

BUSINESS VALUATION

DCF Methods

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INTRODUCTION

The intrinsic value of a business ('Enterprise Value' / 'EntV') can be estimated using techniques that consider future cash flows or income. A value estimated by discounting future cash flows at a risk-adjusted discount rate to their 'Present Value' ('PV') ('Discounted Cash Flow' / 'DCF' valuation), represents the value expected to be received from the business in the future, expressed in economically equivalent terms as if received today. A DCF requires cash flows to be estimated over a forecast period, usually 5 – 10 years, at the end of which a single formula (a perpetuity formula or a 'multiple') can be used to capture the PV of remaining cash flows beyond the forecast horizon ('Terminal Value' / 'TV'). This paper discusses traditional DCF methods as well as alternative discounting approaches (different cash flow or income measures and discount rates). It is structured as follows:

- Part 1: Traditional DCF Valuation. This section shows how 'Free Cash Flows to the Firm' ('FCFF') can be defined, based on post-tax operating and investing cash flows (ignoring financing and related tax), how FCFF can be estimated over the forecast period and how it can be incorporated in the TV formula, assuming a 'steady state' exists. Operating DCF EntV is obtained by discounting FCFF at an appropriate risk-adjusted discount rate (the 'Weighted Average Cost of Capital' / 'WACC' – the subject of a separate article 'Business Valuation: Cost of Capital'). A number of reconciling items (net non-operating assets, debt and debt-equivalents) link DCF EntV to the final 'Equity Value' / 'EqV'.
- Part 2: Alternative DCF Methods. Six other methods are discussed that all give the same answer, using an illustrative example. The income or cash flow measures relate to EntV (methods 1-3) and EqV (methods 4-6), meaning corresponding discount rates represent WACC (pre- or post- tax) and the Cost of Equity (tax shield cash flows, discussed in the article 'Business Valuation: Cost of Capital', are also valued as part of methods 2 and 3).
- Part 3: Cross-border DCF Valuation. This part introduces overseas risks and how they might be incorporated into the traditional DCF approach.

The following appendices are included:

- App. 1: Enterprise value example
- App. 2: EntV – EqV bridge components: deferred tax, pension deficits, leases, options
- App. 3: Formulae & metrics: PV, Perpetuities for the TV, ROE decomposition

¹ This paper combines two papers originally written on 7 May 2026 (Business Valuation: Parts 1 and 2) and includes a section on overseas valuation

Forecasting Free Cash Flows to the Firm ('FCFF')

Definition of FCFF

FCFF is not defined by IFRS GAAP, but for the purpose of a DCF valuation it is defined as after-tax cash flows derived from operating activities (ignoring after-tax financing cash flows), including investments required to generate operating income. FCFF can be calculated from the cash flow or income statement (top down or bottom up), as shown below, using illustrative numbers (alternative cash flow measures, discussed below, are also included in the reconciliations):

Cash flows from operating activities:	
Profit after tax	2,066.7
Dividends	(1,760.1)
Profit retained	306.6
Add back: dividends and tax	2,449.1
Profit before tax	2,755.6
Add back: Finance costs	387.3
Less: Finance income	(12.2)
Operating profit continuing operations (EBITA)	3,130.7
Depreciation	631.5
Operating cash flows before working capital change (EBITDA)	3,762.2
Change in inventories	(44.5)
Change in trade receivables (including long term)	(44.7)
Change in other receivables and current assets	(54.5)
Change in trade payables	39.0
Change in other current liabilities (excl. dividend payable)	21.2
Change in working capital	(83.5)
Change in other current and long term provisions	16.7
Cash generated from operations	3,695.4
Income tax paid (net of repayments)	(688.9)
Net cash generated from operating activities	3,006.5
Remove: tax relief on financing items	(93.8)
Remove: change in non-operating provisions	(16.7)
Purchases of property, plant and equipment	(1,265.8)
Free Cash Flows to the Firm	1,630.3
Add back: New Invested Capital	717.7
Net Operating Profit After Taxes (NOPAT)	2,348.0

Note 1: $(387.3 - 12.2) \times 25.0\% = 93.8$

Note 2: $-631.5 + 83.5 + 1,265.8 = 717.7$

Net cash generated from operating activities	3,006.5
Cash flows from investing activities	
Purchases of property, plant and equipment	(1,265.8)
Interest received	12.2
Net cash used in investing activities	(1,253.5)
Net cash flow before financing activities	1,753.0
Cash flows from financing activities	
Proceeds from borrowings	1,564.7
Repayment of borrowings	(1,158.1)
Interest paid (plus fees)	(387.3)
Dividends paid to company shareholders	(1,760.1)
Net cash from (used in) financing activities	(1,740.8)
Net cash flows	12.2
Opening cash	244.9
Closing cash	257.1

ASSETS	
Intangible assets	116.3
Property, plant and equipment	13,266.8
Investment in associates	1,000.4
Financial Assets	2,480.9
Deferred Tax	119.4
Inventories	936.6
Trade Receivables	939.3
Other receivables	939.3
Prepayments and accrued income	171.4
Tax repayable	34.4
Operating Cash	257.1
ASSETS	20,261.9

EQUITY	
Ordinary Share Capital	1,449.4
Share Premium	153.0
Retained Earnings at start	7,023.0
Retained profits	306.6
Other Reserves	164.1
Total Equity	9,096.1

LIABILITIES	
Retirement Benefit Obligations	(387.4)
Provisions for Other Liabilities	(344.5)
Deferred Tax	(1,009.1)
Other liabilities	(6.5)
Borrowings	(8,153.0)
Trade Payables	(819.7)
Accruals and deferred income	(342.8)
Other Current Liabilities	(102.8)
Total Liabilities	(11,165.8)

EQUITY AND LIABILITIES	20,261.9
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Profit after tax	2,066.7
add back: Interest expense (net of tax)	290.5
add back: Interest income (net of tax)	(9.2)
NOPAT	2,348.0
Net interest after tax	(281.3)
Purchases of property, plant and equipment	(1,265.8)
Depreciation	631.5
(Incr.)/Decr. in Operating Working Capital	(83.5)
New Invested Capital	(717.7)
Change in non-operating provision	16.7
Debt borrowing	1,564.7
Debt repayments	(1,158.1)
Change in gross debt	406.7
Change in cash	(12.2)
Free Cash Flows to Equity	1,760.1

General Approach to Forecasting

The length of the forecast period needs to be determined first. A long period creates more uncertainty, however cash flows and other relevant financial measures need sufficient time to adjust to some 'Steady State' for the TV calculation (when growth in income and net assets is sustainable and the TV perpetuity or multiple formulae are reasonable for the terminal period).

A review of financial statements over the past few years, once adjusted for abnormal items (acquisitions, discontinued operations, restructuring, capitalised expenses, etc), should then be carried out to provide some guidance for growth rate forecasts.

Operating profits

A top-down (market share) or bottom-up (price and volume) approach, with simulation or scenario analysis, can be used to estimate probability-weighted expected revenues over the explicit forecast period. Operating costs that vary with revenue (variable costs), excluding depreciation and amortisation, can be estimated as a percentage of revenues; fixed operating costs must be forecast separately. In general, the result of these forecasts will be the Earnings Before Interest Tax Depreciation & Amortisation (EBITDA). Alternatively, an EBITDA margin of revenues can be assumed, on the basis that operating costs are all variable. Non-operating cash flows that are excluded from FCFF are taken into account via an adjustment to the EntV or via the discount rate (tax benefit of debt financing).

Investing for operating profits

Working capital

EBITDA should be adjusted for non-cash items, which, generally, involves deducting the increase in operating working capital ('OWC') (or adding a decrease), calculated as the closing less opening OWC balance. OWC represents net current assets used in the daily operations which are expected to be consumed or converted into cash in the year or operating cycle (inventory + trade receivables – trade payables) and which require financing. Each component can be estimated based on a percentage of sales.

Capital expenditures

Capex (net of disposals) represents the increase in operating Gross Property, Plant & Equipment (PP&E) after adding back asset retirements that have been removed. As the closing book value of PP&E (cost net of accumulated depreciation) equals the opening net PP&E + capex – depreciation charge, capex will be the balancing item if net PP&E and depreciation are assumed (this avoids the need to forecast retirements).

Net PP&E can be based on a percentage of revenues (inverse of the Asset Turnover):

$$\text{Net PP\&E}_n = \text{Assumed \%} \times R_n$$

Depreciation can be estimated as a percentage of opening gross or net PP&E (the latter is preferred to avoid problems with retirements):

$$\text{Depreciation}_n = \text{Assumed \%} \times \text{Net PP\&E}_{n-1}$$

Capex will then be the balancing figure (ignoring impairments, revaluations, acquisitions, exchange movements and any difference between proceeds and book value removed):

$$\text{Net PP\&E}_n = \text{Net PP\&E}_{n-1} + \text{Capex}_n - \text{Depreciation}_n$$

$$\therefore \text{Capex}_n = \text{Net PP\&E}_n - \text{Net PP\&E}_{n-1} + \text{Depreciation}_n$$

(see Koller et al. (McKinsey) (2025) p.266, p.273)

A more detailed estimate would assume a depreciation profile for PP&E existing at the valuation date balance sheet and would calculate depreciation on capex each year in the forecast period using a 'vintage' approach (straight line depreciation on each year's capex based on average asset lives).

Depreciation could also be a multiple of capex if capex is assumed to be a percentage of revenues rather than estimated as above. Capex is required to increase the productive capacity ('growth' capex) and maintain existing capacity ('maintenance' capex). The latter would represent true economic depreciation rather than accounting depreciation, which is often used as a proxy. Ignoring OWC, Invested Capital will only grow if capex exceeds accounting depreciation, so the capex / depreciation ratio must exceed 1.0 if growth in net PP&E is assumed. Capex and the increase in OWC represent the gross cash investment in Invested Capital (before depreciation), required to generate the forecast EBITDA.

Leasing

Fixed assets used to generate EBITDA (and hence included in the DCF valuation) can be purchased or leased. The cost of assets purchased is recognised in FCFF as capital expenditures in the year incurred, as reflected in the Statement of Cash Flows. The cost of leased assets that meet the requirements for 'Right-Of-Use' / 'ROU' asset treatment under IFRS 16 *Leases* is recognised in the Statement of Financial Position as ROU assets and lease liabilities (as the PV of Lease Payments). The treatment effectively assumes the asset has been purchased with borrowings (hence rentals can be split into hypothetical principal and interest components). Accordingly, the effective purchase price (the amount recognised initially for the ROU asset) should be included in capital expenditures in the FCFF calculation as ROU additions, despite being a non-cash item (similar to employee stock options). See The Footnotes Analyst (www.footnotesanalyst.com) for further discussion.

Taxes

The final calculation to arrive at FCFF (in this simple case) is to deduct the operating cash taxes that would be paid on pre-financing operating and investing cash flows. A tax computation based on taxable profits (net of permanent differences to pre-tax profits), incorporating tax relief on capex rather than depreciation (capital allowances in the UK) and adjustments for accumulated tax losses, would be preferred, but the required information is unlikely to be available. An estimate of the accounting operating tax charge should be made, excluding financing items, before the increase in operating

'Deferred Taxes' is deducted to arrive at taxes paid on operating cash flows. When calculating FCFF, deferred tax needs to be determined for operating assets and liabilities and only the increase in operating deferred tax liabilities is deducted from the statutory tax that applies to operating EBITA (see Koller et al. (McKinsey) (2025) ch.20, Damodaran (2025) ch.10, Bodmer (2015) ch.12).

Towards the Terminal Value: Achieving Steady State

Competition should drive down Return on Invested Capital ('ROIC' – discussed in Part 2), so that new investments generate less value (zero value if the returns equal the discount rate) and the returns and growth rates remain constant thereafter. Once the final forecast period has been reached, a steady state should be in place to allow a reasonable long term growth rate to be assumed in the TV calculation (such as the long-term economic growth rate in the country where the business operates) and to ensure revenues, net profits and balance sheet items grow at the same rate.

The steady state growth rate g^* (usually revenue growth) should be assumed by the final year of the forecast period (year n), so that in the first year of the terminal period ($n+1$) all balance sheet items (including debt and equity) and flows (free cash flows, profit after tax, dividends and 'Residual Income') also grow at g^* . If interest expense is calculated on opening balances, then steady state should apply to year $n-1$ (so that debt grows at g^* in year $n-1$ and interest grows at g^* in year n).

