing out the implied growth rate from a multiple-calculated terminal value uses a rearrangement of the DCF cash flow

perpetuity equation. Substitute the known variables of the TV, WACC and CF<sub>10</sub> and solve for the implied growth (g).

$$TV = \frac{CF_{10}(1+g)}{WACC-g}$$

$$TV(WACC-g) = CF_{10}(1+g)$$

$$TVWACC - TV_g = CF_{10} + CF_{10}g$$

$$TVWACC - CF_{10} = TVg + CF_{10}g$$

$$TVWACC - CF_{10} = g(TV + CF_{10})$$

$$g = \frac{TVWACC - CF_{10}}{(TV + CF_{10})}$$

TV Terminal value calculated using a multiple

CF<sub>10</sub> The cash flow in period 10 (where year 10 is the last year of the visible cash flow period)

g The perpetuity growth rate (implied)

WACC The weighted average cost of capital

An illustration of backing out the implied growth rate from a terminal value calculation using multiples:

**Backing out implied growth rates from TV multiples**

EBITDA (t=10)	159,375
EBITDA multiple	10.00x
Terminal value (using EV/EBITDA)	1,593,750
Cash flow (t=10)	125,000
WACC	10%
Implied growth rate	2.00%

$$g = \frac{TVWACC - CF_{10}}{(TV + CF_{10})}$$

$$g = \frac{1,593,750 \times 10\% - 125,000}{(1,593,750 + 125,000)}$$

## Putting it all together – DCF with terminal value calculation

This does seem a great deal to take on board. However, remember the fundamental structure of this DCF valuation. We are attempting to value a company at the firm level. To do this we have split the cash flow profile of the company into two sections:

- The visible cash flow period
- The terminal value period.

For the visible cash flow period we estimated the FCFF. As we mentioned most analysts will forecast a visible cash flow period over 5 to 10 years. In order to forecast the FCFF during the visible cash flow period, a clear understanding of the company's business model and key drivers of cash flow is a prerequisite.

Beyond the visible cash flow period, the value of the company was captured using a terminal value calculation (using either a DCF cash flow perpetuity or comps calculation). The terminal value calculation expresses the value of cash flows post the visible cash flow period in value terms of the terminal year. The terminal value will still require discounting back to present value.

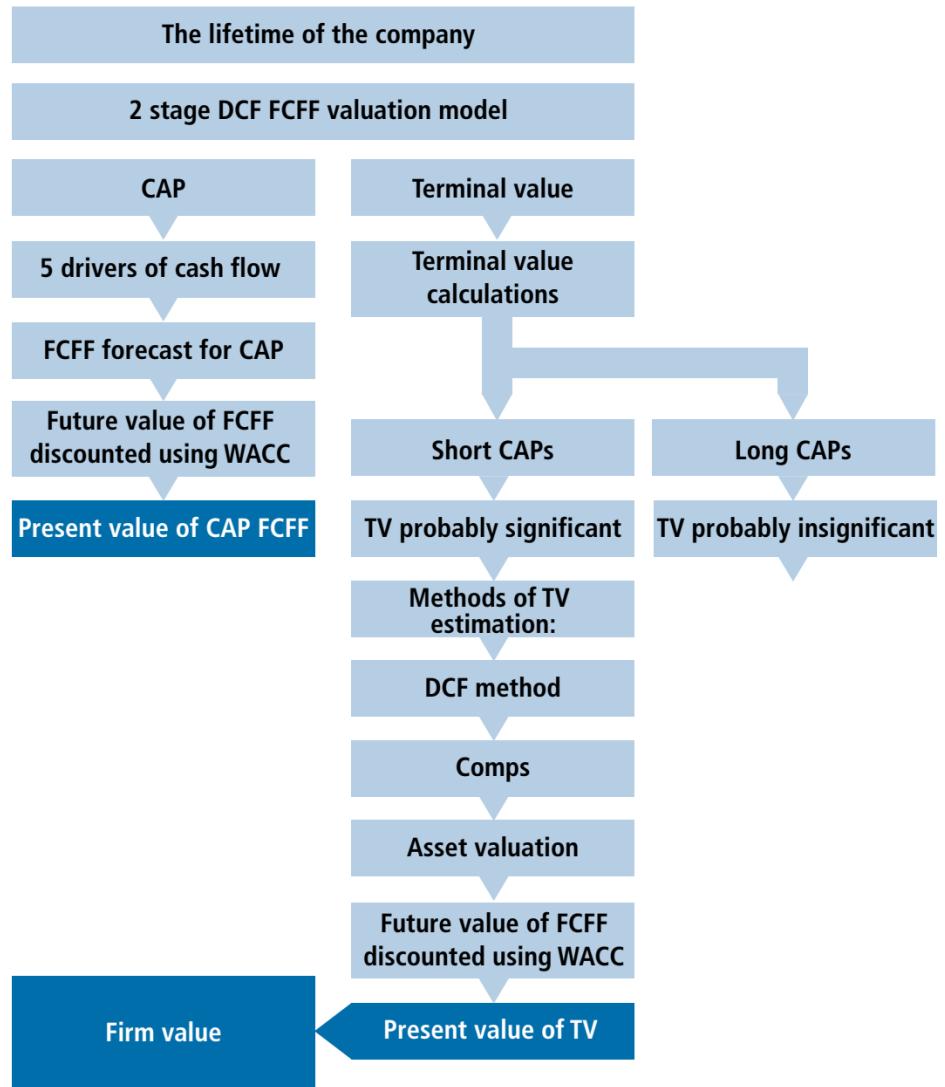
For a DCF FCFF valuation all cash flows are pre finance costs (debt and equity) and post tax. These FCFF are discounted back to present value using an appropriate weighted average cost of capital (WACC). The present value of the FCFF discounted at the WACC will yield the implied firm value of the company (treated as a cash generating asset financed by debt and equity).

The entire procedure is founded on the original tenet that:

**Company value =**

**value of the future cash flows generated by the company  
discounted at the required rate of return demanded by  
the investors**

The following summary illustrates the general steps performed to present a full two-stage DCF FCFF valuation.

***DCF summary (FCFF valuation)******Illustration***

The following illustration is an extract from a formal DCF FCFF financial model. The model is estimating the equity value per share for Tesco plc.

Note the format of the FCFF derivation, the calculation of the terminal value, the discounting of the FCFF using a WACC and the calculation of the implied firm value.

DCF valuation for Tesco plc														
Upside case scenario applied - £m - except per share (in p)			Forecast											
The WACC applied to the DCF is 7.52%			Forecast											
Year ending in February			Forecast											
	Actuals		2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	Terminal	
	2001	2002	2003	1	2	3	4	5	6	7	8	9	10	
Sales	20,988	23,804	26,530	29,979	33,576	36,934	39,889	42,681	44,815	46,608	48,006	48,966	49,456	
EBIT	sales growth		13.42%	11.45%	13.00%	12.00%	10.00%	8.00%	7.00%	5.00%	4.00%	3.00%	2.00%	1.00%
Amortisation	1,166	1,322	1,488	1,679	1,947	2,179	2,393	2,604	2,734	2,843	2,928	2,987	3,017	
EBITA	ebit margin		5.56%	5.55%	5.61%	5.60%	5.80%	5.90%	6.00%	6.10%	6.10%	6.10%	6.10%	6.10%
EBITDA	ebitda growth		13.38%	12.56%	12.82%	16.00%	11.90%	9.83%	8.78%	5.00%	4.00%	3.00%	2.00%	1.00%
Working capital (increase) decrease	8	10	21	21	21	21	21	21	21	21	21	21	21	
Cash flow - operating activities	1,174	1,332	1,509	1,700	1,968	2,200	2,414	2,625	2,755	2,864	2,949	3,008	3,038	
Tax paid	468	524	581	657	735	809	874	935	981	1,021	1,051	1,072	1,083	
Capital expenditure	1,642	1,856	2,090	2,356	2,704	3,009	3,288	3,569	3,736	3,885	4,001	4,080	4,121	
Cash flow before financing	operating cash flow growth		7.82%	7.80%	7.88%	8.05%	8.16%	8.24%	8.34%	8.34%	8.33%	8.33%	8.33%	
Unlevered cash flow (post tax)	Tax rate as a % of EBITA		23.17%	28.38%	17.63%	19.00%	21.00%	23.00%	24.00%	25.00%	26.00%	27.00%	28.00%	29.00%
EBITDA multiple of 7.30x	EBITDA multiple of 7.30x		(1,953)	(1,877)	(2,032)	(2,134)	(2,184)	(1,941)	(2,070)	(2,000)	(1,933)	(1,776)	(1,640)	(1,287)
Terminal value calculated on EBITDA multiple	capex to depreciation		4.17	3.58	3.50	3.25	2.97	2.40	2.37	2.14	1.97	1.74	1.56	1.20
Present value of cash flow	Net cash flow in year Feb 04 (115 days)		(288)	(217)	81	245	394	797	845	1,098	1,215	1,389	1,507	1,912
Cumulated present value of cash flows	77													
Breakdown of firm value to equity value	FCFF discounted using an appropriate WACC		77	394	797	845	1,098	1,215	1,389	1,507	1,912	2,072		
Implied value at 1 November 2003	7.268		66%	14,240										
Present value of visible cash flows (£m)	34%													
Present value of terminal value (£m)	(4,737)													
Implied enterprise value (£m)	21,508													
Net (debt) / cash	(43)													
(Minority value)	343													
Joint ventures/associates	17,071													
Implied total equity value (£m)	7,237,609,183													
Number of shares outstanding	236													
Implied equity value per share (p)	14,240													

Visible cash flow period forecasts

Terminal value calculated using an EV/EBITDA terminal multiple

7.30

30,082

Implied firm value is the sum of the present values of the future cash flows

### Breakdown of firm value to equity value

The above illustration shows the full formal DCF FCFF valuation.

The valuation produces an implied firm value of the company. However, for analysis purposes, it is the equity value analysts will often be more interested in.

The firm value is the value of the entire firm and all its claims. Equity shareholders are but one claim on the entire value of the firm. Therefore to identify the element of the firm value which equity has a claim on, we need to adjust the firm value for non-equity claims.

The DCF FCFF extract below shows a typical implied equity value breakdown:

The firm value of £21,508m is the present value of the FCFF generated by the company. 34% of this value has come from the visible cash flow period and is represented by the present value of the visible cash flows of £7,268m. The remaining £14,240m (66%) of the firm value is represented by the present value of the terminal value calculation.

Implied value at 1 November 2003			
Present value of visible cash flows (£m)	34%	7,268	
Present value of terminal value (£m)	66%	14,240	
Implied enterprise value (£m)		21,508	
Net (debt) / cash		(4,737)	
(Minority value)		(43)	
Joint ventures/associates		343	
Implied total equity value (£m)		17,071	
Number of shares outstanding		7,237,609,183	
Implied equity value per share (p)		236	

To break down the firm value to an equity value the following adjustments are made:

- Net debt is usually a significant claim on the firm value of a company. Debt should be deducted at market value. When a company is in financial distress or there are significant differences between book and market value, debt instruments should be marked to market
- If there is no market value, its market value can be estimated by discounting the cash flows at the current refinancing rate (like valuing a bond). An estimate of the cash flows can be obtained from the accounts. The refinancing costs can be obtained by talking to bankers who know the sector
- Market value information can be found for traded debt in the annual report in some jurisdictions. For example, in the UK, under FRS 13 Derivatives and Other Financial Instruments Disclosures, market values should be disclosed for all financial instruments. This will be the value as at the last balance sheet date which will need to be updated for current valuations
- Minority interest represents, from an accounting viewpoint, an outside ownership interest in a subsidiary that is consolidated with the parent for financial reporting purposes. Equity shareholders have no claim over this element of firm value as it is owned by parties outside the group structure. As the FCFF forecasts include the minority interest element, minority interests must be removed in the breakdown to equity value
- Firm value is measured at the market value of all its components. Minorities are a constituent part of firm value and should, when representing significant value, be valued at market value; otherwise they should be included at book value
- If the subsidiary, where the minority interest arises, is quoted, the market value of the minority can be derived. Practical difficulties in arriving at the market value of minorities exist where the subsidiary is unquoted. Unquoted minorities will have to be valued on a separate basis (using either DCF or comps)
- Due to the accounting rules for the inclusion of joint ventures and associates in the group accounts, (that is, they are generally accounted for below the EBIT or operating profit line in the income statement), the cash flow contribution of these entities has been ignored in the DCF FCFF valuation

- Equity shareholders have an ownership claim on joint ventures and associates. The DCF FCFF valuation does not include cash flows generated by joint ventures and associates, as FCFF drives cash flow from financial information above the EBIT line
- As for minority interests, a market value adjustment (usually an addition) to equity value would be preferable in order to calculate the implied equity value. However, due to practical constraints the book value of joint ventures and associates is often used as a proxy for market value. If the value is a material and significant part of the valuation, a market value should be used.

### **Unfunded pension liability**

The calculation of the FCF will only take account of the ongoing wage related element of the pension payment. The final firm value will need to be adjusted to account for the pension deficit at the time of the valuation. This is in effect an additional source of 'debt type' funding.

The deficit should be deducted when establishing the warranted equity value of the firm.

The post tax unfunded pension liability should be deducted as ultimately the payments will save corporate tax at the normal rate.

For simplicity it is generally assumed that the deficit will eventually be funded in the same ratio of debt to equity as is currently used in the WACC formula thereby negating the need to adjust the WACC.

### **Comparison of FCFE and FCFF DCF valuations**

The analysis has focussed on the FCFF DCF valuation. The main reason for this is that the FCFF DCF valuation is the most commonly used method for valuation purposes. Secondly, if the mechanics are understood for the FCFF valuation the FCFE valuation is straightforward.

The main differences are outlined in the table below:

	DCF firm valuation	DCF equity valuation
Cash flow to be discounted	Unlevered cash flow (residual cash flow after paying for all the operating expenses, capital reinvestment and taxes, but prior to making <b>any payments to the providers of finance</b> )	Levered cash flow (residual cash flow after paying for all the operating expenses, capital reinvestment and taxes, but prior to making <b>any payments to the providers of <u>equity</u> finance</b> )
Appropriate cost of capital	Weighted average cost of capital	Cost of equity
Valuation	Firm value	Equity value

The main issue with the differences between the two methods is the issue of consistency. The most common error is discounting cash flows with inconsistent discount rates:

	DCF firm valuation	DCF equity valuation
Cash flow to be discounted	Unlevered cash flow	Levered cash flow
Appropriate cost of capital	Cost of equity	Weighted average cost of capital
Valuation	Wrong	Wrong

DCF FCFE valuations use a cash flow prior to distributions to providers of equity finance to determine the equity valuation of company. The risk borne by the equity providers is factored into the calculation by discounting the anticipated future cash flows by an equity cost of capital. This consistency of ensuring that the appropriate cash flow is discounted by an appropriate cost of capital is a central tenet of valuation.

The same thinking applies to DCF FCFF valuations. This technique values the entire firm, both debt and equity components. Hence the cash flow estimated prior to discounting is before all cash payments to providers of finance – an unlevered cash flow. The cost of finance for all providers is included in the appropriate weighted average discount rate.

# Cost of Capital

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## An introduction to risk

From an investor's perspective, risk can be defined as the variability of the actual return generated by an investment relative to what the investor expected. An investor in a risk free asset would receive an actual return equal to the expected return.

However, most investments will not generate an actual return exactly in line with expectations. This deviation (risk) in returns around the expected return can be measured by variance and standard deviation calculations.

### Types of risk

There are a number of reasons why the actual return on an investment does not equal the expected return – or why an investment carries an element of risk. However, the reasons can be grouped into two broad categories of risk:

- Firm-specific risk (unsystematic)
- Market risk (systematic).

Firm-specific risks may affect a single investment or possibly a small group of investments. Market risk may impact many or all of the investments in a market. Understanding the different types of risk is a crucial foundation to understanding how investors will get compensated for risk.

### Firm-specific vs. market risk

Firm specific risk is risk that affects single or small groups of investments. This category of risk can be sub-divided into:

- Project risk
  - The risk that a firm may have misjudged its product demand
  - Tesco may purchase a significant number of game consoles for the Christmas season. They later find out that this year's must-have Christmas gift is remote

controlled cars. This type of misjudgement would have an impact on the company's earnings

- Competitive risk
  - The risk arising from the impact of the performance of the competition.
  - Competition taking market share due to an inventive new marketing strategy will affect earnings. The launch of on-line retailing for Tesco plc has seen an impact on its earnings, as well as the earnings of Tesco's competitors
- Sector risk
  - Risks affecting the entire sector, but restricted to that sector.
  - For instance the government decides to increase the corporation tax rate levied on food retailers. The direct impact is felt mainly in this sector.

Some risks can affect one sector, but some can affect all sectors of the economy. The UK economy experienced very low interest rates through 2001 to 2003. However, in late 2003 interest rates started to increase. Though the impact of increasing interest rates will be felt to differing degrees throughout the economy, the impact is widespread.

This type of risk is known as **market (systematic) risk**.

### Risk diversification

An investor has \$1,000 and initially chooses to invest it entirely in AT&T Inc shares. In doing this the investor is exposed to the firm specific risks (project, competitive and sector risks) affecting AT&T Inc, as well as the market risk. An excellent position to be in if the risk is entirely upside, not so good if the risk is downside.

If the investor was to choose to reallocate part of her portfolio out of Telecoms into other sectors, she would be reducing her exposure to firm specific risk. She would be diversifying his risk.

Why does this reallocation reduce firm specific risk?

The first reason is based on the old adage of "...not having all your eggs in one basket..."

Thinking of the initial asset allocation – all of the \$1,000 invested in AT&T shares. All the eggs are in one basket. The telecoms sector sees a significant downturn – the current portfolio bears the full brunt of the downturn as it is fully exposed to the firm specific risk of AT&T.

Shifting some of the "eggs" into another basket, let's say, food retail, may have reduced some of this exposure to AT&T's firm-specific risk when the sector took the downturn. Hence the downturn affects a smaller percentage of the overall portfolio of investments.

The more "baskets" a portfolio has, the more the exposure to firm-specific risk will be reduced.

Empirical research has found that having around 20 to 25 different "baskets" or stocks should be sufficient to eliminate firm specific risk. Because firm specific risk can be diversified away, it is also known as diversifiable risk.

Holding an appropriate number of assets within a portfolio, with all the firm specific risk diversified away, does not make a portfolio risk free. The portfolio is still affected by market risks or non-diversifiable / systematic / non specific risks.

### **Key risk assumptions in models**

Most models that estimate the level of rewards required to compensate for various levels of risk are based on two factors:

- The investor is deemed to be the marginal investor
- The marginal investor is assumed to be well diversified. That is, the marginal investor is only exposed to the influence of non-diversifiable risk.

Thus the only risk a well diversified marginal investor is exposed to is market risk.

### **Risk terminology**

The table below shows the various terms accorded to market and firm specific risks:

Market risk	Firm specific risk
Systematic risk	Unsystematic risk
Non-specific risk	Specific risk
Non-diversifiable risk	Diversifiable risk

### Risk and the cost of equity

Given the above analysis of risk, the marginal well-diversified investor will be exposed to market risks, with all other firm-specific risk being diversified away. Therefore, the rational marginal investor will demand a return (compensation) for the level of market risk he faces.

From a valuation perspective, equity investors provide a cash investment to a company. The initial investment is given in return for future deferred cash flows and value. This return must be sufficient to compensate for the risks embodied in the future cash flows.

The return demanded by the equity investors of a company is called the equity cost of capital. It is the reward to equity investors for the market risks their investment is exposed to.

There are a number of ways to calculate the equity cost of capital:

- Capital asset pricing model (CAPM)
- Arbitrage pricing theory (APT)
- Multi factor model (MFM).

Given that CAPM is the equity cost of capital model favoured by most banks, our analysis will focus on this model. CAPM will then be contrasted with the other risk / reward models.

## Capital asset pricing model (CAPM)

CAPM is the preferred model for calculating the cost of equity for a number of banks. It has the longest history of use and it is the most widely used risk / return model. The added bonus is that it is mathematically easy to apply.

The CAPM is a risk / reward model that assumes that investors holding a risky asset will demand compensation in excess of the return they would receive from a risk free asset and that the additional return demanded (risk premium) is proportional to the market risks they are exposed to.

### Overview

The CAPM calculates the cost of equity for a company.

In fact it calculates the required return to the shareholder (this is the cost to the company,  $k_e$ ).

It is an academic model with many practical applications and its component parts are later examined in detail as they can have a significant impact on the outcome of valuation.

In essence the model can be simply stated as:

$$K_e = \text{Risk free rate} + (\text{Beta}) \times \text{Equity Market Premium}$$

The required return is based on the return from a risk free asset plus a premium for risk.

The Equity Market Premium (EMP) is the excess of the expected return on the market portfolio over the risk free rate.

The  $\beta$  measures the level of risk in a particular share relative to the level of risk in the market overall.

If a share is less risky than the market average it will have a  $\beta$  of less than 1.

So if the risk free rate is 5% and the stock market is returning 12% the Equity Market Premium is 7% (12% - 5%).

If we have a low risk share with  $\beta$  of 0.6, an investor would require a return from this share of:

5% (the risk free rate) + a premium for risk (as the share has a  $\beta$  of 0.6 the premium required will be less than 7%, in fact it will be  $0.6 \times 7\% = 4.2\%$ )

The required return will be 9.2%. This will be used as  $K_e$  (the company's cost of equity).

CAPM and its components will now be examined in more detail.

### Assumptions

CAPM has a number of assumptions embodied in its model.

We have already discussed the benefits of diversification. Diversification however does have its costs, such as transaction and investment monitoring costs. Hence there will come a time where the marginal diversification costs exceed the marginal diversification benefits. At this stage diversification should cease.

CAPM makes a number of other simplifying assumptions:

- There are no transactions costs
- Investments are infinitely divisible
- Investors have access to full information.

The consequence of such assumptions is that there are no additional costs of diversification. Therefore investors will keep diversifying until their portfolios hold all traded assets in the market. That is, investors hold the market portfolio.

The existence of a market portfolio may seem theoretically abstract. However, it is possible to think of it as a large and very well diversified investment or mutual fund.

Further assumptions within CAPM are:

- There are risk-free assets, where the expected return is known with certainty
- Investors can borrow and lend at the risk-free rate. Lending at the risk free rate is achievable through government gilts and bonds. However, borrowing at the risk free rate may be an issue within CAPM.

These assumptions have been relaxed in further developments of the CAPM. However, the conclusions are still broadly consistent with the CAPM.

### Meaning of risk under CAPM

The assumptions above are used to illustrate how individual investors demonstrate their individual risk preferences. Each investor will hold a combination of the risk free asset and the market portfolio. Risk averse investors will hold a greater proportion of their wealth in the risk free asset. Investors with a greater desire to expose themselves to risk will allocate a greater proportion of their wealth to the market portfolio.

In our CAPM world, the risk of an individual asset is the risk that the asset brings to the market portfolio. If the risk of the asset is firm specific, the impact will be diversified away. On the other hand if the asset moves with the market portfolio, it will add to the risk of the market portfolio. This relationship between how the asset moves in relation to the market can be measured using the covariance of the asset with the market portfolio.

The risk of the market portfolio is measured as the variance in the returns on the market portfolio  $\sigma^2_m$ . This is the variance prior to adding a new asset to the portfolio. The variance of the asset that is going to be added to the portfolio is  $\sigma^2_i$ .

Therefore:

$$\text{Pre asset inclusion portfolio variance} = \sigma^2_m$$

$$\text{Post asset inclusion portfolio variance} = w_i^2 \sigma^2_i + (1-w_i)^2 \sigma^2_m + 2w_i(1-w_i) \sigma_{im}$$

Where:

$w_i$  = market value weight of the new asset introduced to the portfolio

$\sigma^2_i$  = variance of the individual asset introduced to the portfolio

$\sigma_{im}$  = the covariance of the asset's return with the market portfolio's return

The weighting of the market portfolio,  $w$ , should be very small.

Therefore,

- The 1st term,  $w_i^2 \sigma^2_i$  should be nearing zero
- The 2nd term,  $(1-w_i)^2 \sigma^2_m$  should be pretty much the variance of the portfolio,  $\sigma^2_m$ .

- This should leave the 3rd term,  $2w_i(1-w_i)s\sigma_{im}$ , in the equation representing the additional risk added to the portfolio due to the introduction of the new asset.

The result of a covariance calculation is a percentage term. Assessing the relative risk of an asset in relation to the portfolio is difficult when dealing with percentage terms. If you were told that the covariance of AT & T Inc shares in relation to the market was 67, you would be none the wiser of how risky this asset was in relation to other assets.

The covariance,  $\sigma_{im}$ , can be standardised in relation to the market by dividing it by the variance of the market portfolio. This equation gives us the beta of the asset, that is, a relative measure of the risk of an asset in relation to the market.

$$\frac{\sigma_{im}}{\sigma_m^2}$$

Where:

$\sigma_{im}$  = the covariance of the asset's return with the market portfolio's return

$\sigma_m^2$  = the variance of the market portfolios return

The covariance of the market portfolio with itself is its variance. Therefore the beta of the market portfolio's return will be equal to 1. Individual assets that are riskier than the average will have betas greater than 1. Likewise, individual assets that are less risky than average will have betas less than 1.

Hence the beta is a standardised method of isolating the additional risk introduced by adding an asset to the market portfolio.

### Understanding the CAPM equation

The next step in the CAPM process is to derive the linear relationship between expected return on an asset and its beta.

The standard CAPM equation is:

$$E(R_i) = R_f + \beta_i[E(R_m) - R_f]$$

Where:

$E(R_i)$  =Expected (or required) return on an asset

$R_f$  =Risk free rate

$E(R_m)$  =Expected return on the market portfolio

$\beta_i$  =Beta of the asset =  $\frac{\sigma_{im}}{\sigma_m^2}$

The CAPM equation calculates the required return as a premium over the risk free rate. The premium is defined by the risk of the asset in relation to the behaviour of the market. Assets which are perceived to be more risky than the market average will attract a higher beta and hence a higher demanded premium over the risk free rate.

For an equity investor the CAPM equation will give a cost of equity for an individual asset.

### ***Using CAPM in a practical context***

To use the CAPM three inputs are required:

- The risk free rate
- The beta of the asset
- The equity risk premium [ $E(R_m) - R_f$ ].

### **Risk free rates**

The risk free rate represents the rate of return available from an asset or portfolio that has no risk. The expected return on the asset equals the actual return on the asset.

This definition rules out the use of corporate bonds to provide a risk free rate, as there is a risk that the corporate may default on its interest or principal payments.

For this reason, most users of CAPM will refer to government bonds to provide a risk free rate. If governments run the risk of default, they are in the position to print more money to service their debt obligations. Strictly, while the government bonds of the US, UK and most countries are free from default risk, they are not risk free. Government bonds will be exposed to

reinvestment risk as interest rates move after the interest rates on the bonds have been fixed.

It is impossible to get a truly risk free rate. For this reason, analysts will use the yield on government gilts or bonds. This information is very easy to obtain through information providers, such as Bloomberg or Reuters. 10 year UK government gilt rates are published by the FT, appearing in the Companies and Markets section of the paper.

### UK GILTS - cash market

Notes	Int	... Yield ...	Price £	Chng	... 52 week ...	
		Red			High	Low
<b>Ten to Fifteen Years</b>						
Tr 7½pc '12-15.....	6.66	5.27	116.37	-.06	126.67	116.04
Tr 5pc '12.....	5.02	5.07	99.52	-.05	108.42	99.18
Tr 9pc '12.....	X 7.09	5.13	126.93	-.08	138.62	126.66
<b>Tr 8pc '13.....</b>	<b>6.53</b>	<b>5.06</b>	<b>122.59</b>	<b>-.08</b>	<b>134.66</b>	<b>122.28</b>
Tr 5pc '14.....	5.04	5.08	99.30	-.08	109.00	98.97
<b>Tr 8pc '15.....</b>	<b>6.34</b>	<b>5.08</b>	<b>126.15</b>	<b>-.11</b>	<b>138.76</b>	<b>125.75</b>
Tr 8½pc '17.....	6.44	5.09	135.97xd	-.13	149.74	135.54

Source: The Financial Times

*The gilts benchmarks and most liquid bond issues are shown in bold.*

It is preferable to use medium to long dated government gilts as these rates will come closest to matching the pattern of the cash flows of the company under valuation. Shorter term bonds (< 10 years) will not achieve this consistency.

The highlighted rate of 5.06% approximates a 10 year UK government gilt yield in 2003 – an appropriate proxy for the risk free rate to be used in the CAPM equation.

### Beta

There are a number of approaches to calculating a beta:

- Use historical information and perform linear regression (historical market betas)
- Estimate the beta from company fundamentals (fundamental betas)
- Estimate the beta from accounting data (accounting betas).

### Historic market betas

The regression of historic investment returns against the returns of the market is the standard method of producing

beta estimates for firms that are established and have traded for a sufficient length of time.

The theory is that the investment returns of the individual asset will be related to the returns of the market, and hence mathematical analysis will produce the beta for the asset.

The standard procedure is to run a regression analysis of the individual investment returns against the market returns, using a market index as a proxy to the market portfolio (FTSE 100, S&P 500, etc.)

Regression estimate for beta:

$$R_i = a + bR_m$$

Where:

$R_i$  = Individual stock returns

$R_m$  = Market returns

$a$  = Regression intercept

$b$  = Slope of the regression =  $\frac{\sigma_{im}}{\sigma_m^2}$  = beta

The following page includes an example of an historic regression beta calculation. The regression was performed using the Microsoft Excel data analysis tool. The investment and market returns are hypothetical.

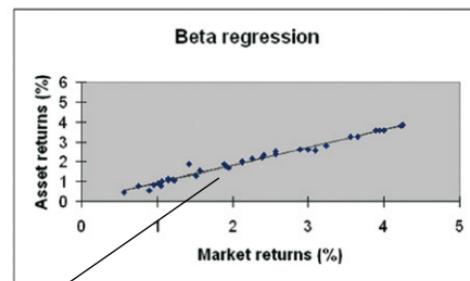
**Regressed beta calculation**

	Observations monthly intervals	Market returns (%)	Asset Returns (%)
Recent	1	4.25	3.86
	2	3.89	3.55
	3	3.65	3.24
	4	4.23	3.78
	5	4.00	3.56
	6	3.94	3.55
	7	3.56	3.25
	8	3.23	2.78
	9	3.09	2.56
	10	2.99	2.60
	11	2.56	2.40
	12	2.12	2.01
	13	1.91	1.80
	14	1.95	1.70
	15	1.52	1.30
	16	1.23	1.06
	17	1.42	1.90
	18	1.20	1.08
	19	1.15	1.04
	20	1.02	0.90
	21	0.95	0.82
	22	0.75	0.78
	23	0.56	0.45
	24	0.89	0.55
	25	1.05	0.78
	26	1.06	0.99
	27	1.15	1.15
	28	1.56	1.56
	29	1.89	1.89
	30	2.12	1.99
	31	2.26	2.16
	32	2.39	2.19
	33	2.41	2.33
	34	2.56	2.50
Older	35	2.89	2.62

Regression Statistics	
Multiple R	98.92%
R Square	97.85%
Adjusted R Square	97.79%
Standard Error	0.150
Observations	35

Coefficients	Standard Error
Intercept	0.052
Beta	0.890

The slope of the regression =  $\frac{\sigma_{im}}{\sigma_m^2}$  – beta



The plot of the individual asset and market observations, together with the regression best fit line

$R^2$  provides a measurement of the goodness of fit of the regression line

In terms of regressing betas, the line of best fit measures how much of the asset return is explained by variations in market returns – hence it provides an estimate of the risk of the asset attributable to market risks

The standard error of the beta estimate is 0.023. This means the true beta could range from  $0.867$  to  $0.913$  =  $0.890 \pm 0.023$

A rearrangement of the CAPM equation can provide a comparison of the asset's investment return relative to that expected by the CAPM equation:

The standard CAPM equation:

$$R_i = R_f + \beta(R_m - R_f)$$

Rearranged through multiplying the brackets out:

$$R_i = R_f + \beta R_m - \beta R_f$$

$$R_i = R_f(1-\beta) + \beta R_m$$

This discloses the CAPM equation in terms of an intercept  $R_f(1-\beta)$  and a line gradient  $\beta$ .

The rearranged CAPM equation and its expected return can now be compared to the regression equation of the historic returns from the market and the individual asset:

$$R_i = R_f(1-\beta) + \beta R_m$$

$$R_i = a + b R_m$$

Hence:

The intercept,  $a$ , can be compared with  $R_f(1-\beta)$ , giving a measure of the asset's performance relative to the CAPM. The difference (known as Jensen's alpha) is a measure of whether the actual return of the asset was greater or less than the required (or expected) return given market performance and risk demonstrated by CAPM.

Jensen's alpha	Asset performance
$a > R_f(1 - \beta)$	Asset performance <b>better</b> than expected during the regression period
$A = R_f(1 - \beta)$	Asset performance as <b>expected</b> during the regression period
$a < R_f(1 - \beta)$	Asset performance <b>worse</b> than expected during the regression period

## Using service betas

Running a historic regression analysis every time we need a beta for our cost of equity calculations will be time consuming. It is for this reason that most analysts will use a beta provided by an information service provider such as Bloomberg, Barra, LBS or S&P.

Using service betas has its own issues.

In performing the previous regressed beta calculation a number of decisions were made prior to the running of the regression:

- What is the length of the estimation period?
- What is the frequency of the historic observations?
- Which index will be used as a proxy to the return on the market portfolio?

Each information service will make these decisions as defaults in their regression calculations. Hence, a beta for Safeway plc produced by LBS will differ from the beta provided by Bloomberg.

These decisions have important implications for the beta estimation:

- Length of the estimation period:
  - The trade-off is straightforward. A longer estimation period will yield more observations. However, over time a firm's risk characteristics can change, as the firm evolves, possibly into new markets or new products. Introducing inappropriate observations into the regression analysis can introduce bias into the estimation.
- Frequency of the historic observations:
  - A shorter time frequency – more observations
  - Shorter time frequencies of observations can introduce non-trading bias into the beta estimation. Non-trading bias arises when a stock does not trade and hence its price remains static, but the market still moves. This

effect will reduce the correlation between market and individual asset returns

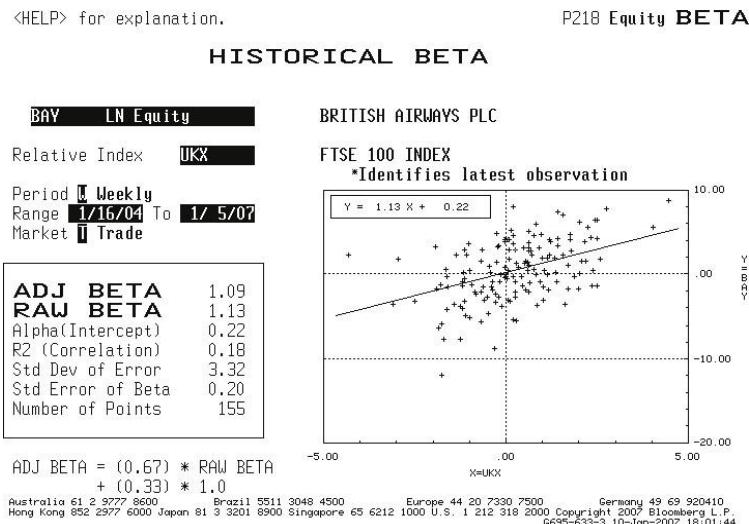
- Non trading bias is certainly more of an issue for smaller, less liquid firms
- The issue can be managed by choosing a frequency interval that is not too short, but still yields a sufficient number of observations for the chosen estimation period. Most analysts will have a frequency period using weekly or monthly returns.

- Market portfolio proxies:

- The standard practice of the information service providers is to use the index of the market that the stock is traded in
- In estimating a beta for Tesco plc, the FTSE 100 would be a sensible market portfolio proxy. For US stocks, the NYSE or S&P 500 would be appropriate proxies.

Bloomberg is one of the few service providers to reveal the estimation techniques used in its beta calculations.

A typical Bloomberg screen is shown below.



Note: Bloomberg issues two beta estimations – a raw beta and an adjusted beta. The raw beta is the beta estimation from the basic regression estimation – i.e. the gradient of the line of best fit. The adjusted beta is calculated using the equation:

$$\text{Adjusted beta} = (0.67) \times \text{RAW}\beta + (0.33) \times 1.00$$

The adjusted beta calculation will weight a raw beta towards 1.

The argument is that over time betas trend towards 1, as firms diversify and get bigger.

### Fundamental beta calculations

Estimating betas using regression techniques relies on the availability of historic investment returns. This will pose problems for private companies, newly listed companies and firms which have recently seen its risk characteristics change. An alternative method of calculating betas, without relying on historic information, is to derive the beta from fundamentals.

#### ***Bottom-up betas***

The technique of calculating bottom up betas is founded on the idea that the beta of a company is dependent on two factors:

- The business it operates in
  - The beta measures the risk of the company relative to the market risk. The more sensitive the business operations are to market conditions, the higher the beta will be
- The degree of financial leverage
  - A company with high gearing will have high financial leverage, as fixed interest payments will result in proportionately higher returns during upturns and proportionately lower returns during downturns
  - Hence the variance of earnings for firms with debt in their capital structure will be higher than for unlevered firms. Intuitively, this higher risk to equity investors will result in a higher beta.

Given that regressed betas rely on the availability of appropriate historic information, bottom up betas provide a beta estimation technique that is less reliant on historic information. Bottom up beta calculations use these factors to estimate betas from comparable information.

#### ***Fundamental betas (Bottom up beta calculations)***

There are a number of steps required to perform a bottom up beta calculation:

- Identify comparable publicly traded firms and regress their historic information to obtain beta estimations
  - Defining the comparable set (universe) of firms can be difficult. If we define a comparable firm as one which demonstrates very similar characteristics to the firm we are trying to estimate a bottom up beta for, it can result in a very small comparable universe, as very few companies will be directly comparable. However, loosening the definition of a comparable firm may introduce firms that may not share the necessary characteristics.

Comparability can be defined with reference to characteristics such as:

- Sector
- Size
- Geographical location
- Growth method (acquisition vs. organic) and growth rates
- Gearing.

The betas for these comparable firms will be influenced by the financial leverage particular to each firm's capital structure. As we mentioned earlier, higher financial leverage will lead to a higher variance (risk) on earnings, hence a higher beta.

This relationship is demonstrated by the equation:

$$\beta_{levered} = \beta_{unlevered} [1 + (1 - t_c) (\frac{D}{E})]$$

Where:

$\beta_{levered}$  = Beta of a levered firm

$\beta_{unlevered}$  = Beta of an equivalent unlevered firm

$t_c$  = Corporate tax rate

$(\frac{D}{E})$  = Debt to equity ratio at market value

- As gearing increases, measured by the debt to equity ratio, the company's equity investors will bear a higher amount of market risk, thus resulting in a higher beta factor. The tax deductibility of interest payments is represented by  $(1-t_c)$

- This equation assumes that all of the firm's risk is borne by the equity investors, that is, the debt has a beta of zero.
- The next step in the bottom up beta approach is to create a level playing field to analyze the beta. This involves stripping the impact of financial leverage out of the comparable beta calculations – deleveraging the comparable betas – a simple rearrangement of the above equation is shown in the illustration below:

$$\beta_{\text{unlevered}} = \frac{\beta_{\text{levered}}}{[1 + (1 - t) \left(\frac{D}{E}\right)]}$$

Where:

$\beta_{\text{levered}}$  = Beta of a levered firm

$\beta_{\text{unlevered}}$  = Beta of an equivalent unlevered firm

$t_c$  = Corporate tax rate

$\left(\frac{D}{E}\right)$  = Debt to equity ratio at market value

- The comparable betas are all now unleveraged betas, free from the influence of financial leverage. A decision must be made to identify what beta will be used to provide the basis of the target beta estimation. This could be a simple or weighted average of the comparable betas, or a subjective judgement
- Once an appropriate unlevered comparable beta has been isolated, it will then be leveraged for the gearing of the target beta company using the equation.

$$\beta_{levered - target} = \beta_{unlevered - comparable} [1 + (1 - t_c - target) \left( \frac{D_{target}}{E_{target}} \right)]$$

Where:

$\beta_{levered - target}$  = Beta of a levered firm

$\beta_{unlevered - comparable}$  = Beta of an equivalent unlevered firm

$t_c - target$  = Corporate tax rate

$\left( \frac{D_{target}}{E_{target}} \right)$  = Debt to equity ratio at market value

The illustration below outlines a bottom up beta calculation, using the comparable levered betas of 10 comparable companies. Market D/E and tax rates are given for each company. This allows each comparable levered beta to be unlevered for the financial leverage reflected in its capital structure.

Comparable universe	Levered beta	Market D/E	Tax Rate	Unlevered beta*
Company 1	1.30	35.00%	38.00%	1.07
Company 2	0.54	102.00%	37.00%	0.33
Company 3	1.26	25.00%	43.00%	1.10
Company 4	0.86	250.00%	12.00%	0.27
Company 5	0.23	52.00%	25.00%	0.17
Company 6	0.73	46.00%	32.00%	0.56
Company 7	0.84	45.00%	42.00%	0.67
Company 8	1.52	62.00%	35.00%	1.08
Company 9	0.64	54.00%	34.00%	0.47
Company 10	0.65	58.00%	34.00%	0.47
Average	0.857	0.729	0.342	0.619
Median	0.785	0.530	0.350	0.512
Minimum	0.230	0.250	0.120	0.172
Maximum	1.520	2.500	0.430	1.103

Unlevered comparable beta applied to bottom up beta

Simple average of comparable betas chosen

0.619

Market D/E of target beta company

54.90%

Tax rate of target company

30.00%

\*\* Comparable beta leveraged for target company market D/E

0.857

$$* \beta_{unlevered} = \frac{\beta_{levered}}{[1 + (1 - t) (\frac{D}{E})]}$$

$$** \beta_{levered - target} = \beta_{unlevered - comparable} [1 + (1 - t_{c,target}) (\frac{D_{target}}{E_{target}})]$$

A bottom up beta is calculated for the target using a comparable unlevered beta as the foundation. (In this case the simple average of the unlevered comparable betas of 0.619 was used).

The bottom up beta is then leveraged for the market D/E of the target beta company, thus producing a bottom up beta of 0.857 derived from comparable company analysis.

As we mentioned earlier bottom up betas are useful as they get away from the dependence on historic information necessary for regressed beta calculations. This is especially useful for private and newly listed companies, as well as for companies that have seen a recent change in their risk profile.

There are further advantages to the bottom up beta approach:

- The comparable betas do not have to be sourced through regression calculations. They can be sourced from information service providers. Remember, when using service betas the estimation techniques and parameters of the beta calculations will differ between service providers. Try to remain loyal to one service provider and make sure that the parameters are consistent through the comparable universe. Using service betas will obviously save a great deal of time on the preparation of the analysis
- Bottom up betas can be easily modified for changes in the business model of the target beta company. For instance, changes in the target company's market D/E ratio can be factored into the leveraged beta calculation. Likewise, if there are structural changes in the company due to the financing impact of acquisitions or changes in business strategy, this can be factored into the beta
- Factoring these changes into the beta can be ex-ante or ex-post. That is, anticipated changes can be introduced to the method, to analyze how business changes can impact the company's beta

### **Accounting beta calculations**

An accounting beta is estimated by comparing market performance against company earnings.

You should have a gut feeling that this method is not the best. The reason is founded on the ease with which accounting information can be manipulated. Calculating betas based on information that can be easily manipulated cannot yield a reliable beta.

### Beta terminology

Leveraged beta	Unleveraged beta
Published beta	Asset beta
Equity beta	Earnings beta
Dividend beta	
$\beta_L = \beta_U [1 + (1 - t_c\text{-target}) (\frac{D_{target}}{E_{target}})]$	$\beta_U = \frac{\beta_L}{[1 + (1 - t) (\frac{D}{E})]}$

### Equity risk premium [ $E(R_m) - R_f$ ]

This is the final step in order to put the CAPM into practice.

In our initial discussions of risk we concluded that equity investors will demand a higher return to compensate them for the increased exposure to risk.

CAPM estimates this risk premium from a well diversified marginal investor's perspective. Therefore given CAPM's assertions, the marginal investor will only be rewarded for the additional market risk exposure, as it is market risk that cannot be diversified.

The beta we have discussed measures relatively how much the individual asset's returns move in relation to the market portfolio (the individual asset's relative exposure to market risk) and factors this into the required equity return.

Beta is a relative measure. The CAPM equation needs to know how the market portfolio has performed in relation to the benchmark risk free rate. This is given by the  $[E(R_m) - R_f]$  part of the CAPM equation. The CAPM will take this absolute performance and, through the beta, quantifies the relative

impact for the individual asset and hence an estimate of the required risk premium.

### ***Estimating the risk premium (historic risk premium analysis)***

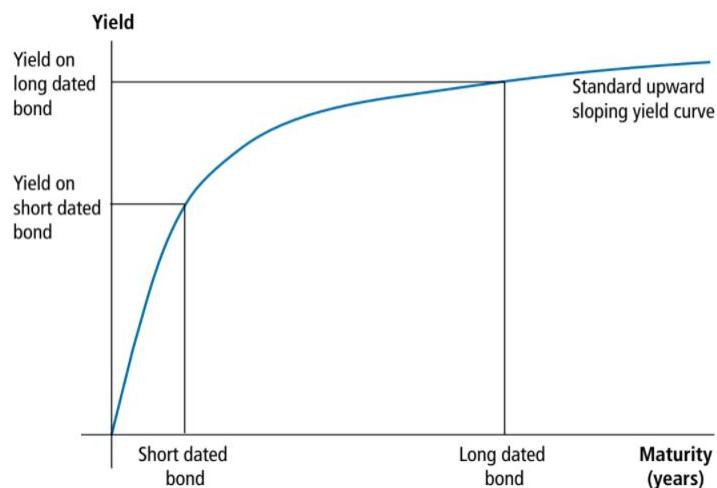
This is an intuitively straightforward method of risk premium estimation. The premium is estimated by analysing the historic return on stocks over the historic return on a risk free security. The difference between the two returns yields the historic risk premium.

The historic risk premium is a widely used approach. However, the results from the approach can vary widely (between 4% and 12%) dependent on the parameters used in the analysis.

There are a number of reasons for the divergence in the historic risk premium results:

- Ibbotson Associates provide the industry standard source of historic risk premium information. Their data goes back to 1926. The decision on how much of this data should be used in the historic analysis varies from analyst to analyst
  - Using data from back in the 1920s and 1930s can obviously be argued to be a little old, as investors' risk perceptions have changed. However, concentrating on more recent information will reduce the sample size in the analysis, making the analysis more open to noise or a higher standard error. For instance, the standard error using a 5-year analysis of historic risk premiums is 8.94%. This could outweigh the size of the actual historic risk premium
  - Generally, analysts feel that the benefits of concentrating on a recent sample of historic risk premiums are outweighed by the associated cost of the increasing standard error (or the increasing noise in the estimate)
  - There are a number of risk free proxies that could be used for the historic risk premium analysis (US T-bills, US T-bonds, short and long dated UK gilts). There is generally a positive relationship between the yield on bonds and their maturity. This relationship is illustrated through yield curves. A standard upward sloping yield curve is shown below

- The yield curve below is for government bonds (US or UK)
- The point being made is that over the term structure of the bonds, the yield or risk free rate increases as the maturity or the term increases
- Hence the choice of bond maturity chosen will affect the proxy risk free rate and hence alter the risk premium. With an upward sloping yield curve, a long dated bond with a higher risk free rate will produce a smaller risk premium.



- Generally, analysts will use US Treasuries (for US based calculations) or UK long dated government bonds (for UK based calculations) as the risk free benchmark. Although the default risk on these bonds is low, the bonds are more sensitive to interest rate changes and inflationary pressure. However, the long dated bond prices reflect future interest rate expectations, which is appropriate if the cost of capital being estimated is being used for long term forecasting (i.e. DCF)
- Using the historic risk premium method requires an average calculation to be applied over an extended time period. The method of calculating this average can have a significant impact on the size of the risk premium. The historic risk premium can be calculated using an arithmetic or geometric average

- The geometric average calculation produces an annually compounded return
- The arithmetic average calculation gives a simple average return
- A simple example of the difference:
  - A share (non dividend paying) has a price of €10 on 1/1/2000, €20 on 1/1/2001 and falls back to €10 on 1/1/2002
  - The arithmetic average return would be 25%
  - The geometric average return would be 0% (equating the beginning and end values)
- There are strong arguments for and against both methods. Analysts will take a view on which averaging calculation to apply. But be aware of the issues.

The historic risk premium analysis is used as a proxy for the prospective risk premium to be used in the cost of equity calculation to be applied to future cash flows.

### A summary of risk / return models

There are a number of ways to calculate the equity cost of capital:

- Capital asset pricing model (CAPM)
- Arbitrage pricing theory (APT)
- Multi factor model (MFM).

The key differences between the three models are outlined below:

	CAPM	APT	MFM
Summary	Assuming no transaction costs and full information, the marginal investor will be fully diversified – therefore every asset is included in a market portfolio	The market has no arbitrage opportunities. Therefore the market risk of any asset must be captured by betas relative to factors that affect all investments	Market risk affects all investments (or at least most of them). Therefore market risk must be the result of macro economic variables
Market risk	The risk added by any investment included in the market portfolio	Market risk reflects the exposure to market factors	Market risk reflects the exposure to macro economic variables
Beta	Single share levered beta relative to the market portfolio	A number of single share levered betas related to unspecified market factors	A number of betas related to macro economic factors

## The cost of debt and WACC

### Introduction

Debt holders require compensation for their investment.

Debt investors when investing in a company will have a debt agreement or indenture. This will set up the repayment schedule, the debt maturity, the call options and debt covenants, amongst other things. This type of agreement very much defines the debt investor's return and contingencies for repayment. For most forms of debt, there is no access to the upside potential of the company they have invested in. Likewise, the debt agreement will limit the downside potential faced by the investor through the use of debt security and covenants.

In summary, the risk faced by the debt investors should in all commercial situations be lower than the equity investors. Hence the compensation demanded by this group of investors will be lower too.

### The cost of debt

The cost of debt measures the current cost of financing faced by the firm from borrowed funds. It is a common misconception amongst naïve investors that debt financing is risk free and that the risk free rate should be an appropriate proxy for a company's cost of debt.

Corporate lending will suffer default risk. If a corporate cannot service its debt obligations it cannot print some more money to satisfy its debt investors. The very fact that a corporate does not have control over the money supply means that all corporates have an element of default risk – no matter how well the company is doing or however remote default could be.

Therefore debt investors lending to corporates will demand a return that includes a premium over the risk free rate. The premium acts as compensation for the additional risk of default faced by a corporate lender. The size of the premium (default spread) will reflect the debt investors' perception of default risk. Higher risk, higher demanded premium.

Debt finance has the general advantage that it is a cheaper source of finance relative to equity. It has the additional benefit that interest payments are tax deductible. That is, a company with a pre tax cost of debt of 6% and a tax rate of 30%, will effectively pay 4.2% [6% X (1-30%)]. As tax rates increase, the tax benefit of debt will increase.

$$\text{Post tax cost of debt} = (\text{Risk free rate} + \text{default risk premium}) \times (1 - \text{tax rate})$$

Remember, the risk free rate is the yield on the Government Bond, not the coupon.

### Estimating the default risk spread

The estimation of the cost of debt, and therefore the implied default risk spread, is very easy if the company's debt is widely traded in a liquid market and the maturity is known. From this information the yield can be calculated and used as a cost of debt.

