Alternative DCF Methods

Introduction

This paper introduces some alternative approaches to DCF valuation, including methods to value the equity cash flows or income streams directly, and multiples valuation. It will refer to Parts 1 and 2 when discussing rates of return, discount rates and tax shield valuation. The methods are:

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

Method 1: Free Cash Flows to the Firm (FCFF)

Method 1 was discussed in Part 1 of this Valuation Series (see Appendix 3 of that Part for an example). Details of how the WACC is calculated were provided in Part 2. As the debt levels were set as a proportion of the Enterprise Value ('EntV'), the tax shields should be discounted at the ungeared cost of equity and hence re-levering of the beta ignores the tax adjustment (1 – t) (see Part 2 Appendix 1).

Highlights of the valuation are reproduced here:

	Forecast Year				
	1	2	3	4	5
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
less: taxes paid (excluding financing)	(35.63)	(26.76)	(23.93)	(24.65)	(25.39)
Net Operating Profits After Taxes	**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	36.29	27.90	17.38	17.90	18.43
Free Cash Flows	70.62	52.39	54.42	56.05	57.73

		Forecast Year				
		1	2	3	4	5
Fixed assets	400.00	424.36	445.83	459.21	472.98	487.17
Working capital (including operating c	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

DCF VALUATION

		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	**750.00**	64.20	43.30	40.89	38.28	563.33
less: market value of debt at valuation date	(150.00)					
Equity Value	**600.00**					
Enterprise value at year end	750.00	754.38	777.43	800.75	824.77	849.52
Debt	(150.00)	(150.88)	(155.49)	(160.15)	(164.95)	(169.90)
Equity	600.00	603.51	621.94	640.60	659.82	679.61
Debt / Enterprise Value		20.00%	20.00%	20.00%	20.00%	20.00%

FCFF Perpetuity TV

Final year FCFF	57.73
Growth rate	3.00%
Discount rate	10.00%
TV = 57.73 x (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

Debt Ratios

	1	2	3	4	5
Net Debt / Invested Capital	27.4 %	26.8 %	26.8 %	26.8 %	26.8 %
Gross Debt / EBITDA	x 0.71	x 0.86	x 0.92	x 0.92	x 0.92
EBITDA / Interest Expense	x 18.04	x 15.29	x 14.22	x 14.22	x 14.22
EBIT / Interest Expense	x 12.12	x 9.05	x 7.85	x 7.85	x 7.85

			Forecast Year 1	2	3	4	5
Cost of debt							
Risk free rate		Rf	4.84%	4.84%	4.84%	4.84%	4.84%	4.84%
Debt risk premium		DRP	3.00%	3.00%	3.00%	3.00%	3.00%	3.00%
Pre-tax cost of debt	= 4.84% + 3.00%	Kd	7.84%	7.84%	7.84%	7.84%	7.84%	7.84%
Tax rate		t	25.00%	25.00%	25.00%	25.00%	25.00%	25.00%
Post-tax cost of debt	= 7.84% x (1 - 25.00%)	Kdt	5.88%	5.88%	5.88%	5.88%	5.88%	5.88%
Debt ratio		L	20.00%	20.00%	20.00%	20.00%	20.00%	20.00%
Weighted rate			*1.176%*	*1.176%*	*1.176%*	*1.176%*	*1.176%*	*1.176%*
Cost of equity							
Risk free rate		Rf	4.84%	4.84%	4.84%	4.84%	4.84%	4.84%
Equity risk premium		ERP	4.50%	4.50%	4.50%	4.50%	4.50%	4.50%
Ungeared, assets beta		ba	1.10	1.10	1.10	1.10	1.10	1.10
Ungeared cost equity	= 4.84% + 1.10 x 4.50%	Ku	9.79%	9.79%	9.79%	9.79%	9.79%	9.79%
Geared equity beta	= 1.10 x (1+ 20& / 80%)	be	1.38	1.38	1.38	1.38	1.38	1.38
Geared Cost of Equity	= 4.84% + 1.38 x 4.50%	Ke	11.03%	11.03%	11.03%	11.03%	11.03%	11.03%
Equity ratio		1 - L	80.00%	80.00%	80.00%	80.00%	80.00%	80.00%
Weighted rate			*8.824%*	*8.824%*	*8.824%*	*8.824%*	*8.824%*	*8.824%*
WACC (post-tax)			**10.00%**	**10.00%**	**10.00%**	**10.00%**	**10.00%**	**10.00%**
WACC (pre-tax) (i.e. assume t = 0)			**10.39%**	**10.39%**	**10.39%**	**10.39%**	**10.39%**	**10.39%**