Appendix 1 provides a simple illustration of reaching 3% steady state growth (g^*) by year 4 of a 5 year forecast, based on the following assumptions:

- ★ From year 3, revenues, invested capital, net debt and equity grow at 3% (everything else grows at 3% from year 4) and EBIT margins are constant.
- ★ The increase in invested capital from net capex and working capital investment is calculated as follows:

- The carrying amount of operating fixed assets (Property, Plant & Equipment 'PP&E') at the year end is calculated as a percentage of revenues for the year:

$$\begin{aligned}\text{Net PP\&E}_{n+1} &= (\text{Net PP\&E}_n / \text{Revenue}_n) \times \text{Revenue}_{n+1} \\ &= \text{Net PP\&E}_n \times (1 + g^*)\end{aligned}$$

- The depreciation expense for the year is calculated as a percentage of opening Net PP&E

$$\text{Depreciation (D)}_{n+1} = \text{Net PP\&E}_n \times \text{assumed depreciation rate \%}$$

- Capex is implied from the above:

$$\text{Capex}_{n+1} = \text{Net PP\&E}_{n+1} - \text{Net PP\&E}_n + D_{n+1} = g^* \cdot \text{Net PP\&E} + D_{n+1}$$

- The carrying amount of working capital at the year end is calculated as a percentage of revenues for the year:

$$\begin{aligned}\text{Working capital (WC)}_{n+1} &= (WC_n / R_n) \times R_{n+1} \\ &= WC_n \times (1 + g^*)\end{aligned}$$

$$\therefore \text{Change in } WC_{n+1} = g^* \cdot WC_n$$

- The Return On Invested Capital (ROIC) and Reinvestment Rate (RR) are constant from year 3, while the Return on New Invested Capital (RONIC) is constant (and equal to ROIC) from year 4 (ROIC, RONIC and RR are discussed in Part 2).

Integrated Forecast Financial Statements

Once the main components of FCFF have been forecasted (revenues, operating costs, changes in invested capital, tax), non-operating forecasts can be made, principally debt and equity cash flows (after tax), which allows forecast financial statements to be prepared. Although a DCF using FCFF to estimate the EntV does not require financial statements for each forecast period, it is useful to produce them for a number of reasons:

- to identify risk and return measures: credit risk ratios can indicate financial strain, whilst return measures are an important 'value driver';
- to calculate net profits and equity cash flows for other calculation methods: residual net income and equity cash flow methods that should give similar EqV s as under the traditional FCFF valuation method (after debt is deducted from EntV);
- to compare capital structure to assumptions used in the discount rate: the discount rate is calculated based on capital structure assumptions that may or may not be consistent with forecast leverage ratios.

Terminal Value

TV based on FCFF

The TV can be determined using a growing perpetuity model:

$$TV_n = \frac{FCFF_{n+1}}{r - g^*}$$

Where n is the last year of the forecast period, $FCFF_{n+1}$ the steady state FCFF in the first year of the terminal period, r the discount rate and g^* the steady state growth rate. This would then be discounted back over the forecast period to the valuation date:

$$\text{PV at valuation date} = \frac{TV_n}{(1 + r)^n}$$

An alternative would be to calculate the TV based on a multiple applied to $FCFF_{n+1}$ (the equivalent to $1 / (r - g^*)$) or some other measure such as EBITDA, so long as the multiple was suitable for EntV (i.e. a Price / Earnings multiple could not be used): $TV_n = EBITDA_{n+1} \times \text{multiple}$. A perpetuity approach would be more traditional, although this could be used to derive the implied multiple as a reasonableness check.

The assumptions that significantly affect the DCF value should be identified so that scenarios can be modelled to indicate a valuation range. Typical 'value drivers' would be revenue growth (including the TV growth rate), EBITDA margins, investments and the discount rate. In the simple case, a best and worst case scenario would be shown in addition to the base case.

The sum of the PV of FCFF over the forecast period (n years) and the PV of the TV represents the operating DCF EntV ('DCF EntV'):

This assumes the discount rate is constant and FCFF is received at the end of the year.

X

Overview

This section discusses six alternative approaches to discounting, using different measures of income or cash flow, although the focus will be on method 1:

	Cash flows	Tax	Discount rate	Value
	Free Cash Flows to the Firm (FCFF)	Post-tax	Post-tax WACC	Enterprise
1	Economic Profits + Existing Invested Capital	Post-tax n / a	Post-tax WACC n / a	Enterprise
2	Free Cash Flows to the Firm + Tax cash flows on debt interest	Post-tax Tax	Pre-tax WACC Pre-tax WACC	Enterprise 'Capital Cash Flows'
3	Free Cash Flows to the Firm + Tax cash flows on debt interest (valuation depends on risk assumption)	Post-tax Tax	Ungeared Cost of Equity Pre-tax Cost of Debt or Ungeared Cost of Equity	Enterprise 'Adjusted PV'
4	Free Cash Flows to Equity	Post-tax	Gearred Cost of Equity	Equity
5	Residual Income + Existing Book Value of Equity	Post-tax n / a	Gearred Cost of Equity n / a	Equity
6	Dividends	Post-tax	Gearred Cost of Equity	Equity

WACC is the Weighted Average Cost of Capital, discussed in a separate article.

[1] Economic Operating Profits discounted at the post-tax WACC

Introduction

Economic return models (such as Economic Value Added (EVA®), created by Stern Value Management), value a business as the value of existing Invested Capital ('IC') (net operating assets) plus the present value of future Economic Profits, being residual Net Operating Profits After Taxes ('NOPAT') less a charge for capital (IC x WACC).

Net Operating Profits After Tax

NOPAT is operating Earnings Before Interest & Tax ('EBIT') less operating taxes. FCFF is NOPAT less New Invested Capital ('NIC') that is incurred to generate NOPAT. NIC represents the change in IC over the period due to capital expenditures ('capex') on property, plant & equipment less a depreciation charge (which has already been deducted in arriving at NOPAT) and increases in working capital (assuming no other net operating assets): NOPAT = EBITDA - depreciation - operating taxes. FCFF = NOPAT - (capex - depreciation) - increases in working capital.

The proportion of NOPAT that is reinvested in NIC is the 'Reinvestment Rate' ('RR'):

$$\text{RR \%} = \frac{\text{NIC}}{\text{NOPAT}}$$

$$\text{FCFF} = \text{NOPAT} (1 - \text{RR})$$

The average Return On Invested Capital ('ROIC') is:

$$\text{ROIC} = \frac{\text{NOPAT}}{\text{Opening IC}}$$

$$\text{Economic profit ('EP')} = \text{NOPAT} - (\text{opening IC} \times \text{WACC})$$

$$= \text{Opening IC} \times (\text{ROIC} - \text{WACC})$$

$$\text{Where WACC} = \text{Weighted Average Cost of Capital (the discount rate used to discount FCFF to PV), discussed in the article 'Business Valuation: Cost of Capital'.$$

Invested Capital

IC represents operating net assets used to generate FCFF and NOPAT. Using the illustrative numbers on page 2:

Invested Capital - balance		Investor Funds - balance	
Inventories	936.6	Borrowings	8,153.0
Trade Receivables	939.3	less: operating cash (if not treated as working capital)	(257.1)
Other receivables	939.3	<i>Net debt</i>	<u>7,895.9</u>
Tax repayable, prepayments and accruals	205.9	Retirement Benefit Deficit / (Surplus)	387.4
<i>Operating Current Assets</i>	<u>3,021.0</u>	Long term non-operating liabilities and provisions	351.0
Trade Payables	(819.7)	<i>Debt equivalents</i>	<u>738.3</u>
Accruals and deferred income	(342.8)	<i>Net debt equivalents</i>	<u>8,634.2</u>
Other Current Liabilities and provisions	(102.8)		
<i>Operating Current Liabilities</i>	<u>(1,265.4)</u>	Equity & Non-Controlling Interests	9,096.1
Operating Working Capital	1,755.6	add back: cumulative amortisation and impairment	37.9
Intangible Assets (excl. goodwill)	19.3	Deferred Tax Liability / (Asset)	889.7
add back: cumulative amortisation and impairment	30.6	Financial Assets	(2,480.9)
Property, Plant & Equipment	13,266.8	Investment in Associates	(1,000.4)
Goodwill	97.0	<i>Net equity equivalents</i>	<u>6,542.4</u>
Cumulative Goodwill Impairments	7.3		
Operating Invested Capital (post- Goodwill)	<u>15,176.6</u>	Investor Funds	<u>15,176.6</u>
Invested Capital - movement			
Capex	1,265.8	Net Assets	9,096.1
less: depreciation and impairments	(631.5)	remove: net debt and debt equivalents	8,634.2
<i>Change in net PP&E</i>	<u>634.3</u>	remove: financial assets	(2,480.9)
Working Capital Investment	83.5	remove: investment in associates	(1,000.4)
Net change in Invested Capital (pre-Goodwill)	717.7	remove: deferred tax liability	889.7
Opening Invested Capital (pre Goodwill)	14,354.6	remove: cumulative amortisation	37.9
Opening Goodwill at cost	104.3	Closing Invested Capital (post- Goodwill)	<u>15,176.6</u>
Closing Invested Capital (post- Goodwill)	<u>15,176.6</u>		

PV of Economic Profits

Using the example from [Appendix 1](#):

ECONOMIC PROFITS MODEL

		Forecast Year				
		1	2	3	4	5
Opening invested Capital (IC_{t-1})		515.00	551.29	579.18	596.56	614.45
NOPAT _t		106.90	80.29	71.80	73.95	76.17
ROIC _t		20.8 %	14.6 %	12.4 %	12.4 %	12.4 %
WACC		10.0 %	10.0 %	10.0 %	10.0 %	10.0 %
Economic Profit		55.40	25.16	13.88	14.29	14.72
Economic profits growing in perpetuity		-	-	-	-	216.63
Discount factor (post-tax WACC)		0.9091	0.8264	0.7513	0.6830	0.6209
PV	235.00	50.37	20.79	10.43	9.76	143.65
add: IC at valuation date	515.00					
Enterprise Value	750.00					
less: debt	(150.00)					
Equity Value	600.00					
Economic profits value at each year end	235.00	203.10	198.25	204.19	210.32	216.63
Invested Capital	515.00	551.29	579.18	596.56	614.45	632.89
Enterprise Value at each year end	750.00	754.38	777.43	800.75	824.77	849.52

The terminal value is the PV of first year economic profits growing at 3.0% in perpetuity:

NOPAT final year x (1 + g)	78.45
Invested Capital at start of terminal period x WACC	(63.29)
First terminal year economic profits	15.16
Growth rate	3.00%
Discount rate	10.00%
TV = 15.16 / (10.00% - 3.00%)	216.63

In the TV equation above, the PV of the future EP is calculated as the first terminal year EP_{n+1} ($= IC_n \times (ROIC_{av\ n+1} - WACC)$) discounted at the growing perpetuity formula ($WACC - g$). If the final forecast year is in a steady state, where the rate of growth of NOPAT and IC (g_{NOPAT} and g_{IC}) equals the perpetuity growth rate, the final forecast year EP can be increased by the growth rate and used for the first terminal period ($EP_{n+1} = EP_n \times (1 + g)$), since the 'spread' ($ROIC - WACC$) will be the same in both years- EP will increase at the NOPAT growth rate.