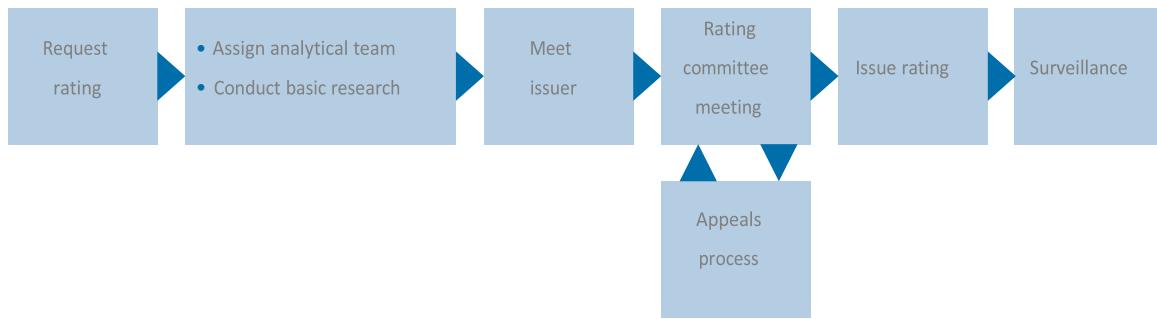
Borrower	Amount m.	Maturity	Coupon %	Price	Yield %	Launch spread bp	Moody's/S&P Ratings	Book-runner
<b>STERLING</b>								
Permanent Fin(No3)A2(u4)‡	750	Sep 2033	(u4.)	100.00	-	-	Aaa/AAA	Citi/CSFB/UBS Inv Bk
Permanent Fin(No3) 5A(u5)	400	Dec 2010	5.521(l)	100.00	5.521	+48(4%Mar09)	Aaa/AAA	Citi/CSFB/UBS Inv Bk
Allied Irish Banks plc(z,S)	350	Nov 2030	5.625	99.924R	5.631	+65(6%Dec28)	A1/A-	Barclays/UBS Inv Bank
Premiertel plc, Srs A(w1)	77.5	Aug 2029	5.683(q)	100.01	5.683	+70(8%Jun21)	-/AA	ABN Amro...
Premiertel plc, Srs B(w2)	208.99	Aug 2032	6.175(q)	99.999	6.175	+120(8%Jun21)	-/A-	...UBS Inv'ment Bank
Danske Bank A/S‡	200	Nov 2006	(v)	100.10			Aa2/AA-	Barclays Capital
Compass Group plc(r2)	125	May 2012	6.375	102.48	5.988	+86(5%Mar12)	Baa1/BBB+	Barc/Citi/RB Scotland
ANZ Banking Group Ltd(E,S)	200	Nov 2015	5.625	99.867	5.649	+64(4%Mar09)	A1/A+	M Stanley/RB Scotland
CFF(F)	200	Dec 2007	5.00	99.583R	5.118	+24(7%Dec07)	Aaa/AAA	Lehman/JP Morgan
SLM SLT 03-12, Class A6(T)	396.5	Sep 2013	5.45(s)	99.668	5.498	+42(5%Sep14)	Aaa/AAA	Citigroup/CSFB/Merrill
CIT Group Inc	200	Dec 2008	5.50#(l)	99.743	5.558	+75(5%Mar08)	A2/A	Barc/HSBC/RBScotland
<b>SWISS FRANCS</b>								
Ares Int'l Finance 92 Ltd(c)§	600	Nov 2008	0.50	100.00	-	-	-/-	Goldman/UBS Inv Bank
Deptfa ACS Bank(h)	200	Dec 2010	2.50	98.705	2.706	-3.4(swaps)	Aaa/AAA	CSFB/Deutsche Bank
Bayerische Landesbank(x)	100	Nov 2008	2.25	99.62	2.332	+1½(swaps)	Aaa/AAA	Bank von Ersnt
AHBR(p)	300	Jan 2008	2.00	99.90	2.025	+3(swaps)	Aa3/AAA	ABN Amro/Basler KB
BNG	250	Dec 2009	2.375	99.80	2.411	-9(swaps)	Aaa/AAA	UBS Investment Bank
Eksportfinans(G)	100	Jul 2006	1.25	99.75	1.348	-10(swaps)	Aaa/AA+	UBS Investment Bank
<b>AUSTRALIAN DOLLARS</b>								
Swedish Export Credit★	860	Nov 2006	5.45#	99.98	-	-	Aa1/AA+	Nomura International
Toyota Finance Australia	100	Dec 2007	6.25	101.121	-	-	Aa1/AAA	RBC Capital Markets
Total Capital	100	Jan 2009	6.25(l)	100.835	-	-	Aa2/AA	TD Securities

Source: The Financial Times

However, most company debt is not traded.

Nevertheless, a debt issuing company will have its debt rated by rating agencies such as S&P, Moody's and Fitch. Using these debt ratings and their associated published default risk spreads, the cost of debt can be estimated using an appropriate risk free rate.

A diagrammatic outline of the S&P ratings process is given below.



Source: Standard & Poor's 2003 Corporate Ratings Criteria

Issues start to arise for companies that do not have rated debt, for example, small companies or companies based in emerging markets. The default risk premium must then be estimated.

There are two default risk estimation options:

- Examine the recent borrowing history
  - Whether or not a company is rated, it will probably still issue debt. Examining the history of recent debt issues and the associated borrowing rates will provide a guide to an appropriate cost of debt.
- Estimate a synthetic rating
  - Perform the role of rating agencies and produce a rating on the basis of financial credit analysis
  - A starting point will be to assess the financial credit analysis of comparable firms which are credit rated to determine the financial characteristics associated with each rating class. Financial credit analysis can then be performed on the unrated firm and compared to that of the rated firms
  - Standard & Poor's 2003 Corporate Ratings Criteria provides a detailed insight into their rating process and the financial analysis they use. An extract from the S&P report is included below, illustrating the key financial ratios they use in their rating process.

## FORMULAS FOR KEY RATIOS

1. EBIT interest coverage =  $\frac{\text{Earnings from continuing operations before interest and taxes}}{\text{Gross interest incurred before subtracting capitalized interest and interest income}}$
  
2. EBITDA interest coverage =  $\frac{\text{Adjusted earnings from continuing operations before interest, taxes and D & A}}{\text{Gross interest incurred before subtracting capitalized interest and interest income}}$
  
3. Funds from operations (FFO)/total debt =  $\frac{\text{Net income from continuing operations} + \text{D & A, deferred income taxes and other non-cash items}}{\text{Long term debts} + \text{current maturities, commercial paper and other short term borrowings}}$
  
4. Free operating cash flow/total debt =  $\frac{\text{FFO} - \text{capital expenditures} - (+) \text{increase(decrease) in working capital (excluding changes in cash, marketable securities and short term debt)}}{\text{Long term debts} + \text{current maturities, commercial paper and other short term borrowings}}$
  
5. Return on capital =  $\frac{\text{EBIT}}{\text{Average of beginning of year and end of year capital, including short term debt, current maturities, long term debts, non-current deferred taxes, minority interest and equity (common and preferred)}}$
  
6. Operating income/sales =  $\frac{\text{Sales} - \text{cost of goods manufactured (before D & A), SG & A and R & D costs}}{\text{Sales}}$
  
7. Long term debt/capital =  $\frac{\text{Long term debts}}{\text{Long term debts} + \text{shareholders' equity (including preferred stock)} + \text{minority interest}}$
  
8. Total debt/capital =  $\frac{\text{Long term debts} + \text{current maturities, commercial paper and other short term borrowings}}{\text{Long term debts} + \text{current maturities, commercial paper and other short term borrowings} + \text{shareholders' equity (including preferred stock)} + \text{minority interest}}$
  
9. Total debt/EBITDA =  $\frac{\text{Long term debts} + \text{current maturities, commercial paper and other short term borrowings}}{\text{Adjusted earnings from continuing operations before interest, taxes and D & A}}$   
  
 $\text{FFO} - \text{capital expenditures} - (+) \text{increase(decrease) in working capital (excluding changes in cash, marketable securities and short term debt)}$   
 $- \text{common and preferred dividends}$
  
10. Discretionary cash flow/total debt =  $\frac{\text{Long term debts} + \text{current maturities, commercial paper and other short term borrowings}}{\text{Long term debts} + \text{current maturities, commercial paper and other short term borrowings}}$

Source: Standard & Poor's Corporate Ratings Criteria

## KEY INDUSTRIAL FINANCIAL RATIOS

### Adjusted Key Industrial Financial Ratios, Long-Term Debt

	<b>AAA</b>	<b>AA</b>	<b>A</b>	<b>BBB</b>	<b>BB</b>
EBIT interest coverage (x)	23.4	13.3	6.3	3.9	2.2
EBITDA interest coverage (x)	25.3	16.9	8.5	5.4	3.2
FFO/total debt (%)	214.2	65.7	42.2	30.6	19.7
Free oper. cash flow/total debt (%)	156.6	33.6	22.3	12.8	7.3
Return on capital (%)	35.0	26.6	18.1	13.1	11.5
Oper. income/sales (%)	23.4	24.0	18.1	15.5	15.4
Long-term debt/capital (%)	(1.1)	21.1	33.8	40.3	53.6
Total debt/capital (%)	5.0	35.9	42.6	47.0	57.7
No. of companies	6.0	20.0	121.0	224.0	279.0

Source: Standard & Poor's Corporate Ratings Criteria

Once the default risk premium has been estimated it is added to an appropriate risk free rate. This will yield a pre-tax cost of debt. However, the appropriate cost of debt for the WACC and the valuation process is a post tax cost of debt. The pre tax cost of debt is converted to post tax by multiplying by (1-Tax rate).

### Full cost of debt

The cost of debt discussed so far reflects the various costs of the issued debt instruments. These debt instruments will be reflected on the balance sheet of the company and will be easy to identify.

The problem arises when the definition of a debt item is expanded. Debt is a liability of a company:

**A liability is an obligation resulting from a past transaction that leads to a probable future outflow of economic benefit.**

**Debt instruments are instruments issued as a means of raising finance other than those classified in/as shareholders funds.**

The main issue that arises is: are all financing obligations accounted for in the WACC calculation? The list below identifies a sample of areas where debt can be positioned off balance sheet due to accounting rules and therefore may be omitted from the WACC calculation.

- Operating leases
- Special purpose vehicles
- Joint ventures and associates

- Net pension deficits.

### The weighted average cost of capital (WACC)

The components of WACC are the individual costs of capital for each provider of finance to the company, weighted by the relative size of their contribution to the pool of finance.

There are a few issues to consider:

- Have all the costs of finance been calculated?
- How should the WACC be weighted – book or market values of finance?

#### ***WACC weighting – book or market value weightings***

The WACC is the weighted average cost of capital. The weighting should reflect the instruments' contributions to the company's capital structure. The issue is whether to use book values of debt and equity to perform the weighting or to use market values.

One of the major weaknesses of the balance sheet is that it is historic, out of date and based on accounting rules. Therefore a strong argument against using book values is that they are out of date and do not reflect current market conditions. Some would argue this is an advantage as book values eliminate the volatility of the market – agreed but they are still historic, out of date and based on accounting rules.

The majority of firms who use WACC use the market value weighting approach; however there are a number of possibilities:

#### **Weighting proportions**

##### ***Current market value***

- This has the advantage of being empirically correct
- However the current position may be atypical. Also if the WACC is being used to calculate a market value there is a degree of circularity in basing one of the inputs on current market value
- When using a WACC (based on current market values) to calculate an implied firm value it would make sense to deduct

the current market value of the net debt when moving from firm to equity value.

### **Optimum leverage ratio**

- Using either Modigliani & Miller or an empirical model, it is possible to derive the optimal capital structure for the firm's WACC. This capital structure can then be used to create the WACC
- Obviously this assumes that the company can and will move towards this optimum position (or is already at its optimum).

### **Target leverage ratio**

- The Board may have stated targets for their long-term leverage. If these are publicly stated and deemed attainable, then it would make sense to use this ratio in creating the WACC.

### **Industry average**

- In certain circumstances (IPO for example) there may be a lack of available data
- In these instances it can be assumed that the company will tend toward the industry average debt to equity ratio.

### **Bottom up**

- If the WACC is itself partly built up from an unleveraged and releveraged cost of equity, then the weighting used in the WACC model should be consistent with the weightings used when re-leveraging the unleveraged beta.

### **The weighted average cost of capital calculation**

$$\text{WACC} = \text{Cost of equity} \times (1 - D/D+E) + \text{Cost of debt} \times (D/D+E)$$

# Comparable company analysis (Comps)

To learn more, please check out our online courses

 View courses

## Why do we do comps?

Analysing the operating and equity market valuation characteristics of a set of comparable companies with similar operating, financial and ownership profiles provides a useful understanding of:

1. The important operating and financial statistics about the target's industry group (e.g. growth rates, margin trends, capital spending requirements).  
This information can be helpful in developing assumptions for a discounted cash flow analysis.
2. The relative valuation of publicly listed companies.  
The resulting multiples guide the user as to the market's perception of the growth and profitability prospects of the companies making up the group. Consequently, comps can be used to gauge if a publicly traded company is over or undervalued relative to its peers.
3. A benchmark valuation for target entities.  
Comps valuations are based on:
  - Metrics of target company (e.g. EBITDA)
  - Multiples of similar quoted company(ies) (e.g. EV / EBITDA).

Valuation multiples from comparable companies may be applied to the financials of the target entity to be valued to give a theoretical value of the target business.

*For example:*

Metric of target	earnings	\$10.0m
Multiple of similar quoted company	p/e	18.0
<b>Theoretical equity value of target</b>	<b>\$10.0m x 18.0</b>	<b>=\$180.0m</b>

4. An indicative market price for a company which is to be floated on the stock market
5. The validity of terminal DCF assumptions
6. Investment returns for financial buyers acquiring assets with the intention of monetising the investment in the public equity market in an IPO.

**Example**

	Tesco	Sainsbury
Share price (p)	261.5	376.0
Equity value (£m)	18,127	7,260
Enterprise value (£m)	20,967	8,172
<b>Enterprise value / Sales</b>		
2003 (Curr.)	0.86x	0.48x
2004 (Prosp.)	0.74x	0.47x
<b>EBITDA</b>		
2003 (Curr.)	10.8x	7.6x
2004 (Prosp.)	9.4x	6.6x
<b>EBIT</b>		
2003 (Curr.)	15.5x	12.4x
2004 (Prosp.)	13.5x	10.4x
<b>Equity Value / Earnings</b>		
2003 (Curr.)	20.8x	17.9x
2004 (Prosp.)	18.5x	15.5x

## Comparable universe

Being a numerically easy exercise, multiples valuation requires in-depth understanding of the target company and its peers. The relative valuation multiples are only useful if the companies are a comparable peer group. Similarly, comps valuations are based on applying the valuation multiples of one company (or a group of companies) to value the target business.

As no two companies are exactly the same the most similar companies are sought. The companies (both target and comparable) should have similar:

- Business activities – industry, products and distribution channels
- Geographical location
- Size
- Growth profiles (including seasonality and cyclicalities)
- M&A profiles
- Profitability profiles
- Accounting policies
- Market liquidity of securities
- Breadth of research coverage.

Additionally, if equity level comps are to be used, similar capital structures are essential.

### ***In conclusion***

Select the universe of comparable companies carefully – more is not necessarily better.

## Sources of information

Information	Source
List of comparable companies	Sector brokers' reports Bloomberg Hoovers Prospectuses (often have a "Competition" section)
Share price	Datastream or Bloomberg
Shares outstanding	Most recent annual report (or interim results or 10Q) updated for any subsequent changes – for UK companies see Regulatory News Service (RNS) for changes Bloomberg
Options outstanding and exercise price of options	Most recent annual report (or, unusually, interim results or 10Q) updated for any subsequent changes reported Companies reporting under US GAAP will disclose the weighted average exercise price
Debt and cash	Most recent annual report or more recent interim results or 10Q
Preference shares	Most recent annual report or more recent interim results or 10Q
Minority interests	Most recent annual report or more recent interim results or 10Q
Income statement information	Most recent annual report (or more recent interim results or 10Q if last 12 months [LTM] analysis is to be done)
Forecast financials	Broker research I/B/E/S database (the median of all estimates)
General information	Extel cards and Datastream 101A

*Note:*

- All source documentation should be marked to show where information has been extracted from with both a Post-it showing the page and a highlighter showing the numbers used
- When choosing a broker, make sure the numbers are sanity checked with Global Estimates to make sure the analyst's projections are in line with peers
- Footnotes should be used for all assumptions and points of interest.

## From Equity Value to Enterprise Value

Enterprise value (\*) = Equity Value (\*\*) + Net Debt (\*\*\*+) + Minority Interest

### 1. Example continued – Enterprise value

<b>Tesco</b>		
Share price (p)	261.5	
Number of Shares (m)	6,932	
<hr/>		
<b>Equity Value (£m)</b>	<b>18,127</b>	<b>[A]</b>
ST Debt	1,413	[B]
LT Debt	1,925	[C]
Cash & cash equivalents		
(liquid resources)	(534)	
		[D]
Net Debt	2,804	[E]=[B+C+D]
Minority Interest	36	[F]
<hr/>		
<b>Enterprise value (£m)</b>	<b>20,967</b>	<b>[A +E + F]</b>

### Enterprise value (EV)

Enterprise value is also referred to as:

- Total enterprise value (TEV)
- Entity value (EV)
- Gross value (GV)
- Total capitalisation
- Firm value (FV)
- Aggregate value

- Leveraged market capitalisation (LMC).

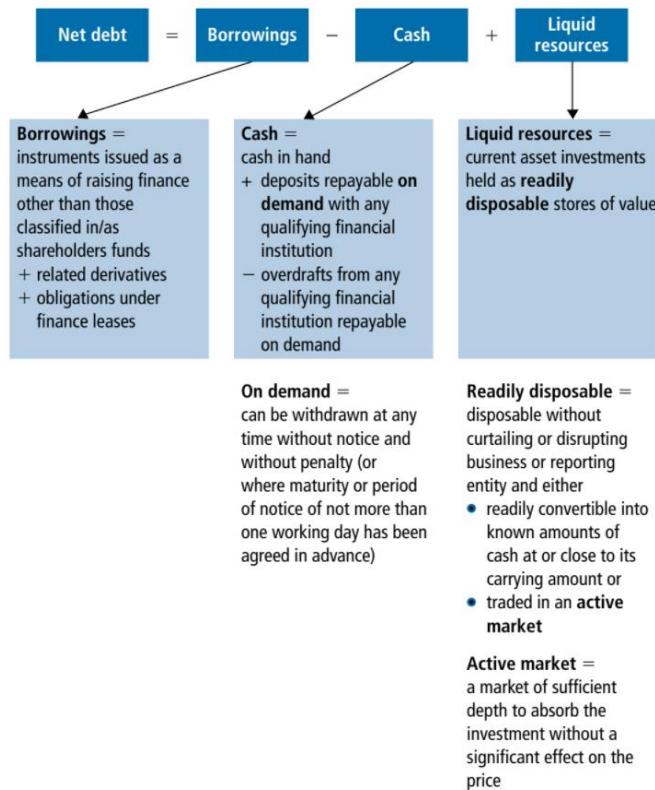
The terms are used loosely and generally interchangeable. If used in a critical context we should define exactly what is meant by them.

## Equity value (Eq.V)

Equity value (Eq.V) is also referred to as:

- Market capitalisation (MC).

## Net debt



Net debt components may be spread around the balance sheet in:

- Liabilities due after more than 1 year
- Liabilities due within 1 year
- Cash at bank and in hand

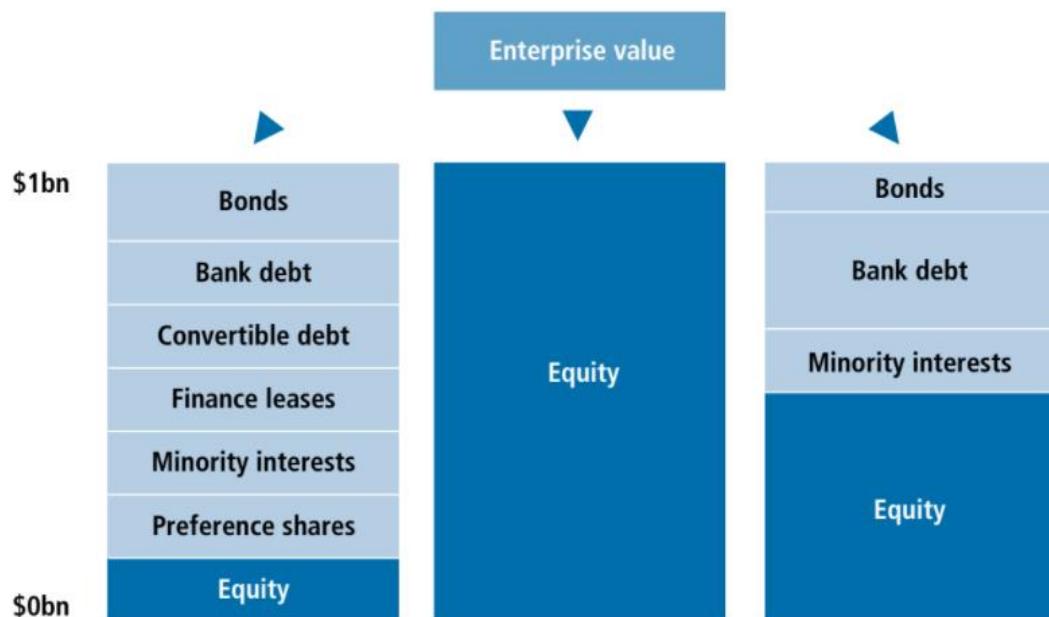
- Investments or marketable securities (held as current assets).

UK companies must disclose an analysis of their net debt (typically in a note to the accounts).

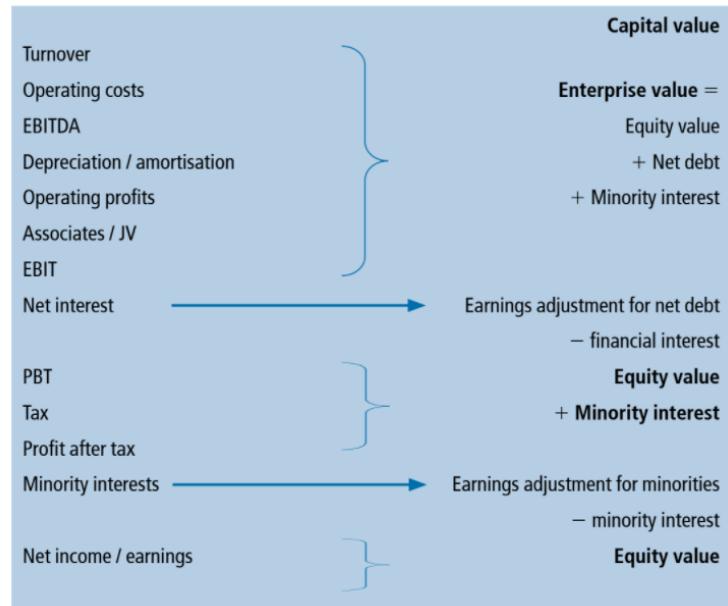
### ***Preference share capital***

Despite falling outside the above definition, preference share capital may be included within net debt for analysis purposes as it has many of the attributes of borrowings without meeting the definitional and legal requirements of borrowings.

The enterprise value is made up of different elements of the capital structure adopted by a company. The way this EV is used in comps is independent of this capital structure. For example, a company may have an enterprise value of \$1bn; this could be made up as follows:



## When to use Equity Value vs. Enterprise Value



**Impact of capital structures on multiples**

	Company A	Company B
Capital structure		
Equity	200	500
Net debt	300	-
Minority interest	-	-
P&L		
Sales	150	150
EBIT	35	35
Net interest	(25)	-
PBT	10	35
Earnings	7	25
Multiples		
Enterprise value / Sales	3.3x	3.3x
EBIT	14.3x	14.3x
Equity value / PBT	20.0x	14.3x
Earnings	28.6x	20.0x

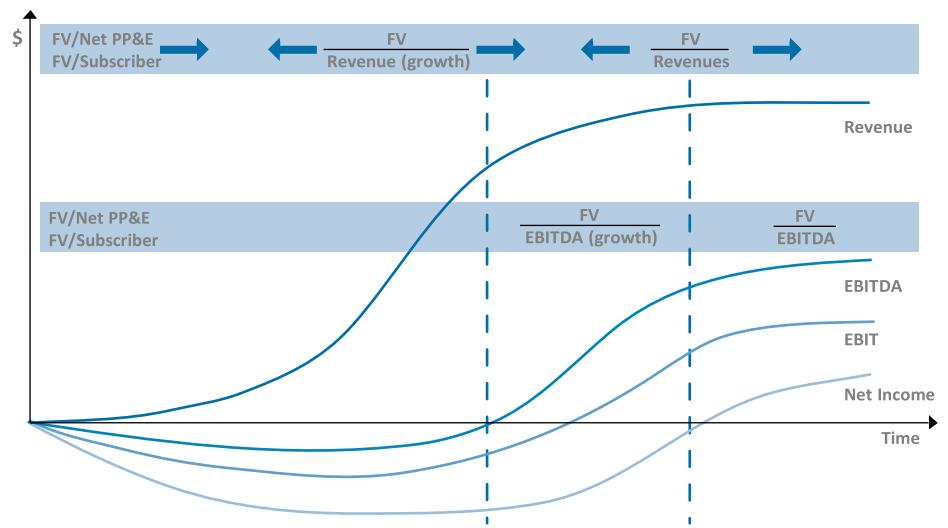
**2. Example continued - the multiples**

<b>Tesco</b>			
(£m – except per share)			
	Enterprise value	20,967	
	Share price (p)	261.5	
		<b>2001A</b>	<b>2002E</b>
	Sales	20,988	24,306
	Enterprise Value / Sales	1.00x	0.86x
	EBITDA	1,663	1,950
	Enterprise Value / EBITDA	12.6x	10.8x
	EBIT	1,187	1,352
	Enterprise Value / EBIT	17.7x	15.5x
	EPS (p)	11.5	12.6
	P/E (Equity Value / Earnings)	22.7x	20.8x
			<b>2003E</b>
			28,212
			0.74x
			2,230
			9.4x
			1,556
			13.5x
			14.1
			18.5x

## Which multiple?

The relevance of the different valuation benchmarks changes over time as business models evolve. Consequently, two key questions must be asked when selecting multiples:

- What is the development stage of the target company relative to comps?
- What is the appropriate comps universe trading on?



	Pros	Cons
EV/Sales	<ul style="list-style-type: none"> <li>• Suitable for companies with similar business model / development stage</li> <li>• May be the only performance related multiple available for companies with negative EBITDA</li> <li>• Sectors where operating margins are broadly similar between companies</li> <li>• Companies whose profits have collapsed</li> <li>• Sectors where market share is important</li> <li>• Limited exposure to accounting differences</li> </ul>	<ul style="list-style-type: none"> <li>• Does not take into account varying revenue growth rates</li> <li>• Does not address the quality of revenues</li> <li>• Does not address profitability issues</li> <li>• Inconsistency of treatment within sales of joint venture in different reporting environments</li> <li>• Different revenue recognition rules between companies</li> </ul>

EV/EBITDA	<ul style="list-style-type: none"> <li>• Incorporates profitability</li> <li>• Most businesses are EBITDA positive so widening the universe</li> <li>• Ignores the most significant accounting differences arising from goodwill</li> <li>• Relatively limited exposure to accounting differences</li> </ul>	<ul style="list-style-type: none"> <li>• Ignores depreciation / capex</li> <li>• Ignores tax regimes and tax profiles</li> <li>• Does not take into account varying EBITDA growth rates</li> <li>• Inconsistency of treatment within EBITDA of joint venture and other unconsolidated affiliates within different reporting environments</li> <li>• Other accounting differences such as revenue recognition, capitalisation policies, finance vs. operating leases</li> </ul>
EV/EBIT	<ul style="list-style-type: none"> <li>• Incorporates profitability</li> <li>• Useful for capital intensive businesses where depreciation is a true economic cost</li> <li>• Good for companies within the same reporting environment where accounting differences are minimised</li> </ul>	<ul style="list-style-type: none"> <li>• Depreciation / amortisation policies may differ</li> <li>• Ignores tax regimes and tax profiles</li> <li>• Does not take into account varying EBIT growth rates</li> <li>• Inconsistency of treatment within EBIT of joint venture and other unconsolidated affiliates within different reporting environments</li> <li>• Other accounting differences such as revenue recognition, capitalisation policies, finance vs. operating leases</li> </ul>
P/E	<ul style="list-style-type: none"> <li>• Widely used in traditional industries with high visibility of earnings</li> <li>• Widely understood</li> <li>• Quick and easy calculation</li> <li>• Useful to check DCF exit assumptions</li> </ul>	<ul style="list-style-type: none"> <li>• Depends on corporate structure</li> <li>• Accounting policies have a significant impact on earnings</li> </ul>

***In conclusion***

By understanding the industry through reading analyst reports and news stories it will become clear:

- What are the most important performance ratios and market multiples to focus on?
- Are there any industry specific statistics (e.g. hotels – price per room)?

## Using comps

### Illustration

Company X is to be valued using Company Y as a comparable company.

Company X	Company Y
Capital structure	
Equity value	?
Net debt	200
Enterprise value	?
P&L	
EBITDA	170.0
Depreciation & amortisation	(22.0)
Operating profit	148.0
Net interest	(20.0)
PBT	128.0
Tax at effective rate of 30%	(38.4)
Earnings	89.6
Multiples	
Enterprise value / EBITDA	?
Equity value / earnings	?

**Valuing Target - Company X**

At equity level			
Metric of target	earnings of X	89.6	
Multiple of similar quoted company	p/e of Y	9.65x	
<b>Theoretical equity value of target (Company X)</b>		<b>89.6 X 9.65=</b>	<b>865</b>
At enterprise level			
Metric of target	ebitda of X	170	
Multiple of similar quoted company	ev/ebitda of Y	5.88x	
Theoretical enterprise value of target		170X5.88=	1,000
Less: net debt & minorities of target			(200)
<b>Theoretical equity value of target (Company X)</b>			<b>800</b>

## How to use Comps

		Comparables Companies Multiples Ranges	Company Financials (£m)	Entity Value (£m)	Net Debt & MI (£m)	Equity Value (£m)
Sales	<b>Curr.</b>	0.50x-0.85x	100	50-85	10	40-75
	<b>Prosp.</b>	0.47x-0.75x	106	50-80	10	40-70
EBITDA	<b>Curr.</b>	7.5x-10.5x	7.3	55-77	10	45-67
	<b>Prosp.</b>	6.5x-9.5x	7.9	51-75	10	41-65
EBIT	<b>Curr.</b>	12.5x-15.5x	5.1	64-79	10	54-69
	<b>Prosp.</b>	10.5x-13.5x	5.5	58-74	10	48-64
Earnings	<b>Curr.</b>	18.0x-21.0x	3.0	-	-	54-63
	<b>Prosp.</b>	15.5x-18.5x	3.3	-	-	51-61
Summary			High			75
Summary			Low			40
Summary			Average			57
Summary			Median			58
Summary			Estimated Equity Value (£m)			<b>55-60</b>

## Special situations

Adjustments may be needed to the metrics and/or the resulting equity or enterprise value when the following issues arise in the target and / or the comparable company:

1. Currency
2. Annualisation
3. LTM (last twelve months)
4. Exceptional items
5. Dilution
6. Convertible debt
7. Mezzanine finance
8. Market value of debt and / or preference shares
9. Associates and JVs
10. Minorities
11. Pro forma: disposal, acquisition.

The over-riding idea behind Comps is to ensure that there are like-for-like comparisons. Consequently, if one of the companies in the Comps group has significant associates whilst its peers do not, then an inconsistency exists amongst the group. The metrics of the company with the associate need to be adjusted to remove the inconsistency and maintain the idea of comparable companies.

### Currency

Multiples (e.g. EV/EBIT) are independent of currency provided that both numerator (e.g. EV in \$m) and denominator e.g. (EBIT in \$m) are in the same currency. Consequently, keep financials and market capitalisation in the (same) local currency – there is no need to translate to target's currency.

For the Euro-zone incorporated companies, convert financials into Euros as the exchange rates have been fixed and the stocks are already trading in Euros.

Always use the share price traded on the primary exchange (Bloomberg: RELS).

## Annualisation

Financials should be adjusted for:

- Different year-ends
- Seasonality of business
- Growing / declining activity.

e.g. to annualise to December a company with a March financial year-end



Alternatively, the annualisation can be done using quarterly or monthly accounts if these are available. For companies quoted in the US, published quarterly information will enable this.

## LTM

LTM (Last Twelve Months) numbers are useful where the profits of the comparable businesses are growing (or declining) significantly and/or are seasonal. In these situations, annualising numbers (by pro-rating on a time basis) may be an over-simplification of the profits generated in a particular time period and may not be indicative of the companies' most recent trading performances.

Where companies have produced quarterly or half-yearly accounts, more upto-date profit figures can be generated. For example, a US company with a year end of 30 November, may have just produced its quarterly results (10Q) for the 3rd quarter to 31 August 2006. Therefore, to find the most recent trading performance, LTM to 31 August 2006 would be calculated and compared with the LTMs (not necessarily all to 31 August) of comparable businesses. The LTM would be calculated as:

	Nov-04	y.e. Nov-05 (A)	y.e. Nov-06 (F)
Annuals		80	100
10Q	Nov-04 Aug-05 Nov-05 Aug-06	45	60
LTM	Aug-05  =80 - 45 + 60 95		Aug-06

## Exceptional / extraordinary items

Exceptional and extraordinary items are characterised by:

- Their unusual nature (unrelated to ordinary business activities)
- The infrequency of occurrence (i.e. not expected to happen again).

The rules vary in different countries as to what should be classified as exceptional or extraordinary. For example, in the UK it is not possible to have extraordinary items, whilst in France, certain items must be classified as extraordinary.

Additionally, companies would prefer losses and charges to be classified as exceptional in order that underlying profits (ie valuation metrics) are unaffected by such bad news.

Consequently, the notes to the accounts should be examined to determine which items are true exceptionals / extraordinaries and worthy of exclusion.

Exceptional / extraordinary items include:

- Restructuring charges
- Profits and losses on disposals
- Financing one-offs (e.g. debt redemption above book value, etc.)
- A share in unconsolidated affiliates' exceptional items.

True exceptional and extraordinary items should be stripped out.

Where adjusting net income (for equity level comps) refer to the tax notes in the accounts to find the tax effect of exceptionals. If not available use the effective or marginal tax rate.

**Example**

	<b>Compco</b>	<b>Adjustments</b>	<b>Pro forma</b>
Sales	100	-	100
Exceptional	(20)	20	-
EBIT	5	20	25
Net interest	(2)	-	(2)
PBT	3	20	23
Tax (*)	(1)	(6)	(7)
Earnings	2	14	16

Notes: (\*) Tax rate on exceptional items is assumed to be 30%.

Not all exceptionals / extraordinaries will have a tax effect. Additionally, the tax effect of like items will be different in different countries. For example:

- Reorganisation / redundancy provisions
  - In the UK it is unlikely that tax relief will arise
  - In Germany it is likely that tax relief will be received
- Property write-downs / impairments
  - In the UK tax relief will not arise
  - In Germany it is likely that tax relief will be received.

**Associates and JVs**

Earnings from associates / joint ventures are not always directly comparable. For example, income from associates is reported:

- In the US, as share of profit after tax (as one line)
- On the Continent, often as share of profit before tax (although could be share of profit after tax) – as one line
- In the UK, as share of EBIT and proportionally consolidated for the post EBIT P&L.

Additionally, income from joint ventures is reported:

- In the US, as per associates in one line
- In the UK, as per associates but with additional disclosure about sales of the joint venture
- On the Continent, may be proportionally consolidated or as per associates depending on jurisdiction.

When material, Associates and JVs should either be:

- Consolidated in proportion (including debt); or
- Excluded and valued on a separate basis

When not material, Associates and JVs may just be included in EBIT.

### ***Illustration***

<b>CompCo has a 40% stake in AssocCo.</b>		
	<b>CompCo</b>	<b>AssocCo</b>
Market value of equity	90	55
Net debt	30	10
Sales	100	50
Operating profit	20	12.5
Associate	5	
EBIT	25	

### ***Consolidate in proportion (including debt)***

This method is used if:

- A joint venture is proportionally consolidated (i.e. the proforma numbers are already presented in the consolidated accounts); and / or

- The associate / joint venture has similar activities and growth prospects to the CompCo so that it is appropriate to apply the same multiples to both parts of the business.

	CompCo	Adjustment	Pro forma
Sales	100	20	120
EBIT	20	5	25
Equity value	90	-	90
Net debt	30	4	34
Enterprise value	<b>120</b>	<b>4</b>	<b>124</b>
EV / Sales			1.03
EV / EBIT			4.96

The equity value of CompCo includes the market value of its stake in AssocCo.

#### ***Exclude and value on a separate basis***

The market has valued CompCo's equity value to include that of the associate / joint venture whereas the P&L metrics do not include the associate / joint venture. Where the two companies have different activities or growth prospects the resulting metrics are not appropriate for all parts of the business.

This method is appropriate where the associate / joint venture has different activities or growth prospects to the CompCo. The multiples that are derived are the multiples of CompCo's business only.

	CompCo	Adjustment	Pro forma
Sales	100	-	100
EBIT	20	-	20
Equity value	90	(22)	68
Net debt	30	-	30
Enterprise value	<b>120</b>	<b>(22)</b>	<b>98</b>
EV / Sales			0.98
EV / EBIT			4.90

**Minorities**

Enterprise value is measured at the market value of all its components. Minorities are a constituent part of enterprise value and should, when representing significant value, be valued at market value. Otherwise they should be included at book value.

Where the subsidiary in which the minority arises is quoted the market value of the minority can be derived.

Practical difficulties in arriving at the market value of minorities exist where the subsidiary in which the minority arises is unquoted. Unquoted minorities will have to be valued on a separate basis.

***Illustration***

**CompCo has a 75% stake in SubsidiCo.**

	<b>CompCo</b>	<b>SubsidiCo</b>
Market value of equity	80	70
Net debt	40	25
Shareholders' funds		30
Minority interest in SubsidiCo	7.5	
Sales	100	60
EBIT	20	12
PBT	16	10
PAT	11	6
Minority interest	(1.5)	-
Net income	9.5	6
	<b>Using book value</b>	<b>Using market value</b>
Equity value	80	80
Net debt	40	40
Minority interest	7.5	17.5 (25% $\times$ 70)
Enterprise value	<b>127.5</b>	<b>137.5</b>
EV / Sales	1.28x	1.38x
EV / EBIT	6.4x	6.9x
Equity value / net income	8.4x	8.4x

## Finance and operating leases

To acquire the use of an asset such as an aeroplane, a business may buy the asset or lease the asset. This leads to three distinct ways in which the financing of the operating assets of a business is accounted for:

### *Illustration*

3 airlines have acquired the use of a plane with a cash price of €95m.

Company A has bought the plane (10 year life) using cash on which it was earning a 4.0% return.

Company B has leased the plane on an 8 year lease paying €16m per annum (the implicit interest rate on the lease is 7.15%) – this will be treated as a finance/capital lease.

Company C has leased the plane on a 3 year lease paying €18m per annum – this will be treated as an operating lease.

After one year the impact on the financial statements of the acquisition of the asset would be:

	<b>Company A</b>	<b>Company B</b>	<b>Company C</b>
	<b>(borrow to) buy</b>		<b>Lease</b>
		<b>Finance / capital</b>	<b>Operating</b>
<b>Income statement</b>			
EBITDAR	–	–	–
Rental expense	–	–	(18.0)
EBITDA	–	–	(18.0)
Depreciation	(9.5)	(11.9)	–
EBIT	(9.5)	(11.9)	(18.0)
Interest expense	(3.8)	(6.8)	–
Pre-tax profit	<b>(13.3)</b>	<b>(18.7)</b>	<b>(18.0)</b>
<b>Balance sheet</b>			
PPE	85.5	83.1	–
Cash	(98.8)	(16.0)	(18.0)
Debt	–	(85.8)	–
Retained earnings	(13.3)	(18.7)	(18.0)
<b>Balance sheet</b>			
Operating	–	–	(18.0)
Interest paid	(3.8)	(6.8)	–
Capex	(95.0)	–	–
Debt repaid	–	(9.2)	–
Cash flow	<b>(98.8)</b>	<b>(16.0)</b>	<b>(18.0)</b>

### ***Consistency of metrics***

For comps purposes, the above example illustrates that where comparable businesses finance their operational assets using different financing arrangements, the impact on the profit metrics can be significantly different. For example, for airlines, the comparability of EBIT or even EBITDA is limited. EBITDAR should be the metric of choice where comparing the underlying trading performances of the business.

Alternatively, the operating leases could be converted (mathematically) into finance leases. For example, in the above illustration, the breakdown of the finance lease charge in the income statement is approximately  $\frac{1}{3}$  interest and  $\frac{2}{3}$  depreciation. This rule of thumb has been identified by the credit rating agencies and so adjusted metrics (e.g. EBIT) can be calculated.

Using Company C in the illustration, the rental expense is removed (and so standardises EBITDA) and replaced with a new depreciation charge of 12 ( $18 \times \frac{2}{3}$ ) and interest of 6 ( $18 \times \frac{1}{3}$ ). If this simplifying assumption is accepted, then the result is that EBIT and all subsequent multiples are similarly standardised no matter how the operating assets have been financed.

### ***Adjusting EV***

If EBITDAR is the metric of choice (or the adjusted EBITDA), then  $EV / EBITDAR$  should be the multiple. However, EBITDAR (by definition before rentals, depreciation and interest) is independent of the method of finance of the asset. Where the asset has been acquired outright or has been finance leased, the net debt (a component of EV) has been increased whilst the operating lease obligation remains off-balance sheet.

For consistency between EV and EBITDAR, operating leases should be converted into finance leases, by calculating the present value of the minimum lease commitments. A schedule of payments and the appropriate discount rate are needed to do this – neither of which is likely to be presented in financial statements.

***Illustration***

A company has a corporate borrowing rate of 7.5% and a disclosed schedule of operating lease payments:

<b>Discount rate</b>	7.50%														
<b>Year</b>	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
<b>Op lease payments</b>	75	72	65	60	58	58	51	46	45	45	30	30	18	12	10
<b>Present value</b>	70	62	53	45	40	38	31	26	23	22	14	13	7	4	3
<b>PV of lease payments (capitalised operating leases)</b>	<b>451</b>														

The illustration would be difficult to recreate in practice due to a lack of disclosed information. Additionally, the derived value of €451m is very sensitive to the length of the leases and the discount rate:

- The longer the lease terms, the higher the present value of the lease payments
- The lower the discount rate, the higher the present value of the lease payments.

For example, if a company's corporate borrowing rate is assumed to be the applicable rate for refinancing the operating leases then the present value of these commitments will be higher than if the WACC was used.

Additionally, as the leases end they may need to be replaced and so the lease terms may be indefinite.

As a result, credit rating agencies and analysts simply capitalise operating leases into net debt by multiplying the annual

operating lease charge by a factor. This factor varies between 5.5 and 8.5 depending on the sector (due to typical length of leases and discount rates). This factor approximates to an appropriate annuity factor.

### **Unfunded pension obligations**

Where a business has guaranteed a minimum pension to employees on retirement, it must make payments into the pension scheme to meet these future obligations – a defined benefit scheme. These payments will be invested by the pension scheme with the intention of meeting the future pension requirements when they fall due. As time moves on, employees within the scheme will be getting closer to pensionable age and may also be entitled to greater pension payouts as they continue to work for the business.

As a result, it is possible to calculate the pension deficit – the difference between the market value of scheme assets and the present value of liabilities to scheme members.

Scheme value of assets	3,921
Present value of scheme liabilities	(5,760)
Net pension scheme deficit	(1,839)

In simple terms, if a business has not made sufficient payments to the pension scheme, then the scheme is likely to be in deficit. Comparable companies which have historically made sufficient cash payments into the scheme (no deficit) will consequently have different net debts to companies with deficits.

### **The accounting issues**

The accounting for defined benefit pension schemes is notoriously varied depending on which accounting regime is followed.

### **Adjusting net debt**

As defined above, the net pension scheme deficit of €1,839 is unlikely to be recognised on the balance sheet (although some variant of the calculation may be). However, when using either

US GAAP, UK GAAP or IFRS, this figure is disclosed in the accounts and so international comparability can be achieved.

As payments into pension schemes are tax deductible, any payments made to reduce this deficit will reduce taxes payable. Consequently, assuming a corporate tax rate of 30%, the adjustment to net debt would be an extra €1,287 [€1,839 X (1 - 30%)] of "debt" to make it comparable to a business which has already made up any deficit.

### ***Adjusting profit***

As with the accounting (or non-accounting) in the balance sheet, internationally the income statement effects will vary. Once more, US GAAP, UK GAAP and IFRS disclose (though don't necessarily recognise) similar figures.

Where EBIT or EBITDA is the metric of choice, the most relevant element is the current service cost – being the increase in the projected benefit obligation (present value of scheme liabilities) due to employees working for the company during the period.

Consequently, to calculate EBIT or EBITDA, the existing accounting for pensions in the income statement (which may well have significant international variation) should be removed and replaced with the current service cost (as an operating expense).

***Illustration***

A company with an EBITDA of €553m and net debt of €1,938m, and which suffers corporate tax at the rate of 30%, has a provision in its balance sheet for pensions of €57m and a pension charge in operating expenses of €64m.

Disclosed in the notes to the accounts is the following information:

Net pension scheme deficit	€1,839m
Current service cost	€92m
Pension contributions paid to scheme	€88m
<b>Revised net debt</b>	
Net debt as originally stated	€1,938m
Net pension deficit (post tax) [1,839 X (1-30%)]	<u>€1,287m</u>
Adjusted net debt	<u>€3,225m</u>
<b>Revised EBITDA</b>	
EBITDA as originally stated	€553m
Add: original pension charge	€64m
Less: current service cost	(€92m)
Adjusted EBITDA	<u>€525m</u>

*Note*

Due to international tax complexities, the tax treatment of the existing and revised accounting may be substantially different and so adjusting post tax profits will prove onerous. Consequently, EPS adjustments are likely to be intricate.

## Keys to success

1. Understand the industry by reading analyst reports and news stories
  - What are the industry specific statistics (sales / employee etc.)?
  - What are the most important performance ratios?
  - What are the most important market multiples?
2. Select the universe of comparable companies carefully – more is not necessarily better.
3. Use the most recent published financials
  - Check the web site and the financial calendar of the individual companies to ensure that the most recent published financial information is used
4. Use only the most appropriate broker
  - Ensure that the research is recent and subsequent to any company result announcements
  - Ensure that the forecast numbers are similar to global estimates
5. All source documentation should be marked to show where information has been extracted from with both a Post-it showing the page and a highlighter showing the numbers used
6. Use footnotes
  - To disclose adjustments made to the numbers
  - To explain unusual operating and financial trends
7. Always reconcile the broker historicals to the published historicals – this will help to understand how the broker has defined key metrics, e.g. EBIT and EPS, so that the historic and the forecasts can be input using the same adjustments
8. Ensure that the numbers are comparable – potentially, the more adjustments made for special situations (true exceptionals / non-recurring items, dilution, associates etc.), the more comparable, but:
  - The more time to input the comps
  - The less likely that all the desired adjustments will be visible in the brokers' research forecasts
  - The more chance of errors
9. Keep the comps analysis up to date
  - Check the web site and the financial calendar of the individual companies to ensure that the most recent published financial information is used

- Update share prices
  - Update exchange rates
10. Check your work
- Double check for data entry or other processing mistakes
  - Step back and look at the finished product – do the results make sense?
  - Get someone else to check your work
11. Understand the results of the analysis and be prepared to discuss them.

# Precedent transactions analysis

To learn more, please check out our online courses

 View courses

## Introduction

Precedent transactions, also known as comparable transactions, comprtrans, transaction comps or premium paid analysis, are used to derive an implied market valuation for a company, either public or private, in an acquisition context.

Precedent transactions reflect the market value of a target's income stream in a takeover situation.

Precedent transactions look at recent acquisitions in the relevant sector from which valuation multiples can be derived by dividing the transaction value by the target company's financials. These valuation multiples are applied to the company being valued in order to give a theoretical value of the business.

## Relevant transactions

Precedent transactions look at recent acquisitions in the relevant sector. Comparable transactions are selected to include corporate activity of companies with similar business activities and ideally operating in the same geographical areas.

As no two companies or transactions are exactly the same the most similar companies and transactions are sought. The target companies (both precedent and intended target) should have similar profiles, i.e.

- Business activities – industry, products and distribution channels
- Geographical location
- Size
- Growth profiles (including seasonality and cyclical)
- Profitability profiles

- Accounting policies
- Public vs. private.

Additionally, the transactions should, ideally:

- Be for similar acquisition proportions
  - The premia for a 30% stake will be lower than for a 100%
- Be for similar considerations (cash vs. debt vs. equity)
  - It is likely that a 100% cash offer will be at a lower price than a 100% equity offer
- Involve similar bidder companies (trading vs. private equity)
  - Private equity acquirers do not value synergies in their offer price
- Arise during similar equity market conditions – recent transactions are:
  - A more accurate reflection of the values buyers currently are willing to pay since the public equity markets and the availability of acquisition finance can change dramatically in a short time period
  - More relevant than older transactions because more recent transactions are more indicative of the current market environment. However, historical transactions can be used to highlight trends in a particular industry
  - Have similar transaction profiles (recommended offer vs. hostile bid vs. contested).

Consequently, it is better to use a small number of relevant comps rather than a large amount of less relevant ones.

## Mechanics

### Summary transaction information

Data	Description
Date	Announcement and/or closing date of transaction
Bidder	Bidder name including parent name if bidder is a subsidiary
Target	Target name including parent name if target is a subsidiary
Target - business description	Very short description of target's business activity
Local currency	Currency in which the transaction took place
Acquired stake	% of the target being acquired (usually 100%)
Equity value	Equity consideration to be paid by the bidder
Grossed-up equity value	The equity value adjusted when the acquired stake is less than 100%, to reflect the equity value for 100% of the target
Net debt acquired	Typically, the net debt of the target. However, special arrangements are possible whereby the acquisition is debt-free or the bidder agrees to take on only part of the target's debt
Implied enterprise value	Grossed-up equity value plus net debt acquired

### Sources of information

Information	Source
<b>List of sector corporate activity</b>	SDC M&A Monitor Sector brokers' reports
<b>When target is a public company</b>	
<b>Offer details</b>	Offer documents Reuters articles Regulatory News Service (RNS) for UK companies
<b>Historic target data</b>	Annual report and offer document – last P&L Annual report or interim results – last BS
<b>Forecast target data</b>	Broker research
<b>When target is a private company / division / subsidiary</b>	
<b>Historic target data</b>	Parent annual report – last P&L Press articles and RNS (for UK companies) – sales & profit

Note:

1. Historic and forecast data for the target company should be extracted from the most recent relevant research immediately prior to the transaction being announced – the transaction was negotiated based on these numbers and the current transaction will be based on comparable research

2. All source documentation should be marked to show where information has been extracted from with both a Post-it showing the page and a highlighter showing the numbers used
3. When choosing a broker, make sure the numbers are sanity checked with Global Estimates to make sure the analyst's projections are in line with peers
4. Footnotes should be used for all assumptions and points of interest.

## Exchange rates

Always make sure you are using the same currency in both numerator and denominator:

- P&L historic – use average exchange rates for the period
- P&L forecast – use most recent exchange rate
- B/S – use the exchange rate at the date of the BS

## Deferred payments

When acquiring a business, a company may defer part of the consideration it offers, or hold back a proportion of the transaction value. This may arise:

- Where the management of the target company hold significant stakes in the business, thereby ensuring they continue to work for the company post-acquisition
- Where the consideration is withheld and is payable upon the acquired company meeting or exceeding the projections contained within its business plans
- Tax restructuring reasons.

When calculating multiples for a transaction in which there is deferred consideration, ensure the terms of how it has been created are noted. Include both values and the range of multiples if possible.

## Equity value vs. enterprise value

The equity and enterprise values are always for 100% of the target company. If Bidder buys 50% of Target, the equity and enterprise values are the implied values for the entire company.

If Bidder buys less than 100%, the amount paid represents a portion of the equity value. Enterprise value is calculated by grossing up the equity value to 100% and adding net debt.

However, if Bidder buys all of Target, Bidder will also assume all of Target's liabilities, and what is described as "amount paid" might or might not include the debt. It is important to understand what the amount paid represents to avoid calculating incorrect transaction multiples.

### Share options and convertible debt

In-the-money share options (and all Long Term Incentive Plans, LTIPs) will be exercisable upon the acquisition and so should be converted (using the treasury method – i.e. after accounting for exercise price) when calculating the equity and enterprise values.

Similarly, convertible debt may be convertible into shares. Equity and enterprise value must be adjusted commensurately.

### The multiples

#### *Examples of multiples*

Sales multiple	Enterprise Value / Sales
EBITDA multiple	Enterprise Value / EBITDA
EBITA multiple	Enterprise Value / EBITA
EBIT multiple	Enterprise Value / EBIT
Price / Earnings multiple	Equity Value / net income
Net assets multiple	(Equity Value + Minority Interests) / Net Assets
Growth ratios	(Yr0 metric / Yr1 metric) -1
Margins	Profit metric / Sales

#### *Private transaction multiples*

By looking at historic precedent transactions, valuation multiples can be derived by dividing the transaction value by the target company's financials.

$$\frac{\text{cash paid} + \text{debt assumed (if any)}}{\text{metric}}$$

**Public transaction multiples**

As for private transactions, by looking at historic precedent transactions, valuation multiples can be derived by dividing the transaction value by the target company's financials (or other metric such as subscribers, square feet, etc.).

$$\frac{(\text{offer price} \times \text{number of shares}) + \text{debt assumed (if any)}}{\text{metric}}$$

For a public company transaction, the premium paid alludes to the fact that a bidder will typically pay a premium above the market valuation to obtain control over the target.