The FCFF can be thought of as the probability weighted expected cash flows, based on possible future up or down 'routes' or 'paths' in a 'Binomial Tree' (used for option pricing – to be discussed in Part 5). Assuming 40% volatility, the FCFF could be shown as follows (expected FCFF = sum of routes x probability x FCFF at each node):

Period	Routes	Prob	FCF
0	1	1.000	64.20
1	1	0.523	95.77
1	1	0.477	43.03
2	1	0.274	96.37
2	2	0.249	43.30
2	1	0.227	19.46
3	1	0.143	135.75
3	3	0.130	Exercise 61.00
3	3	0.119	27.41
3	1	0.109	12.31
4	1	0.075	189.62
4	4	0.068	85.20
4	6	0.062	38.28
4	4	0.057	17.20
4	1	0.052	7.73
5	1	0.039	264.89
5	5	0.036	119.02
5	10	0.033	53.48
5	10	0.030	24.03
5	5	0.027	10.80
5	1	0.025	4.85

Parameters

Up-move factor	1.4918	U = EXP(40.0%*SQRT(1.0000))
Down-move factor	0.6703	D = 1/1.4918
Risk-free return	1.0484	r = EXP(4.73%*1.0000)
True pobability	0.5230	p = (1 + 10.00% - 0.6703)/(1.4918 - 0.6703)

	0	1	2	3	4	5
S Prob x Routes	1.00	1.00	1.00	1.00	1.00	1.00
Expected FCF		70.62	52.39	54.42	56.05	57.73
Discount Factor		0.9091	0.8264	0.7513	0.6830	0.6209
PV of Expected FCF		64.20	43.30	40.89	38.28	35.85

Method 2: Economic Operating Profits

Net Operating Profit After Tax ('NOPAT') and Invested Capital ('IC') were introduced in Part 1 and discussed in the context of the perpetuity Terminal Value ('TV') in Appendix 2, particularly the idea that the EnV TV could be calculated based on IC plus the value of excess residual operating income or Economic Profits ('EP'):

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

see App 2 in Part 1

From Part 2, we can now replace r with WACC.

Economic return models (such as Economic Value Added (EVA®), created by Stern Value Management), value a business as the value of existing net operating assets (IC) plus the present value of future EP, representing residual net operating profits (NOPAT) after a charge for capital has been made:

$$\text{Economic profit } (EP_{n+1}) = NOPAT_{n+1} - (IC_n \times WACC)$$

$$= IC_n \times (ROIC_{av\ n+1} - WACC)$$

$$\text{Where } \quad ROIC_{av\ n+1} = \frac{NOPAT_{n+1}}{IC_n}$$

In the TV equation above, the PV of the future EP is calculated as the first terminal year EP_{n+1} (= IC_n x ($ROIC_{av\ n+1}$ - 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, then the final forecast year EP can be increased by the growth rate and used for the first terminal period (EP_{n+1} = EP_n x (1 + g)). This is because the 'spread' (ROIC – WACC) will be the same in both years, so EP will grow because of the NOPAT growth rate.

Using the example from Part 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 x (1 + 3.00%) / (10.00% - 3.00%)	216.63

From the Appendix 2 of Part 1, this can also be shown as (equation A2.4) (replacing r with WACC):

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

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.

$$= 632.89\left(\frac{12.40\% - 10.00\%}{10.00\%}\right) + \frac{\left[\dfrac{78.45\left(\dfrac{3.00\%}{12.40\%}\right)\left(12.40\% - 10.00\%\right)}{10.00\%}\right]}{10.00\% - 3.00\%}$$

$$= \frac{15.16}{10.00\%} + \frac{4.55}{10.00\% - 3.00\%}$$

$$= 151.64 + 64.99$$

$$= 216.63$$

We can split the TV into a two stage model by assuming RONIC reduces over a given number of years, due to competitive advantages being eroded, so that it 'fades' down to WACC, after which zero value will be added. This is best modelled explicitly in Excel but a single formula can be used (see Professor Dr. Bernhard Schwetzler for more discussion on this: https://www.youtube.com/watch?v=aJflGpTj_S0&t=10s)

Method 3: Capital Cash Flows (CCF)

Part 2 of this Series discusses the tax benefits of leverage ('tax shield') arising from the tax relief on debt interest and the additional value they create for a geared company compared to an ungeared one. In Appendix 1, 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 (10.39% in the example below – see note 9 in the example in Appendix 1 of Part 2) gives the same EntV as under method 1:

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 7.84% x opening balance		(11.76)	(11.83)	(12.19)	(12.56)	(12.94)
Pre-tax capital cash flows to debt holders		(10.89)	(7.22)	(7.53)	(7.75)	(7.99)
Tax relief on interest		2.94	2.96	3.05	3.14	3.23
Debt servicing (post-tax)		(7.95)	(4.27)	(4.48)	(4.61)	(4.75)
Equity Cash Flows		62.67	48.13	49.94	51.44	52.98
Add back: Pre-tax debt servicing		10.89	7.22	7.53	7.75	7.99
Capital cash flows		**73.56**	**55.35**	**57.47**	**59.19**	**60.97**
FCFF		70.62	52.39	54.42	56.05	57.73
Tax Shield (tax on interest)		2.94	2.96	3.05	3.14	3.23
Capital cash flows		**73.56**	**55.35**	**57.47**	**59.19**	**60.97**
Terminal Value		-	-	-	-	849.52
Pre-tax WACC at start of year		10.39%	10.39%	10.39%	10.39%	10.39%
Discount factor		0.9059	0.8206	0.7433	0.6734	0.6100
PV of pre-tax capital cash flows	**750.00**	66.63	45.42	42.72	39.86	555.37
less: debt	(150.00)					
Equity Value	**600.00**					

Final year	60.97
Growth rate	3.00%
Discount rate	10.39%
TV	849.52

TV = 60.97 x (1 + 3.00%) / (10.39% - 3.00%)

If tax is ignored, the traditional WACC formula is modified:

$$\text{Post-tax WACC} = K_g \,.\, (1 - L) + K_d \,.\, (1 - t)\, L$$

$$\text{Pre-tax WACC} = K_g \,.\, (1 - L) + K_d \,.\, L$$

$$= \left(R_f + \beta_g .\, ERP \right) (1 - L) + K_d \,.\, L$$

$$= \left(R_f + \beta_u \left(1 + \frac{L}{1 - L}\right) .\, ERP \right) (1 - L) + (R_f + DRP).\, L$$

$$= \left(R_f + \frac{\beta_u}{1 - L} .\, ERP \right) (1 - L) + (R_f + DRP)\, L$$

$$= K_u + DRP.\, L \qquad = K_u + (K_d - R_f).\, L$$

$$10.39\% = 9.79\% + 3.00\% \times 20\%$$

Where:

L	Leverage (D/(D+E)) where D/E = L/(1-L)
K_g,K_d	Geared cost of equity, pre-tax cost of debt
β_a, β_g	Asset beta, equity beta (here re-levered ignoring debt beta β_d = DRP/ERP
ERP	Equity Risk Premium
DRP	Debt Risk Premium (K_d - Risk Free Rate R_f)

It can also be showns as:

Pre-tax WACC = Post-tax WACC + (Tax Shield / Enterprise Value) x (1 + growth rate)

	Forecast Year 1	2	3	4	5
Tax Shield	2.94	2.96	3.05	3.14	3.23
Enterprise value at year end	754.38	777.43	800.75	824.77	849.52
TS / EntV	0.39%	0.38%	0.38%	0.38%	0.38%

Ungeared Cost of Equity	a	9.79%
Cost of Debt - Risk Free Rate (DRP)	b	3.00%
Leverage	c	20.00%
Pre-tax WACC	a + (b x c)	10.39%

Post-tax WACC	a	10.00%
Tax Shield / EntV	b	0.38%
Growth rate	c	3.00%
Pre-tax WACC	a + { b x (1 + c) }	10.39%

When valuation with CCF was originally presented (1994), the beta was re-geared with a debt beta (see Ruback (2000) note 1 on page 10 and note 6 on page 12). This produces a different post-tax WACC (9.40% - see note 7 in the example in Appendix 1 of Part 2 – equal to K_u - K_d.t.L = 9.79% - 7.84% x 25% x 20%), which on a pre-tax basis equals the ungeared cost of equity (K_u - K_d.t.L with t = 0 = 9.79%)(discounting FCFF at 9.40% rather than 10.00% will obviously increase the EntV). Ignoring the debt beta when re-gearing gives the 10.39% pre-tax WACC (10.00% post-tax), reconciled to ungeared cost of equity as debt beta x ERP x L (10.39% - 9.79% = 0.6667 x 4.5% x 20%).