ROIC

$ROIC_t$ can be expressed in terms of a margin and net operating asset turnover ratio (where $t - 1$ is the opening balance or prior period closing balance):

$$ROIC_t = \frac{NOPAT_t}{Revenue_t} \times \frac{Revenues_t}{IC_{t-1}}$$

$$= \frac{NOPAT \text{ margin}}{\frac{Net\ PP\&E_{t-1}}{Revenues_t} + \frac{Working\ Capital_{t-1}}{Revenues_t}}$$

Taking the example in [Appendix 1](#):

	Forecast Year				
	1	2	3	4	5
$\frac{NOPAT_t}{Revenues_t}$	106.90	80.29	71.80	73.95	76.17
$\div$	2,121.80	2,229.16	2,296.04	2,364.92	2,435.87
$=$	5.04%	3.60%	3.13%	3.13%	3.13%
$\frac{Net\ PP\&E_{t-1}}{Revenues_t}$	400.00	424.36	445.83	459.21	472.98
$\div$	2,121.80	2,229.16	2,296.04	2,364.92	2,435.87
$=$	18.85%	19.04%	19.42%	19.42%	19.42%
$+$	115.00	126.93	133.35	137.35	141.47
$\div$	2,121.80	2,229.16	2,296.04	2,364.92	2,435.87
$=$	5.42%	5.69%	5.81%	5.81%	5.81%
$=$	20.76%	14.56%	12.40%	12.40%	12.40%
$\frac{NOPAT_t}{Invested\ Capital_{t-1}}$	106.90	80.29	71.80	73.95	76.17
$\div$	515.00	551.29	579.18	596.56	614.45
$=$	20.76%	14.56%	12.40%	12.40%	12.40%

RONIC

Part of ROIC will incorporate the return on new invested capital- marginal ROIC or 'Return On New Invested Capital' ('RONIC') - which can be calculated on the assumption that the growth in NOPAT in the period (t) is due to NIC made at the end of the prior period ($t - 1$):

$$RONIC_t = \frac{\text{Change in NOPAT in year}}{\text{NIC in previous year}}$$

$$= \frac{NOPAT_t - NOPAT_{t-1}}{NIC_{t-1}}$$

$$= \frac{g. NOPAT_{t-1}}{NIC_{t-1}}$$

$$\begin{aligned}
\therefore g_t &= \text{RONIC}_t \times \frac{\text{NIC}_{t-1}}{\text{NOPAT}_{t-1}} \\
&= \text{RONIC}_t \times \text{RR}_{t-1} \\
\therefore \text{RR}_{t-1} &= \frac{\text{Growth}_{\text{NOPAT}_t}}{\text{RONIC}_t} \\
\text{NOPAT}_t &= \text{NOPAT}_{t-1} + \left(\text{RONIC}_t \times \text{NIC}_{t-1} \right)
\end{aligned}$$

Taking the example in [Appendix 1](#) again:

		Forecast Year				
		1	2	3	4	5
$ \begin{array}{c} \text{NOPAT}_{t-1} \\ + \\ \left(\begin{array}{c} \text{RONIC}_t \\ \times \\ \text{NIC}_{t-1} \end{array} \right) \\ = \\ \text{NOPAT}_t \end{array} $			106.90	80.29	71.80	73.95
			+	+	+	+
			-73.34%	-30.45%	12.40%	12.40%
			x	x	x	x
			36.29	27.90	17.38	17.90
	=		=	=	=	=
			80.29	71.80	73.95	76.17

ROIC and RONIC

Average ROIC is the return on all invested capital, including NIC made in prior years, so will incorporate RONIC.

$$\begin{aligned}
\text{ROIC}_t &= \frac{\text{NOPAT prior year} + \text{Change in NOPAT this year}}{\text{Invested Capital at start of last year} + \text{New Invested Capital last year}} \\
&= \frac{\text{NOPAT}_{t-1} + g_{\text{NOPAT}_t} \times \text{NOPAT}_{t-1}}{\text{IC}_{t-2} + g_{\text{IC}_{t-1}} \times \text{IC}_{t-2}} \\
&= \frac{\text{NOPAT}_{t-1}}{\text{IC}_{t-2}} \times \left(\frac{1 + g_{\text{NOPAT}_t}}{1 + g_{\text{IC}_{t-1}}} \right) \\
&= \text{ROIC}_{t-1} \times \left(\frac{1 + g_{\text{NOPAT}_t}}{1 + g_{\text{IC}_{t-1}}} \right) \\
&= \text{ROIC}_{t-1} \times \left(\frac{1 + [\text{RR}_{t-1} \times \text{RONIC}_t]}{1 + g_{\text{IC}_{t-1}}} \right)
\end{aligned}$$

From [Appendix 1](#):

		Forecast Year				
		1	2	3	4	5
ROIC _{t-1}				14.56%	12.40%	12.40%
x						
RONIC _t				-30.45%	12.40%	12.40%
x						
RR _{t-1}				34.74%	24.20%	24.20%
=						
1 + a				89.42%	103.00%	103.00%
IC growth _{t-1}						
=						
1 + b				105.06%	103.00%	103.00%
c = a / b				85.11%	100.00%	100.00%
= ROIC _t				12.40%	12.40%	12.40%

[2] Capital Cash Flows discounted at the pre-tax WACC

The cost of capital article discusses the tax benefits of leverage ('tax shield') arising from the tax relief on debt interest and the additional value for a geared company compared to an ungeared one. FCFF was shown as follows: $FCFF + TS = CFE + CFD$, where: TS Tax Shield cash flows = pre-tax interest x tax rate; CFE 'Cash Flows to Equity' = dividends + stock repurchases; CFD 'Cash Flows to Debt' = debt principal net payments + pre-tax interest. CFE and CFD are termed 'Capital Cash Flows' ('CCF') (Kaplan & Ruback (1994)). As the effect of tax relief has been captured in a cash flow (TS), tax in the WACC can be ignored. Discounting at the pre-tax WACC gives the same EntV as under traditional DCF:

CAPITAL CASH FLOWS MODEL

	Forecast Year				
	1	2	3	4	5
Free Cash Flows to the Firm	70.62	52.39	54.42	56.05	57.73
Debt funding / (principal repayments)	0.88	4.61	4.66	4.80	4.95
Interest at 7.00% x opening balance	(10.50)	(10.56)	(10.88)	(11.21)	(11.55)
Pre-tax capital cash flows to debt holders	(9.62)	(5.95)	(6.22)	(6.41)	(6.60)
Tax relief on interest	2.63	2.64	2.72	2.80	2.89
Debt servicing (post-tax)	(7.00)	(3.31)	(3.50)	(3.60)	(3.71)
Opening cash	-	-	-	-	-
FCFE (paid out as dividends) - full payout	63.62	49.08	50.92	52.45	54.02
Equity Cash Flows	63.62	49.08	50.92	52.45	54.02
Add back: Pre-tax debt servicing	9.62	5.95	6.22	6.41	6.60
Capital cash flows	73.24	55.04	57.14	58.86	60.62
FCFF	70.62	52.39	54.42	56.05	57.73
Tax Shield (tax on interest)	2.63	2.64	2.72	2.80	2.89
Capital cash flows	73.24	55.04	57.14	58.86	60.62
Terminal Value	-	-	-	-	849.52
Pre-tax WACC at start of year	10.35%	10.35%	10.35%	10.35%	10.35%
Discount factor	0.9062	0.8212	0.7442	0.6744	0.6111
Forecast period	Yes	Yes	Yes	Yes	Yes
PV of pre-tax capital cash flows	750.00	66.37	45.20	42.52	39.69
less: debt	(150.00)				
Equity Value	600.00				

Final year	60.62
Growth rate	3.00%
Discount rate	10.35%
TV	849.52

$TV = 60.62 \times (1 + 3.00\%) / (10.35\% - 3.00\%)$

In the original papers on CCF (Kaplan & Ruback (1994), Ruback (2000)), the pre-tax WACC was equal to the ungeared cost of equity. The pre-tax cost of debt (K_d) can be shown in terms of a beta:

$$K_d = R_f + \text{DRP}$$

$$= R_f + \beta_d \times \text{ERP}$$

where

$$\begin{aligned} \text{DRP} &= \text{Debt Risk Premium} \\ \text{ERP} &= \text{Equity Risk Premium} \\ R_f &= \text{Risk-free rate} \\ \beta_d &= \text{DRP} / \text{ERP ('implied' debt beta)} \end{aligned}$$

The geared equity beta, ignoring the $(1 - t)$ adjustment, is calculated as (discussed in the article on cost of capital):

$$\beta_g = \beta_u + (\beta_u - \beta_d) \{ L / (1 - L) \}$$

The pre-tax WACC is as follows:

$$\begin{aligned} &\text{Cost of Equity} \quad \left(R_f + \left[\beta_u + (\beta_u - \beta_d) \{ L / (1 - L) \} \right] \text{ERP} \right) \times (1 - L) \\ &+ \\ &\text{Cost of Debt} \quad \left(R_f + \beta_d \times \text{ERP} \right) \times L \end{aligned} \quad \text{L is leverage or } D/(D+E)$$

(pre-tax)

This reduces to the ungeared equity formula:

$$\text{WACC}_{\text{pre-tax}} = R_f + \beta_u \times \text{ERP}$$

In the aforementioned papers, a debt beta was calculated on this basis (see note 1 on page 10 and note 6 on page 12, Ruback (2000)). If another debt beta is assumed (unrelated to the DRP or ERP), the pre-tax WACC will differ from the ungeared cost of equity by: $L \times \text{ERP} \times (\text{Implied } \beta_d - \text{Assumed } \beta_d)$.

Equating the pre-tax WACC and the ungeared cost of equity therefore depends on what assumptions are made about the riskiness of the cash flows.

[3] Adjusted Present Value: FCFF discounted at the ungeared cost of equity and tax shield cash flows discounted at pre-tax cost of debt or ungeared cost of equity

The Adjusted Present Value (Myers (1974)) is similar to method 2 in that the EntV comprises the value of an all equity financed firm plus the value of the tax shield, however the discount rates are different. In the APV, FCFF are discounted at the ungeared cost of equity and tax shields at the pre-tax cost of debt (if debt levels depended on FCFF or the ungeared EntV, the discount rate would be the ungeared cost of equity, to reflect business risk, as in this case):

APV		Forecast Year				
		1	2	3	4	5
Free Cash Flows to the Firm FCFF		70.62	52.39	54.42	56.05	57.73
Terminal Value		-	-	-	-	809.06
Ungeared Cost of Equity		10.35%	10.35%	10.35%	10.35%	10.35%
Discount factor		0.9062	0.8212	0.7442	0.6744	0.6111
Forecast period		Yes	Yes	Yes	Yes	Yes
PV of FCFF	715.05	63.99	43.03	40.50	37.80	529.73

Final year	57.73
Growth rate	3.00%
Discount rate	10.35%
TV	809.06

		Forecast Year				
		1	2	3	4	5
Tax Shields		2.63	2.64	2.72	2.80	2.89
Terminal Value		-	-	-	-	40.45
Ungeared Cost of Equity (since leverage is set using Ent.V)		10.35%	10.35%	10.35%	10.35%	10.35%
Discount factor		0.9062	0.8212	0.7442	0.6744	0.6111
Forecast period		Yes	Yes	Yes	Yes	Yes
PV of FCFF	34.95	2.38	2.17	2.02	1.89	26.49

Final year	2.89
Growth rate	3.00%
Discount rate	10.35%
TV	40.45

Value of FCFF	715.05	718.44	740.41	762.62	785.50	809.06
Value of tax shields	34.95	35.94	37.02	38.13	39.27	40.45
Enterprise Value at each year end	750.00	754.38	777.43	800.75	824.77	849.52
Debt ratio	20.00%	20.00%	20.00%	20.00%	20.00%	20.00%

[4] FCFE discounted at the geared cost of equity

The amount of FCFF remaining after payments (net of tax relief) to financial capital providers with superior claims to equity providers ('Equity Cash Flows' or 'Free Cash Flows to Equity' / 'FCFE') can be distributed as equity cash flows in the form of dividends and / or share repurchases. The present value of FCFE when discounted at the return required by the providers of equity capital (cost of equity) will represent the EqV. We can reconcile EntV to EqV (the 'Bridge') as follows:

Operating EntV (FCFF discounted at the cost of capital)	x
Fair value of non-operating net assets	<u>x</u>
Total EntV	x
Less: net debt (gross debt less surplus cash)	(x)
Less: other non-equity claims and debt-equivalents (e.g. pension deficit)	<u>(x)</u>
EqV (FCFE discounted at the geared cost of equity)	x
Less: equity claims (e.g. employee stock options value)	<u>(x)</u>
EqV for current shareholders	<u>x</u>

This method requires forecasting financing cash flows and related tax in order to calculate residual post-tax cash flows available for distribution to equity holders (via ordinary dividends, special dividends or share buybacks), assuming all excess cash is distributed. The steps are as follows:

- Determine funding requirements, allocate to debt facilities, calculate net interest, pre-tax profit, tax
- Calculate FCFE (see method 2) ² & reconcile to net profit ³
- Calculate the EqV Terminal Value (Eq.TV) at the end of the forecast period
- Calculate the PV of FCFE and Eq.TV at the valuation date
- Add net debt and equivalents to the EqV to determine the EntV