**Outputsheet****SAMPLE PRECEDENTS OUTPUT SHEET**

(All amounts in EUR millions, unless otherwise indicated)									
Date	Target / Acquiror	Business of Target	Local CRY	Equity	Firm	Firm value as a Multiple of			
				Value (a)	Value (a)	Sales	EBITDA	EBIT	EBITDA margin
Jun-02	Dunlop Cox(BTR) / Lear	Electrically-powered automotive seating mechanisms	GBP	578	766	1.09x	8.50x	12.90x	12.8%
Nov-01	Valeo / Investor Group	Automotive parts	SEK	29,931	31,431	1.05x	9.00x	12.30x	14.5%
Oct-01	Borealis Industrier / Lear	Instrument panels, door panels, climate systems and exterior trim	DKK	887	1,288	1.16x	7.50x	17.30x	15.4%
Nov-00	Prince Automotive / Johnson Controls	Automotive overhead systems & consoles, door panels, visors, armrests	USD	21,936	33,667	1.49x	9.90x	22.40x	15.0%
			Median	11,412	16,360	1.13x	8.8x	15.1x	14.8%
			Mean	13,333	16,788	1.20x	8.7x	16.2x	14.4%
			High	29,931	33,667	1.49x	9.9x	22.4x	15.4%
			Low	578	766	1.05x	7.5x	12.3x	12.8%
Note: (a) equity and firm value have been adjusted to reflect 100% of entity in cases of minority positions acquired.									

**SAMPLE PRECEDENTS VALUATIONS: AUTO VALUATION**

(Euros in millions)	Selected Precedents' Range		Auto Metric	Implied Auto valuation	
	Low	High		Low	High
Firm Value /					
LTM Revenue	1.1x	1.4x	€4,510.6	€4,961.7	€6,314.8
LTM EBITDA	8.5x	9.9x	€668.3	€5,680.6	€6,616.2
LTM EBIT	13.0x	17.0x	€480.8	€6,250.4	€8,173.6
Selected Auto Firm Value Range				€5,630.9	€7,034.9

## Valuing the target

The valuation multiples calculated from precedent transaction are applied to the relevant metric of the target company being valued in order to give a theoretical value of the target business.

There are a number of different ways to select the appropriate transaction multiple from the transaction database:

- Average / median of the transactions
- Average excluding outliers
- Range around the average
- Identify highest and lowest likely prices.

The best method will depend on:

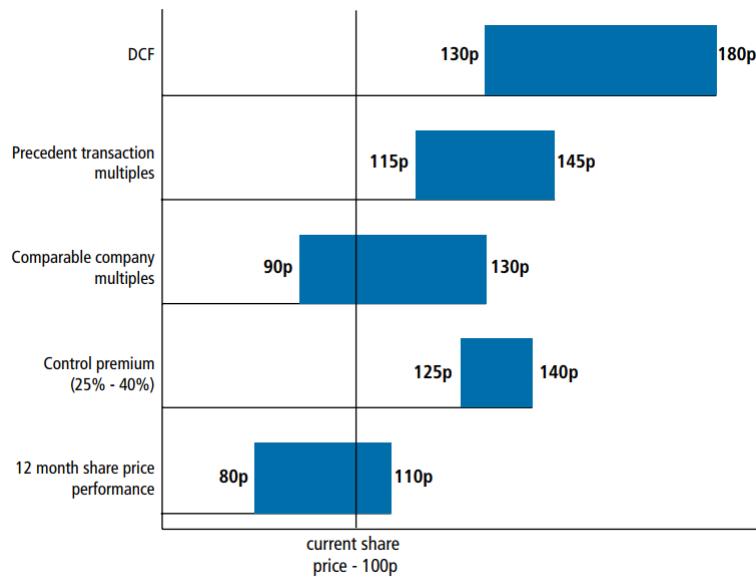
- The quality of the information going into the precedent transactions database
- Who is the audience?
- What is the situation?

		Comparable Transactions Multiples Range	Company Financials (£m)	Enterprise Value (£m)	Net Debt & Minority Interest (£m)	Equity Value (£m)	
<b>Sales</b>	hist. curr. prosp.	0.90x – 1.20x	100	90 – 120	10	80 – 110	
		0.80x – 1.10x	115	92 – 127	10	82 – 117	
		0.70x – 1.00x	125	88 – 125	10	78 – 115	
<b>EBITDA</b>	hist. curr. prosp.	10.0x – 16.0x	7.0	70 – 112	10	60 – 102	
		9.5x – 15.5x	7.5	71 – 116	10	61 – 106	
		9.0x – 15.0x	8.0	72 – 120	10	62 – 110	
<b>EBIT</b>	hist. curr. prosp.	14.0x – 20.0x	5.0	70 – 100	10	60 – 90	
		13.0x – 19.0x	5.5	72 – 105	10	62 – 95	
		12.0x – 18.0x	6.0	72 – 108	10	62 – 98	
<b>Net Income</b>	hist. curr. prosp.	25.0x – 28.0x	3.0	75 – 84	–	75 – 84	
		24.0x – 27.0x	3.5	84 – 95	–	84 – 95	
		23.0x – 26.0x	4.0	92 – 104	–	92 – 104	
		High			117		
		Low			60		
		Average			84		
		<b>Estimated Equity Value (£m)</b>				<b>80 – 85</b>	

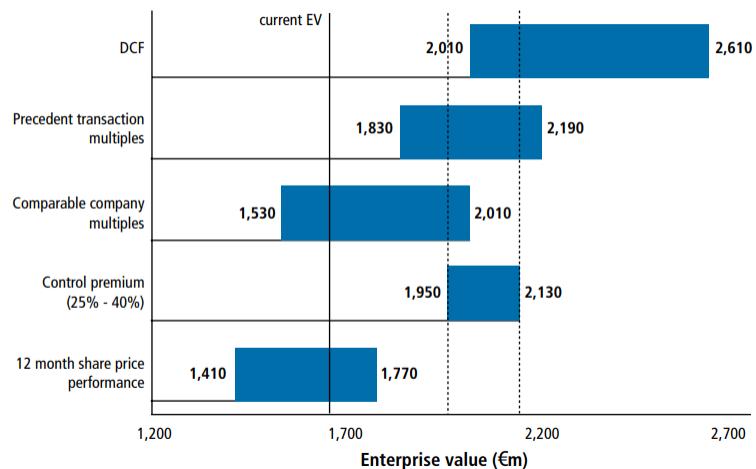
### **Checking**

- Always check your work – use a calculator
- Comparable multiples should be checked with the broker to see if they are in line
- The completed sheet should be checked by eye to make sure there are no obvious mistakes
- Footnotes should be used for all assumptions and points of interest.

### Valuation football field



### Summary valuation (€m)



## Control premia

Typically, acquisitions in the UK are made at c. 30% premium to the company's quoted value, representing a "premium for control" – in certain industries, e.g. technology, this may not be the case.

The ability to control a company has a value:

- Complete control (majority)
- Partial control (minority, significant influence, joint control).

A block of shares providing some level of control may be worth more than the sum of the values of the single shares

i.e. 51 shares > 51 X 1 share

Consequently, transaction multiples are higher than the trading multiples of the company.

It is theoretically not correct to compare an acquisition of 5% of a company with a full take-over since, in the latter case, the Bidder would have to pay a larger premium to gain control. Consequently, purchases of small stakes, i.e. less than 25%, are likely to be excluded from the analysis.

## Why pay a premium?

The ability to control a company has a value, but value in a corporate sense must be represented by future cash flows. When the equity markets value a company, they are assessing the PV of its future cash flows.

## Synergies

The control premium must be justified by higher future cash flows to the new owner. These arise through synergies:

How much additional cash can the bidder earn from the target which is not available to:

- The market; or
- The current owner (in a private transaction)?

Synergies mean that cash flows discounted by bidders are higher than the cash flows being discounted by the market (or current owner). This, therefore, sets a limit on how much the

bidder can pay. If the acquisition is going to add any value to the bidder, then the amount actually paid is generally less than this maximum.

Consequently, precedent transaction multiples are impacted by the split of value of synergies between target and bidder.

### **Drivers of equity return in an LBO**

An investor in an LBO deal does not acquire with the target the benefits of synergies as the target will continue to operate in isolation. Consequently, the LBO team must see different benefits from paying a premium for the target.

### **Benefits of leverage**

- Tax savings from interest
- Downside limited to equity capital injected
- Potentially very high upside for equity holders.

## Problems with precedent transactions

Relative to public comparables, it is more difficult to conduct a valuation based on precedent transactions. It is usually difficult to get a large enough set of transactions to calculate a meaningful average because:

- Valuation multiples tend to be widely dispersed between transactions
- Timing differences between transactions and the different market conditions – recent transactions are a more accurate reflection of the values buyers currently are willing to pay since the public equity markets and the availability of acquisition finance can change dramatically in a short time period
- Differing stakes (minority vs. control acquisitions)
- Access to information / quality of information
- The standard of reporting is different in different markets
- Press reports are generally inaccurate
- Inclusion of assumed debt
- Acquisition of minority stakes
- Volatility of public markets
  - Calculating premia to pre-bid share price - getting the most appropriate pre-bid price
  - Had the market already moved on rumours?
- Use pre-transaction or post-transaction estimates – must compare like with like.

**PART 03**

# Financial modeling

01

02

03



## Guide to the financial modeling section

These chapters lay out best practice and functionality for users to make the most out of financial modeling using Excel 2016.

Tricks and shortcuts for Excel can be found in the Appendix to Best practice financial modeling.

# Best practice financial modeling

To learn more, please check out our online courses



## Introduction

This chapter sets out how Excel can be controlled and exploited to enable:

- Faster and more efficient use of Excel tools
- Better understanding of model design principles
- Reliable, robust and flexible models to be built
- Improved efficiency in identifying inconsistencies when auditing financial models

It will also introduce the tools to better analyze and assess the sensitivity of financial models. The aim is to provide the practical skills to build, modify and audit an integrated and flexible financial model.

## Meeting user needs

The most common complaint about spreadsheet models is that they cannot be understood. The lack of understanding could be a problem for users other than the model preparer, or even the preparer of the model when the model is revisited.

This complaint arises because models:

- Are rarely documented
- Include cumbersome formulae (difficult to understand, check and modify)
- Include wide and / or long spreadsheets
- Are made up of purely numbers (a chart can quickly highlight results)
- Have no consistent format

- Mix the assumptions, other inputs, workings and outputs.

Useful models are those that can be picked up and easily and quickly understood by a reviewer. The more logical, consistent and rigorous the model, the more confidence will be engendered in the results.

These notes should help ensure that models are not only logical, but can also be reviewed by others with the minimum of effort.

### **Excel vs. modeling**

Excel is a particularly powerful application which can be used to generate, analyze and present both simple and complex data. Like any sophisticated tool, when used properly, it can be harnessed to create highly efficient, interactive and robust financial spreadsheets.

The skills introduced by financial modeling harness the functionality of Excel within a methodical and rigorous financial framework which can be applied to a large number of different applications.

Financial modeling, therefore, combines:

#### 1. Financial skills

- The strategy of the business or project
- The product, project or industry competitive dynamics and their value-drivers and key sensitivities
- Accounting, analysis, forecasting, structuring and / or valuation techniques.

#### 2. Excel functionality

- Knowledge of the mechanics of functions and tools
- How to practically apply the functions and tools
- Practical limitations of the functions and tools.

#### 3. Robust spreadsheet modeling techniques

- Design principles
- Modularity
- Quality controls and diagnostics

- Version control
- Formulae conventions
- Format conventions
- Logical thought
- Data analysis and sensitivity.

### The golden rules of modeling

The following modeling rules have been developed to:

- Enhance the quality of models
- Ensure that flexibility can be easily added
- Make models robust
- Enhance the efficiency of calculations within models
- Ensure internal consistency
- Make models easier to review.

### The magic numbers

A financial model is different from a calculator. In a calculator, arguments are input and an answer results:

- The calculator will have limited functionality
- The cumulative effects of a number of calculations are difficult to assess
- There is limited scope to flex the inputs without doing the calculation again
- The inter-relationships between each input / calculation cannot easily be evaluated

Often Excel is used like a calculator but Excel has enormous functionality which can be harnessed to create cumulative calculations which can be flexed and enable inter-relationships to be examined. Consequently, to use Excel efficiently for financial modeling:

**data must only ever be entered once**

Therefore all dates, currencies, numbers, labels etc will be entered once and if used in other places in the model will refer back to this first input cell.

For example, the current year end is often the only date that is entered. All other year ends are related back (via formulae) to this cell. Consequently, if the date is changed, then only one cell needs to be changed and the remainder of the model updates automatically.

**Never** use hard-wired (input) numbers within formulae.  
Permitted exceptions are:

Number	Justification
0	Often defines start period or used to define whether a number is positive or negative (as part of a logical test); also used to denote false as a flag (multiply by 0 if a logical test is failed)
1	Often defines the first period or used to define true as flag (multiply by 1 if a logical test is true); starting point for and increment for row and column counters
12 (and 7)	Number of months in a year (days in a week) – i.e. a fact
100	p in £, c in v and \$ etc – i.e. a fact
365 (or 360 or similar)	Number of days in a year – i.e. a fact

All formulae should therefore only be made up of cell references and the above 5 numbers.

### **Presentation issues**

- Stick to consistent color-coding, e.g. inputs blue, workings black (see Colors, size and number formats later)
- Format consistency: consistent number styles (see Styles later) and sheet set-up (see Sheet consistency later) enables quick interpretation of the results

- Shade areas in different colors for ease of navigation (some sheets may be large)
- Develop a consistent sign convention across all workings, e.g. all numbers are positive unless unusual
- Never hide columns or rows. If data is to be hidden, group the data (see Group outline later). It is then obvious to the user

### ***Formula construction***

- Always refer back to the original reference unless it becomes onerous to do so. For example, if EBITDA is used in many different places, the cell where it was first calculated / input should always be the reference for all other cells. This will speed up calculation and reduce the file size
- The rule of two-thirds: if the formula takes up more than 2/3 of the formula bar, then it is too long
  - The worksheet is 256 cells wide and 65,536 cells deep - over 16.7 million cells to play with per sheet
  - Breaking down long formulae into several steps makes them easier to understand and edit
  - Where possible, use logical operators (AND, OR, etc.) rather than nested IF functions
  - Use flags (e.g. for dates, event triggers) where possible to shorten formulae
- Avoid the macho
  - The shortest formula is often, though not always, the best. '=MAX(0,D16)' and '=IF(D16<0,0,D16)' do exactly the same thing. However, the first belongs to the macho school of modeling (adopt a clever formula whenever possible), whilst the second is widely understood
  - Do not create circular references
    - They slow down calculations and may cause Excel to crash
    - Results depend on Excel settings (in the Tools; Options; Calculations menu), i.e., maximum iterations and maximum change

- Once a circular reference has been created, it is very easy to add further circular references without being aware of it
- They can almost always be avoided with more careful formulation or automated goal seeks. However, in the interests of time you may be able to tolerate it if you close the circularity whilst editing the model (for example by having some sort of switch) (see later)
- Row consistency: where possible, avoid changing formulae across a single row (see F5-Special later)
  - Try to keep to one row / one formula
  - If unavoidable, highlight the non-standard cells
- A reviewer needs to be confident that there are no hidden fixes in individual cells

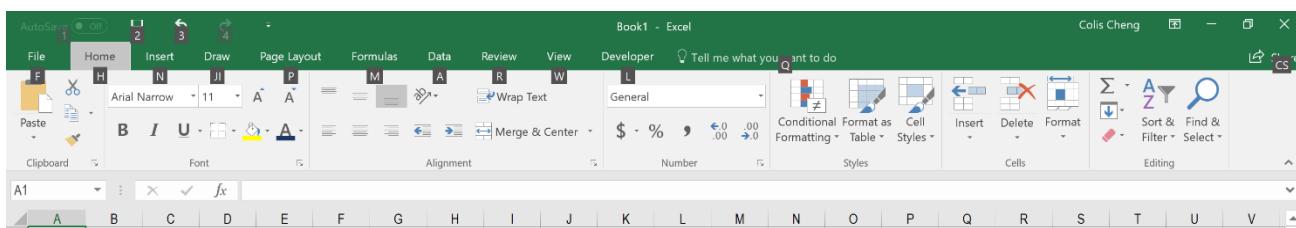
### ***Other best practice modeling rules***

- Only name those ranges/cells that will be used away from the near vicinity (see Names later)
- Insert notes/comments where it may not be obvious what the logic is (for easy review)
- When deleting data at the end (either vertically or horizontally) of a sheet, use Edit, Clear All across the whole area – this will re-set the size of the sheet in the memory, making it easier to identify the reference of the bottom-right of the active sheet: (short cut - Ctrl-End) and may significantly reduce the size of the file
- Make all check digits positive for ease of use in subsequent conditional statements (see Common problems with IF statements and some simple solutions later)
- Use the mouse as little as possible – keyboard shortcuts will make you faster, more efficient and less prone to errors when using Excel. If possible cut down your toolbars to the bare minimum and organize them so that the ones which are onerous to access without using the mouse are at either ends of the toolbars for easy access using Alt; Ctrl-Tab

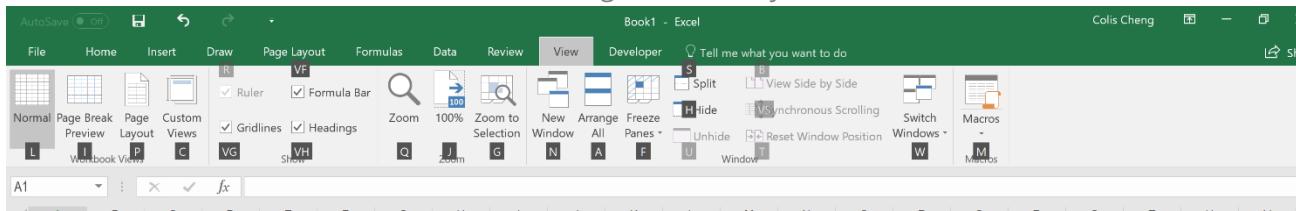
## Introducing the Ribbon

Above is a screen shot of the typical workbook layout. This menu and toolbar layout is called the Ribbon. The Ribbon icons are within the menu functions, making it better for navigation for those who prefer using a mouse. Most modellers however, are more efficient and accurate without the mouse. Menus can still be accessed via the keyboard by using the **Alt** button followed by the relevant letter(s) that has been allocated to each button.

Pressing Alt once reveals the keyboard letters required to access the main menus.



Pressing W on the keyboard reveals the 'View' icons.



See the table below for an overview of what is contained within each Ribbon Tab.

There is enhanced grouping and extra menus.

The commands available in the Ribbon vary depending on which tab has been selected. As a quick overview the main elements of the Ribbon are:



Tip: Look out for underlined letters to help navigate using the keyboard.

Ribbon tab	Overview	Short cut to access
<u>Home</u>	This contains the basic formatting tools, cut, copy and paste as well conditional formatting	Alt-H
<u>Insert</u>	Used for inserting graphs, pivot tables, illustrations and text	Alt-N
<u>Page layout</u>	Includes the functionality for altering the look of the workbook and printing requirements	Alt-P
<u>Formulas</u>	Includes the Excel formula tools and the naming functionality and management	Alt-M
<u>Data</u>	Data related commands	Alt-A
<u>Review</u>	Includes all the proofing, track changes and comment management	Alt-R
<u>View</u>	Management of windows, view options and zooming	Alt-W
<u>Developer</u>	Macro functionality and the switch (VBA) tools used for scenario management building	Alt-L (see below)

### ***Developer***

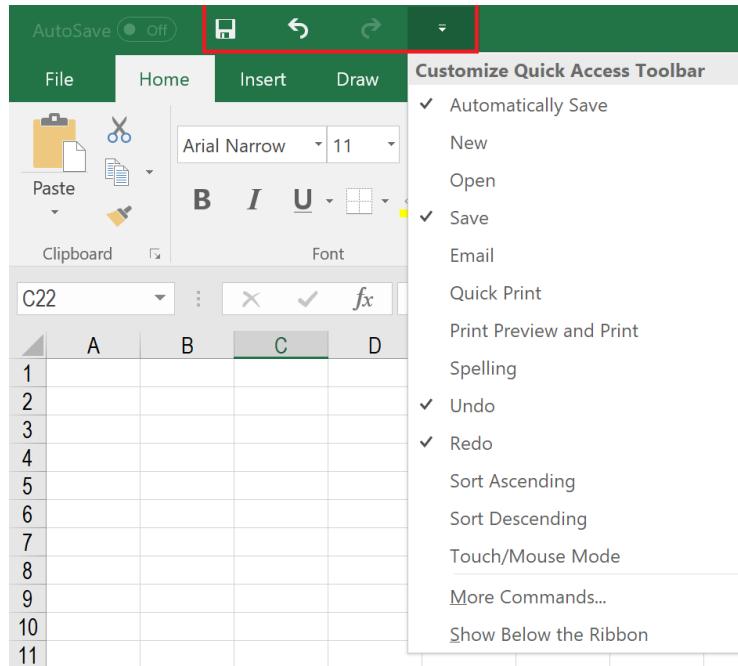
The developer menu does not appear as standard but can be added easily. Left click on the Office Button (Alt-F), select Excel Options (Alt-I) and then select "Show Developer tab in the Ribbon" (Alt-D).

All commands can be added to customise the Quick Access Toolbar.

To hide or display the Ribbon use Ctrl-F1 or right click on the Ribbon and select 'Minimise the Ribbon'.

## Quick Access Toolbar

This toolbar can be set up to include any commands that are useful, so the user can access them quickly with the keyboard.



Typical buttons that are useful and repeatedly used by financial modellers would be:

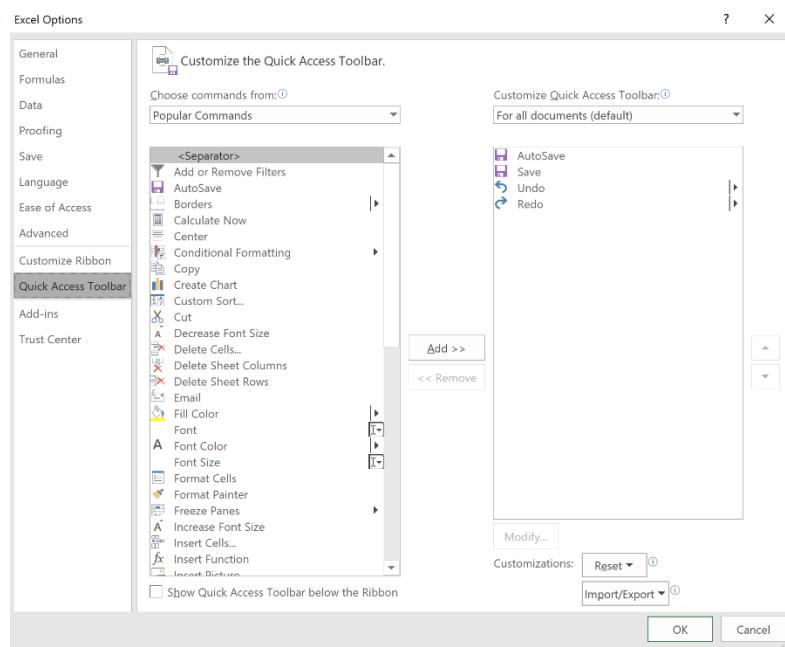
- Font colors
- Fill cell
- Borders
- Cell Style (replaces style dropdown box)
- Camera

The **Customize** menu is located on the left side of the navigation area. Alternatively, you can access the **Customize** menu using the mouse; right click on the Ribbon and select "**Customize Quick Access Toolbar...**" from the dialog box, or use keyboard shortcut Alt-right mouse key (if you have one on your keyboard).

Tip: Look out for underlined letters to help navigate using the keyboard.

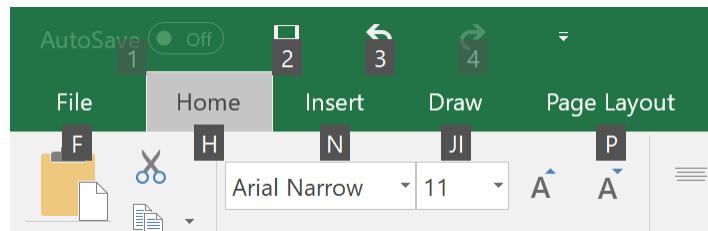
Individual commands can also be added to the Quick Access Toolbar direct from the Ribbon. Select the icon, right-click; select **Add to Quick Access Toolbar**.

Once in the **Customize** menu, commands can be chosen and added to the QAT. Every command is included in the 'Choose commands from' menu.



The QAT can be customised for an individual workbook or for all documents using the dropdown menu below 'Customize the Quick Access Toolbar' in the top right hand corner of the menu.

Once the QAT has been customised, the buttons can be navigated easily by entering Alt and the appropriate number:



In the above example the QAT has been setup with five commands and each can be accessed by pressing Alt and the corresponding number:

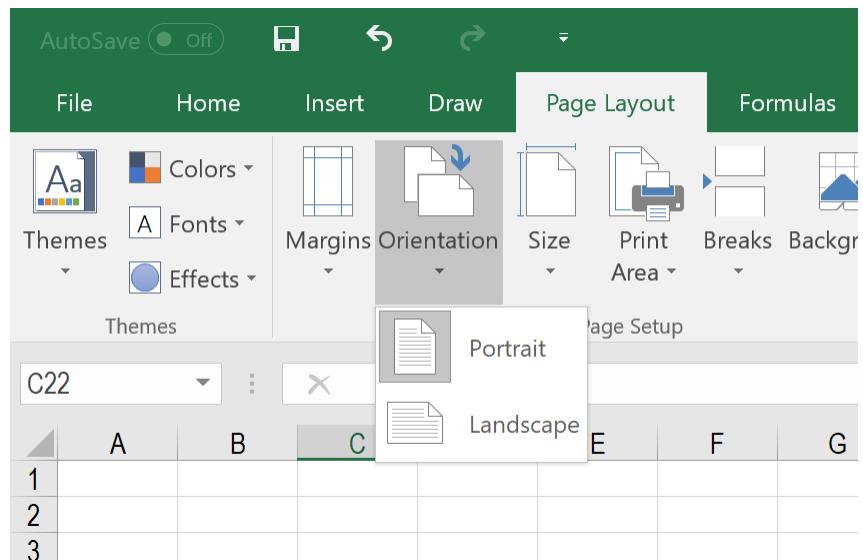
1. Autosave (Alt-1)
2. Save (Alt-2)
3. Undo (Alt-3)

#### 4. Redo (Alt-4)

You can choose to display the QAT either above or below the Ribbon, (rightclick the QAT or check the box within the Customize menu.

## Page Layout menu

The Page Layout menu contains all of the page setup requirements. If all sheets are grouped (still with the shortcut Ctrl-shift page down), the page setup can be completed for all sheets at the same time.



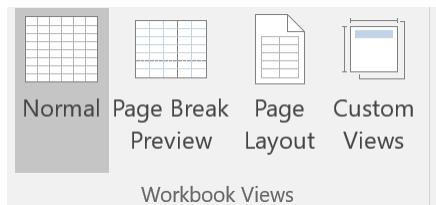
See the appendix for Ribbon shortcuts.

## View menu

Excel has a menu dedicated to organising the way Excel worksheets can be viewed. Alt-W or a mouse click will give the user access to the **View** menu.

This menu will allow the user to change the workbook views between:

- Normal
- Page layout
- Page break preview
- Custom view



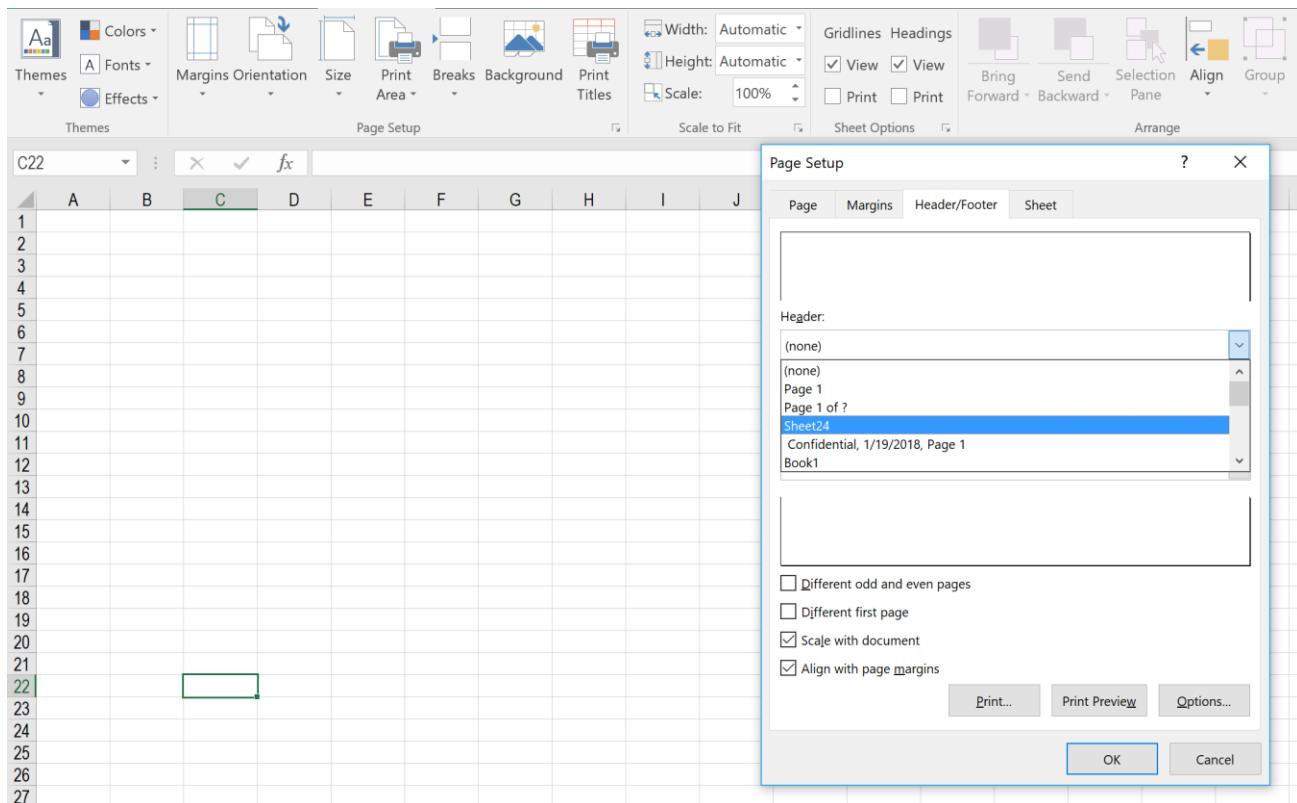
The Normal view is the standard workbook view.

The Page Layout view (Alt-W-P) provides an editable print preview option. This view will usually be used to create and format headers and footers. Below illustrates the appearance of the Page Layout view. The view demonstrates what the spreadsheet will look like when printed out given the current page set up for the workbook.

### Headers and footers

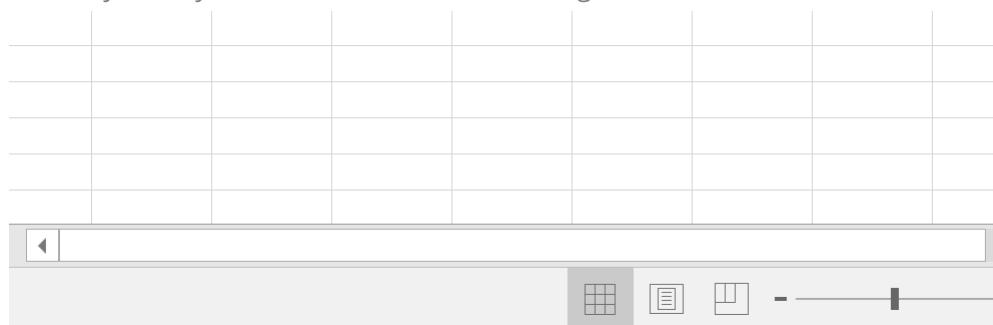
To edit headers or footers, the model should be in Page Layout view. Click into the bottom right-hand corner of Page Setup and the click the Header/Footer tab and click Custom Header or Custom Footer.

A new **Design** tab will appear,



## Zoom

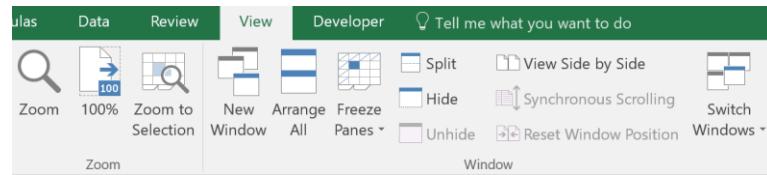
If a user wishes to zoom in on a part of the workbook there are several options. You may hold Ctrl and Scroll up on your mouse to zoom-in or hold Scroll down on your mouse to zoom-out. Or you may use the icon on the bottom right of the sheet.



## View multiple windows

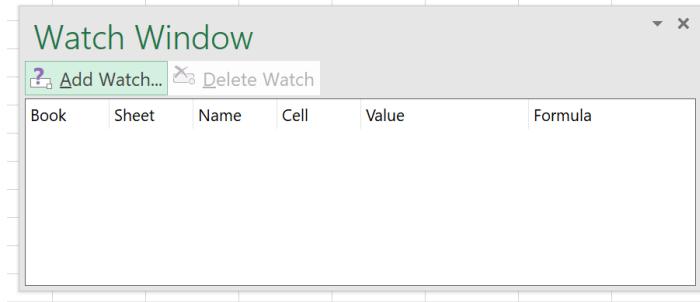
A very useful tool when modeling is the ability to view more than one window in an active workbook. Modellers can make changes in one window, whilst viewing the impact in another.

The **View** menu New Window (Alt-W-N) opens a new window, Arrange All (Alt- W-A) allows the windows to be arranged as before.



## Watch Window

The Watch Window function is found in **Formulas** Menu, in the Formula Auditing grouping (Alt-M-W).



## Excel Options

The Excel Options menu is:

Sub-menu	Sub menu used to:
Popular	Alter default fonts, sizes, number of sheet tabs, set up live preview and mini toolbars
Formulas	Set calculations, switch on iterations, background error checking
Proofing	Set the spelling check parameters
Save	Set the auto save parameters and the back up save locations
Advanced	Set detailed excel options – for instance, after pressing enter setting excel to move the cursor downwards
Customise	Customising the quick access toolbar (see below)
Add-ins	Adds in additional functionality. For instance, the analysis tool pack add-in will add statistical data analysis tools into the excel workbook. For example, this would be required for users wishing to regress their own betas using the excel regression tool
Trust center	Privacy protection and security
Resources	On line resources links into Microsoft.com

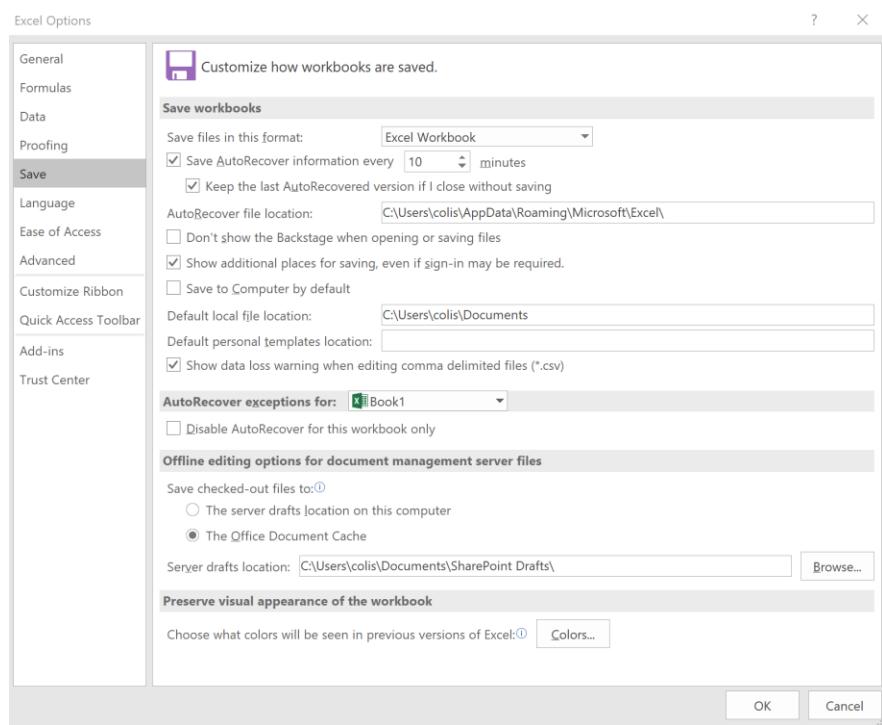
## Model set up

### Excel set up for efficient modeling

In order to use Excel efficiently, it is worth ensuring the profile (where possible) has been amended for the following:

#### Autosave

Autosave will automatically run in the background and so no action is needed. If it is not it must be added in. To do this, select File, Options, Save and the following dialogue box will appear. (This may require the programme disks.)



Check the "Save AutoRecover information every" box, choose time in minutes and press OK.

To change the settings for Autosave or switch it off, click on File, Options, Save and the dialogue box will appear again.

Autosave, like many Microsoft innovations, is controversial amongst modellers and a double edged sword. If you follow the saving procedure, then Autosave is a useful tool. Crashes will not worry you and you will not worry either about saving, only to realise that you accidentally deleted a sheet 10 minutes ago. The worst position you will be in will be to lose a

morning's work. Most of the time, you will only lose 5-10 minutes.

### ***Analysis ToolPak***

The standard set-up of Excel is fine for most users. However, in some financial models, some more advanced statistical tools and / or date functions are needed. These tools and functions are within the Analysis ToolPak, which must be added in the same way as Autosave:

File; Options; Select Analysis ToolPak; OK

Note 1: If you are logged into the network at the time of doing this, your profile will be updated so that these advanced functions are available for all future sessions.

Note 2: If the model is to be sent to others, they may not have incorporated this add-in and so some of the calculated formulae may appear as #NAME?. It may be necessary to indicate that the user must go through the add-in routine to ensure the model works effectively.

### ***Calculation settings***

File; Options; Formulas tab

1. Ensure the Enable Iterative calculation box is not selected

If the Iteration box is selected, Excel will iterate any circularities created within the model. Circularities make models slower to calculate, unstable and more likely to crash. Often circularities within models are created in error or are unnecessary. Whilst the iteration option remains off, any circularities will be flagged (and can be eliminated).

Note: if a circularity exists and the iteration option remains off, the calculated numbers in the model cannot be trusted.

2. Select Automatic except tables

The model will calculate automatically as the model is modified, but F9 must be pressed whenever Data Tables are to be calculated (see Data Tables later).

### ***Grey background***

Following this procedure Excel (together with all other applications) will appear on screen with a grey background. It

is merely the screen color that has changed – the document will continue to print out and be viewed by other users in the same way as before the change.

The benefit of such a change is to allow white text to be used in the model – this can be read on the screen (against the grey background) but will print out as white (probably on white paper) and so be invisible. This can be used for row / column counters, checks etc. which may otherwise confuse the reader of the printed model.

To set the profile to grey:

Files; Options; General; “Under Default view for new sheets”; Select “Page Break Preview”; Open new Spreadsheet

To undo this, select “Normal View”

## Design

Time spent on design is never wasted and will be recouped many times over while building a model. Clear design objectives at the start (which do not change) will enable a simple and straightforward model to be built, which should also be transparent in structure, making it easy to use and easier to find any mistakes.

The first step is to scope out the model. The following questionnaire aims to help uncover the key issues which will drive the way the model is structured and which will also determine the user friendliness and flexibility that is required.

The questionnaire is for modellers to gather responses from the potential users and consumers of the results (these may be different people).

### **Scope questionnaire**

1. Who is the customer? Who wants the outputs and why? What are detailed questions the model will be used to answer? What are the important outputs? Is there a mandatory or preferred format for them? What are the key decisions which need to be made based on the outputs?
2. What is the nature and form of the input data? How detailed and high quality will it be? Can you set the format,

- or get a commitment to format from the input data's author?
3. What is the legal entity or group being modeled? Is this uncertain or likely to change?
  4. Will the model be published in printed form in a prospectus or similar? Will it be issued to third parties in electronic form?
  5. Will the model be formally audited by a third party?
  6. What will the role of the model ultimately be? For example:
    - A "one off" piece of analysis as part of a larger study
    - A standard model to be used as a template for analysis
    - The main forecasting tool to establish the structure and amount of a public finance raising.
  7. What are the critical value drivers which will need to be flexed into the model, and what are the key operating links, e.g. working capital / sales?
  8. What is the range of structures of company or transaction which will need to be examined by the model?
  9. Are timing assumptions likely to change in the model, e.g. do you plan to still be using the model in a year's time when all forecasts will need to start a year later? Is the timing of events in the model likely to change, e.g. an acquisition, a divestment, the start of operation of a project? If in doubt assume the worst.
  10. What detailed questions will the model answer?
    - Valuation
    - Financing structure optimisation
    - Liquidity planning.
  11. Will borrowing or holding assets in foreign currencies need to be modeled?
  12. Will there be large changes in the level of debt?
  13. Will there be significant seasonality in cash flows or revenues?
  14. What will be the inflationary environment of the company being modeled; will real and nominal forecasts be required?

The answers should enable the modeller to do the job clearly understanding the levels of usability and professional polish that the model requires.

Questions 7-14 are particularly important because they are the typical issues of "detail" that may not be discussed at an early

stage, but which will have a fundamental impact on design approach. It will be difficult to bring these issues into a model which is already well developed. Again, planning and providing for a particular development from the start will make a model easier to work with throughout its life.

### **Standard models**

A model is inevitably a very specific answer to a set of very specific questions. A line of thought that occurs at some stage to anyone involved regularly in modeling is: "A good standard model will simplify my life and instead of building models I can focus on analysis."

This is perfectly reasonable but this strategy has practical shortcomings. Creating a standard model will constrain analysis. The standard model will always make the same implicit assumptions; treat companies / projects / data in the same way; and make the same approximations.

Because it is not always appropriate to look at companies / transactions in the same way or because some companies / transactions are very different, standard models tend to develop in two ways:

1. They become very simple.

The result being that the analysis is largely outside the model and only a small number of key variables are used to get results.

If the model only performs limited analysis, it will only help in a limited way with decision-making. What a good model should do is give integrated and consistent analysis from which decisions can be made.

2. They become complex with lots of flexibility, alternative inputs and calculation sections which can be used as necessary.

Large, complex models can become unwieldy and, if the users are not trained or do not regularly use all parts, sections fall into disuse because people do not understand them, do not trust them or just do not know what they do. Most modeling groups have one of these "all singing, all dancing models" and they are often forsaken, not because

of any quality problems but because of lack of confidence on the part of users and lack of familiarity.

Clear, specific objectives supported by documentation and training is very important for the success of a standard model. For a standard model of any complexity, documentation and training are essential.

For any standard model to be accepted the analysis it does and the outputs it produces must be relevant to the decisions to be made by users. This means consultation and clear design scope.

### ***File naming conventions***

As significant changes are made to the model, it can be efficient to create different versions of the model. An audit trail will therefore be created showing how the model has been developed. If a controversial amendment or difficult procedure is to be added a new version should be created. If the amendments prove to be ineffective / wrong then the previous version can be used.

Additionally, if different people are working on the model, coming up with different version names will make the management of the development easier.

Decide on naming convention and stick with it. It should be obvious from the name which is the most up to date version and should be easily identifiable in the directory, e.g.

- Project name v001 (or 001 Project name) – will be filed in file name order
- Project name 2007 03 23 (or 2007 03 23 Project name) – having the year followed by the month followed by the day will file it in name order.

Never call it “project name final”. It never will be the correct name.

### ***Sheet consistency***

The more consistent the format (colors, numbers, columns, titles, headings, footers, views, etc.) between sheets, the easier the construction and review. Hence a lot of the formatting of the entire model can (and should) be done up front.

There are two methods to arrive at the same result of consistent formatting throughout the model:

- Group the sheets and format them all together; or
- Set up one sheet and then copy it the requisite number of times.

The first method could be dangerous as data on other sheets may be overwritten, whilst the second method is slightly more fiddly when trying to get the correct number of properly named sheets. When used with the care, the first group edit option is the more straightforward.

### ***The steps***

1. Assess how many sheets are needed (and add one – it can always be removed). New sheets can be added by right clicking a sheet tab, choosing Insert and Worksheet or pressing Shift + F11

- The easiest way is to name each sheet that you think you will need
- Use abbreviated sheet names – the shortest name that is understandable
  - It is very useful to be able to see all of the sheet tabs at once
  - Short sheet names make shorter cell addresses when used across sheets – making formulae shorter and easier to interpret.

2. Select all sheets to do consistent formatting (to set up group editing)

- Control+Shift+Page Down; or

Right mouse on a sheet tab – Select All Sheets.

3. Size the columns

- Column A (small); Column B (small); Column C (big)
  - Natural indents for ease of reading text / headings
  - To allow sufficient “space” should it be needed
- Column D (very small)

- For check digits
- Allows the data to be selected more efficiently if there is a natural break
- Makes naming ranges easier
- Enables creation of consistent formulae on corkscrews
- Put in all the years (and currency) - i.e. column headings
  - Column E is the 1st period and then copy the sequence across all relevant columns
  - Only if a period (e.g. y/e31/8/07) is in the same column in every sheet throughout the model can the range name tool be used effectively
- Leave a blank column at the end of the final period (make it small)
  - Allows easy insertion of further periods if they are subsequently needed
  - Allows the data to be selected more efficiently if there is a natural break

The final column after the blank will be used for recording range names.

4. Fit the spreadsheet to the appropriate size

- Highlight the next column (after the range names column); and then
- Control+Shift+→ (selects the remaining columns on the sheet);
- Format; Column; Hide or right mouse followed by H or Control+) (hides all the highlighted columns). To restore the hidden columns Control+Shift+) or Format; Column; Unhide.

5. Format numbers and text (see Formatting later) – if Styles are to be used, then this can be done following the group edit phase.

6. Print set-up (so it is ready to go from the start). If the sheets have been grouped together and you use the File; Page; Setup command, the settings you specify will apply to all sheets in the group. If, however, you run File; Print Preview and run the

Setup command from there, the settings only apply to the current sheet, whether or not it is one of a group

- Fit to page. Landscape orientation is often chosen. If a standard layout has been adopted, all sheets will be a constant width but the length will differ. Page Setup offers a percentage value, or to fit to a specified number of pages. Rather than specifying 1 page wide by 1 page tall, the width requirement is entered and the height is left blank
- Default margins are often too large and need to be adjusted
- Headers & footers to include file name; sheet name; date and time; and page&[Page] of &[Pages]. At times more information needs to be entered than the header / footer codes provide. In a worksheet, functions such as =CELL("filename",A1) will return the full path of the spreadsheet rather than the simple file name returned by the &[file] code used in the header / footer dialogue box
- Print titles (probably the periods) – will have to be done outside of the group edit as they are worksheet specific
- Remove the gridlines.

Once setup is complete Print Preview should be reviewed.

### ***Freezing panes***

The Window Freeze Panes command “freezes” the rows and columns above and to the right of the selected cells. This is very useful as it results in the row and column titles always being visible on the screen.

Click the View tab and select “Freeze Panes”

A	B	C	D	E	F	G	H	I	J
1	Company XYZ								
2	DCF (FCFF) - With Debt								
3									
4									
5									
6	(\$000s)								
7									
8									
9									
14									
15	Taxes (Theoretical)		Dec-15	Dec-16	Estimate	Dec-17	Dec-18	Dec-19	
16			498.45	540.17	566.74	594.63	618.25		
17	Free Cash Flow		\$ 1,076	\$ 1,161	\$ 1,219	\$ 1,280	\$ 1,196		
18			1	2	3	4	5		
19	Discount Periods								8,127
20	Terminal Value								
21			\$ 1,076	\$ 1,161	\$ 1,219	\$ 1,280	\$ 9,323		
22	Free Cash Flow (w/ TV)		920	1,161	1,219	1,280	9,323		
23									
24	Present Values								
25	Value of Firm		17.01%	8,575					
26	Value of Debt			2,572.56					
27	Check								
28			(8,575)	\$ 1,076	\$ 1,161	\$ 1,219	\$ 1,280	\$ 9,323	
29									
30			IRR	12.92%					
31									
32									
33									
34									
35									
36									
37									
38	Free Cash Flow to Equity								
39			Dec-15	Dec-16	Dec-17	Dec-18	Dec-19		
40	EBITDA								
41	Capex								
42									

In this case, the freeze panes command was used in cell D10.

## Model structure

The structure of a model will be a function of the results of earlier work in understanding the modeling needs. In particular, the output desired, the level of detail required and the degree of flexibility necessary will have been determined in advance.

Good model design has a logical structure in which different modules are separated into separate sheets in a workbook. A standardised rule-book for the creation of the various sheets will aid easy construction and review.

The most common structure for financial models is Assumptions; Process; Results: i.e. inputs followed by workings followed by outputs. However, no matter what kind of model is being built, it should have a further three elements giving a minimum structure of six key building blocks:

1. Log sheet
2. Description sheet
3. Checks sheet
4. Assumptions (or input) sheet(s)
5. Workings sheet(s)
6. Output sheet(s).

By creating separate sheets for each of the building blocks of the model, a reviewer is able to build up knowledge of the model step-by-step: model genesis, model description, checks, assumptions, process and results. It aids clarity of thought and is easier to maintain, view and print. The twin disadvantages of lengthier formulas and file size are more than outweighed by these advantages.

### ***Log sheet / To-do list***

Modellers face two contrasting problems:

- Having different “current” copies of the same model
- Only having one copy of the model.

Working on the move, at home, on laptops or at clients’ offices gives rise to various copies, all with the same name and

perhaps with only minor but significant differences between them. Particularly when under pressure, it is easy to waste time trying to figure out which is the latest version.

Keeping only one copy can give problems which are more fundamental. Crashing computers which corrupt the model, bad design or changing design needs may leave the modeller wishing he could go back a day or two to get back to an undamaged copy or to avoid unpicking work.

A common practice amongst modellers is to keep a log sheet in each model and to adopt a rigorous saving procedure. A typical log sheet looks like this:

	A	B	C	D	E	F	G	H	I
1									
2									
3									
4									
5									
6	Date	Last file name	How amended						
7		New file	Calendar sheet included, basic structure set up						
8		New Deal 2	Import of assumption, layout architecture, main scenario manger set up, consolidation of monthly to annual set up and trailed for T/o abd CoGS						
9		New deal 3	SG&A completed and linked to P+L						
10	28/09/01	Nw deal 4	P+L completed to Debt line, assumption sheets protected. Capex Sched completed and linked to B/S						
11	1/10/01	New deal 5	Fist near complete sensible run; Debt, Fixed assets and SG+A linked. SGA troubleshooting						
12	1/10/01	New Deal 6	making WI dynamic, and including capex and cost savings related to the vendor						
13	7/10/01	New Deal 7	cash/O/D glitch in B?S solved, rate adjusted down						
14									
15									
16									
17									
18									
19									
20									
21									
22									
23									
24									
25									

**Log** Instru Diagnostics Assum open bs P+L SG+A CF BS FixedA Calendar sale\_bud

### Saving procedure

The log sheet is maintained as part of a saving procedure.

1. When commencing a development session where you will be editing the model, on opening the model, record the name of it in the log sheet on a new line, make some quick notes of what you are planning to do to it and before you commence work, save the model with a new name and use sequential (or date) naming, i.e. give each draft a reference number but otherwise keep the name the same
2. Switch on Autosave, but leave the prompt checked so that Excel only saves when you want rather than when it wants to. For users of Excel 2016, Autosave will automatically run in the background

3. Regularly save material when you are happy with the alterations you have made and keep a record in the log sheet
4. At a milestone in development, or when you start another session go back to step 1 and start the saving routine again.

Although the procedure may seem like a chore, it will give a clear idea of where you are in development, if you reconsider design or have to make important changes / throw out part of the structure, the log sheet will give you another clear option, i.e. to go back to an older version and start again, instead of "unpicking" unwanted code out of the model.