EQUITY CASH FLOW MODEL

		Forecast Year				
		1	2	3	4	5
Equity Cash Flows		63.62	49.08	50.92	52.45	54.02
Terminal Value (equity)		-	-	-	-	679.61
Geared cost of equity at start of year		11.19%	11.19%	11.19%	11.19%	11.19%
Discount factor		0.8994	0.8089	0.7275	0.6543	0.5885
Forecast period		Yes	Yes	Yes	Yes	Yes
PV of Equity Cash Flows	600.00	57.22	39.70	37.05	34.32	431.72
Equity value at each year end	600.00	603.51	621.94	640.60	659.82	679.61
Debt	150.00	150.88	155.49	160.15	164.95	169.90
Enterprise Value at each year end	750.00	754.38	777.43	800.75	824.77	849.52

TV using perpetuity

Final year	54.02
Growth rate	3.00%
Discount rate	11.19%
TV = 54.02 x (1 + 3.00%) / (11.19% - 3.00%)	679.61

[5] Residual Income discounted at the geared cost of equity

The Residual Income (RI) model is similar to the residual operating income method 1, but uses profits after tax and the book value of equity (BVE) rather than NOPAT and Invested Capital (Ohlson (1995)):

$$RI = BVE_n \times (ROE_{n+1} - K_g)$$

where:

BVE_n book value of equity at the start of the period

ROE_{n+1} the return on equity for the period (= profits after tax_{n+1} / BVE_n)

K_g geared cost of equity

The EqV is calculated as BVE at the valuation date plus the present value of future residual income. The terminal value is therefore calculated as:

$$\text{Equity TV}_n = BVE_n + BVE_n \left(\frac{ROE_{n+1} - K_g}{K_g - g} \right)$$

where:

g stable growth in profits after tax

- 2 The interest cash flows need to be consistent with what is used in the WACC calculation, so that if leverage is based on net debt and debt equivalents, the equity cash flows should be after interest is calculated based on net debt and debt equivalents, meaning a notional interest may have to be applied to match the two.

- 3 Net cash in excess of the amount estimated as required for daily operations ('operating cash') is assumed to be paid out in full to shareholders, so that the dividend equals the Free Cash Flow to Equity (this assumes sufficient distributable profits under company law exist), as follows:

	Forecast Year				
	1	2	3	4	5
Profits after tax	99.03	72.37	63.63	65.54	67.51
add: Debt funding	0.88	4.61	4.66	4.80	4.95
less: New Invested Capital	(36.29)	(27.90)	(17.38)	(17.90)	(18.43)
Equity Cash Flows (= dividends)	63.62	49.08	50.92	52.45	54.02
FCFF	70.62	52.39	54.42	56.05	57.73
add: Debt funding	0.88	4.61	4.66	4.80	4.95
less: debt interest	(10.50)	(10.56)	(10.88)	(11.21)	(11.55)
add back: tax relief on interest	2.63	2.64	2.72	2.80	2.89
Equity Cash Flows (= dividends)	63.62	49.08	50.92	52.45	54.02

If the change in BVE reflects profits after tax net of dividends paid ('Clean Surplus' accounting), this method should give the same EqV as the equity cash flow method (4). This value can also be shown as the value of profits after tax in the first year of the terminal period (PAT_{n+1}) if received in perpetuity without growth and capitalised at the geared cost of equity ($= PAT_{n+1} / K_g$) plus the present value of growth from the second year in perpetuity (measured as the growth in PAT less a charge for equity capital based on the prior year change in BVE, equal to PAT less dividends paid). The second period RI growth will be (and similarly for the remaining years in perpetuity):

$$RI \text{ growth} = (g_{n+2} \times PAT_{n+1}) - (K_g \times \text{change in } BVE_{n+1})$$

This is then discounted back to the end of the first year and capitalised in perpetuity (no growth). This can be shown as follows (the equivalent for NOPAT):

$$TV_n = PAT_{n+1} \left[\frac{1}{K_g} + \frac{ROE - K_g}{K_g \cdot ROE} \times \frac{g}{K_g - g} \right]$$

Using our example:

RESIDUAL INCOME MODEL

				Forecast Year				
				1	2	3	4	5
Retained Profits				35.41	23.29	12.71	13.09	13.48
Book Value of Equity	BVE	365.00		400.41	423.69	436.41	449.50	462.98
BVE growth					5.8%	3.0%	3.0%	3.0%
Profits After Tax	PAT			99.03	72.37	63.63	65.54	67.51
Return on Equity = PAT / opening BVE	ROE			27.1%	18.1%	15.0%	15.0%	15.0%
Cost of Equity (geared)	K_g			11.19%	11.19%	11.19%	11.19%	11.19%
Residual Income = PAT - opening BVE x K_g				58.19	27.57	16.23	16.72	17.22
TV perpetuity				-	-	-	-	216.63
BE				-	-	-	-	-
TV				-	-	-	-	216.63
				0.8994	0.8089	0.7275	0.6543	0.5885
Discount factor (geared cost of equity)				Yes	Yes	Yes	Yes	Yes
Forecast period								
PV of Residual Income + TV		235.00		52.34	22.30	11.81	10.94	137.61
add: BVE at valuation date		365.00						
Equity Value		600.00						
Net cash		-						
Equity Value		600.00						
Value of residual income each period		235.00	203.10	198.25	204.19	210.32	216.63	
BVE		365.00	400.41	423.69	436.41	449.50	462.98	
Equity value at each year end		600.00	603.51	621.94	640.60	659.82	679.61	
Debt		150.00	150.88	155.49	160.15	164.95	169.90	
Enterprise Value at each year end		750.00	754.38	777.43	800.75	824.77	849.52	

TV using perpetuity

Final year PAT	67.51
First terminal year PAT	69.53
BVE	462.98
RI	17.74
Growth rate	3.00%
Discount rate	11.19%
TV = 17.74 / (11.19% - 3.00%)	216.63

The TV is shown as the value of profit after tax arising in the first terminal year remaining constant in perpetuity plus the value from growth, less the book value of equity at the terminal date.

Growth rate	3.00%	
First terminal year PAT	69.53	
Geared cost of equity (K)	11.19%	
First year RI	17.74	
ROE	15.02%	
Implied retention ratio (g / ROE)	19.98%	
ROE - Cost of Equity (K)	3.83%	
K. ROE	1.68%	
g / (k - g)	36.64%	
Growth factor	x 0.84	= (3.83% / 1.68%) x 36.64%
No growth value	621.52	= 69.53 / 11.19%
Growth value	58.09	= 69.53 x 0.84
TV plus BVE	679.61	
less: BVE	(462.98)	
TV	216.63	

If the cost of debt (K_d) is calculated as interest paid / opening debt, ROE can be obtained from the ROIC:

$$ROE_t = ROIC_t + \frac{D_{t-1}}{E_{t-1}} (ROIC_t - K_d (1 - t))$$

			Forecast Year				
			1	2	3	4	5
Profit After Tax	PAT		99.03	72.37	63.63	65.54	67.51
Add back: interest	i		10.50	10.56	10.88	11.21	11.55
Less: tax relief on interest	t. i		(2.63)	(2.64)	(2.72)	(2.80)	(2.89)
NOPAT			106.90	80.29	71.80	73.95	76.17
Equity (book value)	E	365.00	400.41	423.69	436.41	449.50	462.98
Debt (book value)	D	150.00	150.88	155.49	160.15	164.95	169.90
Invested Capital		515.00	551.29	579.18	596.56	614.45	632.89
Post-tax interest	i.(1 - t)		7.88	7.92	8.16	8.41	8.66
Debt at start of period	D		150.00	150.88	155.49	160.15	164.95
Effective rate			5.25 %	5.25 %	5.25 %	5.25 %	5.25 %
D/E prior period			41.10 %	37.68 %	36.70 %	36.70 %	36.70 %
ROIC - K _{dt}			15.51 %	9.31 %	7.15 %	7.15 %	7.15 %
D/E x (ROIC - K _{dt})			6.37 %	3.51 %	2.62 %	2.62 %	2.62 %
ROIC			20.76 %	14.56 %	12.40 %	12.40 %	12.40 %
ROE			27.13 %	18.07 %	15.02 %	15.02 %	15.02 %

[6] Dividends discounted at the geared cost of equity ("Dividend Discount Model")

This well known valuation model values dividends rather than equity cash flows, although in the example provided here all equity cash flows are paid out as dividends, so method 4 would be sufficient. It is shown here based on the example in [Appendix 1](#):

DIVIDEND DISCOUNT MODEL

		Forecast Year				
		1	2	3	4	5
Geared Cost of Equity (K_{eg})		11.19%	11.19%	11.19%	11.19%	11.19%
Discount rate		0.8994	0.8089	0.7275	0.6543	0.5885
Dividends		63.62	49.08	50.92	52.45	54.02
PV of dividends	200.07	57.22	39.70	37.05	34.32	31.79
Dividend growth rate (g)						3.00 %
Year 6 dividend (= D_1)						55.64
Perpetuity value = $D_1 / (K_{eg} - g)$						679.61
PV of perpetuity (x yr 5 disc. factor)	399.93					
Equity Value	600.00					
ROE		27.13%	18.07%	15.02%	15.02%	15.02%
Sustainable growth (BVE growth)		9.70%	5.82%	3.00%	3.00%	3.00%
ROE - g		17.43%	12.26%	12.02%	12.02%	12.02%
x opening book value of equity =		63.62	49.08	50.92	52.45	54.02
PV at cost of equity	200.07	57.22	39.70	37.05	34.32	31.79
Year 6 : ROE - g						12.02%
Year 6 : $K_e - g$						8.19%
Price : Book Multiple = $(ROE - g) / (K_e - g)$						x 1.5
x year 5 book value of equity						679.61
PV of terminal value	399.93					
Equity Value	600.00					

PART 3: CROSS-BORDER DCF VALUATION

Domestic vs. Cross-Border Valuations

In a domestic DCF valuation it is assumed that Free Cash Flows are available to the providers of capital based in the same country. An acquirer obtaining control of a 'domestic' target would perform a standalone DCF valuation (based on existing management forecasts) and then add in value generated from improvements it would make post-acquisition (control value) and value generated from synergies (inside and outside the target).

If the target is located abroad, there may be restrictions imposed on the post-acquisition remittance of cash flows to the UK parent / acquirer (exchange control restrictions, withholding taxes, etc), in which case the analysis should consider incremental cash flows from the acquisition arising inside and outside the target. This is similar to the 3-step approach suggested for international capital budgeting appraisal, where project cash flows are adjusted to cash flows that can be remitted to the parent (see ch. 17 Shapiro (2014), ch.15 Bekaert & Hodrick (2018) and ch.22 Buckley (2004)).

Cross-border valuation framework

A cross-border valuation could involve the following steps (adopting Damodaran's framework):

- 1 Forecast and discount target FCFF- the pre-financing operating and investing cash flows under existing management- to give the standalone EntV.

- ② Revise the status quo FCFF ① to incorporate improvements the acquirer could make via its intended operating and investment plans as a result of obtaining control (financing improvements, including value created by increasing the debt tax shield, may reduce the WACC). Royalties or other pre-financing payments the acquirer expects to receive from the target should be ignored or included as a deduction and valued separately on an after-tax basis (incremental tax or remittance effects from royalty payments would need to be considered).
- ③ Adjust the cash flows and valuations in ② for any restrictions and leakages affecting remittances to the parent. As mentioned, this step may not be required. This gives the adjusted standalone EntV with control.
- ④ Forecast and discount synergy cash flows arising (1) inside the target- excluding cash flows already in the control value step- making any adjustments to the discount rate for synergy-related risks, and apply the remittance restriction adjustments, and (2) outside the target. This final step gives the total value to the acquirer (EntV), from which net debt and non-equity amounts would be deducted to arrive at the final EqV .

Cash flows and discount rates in steps ① to ④ must take into account risks associated with investment in the target country (political risk, for example) and be stated before or after the effects of inflation (real, nominal) and in the target currency or acquirer currency. There must be consistency between cash flows and discount rate (same inflation treatment and currency). If parity conditions hold, results should be the same with consistent treatment. This is discussed more in the article 'Business Valuation: Cost of Capital'.

CONCLUSION

The DCF method is generally regarded as the most theoretically sound approach to intrinsic valuation, provided it is applied correctly and the assumptions are reasonable and internally consistent. However, it is highly sensitive to a small number of inputs (discount rates, growth rates, return on new invested capital) and a large proportion of enterprise value typically lies in the terminal value.