#### **To-do list**

Modellers are frequently aware of what is outstanding on a model. Adding a To-do list will provide a reminder of what is still to be done (particularly useful if a number of days separate each bout of model building) and will indicate to anyone picking up the current version of the model where improvements are yet to be made.

The To-do list should be kept up to date, either by indicating the date and in which version it was completed, or by cutting and placing it into the log once it is completed.

#### **Description sheet**

A properly documented model can be picked up and understood by others relatively easily.

It is useful to have a separate worksheet with instructions on how to run the model. This will allow other users to understand how to operate the model, especially when additional or non-conventional procedures are needed to make the model work correctly. Common errors and their solutions should also form a part of this sheet.

The genesis of the model can be reviewed by looking at the log sheet (see above) and the checks sheet (see below) should be reviewed in order to verify that there are no red flags.

However, additional assistance can be derived from a description sheet containing the following:

- Description of the proposed transaction / analysis This brief description should:

- Describe the purposes of the model
- Identify the key assumptions and where they are to be found
- Identify the key outputs
- Give instructions as to how to run the model.

When done properly, this will help set the context for the model and so make it easier to use.

- Implicit assumptions / presumptions

Certain preconditions exist within each model which may be obvious to the modeller but unknown to subsequent users (e.g. that all cash flows arise at the end of each period; or the model is not time flexible).

These implicit assumptions limit the scope of the model and so should be briefly set out on the description sheet.

- Model flow

For more complex models, a description of the links within the model (and, better still, flow diagrams) will help users understand the structure of the model and make review and auditing easier.

- Author / checker

By giving details of those who have worked on the model ownership is assigned.

Additionally, the name and contact details of the author (and the date of their last efforts) may be useful if questions need to be asked. If the model has been reviewed, similar details for the checker gives a second port of call.

Additionally, adding explanatory notes into the model allows other users of the model to understand aspects such as assumptions, formulae etc. that may be neither obvious nor commonly used.

It is important to keep the explanatory notes up to date whilst the model is built. It can be hard to remember what has been done when the model nears completion.

### Checks sheet

When a model goes wrong, the modeller needs to know. It would be unprofessional and embarrassing to print or send out a model with errors.

To help in quickly identifying these problems a checks area is used.

All diagnostic checks from the model are housed in this part of the model.

For larger models with significant checks, this will form a sheet in its own right – an example of which appears below.

Model checks - please review model if some of the checks do not yield "OK"			
Scenario drivers			
Capital structure	3 Capital structure 3		
Operating scenario	1 IM case		
Sales forecasts	2 By business unit		
EBITDA forecasts	1 Total		
Interest rate calculation	1 opening		
Exit multiple manager	1 EV / EBITDA		
Exit year	Year 3 - 3-4 years	30-Apr-11	
Financing			
Sources of funds equal uses of funds	OK	-	If this is not "OK" check "S&U" sheet
Debt schedules are working	OK	-	If this is not "OK" check "Cascade" sheet
Equity proportion	CHECK	30.6%	Can this be justified? - check "Finance(in)" sheet
Minimum EBITDA / Net total cash interest (and date)	CHECK	2.8x	30-Apr-07 Can this be justified? - check "Ratios" sheet
Minimum EBITDA - Capex / Net total cash interest (and date)	CHECK	1.9x	30-Apr-07 Can this be justified? - check "Ratios" sheet
Maximum Senior debt / EBITDA (and date)	CHECK	3.3x	30-Apr-07 Can this be justified? - check "Ratios" sheet
Maximum Total debt / EBITDA (and date)	CHECK	5.0x	30-Apr-07 Can this be justified? - check "Ratios" sheet
Minimum Fixed charge cover (and date)	CHECK	1.1x	30-Apr-08 Can this be justified? - check "Ratios" sheet
Maximum revolver drawdown - £m (and date)	OK	-	If non-nil, revolver used during investment - ensure leverage is adequate
LBO Returns			
Exit multiple same as entry multiple	OK	-	Ensure you can justify the change ("Control(in)" sheet)
DCF value bigger than offer value	CHECK	27.8%	Ensure you can justify the price paid, WACC of Target ("Control(in)") & forecasts
Equity value creation can be reconciled to drivers of value	OK	-	If this is not "OK" check the value creation reconciliation ("LBORet" sheet)
Chart of equity value creation bridge matches the total value created	OK	-	If this is not "OK" check the value creation chart workings ("LBORet" sheet)

For smaller models, this may be housed on the output or description sheet.

Checks will come in two forms:

- Those that check whether the model is functioning
- Those that check the sense and logic of the outputs

### Examples of checks

#### Historic financials

- Historic balance sheet balances
- Historic model net income ties into historic income statement from published financial statements

- Historic retained earnings in balance sheet reconciles to income statement
- Historic model net cash flow ties into historic cash flow statement in published financial statements
- Historic cash in balance sheet reconciles to cash flows
- Historic debt reconciles to cash flows

### Forecast financials

- Proforma balance sheet balances
- Forecast balance sheet balances
- EBITDA in income statement is internally consistent – i.e. the income statement adds down to give the same figure
- Retained earnings in balance sheet reconciles to income statement
- Cash in balance sheet reconciles to cash flows
- Debt reconciles to cash flows
- The sum of all the capex workings ties into financials
- Sufficient capex, depreciation and book value inputs have been used to drive all forecasts
- The return on capital has grown from x% to y% over the forecast period – is this justifiable?
- Operating cash flow to sales moves from the current x% to y% in the final forecast period – is this justifiable?
- Capex/depreciation is x in the final forecast period – is this justifiable?
- Capex to sales growth moves from the current x% to y% in the final forecast period – is this justifiable?

### Financing

- Sources of funds equal uses of funds
- Debt schedules are working
- Senior A has been repaid by the end of its term
- Senior B (Senior C etc) has been repaid by the end of its term

- Maximum revolver drawdown - um (and date)
- Equity proportion – can this be justified?
- Minimum EBITDA / Net total cash interest (and date) – is this sensible?
- Minimum EBITDA - Capex / Net total cash interest (and date) – is this sensible?
- Maximum Senior debt / EBITDA (and date) – is this sensible?
- Maximum Total debt / EBITDA (and date) – is this sensible?
- Minimum Fixed charge cover (and date) – is this sensible?

### **LBO returns**

- Equity IRR is x% below the hurdle rate
- Equity cash on cash multiple is x% below the hurdle rate
- Exit multiple same as entry multiple
- DCF value is x% bigger than offer value
- Equity value creation can be reconciled to drivers of value
- Chart of equity value creation bridge matches the total value created

### **DCF**

- Does the present value of the visible cash flows cover the current net debt?
- Terminal value is x% of total implied EV – is this justifiable?
- Return on capital in terminal year is x% – is this justifiable?
- Cash flow growth in terminal year is x% – is this justifiable?
- Implied growth (using Gordon's (rb) Growth Model) in terminal year is x% bigger than the y% used in the model
- EBITDA multiple implied in the terminal value is x – does this tie in with peer multiples?
- WACC of x% – is this justifiable?

### **Sensitivities / pivot tables**

- The sensitivity table outputs match the model outputs

- F9 needs to be pressed to update the tables
- The pivot tables must be refreshed

### Inputs & assumptions

Keeping all of the inputs and assumptions (i.e. the model drivers) in one place is an essential element to any model. The user needs to be confident that he or she can control the model from this single assumptions section. Having inputs dotted throughout the model adds to the complexity of using and reviewing the model.

Additionally, there are some Excel tools which require like items to be grouped on the same sheet. The most common of these is the Data Table which is used to check the sensitivities of key assumptions to key outputs. Data Tables can only be created on the same sheet as the assumptions.

The exception to this idea of keeping all of the inputs in one place is historic (financial) figures. Although inputs should go on the inputs page, historic financials are facts rather than assumptions driving future value, and so it is reasonable to put them on the appropriate sheets (e.g. P&L historics on P&L sheet).

### ***Control panel***

Having a separate assumptions sheet (or sheets) is good discipline in any model and a logical development is to integrate a control panel into it.

A control panel is simply an area of the assumptions sheet (or sheets) where all of the switches, list boxes and other controls which are used to select scenarios and pick particular calculation bases are placed.

It is not unusual for some of the key outputs from the model to be linked back to the control panel area, so that the impact of changing switches or scenarios can be seen immediately.

The fundamental design issue here is that once the model is built, it needs to be easy to use, and that means that it must be easy to input data and to see the results changing as this is done.

The following is an example of a control panel on an assumptions sheet from a simple model (no outputs are linked to this control panel in the illustration):

Model OK		2001	2002	2003	2004	2005	2006	2007
Year Ending								
<b>3.0 Debt Financing</b>								
Funding - debt to total asset ratio		40.0%	DebtRatioIn					
Interest rate - senior debt		7.00%	InterestRateIn					
Senior debt term (years)	1	20.0	DebtTermIn					
20 year annuity repayment	7							
20 year annuity repayment	13,480,943.6		975,717.0	1,044,017.2	1,117,098.4	1,195,295.3	1,278,966.0	1,368,493.6
10 Year Bullet	40,000,000.0							
10 year amortising	40,000,000.0		1,540,910.3	1,049,092.3	2,218,910.8	2,662,693.0	3,195,231.5	3,834,277.9
Blank 1								
Blank 2								
<b>4.0 Equity Financing Assumptions (see 7.0 for subscription amount)</b>								
Dividend payout as % of maximum		45.0%	DiviPayoutIn					
Equity discount rate		13.00%	EquityDiscRateIn					
<b>5.0 Tax Assumptions</b>								
Tax rate		30.0%	30.0%	30.0%	30.0%	30.0%	30.0%	30.0%
<b>6.0 Valuation Assumptions</b>								
EBITDA exit multiple (ii)		7.00	ExitMultipleIn					
Growth in perpetuity		3.00%	Growth					
Terminal year		2011	TerminalYear					
EBITDA/Perpetuity switch	TRUE	<input checked="" type="checkbox"/>	EBITDA exit multiple					
<b>7.0 Acquisition Sources and Uses - Financing Inputs</b>								
Sources								
Initial Debt Financing		40,000,000						
Initial Equity Subscription		60,000,000						

In this case there are relatively few controls as the model is quite simple – there is a scenario selector for the debt structure and a switch to allow the valuation basis to be changed from EBITDA multiple to perpetuity.

### Workings

The workings (like the outputs) are merely calculations based on the inputs and other workings. Inputs from the input sheet are brought through to the workings sheet using link formulae. Workings are most easily built up on a modular basis and for navigation purposes it is easier if each module is located on a separate sheet. For example, capital expenditure, depreciation and book value calculations are inter-dependent and should, therefore, be together on one sheet.

### ***Outputs***

Depending on the size of the model, the outputs may be the same as the workings or, more often, a summary of the workings (and inputs). Here, format matters.

- Outputs should require little calculation other than totals
- The most important figures (e.g. debt service coverage, NPV etc.) should be formatted to give them the importance they deserve
- Pictures speak a thousand words – diagrams and charts often clarify the results and flows better than pure numbers
- Text strings may be useful to put the output numbers into meaningful sentences.

## Referencing

### **Relative vs. absolute references**

Excel calculates in terms of the relative position of an item – i.e. cell C4 is 3 columns and 4 rows into the sheet. Fortunately, to ease interpretation, the references in Excel use the column letter and row number address (i.e. C4).

	A	B	C	D	E
1	147	852	654		
2	741	951	357		
3	753	258	456		
4					
5					
6					
7					

If we placed the formula '=A1' in cell C4 this is interpreted by Excel as entering the value from 3 cells above and 2 columns to the left, i.e. 147 from cell A1 in the above spreadsheet.

If we copy the formula in C4 to:

- D4, we are still trying to pick up the value from 3 cells above and 2 columns to the left (of D4 this time) – i.e. 852 from B1
- C6, we are still trying to pick up the value from 3 cells above and 2 columns to the left (of C6 this time) – i.e. 753 from A3.

By default Excel works in this relative way.

### **F4 – absolute referencing**

'Dollarising' the cell reference in a formula (press F4 whilst the cell reference is input or edited) will add dollars to a reference. If we placed the formula “=\$A\$1” in cell C4 this fixes the address as always column A and always row 1. This is still interpreted by Excel as the 147 from cell A1.

However, if we copy the formula in C4 to:

- D4, we are still trying to pick up the value from column A and row 1 – i.e. 147
- C6, we are still trying to pick up the value from column A and row 1 – i.e. 147.

Alternatively we can partly dollarise or fix the reference. When entering or editing a formula, pressing F4 repeatedly will toggle through the fixing options.

- \$A1 fixes the column A with the row number remaining relative
- A\$1 fixes the row 1 with the column remaining relative.

A rule of thumb: when trying to fix a reference to a cell which is

- To the side of the formula – the \$ is to the side
- Above or below the formula – the \$ is in the middle.

### **Naming (cells & ranges)**

Cells and ranges can be named – that is, they can be referenced in terms of a name rather than its column and row position within the model.

A name may only be defined once per sheet – i.e. the name relates to a unique cell or range on that sheet. However, the same name can be defined across different sheets, e.g. 3 different cells named TaxRate can be created as cell E30 on Sheet 1; as E45 on Sheet 2; and as F10 on Sheet 5.

F3 is the function key which triggers most of the functionality, i.e. the third function key. This implies that Microsoft believes that the use of names is the third most important function to the smooth running of Excel, behind only Help and formula editing (F1 and F2 respectively).

### **Why name?**

#### **1. Clarity and speed**

Using the F4 dollarising option is quick and widely understood and so has its advantages. However, where the cell or cell-range is to be used in calculations:

- On a number of occasions

- At a distance from where it is situated
- On different sheets
- In different models
- As part of a complex formula or function
- Within a macro

then naming the cell or cell-range is a better solution. Applying a name to a cell or range can make model construction and review quicker and easier.

## 2. Auditing

As will be covered later, all the auditing tools work in exactly the same way for both cell references and names. However, if names are used then additional auditing approaches can be introduced.

## 3. Functionality

Additionally, Excel was created with the intention that names would be used. Consequently, some functions require the use of names, particularly across sheets (e.g. conditional formatting and data validation).

## 4. Geographic precisions

Some modellers prefer the geographic precision of the cell reference. There is no dispute over Inputs!D2. However, most of the time, it is what the cell contains rather than where it is, that is more important.

### *Creating names*

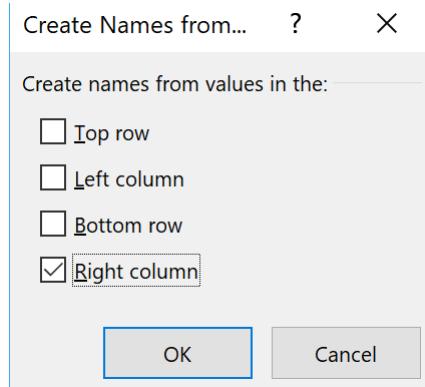
There are a number of ways to name cells or ranges. The following are the two most widely used.

#### 1. Insert; Name; Create

The Name Create command uses labels at the end of a range, or beside a cell, to name the range or cell respectively. By using this standard referencing approach and formatting these labels (red, italic) the named cells and ranges are clearly identified.

This can be automated:

1. Type the name to the right of the cell or range to be named
2. Highlight the cell containing the name that has just been typed in
3. Control+Shift+← this will highlight all the cells, which may just be one, with contents to the left which require naming
4. Control+Shift+F3 – should see the following dialogue box:



5. Check the Right column box (Excel may have already checked it)
6. Press Return.

The real value of this function is that all of the row ranges in a sheet can be named simultaneously by highlighting all required ranges or cells and the cells containing their names and then following the above steps.

If the name is typed to the Right of the cell or range, ensure only Right column is checked.

## 2. Quick and dirty

1. Highlight the range or cell to be named
2. Click in the name box at the top left
3. Type in the name (with no spaces)
4. Press Return.

To check the name just click on the down arrow by the name box and the names which have been defined in the model will be listed.

Name box

IS Assump									
A	B	C	D	J	K	L	M	N	O
1									
2									
3									
4									
5									
25	Company XYZ								
26	Income Statement Assumptions								
27	Avg Life on CAPEX		Actual Dec-14		Dec-15	Dec-16	Estimate Dec-17	Dec-18	Dec-19
28	Avg Life of Acq Assets				9	9	9	9	9
29	Amort Life of Goodwill				0	0	0	0	0
30	A/P Days		26		30	30	30	30	30
31	Accrued - % of Sales		2.4%		2.5%	2.5%	2.5%	2.5%	2.5%
32	Other Liab - % of Sales		1.6%		1.5%	1.5%	1.5%	1.5%	1.5%
33	Capital Structure								
34	Debt			30%					
35	Equity				70%				
36									
37									
38									
39									
40									
41									

This is the range  
which will be called  
"IS Assump"

The Ctrl+Shift+F3 method has a formality to the method (so reducing modeling errors) and visibly identifies the named cells and ranges immediately to the right (so helping use and review). However it cannot be used for two-dimensional ranges, which is where this second method proves useful.

### ***Changing or "stretching" a range which has already got a name***

Where a row of data for a number of periods is to be named, leave a blank cell between the data and the name and follow the Ctrl+Shift+F3 naming procedure. This allows additional periods to be added (as per best practice model set-up procedures) with the named range automatically extending as new periods are inserted.

However, it is not unusual to want to extend a range after it has already been created. If the above has not been done or a two-dimensional data range is to be changed, the only practical way to do this, without deleting the name and recreating it, is as follows:

- Ctrl+F3
- Select the name from the list which you want to attach to the new or stretched range
- Press the browse button. Excel will display and highlight the range that is attached to the name. Now click and drag to

highlight the new range you want to attach. Press the finish selection button, you will now return to the Define Name dialogue box

- Click on the Add button. This overwrites the old definition of the name and range with the new one you have just selected.

### ***Using names***

Names can be used in formulae in the same way as other references. To use a name in a formula:

- Click on the named cell; or
- Type in the name (it is not case sensitive); or
- Press F3 and the names listed alphabetically will be available for selection. As the list of names can be quite long, the initial few letters of the name can be typed in to enable more rapid scrolling through the list.

When a cell name is used, it is used as an absolute reference – as if it were fully dollarised.

When a range name relating to a row of data is used in a particular cell, the data within the range which is in the same column as the particular cell will be returned.

For example, if the range named “Sales” is defined on Sheet1 as E6:N6 and if the formula in cell G72 on any sheet is “=Sales”, the value returned will be that from column G in the named range (i.e. cell G6 on Sheet1). If the formula is in a cell which does not have a corresponding name in the same column, the result is #VALUE.

Note, only those ranges which will be used extensively elsewhere on the model have been named. These cells are easy to review due to the use of names.

### ***Pasting the list of names***

This feature is used to create a checklist of all the names and the number of names used within the model by listing the names and their location.

Select the place where the first name is to be listed and then

- Formulas; Use in Formula; Paste names

The names will be in the first column and the location will be in the next column.

### ***Applying names***

It is undoubtedly quicker to write some formulae using cell references and it would be laborious to then rewrite the formula using the appropriate names. Instead, the Insert; Name; Apply commands can be used. Excel will scan through the worksheet and identify any cell references that correspond to named ranges and convert the reference to the name. When using this command, Excel has automatically selected one or more names. This is because Excel remembers the last names that have been created.

### ***Deleting names***

Good practice suggests that misspelled or redundant names should be deleted at the earliest opportunity. Control+F3 is the only way to delete range names.

If the deleted name has already been used in a formula the #NAME? error value appears. To correct this problem use Home; Find&Select; Replace (Control+H) to substitute a new or corrected name for the deleted name.

***When to use a name******Naming rules******Do not name everything***

Despite all the advantages of naming cells and ranges, too many names cloud the model (a list of 237 names is not easy to use or review).

Only name those cells or ranges which will be used extensively and at some distance from their current location – be systematic but not out of control.

***Range names – all sheets must be consistent***

If rows of data are named, Excel interprets the reference in subsequent formulae in relation to the columns. As seen, if the range named "Sales" is defined on Sheet1 as E6:N6 and if the formula in cell G72 on any sheet is "=Sales", the value in this cell will be that from column G in the named range (i.e. cell G6 on Sheet1).

Where range names are used, all sheets must be consistent – column G in the source sheet must relate to the same time period, for example, as on the target sheet.

If new columns are to be added on any sheet, then they must be added to all sheets in order to allow named ranges to be used.

***Naming conventions***

- The name labels should be formatted as Red and Italic and should lie directly to the right of the cell or range to which it relates
- The shorter the name the better – as long as it is understandable to the user and reviewer
- Avoid spaces – Excel will interpret these as "\_" making unwieldy names such as Costs\_gas\_in rather than the more refined CostsGasIn (i.e. capital letters can be used to separate words instead)
- CostsGas, PriceGas, DepnTax, etc. – i.e. begin name by category or by most important word first for ease of use later

- CostsTot is better than TotCosts – otherwise searching for total costs may require trawling through 30 names in the list starting with total
- WkCapIncr is better than WkCapChange – it is easier to understand the sign convention: a positive number must be an increase
- Those on the inputs page should end with “In”, e.g. CostsGasIn, PriceGasIn, etc. for ease of review
- Names must be unique. If a name is created that already exists on the same sheet Excel will prompt and offer the choice of going ahead with a new name and eliminating the earlier definition or to stop and set up an alternative name for the current range.

### **Do not over-engineer**

A name should be used in a formula when it is helpful and not too onerous to do so.

- For example, if sales is calculated as a function of three names and EBITDA is calculated as a (named) percentage of sales, it would be over-engineered to calculate the EBITDA based on four names rather than the more straightforward named percentage % (the previously calculated) sales.

Subtotals on workings and outputs can be calculated in two ways – by reference to a (possibly named) cell elsewhere in the model or by summing the nearby cells.

The latter method is the preferred route as this checks that the current region is populated with only appropriate values – particularly important on outputs.

- For example, if EBITDA has been calculated in a working (as above) and is then used as part of the income statement – the EBITDA on the income statement should be re-calculated using the details on the income statement (sales less costs) rather than referred back to the original working.

### **The MAX MIN issue**

When the MAX and MIN functions are being used with named ranges, the maximum (or minimum) number in the range is returned rather than those relative to the column in which we

are interested. This is avoided by including a + sign in front of the named range when coding the formula. For example:

=MAX(+PAT,+RetainedProfits)

### **Copying to other models**

As long as the inputs to the tax sheet, for example, are defined in the destination model (i.e. using the same names) then the tax workings sheet can be easily inserted into the destination model.

- Click right mouse button on the tax sheet's tab in the source model
- Move or Copy
- Define the destination model
- Check the copy box.

This can be useful, but can also cause problems if there is not complete rigour in naming – the more rigour incorporated in naming and model set-up, the easier the copying of modules between models.

### ***Transpose***

Occasionally numbers appear horizontally in a row when it would be useful to have them vertically in a column or vice versa.

If these are numbers (rather than formulae), then the solution is straightforward:

- Copy the relevant range
- Go to the first of the cells where the range is to be copied to
- Home, Paste Special, Transpose.

The transpose function can be combined with other functions in paste special.

More likely, the range to be transposed is made up of formulae.

The paste special transpose will only be suitable if all formulae contain only constants and absolute references (i.e. named cells or cells of the type \$D\$4). Where more complex formulae

exist which have relative references, the TRANSPOSE function can be used.

For example, it would be useful to show the formulae from the range D3:J3 vertically in D10:D16:

- Count the numbers of cells in the range to be copied (7)
- Select the cells in the range to be copied to (D10:D16)
- Type: =TRANSPOSE(D3:J3)
- Press Control+Shift+Enter.

By pressing Control+Shift+Enter, an array has been created (as shown by the { } around the equation). Deleting the whole array rather than any one individual cell is the only way to modify this.

## Formatting

Some formats and formatting conventions (for example, outputs) will be pre-defined to adhere to corporate templates which will have their own logic. The more logical and consistent the formats, the easier the model is to use and review.

### ***Sign convention***

Choose a sign convention, stick with it and explain it.

Negatives are difficult to work with and it may be easier to avoid them.

All inputs and workings should therefore be positive, unless they are unusual.

For example, interest in the income statement is mostly an expense but should be entered and calculated as a positive. To ensure that this is clearly understood it is necessary to describe the line as "Net interest expense (income)". In this way, the user of the model understands that a positive number refers to an expense whilst a negative implies net interest income.

The downside to this is that users misunderstand the sign convention (through not reading the description carefully) and the simple =Sum() calculations may not be possible. The major advantage is that the logic of the model is uncluttered by thoughts of sign convention – everything is positive.

### ***The exceptions***

- Outputs

This may be governed by the corporate style rules. Ordinarily the sign convention on the outputs is the one which is most easily understood by the reviewer. If it is easier to understand an income statement if expenses are negatives, then expenses should be negatives.

- Specifics

Some workings, for example cash flows, may be easier to work with if the sign convention follows the cash flows. An increase in working capital will reduce cash flow – trying to explain this in words as "Decrease (increase) in working capital" may prove cumbersome whereas having the increase as a negative (and

all other cash flows following this convention) is likely to be easier.

### **Colors, size and number formats**

#### **Text & data**

Feature	Setting	Justification
Size	Default – probably 8 point  Change the view settings if this is too small on the screen  Anything smaller than 8 point will default to Times New Roman when pasted into other applications	If elements are to be pasted into other applications such as PowerPoint, it is easier to expand than contract the selection once it is in PowerPoint.  For example, a sheet using 14 point when pasted into PowerPoint may miss some data. When using 8 point, more data can be trapped (and dragged to expand if needed)
Inputs	Blue text, pale yellow background and underlined	To stand out – underlining stands out even if printed in black and white
Names	Red and italic	To stand out
Workings sheets	Different backgrounds to highlight different sections and summaries	To help navigation
Totals, sub-totals	Bold, italic, borders – use sparingly	Used to emphasise

Headings & outputs	To highlight key rows, columns and cells	Format is a personal / corporate decision
Everything else	Default settings	So that all outputs and inputs stand out

### Numbers

Number	Format	Comments
Decimal points & commas	12,345.6	Align with negatives
Negatives	(12,345.6)	Bracket (parenthesis) stands out more than a minus sign
Zeros	-	Stands out more in a list of figures than 0.0  Unfortunately, rounding errors will still appear as 0.0 which may be misleading
Thousands & millions	May take out the 000s and millions	In the <i>outputs</i> only

### Formatting numbers

To format the numbers:

- Select the range to be formatted
- Format; Cells; Custom; or
- Control-1; Custom and press Alt-T into the type box.

The sections, separated by semi-colons, define the formats (in order) for:

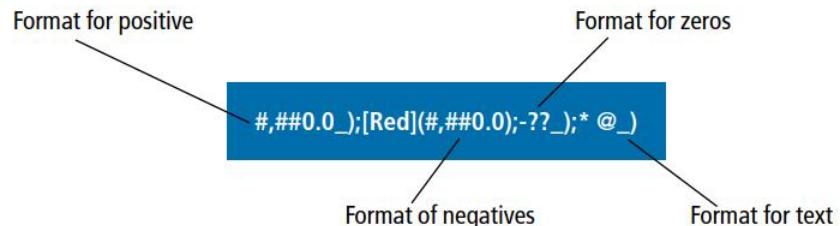
1. Positive numbers

2. Negative numbers

## 3. Zero values

## 4. Text.

If you specify less than 4 sections then the text will have a standard format. e.g.



# displays only significant digits; does not display insignificant zeros.

0 displays insignificant zeros if a number has fewer digits than there are zeros in the format. [the above would show 1234.56 as 1,234.6; .123456 as 0.1; and 0.0 as -]

,

adds a comma to separate 000s.

Additionally, it can scale a number by a multiple of one thousand (useful for the output sheets)

e.g. 1234567890 as 1,234,567,890.0      #,##0.0

1234567890 as 1,234,567.9      #,##0.0,

1234567890 as 1,234.6      #,##0.0,,

1234567890 as 1,234.6m      #,##0.0,"m"

- aligns the numbers with the character following the underscore. For example, when an underscore is followed by a closing parenthesis "\_)", positive numbers line up correctly with negative numbers that are enclosed in parentheses.

? adds a space a character wide, used to indent (normally from the right)

\* put at the front, a format will add the next character to fill the cell.

e.g. 123 as -----123.0      \*-0.0

[Red] also available in black, blue, cyan, green, magenta, white and yellow. Only used for outputs as may undermine default color conventions.

@ used to denote text. The default alignment for text is left. However, it can be right aligned to match with numbers) if the following reference is used after the third semi-colon.

\*@\_)

The following is the normal format used at CTG:

#,##0\_);(#,##0);--\_)

(See later for date formats.)

### ***Numbers (with text for presentation)***

Sometimes it is useful for a number to be followed by the units, e.g. p, years, cents, x.

For example, if an input in a model is the number of years on which a valuation is to be based, the number of years can be entered, say 7, and it will appear in the cell as '7 years'.

As before, select the area to be formatted, Control+1; Custom, choose the number format (e.g. 0) and then leave a space followed by "years" – i.e.

0 "years"

Combined with knowledge of other number formatting rules, this can be very useful as custom formatting can be used as a basic type of conditional formatting.

For example, if a company has a price per share of 36.50 and an earnings per share of -1.25 and 3.30 in years 1 and 2 respectively, its P/E ratio (price ÷ earnings) can be easily calculated.

The results are -29.2 and 11.0606 for years 1 and 2 respectively. The result in year 2 should appear as 11.1x (format "0.0x"), whilst that for year 1 is not meaningful or "nm" – all negative results from such an equation are not meaningful.

Armed with this the following number format can be applied to the P/E cells:

0.0x;"nm "\_x

Note that the "nm " has a space the width of a x at the end to align it with the positive.

### **White text**

It will often be necessary to use white text where certain cells are not to be part of the presentation. Not only can this be done using conditional formatting, where data is to be hidden on the output pages if certain conditions are fulfilled (i.e. through conditional formatting), but also there will be cells used as counters (maybe linked to switches or as part of VLOOKUP or INDEX) which you do not want to be part of any presentation. For these cells select the white font.

The main problem now is that with a white background, these cells cannot be seen. It is therefore recommended that the background be altered to grey:

– see Excel set-up earlier in the notes.

### **Styles**

The use of styles within Excel, as within Word, enables quick and easy changing of all the formats within the whole model. Headings, dates, subtotals, percentages and others can be selected (and globally modified) quickly.

At set-up it is worth defining the styles (i.e. the formats) that may be used in the current model – consequently, formatting need only be done once and then quickly and easily applied elsewhere.

For example, it is often worth having the font size as 8 pt for easy transfer to presentations. By defining styles up front the default can be changed for the whole model.

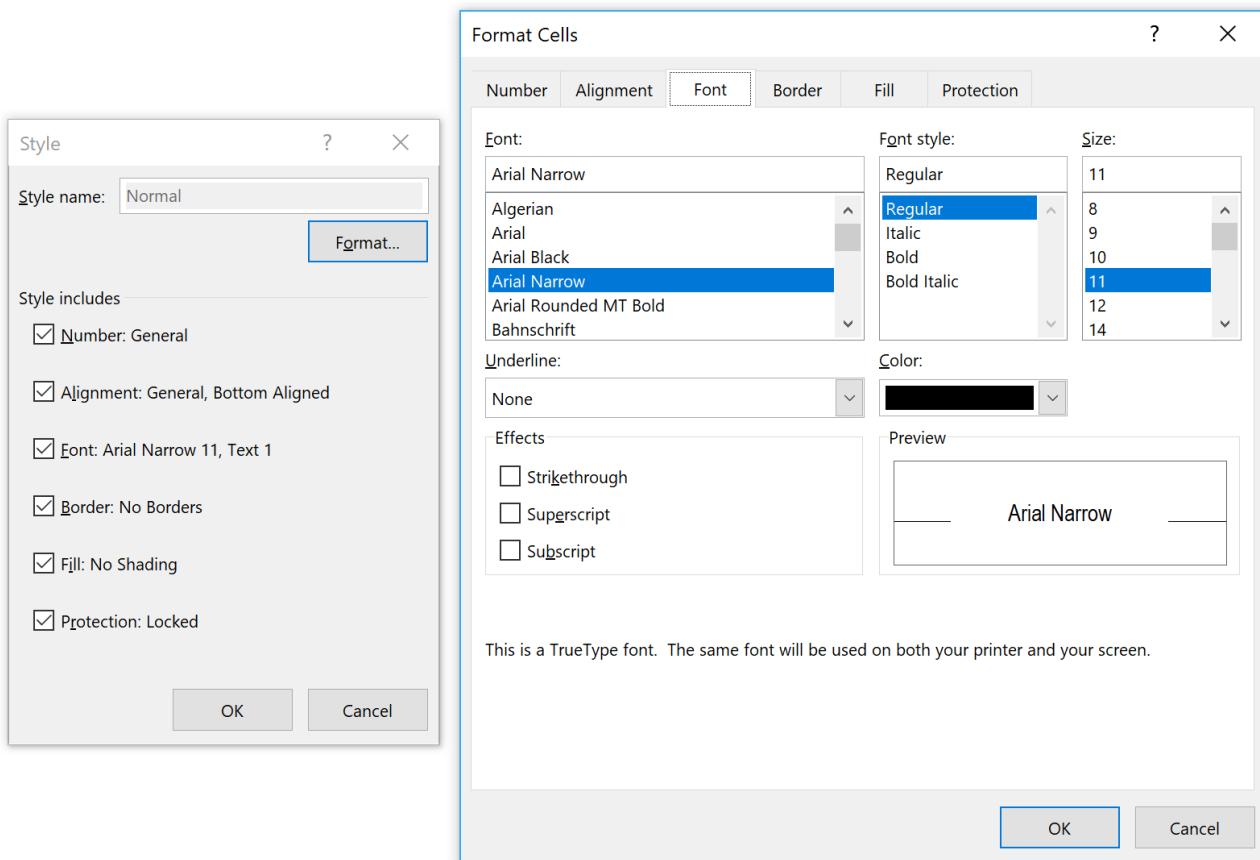
As within Word, to apply a defined style – use the styles drop-down box for the selected cell(s).

### **Adding styles to the toolbar**

In order to use styles efficiently, add the styles drop-down box to the toolbar – the style in use will then be listed.

The Styles drop-down box can be added by:

- The Style drop-down box is part of the Formats category
- Drag the drop-down box into the toolbar.



Once the drop-down box has been placed in the toolbar it can be accessed by

Alt '

followed by Alt + either the up or down arrow key to scroll through the styles.

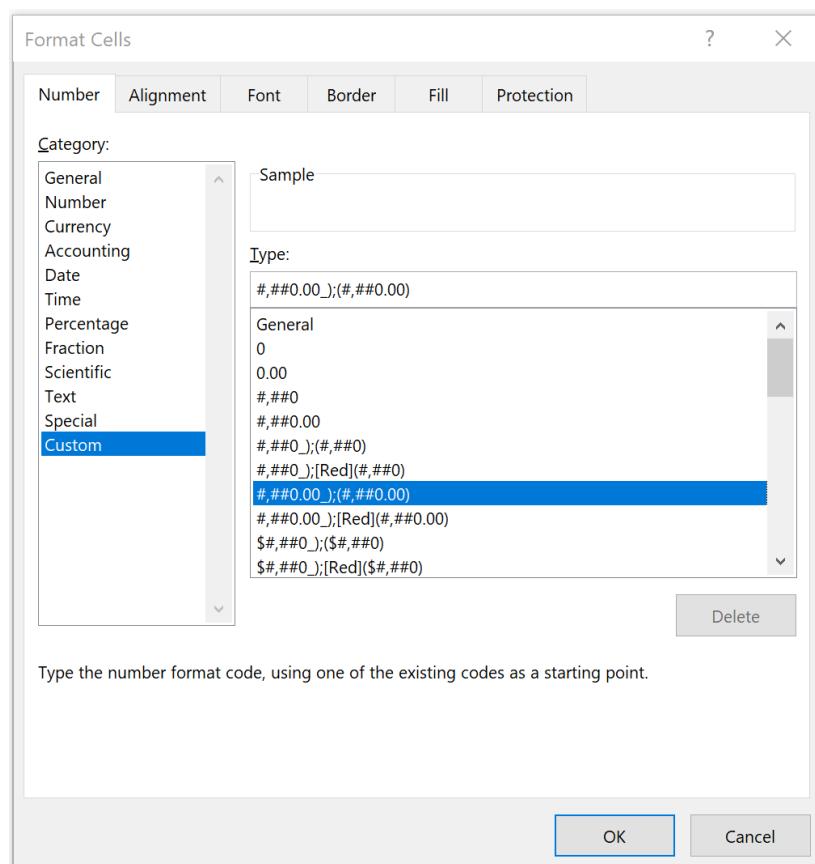
**To change / add a style**

The Comma, Currency and Percent styles exist by default in Excel to support the corresponding toolbar buttons and should not be deleted. Additionally, the default setting for all cells is Normal.

1. To change, for example, Normal:

- Home; Bottom Right Icon of the Number Section ; Custom
- Format, as required, the
  - Number format (e.g. #,##0.0\_);(#,##0.0);-\_)
  - Alignment (e.g. vertically Center (sic) Aligned)
  - Font (e.g. Automatic, Arial 8)
- Select OK.

The formats of all (previously unformatted) cells within the model will change to this new default normal.



2. If you wish to create a format, e.g. dates, to be used as a standard to be applied elsewhere:

- Home; Bottom Right Icon of the Number Section ;  
Date

On any of the tabs in the dialogue box, select the formats you want, and then click OK – e.g. number to custom “dd-mmm-yy” (without the quotation marks) etc.

- To define and apply the style to the selected cells, click OK
- To define the style but not apply it to the selected cell, click Add, and then click Close.

3. If you wish to choose the format of a particular, previously formatted, cell, e.g. a multiple, as a standard to be applied elsewhere:

- Select the cell containing the required format
- In the Style drop down box type in the name – e.g. “Multiple” – and press Enter.

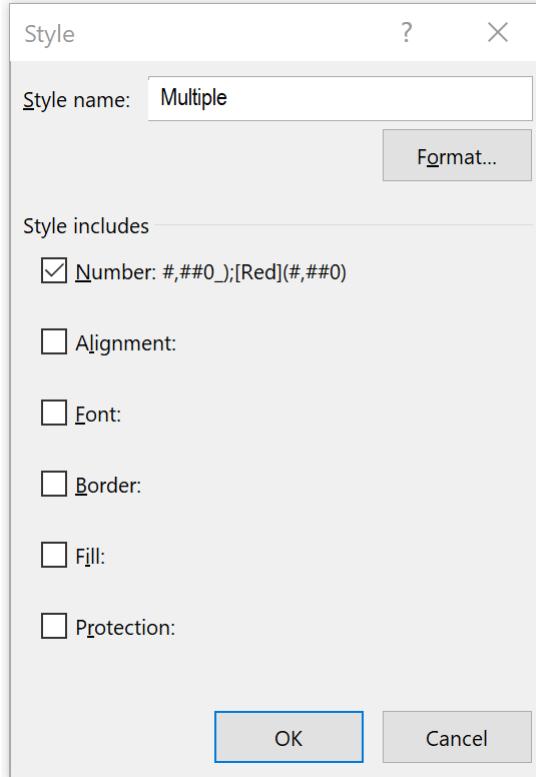
Alternatively:

- Home; Bottom Right Icon of the Number Section ;
- In the Style name box, type a name for the new style – e.g. “Multiple” (without the quotation marks)
- To define the style, click Add, and then click Close.

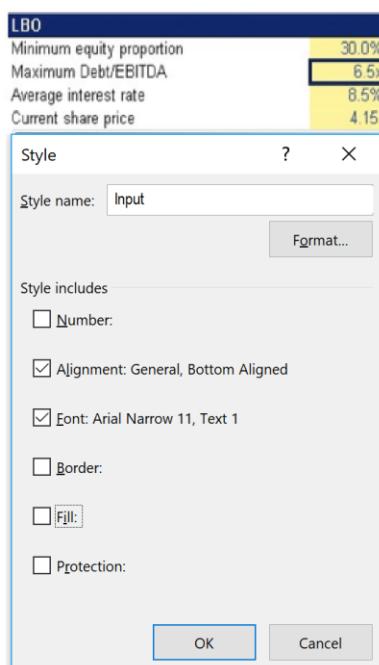
#### **To check the boxes or not**

A cell can have more than one style applied to it. As a result, a cell may have the Dates style applied and then another style laid on top – where there are any conflicts in styles the second style will take precedence.

For example in the following, the Dates style has been defined using only Number format. All other Cell formats in the Dates style have not been defined.



Input cells should be differentiated from calculation cells by format (and protection) and so an input style should be defined. As there are likely to be a number of different input types it is useful to have the common features of an input style superimposed onto other styles. For example, a cell could have both a Multiple and Input format:



As the number format in the Input style is not defined it will follow the previously selected number format for all cells. The components of the Input style which are applied are:

- Font – Blue
- Protection – No protection

As the Multiple and Input styles do not conflict, the cell has both styles applied.

### ***Copy styles from another workbook***

Once the time has been taken to define a set of styles in a model, these can be used as the template for future models.

- Open the workbook that contains the cell styles that you want to copy.
- Open the workbook that you want to copy the styles into.
- On the Home tab, in the Styles group, click Cell Styles.
- Click Merge Styles.
- In the Merge Styles dialog box, in the Merge styles from box, click the workbook that contains the styles that you want to copy, and then click OK.
- If both workbooks contain styles that have identical names, you must indicate whether you want to merge these styles by doing the following:
  - To replace the styles in the active workbook with the copied styles, click Yes.
  - To keep the styles in the active workbook as they are, click No.

### **Color**

Note: the color template used on the source document may be different to that in the destination file – so that when styles are merged, the text, borders and background colors are not as required. To apply the colors from the source document, ensure that both models are open and in the destination model:

- File; Options; Save; Under “Preserve visual appearance of the workbook”; Click “Colors...”

- In the “Copy colors from” box select the workbook that contains the colors to be copied
- OK.

In this way a template model with all necessary styles and colors can be easily created (and updated) for quick merging into all future models.

### ***Conditional formatting***

Conditional formatting applies a defined format to cells which fulfil a condition.

To conditionally format the numbers (for example, where a negative result should not be possible, or should be flagged, or where a balance sheet does not balance)

- Select the range to which the conditional formatting will apply
- Home; Styles; Conditional Formatting.

The more obvious the formatting (size, color etc.) the more useful the result.

There are two condition (logical argument) options:

- Cell Value Is the value of the current cell fulfils the criteria
- Formula Is the result of the formula (which may not refer to the current cell) fulfils the criteria.

Note the format chosen is only applied when the condition is true.

When using multiple conditions it is important to get the sequence right:

- Cell value less than 10 Blue
- Cell value less than 100 Green
- Cell value less than 1,000 Red.

The above sequence gives expected results.

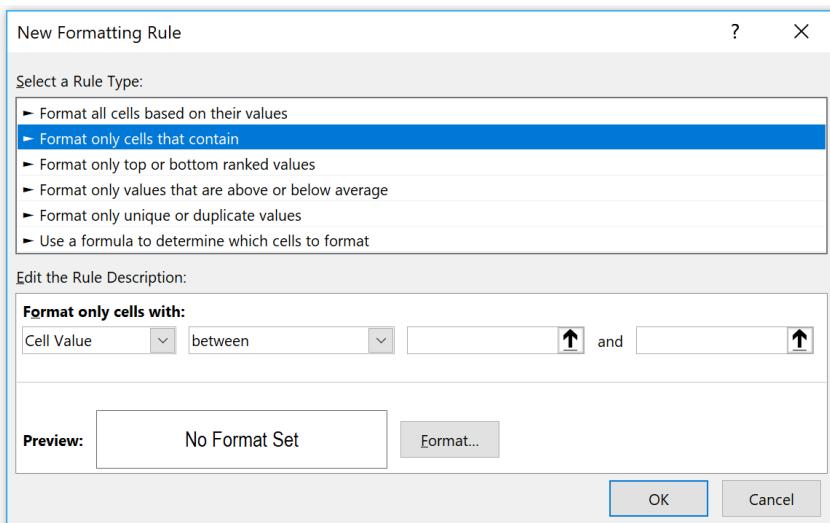
- Cell value less than 1,000 Red
- Cell value less than 100 Green
- Cell value less than 10 Blue.

This sequence gives unexpected results – any value below 1,000 is colored red and the subsequent criteria are not applied.

### **Conditional formatting to hide cells**

There will be occasions where it will be useful for cells to be hidden. For example, if a discounted cash flow (DCF) valuation model has been set up for a maximum of 10 years, but 7 years has been input as the project length (named “length”), from a presentation perspective, it would be good to hide the 3 years which are now not part of the output. (It is assumed that there is appropriate coding to calculate the valuation based on 7 years!).

If the year counters are in row 2 with column D containing the first period, go to Format; Conditional Formatting; enter the appropriate formula (essentially the logical test of an IF statement); then choose Format and select white font and no borders from the menus.



### **Text strings**

Text strings allow phrases, sentences, labels and headings within a model to be automatically updated for changes in assumptions or outputs. For example, it may be useful to have a standard header in B2 with the company name (Bigco defined in cell E5) and currency (um defined in cell E6) – both of which are inputs which may change.

The ampersand [&] is the key to linking different bits of text:  
The formula in B2

=E5&" in "&E6 results in Bigco in **um**

In the above example, there are three bits of text (the company name, the word "in" with spaces around it and the currency) each connected using the ampersand.

#### *The TEXT function*

Text and numbers which use the default format settings can be linked with the use of the ampersand. However, where numbers form part of the text string, they may need to be formatted. This is when the TEXT function needs to be added to the text string.

For instance, a model may be titled "Year ended 31 December 2006". Assumptions within the model may change the year-end which has been defined in cell G4. Without a text string, whenever the date in G4 changes the model will have to be updated cell by cell, a tedious task!

Alternatively, the text can be coded as:

= "Year ended "&TEXT(G4,"dd mmmm yyyy").

The TEXT function picks up cell G4 (assumed to contain the year-end information) and then formats the number contained within this cell into the date format dd mmmm yyyy (which must be put within quotation marks).

Similar things can be done for multiples [=TEXT(G6,"0.0x;"nm"")] and percentages [=TEXT(G7,"0.0%;(0.0%)")] etc. Note that where more than one format is to be chosen in a TEXT function (for positives and negatives), they must be separated by a semi-colon within the format text part of the function.

#### **Regional settings**

To change / view the profile for regional settings:

Start; Settings; Control Panel; Regional and language options; Regional options

This is a profile setting rather than merely an Excel setting – it has applicability across all applications.

Often there are company policies on regional settings – all staff in all locations have the same regional setting, e.g. English (United States). However, it may be useful from time to time to alter this for local language, currency and formatting idiosyncrasies.

Where a cell is formatted using the number formats and the users regional settings are English (United Kingdom) then the language (d for day, m for month, etc.) and settings (e.g. commas as thousand dividers, etc.) will be used. If the model is then passed onto someone with a French (France) regional setting, then the language (j for day, m for month, etc.) and settings (space as thousand dividers, etc.) will automatically update even if formats have been customised.

However, the regional settings do not update the formats contained within a TEXT function. The result is that Excel is unable to interpret the TEXT function. Care must be taken when using the TEXT function if it is likely that a model will be accessed by users with different regional settings.

## IF and some other logical functions

When writing functions into the spreadsheet it can be difficult to remember the sequence of arguments. Shift+F3 can be used to bring up the paste function dialogue box or Control+A brings up the function window once the function name has been typed.

A fundamental function to add flexibility to models is the IF statement. IF can most simply be thought of as a switch. Excel carries out a test and depending on the result chooses between two answers, TRUE and FALSE.

The syntax of an IF statement is as follows:

=IF(logical\_test,value\_if\_true,value\_if\_false)

Excel evaluates the test and if it is true it returns the value\_if\_true, otherwise it returns the value\_if\_false. The following extract shows a simple example:

D53	B	D	E	F	G
1					
2	Classical cashflow analysis of ICI		2001	2000	
43	2.0 ICI EBITDA based ratios				
44		Ebitda/Sales	12.2%	10.9%	
45		Continued EBITDA/Continued sales	11.0%	11.1%	
46		Continued EBITDA/Interest	3.4	3.1	
47		EBITDA/Interest	3.8	3.7	
48		Net Debt/EBITDA	3.7	3.3	
49		Net Debt (continuing EBITDA)	4.1	3.9	
50		EV/EBITDA	6.8	7.7	
51		EV/Continuing EBITDA	7.5	9.1	
52		EV/Sales	83%	83%	
53		In breach of covenant	Ok		
54					
55					

The formula in the formula bar at the top has been copied across the row:  
 The result of D48 is greater than 3.5 and so the result of the test is TRUE:  
 Excel therefore returns "in breach of covenant". The ratio in E48 is less  
 than 3.5, and so the result of the test is FALSE. Excel therefore chooses the  
 value\_if\_false, i.e. "OK".

### Logical test

Any formula or cell result which yields TRUE or FALSE is a test. When the test is in the form of a formula, Excel evaluates it and produces the result TRUE or FALSE.

There are a number of "operators" that can be used to create different logical tests:

= Equals

>	Greater than
<	Less than
>=	Greater than or equal to
<=	Less than or equal to
<>	Not equal to

Excel is capable of evaluating logical statements. Try typing in =1=2 and look at the result: the result is FALSE.

The words TRUE and FALSE in Excel have a special status, in that Excel understands them in the same way that it understands a number or a formula. Excel also understands TRUE as the number 1 and FALSE as

a zero. In the above =1=2 equation, the result of this cell could either be regarded as FALSE or 0 for further calculations.

If the formula is rewritten:

= $(1=2)+0$

Excel will return a 0, 0 is FALSE (1 being TRUE). The addition of the zero forces Excel to return the value of the logical operator.

### ***Value arguments***

The arguments value\_if\_true and value\_if\_false can be given any of a number of different types of statements, for example:

1. Numbers – commonly 0 and 1 for use in flags.

2. Formulae – for example

=IF((C5/C17)>=3.75,C5/C17,"N/A")

Note: it is not necessary to put an equals sign immediately before the logical test formula (C5/C17)>=3.75, nor before the value\_if\_true argument formula C5/C17.

3. Comments or “labels” – the label N/A is enclosed in inverted commas. If not in inverted commas, Excel will try to interpret the message as one of the following: a formula name; the name of a range; the address of a cell; or a logical value such as TRUE or FALSE. N/A is none of these and the formula will produce an error when Excel tries to return this as a result.

## **Common problems with IF statements and some simple solutions**

### **Using equals in a test**

1. Although IFs are very useful, they can easily break down. If we are testing for a particular numerical value from a formula, =0 can give spurious results because Excel shortens decimals to store them and therefore cannot calculate exactly.

As a result of Excel's rounding, a formula which logically should give exactly zero as a result will often give a very small number, typically of approximately 0.000000000001 in value. This problem can easily be solved by using an AND statement to test if a number is nearly zero, i.e.

=IF(AND(cell<0.001,cell>-0.001),"Effectively zero","Not zero")

Alternatively one of Excel's rounding or other functions, such as ROUND(), ROUNDDOWN() or ABS() can be used instead.

=IF(ABS(cell)>0.001, "Not zero", "Effectively zero")

2. Another potential problem in using equals is where the IF statement refers to a user input; for example where the user has to type "yes" or "no" into a cell and then using IF to switch to the relevant formula.

Simple typing errors can cause big problems here: a typo in the cell entry will result in the second choice, i.e. the value if false being selected in error. This is a particularly insidious type of mistake because it will usually not result in an error message, but the wrong data or a wrong calculation being used in the model.

Using data validation to limit data entry into the 'switch' input cell, so only the specific alternatives (for example, "yes" or "no") can be selected, will solve this problem.

### **Checks**

Checks are commonly used to indicate when errors have occurred. For example, the difference between the top-half and the bottom half of the balance sheet should indicate whether the balance sheet balances. An IF statement can then be used of the type

=IF(difference=0, "BS OK", "Balance sheet OFF")

Due to Excel's occasional rounding problems, the error message may result even when the balance sheet does balance.

By understanding the imperfections in Excel we can come up with statements such as:

```
=IF(difference>0.0001, "Balance sheet OFF", "BS OK")
```

But this doesn't solve the problem if the difference is a negative number. Consequently, most check digits should be made absolute (typically we don't care whether the check is positive or number, we merely care that it exists) so that the conditional statement is, therefore, easier to solve:

```
=IF(ABS(difference)>0.0001, "Balance sheet OFF", "BS OK")
```

### **The AND and OR Statements**

Suppose we want to choose an option if two tests are passed. To deal with these more complex problems there are two other useful tools, the AND and OR function. These functions are often used as the logical test of IF statements. The syntax of an AND statement is as follows:

```
=AND(test1,test2, test3....testn)
```

In the case of the AND statement, Excel evaluates all of the tests in the formula (and there may be up to 30 of these) to see if they are TRUE or FALSE. If they are all TRUE, then the AND statement will give TRUE as a result. Otherwise it will give a FALSE.