The main practical points from the above discussion are:

- Value drivers Free cash flow should be built up from its underlying drivers at the most granular level practicable, with all relevant variable and fixed costs, both operating and investment, identified. Forecasts should represent expected (probability-weighted) cash flows.
- Reinvestment Revenue and EBITDA growth must be supported by new capital invested. Capital expenditure in excess of the maintenance level (the depreciation charge being a rough proxy) and investment in working capital must be consistent with the growth assumed.

- **Value creation** Value is created from growth only where new capital invested earns a return in excess of the cost of capital ($RONIC > WACC$). Growth in NOPAT equals $RONIC$ multiplied by the reinvestment rate (the proportion of NOPAT reinvested in new operating capital).
- **Consistency** Forecast cash flows and the discount rate must be determined on a consistent basis (comparable numerator and denominator) as regards non-operating cash flows, inflation (nominal or real), currency and exchange rates, taxes, capital structure and risk (company-specific risk should be captured in cash flows and not again in the discount rate).
- **Terminal value** The explicit forecast period must be long enough for the terminal value to reflect steady-state conditions: revenues, profits, operating invested capital and cash flows should all be growing in perpetuity at a constant, sustainable rate that does not exceed long-term nominal economic growth. The terminal value should also reflect reinvestment consistent with that growth rate and a sustainable $RONIC$. The terminal value should be tested for reasonableness with implied EBITDA multiples, sensitivity and scenario analysis.
- **Bridge** A reconciliation from operating enterprise value to equity value available for ordinary shareholders (the enterprise-equity value bridge) should be prepared. Bridge items must be consistent with the free cash flows and discount rate used: no adjustment should be made for items already captured in free cash flows used for the enterprise value calculation.
- **Cross-check** The alternative DCF methods should be used as a check on the traditional DCF method valuation: they should give the same result provided the assumptions are consistent, so any difference needs to be investigated. Furthermore, the economic profit model (alternative method no.1 above) provides additional supportive information in terms of rates of return, growth and reinvestment assumptions.

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Appendix 1: EntV Example

This simplified example illustrates the basic principles of DCF Enterprise Valuation ('EntV'), particularly the requirement for a steady state towards the end of the forecast period. A detailed discussion of steady state cash flows, along with a DCF model can be found in Jennergren (2011). To simplify things, deferred tax and adjustments to the EntV to arrive at EqV have been ignored, other than net debt.

In the base case, revenues have reached the long term sustainable growth rate used in the perpetuity (3.0%) by year 3, and by year 4 all flows and balances (operating and aggregate financing balances) in the financial statements grow at this rate. ROIC and RONIC are both constant and equal to 12.40% (and will remain this way happily forever), since the proportion of NOPAT reinvested as New Invested Capital (NIC) is fixed at the year 5 level ⁴. Discounting the year 5 TV and forecast period cash flows at a constant 10.0% gives a base case EntV of 750.00 and EqV of 600.00.

If revenue growth, operating expenses / revenues and the discount rate are changed by 1.0% increase / decrease, 0.5% decrease / increase and 1.0% decrease / increase respectively, the EntV ranges from 1,120.87 to 544.69. Over 85% of the variation is due to the TV, because the base case growth adjusted perpetuity discount rate ranges 7.0% +/- 2.0%. Also RONIC in the worst case scenario has decreased below the discount rate, meaning new investments are value destructive.

It is assumed the book value of debt equals market value ('MV') and all 'excess cash' is paid out to shareholders. This valuation illustrates the approach of some experts by assuming cash required to operate the business ('Operating Cash') approximates 2.0% of annual revenue (see Koller et al. (McKinsey) 2025 p.213, p.336). Some argue that cash should not be separated into operating and excess cash (see Canessa & Jarrell (2022)), but is separated in this example. Some also question whether operating cash should be included in working capital rather than treated separately as cash. It is treated here as part of working capital, so the increase in working capital includes the increase in operating cash.

Calculation of the discount rate assumes the MV of debt as a percentage of the MV of debt and equity (the EntV) is constant at 20%, and debt levels have been set to ensure this occurs. This requires a 'recursive' procedure, where the EntV Terminal Value ('TV') is first calculated in order to set the debt at the end of the forecast period (it will require circularity if WACC and leverage are not assumed). The EntV at the prior period (year 4) equals the TV plus the year 5 Free Cash Flow to the Firm (FCFF) both discounted back one period, which allows year 4 debt to be calculated. This procedure is carried on back to the valuation date, at which time interest can be calculated (going forward) and net income determined (allowing for tax relief).

⁴ If, instead, RR were to increase to 30% and growth rates remain at 3.0%, RONIC would reduce to 10.0% (ROIC reduces to 10.0% very slowly over some 200 years) since more investment would be required to generate the same growth ($RONIC = g / RR$). As this equals the discount rate, the NIC will not add any value.

	Forecast Year				
	1	2	3	4	5
PROFIT & LOSS					
Revenues	2,121.80	2,229.16	2,296.04	2,364.92	2,435.87
Operating expenses	(1,909.62)	(2,048.22)	(2,122.69)	(2,186.37)	(2,251.96)
EBITDA	212.18	180.94	173.35	178.55	183.91
Depreciation	(69.64)	(73.89)	(77.62)	(79.95)	(82.35)
EBIT	142.54	107.05	95.73	98.60	101.56
Interest	(10.50)	(10.56)	(10.88)	(11.21)	(11.55)
Pre-tax profits	132.04	96.49	84.84	87.39	90.01
Tax	(33.01)	(24.12)	(21.21)	(21.85)	(22.50)
Post-tax profits	99.03	72.37	63.63	65.54	67.51
Dividends	(63.62)	(49.08)	(50.92)	(52.45)	(54.02)
Retained profits	35.41	23.29	12.71	13.09	13.48

CASH FLOWS					
EBITDA	212.18	180.94	173.35	178.55	183.91
less: capital expenditures	(94.00)	(95.36)	(91.00)	(93.73)	(96.54)
less: increase in working capital	(11.93)	(6.42)	(4.00)	(4.12)	(4.24)
less: taxes paid (excluding financing)	(35.63)	(26.76)	(23.93)	(24.65)	(25.39)
Free Cash Flows to the Firm FCFF	70.62	52.39	54.42	56.05	57.73
Debt cash flows (after tax relief on interest)	(7.00)	(3.31)	(3.50)	(3.60)	(3.71)
Dividends paid to ordinary shareholders	(63.62)	(49.08)	(50.92)	(52.45)	(54.02)
Net cash flows	-	-	-	-	-
Opening cash	-	-	-	-	-
Closing cash	-	-	-	-	-
EBITDA	212.18	180.94	173.35	178.55	183.91
Depreciation	(69.64)	(73.89)	(77.62)	(79.95)	(82.35)
EBIT	142.54	107.05	95.73	98.60	101.56
less: taxes paid (excluding financing)	(35.63)	(26.76)	(23.93)	(24.65)	(25.39)
Net Operating Profits After Taxes NOPAT	106.90	80.29	71.80	73.95	76.17
Capital expenditures ('capex')	94.00	95.36	91.00	93.73	96.54
less: replacement capex (depreciation)	(69.64)	(73.89)	(77.62)	(79.95)	(82.35)
Growth capex	24.36	21.47	13.37	13.78	14.19
Increase in working capital	11.93	6.42	4.00	4.12	4.24
New Invested Capital NIC	36.29	27.90	17.38	17.90	18.43
Free Cash Flows FCFF	70.62	52.39	54.42	56.05	57.73

BALANCE SHEET						
	Opening					
At cost	500.00	533.25	564.16	587.45	611.43	636.14
Accumulated depreciation	(100.00)	(108.89)	(118.33)	(128.24)	(138.45)	(148.97)
Fixed assets	400.00	424.36	445.83	459.21	472.98	487.17
Working capital (including operating cash)	115.00	126.93	133.35	137.35	141.47	145.71
Invested Capital	515.00	551.29	579.18	596.56	614.45	632.89
Opening Invested Capital	515.00	515.00	551.29	579.18	596.56	614.45
New Invested Capital	-	36.29	27.90	17.38	17.90	18.43
Closing Invested Capital	515.00	551.29	579.18	596.56	614.45	632.89
Gross debt	150.00	150.88	155.49	160.15	164.95	169.90
Excess cash	-	-	-	-	-	-
Net debt	150.00	150.88	155.49	160.15	164.95	169.90
Share Capital	100.00	100.00	100.00	100.00	100.00	100.00
Reserves	265.00	300.41	323.69	336.41	349.50	362.98
Equity	365.00	400.41	423.69	436.41	449.50	462.98
Financial Capital	515.00	551.29	579.18	596.56	614.45	632.89

ASSUMPTIONS

Revenue growth rate
Operating expenses / revenues
Operating cash / revenues
Working capital / Revenues
Depreciation / Opening Net PP&E
Retirements / Opening Net PP&E
Net PP&E / Revenues
Tax rate

	Forecast Year				
	1	2	3	4	5
Revenue growth rate	6.09%	5.06%	3.00%	3.00%	3.00%
Operating expenses / revenues	90.00%	91.88%	92.45%	92.45%	92.45%
Operating cash / revenues	1.90%	1.90%	1.90%	1.90%	1.90%
Working capital / Revenues	4.08%	4.08%	4.08%	4.08%	4.08%
Depreciation / Opening Net PP&E	17.41%	17.41%	17.41%	17.41%	17.41%
Retirements / Opening Net PP&E	15.19%	15.19%	15.19%	15.19%	15.19%
Net PP&E / Revenues	20.00%	20.00%	20.00%	20.00%	20.00%
Tax rate	25.0%	25.0%	25.0%	25.0%	25.0%

METRICS

Growth rates

Revenue growth	5.06%	3.00%	3.00%	3.00%
EBITDA growth	-14.72%	-4.19%	3.00%	3.00%
Depreciation growth	6.09%	5.06%	3.00%	3.00%
EBIT growth	-24.89%	-10.58%	3.00%	3.00%
NOPAT growth	-24.89%	-10.58%	3.00%	3.00%
Capex growth	1.44%	-4.57%	3.00%	3.00%
Working capital growth	5.06%	3.00%	3.00%	3.00%
Free Cash Flow growth	-25.80%	3.87%	3.00%	3.00%
Fixed Assets growth	5.06%	3.00%	3.00%	3.00%
Invested Capital growth	5.06%	3.00%	3.00%	3.00%
Interest growth	0.58%	3.05%	3.00%	3.00%
Net Profit growth	-26.92%	-12.07%	3.00%	3.00%
Net debt growth	3.05%	3.00%	3.00%	3.00%
Equity growth	5.82%	3.00%	3.00%	3.00%

Ratios

EBIT margin	6.72%	4.80%	4.17%	4.17%	4.17%
Capex / depreciation	x 1.35	x 1.29	x 1.17	x 1.17	x 1.17
Capex / revenue	4.43%	4.28%	3.96%	3.96%	3.96%
Change Working Capital / Revenues	0.56%	0.29%	0.17%	0.17%	0.17%
Invested Capital / Revenues	25.98%	25.98%	25.98%	25.98%	25.98%
Reinvestment Rate	33.94%	34.74%	24.20%	24.20%	24.20%
Return On Invested Capital (ROIC)	20.76%	14.56%	12.40%	12.40%	12.40%
Return on New Invested Capital (RONIC)		-73.34%	-30.45%	12.40%	12.40%
Discount rate	10.00%	10.00%	10.00%	10.00%	10.00%

DCF VALUATION

Free Cash Flows to the Firm
Terminal Value
Post-Tax WACC at start of year
Discount factor
PV of cash flows today
less: market value of debt at valuation date
Equity Value

	Forecast Year				
	1	2	3	4	5
Free Cash Flows to the Firm	70.62	52.39	54.42	56.05	57.73
Terminal Value	-	-	-	-	849.52
Post-Tax WACC at start of year	10.00%	10.00%	10.00%	10.00%	10.00%
Discount factor	0.9091	0.8264	0.7513	0.6830	0.6209
PV of cash flows today	64.20	43.30	40.89	38.28	563.33
less: market value of debt at valuation date					
Equity Value					
Enterprise value at year end	750.00	754.38	777.43	824.77	849.52
Debt	(150.00)	(150.88)	(155.49)	(164.95)	(169.90)
Equity	600.00	603.51	621.94	659.82	679.61

Debt / Enterprise Value	20.00%	20.00%	20.00%	20.00%	20.00%
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WACC is the discount rate, or the 'Weighted Average Cost of Capital', which is the subject of another article.

FCFF Perpetuity TV

Final year FCFF	57.73
Growth rate	3.00%
Discount rate	10.00%
TV = $57.73 \times (1 + 3.00\%) / (10.00\% - 3.00\%)$	849.52

Final year NOPAT	76.17	
Reinvestment Rate	24.20%	g 3.00%
FCFF	57.73	RONIC 12.40%
First terminal period EBITDA		189.43
Implied Forward EBITDA x		x 4.5

		BEST CASE							WORST CASE				
		Forecast Year							Forecast Year				
		1	2	3	4	5			1	2	3	4	5
EBITDA		224.70	195.47	189.91	197.51	205.41			199.50	166.35	157.05	160.19	163.40
Depreciation		(69.64)	(74.52)	(78.99)	(82.15)	(85.44)			(69.64)	(73.13)	(76.05)	(77.57)	(79.12)
EBIT		155.06	120.95	110.92	115.36	119.97			129.86	93.23	81.00	82.62	84.27
less: taxes paid (excluding financing)		(38.76)	(30.24)	(27.73)	(28.84)	(29.99)			(32.46)	(23.31)	(20.25)	(20.66)	(21.07)
Net Operating Profits After Taxes	NOPAT	116.29	90.71	83.19	86.52	89.98			97.39	69.92	60.75	61.97	63.20
Capital expenditures ('capex')		97.64	100.20	97.14	101.02	105.06			89.64	89.93	84.79	86.48	88.21
less: replacement capex (depreciation)		(69.64)	(74.52)	(78.99)	(82.15)	(85.44)			(69.64)	(73.13)	(76.05)	(77.57)	(79.12)
Growth capex		28.00	25.68	18.15	18.87	19.63			20.00	16.80	8.74	8.91	9.09
Increase in working capital		13.01	7.68	5.43	5.64	5.87			10.62	5.02	2.61	2.67	2.72
New Invested Capital	NIC	41.01	33.36	23.57	24.52	25.50			30.62	21.82	11.35	11.58	11.81
Free Cash Flows	FCFF	75.28	57.35	59.62	62.00	64.48			66.77	48.09	49.40	50.39	51.40

Revenue growth rate	+ 1.00%	7.00%	6.00%	4.00%	4.00%	4.00%	- 1.00%	5.00%	4.00%	2.00%	2.00%	2.00%
Op. expenses / revenues	- 0.50%	89.50%	91.38%	91.95%	91.95%	91.95%	+ 0.50%	90.50%	92.38%	92.95%	92.95%	92.95%
EBIT growth			-22.00%	-8.29%	4.00%	4.00%			-28.21%	-13.11%	2.00%	2.00%
Free Cash Flow growth			-23.82%	3.95%	4.00%	4.00%			-27.97%	2.72%	2.00%	2.00%
Invested Capital growth			6.00%	4.00%	4.00%	4.00%			4.00%	2.00%	2.00%	2.00%
Net debt growth			4.00%	4.00%	4.00%	4.00%			2.06%	2.00%	2.00%	2.00%
Equity growth			7.41%	4.00%	4.00%	4.00%			4.48%	2.00%	2.00%	2.00%
Free Cash Flows to the Firm		75.28	57.35	59.62	62.00	64.48		66.77	48.09	49.40	50.39	51.40
Terminal Value		-	-	-	-	1,341.18		-	-	-	-	582.50
Post-Tax WACC at start	- 1.00%	9.00%	9.00%	9.00%	9.00%	9.00%	+ 1.00%	11.00%	11.00%	11.00%	11.00%	11.00%
Discount factor		0.9174	0.8417	0.7722	0.7084	0.6499		0.9009	0.8116	0.7312	0.6587	0.5935
PV of cash flows today	1,120.87	69.06	48.27	46.03	43.92	913.58	544.69	60.15	39.03	36.12	33.19	376.19
Final year FCFF						64.48						51.40
Growth rate						4.00%						2.00%
Discount rate						9.00%						11.00%
TV = 64.48 x (1 + 4.00%) / (9.00% - 4.00%)						1,341.18						582.50
Final year NOPAT				89.98						63.20		
Reinvestment Rate			28.34%							18.68%		
FCFF			64.48		g	4.00%					g	2.00%
					RONIC	14.11%					RONIC	10.71%
First terminal period EBITDA						213.62						166.66
Implied Forward EBITDA x						x 6.3						x 3.5

DeferredTax

Deferred tax liability balances are ignored when adjusting the EntV for net non-operating assets (Holthausen & Zmijewski (2020) p.117). Deferred tax assets should be treated as non-operating assets and valued separately (Koller et al. (McKinsey) (2025) p.216). Deferred tax is discussed in the article 'Business Acquisitions: Taxation (UK) & Accounting (IFRS)'.

Pension Deficits (Defined Benefit)

In a funded Defined Benefit Plan the company agrees to provide future benefits from a fund of investments built up over the years with contributions by the employer (and possibly the employees). The present value of the Defined Benefit obligations (DBO) may be more than the market value of the fund assets, meaning a shortfall ('deficit'), for which the company is liable, has arisen (a 'surplus' arises if plan assets are valued in excess of the obligations). The fund accumulates from ongoing contributions and a return on investment (dividends, interest) which are reinvested. Whilst the plan assets are easily measured, the liability requires actuarial techniques to forecast future benefit payments. In simplistic terms:

- ★ the fair value of the fund assets will change over the period n to $n + 1$ as follows:

$$\text{Assets}_{n+1} = \text{Assets}_n + \text{contributions paid in} + \text{interest income} - \text{benefits paid out} + A_{G/L}$$

- ★ the PV of the DBO will change as follows:

$$\text{DBO}_{n+1} = \text{DBO}_n + \text{service cost} + \text{interest costs} - \text{benefits paid out} + \text{DBO}_{G/L}$$

Where:

- Service cost (P&L operating profits) = increase in PV of DBO from employee service in the current period ('current service cost') + prior periods (amendments and curtailments)
- Net Interest income and costs (P&L non-operating) = the discount rate applied to the opening value of plan assets and DBO (the difference between the discount rate and actual return on assets is included in $A_{G/L}$). The discount rate must reflect the start of period yield on high quality corporate bonds.
- $A_{G/L}$ and $\text{DBO}_{G/L}$ (Other Comprehensive Income) = the gain / loss on re-measurement of plan assets at year end market prices and obligations at revised actuarial assumptions.

A surplus is recognised on the balance sheet as an asset subject to an 'asset ceiling' that reflects the surplus recoverable amount (the PV of future refunds and reductions in future contributions resulting from there being a surplus).

Operating EBITA should include the service cost and no adjustment is made for valuation purposes (it is part of NOPAT). If FCFF or NOPAT is calculated from net income, the defined benefit cost excluding the service cost needs to be added back, net of tax.

A DBO net liability for valuation purposes should be treated as a debt equivalent and deducted from the EntV. If contributions required to eliminate the deficit are fully tax deductible, the amount deducted is $\text{DBO net liability} \times (1 - \text{marginal tax rate})$. Any related interest costs (net of tax) should be excluded from FCFF (and included in the discount rate as they relate to the pension deficit debt-equivalent). Adjustments may also be made when de-levering and levering betas under CAPM for the cost of equity estimate, to factor in additional risk borne by shareholders if appropriate (betas would need to be estimated for pension liabilities and assets)

(See Koller et al. (McKinsey) (2025) p.455-464, 881; Jin, Merton & Bodie 2006; <https://www.footnotesanalyst.com/dcf-and-pensions-enterprise-or-equity-cash-flow/>)

Leases

Under a lease agreement, one party (the 'lessor') grants another (the 'lessee') full use of an asset for a period ('primary lease term') in return for a rental, subject to certain terms and conditions. The lessee would normally return the asset to the lessor at the end of the primary lease term, having maintained it and restored it to the minimum condition stated in the lease agreement; however, it may be granted the right to extend the lease into a 'Secondary' term at a stipulated rent ('Renewal Option') or to purchase the asset ('Purchase option'). A significant risk for the lessor is the uncertainty associated with the value of the asset at the end of the lease term ('Residual Value').

If the lessor can earn its required rate of return from cash flows that the lessee has contracted to pay or guarantee over a non-cancellable term ('Minimum Lease Payments' / 'MLP', being rentals and any guaranteed payments for all or part of the Residual Value), the lease would be termed a 'Full Payout' lease. The lessor has effectively sold its economic interest in the asset to the lessee, and its required return would be achieved whatever the Residual Value: any proceeds from the sale of the asset at the end of the lease could be returned to the lessee as a rebate of rentals (if the asset had a nil Residual Value, the lease term would represent 100% of the asset's remaining economic life at the start of the lease). The PV of the MLP, as a percentage of the asset fair value is an indication of how much effective economic ownership has been transferred to the lessee.

Prior to the introduction of IFRS 16 *Leases* (effective from 2019), under IAS 17, leases classified as Finance Leases ('FL') (substantially all the risks and rewards associated with ownership transferred to the lessee) were capitalised by lessees at the PV of MLP. By contrast, where the lessor retained enough risk, the lease was classified as an Operating Lease ('OL') with lessee rentals charged to the P&L and no requirement for lessee to capitalise lease payments (a form of off-balance sheet financing). The PV of future lease payments under a FL effectively represents debt servicing on borrowings used to purchase the asset (payments of principal and interest added into the lease rental), which would be treated separately (a liability for future rentals, a depreciated asset and interest and depreciation expenses in the P&L). An OL required only the rental charge to be shown as an expense.

Under IFRS 16, if an agreement that qualifies as a lease contract conveys the right to the lessee to control the use of an identified asset for a period of time in return for consideration, it should be classified as a lease and capitalised as a 'Right-Of-Use' asset ('ROUA'), even if it would have been classified as an OL under the old rules (the lessee can opt out if the lease is for 12 months or less and does not contain a purchase option, or if the lease is deemed to be of low value). On initial recognition, the cost of the ROUA is recognised as an asset and the PV of the Lease Payments ('LP') as a liability discounted at the interest rate implicit in the lease. LP are the enforceable payments over the lease term (actual and 'in-substance' fixed payments, variable payments that depend on an index or rate, the exercise price of any purchase option that the lessee is reasonably certain to exercise and amounts payable by the lessee under any RV guarantees). In a DCF valuation, ROUA additions are treated as capex and the lease liability is deducted as debt.

The term starts on the date the asset is made available for use by the lessee and ends when the lease is no longer enforceable. This includes the non-cancellable period and any period covered by an option granted to the lessee to extend the lease (where it is reasonably certain the extension option will be exercised) or terminate the lease (where it is reasonably certain the termination option will not be exercised). If the lessee has the right to purchase the ROUA, and exercising the right was reasonably certain, that would be considered as well. When the lessor and lessee can terminate the lease for an insignificant penalty and without permission from the other party, the lease is no longer enforceable and has come to an end.

The interest rate implicit in the lease is the IRR that discounts the lessee's LP and any unguaranteed RV that the lessor expects to receive to the asset fair value (plus any 'initial direct costs'). If the lessee cannot readily determine this rate (if it does not know what unguaranteed RV the lessor is expecting), it may use its 'incremental borrowing rate' (the rate the lessee would expect to pay to borrow funds to obtain an asset of similar value to the ROUA, based on a similar term, security and economic environment).

Employee Stock Options

General principles

A company which has granted employee stock options (ESOs) that remain unexercised at the valuation date has created a future claim (or 'contingent' claim) over the EqV, triggered when the options are exercised (assuming exercised at a price below market price). The cost for the company of repurchasing stock to give as options (number of options x share price) less the proceeds received on exercise (number of options x exercise price), reflects the loss of value (the Treasury method assumes exercise proceeds are used to repurchase shares at the share price with the excess shares required to top up to the number of options being new diluting shares). Similarly, if options are granted after the valuation date, a further claim on equity will arise via a reduction in expected future cash flows to which existing equity investors are entitled.