In the following illustration, €45m of debt is raised (DebtInitialIn) on 31

December 2005 and then is to be repaid following a 2 year grace period (DebtGraceIn) over the remaining 5 years of its 7 year term (DebtTermIn).

One solution is to use AND as the logical argument, using the year counters to decide whether it is after 2 years and also within the 7 year period:

	A	B	C	D	E	F	G	H	I	J	K	L	M	N
	1	2	3	4	5	6	7	8	9	10	11	12	13	14
3	Year ending		Dec 2005	Dec 2006	Dec 2007	Dec 2008	Dec 2009	Dec 2010	Dec 2011	Dec 2012	Dec 2013			
4	€		-	1	2	3	4	5	6	7	8			
13	Grace period (years)		2.0	DebtGraceln										
14	Debt term(years)		7.0	DebtTermLn										
15	start of year		-	45,000,000	45,000,000	45,000,000	36,000,000	27,000,000	18,000,000	9,000,000	-			
16	Increases		45,000,000	-	-	-	9,000,000	9,000,000	9,000,000	9,000,000	-			
17	Principal repayment		-	-	-	9,000,000	9,000,000	9,000,000	9,000,000	9,000,000	-			
18	end of year		45,000,000	45,000,000	45,000,000	36,000,000	27,000,000	18,000,000	9,000,000	-				
19														

The syntax of an OR statement is the same:

=OR(test<sub>1</sub>,test<sub>2</sub>, test<sub>3</sub>....test<sub>n</sub>)

In the case of the OR statement, if any of the tests are TRUE, the statement will result in TRUE.

Another solution to the debt problem above is to decide whether the year is within the grace period or after the debt term. If this is the case, no payment is made:

	A	B	C	D	E	F	G	H	I	J	K	L	M	N
	1	2	3	4	5	6	7	8	9	10	11	12	13	14
3	Year ending		Dec 2005	Dec 2006	Dec 2007	Dec 2008	Dec 2009	Dec 2010	Dec 2011	Dec 2012	Dec 2013			
4	€		-	1	2	3	4	5	6	7	8			
13	Grace period (years)		2.0	DebtGraceln										
14	Debt term(years)		7.0	DebtTermLn										
15	start of year		-	45,000,000	45,000,000	45,000,000	36,000,000	27,000,000	18,000,000	9,000,000	-			
16	Increases		45,000,000	-	-	9,000,000	9,000,000	9,000,000	9,000,000	9,000,000	-			
17	Principal repayment		-	-	-	9,000,000	9,000,000	9,000,000	9,000,000	9,000,000	-			
18	end of year		45,000,000	45,000,000	45,000,000	36,000,000	27,000,000	18,000,000	9,000,000	-				
19														

Whether to use AND or OR depends on your thought process.

- If you are an inclusive modeller, then your thought process is to define everything that falls within boundaries – AND is your solution.

In the above illustration, the logical argument is to require all the criteria to be met / to fall within the boundaries.

- If you are an exclusive modeller, then your thought process is to define anything that falls outside boundaries – OR is your solution.

In the above illustration, the logical arguments were written so that if any were outside the limits, then no payment was made and if 'value\_if\_false' was returned, payments were made.

### Nested statements

Excel is a very simple and flexible language and it is very easy to combine formulae to write quite complex programmes in a single cell.

For example, a corporate tax formula:

If we make a loss, we do not pay tax, if we make a profit, then if our profit is less than 300,000, we will have a tax rate of 19%, if we have profit of 300,000 or more, we will be charged at 30%.

This would be written as follows:

Tax charge = IF(profit < 0,0,IF(profit < 300,000,profit \* 19%,profit \* 30%))

Test      Value if true

Value if false

Here the “value if false” of the first IF statement is another IF, and both of the results from the second IF are formulae too.

The main thing to be aware of here is that as the formula gets longer, it becomes harder to work out what the formula is trying to achieve.

## Data retrieval – the LOOKUP school

IF, although perhaps the most useful function for creating flexibility in models, is limited in its applications. If we have a problem involving a selection of possible answers, rather than a simple yes / no, then IF rapidly becomes difficult to use.

Excel will allow us to use a maximum of 7 IFs in a statement. This is very hard work to both code and audit.

The following functions can help resolve this problem.

- CHOOSE
- MATCH
- INDEX
- OFFSET
- VLOOKUP
- HLOOKUP.

They can all be found in Insert; Function; Lookup & Reference. Which function to use depends on:

- The flexibility required
- The way the data is sorted
- The sort of information that needs to be returned.

### **CHOOSE**

A CHOOSE function takes the role of up to 29 embedded IF statements and is used widely in scenario management. It is driven by a selector cell which must be an integer between 1 and 29 and consequently requires references to up to 29 different target cells.

D13	A	B	C	D	E	F	G
	1						
	2			31-Mar			
	3	Sales scenario					
	4	1 Management case		342.0			
	5	2 Base case		330.0			
	6	3 Best case		360.0			
	7	4 Downside case		310.0			
	8	5 Single driver case		275.0			
	9						
	10	Scenario selected		2			
	11						
	12	Income statement					
	13	Sales		=CHOOSE(\$C\$10,D4,D5,D6,D7,D8)			

=CHOOSE (index\_num,value1,value2,...)

In the above illustration, the scenario to be used to drive the income statement sales figure is selected using C10 – known as the index\_num in the CHOOSE function. In order to use CHOOSE, this must be a positive integer (not text) – value of 2 in this case.

The reference of the cell to be used if the selector cell (or index\_num) is 1 is the next argument in the function (value1 – if C10 is 1 this indicates that the first or “Management case” has been chosen and so the 342 in cell D4 should be referenced), and then 2 (second scenario and so D5), etc. up to the number of options (maximum 29, although only 5 used in the above).

The CHOOSE function is easy to use, but requires a significant amount of input – i.e. if 10 options are to be used, then the CHOOSE function requires reference to the selector cell and the cell to be returned for each of these 10 options in the correct order.

This, together with the manual nature of extending the CHOOSE function for, say, adding new scenarios, may cause modeling errors to creep in.

If the user enters an invalid scenario number #VALUE! errors are generated. If the order of the option listed should change or if an option should be added or deleted, the dependent CHOOSE function will need updating. Consequently, where the

data to be selected is large and / or will be extended, then other functions may prove more flexible and robust.

### **MATCH**

MATCH is a much under-used and relatively straightforward function. It returns the relative position of an item in a 1-dimensional data area, i.e. the output is a number referring to the position within a series.

As a result, it is often used to identify coordinates for use in other lookups – namely INDEX, OFFSET, VLOOKUP and HLOOKUP.

	A	B	C	D	E	F	G	H	I	J	K
11	<b>Income statement - monthly</b>		31-Mar	30-Apr	31-May	30-Jun	31-Jul	31-Aug	30-Sep		
12			1	2	3	4	5	6	7		
13	Sales		330	353	357	350	322	274	334		
14											
15	<b>Income statement - periods</b>		30-Jun	31-Dec	30-Jun	31-Dec	30-Jun				
16	Start month		1	5	11	17	23				
17	End month		=MATCH(D15,DateMonthly,0)			22	28				
18											
19	Sales		1,390	2,106	2,254	2,268	2,430				

In the above illustration, the MATCH function is used to indicate the period number in which the semi-annual sales finish. 30 June is the 4th monthly period in the sequence and so the MATCH function is used to calculate this.

The function is of the form:

=MATCH(lookup\_value,lookup\_array,match\_type)

- lookup\_value

The value we want to find the relative position of. This is the semi-annual period end (30 June in cell D15) above.

- lookup\_array

The one-dimensional data area in which the lookup\_value can be found. This area (D11:AE11) has been named DatesMonthly for ease of reference. 30 June appears in cell G11 – the 4th item in the data area.

- match\_type

A key element in many lookup formulae, not just MATCH. The reference 0 has been used above to indicate that only an exact match is possible. If the value in D15 were anything other than a month end (say 28 June) then the MATCH equation

would not be able to find that value in DatesMonthly resulting in #N/A.

The other possibilities for match\_type are 1 or -1. These require the data area (lookup\_array) to be sorted in ascending order or descending order respectively. If match\_type is 1, MATCH finds the largest value that is less than or equal to lookup\_value. If the value in D15 is 28 June then MATCH returns 3: 31 May is the next lowest value. If match\_type is -1, MATCH finds the smallest value that is greater than or equal to lookup\_value. If the value in D15 is 28 June then MATCH returns #N/A: the DatesMonthly are not sorted in descending order.

If this argument is omitted, Excel assumes that the match\_type is 1.

## **INDEX**

The simplest explanation of INDEX is:

=INDEX(range,position)

Range is the area to be looked up. Position is a value corresponding to the location of the value to be returned. Position must be a positive whole number. Position 1 is always the left hand cell in a row, or the top cell in a column.

There are two forms of INDEX:

1. =INDEX(array,row\_num,column\_num)

2. =INDEX(reference,row\_num,column\_num,area\_num)

Both are used to return the contents (or position) of a cell as defined by its coordinates from within a data area (or data areas for the reference version). INDEX is a highly flexible and robust function as long as the coordinates (row and column position) can be identified.

### ***The array version***

=INDEX(array,row\_num,column\_num)

If a data area is 5 rows deep by 6 columns across and we wish to extract the value in the 3rd row and 6th column. The formula becomes: =INDEX ( DataArea, 3, 6)

The row\_num and column\_num are often found by use of the MATCH function. For example, in the following illustration we are trying to find the charge out rate for a director in Hong Kong. The data area has been set up so that it is easy to interpret, using text as row and column headers. Similarly, the way to select the data is based on these headings (selected in cells E14 and E15). Only once these selections of Hong Kong and director have been turned into numbers can we use an INDEX function.

E17								
A	B	C	D	E	F	G	H	I
1	Data grid							
2				Analyst	Associate	VP	Director	MD
3		London	345	690	1,380	2,760	5,529	
4		Paris	293	587	1,173	2,346	4,692	
5		Milan	264	528	1,056	2,111	4,223	
6		New York	373	745	1,490	2,981	5,962	
7		Chicago	317	633	1,267	2,534	5,067	
8		Los Angeles	348	697	1,394	2,787	5,574	
9		Hong Kong	311	621	1,242	2,484	4,968	
10		Singapore	295	590	1,180	2,360	4,720	
11		Tokyo	357	714	1,428	2,857	5,713	
12								
13	Desired number							
14	row selector			Hong Kong	7	=MATCH(E14,C3:C11,0)		
15	column selector			Director	4	=MATCH(E15,D2:H2,0)		
16								
17	Charge out rate				2,484			

## One dimensional data

Often, the trick with such functions is finding a way in which it will help.

The following is an asset schedule for one class of assets which calculates the depreciation charge (in row 13) based on the cumulative cost at the end of the year (in row 9). The key is to ensure that assets which have been fully depreciated drop out of the calculation – which is where row 8 comes in. If the asset life (in E3) was to always stay the same at 4 years, then we could merely link cell J8 to F2. However, to ensure a fully flexible solution the equation in row 8 needs to be flexible also.

									J	K	L	M
AE	C	D	E	F	G	H	I	J	K	L	M	
1	Years		1	2	3	4	5	6	7	8		
2	Capex		436	324	460	540	344	678	876	654		
3	Life		4 years									
4												
5	Cost											
6	Start			436	760	1220	1760	1668	2,022	2,438		
7	Capex			324	460	540	344	678	876	654		
8	Disposal			-	-	-	436	324	460	540		
9	End			436	760	1220	1760	1668	2,022	2,438	2,552	
10												
11	Depreciation											
12	Start				109	299	604	1044	1025	1207	1,356	
13	Charge				190	305	440	417	506	610	638	
14	Disposal				-	-	436	324	460	540		
15	End				109	299	604	1044	1025	1207	1,357	1,454
16												
17	Book value				327	461	616	716	643	816	1,082	1,098
18												

The trick with INDEX, as with many functions, is to know what the answer should be. In cell J8 (in year 6) we want to eliminate the assets acquired in year 2 – the 324. This is the number which appears in the second column of the data area in E2:L2 (named Capex). As we know the coordinates of this within the data area (row number irrelevant as it is a one row data area; and second column) we can use INDEX to pick up the required cell.

Analysing the above formula but ignoring the IF statement:

- array

The data area from which the target value of 324 is to be extracted - E2:L2 (named Capex).

- row\_num

The row number within the data area where the target value of 324 is situated. In the above, the data area (Capex) is a one row array and so it can be ignored.

- column\_num

The column number within the data area where the target value of 324 is situated. In the above, the 324 is in the second column of the data area and so the column number coordinate should be 2. The "J\$1-Life" [6-4] is merely a way of ensuring we have the appropriate column counter as the formula is copied along row 8.

In summary, the formula is:

$$= \text{INDEX}(\text{E2:L2}, \text{leave blank}, 2)$$

which returns the value in the second column of the range contained in E2:L2.

### **The reference version**

=INDEX(reference, row\_num, column\_num, area\_num)

The reference version comes into its own when there are different versions of the same data. It could be that:

- The input assumptions are based on three different options
- There are income statements for 10 different companies / divisions
- There are costing structures for 25 different products; etc.

The key is to ensure that each data area is set up in the same way and that row and column counters are introduced.

In the following illustration, there are operating contribution calculations set out in the same way for each of 4 regions (North, South, East and West), each of which has been appropriately named (e.g. North is the name for the range E13:J19). We wish to select one of these regions (using cell C2) as the output in rows 3 to 9.

		C	D	E	F	G
1	2	South		30-Apr	31-May	30-Jun
3	1	Sales		1	2	3
4	2	COGS		459	464	455
5	3	Gross Profit		260	257	248
6	4	Wages		199	207	207
7	5	Other variable costs		55	55	52
8	6	Other fixed overheads		80	83	83
9	7	Operating contribution		38	38	38
10				26	31	34
11						
12		North				
13		Sales		353	357	350
14		COGS		192	198	191
15		Gross profit		161	159	159
16		Wages		39	40	38
17		Other variable costs		64	64	64
18		Other fixed overheads		30	30	30
19		Operating contribution		28	25	27
20						
21		South				
22		Sales		459	464	455
23		COGS		260	257	248
24		Gross profit		199	207	207
25		Wages		55	55	52
26		Other variable costs		80	83	83
27		Other fixed overheads		38	38	38
28		Operating contribution		26	31	34

- reference (North, South, East, West)

This defines the various data areas from which the data is to be retrieved. Each of the data areas is the same size and has been named for ease of identification.

Note: all the data areas must be contained within a set of parentheses inside the INDEX function.

- row\_num \$A6

We are trying to return wages which is in the 4th row of the data area called South. As the data area is of the same dimensions as the summary, we can put in row counters in column A to help.

- column\_num E\$2

We are trying to return the result for April which is in the first column of the data area called South. As the data area is of the same dimensions as the summary, we can put in column counters in row 2 to help.

- area\_num \$B\$2

This identifies which of the data areas (defined in reference) is to be used. As South is the second in the list, then we need to convert the selector word "South" into the number 2. MATCH again comes in handy.

For three parts of the function, numbers have been used to identify the row, column and data area. If we are concerned about presentation, these counters could be hidden using white text.

### **OFFSET**

Like the INDEX function, the OFFSET function uses row and column coordinates to identify the value (or position) of the target cell. In simple terms, the OFFSET function identifies the target cell in relation to how many rows and columns it is positioned away from a starter cell – the data area does not need to be identified.

Using the same example as for the INDEX function, the charge out rate for a director in Hong Kong can be found using OFFSET.

A	B	C	D	E	F	G	H	I
1	Data grid							
2				Analyst	Associate	VP	Director	MD
3		London		345	690	1,380	2,760	5,529
4		Paris		293	587	1,173	2,346	4,692
5		Milan		264	528	1,056	2,111	4,223
6		New York		373	745	1,490	2,981	5,962
7		Chicago		317	633	1,267	2,534	5,067
8		Los Angeles		348	697	1,394	2,787	5,574
9		Hong Kong		311	621	1,242	2,484	4,968
10		Singapore		295	590	1,180	2,360	4,720
11		Tokyo		357	714	1,428	2,857	5,713
12								
13	Desired number							
14	row selector			Hong Kong		7 =MATCH(E14,C3:C11,0)		
15	column selector			Director		4 =MATCH(E15,D2:H2,0)		
16								
17	Charge out rate				2,484			

=OFFSET(reference,rows,columns)

- reference \$C\$2

This is the “starter cell” or the reference point from which the OFFSET rows and columns are counted. To make the row and column counting easier, with two-dimensional data areas it is usually best to have this cell immediately above and to the left of the data area as the reference cell.

- rows, columns F14, F15

As with the INDEX function, we need to turn the row and column selectors (in E14 and E15 respectively) into numbers so that they can be used within OFFSET. Hong Kong is in the seventh row of the city names and Director is in the fourth column of job titles – MATCH has been used to identify these. Likewise, they are 7 rows and 4 columns respectively away from the reference cell C2.

The row and column numbers can be negative, in which case the target cell will be above and / or to the left of the reference cell.

### ***Identifying the reference***

OFFSET is often used to locate the contents of a target cell. However, it can also be used to identify the position of a cell from within a range, or a range from within a range for use in other functions.

In the charge out illustration, OFFSET can be used to identify the charge out rates for all of the Directors or the Hong Kong office using the extended version:

=OFFSET(reference,rows,columns,height,width)

Using the extended function to find the reference of the Director charge out rates:

=OFFSET(\$C\$2,1,F15,9,1)

The range we are looking for starts 1 row (rows) below the starter cell C2 (reference) and 4 columns to the right (cols – using F15). It is 9 rows deep (height) and 1 column wide (width).

An alternative is:

=OFFSET(C3,,F15,9)

This time the starter cell (C3) is in the same row as the start of the range.

Consequently, we do not need to define how many rows away the range starts (the second argument, rows, is left blank). Additionally, as the default (height and) width is 1 then we do not need to populate the final (width) argument.

The above formulae have identified a reference and are only of use when incorporated within another function. For example:

=AVERAGE(OFFSET(C3,,F15,9))

will return the average charge out rate for the directors.

### **INDEX vs. OFFSET**

INDEX and OFFSET both require column and row coordinates to identify the target cell or cells. However, they both have their idiosyncrasies:

#### 1. Defining ranges for use in other functions

If a range from within a range is to be defined for use in other functions then the full version of OFFSET has been created for this purpose. However, two INDEX functions can be used to define the start and end positions of a range. The start and end point can be used to define the range for a function if the two INDEX functions are separated by a colon within the equation. For example:

=SUM (INDEX (DataArea,3,6) : INDEX (DataArea,4,10))

#### 2. Auditing

An INDEX function is easier to audit. If F2, the trace precedents or the

Ctrl-[ is pressed, then the components of the formula are shown. If the OFFSET function is used, then the data area from which the target cell or range is to be retrieved, is not shown as it is not part of the function.

Additionally, if we are trying to find the dependents of a cell, it will not be identified as a precedent of an OFFSET whereas it will indicate the relationship with the INDEX. This can cause problems as whole tracts of data may appear to have no links with any other parts of the model if OFFSET is used – and could, therefore be changed or deleted without understanding the impact until it is too late. This may prove difficult to audit for those users of the model who are unfamiliar with OFFSET.

### 3. Volatility

OFFSET is volatile whilst INDEX is not. Volatile functions always recalculate when the model is calculated, even if their components have not changed. For most users this is whenever anything is changed anywhere in the model.

This means that if the model is heavily populated with OFFSET functions, it will take a long time to recalculate.

### 4. Variable data area

Often the data area from which values or references are to be retrieved is fixed. However, if this database is variable in size, (eg it is downloaded data the size of which varies; or it is from / linked to another model in which changes are made) then problems may arise in the use of Index as it requires a data area to be defined.

Offset may be useful in such circumstances as the "starter" cell is likely to remain the same and Match can be used to locate the row / column position within the variable data area.

### 5. Macros

The OFFSET function is a fundamental tool in visual basic.

## VLOOKUP

A flexible solution for multiple option selection is VLOOKUP. However, it may require some planning as VLOOKUP requires the data to be set out in a specific way.

If we take the simple case of recommending whether to buy, sell etc. a stock based on the target price generated by the model, then we see how simple a VLOOKUP solution can be.

The value of a share is computed using a DCF valuation approach and then this value is compared to the current share price.

The threshold for a "buy" recommendation is that the current share price is at a discount of up to 15% to the DCF share valuation, up to no premium for an "Add" recommendation and so on.

	Premium to DCF implied price target (%)	Vlookup Recommendation	Decision Box
Tesco	24.5%	Sell	-100% Buy
Asda	3.0%	Hold	-15% Add
Carrefour	-22.0%	=VLOOKUP(B7,DecisionBox,2)	0% Hold
Sainsbury	-14.7%	Add	10% Reduce
Ahold	-29.0%	Buy	20% Sell

The lookup table – named DecisionBox

This is easier to think about if we know what the answer should be. Our model suggests that the current share price undervalues Carrefour shares by 22%. Looking at the decision box would indicate -100% to -15% is a Buy; -15% to 0% is Add; 0% to 10% is a Hold etc. Consequently, we think that Carrefour should be a Buy.

The VLOOKUP formula at its simplest has three components:

=VLOOKUP(lookup\_value,table\_array,col\_index\_num)

- lookup\_value      B7

This is the output driver (the -22% premium to DCF implied price target for Carrefour in cell B7)

- table\_array E5:F9 – named DecisionBox

The data area where the required result is located (the decision box with the grid of premia and investor action). The lookup\_value will be checked against the values in the first column of the table\_array – i.e. the values to be checked must be in the first column.

- col\_index\_num 2

The column number of the required result (the investor action) within the lookup table (i.e. the second column of the DecisionBox). The first two arguments of the equation have narrowed the result down to the specific row in the specific data area. The col\_index\_num indicates which column in that data area to then select from.

How VLOOKUP works is very simple: Excel takes the lookup\_value

(-22%) and looks down the first column of the table\_array (-100%, -15%,

0%, 10%, 20%) until it finds a match. If it cannot find an exact match, then Excel chooses the next nearest lower number instead (i.e. the last number it is bigger than on the way down: -100% in this case).

In the case of Tesco, it will get to the last line of the table before it stops. Having chosen a line in this way, Excel then chooses the result from the column number (2) you have specified.

#### **Beware**

1. The data in the first column must be in ascending order down the table for this kind of VLOOKUP to work properly
2. The column number is just that. Excel will consider the first column of the lookup table as column 1, the second column as 2 and so on. If the lookup table does not have enough columns, i.e. the column number is bigger than the total number of columns in the table, an error message will be returned.

#### ***The final argument – TRUE / FALSE***

In the example above, we have not included a final fourth argument. The final argument is TRUE or FALSE. If we put

TRUE or omit the last argument, then VLOOKUP works as in the above example.

If we enter FALSE, then VLOOKUP accepts only exact matches. If an exact match cannot be found, then a #N/A error message will be returned. This form of VLOOKUP must be used when the selector cell is text (or if column 1 is not in ascending order).

The screenshot shows a Microsoft Excel spreadsheet. The formula bar at the top displays =VLOOKUP(B14,Data,4, FALSE). The spreadsheet has columns A through G. Row 1 contains labels: SUM, Company, Country, Price, and Mkt Cap (Local). Rows 2 through 10 contain data for various companies. Row 13 is a blank row. Row 14 contains the formula =VLOOKUP(Casino, Data, 4, FALSE) in cell D14, with the word "Casino" selected. Row 15 is a blank row.

SUM	A	B	C	D	E	F	G
1							
2		Company		Country	Price	Mkt Cap (Local)	
3							
4		Delhaize		Belgium	€ 54.25	€ 4,995 m	
5		Carrefour		France	€ 53.00	€ 37,691 m	
6		Casino		France	€ 89.10	€ 9,770 m	
7		Metro		Germany	€ 36.11	€ 11,800 m	
8		Ahold		Netherlands	€ 23.95	€ 22,057 m	
9		Laurus		Netherlands	€ 1.15	€ 149 m	
10		Jeronimo Martins		Portugal	€ 7.58	€ 725 m	
11							
12							
13					Price		
14		Casino			=VLOOKUP(		
15							

The result of the formula in cell D14 is €89.10 (the value in the 4th column of the Casino row). The selector cell is B14, which this time is text (Casino).

Additionally, the data in the first column of the data area (named Data in cells B2:F10) is not sorted in any particular order. Consequently, the last argument in the VLOOKUP must be FALSE (or 0).

Strangely, if FALSE was missed off, the VLOOKUP may give

1. The right answer 2.  
Another erroneous value or  
3. #N/A.

It is the second one of these which is the dangerous one – a number appears and so it is assumed that it must be right, but it may not be. Therefore, when using text as a selector in VLOOKUPs, ALWAYS USE FALSE.

## HLOOKUP

VLOOKUP and HLOOKUP work in very similar ways. The difference in their use depends on the way the data is arranged:

- VLOOKUP requires the lookup\_value to be represented in the first column of the data area (or table\_array) – that is, the lookup is driven by vertically looking down the first column of the data area to find the correct row (and then finding the appropriate column)
- HLOOKUP requires the lookup\_value to be represented in the first row of the data area (or table\_array) – that is, the lookup is driven by horizontally looking across the first row of the data area to find the correct column (and then finding the appropriate row).

In the comparable company table below, supposing the company (Ahold – in row 8 of the spreadsheet, but row 7 of the data area) was a given and we wanted a formula that would return Netherlands if Country was chosen, €23.95 if Price was chosen and so on.

A	B	C	D	E	F
1					
2	Company	Country		Mkt Cap	
3				(Local)	
4	Delhaize	Belgium	€ 54.25	€ 4,995 m	
5	Carrefour	France	€ 53.00	€ 37,691 m	
6	Casino	France	€ 89.10	€ 9,770 m	
7	Metro	Germany	€ 36.11	€ 11,800 m	
8	Ahold	Netherlands	€ 23.95	€ 22,057 m	
9	Laurus	Netherlands	€ 1.15	€ 149 m	
10	Jeronimo Martins	Portugal	€ 7.58	€ 725 m	
.					

=HLOOKUP(lookup\_value,table\_array,row\_index\_num,range\_lookup) =HLOOKUP(C12,Data,7,false).

- lookup\_value C12 (Country in this case)

As with VLOOKUP, this is the output driver (the word Country). This points to which type of output value we are looking for.

- table\_array B2:F10, named Data

The data area where the required result (Netherlands) is located. The lookup\_value, Country, will be checked against the values in the first row of the table\_array – i.e. the values to be checked must be in the first row / header of the data area.

- row\_index\_num 7

The first two arguments have narrowed it down so that the lookup is looking down the Country column of the range named Data. The 7 indicates that we are looking for the 7th row in that column – that relating to Ahold.

The 7 has been hard-wired into the formula for illustration only. It should not be a hard input number but related to a row counter which could be derived using MATCH to find where Ahold is positioned.

- range\_lookup      false (or 0)

As the first row is not sorted in any particular order and the lookup\_value is text, we want an exact match only (not the closest approximation). As we have seen with VLOOKUP, if the FALSE argument is not added the HLOOKUP may give:

1. The right answer
2. Another erroneous value or
3. #N/A.

### **INDIRECT**

The INDIRECT function returns the reference specified by a text string and allows you to put the address of one cell in another cell, and get data from the first cell by referencing the second cell. For example, if cell A1 has the value "C3" and the content of C3 is 12,345 then =INDIRECT(A1) will return the value in C3, i.e. 12,345.

The syntax is:

INDIRECT(ref\_text,a1)

Where

Ref\_text is a reference to a cell that contains a cell reference or a name defined as a reference, or a reference to a cell as a text string. If ref\_text is not a valid cell reference, INDIRECT returns the #REF! error value.

A1 is a logical value that specifies what type of reference is contained in the cell ref\_text: If a1 is TRUE or omitted, ref\_text is interpreted as an A1-style reference; if a1 is FALSE, ref\_text is interpreted as an R1C1style reference.

The real power of the INDIRECT function is that it can turn any string into a reference. This includes any string that you build up using string constants and the values of other cells in the formula, strung together with the "&" concatenation operator. For example, the simple formula

=SUM(A5:A10)

will sum the values in the range A5:A10. However, suppose you want to be able to specify which range of rows to sum (for example, based on which year / division / scenario is to be summed) without having to change the formula. The INDIRECT function allows you to do this. Suppose the starting row number is placed in cell B1, and the ending row number is in C1, then you can use the formula

=SUM(INDIRECT("A"&B1&":A"&C1))

If B1 contains 5 and C1 contains 10, this evaluates the string as "A5:A10". The INDIRECT function converts this string to an actual range reference, which is passed to the SUM function.

### **Warning**

Care must be taken in using the Indirect function as it is a volatile function. Volatile functions always recalculate when the model is calculated, even if their components have not changed. For most users this is whenever anything is changed anywhere in the model.

This means that if the model is heavily populated with OFFSET functions, it may take a long time to recalculate.

### **Address**

The INDIRECT function is frequently used in conjunction with the

ADDRESS function. The ADDRESS function uses row and column numbers to create a string address using the following syntax:

ADDRESS(row\_num,column\_num,abs\_num,a1,sheet\_text)

Where

Row\_num is the row number to use in the cell reference

Column\_num is the column number to use in the cell reference

Abs\_num specifies the type of reference to return – probably omitted

A1 is a logical value that specifies what type of reference is contained in the cell ref\_text: If a1 is TRUE or omitted, ref\_text is interpreted as an A1-style reference; if a1 is FALSE, ref\_text is interpreted as an R1C1style reference.

Sheet\_text is text specifying the name of the worksheet to be used as the external reference. If sheet\_text is omitted, no sheet name is used.

For example, the formula =ADDRESS(5,6) returns the string \$F\$5, since \$F\$5 is the 5th row of column 6. You can then pass this to INDIRECT to get the value in cell F5. For example,

=INDIRECT(ADDRESS(5,6))

If additionally the sheet\_text can also be defined then the indirect can be a very powerful tool to retrieve data.

In the following example, we have six divisions laid out in the same format on six individual sheets (named after the division). The indirect function can then be used to retrieve a specified division on the summary sheet by inputting the division name in cell D8:

The screenshot shows a Microsoft Excel spreadsheet with a table of financial data. The table has columns for years 2006 through 2009 and rows for various financial metrics like Revenues, Costs, EBITDA, and Depreciation. The formula bar at the top shows the formula =INDIRECT(ADDRESS(ROW(),COLUMN(),,,\$D\$8)). The cell D8 contains the text "WP", which is highlighted in yellow. This indicates that the formula in the table is using the value in D8 to determine which sheet to pull data from. The table data is as follows:

		P&L heading	2006	2007	2008	2009
1		Revenues	257	251	266	282
2		Costs	(168)	(151)	(163)	(166)
3		EBITDA	89	100	102	116
4		Depreciation	(48)	(49)	(52)	(50)
5		EBITDA	41	52	50	65
6						
7						
8		WP				
9						

A frequently seen alternative solution to the above would be:

```
=INDIRECT($D$8&"!"&ADDRESS(ROW(),COLUMN()))
```

The reference we are trying to retrieve in cell F2 is from WP!F2 and so we must create a text string with all these components for use in the indirect function. As you can see, using the Address function to its full effect (per the original solution) gets around this problem.

## Volatile functions

Volatile functions recalculate each time a change of any sort occurs in any cell on any sheet. Most functions will only recalculate if a cell which they are referencing has changed, i.e. a volatile function in a formula means that cell **will always be recalculated at each recalculation** even if it does not appear to have any changed precedents and will lead to the Excel prompt to save changes to the model when you close it. The result is a model which takes longer to calculate.

To understand the issue, enter the formula:

=RAND()

in any cell. On Pressing F9 (the calculate key), the value in the cell will recalculate. If cells, rows or columns are deleted or inserted or another formula is entered elsewhere, the cell will also recalculate. This illustrates how these volatile functions work and shows that many actions in Excel cause all volatile functions to automatically recalculate.

Consequently, avoid volatile functions wherever possible. Using volatile functions sparingly will afford the benefit that the model will recalculate faster because it is only recalculating what it needs to.

The reason functions are specified as volatile is because Excel has no means of knowing when to recalculate them because they are in some sense outside of the normal dependency chain. INDIRECT for example, as its name implies, only has an indirect link with its source data – the rangename. Random number functions do not depend on anything, so the only safe thing to do is to generate a new random number every time the spreadsheet is recalculated.

### **Excel's volatile functions**

Some of Excel's functions are obviously volatile: RAND(),

RANDBETWEEN(), NOW(), TODAY()

Others are less obviously volatile: OFFSET(), CELL(), INDIRECT(),  
INFO(),

COLUMNS(), ROWS()

Some are volatile in some versions of Excel but not in others: INDEX() became non-volatile in Excel 97.

Using a volatile function in a formula will flag the cell containing the formula as volatile, even if the volatile function never gets executed. e.g.

=IF(1<2,99,NOW())

will always return 99 and the volatile NOW() function will never be called, but the cell containing the formula will be treated as volatile.

If the results of volatile functions are going to be used frequently throughout a model, avoid the temptation of nesting these functions within other functions. Instead, simply type the volatile function into a single cell and reference that cell from within other functions. This alone can potentially cut down on the amount of volatile functions by hundreds, if not thousands at times, and speed up the model's performance.

### ***Conditional formats***

Because conditional formats need to be evaluated at each calculation any formulae used in a conditional format is effectively volatile. Actually conditional formats seem to be super-volatile: they are evaluated each time the cell that contains them is repainted on the screen, even in Manual calculation mode, although VBA functions used in conditional formats will not trigger breakpoints when executed by the repaint.

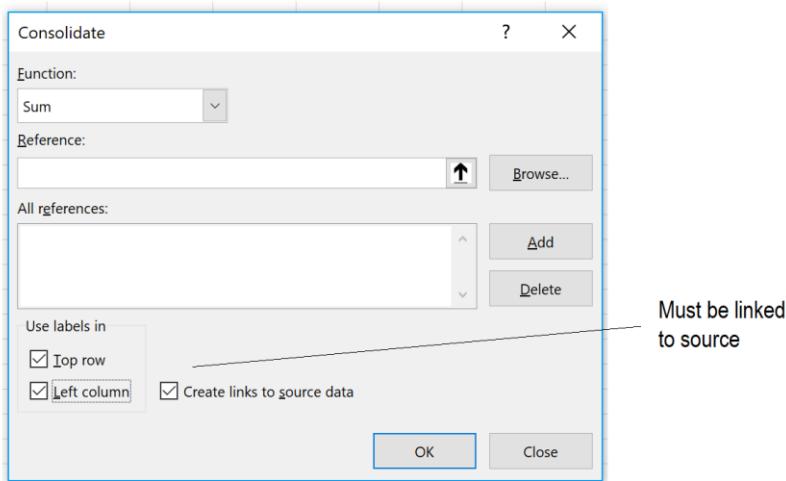
## Consolidating data

Similar data may need to be pulled together and summarised. Excel can do this in a number of ways, some of which are more rigorous and flexible than others.

### Data Consolidation

The Data Consolidation tool within Excel would appear ideal. To use it, select the cell where the consolidated data is to be

presented and enter Data, Data Tool, Consolidation . The following dialogue appears:



In the illustration above, the same data is presented in the same cells on 6 different sheets (although only 4 references are visible above). Select the data on the first sheet and then press Add. If a second sheet is selected, the reference will automatically be for the same cells on this second sheet etc.

### Linked or not linked?

If the check box to link the data remains un-checked then the consolidation function will merely sum (or whichever function is chosen) all the relevant cells and paste the values. Changes to the base data will not alter the consolidated data. This method has limited applicability to modeling.

If the data is linked then the following output will result:

	A	B	C	D 2014A	E 2015A	F 2016E	G 2017E	H 2018E	I 2019E	J 2020E
1	USD \$000's									
2										
<b>3 Income Statement USD \$000's</b>										
<b>14 Assumptions</b>										
16 Revenue Growth				10.0%	10.0%	10.0%	10.0%	10.0%	10.0%	10.0%
17 COGS % of Revenue				45.0%	45.0%	45.0%	45.0%	45.0%	45.0%	45.0%
18 SG&A				16,500.0	18,150.0	20,000.0	20,000.0	20,000.0	20,000.0	20,000.0
19 Depreciation % revenue				4.4%	4.4%	5.0%	5.0%	5.0%	5.0%	5.0%
20 Interest				1,000.0	1,000.0	1,000.0	1,000.0	1,000.0	1,000.0	1,000.0
21 Tax Rate				30.0%	30.0%	30.0%	30.0%	30.0%	30.0%	30.0%
22										
<b>23 Analysis</b>										
56										
57										
58										

The Data Consolidation function automatically groups the individual data lines (the default is that they are hidden) and then sums them up in the summary lines. In the illustration, the rows 2 to 7 are automatically linked to the source (in alphabetic order according to sheet name) and row 8 sums them up. The formatting (borders) have been done manually.

### Partial consolidation

If only a selection of the divisions were to be summed, then flags (0,1) would have to be used against each line (each of which would also have to be manually identified). This would involve altering 6 rows for each of revenues, costs and depreciation.

The standard way in which Excel outputs the combination and the difficulty in subsequently manipulating is seen by some as a drawback to this method and shows its inflexibility.

### 3-D formulae

Excel can create 3-dimensional formulae which may be useful when the data to be consolidated are of the same dimensions and in the same position on different sheets. All sheets must be arranged together, i.e. no other sheets can be between them.

- Select the cell where the consolidated data is to be presented (e.g. first year's sales)
- Enter the formula =SUM(
- Go to the first sheet and select the relevant cell (e.g. first year's sales)
- Ctrl-Shift-Page Dn until you get to the last relevant sheet and select the relevant cell (e.g. first year's sales) – alternatively, using the Shift key select the final sheet

- Close the bracket on the sum

The result is a 3-dimensional formula summing up all the divisions.

=SUM(WP:Holding!F2)

This formula can then be copied to all other relevant cells.

### Partial consolidation

If only a selection of the divisions were to be summed then the sheets containing the divisions to be excluded could be manually moved to be outside the relevant range. For example, the order of the sheets initially is:

1. Summary
2. WP
3. WT
4. ES
5. IS
6. IW
7. Holding

If the ES and IW divisions are to be excluded, then the sheets should be dragged to either before the WP sheet or after the Holding sheet.

This is a manual process which somewhat limits flexibility. Additionally, if other sheet are introduced between WP and Holding (or these sheets are moved) then the 3-dimensional formula will be selecting inappropriate data.

### Named ranges

An alternative to the Data Consolidation route is using named ranges. If all of the data areas are of the same dimensions on different sheets, then they can be individually named (select the area, then type the name in the Name box avoiding spaces).

If the summary consolidation area is to have the same position on a separate sheet, then the row and column references will be the same and so the following simple formula can be copied everywhere:

		F2	x	✓	fx	WP+WT+ES+IS+IW+Holding			
	A	B	C	D	E	F	G	H	I
1				P&L heading	2006	2007	2008	2009	
2				Revenues	400	410	562	541	
3				Costs	(308)	294	(434)	(401)	
4				EBITDA	92	115	128	140	
5				Depreciation	(57)	67	(74)	(69)	
6				EBITDA	36	48	54	71	
7									

The formula in cell F2 uses the reference of a 2-dimensional range called WP (from the sheet of the same name). Excel will look to the same row, same column in the source, i.e. cell F2 on the sheet WP.

### Partial consolidation

If only a selection of the divisions were to be summed, then flags (0,1) could be easily appended to the full consolidation formula:

SUM	A	B	C	D	E	F	G	H	I	J	K	L
				P&L heading	2006	2007	2008	2009				
1				Revenues	=WP*\$G\$9+WT*\$G\$10+ES*\$G\$11+IS*\$G\$12+IW*\$G\$13+Holding*\$G\$14							
2				Costs	(139)	(143)	(160)	(139)				
3				EBITDA	4	15	14	18				
4				Depreciation	(8)	(19)	(14)	(13)				
5				EBITDA	(5)	(4)	0	5				
6												
7												
8												
9												
10												
11												
12												
13												
14												
15												
16												

Divisions Include?	
WP	-
WT	1
ES	1
IS	--
IW	--
Holding	--

### Indirect

The indirect function can be used to do the full consolidation – e.g. combining all the divisions – but is probably best used for selecting individual components.

For full (or partial) consolidation, the summary sheet is best set up along the lines of that automatically created using Data Consolidation – separate rows for each division for each of the revenues, costs and depreciation (the revenue rows are shown in the model below).

Using the indirect function we need to come up with the cell reference of the source. For example, in F4 we need to source the data from F2 on the ES sheet. The ADDRESS function inside the indirect does this by

Row\_num (2) – cell A8 has a number 2 in it (derived from a MATCH function to pick out the row number of the “Revenue” row title in the source data

Column\_num (6 or F) – using the COLUMN() function to denote the current column

Sheet\_text (ES) – using cell C4 which contains the sheet name

				E	F	G	H	I	J	K	L	M	N	
1	2	3	4	P&L heading	2006	2007	2008	2009	2010	2011	2012	2013	2014	
.	1	WF	--	--	--	--	--	--	--	--	--	--	--	
.	2	WT	1	--	--	12	15	10	9	9	9	9	9	
.	3	ES	1	(No., \$C4))	145	141	127	135	138	144	143	146		
.	4	IS	--	--	--	--	--	--	--	--	--	--	--	
.	5	MV	--	--	--	--	--	--	--	--	--	--	--	
.	6	Hol	1	--	14	21	15	13	13	13	13	13	14	
8	2	Revenues		143	159	174	157	158	161	166	166	169		
15	3	Costs		(139)	(143)	(160)	(139)	(142)	(144)	(151)	(152)	(154)		
16	4	EBITDA		4	15	14	18	17	16	15	14	14		
23	5	Depreciation		(8)	(19)	(14)	(13)	(13)	(13)	(13)	(13)	(13)		
24	6	EBIT		(5)	(4)	0	5	4	4	2	1	2		
25														
26														
27		WP												
28		Indirect consol pivot etc.xls		35	WP	--								
29		Indirect consol pivot etc.xls		35	VWT	1								
30		Indirect consol pivot etc.xls		35	ES	1								
31		Indirect consol pivot etc.xls		35	IS	--								
32		Indirect consol pivot etc.xls		35	MV	--								
33		Indirect consol pivot etc.xls		40	Holding	1								

The 0s and 1s in column D are flags to indicate whether a division is to be consolidated or not.

A more straightforward format and formula can be used if only one of the divisions is to be output – see the indirect section of the notes.

### Pivot table

A pivot table can be easily created to output one, some or all of the data to be consolidated. See the pivot tables section of the notes.

Despite their suitability for consolidating, pivot tables have limitations in that:

- They must be manually updated / refreshed when changes are made to the model
- The format is often sub-optimal
- They are not widely understood by all users

## Arrays

An array is a rectangular range of cells or values. In Excel, data can reside in a single row (called a one-dimensional horizontal array), a column (a one-dimensional vertical array), or multiple rows and columns (a two-dimensional array).

Most data analysis is done in one cell and then copied to others, but advocates of arrays would suggest that this approach is:

- Cumbersome
- Error-prone
- Hard to follow and maintain.

Most of these potential problems can be avoided with a rigorous approach to model building. However, an array formula returns an array that is spread over the cells and so has the advantages of:

- One array=>One formula
- Faster computations.

An array formula is a formula that can perform multiple calculations on one or more of the items in an array. Array formulae can return either multiple results or a single result. For example, an array formula can be placed in a range of cells and calculate a column or row of subtotals. An array formula can also be placed in a single cell and calculate a single amount. An array formula that resides in multiple cells is called (logically enough) a multi-cell formula, and an array formula that resides in a single cell is called a singlecell formula.

### Illustration

Using the following data:

Site	Product	Number Sold	Unit Price	Total Sales
North	Tailored	5	2,200	
	Menu	4	1,800	
South	Tailored	6	2,300	
	Menu	8	1,700	
East	Tailored	3	2,000	
	Menu	1	1,600	
West	Tailored	9	2,150	
	Menu	5	1,950	
Central	Tailored	6	2,250	
	Menu	8	2,000	
Total sales				

### To create a multi-cell array formula

To multiply the values in the array (the cell range C2 through D11):

1. Select cells E2 through E11
2. Enter the following formula =C2:C11\*D2:D11
3. Press CTRL+SHIFT+ENTER.

Excel surrounds the formula with brackets ({} ) and places the same formula in each cell of the selected range. This happens very quickly, so what you see in column E is the total sales amount for each product for each region.

### To create a single-cell array formula

1. Select B13
2. Enter the following formula =SUM(C2:C11\*D2:D11)
3. Press CTRL+SHIFT+ENTER.

In this case, Excel multiplies the values in the array (the cell range C2 through D11) and then uses the SUM function to add the totals together. The result is a grand total of 111,800 in sales.

(Note: The same result could have been arrived at without the use of arrays by the use of the SUMPRODUCT function.)

Site	Product	Number Sold	Unit Price	Total Sales
North	Tailored	5	2,200	11,000
	Menu	4	1,800	7,200
South	Tailored	6	2,300	13,800
	Menu	8	1,700	13,600
East	Tailored	3	2,000	6,000
	Menu	1	1,600	1,600
West	Tailored	9	2,150	19,350
	Menu	5	1,950	9,750
Central	Tailored	6	2,250	13,500
	Menu	8	2,000	16,000
<b>Total sales</b>		<b>111,800</b>		

This can be a very powerful type of formula. For example, say there are 15,000 rows of data. Part or all of that data can be summed with a single formula in a single cell.

Also, notice that the single-cell formula is completely independent of the multi-cell formula. This points to another advantage of using array formulas – flexibility. Any number of

actions, such as changing the formulae in column E or deleting that column altogether, will not affect the single-cell formula.

### **Rules for entering and changing array formulae**

The main rule is to press CTRL+SHIFT+ENTER whenever you need to enter or edit an array formula. This rule applies to both single-cell and multi-cell formulae. However, whenever working with multi-cell formulae, there are additional rules to follow:

- You must select the range of cells to hold the results before you enter the formula
- You cannot change the contents of an individual cell in an array formula
- You can move or delete an entire array formula, but you cannot move or delete part of it. In other words, to shrink an array formula, you first delete the existing formula, and start again
- You cannot insert blank cells into a multi-cell array formula.

### **Expanding an array formula**

At times, it may be necessary to expand an array formula (though it is not possible to shrink them). The process is not complicated, as long as the rules listed in the previous section are followed.

#### **Illustration**

To add the following data to the previous illustration

Site	Product	Number Sold	Unit Price
City-North	Tailored	6	2,500
	Menu	7	1,900
City-East	Tailored	4	2,200
	Menu	3	2,000
City-Other	Tailored	8	2,300
	Menu	8	2,100

In the sample model insert these additional lines of data into the model starting at cell A12. Note, that the new data cannot be entered into the middle of the current data due to the multi-cell array formula.

- Select the range of cells that contains the current array formula (E2:E11), plus the empty cells next to the new data (E12:E17)
- Press F2 and edit the formula to extend the C11 to C17 and change D11 to D17
- Press CTRL+SHIFT+ENTER. Excel places the revised formula in the new cells.

The same process can be followed to edit the single-cell array formula in B19:

The screenshot shows a Microsoft Excel spreadsheet. The formula bar at the top displays the formula {=SUM(C2:C17\*D2:D17)}. The main area contains a data table with columns A through F. Column A is labeled 'Site' and column B is labeled 'Product'. The data includes various sites like North, South, East, West, Central, City-North, City-East, and City-Other, with products Tailored and Menu. Column C is 'Number Sold', column D is 'Unit Price', and column E is 'Total Sales'. Row 19 is highlighted in green and contains the formula =190,100, which is the result of the array formula in row 19.

	A	B	C	D	E	F
1	Site	Product	Number Sold	Unit Price	Total Sales	
2	North	Tailored		5	2,200	11,000
3		Menu		4	1,800	7,200
4	South	Tailored		6	2,300	13,800
5		Menu		8	1,700	13,600
6	East	Tailored		3	2,000	6,000
7		Menu		1	1,600	1,600
8	West	Tailored		9	2,150	19,350
9		Menu		5	1,950	9,750
10	Central	Tailored		6	2,250	13,500
11		Menu		8	2,000	16,000
12	City-North	Tailored		6	2,500	15,000
13		Menu		7	1,900	13,300
14	City-East	Tailored		4	2,200	8,800
15		Menu		3	2,000	6,000
16	City-Other	Tailored		8	2,300	18,400
17		Menu		8	2,100	16,800
18						
19	Total sales			190,100		

### Adding logic to arrays

As seen, arrays perform the same action many times. Consequently, the same logical argument can be performed many times.

### Illustration

Suppose we want to find how many of a certain product was sold or what the revenue was for that product.

If we want to calculate the total number of tailored products sold we could create a series of IF statements in column F of the =IF(B2="tailored",C2,0) type (or a multi-cell array of the same type {=IF(B2="tailored",C2,0)}) and then sum these up.

As the same logical argument and the same result if true or false is used for the whole range, then a single-cell array formula can be used.

To calculate the total number of tailored items sold in cell C20:

`{=SUM(IF(B2:B17="tailored",C2:C17,0))}`

i.e., the IF statement looks in the array B2:B17 for those matching "tailored", and then returns the number of units sold for each. By placing the SUM around it, all the units fulfilling the criteria are summed.

(Note: the Excel function SUMIF would produce the same result without the use of arrays.)

To take this further and calculate the revenue from all tailored sales in E20:

`{=SUM(IF($B$2:$B$17="tailored",$C$2:$C$17*$D$2:$D$17,0))}`

(There is no one function within Excel which could perform this without the use of arrays.)

E20					<code>{=SUM(IF(\$B\$2:\$B\$17="tailored",\$C\$2:\$C\$17*\$D\$2:\$D\$17,0))}</code>				
	A	B	C	D	E	F	G	H	I
1	Site	Product	Number Sold	Unit Price	Total Sales				
2	North	Tailored	5	2,200	11,000				
3		Menu	4	1,800	7,200				
4	South	Tailored	6	2,300	13,800				
5		Menu	8	1,700	13,600				
6	East	Tailored	3	2,000	6,000				
7		Menu	1	1,600	1,600				
8	West	Tailored	9	2,150	19,350				
9		Menu	5	1,950	9,750				
0	Central	Tailored	6	2,250	13,500				
1		Menu	8	2,000	16,000				
2	City-North	Tailored	6	2,500	15,000				
3		Menu	7	1,900	13,300				
4	City-East	Tailored	4	2,200	8,800				
5		Menu	3	2,000	6,000				
6	City-Other	Tailored	8	2,300	18,400				
7		Menu	8	2,100	16,800				
8									
9	Total sales		190,100						
10	Total Tailored		47		105,850	Tailored			
11	Total Menu		44		84,250	Menu			

### Testing for duplicate entries

In the following illustration, the summary at the foot of the table is wrong as the data contains duplicate entries:

Company	Country	EV/EBITDA 2008	PER 2008	EBITDA growth	EBITDA margin 2008
Ahold	Netherlands	5.9 x	10.2 x	11.9%	7.3%
Metro	Germany	5.5 x	22.1 x	10.9%	4.9%
Carrefour	France	9.1 x	23.6 x	8.8%	5.9%
Tesco	UK	8.7 x	16.2 x	12.6%	8.2%
Kroger	US	7.1 x	13.8 x	2.8%	7.3%
Tesco	UK	8.7 x	16.2 x	12.6%	8.2%
Tesco	UK	8.7 x	16.2 x	12.6%	8.2%
Sainsbury	UK	6.9 x	15.1 x	7.2%	7.2%
Metro	Germany	5.5 x	22.1 x	10.9%	4.9%
Wm Morrison	UK	8.3 x	18.3 x	10.8%	8.0%
Average		7.4 x	17.4 x	10.1%	7.0%
Median		7.7 x	16.2 x	10.9%	7.3%
High		9.1 x	23.6 x	12.6%	8.2%
Low		5.5 x	10.2 x	2.8%	4.9%

If you need to determine whether a 1 dimensional range (CoNames – the list of names in the first column above) has duplicate entries, you can use the following formula. It will display "Duplicates" if the list in Range1 has duplicate entries or "No Duplicates" if the range does not have any duplicates.

```
=IF(MAX(COUNTIF(CoNames,CoNames))>1,"Duplicates",
    No duplicates")
```

This formula requires that the complete range contains data. If only the first N cells contain data, and the rest are empty, the formula will return "Duplicates" because it considers the empty cells to be duplicates of themselves.