Valuation treatment

- ★ One approach to valuation is as follows:
- ★ Options granted before the valuation date (deduct from value) - The Fair Value ('FV') of options outstanding at the valuation date can be estimated using an option pricing model and deducted from the equity DCF value (option pricing methods will be discussed in another article). The EqV per share should be based on outstanding shares (issued shares less treasury shares) and not increased to reflect dilution arising on option exercise (the effect is already taken into account by reducing EqV).
- ★ Options granted after the valuation date (deduct from cash flows) - Rather than attempt to forecast future option grants and exercise behaviour, the FV of option grants can be based on a percentage applied to revenues (Damodaran (2005)) or a growth rate applied to the previous period amount (Li and Wong (2004)). This would then be deducted from earnings and cash flows (despite being a non-cash item). Deducting from Free Cash Flows estimated cash outflows arising from the granting of options over the forecast period would require a forecast of DCF share prices (equity DCF value per share at each period), exercise prices (which could be the grant date DCF share price), option grants and exercise behaviour, making the calculation tricky (see Barenbaum & Schubert (2019)). Using an option pricing model to measure the FV charge each period would need more assumptions for the risk free rate, volatility and dividend yield, adding more complexity.

Present Value Formulae

Finite Period

If an amount invested (capital or principal) is certain to be recovered at some future date, together with income (investment or interest income based on some rate of return), we can say the investment is risk free as to the amount and timing of the cash flow. The risk free rate of return should apply, meaning the investor is rewarded for the 'time value of money'.

An investment or deposit of PV would, in this case, grow to C_1 at the risk free rate, such that after 1 year $C_1 = PV \times (1 + r)$, where C_1 = the cash flow received at the end of the year or the Future Value, PV = Present Value and r = the risk free rate (effective annual rate). The risk free rate is the rate required by the investor for the zero risk investment. Of course, business cash flows are risky and investors will expect a risk premium to be added to the risk free rate.

If C is received after more than 1 year, PV will be compounded if interest is retained on deposit: interest (assumed in this case to be paid annually at the end of each year) will accrue on the opening balance (interest on interest). The future value will equal the present value when the income return has been factored out (discounted, the reverse of compounding):

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

C received after 1 year

$$PV = \frac{C_n}{(1+r)(1+r)(1+r) \dots} = \frac{C_n}{(1+r)^n} \quad C \text{ received after } n \text{ years}$$

The present value of a constant cash flow (C) received over a specified forecast period can be estimated from:

$$PV = \frac{C}{(1+r)^1} + \frac{C}{(1+r)^2} + \frac{C}{(1+r)^3} + \dots + \frac{C}{(1+r)^n}$$

This can be simplified to:

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

$$\begin{aligned} \text{PV of constant cash flow received annually for n years} &= £1.00 \times \frac{1}{r} \times \left[1 - \frac{1}{(1+r)^n} \right] \\ &= £1.00 \times \frac{1}{0.10} \times \left[1 - \frac{1}{(1+0.1)^3} \right] \\ &= £2.49 \end{aligned}$$

C	Cash Flow received at period n	£1			
r	Discount rate p.a.	10.00%			
n	Time in years	3			
		1	2	3	
		1.00	1.00	1.00	Cash Flow
		2.49	0.91	0.83	0.75
					PV

One Finite Period + Perpetuity ('2-Stage Model')

The 2-stage model combines the equations for finite (time 0 to n) and infinite (time n+1 on) cash flows, allowing for different growth rates (for example an initial high rate g_H followed by a low rate g_L):

$$PV = \underbrace{C_1 \times \frac{1}{r - g_H} \times \left(1 - \frac{(1 + g_H)^n}{(1 + r)^n} \right)}_{\text{PV today of stage 1}} + \underbrace{C_{n+1} \times \frac{1}{r - g_L} \times \frac{1}{(1 + r)^n}}_{\substack{\text{PV at } t_n \text{ of stage 2} \\ \text{PV today of stage 2}}}$$

where

C_{n+1} is the cash flow at the end of the first period after the finite period (n + 1). As C_1 is the cash flow received at the end of year 1, $C_{n+1} = C_1 \times (1 + g_H)^{n-1} \times (1 + g_L)$

If we assume a cash flow received today (C_0) grows at g_H to C_1 after one year, then the above formula becomes:

$$PV = C_0 \times \left\{ \frac{1 + g_H}{r - g_H} \times \left(1 - \frac{(1 + g_H)^n}{(1 + r)^n} \right) + \frac{(1 + g_H)^n (1 + g_L)}{r - g_L} \times \frac{1}{(1 + r)^n} \right\}$$

$$\begin{aligned} \text{PV of growing cash flow received annually for } n \text{ years at a high growth followed by a low rate in perpetuity} &= £1.00 \times \left\{ \frac{(1 + 5.0\%)}{(10.0\% - 5.0\%)} \times \left(1 - \frac{(1 + 5.0\%)^3}{(1 + 10.0\%)^3} \right) + \left(\frac{(1 + 5.0\%)^3}{(10.0\% - 3.0\%)} \times \frac{(1 + 3.0\%)}{(1 + 10.0\%)^3} \right) \right\} \\ &= £1.00 \times \left\{ \frac{1.05}{5.00\%} \times \left(1 - \frac{1.1576}{1.3310} \right) + \left(\frac{1.1576}{7.00\%} \times \frac{1.03}{1.3310} \right) \right\} \\ &= £1.00 \times \left\{ \left[21.00 \times 0.1303 \right] + \left[16.5375 \times 0.7739 \right] \right\} \\ &= £1.00 \times \left[2.7354 + 12.7976 \right] \\ &= £15.5331 \end{aligned}$$

		PV	1	2	3	4	
C	Cash Flow received at period n	£1	5.00%	5.00%	5.00%	3.00%	Growth
r	Discount rate p.a.	10.00%	1.05	1.10	1.16	1.19	Cash Flows
n	Time in years	3	0.95	0.91	0.87		
gH	High growth	5.00%				17.03	Perpetuity PV
gL	Low growth (perpetuity)	3.00%				12.80	
			2.7354				
			12.7976				
			15.5331				

If there is an immediate linear decrease in the growth rate from g_H to g_L over period $2H$ followed by a constant growing perpetuity at g_L , the 'H' fade model can be used (Fuller and Hsia 1984):

$$\text{PV at time 0} = C_0 \left(\frac{1 + g_L}{r - g_L} \right) + C_0 \left(\frac{H (g_H - g_L)}{r - g_L} \right)$$

PV with H Model $= £1.00 \times \left[\frac{(1 + 3.0\%)}{(10.0\% - 3.0\%)} + \frac{(5.0\% - 3.0\%)}{(10.0\% - 3.0\%)} H = 1.5 \right]$ $= £1.00 \times \left[\begin{array}{cc} 14.7143 & + & 0.4286 \\ \text{Low } g & & \text{Fading high } g \end{array} \right]$ $= £15.1429$	<table border="0"> <tr> <td>C</td> <td>Cash Flow received at period 0</td> <td>£1</td> </tr> <tr> <td>r</td> <td>Discount rate p.a.</td> <td>10.00%</td> </tr> <tr> <td>n</td> <td>Time in years</td> <td>2H</td> </tr> <tr> <td></td> <td></td> <td>3</td> </tr> <tr> <td>H</td> <td>Time in years</td> <td>H</td> </tr> <tr> <td></td> <td></td> <td>1.5</td> </tr> <tr> <td>gH</td> <td>High growth</td> <td>5.00%</td> </tr> <tr> <td>gL</td> <td>Low growth (perpetuity)</td> <td>3.00%</td> </tr> </table>	C	Cash Flow received at period 0	£1	r	Discount rate p.a.	10.00%	n	Time in years	2H			3	H	Time in years	H			1.5	gH	High growth	5.00%	gL	Low growth (perpetuity)	3.00%
C	Cash Flow received at period 0	£1																							
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		3																							
H	Time in years	H																							
		1.5																							
gH	High growth	5.00%																							
gL	Low growth (perpetuity)	3.00%																							

(See Damodaran (2025) ch.14 for further discussion on the H model).

Two Finite Periods + Perpetuity ('3-Stage Model')

The 3-stage model shows cash flows growing at three different rates, an initial phase (with growth g_1), an interim phase (with growth g_2) and a perpetuity phase (with growth g_3). Growth rates would typically reduce from g_1 to g_3 , although the transition period can incorporate a reducing growth rate that 'fades' over the period from g_1 to g_3 , following the H model above.

The 3-stage model can be shown as (n_1 = length of stage 1 in years, n_2 = length of stage 2 in years):

$$\begin{aligned}
 PV = & C_1 \times \frac{1}{r - g_1} \times \left(1 - \frac{(1 + g_1)^{n_1}}{(1 + r)^{n_1}} \right) && \text{1st stage} \\
 & + \frac{C_{n_1+1} \times \frac{1}{r - g_2} \times \left(1 - \frac{(1 + g_2)^{n_2}}{(1 + r)^{n_2}} \right)}{(1 + r)^{n_1}} && \text{2nd stage} \\
 & + \frac{C_{n_1+n_2+1} \times \frac{1}{r - g_3}}{(1 + r)^{(n_1 + n_2)}} && \text{3rd stage}
 \end{aligned}$$

Growth rates are assumed to be constant in each stage.

Terminal Value Perpetuity Formulae

TV formula using NOPAT, ROIC, RONIC and g

The main growing perpetuity TV formula that decomposes FCF into NOPAT, g and RONIC is:

$$TV_n = \frac{NOPAT_{n+1} \times \left(1 - \frac{RR}{r - g^*} \right)}{r - g^*}$$

$$= \frac{NOPAT_{n+1} \times \left(1 - \frac{g^*}{RONIC_{n+1}} \right)}{r - g^*}$$

where:

- NOPAT = Free Cash Flows to the Firm (FCFF) + New Invested Capital (NIC)
- NIC = (Capital expenditures – Depreciation) + Increase / (decrease) in working capital
- RONIC = Return On New Invested Capital
- g^* = Steady state (sustainable) growth rate of NOPAT (and Invested Capital)

Replacing NOPAT with $ROIC_{n+1} \times IC_n$:

$$TV_n = \frac{ROIC_{n+1} \times IC_n \times \left(1 - \frac{g^*}{RONIC_{n+1}} \right)}{r - g^*}$$

The TV in Appendix 1 can be shown as:

$$\frac{12.40\% \times 632.89 \times \left(1 - \frac{3.00\%}{12.40\%} \right)}{10.00\% - 3.00\%}$$

$$= \frac{78.45 \times \left(1 - \frac{24.20\%}{7.00\%} \right)}{7.00\%}$$

$$= \frac{59.47}{7.00\%}$$

$$= 849.52$$

As Invested Capital grows at the steady state rate of g^* and $NIC = \text{growth} \times \text{Invested Capital at the start of the period}$:

$$NIC_{n+1} = g^* \times IC_n$$

We can substitute these expressions in the FCFF – NOPAT equation:

$$FCFF_{n+1} = NOPAT_{n+1} - NIC_{n+1}$$

$$= (ROIC_{n+1} \times IC_n) - (g^* \times IC_n)$$

$$= IC_n \times (ROIC_{n+1} - g^*)$$

$$TV_n = IC_n \times \left(\frac{ROIC_{n+1} - g^*}{r - g^*} \right)$$

The TV in Appendix 1 can also be shown as:

$$= 632.89 \times \left(\frac{12.40\% - 3.00\%}{10.00\% - 3.00\%} \right) = 849.52$$

This TV formula can be rewritten in a number of ways:

(see Koller et al. (McKinsey) 2025 p.866, p288)

$$\begin{aligned} TV_n &= IC_n + IC_n \left(\frac{ROIC_{n+1} - r}{r - g^*} \right) \\ &= 632.89 + 632.89 \left(\frac{12.40\% - 10.00\%}{10.00\% - 3.00\%} \right) \\ &= 632.89 + 216.63 \\ &= 849.52 \end{aligned}$$

The formula shows the TV as the value of net operating assets (Invested Capital) existing at the start of the terminal period (IC_n) and the value derived from excess returns on existing capital as well as future investment (NIC) made in perpetuity. Value will be created if the expected return on assets (ROIC) exceeds the required return ('r') ('excess returns'). The average return on all assets (ROIC) is used here as it is being calculated on total net operating assets (IC).