The duplicate cells can then be tagged by use of the following non-array formula in a matching column to Range1 (where B3 is the first cell in the Range1 to be tested):

```
=IF(COUNTIF(CoNames,B3)>1,"Duplicate","")
```

We can then create another non-array formula in a further column to extract the non-duplicate entries:

```
=IF(COUNTIF($B$3:B3,B3)=1,B3,"")
```

Company	Country	EV/EBITDA 2008	PER 2008	EBITDA growth	EBITDA margin 2008	Duplicates?	Unique names
Ahold	Netherlands	5.9 x	10.2 x	11.9%	7.3%	Ahold	
Metro	Germany	5.5 x	22.1 x	10.9%	4.9%	Duplicate	Metro
Carrefour	France	9.1 x	23.6 x	8.8%	5.9%	Carrefour	
Tesco	UK	8.7 x	16.2 x	12.6%	8.2%	Duplicate	Tesco
Kroger	US	7.1 x	13.8 x	2.8%	7.3%	Kroger	
Tesco	UK	8.7 x	16.2 x	12.6%	8.2%	Duplicate	
Tesco	UK	8.7 x	16.2 x	12.6%	8.2%	Duplicate	
Sainsbury	UK	6.9 x	15.1 x	7.2%	7.2%	Sainsbury	
Metro	Germany	5.5 x	22.1 x	10.9%	4.9%	Duplicate	
Wm Morrison	UK	8.3 x	18.3 x	10.8%	8.0%	Wm Morrison	
Average		7.4 x	17.4 x	10.1%	7.0%		
Median		7.7 x	16.2 x	10.9%	7.3%		
High		9.1 x	23.6 x	12.6%	8.2%		
Low		5.5 x	10.2 x	2.8%	4.9%		

No duplicates

## Advantages and disadvantages of arrays

Array formulae offer these advantages:

- Consistency

Clicking any of the cells from E2 downward (in earlier illustration), the same formula is revealed. That consistency can help ensure greater accuracy.

- Safety

Part of a multi-cell array formula cannot be overwritten. For example, clicking cell E3 and pressing DELETE would not work. It is necessary to either select the entire range of cells and change the formula for the entire array, or leave it as is.

- Smaller file sizes

A single array formula can be used instead of several intermediate formulae. For example, the model created for this exercise uses two array formulae. Standard formulae (such as =C2\*D2), would have required 11 different formulas.

Array formulae can work what seems like magic, but they also have some disadvantages:

- Do not forget to use CTRL+SHIFT+ENTER

Remember to press those keys whenever entering or editing an array formula

- Other users may not understand the array formulae

Array formulae are relatively undocumented, so if other people need to modify models, it is necessary to either avoid array formulae or make sure they understand how to change them

- Depending on the speed of the system, large array formulae can slow down calculations.

## Dates

When a date is used in Excel, it is identified as a number providing it is written in a valid date format. For example, 30 July 1966 day is the 24,318th day of the world, according to Microsoft i.e. it has been given the unique number 24,318. This can be seen by entering the date 30/07/66 and then stripping the formatting from the cell by using Control+Shift+1. The cell can be reformatted to the date format using Control+#.

So when did the world begin? The first day of the world (according to Microsoft), i.e. number 1, is 1 January 1900, despite a sizeable body of evidence to suggest otherwise. This is an important date: if Excel knew that the world started on that date then any other date is merely a number of days from 1 January 1900. Hence, a unique number can be allocated.

### Date formats

1 January 1900 was a Sunday (which Excel, by default, treats as the first day of the week). Consequently, not only can Excel count the number of days from 1 January 1900, but also can very easily work out which day of the week it is.

As dates are numbered, they can be formatted in the same way as other numbers. For example, to format the date 4 July 2006 (number 38,537):

- Control-1, Number and Custom

Days	d	dd	Ddd	ddd
	4	04	Mon	Monday
Months	m	mm	Mmm	mmm
	7	07	Jul	July
Years	y	yy	Yyy	yyy
	06	06	2006	2006

### Date functions

Appreciating that a date is a number adds a lot of functionality. Some of these functions are not in the standard set-up of Excel and may need to be added:

- File; Options; Add-ins
- Select Analysis Toolpak

### ***YEAR, MONTH, DAY etc.***

Where the data is in 3 different cells, being day of the month (28), number of month (2 for February), and year (2004), this can all be combined into '28 February 2004' by the Date function:

=DATE(year,month,day)

The result in the cell is now the unique number for 28 February 2004 which can be formatted as appropriate.

The YEAR, MONTH and DAY functions can be used to reverse this process to find the component parts of a particular date.

WEEKDAY can be used to find out which day of the week a date is from 1-7 (although this could also be done by formatting the number with enough "d"s). Note: because 1 January 1900 was a Sunday, then by default, Sunday is assumed to be the first day of the week, whilst Saturday is the 7th. By changing the return type, the start of the week can be altered to, say, Monday.

### ***Defining time periods***

#### Date series

Excel can help set up sensible date series as, for example, column headings. If a row of dates for the week commencing is required, the first two dates of the sequence are input. The fill method can be used to copy the series across the row.

- Select both cells
- Edit; Fill; Series
- Type; Date should be checked
- Step value 7
- OK.

Or select both cells, click and drag the little box (AutoFill handle) at the bottom right corner of the active range.

The same functionality can be used to put in month ends.

- Put in a month end and select area to put in month ends
- Edit; Fill; Series
- Date unit; Month should be checked
- Step value 1
- OK.

Alternatively, this can be done by typing in the date of the first month end and this time right click and drag the AutoFill handle.

If the start date is 31 January 2004 (say in cell D1), then to link other cells (to create more dates) to the start date can be done in a number of different ways:

1. =D1+365

As all dates are numbers, and years are 365 days, this will generally work. In the above example, the result will be 30 January 2005 because 2004 is a leap year.

This method is good but not great.

2. =EDATE(D1,12)

EDATE adds the full number of months (in this case 12) to the starting number. In the above example, the result will be the correct date, 31 January 2005.

3. =EOMONTH(D1,12)

EOMONTH puts in the last day of the month specified (in this case 12 months later) after the starting month. In the above example, the result will be the correct date, 31 January 2005.

This method always works – but is less useful if the month end is not the relevant date.

If monthly or quarterly dates are to be used, method 1 is not suitable but either method 2 or 3 can be used.

If the relevant date is to be, say, the 5th (of each month, quarter or year) then EDATE is the appropriate function.

If the month end is the relevant date then EOMONTH always works. By comparison, EDATE will always add on the relevant

number of months from a given date - if quarterly dates are needed and the last day of February is to be used, then 3 months after that is 28 May rather than 31 May. The same issues can arise with other month ends as some months have 30 days and some 31.

### ***Length of periods***

As dates are numbers, then subtracting one date from another generates the number of days between the dates. Consequently, to count the number of days in a month, quarter or in fact between any 2 dates is easy.

### **Yearfrac**

The YEARFRAC function looks at the proportion of a year between 2 given dates:

=YEARFRAC(start\_date,end\_date,basis)

The basis should be one of the following, each giving a slightly different outcome:

0 or omitted	US (NASD) 30/360
1	Actual / actual
2	Actual/360
3	Actual/365
4	European 30/360

Note: the function only gives positive results and so care should be taken in ensuring that the start date is the earlier date as it will not be apparent from the output.

### ***Consolidating time periods***

It is possible to consolidate monthly, quarterly or semi-annual workings into annuals. There are a number of fully flexible approaches to this, the most straightforward of which depends on the modeller and users' Excel proficiency and preferences.

The coding can be simplified by the use of range names. However, care must be taken when using range names when

the model contains different time frames. For example, the data in column H may relate to a quarter in one part of the model, whilst referring to an annual period elsewhere. Range names such as DatesQ, SalesQ could be used to contrast with DatesY etc. to help identify quarterly and annual data so that only the appropriate ranges are used.

### Illustration

The quarterly and annual dates have both been created using EOMONTH with 3 and 12 being the number of months respectively.

We are trying to sum the quarterly sales which fall between the year ends – note the first year is not a full 4 quarters.

A	B	C	D	E	F	G	H	I	J	K	L
1			1		2	3	4	5	6	7	8
2	Period		30-Sep-06	=EOMONTH(E2,3)		31-Mar-07	30-Jun-07	30-Sep-07	31-Dec-07	31-Mar-08	30-Jun-08
3	Sales per period		1,324		2,540	1,985	2,123	1,456	2,794	2,184	2,335
4											
5	Outputs										
6	Year ends		31-Mar-07	=EOMONTH(E6,12)		31-Mar-09	31-Mar-10	31-Mar-11	31-Mar-12	DatesY	
7											
8	Summary annual sales									Total	
9	SUMIF working		5,849	=SUMIF(DatesQ,"<="&F8,SalesQ)		23,818	34,172	45,562	58,090		
10	SUMF		5,849	=F9*12		9,413	10,354	11,389	12,528	58,090	
11	SUM OFFSET		5,849	=SUM(OFFSET(\$D\$3,F15,F16-16))		9,413	10,354	11,389	12,528	58,090	
12	SUM INDEX		5,849	=SUM(INDEX(SalesQ,F15):INDEX(SalesQ,F16))		9,413	10,354	11,389	12,528	58,090	
13											
14	Workings										
15	start counter		1	=E16+1		8	12	16	20		
16	end counter		3	=MATCH(F6,DatesQ,0)		11	15	19	23		

### SUMIF

=SUMIF(range,criteria,sum\_range)

The SUMIF function requires data (the range) to fulfil a criterion (criteria). If it does fulfil this requirement, then a corresponding set of data (sum\_ range) can be summed.

As dates are numbers (masquerading in a text format), the quarterly dates are the data which must be less than or equal to the annual date (which must be the criteria). Unfortunately, by default, the data must equal the criteria. It is only by adding the text string component ("<="&F6) to the criteria that we can get around this restriction within SUMIF.

Once the quarterly dates have been identified as being less than or equal to the respective year end, then the corresponding sales data to be summed must be chosen (from the same columns as the quarterly dates). As the criteria is to be less than or equal to the respective year end then the function will sum all sales up to that date. Consequently, a further line, which eliminates all previous year's sales, can be easily added to create only the relevant sales.

in F9      =SUMIF(DatesQ,"<="&DatesY,SalesQ)

or  $\text{SUMIF}(\$E\$2:\$AA\$2, "<=" \& F6, \$E\$3:\$AA\$3)$

in F10 =F9-E9

### SUM OFFSET

OFFSET can be used to identify a single cell or a range. For the latter, the address of the range is identified and then the contents summed. The trick is to identify the starting and finishing point of the range.

#### Preliminary step – period counters

In the above illustration, the first year's sales are for the first 3 quarters (i.e. the 1st to 3rd sales figures) and the second year is from the 4th to 7th figures, etc. The start and end point in the sales range can be identified in the following corkscrew:

- The end position within the range can be identified using the MATCH function to find the relevant year end in the range of quarterly dates (using the exact [0] matching criteria):

in F16 =MATCH(DatesY,DatesQ,0), or

=MATCH(F6,\$E\$2:\$AA\$2,0)

- The start is merely 1 period after the previous ending period in F15 =E16+1

### OFFSET

The OFFSET function identifies a cell or range which is a specified position away from a starter cell. The sales data is a 1-dimensional (1 row) range and so only the column and width criteria are required (together with the required starter cell). It is cleaner to use a cell outside the data area as the starter cell (in this case D3 – immediately to the left of the data to be summed) as the address of the target area is always offset a given number of cells from this point.

The OFFSET function then identifies the relevant range as starting so many columns (1, 4, 7 etc.) away from the starter cell (D3) and being 3, 4, 4 etc. cells wide (being the difference between the end position for the relevant year and that of the previous year). As a result, the OFFSET function has identified

E3:G3 for year 1 and H3:K3 for year 2 etc. By placing a SUM around this range, the relevant consolidated sales is returned:

in F11 =SUM(OFFSET(\$D\$3,,F15,,F16-E16))

### **SUM INDEX**

INDEX can be used to identify, from within a specified data area, a cell value or address. For the latter, the addresses of the start and end of a range are identified and then the contents summed. As with OFFSET, the starting and finishing point of the range needs to be identified – done using the same preliminary step as for OFFSET.

Two similar INDEX functions are used to identify the addresses of the start and end of a range. As the sales data area is a 1-dimensional (1 row) range then only the sales data area and the start (or end) column number within this area need be identified.

In cell F15, the starter cell address is identified by =INDEX(SalesQ,,F15) where SalesQ is the sales data area and F15 indicates that the cell is in the 4th column of this data. On its own, the result of this function would be the sales in the 4th quarter. However, when combined with another function, Excel knows to use the address result instead. Similarly, the end cell address is identified by =INDEX(SalesQ,,F16).

By combining the results of the 2 INDEX functions a range can be identified and then placed within a SUM:

in F12 =SUM(INDEX(SalesQ,,F15):(SalesQ,,F16))

or =SUM(INDEX(\$E\$3:\$AA\$3,,F15):INDEX(\$E\$3:\$AA\$3,,F16))

## Switches

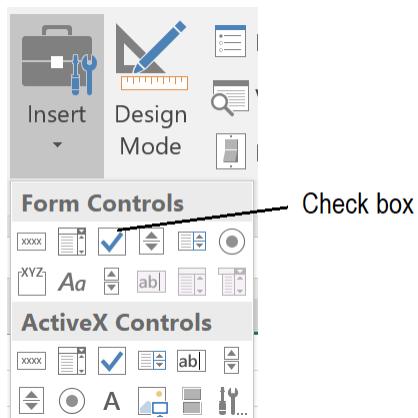
A switch can be created to allow a model to alternate between different sets of criteria. This allows Excel to model different potential outcomes.

For example, if the funding for the project / acquisition will be either 75% or 100% debt, then a switch can be used to highlight the 2 alternatives; or where Monte Carlo simulation is used so that the model shows either the expected or the Monte Carlo output results.

The Forms toolbar is used to create boxes and buttons which enable the user to quickly select between the various options. All items within the Forms toolbar are created and amended in the same way. The common theme is that the buttons / boxes all sit on top of the model and require some link between the model and the box / button through a cell link – a previously blank cell - which is then used to drive further equations.

### Two-way switch

For example, to create a two-way switch:



- Open the Forms toolbar (Developer; Insert) or right click whilst on toolbar and select forms
- Select the Check Box, move the cursor onto the model where the check box is to appear (the cursor now becomes a crosshair) and create the check box by dragging with the left mouse button held down

- Using the right mouse button, click on the check box and select Format Control; Control; Cell Link (type or go to the cell reference for an unused cell)
- Click outside the check box to finish.

A ticked checkbox will return TRUE in the linked cell, whilst an unticked checkbox will result in FALSE in the linked cell.

An IF statement based on whether the switch is TRUE or FALSE can be used to alternate the model assumptions. When using the IF statement it is useful to name the linked cell containing the TRUE / FALSE statement.

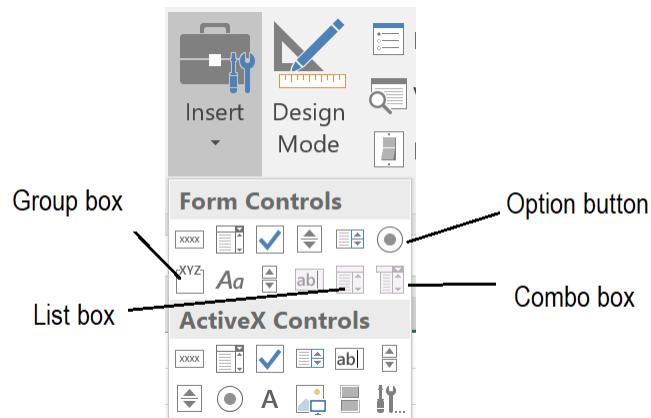
For example, if the switch is to be used to alternate between equity accounting and proportional consolidation as the two options, then

=IF(Switch=TRUE,"Equity accounting","Proportional consolidation"); or, more simply

=IF(Switch,"Equity accounting","Proportional consolidation") would change the cell text from equity accounting to proportional consolidation.

The check box can be formatted for color, using the right mouse button, Format Control; Colors and Lines.

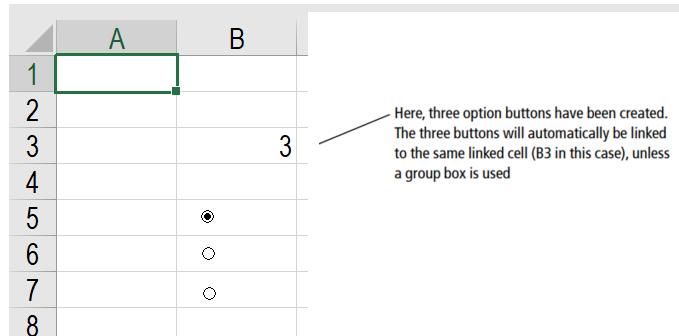
### Multiple options



These buttons / boxes are created and amended and then linked to further formulae in the same way as the Check Box.

### Option button

When an option button is created and linked to a cell (B3 below), 1 appears in the linked cell. If a further option button is created and clicked, the number 2 will appear in the linked cell, and so on. The number allocated to each option button is the order in which they are created (the first created is allocated value 1, the second value 2,...).



A screenshot of a Microsoft Excel spreadsheet. The columns are labeled A and B. Row 1 contains the numbers 1 and 2 respectively. Row 2 contains 3 and an empty cell. Row 3 contains 4 and an empty cell. Row 4 contains 5 and an empty cell. Row 5 contains 6 and an empty cell. Row 6 contains 7 and an empty cell. Row 7 contains 8 and an empty cell. Row 8 contains an empty cell and a radio button icon. A callout line points from the text to the radio button in row 5.

	A	B
1		
2		
3		3
4		
5		●
6		○
7		○
8		

The option button is useful where there are several different possibilities allowed. The linked cell could then be used with an embedded IF function (or a lookup function such as CHOOSE).

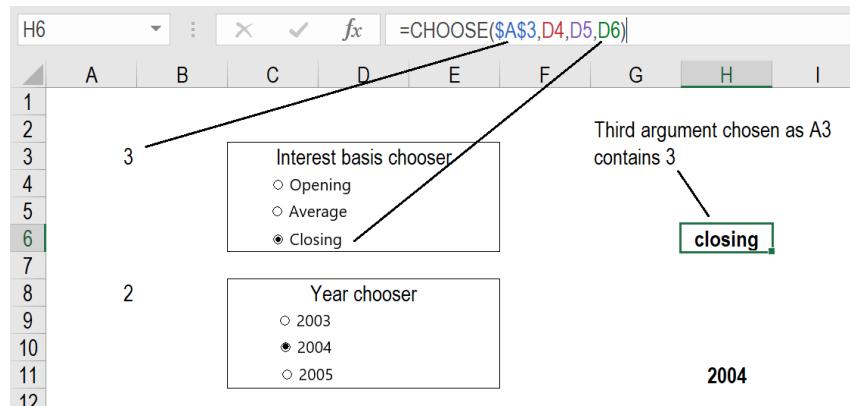
For example, if the calculation of interest on an overdraft balance could be performed on either the opening, average or closing balance, the following formula would generate the appropriate text.

=CHOOSE(\$B\$3,"opening","average","closing")

The CHOOSE function returns a value from a list of arguments, which could be text, references, calculations, etc. In the above formula, B3 returns a value between 1 and 3. If, say, option button 2 is chosen, then the formula would generate the result average.

### Option button with group box

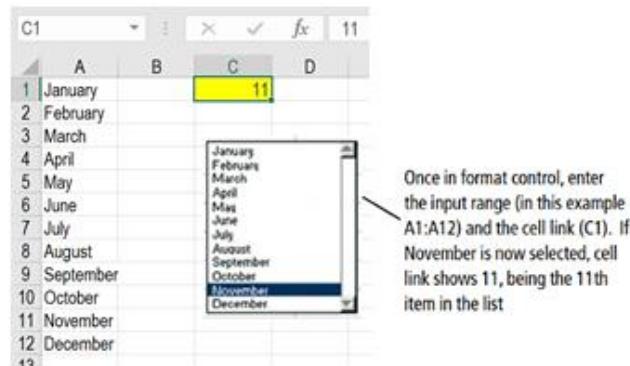
As more option buttons are created on the same sheet, they are automatically linked to the original linked cell. If more than one set of option buttons is required on the same sheet, it is necessary to use the group box.



In the above, two different sets of option buttons are being used to drive different scenarios. If the group box was not used, all the options buttons would have the same cell link (either A3 or A8) which would count between 1 and 6.

### List box

The list box generates a drop-down list box. The item that is selected in the list box appears in the text box. The linked cell generates a number, being the numerical position of the selected item within the list.



### Combo box

The combo box works in broadly the same way as the list box, requiring the same inputs as the list box. The key difference is in the appearance – a dropdown box with the options will appear when the combo box is selected; whilst only the menu item selected will show when the box is not selected.

### Formality

As we have seen, the boxes and buttons sit on top of the model and then are linked to the model by use of cell links (and extract data from the model, for combo and list boxes, through

the input range). Consequently, they result in the cell link values changing as the different options are selected. Therefore, despite the user not physically using the keyboard to type in a hard-wired number (or TRUE / FALSE), the cell link changes.

The consequence of this is that all cell links MUST be situated on the Inputs sheet – the home of all other hard-wired inputs.

The switches should, therefore, also appear on the Inputs sheet as they are the way in which the user effects the change in the hard-wired cell link. However, this can be inconvenient. For example, if we wish to see the impact on the key outputs of changing an option, then we may wish to have the switches on the key workings / outputs sheet.

Switches can be copied – the key is to ensure that the cell link (and input range, if relevant) refers to the same cell in both locations. The result will be that the options can be changed simultaneously:

- On the input sheet using the switch
- On the workings / output sheet using the copied switch;  
or
- On the input sheet by changing the value in the cell link.

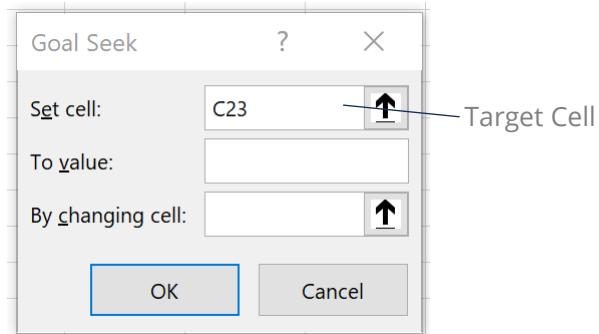
## Sensitivity

### Goal seek

Goal Seek is a simple but powerful sensitivity and testing tool. Goal Seek can be used for “break even” analysis and to answer many typical questions that would be asked of a model for example: ‘how much growth is required in order to achieve the target return?’.

Goal Seek is very easy to use:

1. Select the cell containing the formula whose result you wish to calculate (in this case D23), then select Data;What-If-Analysis; Goal seek. The following dialogue box will be displayed:



2. In the second (To value) box enter the value you would like the Set cell to equal
3. In the third (By changing cell) box input the address of the cell containing the input you wish to vary. In the case of the question above it would be the cell containing the growth rate assumed in the model. This must be an input – it cannot be a formula
4. Press OK.

Excel will then vary the value in the input cell until the value in the target cell reaches the target value.

If the target cell is formatted to a number of decimal places, you will notice that Excel usually does not exactly hit the target. Excel stops the iteration process when it meets the target value set +/- the iteration limit set in the model. To change the iteration limit to get Excel to get closer to the target, go to File; Options; and select the Calculation tab. Set the iteration limit to an appropriate number of decimal places.

Goal Seek, like the Data Table tool which follows, is very powerful, but both rely on a simple set of single parameter inputs and key results. Both of these tools lend themselves very well to simple broad brush models. The more that inputs can be simplified, for example using a single interest rate, sales growth rate or inflation rate for the whole forecast, the more useful simple powerful tools like Goal Seek will be.

### **Data tables**

Data Tables are sensitivity tables by another name and they are brilliant as they are highly effective tools in assessing which are the most sensitive inputs (i.e. have the greatest impact on outputs) of the model. Sadly they use up a lot of memory and so it is essential that the

- File; Options; Calculation tab.

is checked for a manual (F9) calculation (or automatic except tables). Otherwise, after each new entry anywhere on the model, Excel will try to recalculate the table – which will take a particularly irritating amount of time.

The sensitivity table can look at variations of up to 2 variables.

Unfortunately, Excel requires that the 2 variables are on the same sheet as the sensitivity table. It is likely, therefore, that the table will need to be on the input sheet (although the tables' contents can be referred to an output page for printing purposes).

To set up a data table to check the sensitivity of the Enterprise Value for changes in the EBITDA exit multiple and equity discount rate, the following steps must be followed:

1. Select the output value upon which the sensitivity is to be performed (the Enterprise Value) and place the reference for this in the cell to the top left hand corner of the table
2. Choose the inputs to be varied (e.g. EBITDA exit multiple and equity discount rate) and input a series of values in the row across the top of the table (e.g. EBITDA exit multiple) and a series down the left hand column of the table (e.g. equity discount rate). Note: these series of inputs must NOT be linked to the inputs that you are looking to vary

3. The ranges in the top row and left column are generally driven from the center values (7.0 and 13.0% respectively in the following illustration) with equal increments from this center value

4. Highlight all the entries thus made which will, therefore, require a rectangular table to be highlighted

5. Using the

- Data; Table function

The row input cell reference (being the input varying across the top row of the table) – will be the input for EBITDA exit multiple which drives the rest of the model; and

Column input cell (being the input varying in the left column of the table) – will be the input for equity discount rate which drives the rest of the model.

6. Using

- F9

A data table will be produced which highlights the sensitivity of the Enterprise Value to the changing EBITDA exit multiple and varying equity discount rate.

### ***Enterprise Value – £m sensitivity***

EBITDA exit multiple						
Equity discount rate	147.7	5.0	6.0	7.0	8.0	9.0
	12.0%	133.0	143.7	154.3	165.0	175.7
	12.5%	130.2	140.6	151.0	161.4	171.7
	13.0%	127.5	137.6	147.7	157.8	167.9
	13.5%	124.8	134.7	144.5	154.4	164.2
	14.0%	122.3	131.8	141.4	151.0	160.6

In the above table, the model output for Enterprise Value is £147.7m with an EBITDA exit multiple of 7.0x and equity

discount rate of 13.0%. This is the value at the center of the sensitivity table and in the top left corner.

If the EBITDA exit multiple were to be 5.0x and the equity discount rate became 13.5%, on the assumption that all other inputs remained unchanged, then the Enterprise Value would be £124.8m – i.e. £22.9m of value has been destroyed.

### ***Making the table more flexible***

To make tables more flexible and more useful to review, it is sensible for the middle of the series of values across the top of the table (7.0 above) and the middle of the series of values down the left hand side (13.0% above) to be equal to the actual inputs in the model.

However as said above, the table will not work if these are linked to the actual inputs.

Therefore a sensitivity range schedule can be set up as follows:

	<b>Link to actual inputs</b>	<b>This is middle value</b>	<b>Incremental change</b>
EBITDA exit multiple (x)	7.00	7.00	1.00
Equity discount rate	13.0%	13.00%	0.50%

The first column is directly linked to the actual inputs. The second and third columns are entered as hard numbers.

- The number **input** in the second column must be the same value as that in the first column (but not linked). It is this cell which is linked into the center of the top row / left column of the sensitivity table
- The values either side of the middle values can be controlled by setting the increment (in the third column) by which the values should increase or decrease.

### ***Error diagnostics***

Often the model works in the way it should and the user concentrates on the key outputs. Sometimes, however, due to changes made to inputs, the sensitivity tables do not represent

the values appearing in the rest of the model. Sadly, this is often only spotted once the model has been printed.

Error messages can be used to flag up problems with sensitivity tables.

These errors are of two types:

1. When inappropriate values are being input into the top rows / left columns of the tables which do not coincide with those of the inputs used in the rest of the model.

By setting up a sensitivity range table (as above), the values in column 1 (based on the numbers driving the rest of the model) and column 2 (used to drive the sensitivity tables) can be compared. Any differences should be flagged and all differences summed.

An error message can be driven from this sum of the differences.

2. The sensitivity tables may not have recalculated as F9 may not have been pressed.

When the sensitivity tables are working, the value in the center of the table and that in the top left corner should be the same. The user can be alerted to press F9 by comparing these two numbers and driving an error message if they do not agree.

## Validating data

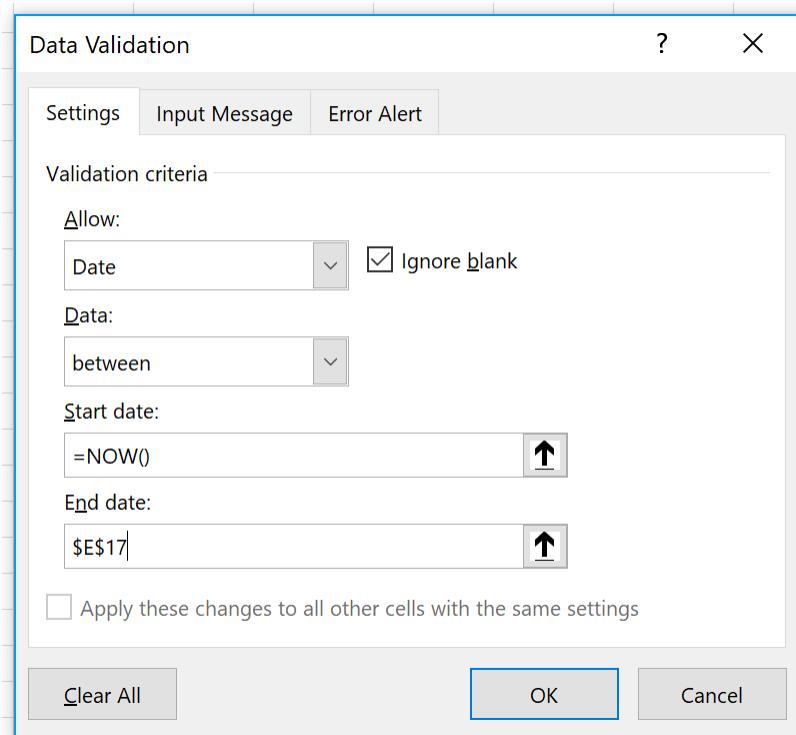
A major problem of financial modeling is controlling the quality of inputs and the results. Data validation is tremendously useful because it enables data entry to be limited, cell by cell, within a model.

### **Data validation – with inputs**

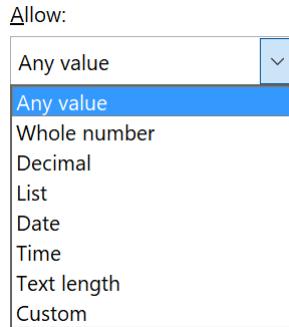
Where the cell is an input cell, invalid inputs will not be allowed (and a prompt will indicate why). This is particularly useful if dates, currencies or text are to be entered in a precise format or to ensure that an input is within an allowable range.

For example, assume that only a date lying between today and the next year end (which is in cell E17) can be chosen.

- Select Data; Data Tools; Validation 



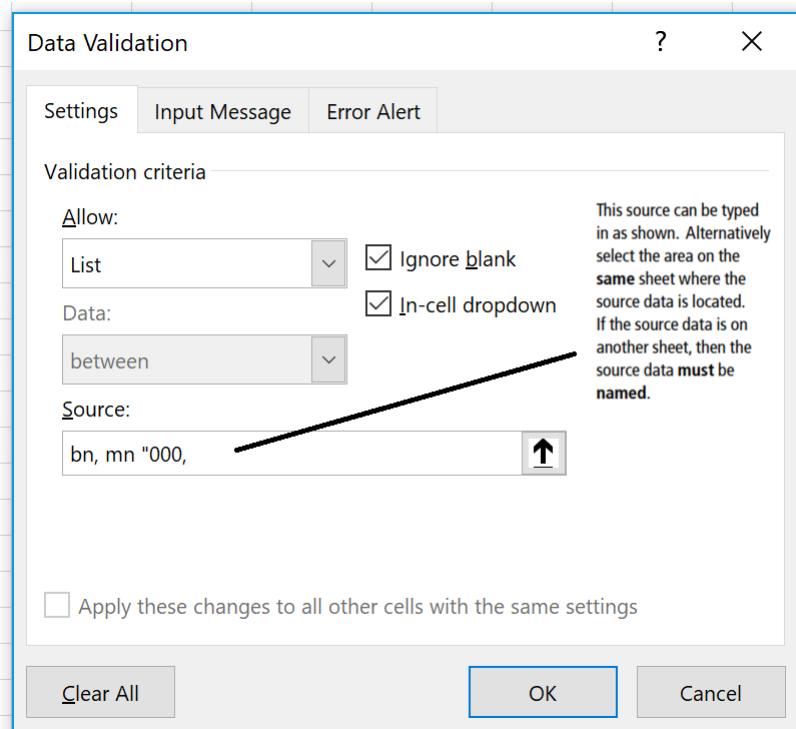
- Click on the down arrow by the Allow box and a list of options will be displayed
- Allow Date, between, and then either enter the start and end date or link to dates within the model.



The above Allow list shows the different ways in which the inputs can be constrained, e.g. whole numbers only, dates, values from a list and so on.

The Data box gives a series of choices for limiting the data (between, not between, greater than etc.) once a category has been chosen. The illustration shows the relevant entries to constrain date entry to the range described above.

If it is necessary to control the denomination entered to, say, bn, m, or '000, Select Data; Validation; select List – either enter the data as shown below in the source box or put the source data somewhere within the Excel model and then click on the arrow and highlight the area where the source data is entered.



Note. As shown, if the source data is on another sheet, then it is necessary to name the source data.

### ***Input message***

Input messages can appear at the same time as the data validated cell is selected. There is no other visual indication in the worksheet that validation is in use. This should give instructions as to what to enter in the cell.

Where a dropdown (list) box has been chosen in the settings it is unlikely that an input message will be necessary.

However, where the user has to enter, for example, a forecast date, then by selecting the Input Message tab, a message can be composed so that the following instruction will appear:

“The forecast date entered must be within the next 12 months”

### ***Error alert***

Data validation is best used to make inputting easy and to ensure robust inputs drive the model. It is imperative that inappropriate inputs are blocked – which is what data validation does.

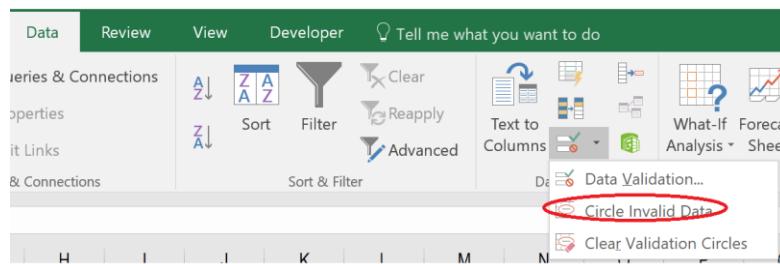
When entries are blocked the following default message appears:



As this does not indicate how to solve the problem, it is useful to change the message. By selecting the Error Alert tab, a message can be composed so that the above message is replaced by “Must enter a forecast date within the next 12 months”.

### **Data validation – with outputs**

Additionally, data validation of outputs can be used to “sense check” results: If we apply data validation to a range of cells containing formulae, Excel will not stop the results of the formulae from being outside the required range, but if the “Circle Invalid Data” button is pressed under Data; Data Tools; Consolidate Data Dropdown, then cells with results outside the required range will be highlighted:



	2001£m	2000£m	1999£m
<b>2.0 ICI EBITDA based ratios</b>			
EBITDA/Sales	12.2%	10.9%	10.5%
Continued EBITDA/Continued sales	11.0%	11.1%	10.8%
Continued EBITDA/Interest	3.4	3.1	2.2
EBITDA/Interest	3.8	3.7	2.9
Net Debt/EBITDA	3.7	3.3	2.6
Net Debt/(continuing EBITDA)	4.1	3.9	3.5
EV/EBITDA	6.8	7.7	6.6
EV/Continuing EBITDA	7.5	9.1	8.8
EV/Sales	83%	83%	70%

The cells in the highlighted area have been constrained to a value greater than 2.95

### **Conditional formatting**

Conditional formats can be used to validate results. For example, conditionally format so that those cells which are not valid / do not fulfil the benchmark criteria appear as a different color, with borders, with a colored background, etc.

The advantage of this is that the problems are highlighted without the use of other functions (i.e. the auditing toolbar for data validation above).

The disadvantage of this method is that these cells are merely formatted without having any other functional implication – i.e. the fact that a cell fails a test does not prevent that cell from being used elsewhere.

### ***Conditional statements***

The use of flags (0 and 1) through IF statements can add functionality if the result of an equation is not valid / does not meet the benchmark criteria.

If, for example, a project has to fulfil 4 out of 5 criteria to get funding then conditional formatting and data validation can still be used to identify whether the benchmarks have been reached on each criteria.

However, to indicate that some of the inputs need to be changed as they do not fulfil 4 criteria, a series of IF statements with 1 or 0 as the values if TRUE or FALSE respectively can be added. If the sum of these statements is greater than 1 then the tests have failed (and so a message stating that inputs should be changed should appear). If the sum comes to 1 or less then the project can get the funding.

### ***The ISERROR function***

It can be irritating when #DIV/0! appears in a cell, not because a genuine error has been made but because one of its precedents has not yet been completed. It then has a knock-on effect to all the current cell's dependents, so making the model ugly.

This function effectively eliminates errors from the formula and also stops its spread to any of its dependents.

For example:

If the contents of A1 were 187; A2 were 0; and those of A3 were =A1/A2 the result would be #DIV/0!.

By amending the formula in A3 to:

=ISERROR(A1/A2)

the result would be TRUE (i.e. there has been an error).

This has its uses, but could be made more useful by adding a logical test to the function:

=IF(ISERROR(A1/A2),0,A1/A2)

The result being 0 this time rather than TRUE.

Note: the ISERROR function should be used with care. Sometimes when an error occurs it is because something has gone wrong with the model. This error needs to be fixed. The ISERROR function will cover up any errors and so can undermine the controls put in the model.

## Pivot tables

Pivot tables are used to quickly summarise large volumes of data. By using a pivot table, you can calculate and present summary information without writing a single formula or copying a single cell. They allow data to be analyzed by using multidimensional data views which can be quickly created by dragging and dropping category headings to move data around.

There are three key reasons for using a pivot table:

1. To summarise the data contained in a lengthy format into a more compact, readily understandable form;
2. To find relationships between the data; and
3. To organize the data in a form that is easy to chart.

### ***Caution***

Best practice modeling techniques create models which update based on changes to the inputs and workings. Unfortunately, the data in the pivot table is not automatically linked to the original source – changes in the source data will not automatically alter the values in the pivot table. The pivot table can be refreshed, but there is no default message to warn about this. Consequently, pivot tables should be used with caution in financial modeling.

### ***Pivot table data***

When using pivot tables, the source data must be set out in a table: i.e. there must be more than one column of data and each different column must have a heading.

When setting up a table the following points should be noted:

- Headings must be in the row directly above the data, i.e. there cannot be rows separating the headings from the data
- Blank cells should be avoided
- Leave a blank column between different tables on the same sheet
- It is easier to work with the pivot tables if the data ranges are named.

### Data characteristics

The following characteristics must be identified within the data:

- The data field, where the data field is the variable that you want to summarise. In the table below, this will be the “score”.
- The row and/or a column field, where the row and/or the column fields are the variables that will control the data summary. The month, subject and student will be the row or column fields in the following data.

Month	Subject	Student	Score
January	English	Elisa	87
January	Maths	Elisa	65
January	Science	Elisa	58
January	Art	Elisa	89
January	History	Elisa	81
January	French	Elisa	62
February	English	Elisa	51
February	Maths	Elisa	72
February	Science	Elisa	89
February	Art	Elisa	83
February	History	Elisa	84
February	French	Elisa	57
March	English	Elisa	41
March	Maths	Elisa	71
March	Science	Elisa	41
March	Art	Elisa	92
March	History	Elisa	91
March	French	Elisa	56
January	English	Mary	87
January	Maths	Mary	53
January	Science	Mary	35
January	Art	Mary	61
January	History	Mary	58
January	French	Mary	92
February	English	Mary	68
February	Maths	Mary	54
February	Science	Mary	56
February	Art	Mary	59
February	History	Mary	61
February	French	Mary	93
March	English	Mary	41
March	Maths	Mary	35
March	Science	Mary	41
March	Art	Mary	48
March	History	Mary	67
March	French	Mary	90

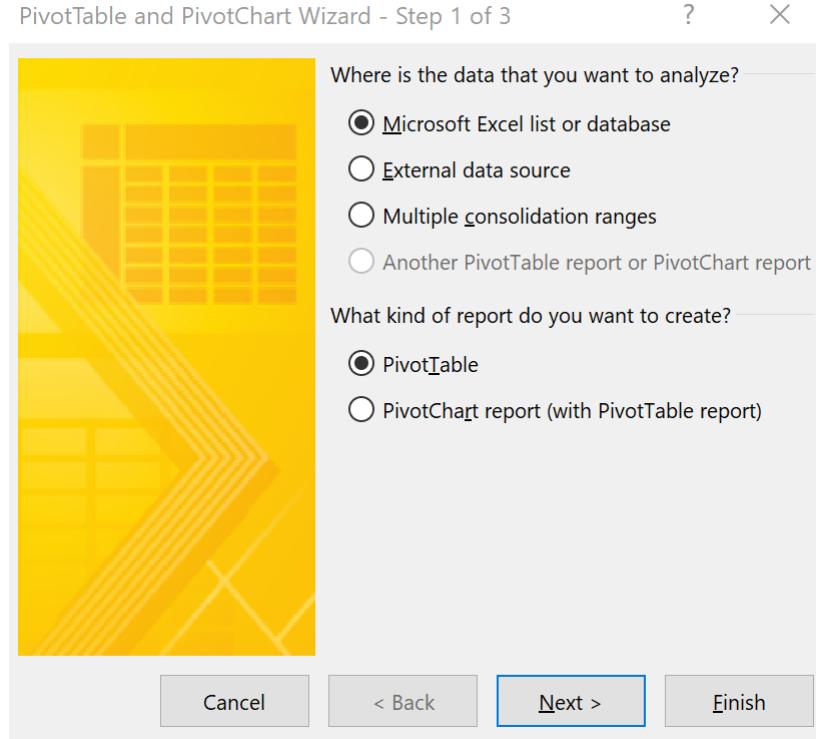
### Creating the pivot table using the wizard

To create a pivot table place the cursor anywhere in the data area and then start the pivot table wizard as follows:

- ALT + D; P
- The Pivot Table wizard starts up

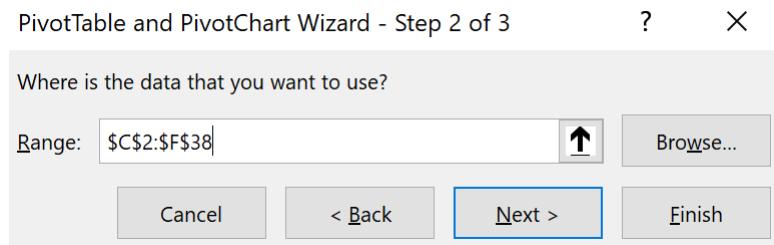
#### Step 1

Specifies the source data and whether you want a chart as well as a table. Most commonly you will get your data from the table that is part of the current sheet. Therefore select an Excel list.



### Step 2

If you were in the table when you started the wizard, Excel will display the range of cells automatically. If not, select the cells to be analyzed. If the table is to be extended at a later stage it may be better to name the table.



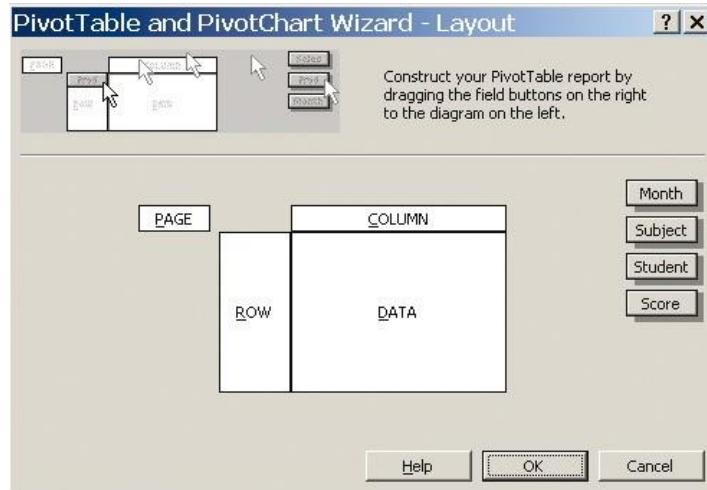
Based on the above selection, Excel will use the words from Row 2 (the top row of the data range) as the headings.

### Step 3

The final screen displayed asks for the position of the pivot table. The pivot table can either be displayed on a new sheet or on the same sheet. If the pivot table is to be displayed on the same sheet then a cell reference must be given.

However, it is useful at this stage to click on the **Layout** button. Here you can design the table by dragging the field buttons,

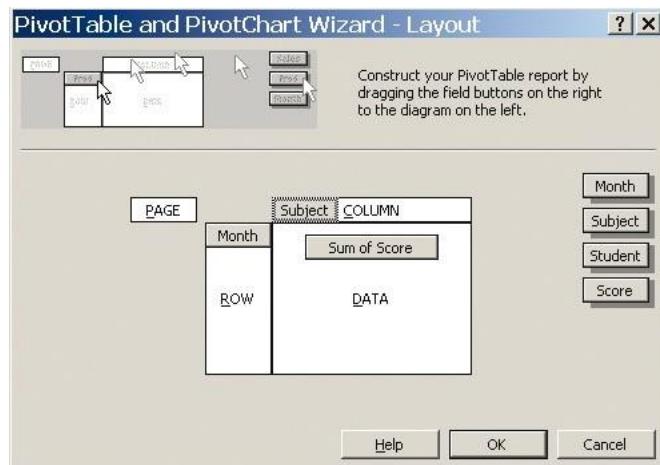
located on the right of the dialog box, to the appropriate row page and data fields.



The “field buttons” mentioned in the Wizard are those four on the right: Month, Subject, Student and Score. These can be dragged to an area on the left. One button will be dragged to the Column area, one to the Row area, and one to the Data area.

Click on **Month** and drag it over to the **Row** area. A button will appear in the row area.

Drag the **Subject** button to the **Column** area, and the **Score** button to the **Data** area (the sum function will be the default and is used for columns containing numerical data. It will count the number of entries for text values).



The final pivot table will look like the following:

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	
1																
2		Month	Subject	Student	Score		Sum of Score	Column Labels								
3		January	English	Elisa	87			Row Labels	Art	English	French	History	Maths	Science	Grand Total	
4		January	Maths	Elisa	65				January	150	174	154	139	118	93	828
5		January	Science	Elisa	58				February	142	119	150	145	126	145	827
6		January	Art	Elisa	89				March	140	82	146	158	106	82	714
7		January	History	Elisa	81				Grand Total	432	375	450	442	350	320	2369
8		January	French	Elisa	62											
9		February	English	Elisa	51											
10		February	Maths	Elisa	72											
11		February	Science	Elisa	89											
12		February	Art	Elisa	83											
13		February	History	Elisa	84											
14		February	French	Elisa	57											
15		March	English	Elisa	41											
16		March	Maths	Elisa	71											
17		March	Science	Elisa	41											
18		March	Art	Elisa	92											
19		March	History	Elisa	91											
20		March	French	Elisa	56											
21		January	English	Mary	87											
22		January	Maths	Mary	53											
23		January	Science	Mary	35											
24		January	Art	Mary	61											
25		January	History	Mary	58											
26		January	French	Mary	92											
27		February	English	Mary	68											
28		February	Maths	Mary	54											
29		February	Science	Mary	56											
30		February	Art	Mary	59											
31		February	History	Mary	61											
32		February	French	Mary	93											
33		March	English	Mary	41											
34		March	Maths	Mary	35											
35		March	Science	Mary	41											
36		March	Art	Mary	48											
37		March	History	Mary	67											
..	.	.	.	.	.											

### Modifying a pivot table

Pivot tables are so called because they allow the tables of data to be pivoted so allowing data to be analyzed in different ways. Using the Pivot Table toolbar allows this analysis to take place.

If you don't see the Pivot Table toolbar

- click on View > Toolbars > Pivot Table; or
- click on any part of the pivot table

### Moving or adding pivot table fields

Dragging the drop-down field box to the appropriate position is the quickest, though sometimes most fiddly approach to moving the fields around.

To put the Students button on the pivot table, locate the Student button on the pivot table toolbar and drag the **Student** button to the top of the pivot table, where it says "Drag Page Fields Here."

Each of subject, student and month are now shown as drop-down boxes. Any or all categories within each can be displayed (e.g. all subjects, selected subjects or an individual subject could be shown).

A field can be removed by dragging the field to any location outside the pivot table boundaries.

### Using the Pivot Table Field List

The Pivot Table Field List should appear when you click on a pivot table. If it doesn't, click on the field list button on the pivot table toolbar.

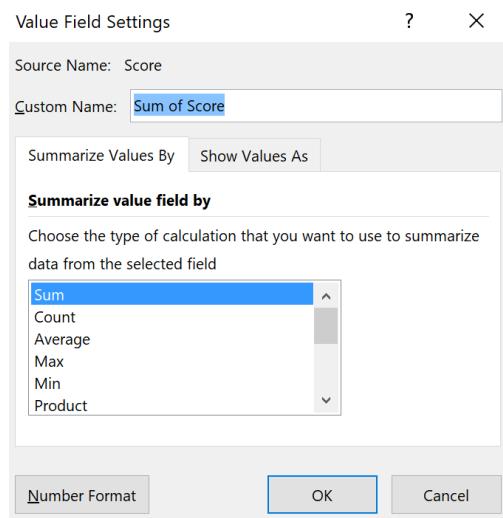
To alter the pivot table, select the field to be moved and the position to be moved to (displayed at the bottom of the pivot table field list).

Adding a new row or column field widens the view, whilst adding a new page field helps you to focus on the detail of your table.

### ***Changing values***

To change the values from say sum to average, on the pivot table toolbar, click on the pivot table button. Alternatively, right mouse on the data area of the pivot table.

- Select Field Settings and the following dialogue box appears:



### ***Changing the format of numbers***

Click in the data area of the pivot table, then click Field Settings button

(either by right mousing or using the Pivot Table toolbar). Click on the Numbers button, a format dialog box is displayed containing only the numbers sheet. Select the category required and build the format.

### ***Displaying the source of data***

To display the data that gives a specific result, double click on the data entry and the source will be presented on its own sheet. Caution should be used: this new data is not linked to the original source so changes to the source data will not alter this new data and it cannot be refreshed, unlike the pivot table.

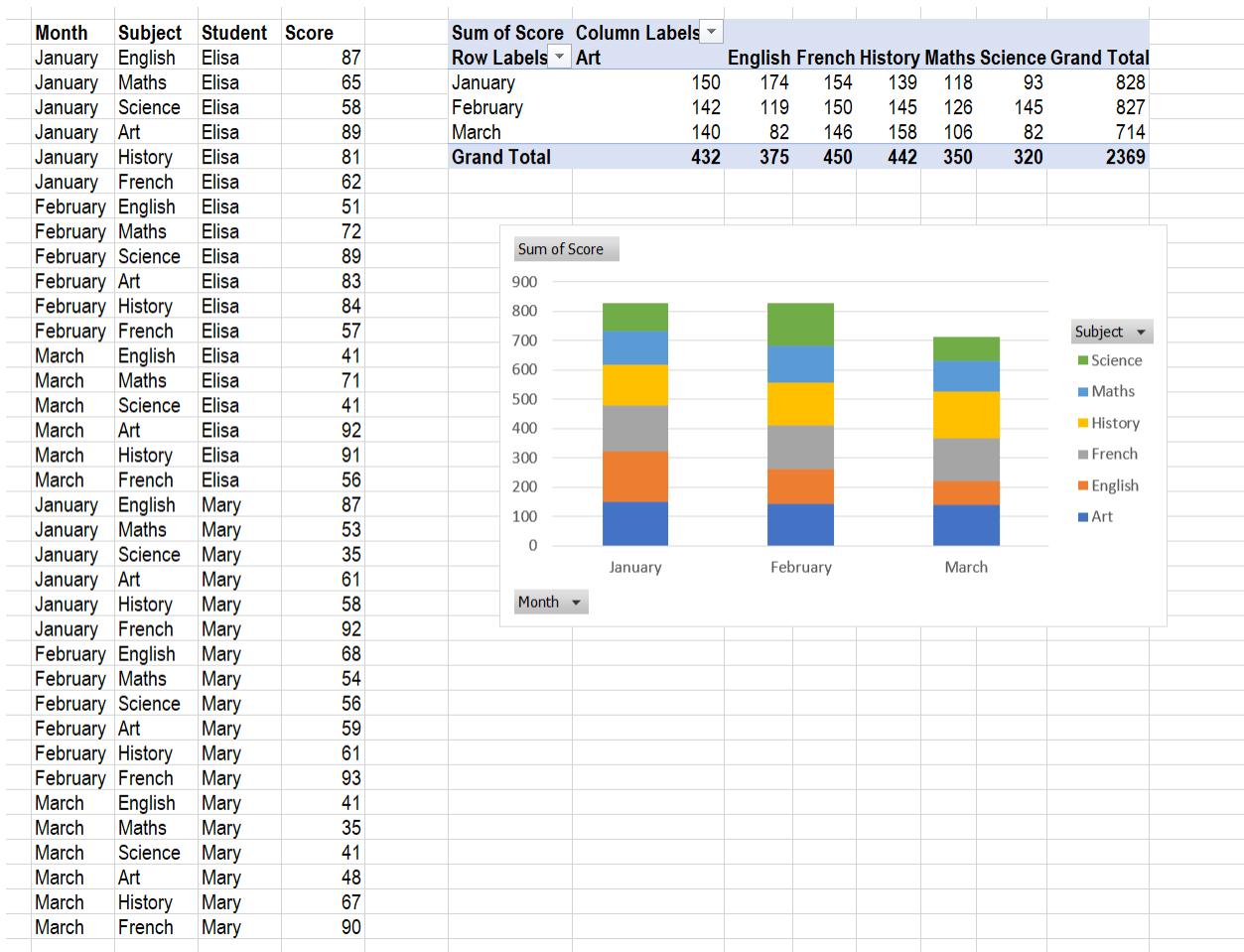
### ***Creating a pivot chart***

Pivot charts can be created at the same time as the pivot table or as required simply by clicking on the Pivot Chart button.

A new window will be opened containing a stacked bar chart (as default) of the data contained in the Pivot Table.

Once the chart has been created it can be manipulated in a similar manner to the pivot table and you can change the chart type and format as with any other chart.

The following shows the result if a pivot chart is added based on the pivot table:



### **Consolidating data with a pivot table**

Pivot tables can also be used to consolidate data. In the following example, we have six divisions laid out in the same format on six individual sheets and with no empty rows between the headings (date) and the data. As the data areas are all the same, a pivot table can be used to summarise, consolidate or select any number of these divisions.

P&L heading	2006	2007	2008	2009	2010	2011	2012
Revenues	257	251	266	282	300	312	322
Costs	(168)	(151)	(163)	(166)	(164)	(168)	(170)
EBITDA	89	100	102	116	136	144	152
Depreciation	(48)	(49)	(52)	(50)	(55)	(58)	(60)
EBIT	41	52	50	65	81	86	92

Using the pivot table wizard we can consolidate this data.

1. Select one of the sheets / divisions and start the wizard – this time check the “Multiple consolidation ranges” in step 1
2. Create a single page field for me in step 2a
3. Select the data range on the first sheet; press “Add” and then click on the next sheet tab – the same data range for the next sheet will automatically be selected; continue this for all 6 divisions before moving on to the final step. Note the pivot wizard orders the divisions alphabetically according to sheet name.

	D	E	F	G	H	I	J	K	L	M
1	P&L heading			2006	2007	2008	2009	2010	2011	2012
2	Revenues				14					
3	Costs				(11)					
4	EBITDA			--	3					
5	Depreciation				(2)					
6	EBIT			--	1					
7										
8										
9										
10										
11										
12										
13										
14										
15										
16										
17										
18										
19										
20										

PivotTable and PivotChart Wizard - Step 2b...

Where are the worksheet ranges that you want to consolidate?

Range:

Add Delete Browse...

All ranges:

- ES!\$D\$1:\$A1\$6
- IS!\$D\$1:\$A1\$6
- IW!\$D\$1:\$A1\$6
- WP!\$D\$1:\$A1\$6
- WT!\$D\$1:\$A1\$6

Cancel < Back Next > Finish

4. Having the pivot table as a new sheet will default to the following:

Page1		(All)		PivotTable Field L					
Sum of Value		Column		Drag items to the PivotTable report					
Row		2006	2007	2008	2009	2010	2013		
Costs		(308)	(294)	(434)	(401)	(402)			
Depreciation		(57)	(67)	(74)	(69)	(74)			
EBIT		36	48	54	71	85			
EBITDA		92	115	128	140	158			
Revenues		400	410	562	541	560			
Grand Total		163	211	235	283	327			

Add To Row Area

The default pivot table is not perfect, but minor changes will get it into the required form:

- The order of the income statement is alphabetical – drag “Revenues” to the top then the order can be re-worked. Some income statement headings can even be removed (through the use of the “Row” drop-down menu)

- The number of years of output can be refined by eliminating some through the use of the “Column” drop-down menu
- The default is for all divisions to be included in the summary. Alternatively any one division could be shown in the output by changing the selection in the “Page 1” drop-down menu. Note, each of the divisions is known as “item 1”, “item 2” etc so care is needed to ensure the correct division is output.
- If a selection of divisions is required, drag the “Page 1” to beside the Row in the row headings part of the table. At this point all 6 divisions will appear. Their names can be changed by typing over them (remember “item 1” is the first of the sheets alphabetically) and then using the “page 1” drop-down menu to select the number of divisions required.

The final table could look like the following:

		Sum of Value	Column	Page1	2009	2010	2011	2012	PivotTable Field L	2015	2016	Grand Total
Row									Drag items to the PivotTable report			
Revenues	ES	127	135	138	144				Row			
	Holding	15	13	13	13				Column			
	WP	282	300	312	322				Value			
Revenues Total		424	448	464	479				Page1			
EBITDA	ES	12	16	17	16				Add To			
	Holding	4	3	3	2				Row Area			
	WP	116	136	144	152							
EBITDA Total		132	155	164	170							
EBIT	ES	3	6	8	7							
	Holding	1	0	0	(0)							
	WP	65	81	86	92							
EBIT Total		69	88	94	99							
Grand Total		625	691	722	748							
						771	780			809	827	5,974

## Model completion

### ***Group outline***

When printing or presenting the model, there may be parts of the model which you do not want to print – e.g. historic periods, detailed calculations for check balances etc. In this case, the relevant rows or columns can be hidden:

- Select the column(s) or row(s)
- Right mouse
- Hide.

This is quick, but is shoddy practice:

- It is not always obvious that columns or rows are hidden
- Why are they hidden?
- Do they have any effect on any other parts of the model?
- Do they contain fixes for the rest of the model...?

There may be perfectly good reasons for doing it but many users would be suspicious as it is seen as a way to hide things that are suspicious.

A far better way is to:

- Select a cell(s) in the relevant column(s) or row(s)
- Data; Group and Outline; Group – Alt-D-G-G
- Select either rows or columns.

The selected area can now be hidden but with the use of a column or row bar (to the top or left hand side of the window respectively). If the bar outline symbol is “+” then the user can click this to show the hidden area. If the “-“ symbol appears in the outline bar then a defined area can be hidden.

### ***Protecting the model***

Once the model is complete and everything works, then it is worth protecting the model to ensure the modeller (or the reviewer) does not amend the formulae and corrupt the hard work done to date.

It is unlikely that the inputs and assumptions should be protected, but all other sheets are formula-driven and these are the ones that need protecting.

Note: If report manager is used, at least one sheet must remain unprotected in order to allow report manager to be activated.

Whole sheets can be protected by:

- View; Project; Protect sheet. Leave the default boxes in the dialogue box ticked
- The use of a password is optional – without a good reason, it is sensible not to use one, unless the modeller wants to be contacted at any time of the day or night by any subsequent user for the rest of the model's life!

### **Selective protection**

The default setting within Excel is that all cells will be protected when a sheet is protected.

To protect a sheet, but allow some specific cells to be changed, then cells and ranges can be “selectively unprotected” using the following procedure (note: this will only work if the sheet is unprotected first):

- Highlight the cells which you want to be able to amend • Format; Cells; Protection, untick the “Locked” box. Press OK
- Protect the sheet (as above).

This creates “windows” in the locked sheet where the model can be manipulated. This is useful for the inputs sheet where the text is protected but the actual inputs can be changed.

### **Styles and protection**

Selective protection can be done through the use of Styles. The last of the Style options is “Protection”. All input styles should have this box checked and then modified (protection – locked box is NOT checked) to be “No protection”.

As the default setting for cells is to be Locked when the sheet is protected, by leaving the “Protection” style option unticked for all other styles, the result will be that only those

cells with the input style can be changed once the sheet is protected

### Hiding

If you wish to hide all (or some) of the formulae and only allow the user to have access to the results of the cell(s), ensure the sheet is unprotected and then:

- Select the sheet – Control+A
- Format; Cells; Protection, tick the “Hidden” box. Press OK
- Protect the sheet (as above).

What you have created is a sheet which looks the same, but is protected and the user cannot see the formulae that underlie each cell.

## Charts

To quickly create a chart that is based on the default chart type, select the data that you want to use for the chart, and then press ALT+F1 or F11. When you press ALT+F1, the chart is displayed as an embedded chart; when you press F11, the chart is displayed on a separate chart sheet. This chart can then be modified as required.

The default chart type created by using the above shortcut can be easily changed by:

- Right mouse on any chart and select Chart Type
- Use the menu to select the preferred chart type
- Select “set as default chart” to the bottom left of the menu

Typically, however, the chart wizard is used to create charts.

### ***Chart wizard***

To create a chart using the chart wizard, select the cells that contain the data that you want to use for the chart. If you select only one cell, Excel automatically plots all cells containing data that directly surround that cell into a chart. If the cells that you want to plot in a chart are not in a continuous range, you can select nonadjacent cells or ranges as long as the selection forms a rectangle. You can also hide the rows or columns that you don't want to plot in the chart.

The chart wizard can either be accessed by the button in the toolbar or from the Insert menu (Alt+I H):

#### **Step 1 of 4 – chart type**

Click the chart type, and then click a chart subtype that you want to use. To see whether a specific chart looks right for your data select the “Press and hold to view sample”. Click Next.

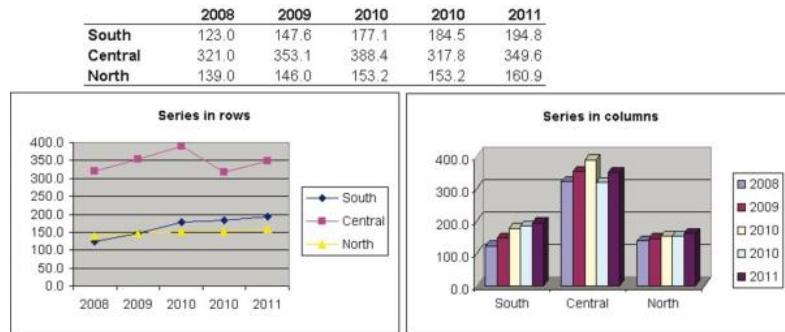
#### **Step 2 of 4 – source data**

a. On the Data Range tab, the data from the first step will be selected. It can be changed at this point.

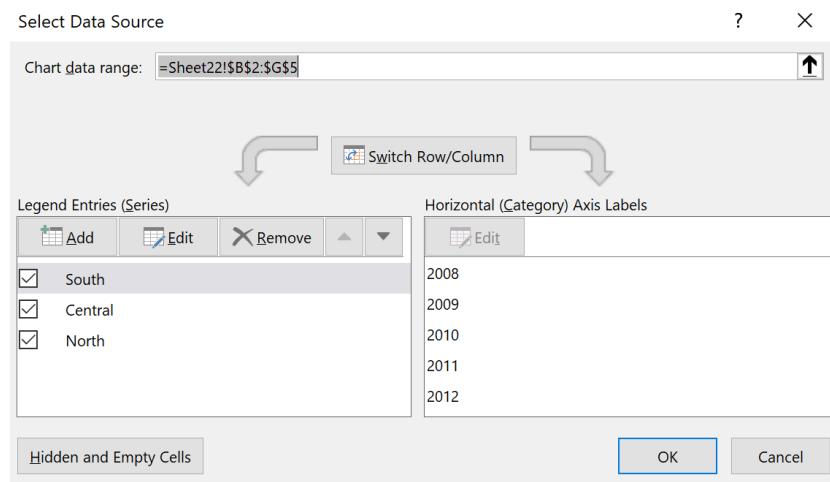
You are also asked whether the data series is in a row or a column. For example, using the following data, if we wish to

compare the performance of each division over time (as a line chart), then the series are in rows. Alternatively, if we wish to chart the development of the performance of each division (as clustered columns), then the series are in columns.

In short, the series relates to the legend and the other heading will form the x-axis.



b. The Series tab. If the data range is a continuous area, then the series names and values will be automatically selected together with the X values. If the data range is not continuous or the default references are inappropriate, the names and ranges can be altered at this stage on a series by series nature. Note, the series name can be named by either using a reference or typing in the appropriate text directly in the name box. Click Next.



### Step 3 of 4 – chart options

a. Titles – The axes and chart title can be added at this stage. Despite the need to type in the appropriate labels rather than using references to the labels used in the model it is worth doing – these can be changed (dynamically) later. Axes – used

to select whether both axes are to be presented. Usually don't change from default

b. Gridlines – used to select the need for gridlines. Usually don't change from default

c. Legend – used to select whether to show the legend and its position. Usually don't change from default – it can be easily removed and its position altered later

d. Data Labels – used to give labels for each data point. Unless there are very few data points (e.g. pie chart), the chart will look cluttered with the labels. Individual labels can be added later

e. Data Table – used to show the values as a data table directly below the chart. Infrequently used. Click Next

#### **Step 4 of 4 – chart location**

Charts can be created:

- In a separate chart sheet – a sheet in a workbook that contains only a chart. A chart sheet is beneficial when you want to view a chart or a PivotChart report separately from worksheet data or a PivotTable report
- As an object in a sheet as an embedded chart. Embedded charts are beneficial when you want to view or print a chart or a PivotChart report with its source data or other information in a worksheet

#### ***Modifying the chart***

When a chart is created, the chart tools become available and can be used to modify the chart so that it presents the data the way that you want. In general, right-mousing on the relevant part of the chart will give the appropriate modification options. Sadly, some of the steps are a little onerous and take time to master.

Fortunately, many of the normal Excel menus and functions remain active and so the chart can be manipulated in the same way as data is manipulated. When selecting the chart, see which of the menu items and icons remain active.

Different elements of the chart can be selected by use of the up and down arrows to move between components – when doing

this, the Name box (to the left of the Formula bar) will show the name of the item selected.

### ***Change the location of a chart***

If a chart is embedded as part of a sheet it can be easily dragged around the sheet. If the chart is on a chart sheet or it is embedded on one sheet and needs to be moved to another, then right-mouse on the chart and change its location, using the location choice.

Under 'Choose where you want the chart to be placed', do one of the following:

- To display the chart in a chart sheet, click New sheet. If you want to replace the suggested name for the chart, you can type a new name in the New sheet box
- To display the chart as an embedded chart in a worksheet, click Object in, and then click a worksheet in the Object in box

### ***Change the standard text size, font and color***

When the chart is selected, the size and font of all text within the chart can be changed at one time by using the Font and Font Size drop-down menus (and color if needed) rather than having to select each bit of text separately.

### ***Removing elements of the chart***

To quickly remove any part of the chart, select that item by use of the left mouse and press the delete key. For example, the legend, an axis, the (default grey) background color, or the gridlines, etc could be removed.

### ***Adding a series***

There are two ways of adding a series, the standard way and the quick way:

#### **Standard approach**

- Right mouse on the chart and select Source data
- On the Series tab select Add
- Enter the Values section and select the new data range (and Name if required)

### Quick approach

- Select and then copy (Ctrl+C) the data series to be added
- Click on the chart and paste (Ctrl+V) – the series should be automatically added

### Mixing bar charts and line charts

- Select any individual series (using the up and down arrows to tab through the series)
- Right mouse on the series and select Chart Type
- The bar chart for that series can then be changed to a line chart (or vice versa)

### Modifying the axes

An axis can be modified in many ways through the menu derived from right mousing (or double clicking) on it. Some of the options require you to play around to get the right look for your chart but the following options may be useful:

- Scale – the default maximum and minimums (commonly zero) may not be appropriate for your data
- Font – Autoscale is the default so that when the chart is resized, the font size moves relatively. If the font size is to remain at, say, 8 point then the Autoscale should be removed
- Number – Linked to source is the default which may not always be appropriate. For example, where the range is €0 - €10,000,000 it may be useful to specify the number style as €#,##0.0,,"m". The result will show the axis €0.0m - €10.0m.

### Dynamic axes and titles

The chart title or axes labels must be typed in using the chart wizard rather than being dependent on data from the model. Consequently, changes to the model may change the chart, but the axes and title labels will not change. These labels can easily be made dynamic (i.e. linked to the model) once the chart has been created.

By selecting a label on the chart (e.g. the title or an axis label), the formula bar becomes active (and the Name box to the left of the formula bar shows "Chart Title" or "Value Axis Title", etc). A formula can then be entered into the formula bar – this

should be the cell reference of the text which needs to be the label.

For example, if the chart title is to be "Value creation – exit year 3" (where 3 is a variable in cell E4), a text string of the form

= "Value creation – exit year "&E4

can be created in, say, cell C43. The formula to be input into the formula bar once the chart title is selected should be

=C43

Note, the text string cannot be created in the formula bar of the chart title – only simple single cell references can be used.

Additional dynamic labels can be added by the use of text boxes. (A quick way to get a new text box is to start typing in the formula bar: a new text box is then created using this formula which can then be moved and formatted as appropriate).

### ***Dynamic labels***

The chart wizard can be used to label each data point. Alternatively, by selecting the data series in the chart and then using the Format Data Series menu (by right mouse), a data label can be added for the entire series. However, this is often overkill so that the labels take over the chart.

If only selected labels are wanted then each superfluous label can be selected in turn and deleted so that only the required labels remain. When there are many data points or data series then this can be onerous (and not dynamic).

If, for example, only the final data point should show a label, this can be easily created:

- select the data point on the chart
- right mouse to get Format Data Point menu
- add a label using the Data Labels

Another approach is to create a new series which only has one point. For example, if a chart is to be created from a column of data and only the maximum point in the series is to be labeled,

then a new series can be easily created to show this dynamic data label.

If the values making up the series are in E20:E39, then a new range can be created in column F of the form:

=IF(E20=MAX(E\$20:E\$39),E20,0)

The formula will give a series of 19 zero values and one true value. If the range is charted for this series, Excel will give one point surrounded by 19 zero values. If a line chart is created from this series then this hasn't quite fulfilled the need.

In charts, Excel ignores any error values and does not attempt to plot them. Understanding this, an alternative can be created:

=IF(E20=MAX(E\$20:E\$39),E20,NA())

The result will be a series of 19 #N/A and one value. If the range is charted for this series, Excel will ignore the #N/A references and merely give one point. The series can then be formatted to show labels; the result being that only the maximum will be shown.

### ***Dynamic gridlines***

By adding new series, dynamic gridlines can be inserted. Using the above example, if a gridline is required for the maximum value in a series then a new series can be created in G20:G39:

=MAX(E\$20:E\$39)

By selecting and then copying the data in G20:G39, followed by selecting the chart and then simply pasting, a horizontal (grid) line will be created at the maximum value which can then be appropriately formatted.

## Historic financials

Decide which historics are necessary – i.e. income statement, cash flow statement and balance sheet.

Inputs should go on the inputs page, but historics are facts rather than assumptions driving future results or value and so it is reasonable to put them on the appropriate sheets (i.e. income statement historics on IS sheet, etc.).

Think about the structure of the financials.

- Decide on which headings are necessary in each – for example, in an income statement it may be Sales, EBITDA, EBIT and net income with all other numbers being of limited interest to the output
- Alternatively, a detailed income statement might be deemed necessary for the required output. Here the limit may be the level of detail in the historic financials, or more likely, the level of detail in the forecast assumptions available (e.g. from brokers or management)
- In the balance sheet, a detailed breakdown is lovely, but realistically, it is often only the capital structure that is necessary for most outputs – many of the other categories can be combined.

### The income statement

Put in the necessary headings – and the other figures between these are “noise” to make the statements reconcile.

Ensure that the bottom line figure ties in with the source – and put in a check to ensure this.

It will be necessary to tie some of these numbers into the other financials – a profit figure (one of EBITDA, EBIT or net income depending on preference) to start the cash flow and the cumulative reserves (or equity) for the balance sheet (see below).

### The cash flow

Put in the necessary headings (probably operating cash flow and prefinancing cash flow) and the other figures between these are “noise” to make the statements reconcile.

The starting point for the operating cash flow is likely to have been fed from the income statement sheet (one of EBITDA, EBIT or net income depending on preference).

Ensure that the bottom line figure ties in with the source and put in a check to ensure this.

It will be necessary to tie the cumulative cash (or net debt) into the balance sheet (see below).

### The balance sheet

Put in the necessary headings (probably capital structure, PPE and working capital) and the other figures between these are "noise" to make the statements reconcile.

The source for the equity (or retained earnings) should come from the income statement sheet:

On the income statement sheet, reconcile the bottom line to the equity (or retained earnings) from the balance sheet using:

Start of year	X
Net income	X
Less: Dividends	(X)
Other additions (deductions)	X
End of year	X

The category "Other" should be explainable (e.g. equity raised, other recognised gains or losses), but some adjustments may not always be laid out in the source.

The source for debt, cash or net debt should come from the cash flow sheet:

On the cash flow sheet, reconcile the bottom line to the net debt (or cash) from the balance sheet using:

Start of year	X
Cash flow (pre net debt flows for net debt reconciliation)	X
Other additions (deductions) – e.g. foreign exchange	X
End of year	X

The category “Other” should be explainable, but some adjustments may not always be laid out in the source.

Put in some checks to ensure that the balance sheet balances and put the result on the Checks sheet.

The historic balance sheet from the source will always balance and so must the balance sheet in the model before moving on – and this should be done without the need for a “fudge” figure.

## Forecast financials

To make life easier, the first step must be to get the forecast balance sheet to balance.

### Ensuring balancing balance sheets

This is done by:

1. Filling in all the totals and subtotals in all the forecast financial statements (including the retained earnings / equity and cash / net debt reconciliations together with the balance sheet check calculations).  
If the historic financial statements have been set up correctly, then all these formulae can be copied from the historics.  
In order to ensure that the forecast financials continue to integrate, the retained earnings / equity will be fed from the retained earnings / equity reconciliation in the income statement workings and the cash / net debt from the cash / net debt reconciliation. As profits are inserted into the forecast income statement and cash flows into the cash flows statement then the balance sheet will update. On setting these up in the forecast periods, there will, initially, be no movement.
2. The balance sheet will not currently balance. By linking each value in the balance sheet (other than retained earnings / equity and cash / net debt) to the value in the previous year, the balance sheet should initially balance (at the same value as the last historic year).
3. All movements in other categories within the balance sheet will be updated on a module by module basis.  
For example, if capex is forecast, formulae should be updated to accommodate this - capex will reduce cash in the cash flow and increase assets in the balance sheet.  
When adding the results of the forecast workings, the financial statements should then automatically update and any errors will immediately be revealed through the checks you put in earlier – if they do not, you should not move on.

The objective is to create all the individual lines which will make up the income statement, cash flow and balance sheet. The usual minimum requirements in terms of the number of modules is three and the components are as follows:

**a) Operations and working capital**

- Sales
- EBITDA margin
- Working capital balances

**b) PPE / fixed assets**

- Net book value
- Annual depreciation charge
- Aggregate annual capital expenditure

**c) Debt**

- Closing debt balances
- Interest costs
- Fees payable
- Aggregate drawdown and repayment assumptions
- Repayments of overdrafts or revolving credits from free cash flow.

***Error identification***

After each module, the outputs from the workings should be tied into the financials, so creating a balancing balance sheet at each stage of building up the model. For example, if the balance sheet does not balance after processing the operations and working capital numbers, then the error must have occurred in that module and so the error should be easier to track.

Find the difference in the balance sheet in the first period of imbalance.

- If the difference is recognisable – error of omission – the entry has not been entered in all the appropriate places
- If the difference  $\div 2$  is recognisable – the entry has been made but added rather than taken away or vice versa.

For example, to tie in the operations and working capital numbers:

Sales, operating costs (excl. depreciation & amortisation) & EBITDA	IS
Working capital increase (add to appropriate brought forward figure)	BS
EBITDA & working capital increase	CFS

### Setting up the reconciliation

P&L	Balance sheet	CFS
	opening forecast	
Sales		EBITDA
Operating costs	PPE 600 → 600	Wking cap incr
EBITDA	other net assets 300 → 300	Operating CF
Dep & amort	cash 50, 50	Capex
EBIT	950, 950	Tax
Interest		Pre-financing CF
Tax		Dividends
Net income	Debt 625 → 625	Interest
Dividends	Shares 75 → 75	Equity
Retained earnings	Retained earnings 250 → 250	Net debt flow
		Debt
		Cash flow
Ret earnings		
Start 250		Cash
Retained earnings	(BOLD numbers - inputs this module)	Start 50
Other		Cash flow
End 250		Other
		End 50

### Operations and working capital

P&L	Balance sheet	CFS
	opening forecast	
Sales 750		EBITDA 350
Operating costs 400	PPE 600, 600	Wking cap incr (40)
EBITDA 350	other net assets 300, 340	Operating CF 310
Dep & amort	cash 50, 360	Capex
EBIT 350	950, 1,300	Tax
Interest		Pre-financing CF
Tax		Dividends
Net income 350	Debt 625, 625	Interest
Dividends	Shares 75, 75	Equity
Retained earnings	Retained earnings 250, 600	Net debt flow
Ret earnings	950, 1,300	Debt
Start 250		Cash flow
Retained earnings	(BOLD numbers - inputs this module)	
Other		Cash
End 600		Start 50
		Cash flow
		Other
		End 360

**PPE**

	P&L	Balance sheet		CFS
		opening forecast		
Sales	750			EBITDA 350
Operating costs	400	PPE 600	625	Wking cap incr (40)
EBITDA	350	other net assets 300	340	Operating CF 310
Dep & amort	150	cash 50	185	Capex (175)
EBIT	200		950 1,150	Tax
Interest				Pre-financing CF
Tax		Debt 625	625	Dividends
Net income	200	Shares 75	75	Interest
Dividends		Retained earnings 250	450	Equity
Retained earnings	200		950 1,150	Net debt flow
				Debt
				Cash flow
Ret earnings				Cash
Start	250			Start
Retained earnings	200			Cash flow
Other				Other
End	450			End
(BOLD numbers - inputs this module)				

**Debt and interest**

	P&L	Balance sheet		CFS
		opening forecast		
Sales	750			EBITDA 350
Operating costs	400	PPE 600	625	Wking cap incr (40)
EBITDA	350	other net assets 300	340	Operating CF 310
Dep & amort	150	cash 50	225	Capex (175)
EBIT	200		950 1,190	Tax
Interest	60			Pre-financing CF 135
Tax		Debt 625	725	Dividends
Net income	140	Shares 75	75	Interest (60)
Dividends		Retained earnings 250	390	Equity
Retained earnings	140		950 1,190	Net debt flow
				Debt
				Cash flow
Ret earnings				Cash
Start	250			Start
Retained earnings	140			Cash flow
Other				Other
End	390			End
(BOLD numbers - inputs this module)				

## **Tax and dividends**

	P&L	Balance sheet		CFS
		opening forecast		
Sales	750			
Operating costs	400	PPE	600	EBITDA 350
EBITDA	350	other net assets	300	Wkng cap incr (40)
Dep & amort	150	cash	50	Operating CF 310
EBIT	200		950	Capex (175)
Interest	60		1,080	Tax (40) →
Tax	40	Debt	625	Pre-financing CF 95
Net income	100	Shares	75	Dividends (70) →
Dividends	70	Retained earnings	250	Interest (60)
Retained earnings	30		280	Equity
			950	Net debt flow (35)
			1,080	Debt 100
		check	-	Cash flow 65
Ret earnings				
Start	250			Cash Start 50
Retained earnings	30			Cash flow 65
Other				Other
End	280			End 115

(BOLD numbers - inputs this module)

## Debt modeling

The big problem when modeling debt is the ease with which circularities can be created. As a model is a simplification of the world, then the circularity problem can be circumvented by use of appropriate simplifying assumptions.

### ***The problem***

Tax is often calculated using the following:

EBITDA	X
Depreciation (tax based)	(X)
Net interest expense	(X)
Taxable profit	X

Net interest expense is interest on debt less (add) interest on cash (revolver) respectively.

Interest on cash / revolver balances is calculated using the following:

Opening cash (revolver) balance	X
Cash increase / (decrease) in year	X
Cash (revolver) at end of year	X

Cash increase in the year is a post-tax, post-interest figure and so, therefore, is the cash at the end of the year. Consequently,

- The tax expense is dependent on interest on cash and
- Interest on cash is dependent on both tax expense and interest on cash

i.e. a circularity has been created:

- Without changing the calculation settings of Excel, the model is likely to crash and even if it doesn't, the numbers populating the model cannot be trusted.
- By changing the calculation settings to switch the iteration on (Tools, Options, Calculation, Iteration) the numbers can be trusted, but, particularly with a large model, the model remains unstable. If the model is populated with volatile functions and data tables then it may from time to time crash and/or #REF! out.

### A solution

(Assumption: the debt instruments have a structured repayment profile and any shortfalls or spare cash goes to the cash / revolver)

- Build up the individual debt schedules with structured repayments
- Calculate the interest arising on debt instruments
- Set up the cash / revolver schedule as:

Opening cash (revolver) balance	X
Cash increase / (decrease) in year (leave blank for now)	
Cash (revolver) at end of year (opening +/- increase / (decrease))	X

- Calculate interest on cash / revolver based on OPENING balance (to avoid circularity)
- Sum up all interest to find net interest expense
- Do tax working (including the net interest from above)
- Put tax expense into both the P&L and the cash flow (and balance sheet if it is not all to be paid in the year)
- Fill in the "Cash increase / (decrease) in year" line above as

Net debt decrease (increase) in year	X
Scheduled debt repayments	(X)
Cash increase / (decrease) in year	X

Where net debt decrease (increase) in the year is the post-tax (but not yet post interest) cash flow.

9. All the debt (and cash) and interest information is now calculated and so can be put into the financial statements
10. Put a check to ensure that the net debt (or cash) from the debt sheet equates to that in the balance sheet (which already equates to that in the cash flow).

### **Putting in a switch**

The interest on cash / revolver uses a simplifying assumption to get around the circularity problem. However, if there are significant movements in cash then the interest may not be accurate enough.

In this case it would be useful to build a switch which would vary the way the interest was calculated:

- If the switch was on, interest would be calculated on average balance (and hence circularity)
- If it were off, then interest would be calculated on opening balance (no circularity).

The settings should be set to allow iteration in the calculations (Tools, Options, Calculation, Iteration). The model will work but is less stable – and so the switch should be on only when there are few amendments left to be made to the model in order to avoid the model crashing. A check can be put in to inform whether to turn the iteration on or off.

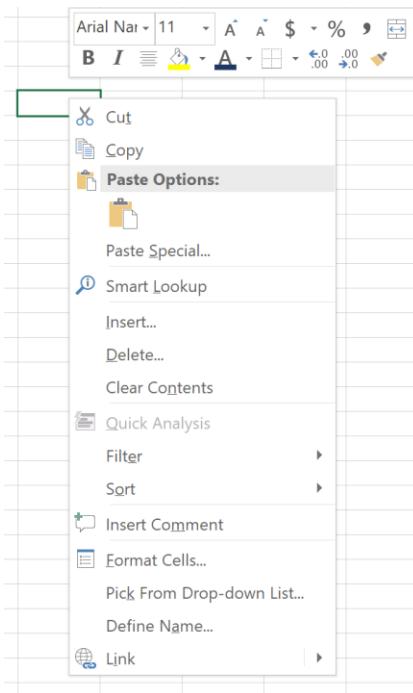
If the model crashes and/or #REF! out whilst the circularity mode (average method) is used, simply switching back to the opening method should fix the model.

## Formatting Continued

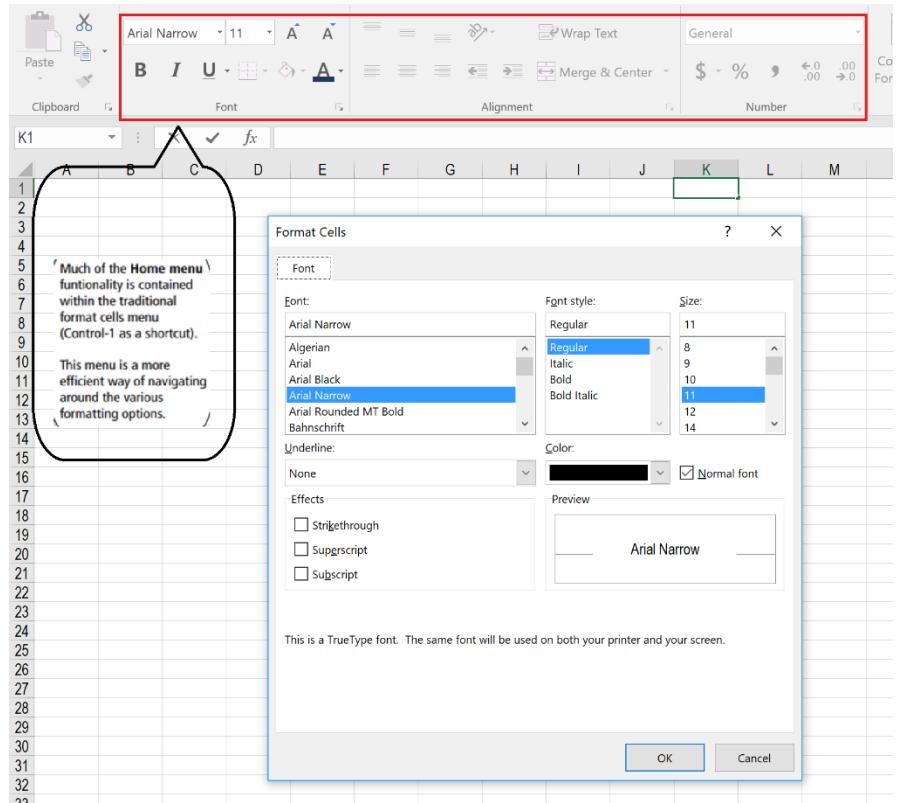
The **Home** menu in Excel (Alt-H) is home to most formatting tools. Sub-menus for Clipboard, Font, Alignment, Number, Styles, Cells and Editing are grouped under Home.

Note: All of these commands can be accessed using the keyboard via Alt, as well as with the mouse.

The mini toolbar forms part of the menu when you right click on a cell using the mouse. The mini toolbar allows the user to quickly apply basic formats to text and numbers. Unfortunately the mini-toolbar cannot be customised.



Most formatting tools from the **Home** menu can be more efficiently navigated using the Format Cells menu that is accessed through the shortcut Ctrl+1 as before.

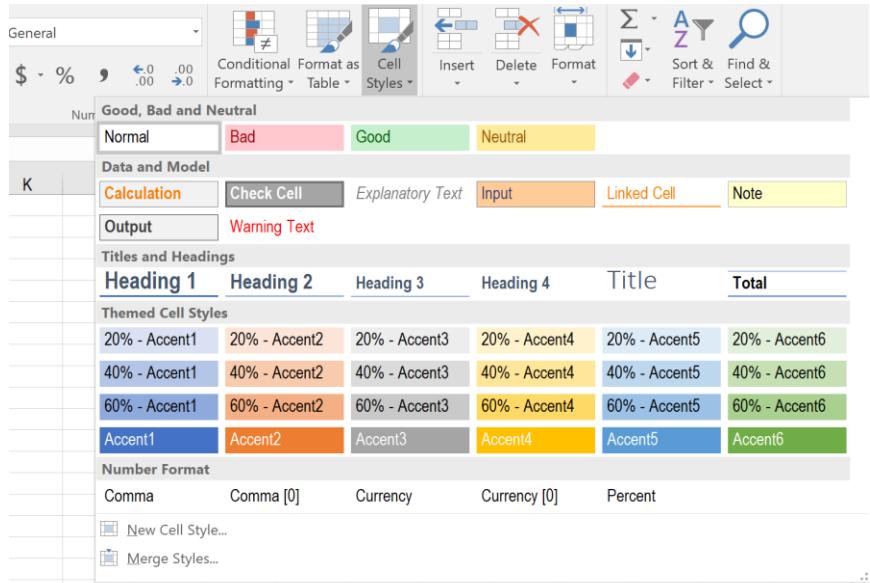


## Styles

Cell styles is possibly one of the least used areas of Excel. Some applications may be useful to the financial modeller.

Style functionality is now found in the **Home** menu. The extract below displays all the new default styles that are included in Excel, revealed in the command **Cell Styles** (Alt-H-J), a useful icon to have on the Quick Access Toolbar, replacing the Style dropdown box.

A new feature is the introduction of the “live preview”. This feature will display the impact of a style directly into the workbook so that when the mouse glides over the style options, the selected cell or range in the workbook temporarily displays the style (unless the style options area completely covers the chosen cells!). When you identify your chosen style, click on the selection and the style will be applied.

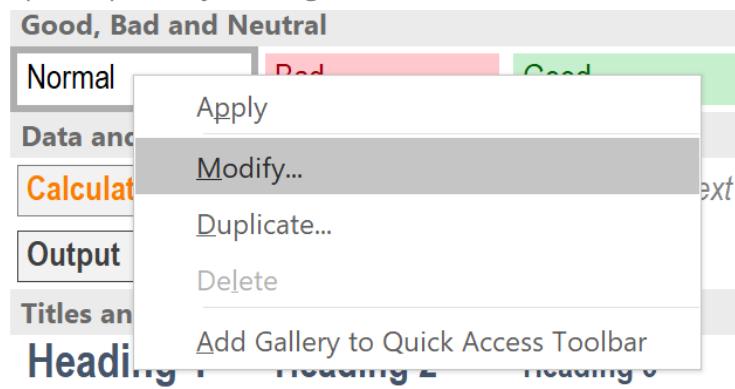


Excel enhances the style control. We are able to:

- Modify an existing style (refine the normal style)
- Create new styles
- Delete styles
- Merge styles from an another workbook into the active workbook

### Modifying an existing style

To modify an existing style the user must go through the **Home** menu and hit the **Cell Style** tool ( or Alt-H-J). This will open up all the styles available in that particular workbook. Pick the style you wish to modify and right click it (or shift-F10). This opens up the style dialog box below.



If we are building a financial model, we will usually wish to redefine the default Normal style in Excel. Therefore a right click / Shift F10 and modify on the Normal style will allow the

user to redefine the Normal style to a financial modeling standard

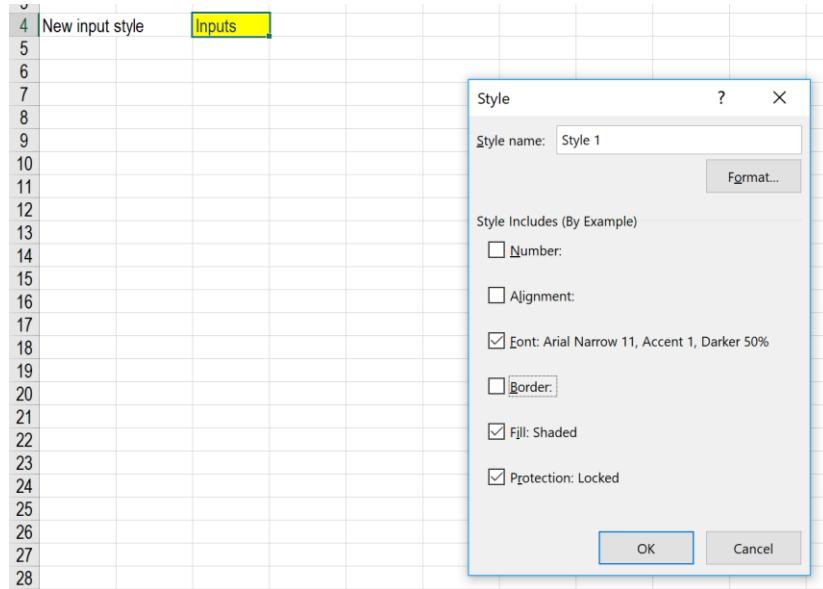
### ***Creating a new style***

The example below will illustrate how new styles are created, using an input style as an example. Cell E4 below has been formatted with a yellow background color, blue font and not protected. Note, Excel has a standard style called Input, hence we have used the name Inputs. The Input style can be modified to suit users requirements.

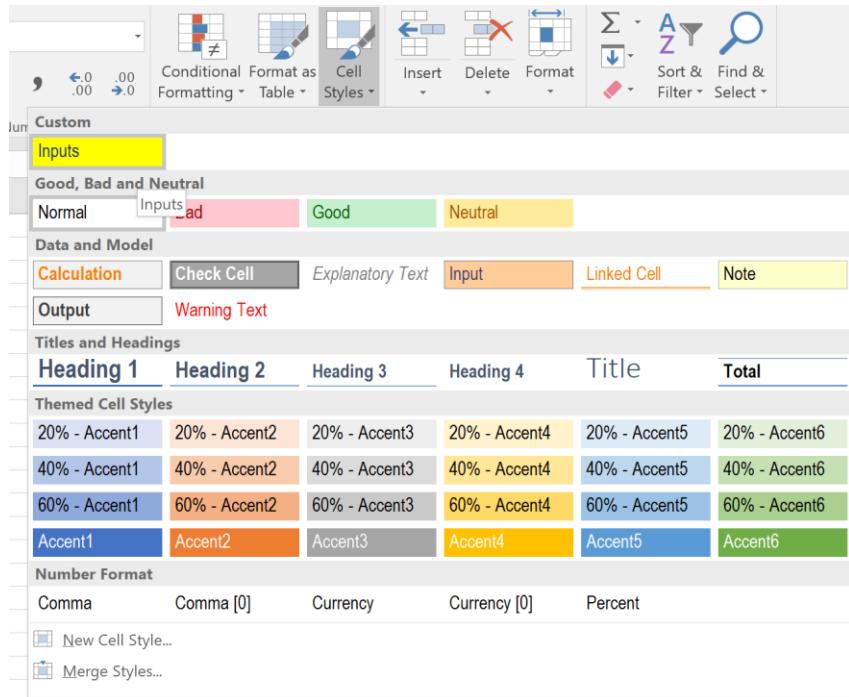
To record this formatting as a style navigate to **Home menu; Cell Styles ; New Cell Styles** (Alt-H-J-N) found at the bottom of the style listings. This opens up a Style dialog box. The user must then:

- Enter a new style name in the name box. The check boxes display the current formats for the cell. By default all check boxes are checked.
- If you do not want the style to include one or more of the format categories, then remove the checks from the appropriate boxes. For instance, the Inputs style needs flexibility on the number format, as inputs can be various types of number or text. Therefore in the example below, checks have remained only in Font, Fill and Protection. This suggests that this user wishes the style to apply the font and fill color consistently, and be unprotected even if a sheet is protected.

- Click OK to create the style and to close the dialog box.



User customised styles appear first in the Cell Style list.



### **Deleting styles**

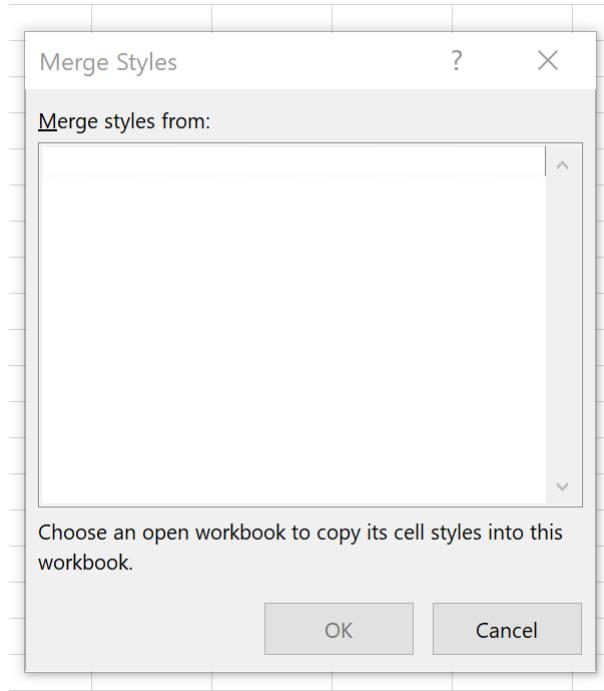
To delete a style in the menu, right click on the style and select Delete.

### **Merging styles from another workbook**

User defined styles are stored only in the workbook in which they were created. If you have created some styles which would be useful in another financial model, these styles can be transferred to the new model.

To merge styles from another workbook:

- Open both the workbook that contains the styles that you want to merge and the workbook into which you want to merge styles
- From the workbook into which you want to merge styles, choose **Home; Cell Styles; Merge** (Alt-H-J-M)
- Excel will then display the merge styles dialog box. This box will display a list of all open workbooks.



- Select the workbook that contains the styles you want to merge and click OK. Excel will transfer across all styles to the new workbook.

### Paste Special

Paste special is now within the **Home; Paste; Paste special** menu (Alt-H-V-S).

As before, copy the area first, Ctrl+C. Then navigate to the Paste menu (AltH-V). A sub-menu appears that allows the user to paste one of six qualities:

- paste (P)
- formulas (F)
- paste values (V)
- no borders (B)
- transpose (T)
- paste links (N).

Alternatively select the Paste Special (S) tab. To paste formats (Alt-H-V-S-T)

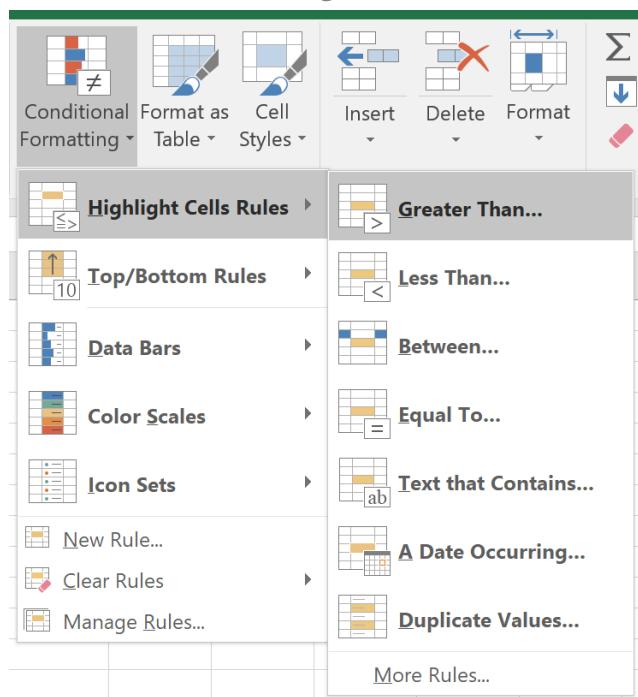
## Conditional formatting

Conditional formatting can be found within the Styles section of the Home menu, Alt-H-L. The key improvements in Excel are:

- No limit to the number of conditional formatting rules per cell (previously restricted to three). In past versions of Excel if more than one of the conditional formatting rules evaluated to "True", only the first conditional format was applied. In Excel, all rules are applied in order of listing which can be managed in the Manage Rules menu.
- Number formatting can result from conditional formatting.
- In previous Excel versions, it was relatively easy to accidentally wipe out conditional formatting by copying and pasting a range of cells to cells that contained conditional formatting. This conflict has been eliminated in 2016.

The conditional formatting menu looks very different to earlier versions of Excel.

To apply a conditional formatting rule to a cell or range, the range must be selected and then one of the commands from the conditional formatting menu must be chosen.



Alt-H-L opens the conditional formatting menu.

Conditional formatting choices are:

<b>Highlight cell rules</b>	This choice accords with the traditional use of conditional formatting. This option includes rules that highlight cells that are greater than a particular value, between two values, contain a specific text string or are duplicated
<b>Top bottom rules</b>	This type of conditional formatting will highlight, for instance, the top ten items, items in the bottom 20% or items that are above average
<b>Data bars</b>	Applies graphic bars directly to cells, proportional to the cell's value
<b>Color scales</b>	Applies background colors, proportional to the cell's value
<b>Icon sets</b>	Displays icons directly in the cells. The icons depend on the cell's value
<b>New rules</b>	Enables the user to specify other conditional formatting rules for the selected cells
<b>Clear rules</b>	Deletes all the conditional formatting from the selected cells
<b>Manage rules</b>	Displays the rules manager dialogue box, in which the user can create new rules, edit rules and delete rules

One problem with conditional formatting is we are unable to conditionally format across a number of sheets at the same time. When sheets are grouped the function is not available. To resolve this, create the conditional format rule on one sheet, then copy and paste the formats using paste special or the format painter, it can be paste to multiple sheets at once.

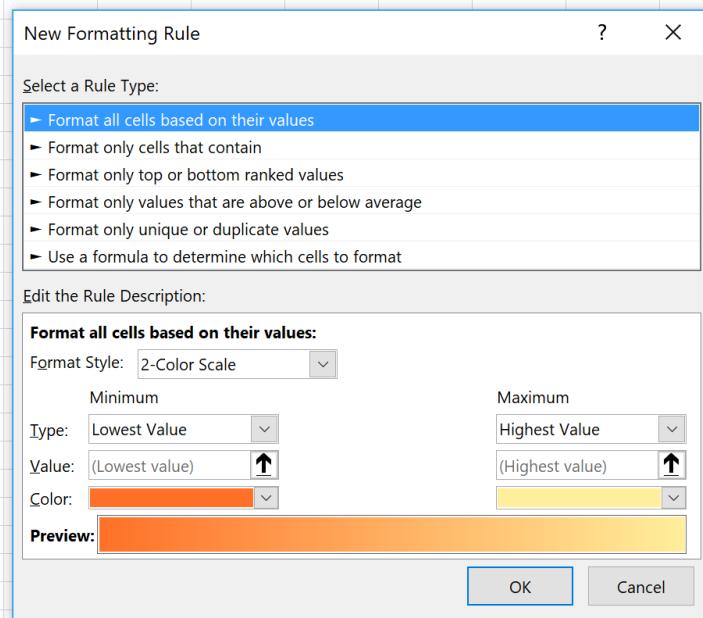
#### ***User defined conditional formatting rules***

Modellers can define their own conditional formatting rules through the New Rules menu within conditional formatting. This menu allows the user to recreate all default conditional formatting rules as well as new rules. As with all other

conditional formatting, the user must select the cells to be formatted and then navigate to the New Rules menu.

- Select cells to which the conditional formatting rules will apply
- Select a Rule Type (see extract below)
- With each rule type the 'Edit the Rule Description' changes to show the rule components.
- The preview pane provides an idea of the nature of the formatting to be applied.

As normal, cells on other worksheets can be referenced in conditional formatting rules if those cells have been named.



### **Conditional formats using graphics**

The spreadsheet extract below illustrates a few examples of how the new conditional formatting functionality in Excel can be easily used. All of the examples below were set up by typing in the numbers, selecting the ranges and applying the relevant type of conditional formatting (Icon sets, data bars, color scales etc).

Conditional formatting examples		
Icon sets	Data bars	Colour scales
✓ 1	30	30
✗ --	40	40
✓ 1	10	10
✓ 1	20	20

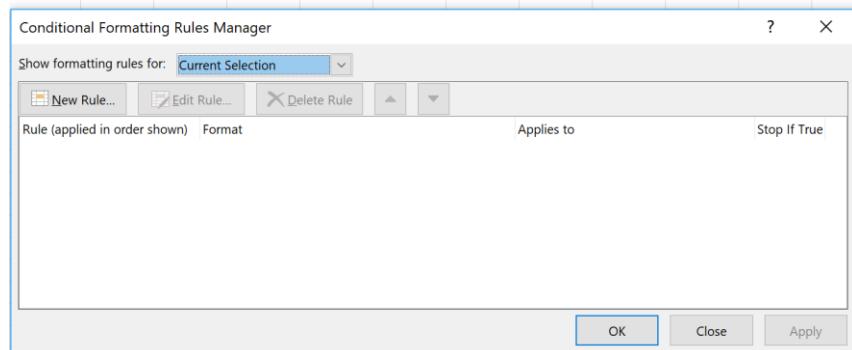
Icon sets	Icon sets	Top 10%
30	30	30
40	40	40
10	10	10
20	20	20

### Conditional formatting rules manager

The conditional formatting rules manager (found at the bottom of the conditional formatting dialog box in the Home menu) allows the user to fully manage the conditional formatting rules contained within the current worksheet.