The second term $IC_n \left(\frac{ROIC_{n+1} - r}{r - g^*} \right)$ can also be shown as follows: (see Koller et al. (McKinsey) 2025 p.288)

$$\begin{aligned} TV^{EP} &= \frac{IC_n (ROIC_{n+1} - r)}{r} + \left\{ \frac{NOPAT_{n+1} \left(\frac{g^*}{RONIC_{n+1}} \right) (RONIC_{n+1} - r)}{r - g^*} \right\} \\ &= 632.89 \left(\frac{12.40\% - 10.00\%}{10.00\%} \right) + \left\{ \frac{78.45 \left(\frac{3.00\%}{12.40\%} \right) (12.40\% - 10.00\%)}{10.00\% - 3.00\%} \right\} \end{aligned}$$

TV^{EP} is the economic profit component of the TV ($TV = 632.89 + 216.63 = 849.52$).

$$\begin{aligned}
&= \frac{15.16}{10.00\%} + \frac{4.55}{10.00\% - 3.00\%} \\
&= 151.64 + 64.99 \\
&= 216.63
\end{aligned}$$

This breaks the return on all assets down into a constant perpetuity value (first terminal year excess returns on all assets received in perpetuity) and a growing perpetuity value (second terminal year excess returns on new investments growing in perpetuity). If $RONIC = r$ the second term is zero as new investments will not create value (until $RONIC$ is greater than r).

This can also be shown as (replacing r with WACC):

$$TV^{EP} = \frac{IC_n (ROIC_{n+1} - WACC)}{WACC} + \left\{ \frac{\frac{NOPAT_{n+1} \left(\frac{g^*}{RONIC_{n+1}} \right) (RONIC_{n+1} - WACC)}{WACC}}{WACC - g} \right\}$$

where $RONIC$ is the Return On New Invested Capital (increase in NOPAT this year / New Invested Capital last year). The above shows the PV of first terminal year economic profits received in perpetuity without growth and the PV of economic profits from New Invested Capital made each year in perpetuity.

$$\begin{aligned}
TV^{EP} &= 632.89 \left(\frac{12.40\% - 10.00\%}{10.00\%} \right) + \left\{ \frac{78.45 \left(\frac{3.00\%}{12.40\%} \right) (12.40\% - 10.00\%)}{10.00\% - 3.00\%} \right\} \\
&= \frac{15.16}{10.00\%} + \frac{4.55}{10.00\% - 3.00\%} \\
&= 151.64 + 64.99 \\
&= 216.63
\end{aligned}$$

We can also write the TV as a no growth value ($NOPAT / r$) plus the value of future growth:

(see Arzac 2008 p.90)

$$TV_n = \frac{NOPAT_{n+1}}{r} + \frac{NOPAT_{n+1}}{r} \left(\frac{RONIC_{n+1} - r}{RONIC_{n+1}} \right) \left(\frac{g^*}{r - g^*} \right)$$

$$\begin{aligned}
& \frac{78.45}{10.00\%} + \frac{78.45}{10.00\%} \left(\frac{12.40\% - 10.00\%}{12.40\%} \right) \left(\frac{3.00\%}{10\% - 3\%} \right) \\
&= 784.53 + 784.53 \left(19.33\% \times 42.86\% \right) \\
&= 784.53 + 64.99 \\
&= 849.52
\end{aligned}$$

Inflation Adjusted RONIC

In a high inflation environment, growth rates and returns may be expressed in real terms to account for inflation:

$$TV_n = \frac{NOPAT_{n+1} \times \left(1 - \frac{g^{*real}}{RONIC_{n+1}^{real}} \right)}{(r^{real} - g^{*real})(1+i)}$$

Where:

$$\begin{aligned}
i &= \text{the inflation rate} \\
g^{*real} &= (1 + g^{*nominal}) / (1 + i) - 1 = (g^{*nominal} - i) / (1 + i) \\
RONIC_{n+1}^{real} &= g^{*real} / \text{reinvestment rate (RR)}
\end{aligned}$$

So:

$$\begin{aligned}
RONIC_{n+1}^{nominal} &= (1 + RONIC_{n+1}^{real})(1 + i) - 1 \\
&= i + (g^{*nominal} - i) / RR \quad \text{after substitution}
\end{aligned}$$

The TV example calculated using the above formula is:

Inflation	1.98%			
RR	24.20%			
		Nominal	Real	
Growth		3.00%	1.00%	$= (1 + 3.00\%) / (1 + 1.98\%) - 1$
r		10.00%	7.86%	$= (1 + 10.00\%) / (1 + 1.98\%) - 1$
Implied Real RONIC			4.13%	$= 1.00\% / 24.20\%$
Implied Nominal RONIC		6.19%		$= (1 + 4.13\%) \times (1 + 1.98\%) - 1$
RONIC (ignoring inflation)		12.40%		
	78.45	$\left(1 - \frac{1.00\%}{4.13\%} \right)$		
		$\left(7.86\% - 1.00\% \right) \times 101.98\%$		
	= 78.45	$\left(1 - 24.20\% \right)$		
		6.86%	x	101.98%
	= 59.47			
	7.00%			
	= 849.52			

The nominal RONIC ignoring inflation (12.40%) assumes the reinvestment generates all the nominal growth ($g^{\text{nominal}} = \text{RONIC}^{\text{nominal}} \times \text{RR}$). The nominal RONIC implied from the real RONIC (6.19%) assumes the reinvestment generates real growth ($g^{\text{nominal}} = i + \text{RR} (\text{RONIC}^{\text{implied nominal}} - i)$). The difference between the nominal RONIC and implied RONIC is therefore: $i \times (1 - \text{RR}) / \text{RR}$. In the above example: $6.19\% = 12.4\% - 1.98\% \times (1 - 24.2\%) / 24.2\%$.

(The above inflation work is based on Arzac 2008 p.17 and Koller et al. (McKinsey) 2025 p.502. A.I. assistance was obtained for the RONIC actual and implied reconciliation – GPT-6 Astra).

TV using EBITDA multiple

If we replace IC_n with an expression for EBITDA, we can derive the forward TV EBITDA multiple version:

$$\begin{aligned} \text{IC}_n &= \frac{\text{NOPAT}_{n+1}}{\text{ROIC}_{n+1}} \\ &= \frac{\text{EBITDA}_{n+1} \times (1 - \text{tax rate } t) \times (1 - \text{Depreciation} / \text{EBITDA})}{\text{ROIC}_{n+1}} \\ \frac{\text{TV}_n}{\text{EBITDA}_{n+1}} &= \left(\frac{(1 - t) \times (1 - \text{Depreciation} / \text{EBITDA})}{\text{ROIC}_{n+1}} \right) \times \left(\frac{\text{ROIC}_{n+1} - g^*}{r - g^*} \right) \end{aligned}$$

The final term is the EntV equivalent version of the price-book multiple, where price is shown as:

$$\text{Price} = \text{Book Value}_{\text{equity}} \times \left(\frac{\text{Return on Equity ROE} - g}{\text{Cost of Equity } K - g} \right)$$

The terminal value multiple using the example above is 4.48:

$$\begin{aligned} \text{TV/EBITDA} &= \frac{1}{\text{ROIC}_{n+1}} (1 - \text{tax rate}) \times (1 - \frac{\text{Depreciation}}{\text{EBITDA}}) \times \left(\frac{\text{ROIC}_{n+1} - g}{\text{WACC} - g} \right) \\ &= \frac{1}{12.40\%} (1 - 25.00\%) \times (1 - 44.78\%) \times \left(\frac{12.40\% - 3.00\%}{10.00\% - 3.00\%} \right) \\ &= 8.067108 \times 75.00\% \times 55.22\% \times 1.34 \\ &= \times 4.48 \\ &\quad \begin{array}{ll} 849.52 & \text{TV} \\ 189.43 & \text{First year EBITDA} \\ \times 4.48 & \text{Forward EBITDA } \times \end{array} \end{aligned}$$

Decomposing ROE

ROE & ROIC

ROE can be analysed further in terms of ROIC and leverage. Assuming there are no non-operating items or other adjustments, we can reconcile NOPAT to profit after tax as:

NOPAT	x
Less: net interest expense x (1 – tax rate τ)	<u>x</u>
Profit After Tax (PAT)	<u>x</u>

$$\begin{aligned} \text{ROIC}_t &= \frac{\text{PAT}_t + i(1 - \tau)}{\text{BVE}_{t-1} + \text{Debt}_{t-1}} \\ &= \frac{\text{ROE}_t + \left(\frac{i(1 - \tau)}{\text{BVE}_{t-1}} \right)}{1 + \frac{\text{Debt}_{t-1}}{\text{BVE}_{t-1}}} \end{aligned}$$

After dividing top and bottom by BVE_{t-1}

$$\therefore \text{ROE}_t = \text{ROIC}_t + \frac{D_{t-1}}{E_{t-1}} \left(\text{ROIC}_t - K_d(1 - \tau) \right)$$

Where K_d = Pre-tax cost of borrowing %

$$\begin{aligned} \text{ROIC}_t &= \frac{\text{NOPAT margin}}{\frac{\text{Net PP\&E}_{t-1}}{\text{Revenues}_t} + \frac{\text{Working Capital}_{t-1}}{\text{Revenues}_t}} \\ &= \text{Prior year ROIC}_{t-1} \times \left(\frac{1 + \frac{g_{\text{NOPAT } t}}{1 + g_{\text{ICt-1}}}}{1 + g_{\text{ICt-1}}} \right) \end{aligned}$$

ROE & growth

If we assume a dividend of D_1 is received in 1 year and thereafter in perpetuity from a company which is all equity financed, assuming a dividend growth rate of g , the present value of those dividends should be a fair value for the share price ('P'), assuming for now that all distributable net income is paid out. As the company is debt free, the discount rate is the ungeared cost of equity used in the Gordon Growth formula:

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

The dividend paid per share will depend on the proportion of net income (Earnings Per Share / 'EPS') that the company decides to retain and reinvest ('Retention Ratio' / 'b') rather than pay out ('Payout Ratio' / 'PR', where $b + \text{PR} = 100\%$). In a growing perpetuity model, we can replace the dividend at time 1 with $\text{EPS} \times \text{PR}$ or $\text{EPS} \times (1 - b)$:

$$P_0 = \frac{EPS_1 (1 - b)}{K_u - g}$$

$$\frac{P_0}{EPS_1} = \frac{(1 - b)}{K_u - g}$$

The retention ratio (b) is similar to NOPAT reinvestment rate (RR) in method 1, so that

$$b = \frac{\text{Growth}_{EPS}}{ROE}$$

$$\begin{aligned} \frac{P_0}{EPS_1} &= \frac{1 - \frac{g}{ROE}}{K_u - g} \\ &= \frac{1}{ROE} \left(\frac{ROE - g}{K_u - g} \right)^* \end{aligned}$$

Since ROE (Return on Equity) = (Earnings / Book Value of Equity) per share:

$$= EPS / E_s$$

$$P = E_s \left(\frac{ROE - g}{K_u - g} \right)$$

$$\begin{aligned} \text{where } E_s &= \text{book value of equity per share} \\ EPS &= ROE \times E_s \end{aligned}$$

* This can be decomposed into the following after $1/K_u$ is added and subtracted:

$$P / E = \frac{1}{K_u} + \underbrace{\left(\frac{ROE - K_u}{ROE \times K_u} \right)}_{\text{Franchise Factor}} \underbrace{\left(\frac{g}{K_u - g} \right)}_{\text{Growth Factor}}$$

(see Arzac 2008 p.77, Leibowitz 2004)

In terms of K_u , this can be re-arranged into:

$$K_u = \frac{1}{P / E} \left(1 - \frac{g}{ROE} \right) + g$$

(see Koller et al. (McKinsey) 2025 p.307)

In a finite period we use the PV formula (this excludes any terminal value):

$$\text{Price} = \text{Cash flow per share (C)} \times \frac{1}{r - g} \times \left(1 - \frac{(1 + g)^n}{(1 + r)^n} \right)$$

where

$$C = E_s \times (ROE - g)$$

$$= (EPS / ROE) \times (ROE - g)$$

In a 'steady state' scenario, ROE and b are constant in perpetuity, so g is constant (ROE x b) and E_s grows at this rate. Over one period this is:

$$g = \left\{ \frac{BVE_1 - BVE_0}{BVE_0} \right\}$$

$$= \left\{ \frac{(BVE_0 + EPS \times b) - BVE_0}{BVE_0} \right\}$$

$$= ROE \times b \quad (\text{as } EPS = ROE \times BVE_0)$$

This assumes BVE changes only due to net income less dividends paid out ('clean surplus'), where EPS x b equals EPS less dividend per share (EPS x (1 - b)). The Price / Book ratio (price / BVE) can be calculated as ROE x P/E ratio.