Conditional formatting rules can be viewed for:

- A selection
- An entire workbook
- Individual sheet tabs



Once the rules have been displayed, they can be edited or deleted. New rules can be added and the rule priority can also be altered within this manager.

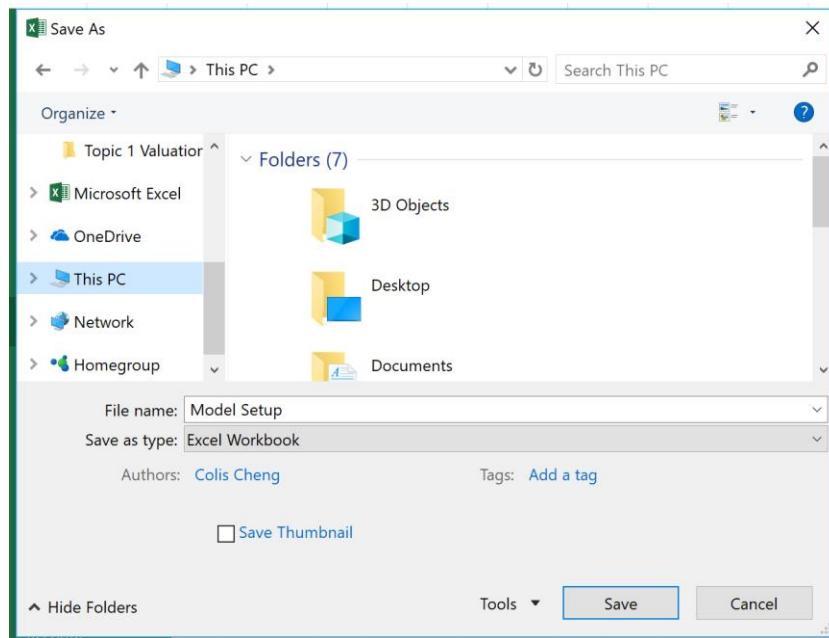
## Creating a workbook template

Saving a template for modeling workbooks is good practice to save time for future models.

Setting up a workbook from scratch ready for financial modeling is a 10-15 minute task for an experienced modeller. The setup procedure is relatively standard from model to model. As a time saving device, once you have set up your model, the Excel document can be saved as a template. Therefore, each time a new model is required, a standard setup template can be applied, thus saving a little time during the initial set up procedure.

Once the setup has been completed, save the file as a template. The “Save

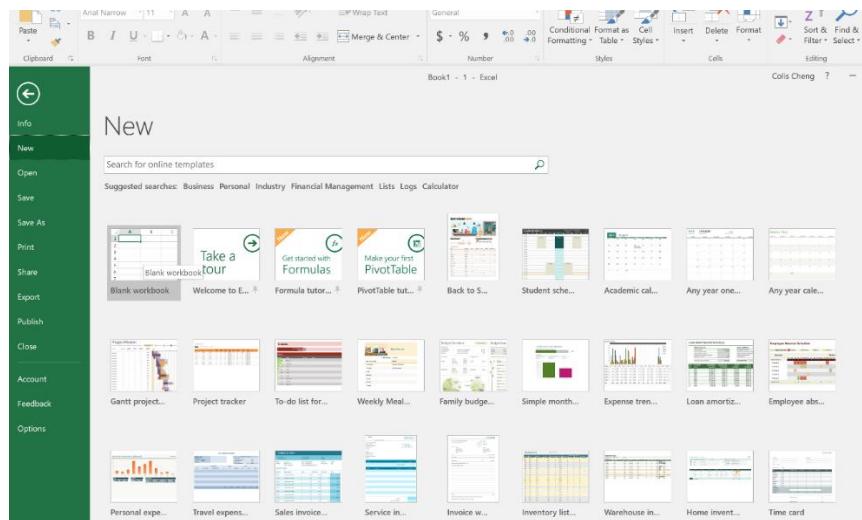
As” (F12) command is included in the **Office Button**. This will display the Save As menu. The user must then choose Excel Template from the “Save as type” field.



Once the template has been saved, it will be stored and the next time the user wishes to set up a new model the template can be opened. The template will be found through the **Office** menu within the **New** command.

Excel has a number of embedded templates which are listed in the

New Workbook dialog box. All user defined templates are stored in the My Templates options. Choose the template and the workbook will be setup automatically.

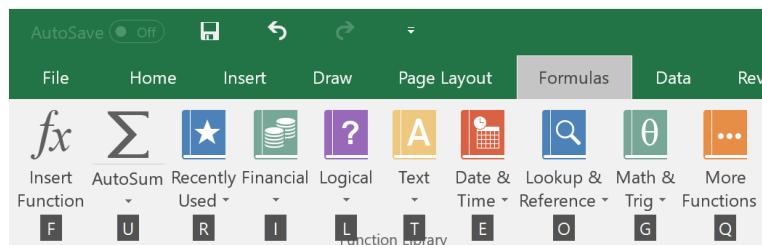


## Formulas

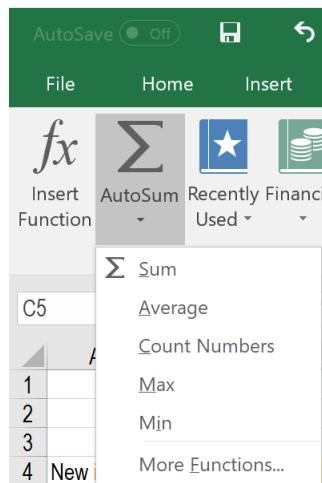
Excel now has a dedicated **Formulas** menu. All formula commands are contained within this area of the product. The Function Library within the **Formulas** menu conveniently organizes the 340 standard excel functions into nine categories:

- AutoSum
- Recently Used
- Financial
- Logical
- Text
- Date & Time
- Lookup & Reference
- Maths & Trig
- More Functions

The menu below is accessed using Alt-M



The sum and other common mathematical formula commands can then be accessed through the AutoSum ( $\Sigma$ ) dropdown button. Alt+= still works as the keyboard shortcut to sum.



Shift+F3 still works as a shortcut to access the Function Arguments box.

Ctrl+A still works to access the Functions Arguments box, when opening a new function.

### Interesting functions

Excel has 5 interesting functions:

New function	Purpose
<b>IFERROR</b>	Used to check for an error and display a message or perform a different calculation Better than ISERROR
<b>AVERAGEIF</b>	Used to calculate an average if condition fulfilled (similar really to sumif and countif)
<b>AVERAGEIFS</b>	Used to calculate an average if multiple criteria fulfilled
<b>SUMIFS</b>	Used to calculate a sum if multiple criteria fulfilled
<b>COUNTIFS</b>	Used to count if multiple criteria fulfilled

If these new functions are used in any financial model that you build, bear in mind that the model cannot then be shared with users of earlier versions of Excel. See section on compatibility.

### New features of existing functions

Some commonly used functions have been enhanced. Those relevant to financial modeling include:

Function	New feature
IF	Up to 64 nested IFs are possible now, though not recommended for good practise modeling.
CHOOSE	Up to 254 values can be chosen. It is advisable to use an array if you require large selections.

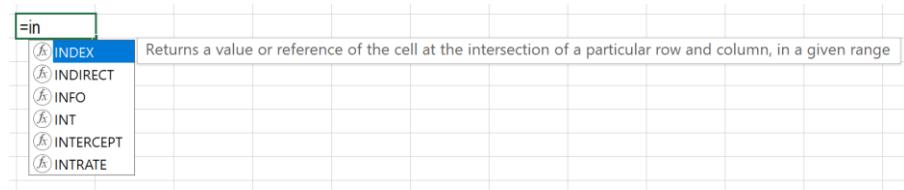
## Formula AutoComplete

Formula AutoComplete is very useful and easy to use. With Formula AutoComplete, you can quickly write or select proper formula syntax and get help completing the formula arguments.

Formula AutoComplete is prompted by the user typing = plus a letter into a cell. It provides additional assistance by displaying an alphabetical list that contains function names and range names. The extract below helps to illustrate this.

The user in this extract has merely typed =in into cell F5. The dropdown list has initially highlighted the Index function and has provided a short description of what the function does.

Once the correct formula has been found from the dropdown list using the arrow keys, press **TAB** and the formula will populate the cell and can be edited as normal.



Formula assistance works with nested formulas as well. Getting to grips with this additional functionality will increase the speed and accuracy of your formula construction.

Formula AutoComplete can also be used to apply historically created names. See section on Using Names.

## Resizable formula bar

The formula bar automatically resizes to accommodate long, complex formulas, thereby preventing the formulas from covering other data in your worksheet. You can also write longer formulas with more levels of nesting (though not best practice!) than you could in earlier versions of Excel.

To expand the formula bar click on the dropdown arrows at the far right of the bar or Ctrl+Shift+U.

## Watch Window

The Watch Window function is found in **Formulas** Menu, in the Formula Auditing grouping (Alt-M-W).

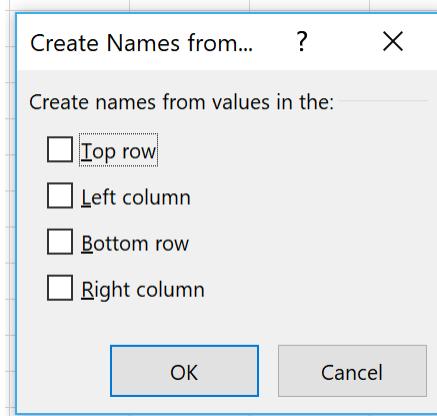
## Names

Names functionality is located within the **Formulas** menu.

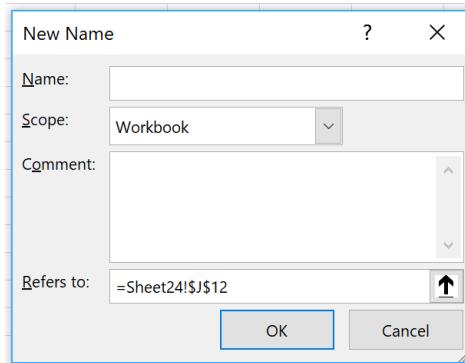
Microsoft has added more functionality to this area of the product, making the use and management of names significantly easier with the introduction of the Names Manager. This has addressed an area of conflict amongst financial modellers, as some financial modellers have criticised the use of names due the difficulty of auditing a model containing a number of named cells and ranges.

### Creating names

Names can be created using Ctrl+Shift+F3 shortcut. This will bring up the traditional Create Name dialog box.



Alternatively, the name can be created using the New Name dialog box that has been included in Excel. Select the cell or range you wish to name and then navigate to Define Name command in the **Formulas** menu (Alt-MM-D). This will activate the new name dialog box below.



The name of the cell or range is typed into the "Name" field.

The location of the named cell/range is displayed in the "Refers to" field.

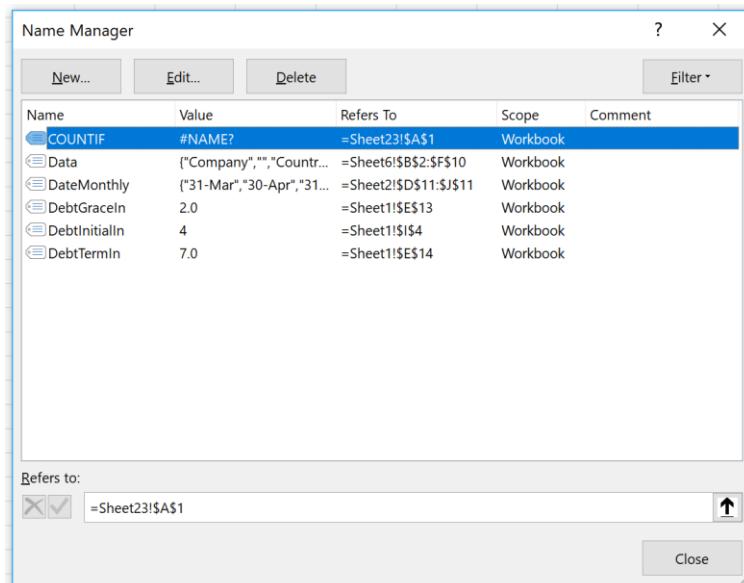
A feature of Excel is the ability to define the “Scope” of the name. The scope of a name can be set to apply to a whole workbook or just individual sheets. It allows a user to avoid circularity if using the same name on different sheets. However, this is not best practice and causes major auditing issues. If you are using the keyboard shortcut (Ctrl+Shift+F3) to apply a name, the default applies the name to the workbook and cannot be changed retrospectively.

Users can also add a comment to be associated with the name; this can be edited at any time. This comment can be very useful when using the Name Manager (next section) as it will assist in the auditing of names within larger financial models.

### Name Manager

Name Manager is an enhancement of the old define name menu. The manager is accessed with the shortcut Ctrl+F3. Name Manager provides:

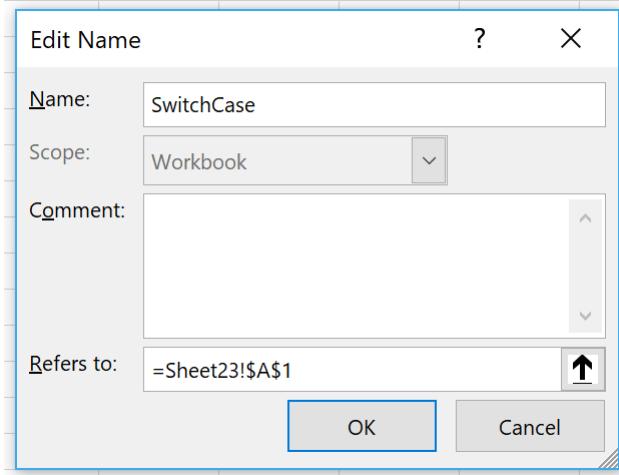
- full disclosure of the cell reference
- the values included in the name cell / range
- the ability to filter the names according to purpose
- the scope of the name (whether the name is workbook specific or not)



Name Manager dialog box is re-sizeable to view more information as required.

New functionality included in the Name Manager is the ability to add comments associated with the name. If the modeller

double clicks on a name in the list or hits the Edit button (Alt-E), the menu below pops up and allows the modeller to add comments to the name.



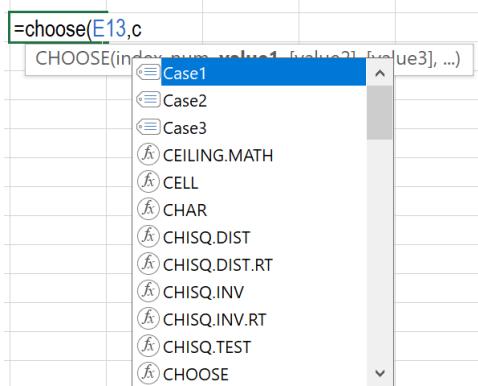
Such comments could outline the use of the name and how it is used within the model – useful for numerical switches.

## Using names

In addition to pasting names using the F3 key, functionality has been included with respect to using names through Formula AutoComplete which we mentioned previously.

The extract below shows a choose function that will select from one of three named ranges. The formula has been partly set up and the user is about to define the three arguments of the equation. The user has just typed in the letter "c". Formula AutoComplete displays a dropdown list with entries beginning with the letter "c". Names and functions appear alphabetically.

The arrow keys can then be used to find the relevant name or function. Hit the TAB key to apply.



### Saving a workbook as a PDF file

You can download a free Office add-in that enables the user to save a workbook as a PDF file. The add-in can be downloaded from <http://office.microsoft.com/downloads>

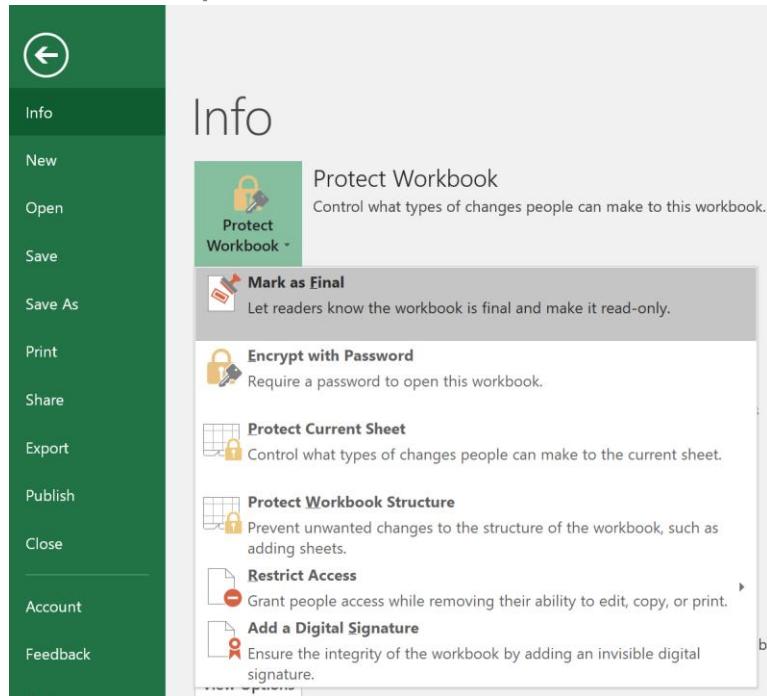
The PDF file format is widely used as a way of disclosing information to third parties in a read-only format that allows precise control over the form and content of the document. Once the add-in has been included, financial models can be saved in a PDF format via the “Save As” menu.

### Finalising a workbook

Models can be marked as final. This action will make two changes to the model:

- It will make the model read-only so that the file cannot be saved with the same filename.
- It makes the workbook view-only so that nothing may be changed in the model. When you open a finalised document, the status bar displays an additional icon. Also most of the Ribbon will be made inactive.

In order to finalise a workbook, go to the **File; Protect Workbook Dropdown; Mark as Final**.



Marking a document as final is not a security measure. Excel will prompt you to look for the security icons in the status bar

below the sheet tabs. The finalising can be easily switched off by repeating the steps above.

### Inspecting a workbook

In the **Office; Prepare** menu there is the option to **Inspect Document**. This tool is useful if you plan to distribute your financial model to others. Excel can inspect the file for comments, hidden data and personal information. This tool can locate hidden information about you, your team or about the workbook that you may not want to share with others. It also allows the reviewer to delete comments, hidden data or block personal information. It is advisable to save the workbook before inspecting as changes using this cannot be undone.

### Comments

From a financial modeling perspective the use of the comment is an essential and often an underused discipline. These comments form part of the documentation that supports a model. They should be used for:

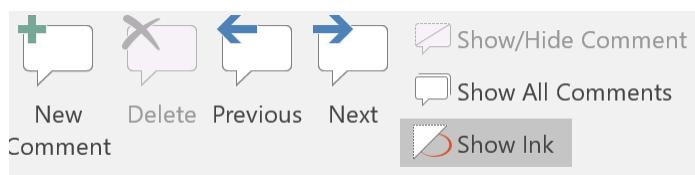
- assumption justification
- formula explanation
- sourcing information
- general reminders

Comments can still be inserted with the shortcut Shift+F2.

Excel has added some additional comment management in the Review menu in the Comments grouping.

The tools allow the user to quickly:

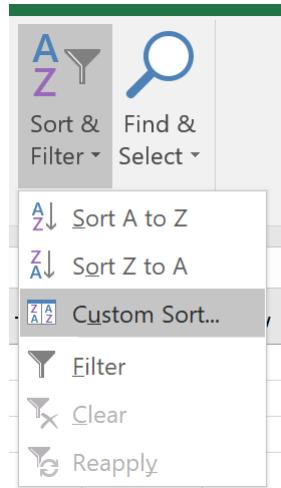
- Insert new comments
- Go to the next comment in the model
- Go to the previous comment in the model
- Show all comments
- Show/Hide comments



## Data functionality

### Sort and filter

The sort and filter functionality is housed in the **Home** menu as part of the Editing grouping.



### Dates

Excel automatically recognises some inputs as dates. Excel applies a date format where a date is recognised. For example, the date 1st January 2009, which is denoted by the general number 39814, will return as a particular formatted date depending on the cell input:

Cell input	Return
1 January 2009	01-Jan-09
01 Jan 2009	01-Jan-09
01 Jan 09	01-Jan-09
01/01/2009	01/01/2009
01/01/09	01/01/2009

Note: The cell style does not change in the style name box.

Date formats can be customised as in previous versions of Excel.

## Auditing and error detection tools

### ***Tracking editing changes***

The track changes function will provide a clear trail of amendments made to a model from a specified date using comment boxes. The comment will detail the nature of the change, the date and its time.

For example:

- Tools; Track Changes; Highlight changes
- Tick checkbox for track changes while editing.

Excel will save a temporary file – maintaining a record of the model pre changes.

Any editing changes made will be noted in a comment box providing a full trail of amendments.

To subsequently accept or reject the changes:

- Tools; Track changes; Accept or reject changes (Excel will save a temporary file maintaining a record of all changes made)
- Select changes to Accept or Reject; OK
- Review proposed changes selecting from the menu whether to accept or reject changes.

Once the work has been reviewed, the original model can be updated with the reviewed changes by:

- Tools; Merge workbooks

To switch off the track changes function:

- Tools; Track changes; Highlight changes
- Remove tick checkbox for track changes while editing.

This function is also very useful when making changes to or reviewing somebody else's model to explain or provide detail about the amendments.

### ***Error values***

#### **#VALUE!**

This error has two common causes:

1. Referencing a cell that contains text. Select the cell with the error and press F2 or Control+[. Inspect the precedents and correct as necessary

2. Referencing a range instead of a single cell, for example, =E10+(E12:E20). In this case SUM is required.

#### **#REF!**

This error is commonly found when rows or columns are deleted from the model, such that a formula refers to a cell which no longer exists.

#### **#NAME?**

This indicates that Excel does not recognise the range name entered in the formula.

#### **#DIV/0!**

This error often occurs either when data is being deleted from a model, or when formulae are written in advance of the information being provided. The denominator is missing or is 0.

#### **#NUM!**

This usually occurs with the IRR function. If it cannot generate an answer within 20 iterations when calculating IRR it returns the #NUM! error.

#### **#N/A**

This is often generated by VLOOKUP, HLOOKUP and MATCH type functions, often because no exact match for them can be found.

The NA() function will return a #N/A which can be useful in charts. For example, if a data label is to be added for the maximum value in a series then a new series can be created by copying the following in the column to the side of series 1:

=if(cell value=max(series 1),cell value, NA())

When this is added as a new series to the chart, Excel will ignore all #N/A values and so only one value will be charted which can then be automatically labeled.

***Auditing a formula*****F2**

The F2 button, when on a cell, edits a formula. Excel will highlight the cells in colored boxes which are precedents of the cell that is being edited. Consequently, F2 is the quickest way to audit a formula when the precedents are located close to the formula, but of limited use when they are elsewhere.

If more information about the cell is needed, press F2 to inspect the formula and then select one of the cell references. If F9 is then pressed the reference converts to the value of the precedent cell. This can be repeated until all cell references are converted to values. Do not press Enter, otherwise the references are permanently converted to values. If this technique is used with range names, Excel will treat the name as an array reference and on pressing F9 will return every value in the array!

***Control+]***

Control+[	Goes to all the precedent cells on the same sheet (goes to first precedent only if on different sheets)
Control+]	Dependent cells (on same sheet only)

**F5**

When the precedents are elsewhere in the model, highlighting the cell reference or name in the formula and pressing F5 (the Go To command) will go to the relevant cell (or range). Unfortunately each component of the equation needs to be done in isolation.

Often the best use of this function is when switching between 2 parts of the model. By going to a cell (possibly by using the auditing toolbar or Control-[]), F5-Enter will return you to the original cell.

***Auditing toolbar***

The auditing toolbar is a powerful tool and should form part of the main toolbar for any Excel user. It can be used to:

- Trace all the **precedents** of a cell (and their precedents, and their precedents ... if needed) in order to find what a cell is dependent upon

This is particularly useful for identifying where the coding has gone wrong (a negative has been formed when it should not have been, or worse a #REF! or #DIV/0!) or when you are trying to follow someone else's model.

- Trace all the **dependents** of a cell (and their dependents ...) in order to find what effect the cell has elsewhere

Particularly useful for finding out if, by the end of model, a cell is not referred to something. If this is the case, it is either an output or rubbish. The tool is also useful for finding out why a cell is used when picking up someone else's model.

- Trace **errors**. Where a cell has an error in it (such as #VALUE! or #NAME!), the use of this function selects the cell that contains the original formula that has an error and has all that cell's direct precedents arrowed.

Double clicking on the trace precedents / dependents tool will show both direct and the next indirect precedent / dependent.

Double clicking on the arrows takes the cursor to the end of the arrow.

Where an arrow points to another sheet, double click on the dotted arrow which then returns the relevant locations in the Go To dialogue box.

***Summary***

Order		Pros	Cons
1. F2	Highlights precedents	Quickest when precedents are near	Only useful if precedents are near
2. Control+[	Go to precedents	Quick	Only goes to first precedent on other sheets
3. Auditing toolbar	Traces precedents	Easy visual reference  Double clicking on precedent line takes you to other end of line	Requires significant mouse action
4. F5	Go to precedents	Can go to specified precedents  Better as a way to get back to original cell	Only goes to one precedent at a time  Requires significant mouse action

***Additionally, if names have been used:***

- 5. The name means something to the reviewer
- 6. Name (drop-down) box – top left of spreadsheet – can be used to go to the named cell / range
- 7. F5 (all names are listed) – can be used to go to the named cell / range

***Finding links***

For reviewing a model from a third party or for modellers trying to fix their own models, locating and understanding the links is very important. Excel does not have any built in tools to help, but this can be easily done: Firstly, to find the name of any linked files, open the Edit menu and select Links. A dialogue box will be displayed showing the names of linked files and allowing the links to be updated.

The address of the linked cell(s) will appear as

='[Big and Clever.xls]Input'!\$P\$134

Finding the cells containing links in the workbook requires the following method:

1. Go to the first sheet in the model, go to the Edit menu and select Find
2. As the [ is a bit of a give away in the above address, insert a square bracket, [, into the find box and press return. Excel will take the cursor to the first linked cell in the sheet and further linked cells can be found by pressing the find next button in the Find dialogue box.

The shortcoming of this method is that it is laborious: if there are a lot of links in a sheet this process can take a long time and Excel will only reliably search to find links if searching sheet by sheet.

#### ***Contained in old names***

A source of spurious links is the copying of data between models where the copied cells use a range name. This can lead to a range name being included in the list of range names in a workbook, where the cells in that range are in another workbook. These can be found by going to the Insert menu and selecting Name and Define (or Ctrl+F3). Selection of the names in the list one by one will show up any ranges defined in other workbooks.

### The F5 Special

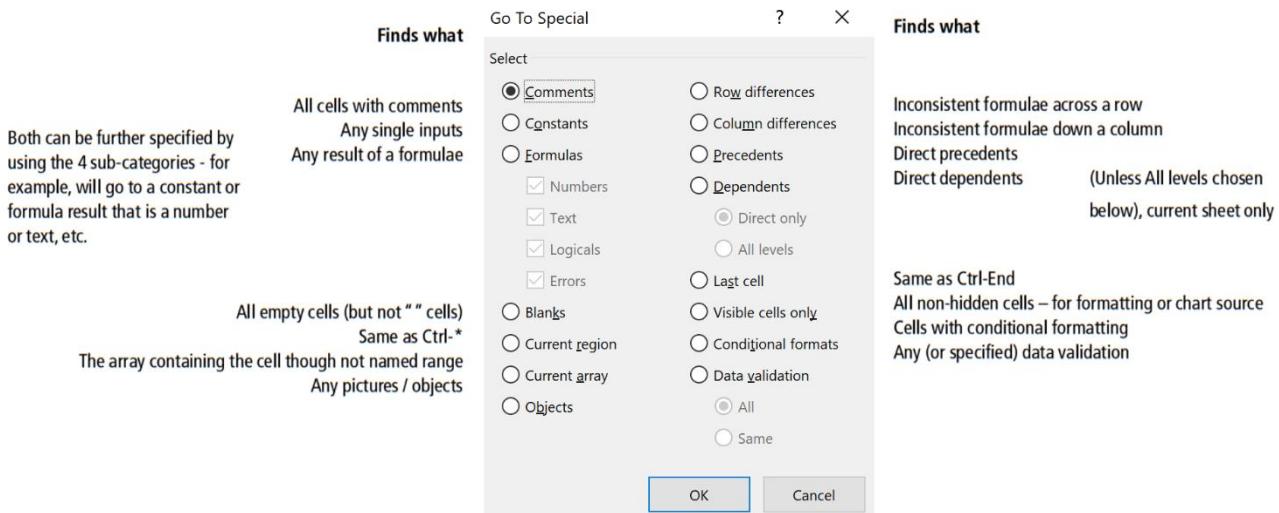
The Go To Special is a very powerful auditing and orientation tool.

It can be activated by

- Selecting a single cell for most of the options in which case the whole sheet is searched (not possible for Row and Column differences)
- Selecting an area in which case only the selection is searched; or
- Highlighting the whole sheet in which case the whole sheet is searched (very useful for Row and Column differences).

When the cell or area is selected:

- Press F5 and then Special and then the following box appears:



### *Auditing for consistency over columns*

A good model should have the contents of column E (assuming this is the first period of data) copied to each subsequent column on all sheets (other than inputs, of course). This will ensure that each period is calculated consistently and that the same assumptions are being used in each period.

The F5 Special function can highlight rows where there are inconsistencies across the periods.

- Select the appropriate columns (probably from column E to the end period)
- F5 (Go To)
- Special
- Row differences.

The inconsistent rows are highlighted for further investigation. To move between the differences use the Tab function.

(If there are inconsistencies which are quite spread out, then whilst they are highlighted, fill the selected cells with a color so that it is easy to identify the inconsistencies. Each inconsistency can then be examined individually.)

### ***Other auditing tips***

#### *Unknown functions*

If a formula contains a function which needs some explanation, by pressing the fx button when editing the formula, Excel will bring up the dialogue box for that function.

In the following, as the CHOOSE function is selected from within the IF statement (cursor flashing on that part of the equation), then the dialogue box for CHOOSE will be shown.

Alternatively Shift F3 can be used to put functions back into their dialogue boxes.



### Alt-Return

Although formulae should never be long and complicated, occasionally someone else's model has these features. When auditing the formula it is useful to break it down. For example, the following formula has no complex functions but is not easy to decipher:

```
=-((PP/(PP+'Inputs & Results'!$F$25+AStart)) *((SUM(F76:F81)+SUM(F84:F93))*(1-tax)- =-(Crat_e_monthly *Cstart*(F29/F30)))/(1-((PP/(PP+'Inputs & Results'!$F$25+AStart)*tax)))
```

By pressing Alt-Return at the appropriate breaks in the formula, the formula will read as:

```
=-(  
    (PP/(PP+'Inputs & Results'!$F$25+AStart))  
    *(  
        (SUM(F76:F81)+SUM(F84:F93))  
        *(1-tax)-  
        (Crat_e_monthly *Cstart*(F29/F30))  
    )  
)  
/(1-((PP/(PP+'Inputs & Results'!$F$25+AStart)*tax)))
```

The formula will remain in this form for subsequent users.

### F2-F9

A formula can be edited and audited by pressing F2. If we then select part of the formula, e.g. a cell reference, an argument or a function within the formula, its value can be assessed by pressing F9. For example, with the following:

```
=-((PP/(PP+'Inputs & Results'!$F$25+AStart)) *((SUM(F76:F81)+SUM(F84  
:F93))*(1-tax)- (Crat_e_monthly *Cstart*(F29/F30)))/(1-((PP/(PP+'  
'Inputs & Results'!$F$25+AStart)*tax))) by pressing F2 and then  
selecting 'Inputs & Results'!$F$25
```

and then pressing F9, this part of the formula changes to the value of that source cell, i.e. 3. (press escape after this or the reference will be replaced by the number 3 in the formula).

Alternatively, if we pressed F2 and then selected

SUM(F76:F81)

By pressing F9 the value of this sum function replaces the reference in the formula, i.e. 1,587.35.

### ***Evaluate formula***

Evaluate formula is a more advanced version of F2-F9.

- Select a cell to be evaluated
- Tools; Formula auditing; Evaluate formula

Two options are then given:

- Evaluate – the underlined part of the formula is evaluated (i.e. the value replaces the cell reference).
- Step in – the precedents of the underlined part of the formula are shown. If the precedent is a further formula then the same options of Step in or Evaluate remain available until the ultimate hard-coded precedent is reached.

At any stage any underlined part of the formula could be evaluated (i.e. the value replaces the cell reference) or where a precedent has been selected a further option of Step out becomes available (i.e. we are moved back up the chain of precedents)

### ***Other model review tools***

The inputs are generally some distance from the outputs and so it may not be easy to analyze how changes in these outputs affect the key outputs. Excel has a number of ways of making this review easier.

### ***Using more than one window***

When reviewing a model it is often useful to be able to see two parts of the model simultaneously.

This can be achieved by opening a second window and viewing both of them at the same time. In this way, as we make changes in one part of the model, we can look at the impact of

those changes in a completely different and, possibly, distant part of the model.

With the current model visible:

- Select Window; New Window – there are now 2 windows open, both looking onto the same file – Filename.xls:1 and Filename.xls:2
- To see them simultaneously, select Window; Arrange; Horizontal (or vertical or cascade) and ensure 'Windows of active workbook' is checked

Amending either window will update the model in the normal way. When 2 windows are no longer required, one of them (preferably the new window opened) can be closed and the original version will still be open.

Switching between windows is very straightforward: through the Window menu by selecting the relevant window from the list, or by using the shortcuts Ctrl+F6 or Ctrl+Tab. Using this shortcut repeatedly will take you consecutively from one window to another window.

### ***Watch window***

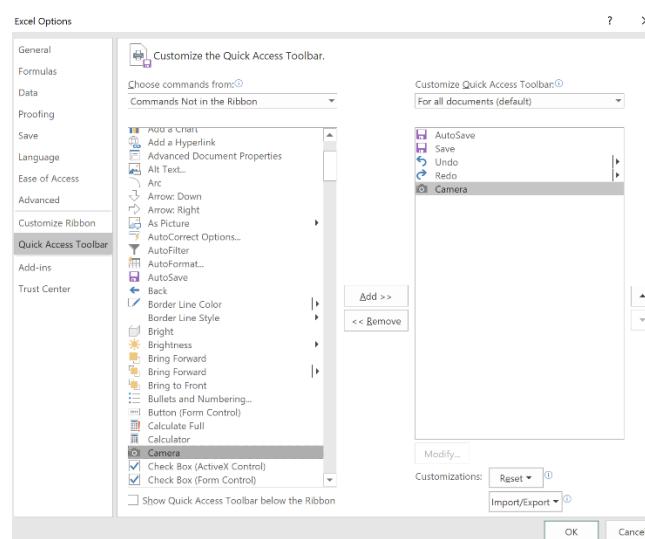
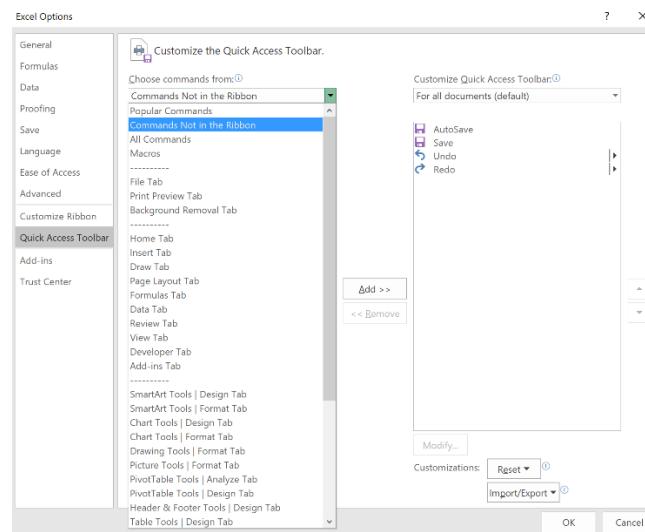
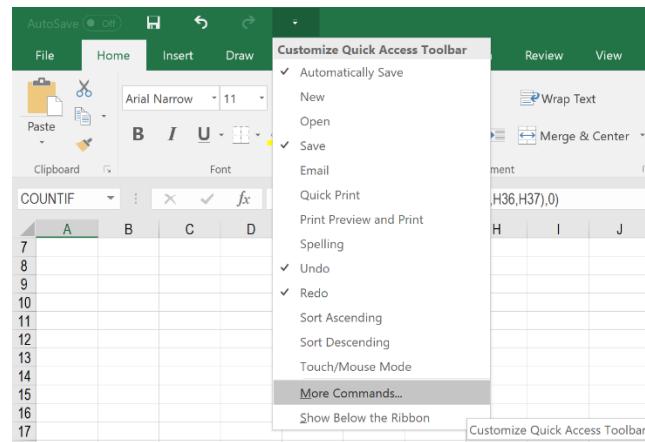
Specific cells can be selected and their values watched as other parts of the model are changed.

- Select the cell(s) to be watched
- Select Tools; Formula auditing; Show watch window
- Click Add Watch

As other inputs are altered the values of the watched cell(s) will change in the watch window. Double-clicking on the cell reference in the watch window will take you to the cell.

### ***Camera***

A camera icon is available in the Tools category when customising toolbars and should be placed in your toolbar.



Once the camera is in the toolbar:

- Select the (output) area to assessed
- Press the camera icon – a picture has now been taken of the selected area
- Go to the (input) area which drives the outputs which have had their picture taken
- Click on a blank area and the picture of the output area will be pasted into this new location

The picture is an image which sits on top of Excel which can be deleted or moved without affecting the running of the model.

The inputs can now be changed and the values in the picture alter, i.e. it is still linked to the original formulae and so any changes to the model affect the picture – more like a CCTV image than a still photograph.

## Auditing a model – a process

### ***Upon opening***

- Does it contain macros (message when opening re. enable / disable macros)?
- Does it have links to other models?

Message on opening states "The workbook you opened contains links to information in another workbook. Do you want to update ..."

It is unlikely that you will be able to update the links as the file path of the linked file(s) are likely to be different to your path.

To find the links, select all sheets and

Control F (find)

In the dialogue box window for "Find what" type [

(all references to file locations have square brackets)

Alternatively, on the bottom of one of the sheets

F3

Paste List

Review the addresses of the names for any that have links to other models

- What size is it?

File, Properties, General

- Are the sheets protected?

Tools, Protection

and then one of the options available is Unprotect sheet (alternatively, have the protection icon in the toolbar – it will state "Unprotect sheet" if the sheet is protected)

- Are there any hidden sheets?

Format, Sheet

And then one of the options available is Unhide

**Coding clarity index**

The coding clarity index is a scoring system to quickly assess the quality of the code in a model.

The purpose of the index is to give an “objective”, or at least independent, basis for assessing quality in the model and give a guide as to the ease with which the model will be audited. Using the index is very simple.

1. Choose 50-60 lines of code in total from 3-4 different areas in the forecasts and review the code
2. Review the whole model to get a feel for the layout and structure and review any documentation, help or notes that come with it
3. Review the questions in the questionnaire and score the model. If the answer to the question has a score against it, score the relevant marks for that question. It does not matter how many times or how few times the design problem has occurred
4. Add up the scores and look up the score in the results table.

***Coding clarity questionnaire***

		Score for a yes	Score for a no	Model score
<b>1.</b>	Are any numbers hard coded or embedded into formulae? Even just for the conversion of units?	5		
<b>2.</b>	Are formulae inconsistent across the rows in the forecast area?	5		
<b>3.</b>	Are assumptions spread around the various schedules of the model and not in a separate assumptions sheet or sheets?	3		
<b>4.</b>	Are inputs color coded?		1	
<b>5.</b>	Are complex formulae used where more than 2 formulae are nested inside each other?	1		
<b>6.</b>	Is switching done by multiplying formulae by statements like (c3=1), instead of using an If statement?	1		
<b>7.</b>	Are complex formulae annotated with "post-it" notes or clear labels or explained in model documentation?		1	
<b>8.</b>	Are dynamic labels used if relevant?		1	
<b>9.</b>	Are data tables annotated?		1	
<b>10.</b>	Are range names used for key assumptions?		1	
<b>11.</b>	Does the model have diagnostic calculations to flag inconsistencies?		1	
<b>12.</b>	Does the model have documentation, User instructions or Help?		2	
<b>Total</b>				

**Coding clarity results table**

Score	Conclusion
<b>0-6</b>	This is a good score, and the model should be straightforward, clear and simple. As a general rule, this is easy to achieve in simple small models but more difficult as models grow.
<b>7-10</b>	<p>This score should be readily achievable in most models and is a reasonable level to set as a minimum quality standard.</p> <p>It is important to consider when reviewing scores to see if a score in this range has been achieved without answering yes to question 1 or 2. These are much higher scoring than the other questions because the implication of them is poor discipline and structure. If these are the problem, then they should be resolved before the model is used.</p>
<b>11 &amp; above</b>	<p>The model will have scored on question 1 or 2 and on most of the other questions too. This suggests that the model has been put together in a hurry or that the design scope has changed as the model has developed. It also suggests that the discipline and structure, which ensure quality, are missing.</p> <p>The obvious quick test of quality on a model like this is to look at the balance sheet and whether it balances. Whilst the model may appear alright now, it is unlikely to have a clear structure and is likely to have hidden implicit assumptions not explained in notes. It will be difficult to work with and develop later if it is not "polished" now.</p> <p>There will be big concerns about the internal consistency of the model and of its ability to produce sensible representative forecasts. It will be very difficult to be confident as to what the shortcomings and approximations are</p>

	which will affect how the model's results will change as it is sensitised.
--	--

### **Troubleshooting**

The steps for spotting errors in models:

#### **1. Find and correct errors**

Find and correct the original source of any of the following (i.e. the location of where the original problem started), by use of the "Control-[" or the auditing toolbar:

#N/A #VALUE! #REF! #DIV/0! #NUM! #NAME?

Until these are corrected the model will continue to have errors.

#### **2. Find any inconsistencies in the sheets**

Use the F5-Special-Row differences on each sheet to highlight where different formulae have been used across a row.

Find what is the appropriate formula to apply all the way across the row and then copy this across for consistency.

#### **3. Balance sheet not balancing**

Find the difference in the balance sheet in the first period of imbalance:

If the difference is recognisable – error of omission – the entry has not been entered in all the appropriate places.

If the difference ÷ 2 is recognisable – the entry has been made but added rather than taken away or vice versa.

#### **4. Check specific diagnostics**

A good model should have specific diagnostics telling the user when errors / inconsistencies have occurred, such as the need to press F9 to recalculate the data tables. Ensure that all these diagnostics have appropriate messages.

#### **5. Sense checks**

By eye and calculator, check as to whether the output numbers are sensible.

## Appendix

### Excel tricks

Auditing consistency over columns (highlights rows that are inconsistent)

- Select the appropriate columns; F5; Special; Row differences (or Constants if inputs / hard-wired numbers are to be identified)
- F5, Special can also be used to find conditional formatting, data validation, row differences ...

Auditing tools

- Ensure these form part of your Quick Access Toolbar to enable inconsistencies to be spotted quickly
- Double clicking on the trace precedents / dependents tool will show both direct and the next indirect precedent / dependent
- Double clicking on the arrow takes the cursor to the end of the arrow
- Where an arrow points to another sheet, double click on the dotted arrow which gives the relevant locations in the Go To dialog box
- Ctrl+[ to trace precedents or Ctrl+] to trace dependents

Column selection

- Ctrl+space bar; or
- Place cursor on column header – Left mouse button
- Ctrl+- to then delete selected column; or
- Ctrl++ to then insert a column

Comment insertion (descriptive labels for more complex calculations)

- Shift+F2; or right mouse button
- Shift+F10; Insert comment

Conditional formatting

- Home; Conditional Formatting; (Alt-H-L) and then follow the prompts
- F5, Special can also be used to find conditional formatting on selected sheet

### Constants creation (dollarising)

- F4 – pressing F4 toggles between the various dollar options

### Data validation (to ensure only valid results can be input)

- Data; Data Validation; and then follow the prompts (Alt-A-V)

### Find

- Shift+F5 or Ctrl+F

### Format painter

- Put the paint-brush symbol on the Quick Access Toolbar to allow for easy copying of formats. Double clicking on the paint-brush symbol retains the copied format, so that it can be applied to further cells straight after. Press Esc key when finished with copying formats
- Alternatively: Ctrl+C on the cell(s) with the appropriate format; go to target cell(s) and Alt-H-V-S-T (paste special, formats)

### Formatting numbers for consistency

- Ctrl+1
- For use of \_#; , see Formatting section

### Function wizard

- 'fx' button to use function wizard or Shift+F3
- Type in name of function preceded by =; press Ctrl+A to go directly into the function wizard for that function

## Go To

- F5
- Ctrl+Home Top of sheet
- Ctrl+End End of active part of sheet, i.e. the junction of last row and column used
- Ctrl + any arrow Goes to the start/end of the block of formulae/data that the cursor is in
- Ctrl+Page Up/Page-Down Previous/next sheet
- Ctrl+F6 or Ctrl+Tab Switch between open workbooks
- Shift+F6 Switch to other window when screen is split
- Ctrl+[ Moves the cursor to the precedent cells (on same sheet); Moves to the first precedent cell in formulae if on different sheets
- Ctrl+] Moves the cursor to the dependent cells (on same sheet)

## Graphs

- F11 produces instant best fit graphs for selected data

Hide extraneous columns to fit sheet to appropriate width

- Select the first column to be hidden (either by mouse or Ctrl+Spacebar)
- Ctrl+Shift→ (selects the remaining columns on the sheet)
- Home; Format; Hide (Alt-H-O-U-C) hides all the highlighted columns
- Alternatively, select columns to be hidden, Right mouse; Hide, or
- Select columns to be hidden - Shift+F10; Hide or Ctrl+0

## Insert

- Shift+F11      New sheet
- Alt+H-I-R or C      New row or column
- Ctrl++      New row or column when column or row selected
- F3      Paste name into a cell or formula

## Listing names

- Formulas; Use in formulas; Paste names; Paste list
- Alternatively, F3, Paste List

## Menu selection

- Alt followed by letter to get to Ribbon or Office Button (e.g. Alt+F to enter Office Button);
- To get to next level merely press the letter (e.g. I to enter Excel Options)

## Naming a cell/range

- Type in text in cell to the right of cell or range
- Ctrl+Shift+←; then F3 (whilst Ctrl+Shift still held); check the right box; Return

## Protecting the contents

- Review; Protect sheets – leave the default boxes ticked and don't bother with a password. This stops any editing of the sheet.
- Selective protection – see Protecting the model

## Repeat previous action

- Ctrl+Y, or F4

## Replace

- Ctrl+H

## Reveal / hide formulas

- Ctrl+` (i.e. the top left key on the standard UK keyboard known as Tilde). This toggles between showing the results of formulae in the cells and the formulae themselves

## Right click mouse button menu

- Shift+F10 (often there is a right click mouse button on the bottom row of keyboard)

#### Row selection

- Shift+space bar
- Place cursor on row header – left mouse button
- Ctrl+- to then delete selected row; or
- Ctrl++ to then insert a row

#### Save model (often)

- Ctrl+S

#### Save model as...

- F12 – useful to do at the start of each major change as a new version

#### Select

- |                           |   |
|---------------------------|---|
| • Ctrl+Shift + any arrow  | Selects cells to start/end of next/current series           |
| • Shift + any arrow       | increase the selection one cell at a time in that direction |
| • Ctrl+A; or              | All of current sheet  |
| • Ctrl+shift; space bar;  | All of current sheet  |
| • Ctrl+space bar;         | Column  |
| • Shift+space bar         | Row   |
| • Ctrl+Page Down/Up       | Select next sheet/previous sheet                            |
| • Ctrl+Shift+Page Down/Up | Select sheets (file name now includes [group])              |

Alternatively, Right mouse on a sheet tab - Select All Sheets

#### Sensitivity table creation

- Ensure it is on the same sheet as the inputs to be varied
- Data; What-If Analysis; Data Table (see notes)

#### Switch creation

For example

- Open the Forms toolbar (Developer; Insert; Form Controls)
- Select the check-box and create its text
- Using the right mouse, Format Control; Control; Cell Link (giving cell reference for an unused cell which will now switch between reading either TRUE or FALSE)

Switching between sheets

- Ctrl+Page Up/Down

Switching between split sheets

- Shift+F6

Switch to other open workbooks/documents

- Ctrl+F6

Spell-check

- F7

View multiple workbook/sheets

- Open required workbook(s)
- View; New window – more than one version of the current model has been created
- View; Arrange All; Horizontal (if only want views of current model ensure "Windows of active workbook" is selected)
- Ctrl+F6 switch between workbooks/sheets

## Excel function keys

Key	Function	Shift	CTRL	CTRL+ Shift	ALT	ALT+ Shift
F1	Get help. Displays the assistant balloon	For help on an option, select the option, and press shift F1	Hides or displays the Ribbon		Create a chart that uses the current range	Insert a new worksheet
F2	Edit the active cell	Insert comment	Print preview		Save active workbook	Display the save as dialog box
F3	Paste a defined name into a formula	Paste a function into a formula, or enter the formula dialogue box	Name Manager box	Create names from row and column labels		
F4	Repeat the last function  Dollarises cell (creates constant)	Repeat the last find action	Close the active workbook window		Quit Excel	
F5	Display the Go To dialog box	Display the Find dialog box	Restore the active workbook window size			
F6	Move to the next pane in a workbook that has been split	Move to the previous pane in a workbook that has been split	Move to the next workbook or window	Move to the previous workbook or window	Switch to VBA	
F7	Display the spelling dialog box	Thesaurus				
F8	Turn on extending a selection by using the arrow keys	Add another range of cells to the selection; or use the arrow keys to move to the start of the range you want to add, and press F8 and the arrow keys to select the next range	Carry out the size command (workbook), or use the arrow keys to size the window		Display the macro dialog box	
F9	Calculate all sheets in all open workbooks	Calculate the active worksheet	Minimise the workbook window into an icon			
F10	To make the menu bar active, or close a visible menu and submenu at the same time	Show a shortcut menu	Maximise or restore the workbook window			
F11	Create a chart that uses the current range	Insert a new worksheet	Insert a Microsoft Excel macro sheet		Display the visual basic editor	

Key	Function	Shift	CTRL	CTRL+ Shift	ALT	ALT+ Shift
F12	Display the save as dialog box	Display the save dialog box	Display the open file dialog box	Display the print dialog box		

## Other shortcuts

Key	Alone	Shift	Ctrl	Alt	Ctrl+Shift
A			Select all + After typing in function name will give function dialogue box	Data menu	Formula arguments
B			Bold		
C			Copy		
D			Fill down		
E					
F			Find	Office Button	Toggle formula view
G			Goto		
H			Replace	Home menu	
I			Italics		
J					
K			Insert hyperlink		
L					
M				Formula menu	
N			New workbook	Insert menu	
O			Open workbook		Select comments
P			Print	Page Layout menu	Font size
Q					
R			Fill right	Review menu	
S			Save		
T					
U			Underline		Expands/contracts formula bar
V			Paste		
W			Close workbook	View menu	
X			Cut		
Y			Repeat action		
Z			Undo		
` (-)			Toggle formula view		
1 (!)			Cell format		Number format
2 (@)			Toggle bold		Paste value from above
3 (£)			Toggle italics		

Key	Alone	Shift	Ctrl	Alt	Ctrl+Shift
4 (\$)			Toggle underline		Currency format
5 (%)			Toggle strikethrough		Percent format
6 (^)					Exponent format
7 (&)					Apply border
8 (*)			Outline		Select region
9 ()			Hide rows		Unhide rows
0 ()			Hide columns		Unhide columns
-			Delete selection		No border
= (+)	Formula			Auto sum	Insert
[			Goto precedents		All precedents
]			Goto dependents		All dependents
;			Insert date	Select visible cells	Insert time
'			Copy down	Style	Date:time format
:			Insert time		
/			Select array		Select array
\			Select differences		Select unequal cells
Insert	Insert mode		Copy		
Delete	Clear	Cut			
Home	Begin row		Start of sheet		
End	End row		End of sheet		
Page Up	Page up		Previous sheet	Left 1 screen	Select previous sheet
Page Down	Page down		Next sheet	Right 1 screen	Select next sheet
Left Arrow	Move left	Select left	Move to end/start of range - left		
Right Arrow	Move right	Select right	Move to end/start of range - right		
Up Arrow	Move up	Select up	Move to end/start of range - up		
Down Arrow	Move down	Select down	Move to end/start of range - down	Drop down list	
Space Bar	Space	Select row	Select column		Select all
Tab	Move right + After typing a function applies AutoComplete	Move left	Next window	Next application	Previous window

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