Method 4: Valuing FCFF and tax shield cash flows at pre-tax cost of debt (K_d)('APV')

The Adjusted Present Value (Myers (1974)) is similar to method 3 in that the Ent.V 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 enterprise value, the discount rate would be the ungeared cost of equity, to reflect business risk).

Method 5: Valuing FCFE at the geared cost of equity (K_g)

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 Equity Value. We can reconcile Enterprise Value to Equity Value (the 'Bridge') as follows:

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

This method requires forecasting all 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 and tax
- Calculate FCFE[1] & reconcile to net profit [2]
- Calculate the Equity Value Terminal Value (Eq.TV) at the end of the forecast period
- Calculate the PV of FCFE and Eq.TV at the valuation date (Equity Value)
- Add net debt and equivalents to the Equity Value to determine the Enterprise Value

1 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.

2 See Part 1 of this series for a reconciliation of net profit to FCFE

From method 3 above, we can start with the equity cash flows for our example:

EQUITY CASH FLOW MODEL		Forecast Year				
		1	2	3	4	5
Equity Cash Flows		62.67	48.13	49.94	51.44	52.98
Terminal Value (equity)		-	-	-	-	679.61
Geared cost of equity at start of year		11.03%	11.03%	11.03%	11.03%	11.03%
Discount factor		0.9007	0.8112	0.7306	0.6580	0.5927
PV of Equity Cash Flows	600.00	56.45	39.04	36.49	33.85	434.18
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	52.98
Growth rate	3.00%
Discount rate	11.03%
TV = 52.98 x (1 + 3.00%) / (11.03% - 3.00%)	679.61

Method 6: Residual Income Model

The Residual Income (RI) model is similar to the residual operating income method 2, but uses profits after tax and the book value of equity (BVE) rather than NOPAT and Invested Capital (Ohlson (1995)). The equity value is calculated as BVE at the valuation date plus the present value of future residual income. The perpetuity value is:

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

where:

BVE_n book value of equity at the end of the forecast period

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

K_g geared cost of equity

g stable growth in profits after tax

If the change in BVE reflects profits after tax net of dividends paid ('Clean Surplus' accounting), this method should give the same equity value as the equity cash flow method (5).

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):

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

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 is discussed in Appendix 2 of part 2):

$$TV_n = PAT_{n+1}\left(\frac{1}{K_g} + \frac{ROE - K_g}{K_g . ROE} \times \frac{g}{K_g - g}\right)$$

Using our example:

RESIDUAL INCOME MODEL			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
EBIT			142.54	107.05	95.73	98.60	101.56
Interest			(11.76)	(11.83)	(12.19)	(12.56)	(12.94)
Pre-tax profits			130.77	95.22	83.53	86.04	88.62
Tax			(32.69)	(23.81)	(20.88)	(21.51)	(22.16)
Post-tax profits			98.08	71.42	62.65	64.53	66.47
Dividends			(62.67)	(48.13)	(49.94)	(51.44)	(52.98)
Retained profits			35.41	23.29	12.71	13.09	13.48
BALANCE SHEET							
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
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
Profits After Tax	PAT		98.08	71.42	62.65	64.53	66.47
Return on Equity = PAT / opening BVE	ROE		26.9%	17.8%	14.8%	14.8%	14.8%
Cost of Equity (geared)	K_{eg}		11.03%	11.03%	11.03%	11.03%	11.03%
Residual Income = PAT - opening BVE x Keg			57.82	27.25	15.92	16.40	16.89
TV perpetuity			-	-	-	-	216.63
Discount factor (geared cost of equity)			0.9007	0.8112	0.7306	0.6580	0.5927
PV of Residual Income + TV		235.00	52.08	22.11	11.63	10.79	138.40
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	66.47
First terminal year PAT	68.46
BVE	462.98
RI	17.39
Growth rate	3.00%
Discount rate	11.03%
TV = 17.39 / (11.03% - 3.00%)	216.63

The TV is shown on the right 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	68.46	
Geared cost of equity (K)	11.03%	
ROE	14.79%	
ROE - Cost of Equity (K)	3.76%	
K. ROE	1.63%	
g / (k - g)	37.36%	
Growth factor	x 0.86	= (3.76% / 1.63%) x 37.36%
No growth value	620.69	= 68.46 / 11.03%
Growth value	58.92	= 68.46 x 0.86
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 as follows (see Appendix):

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

			Forecast Year 1	2	3	4	5
Profit After Tax	PAT		98.08	71.42	62.65	64.53	66.47
Add back: interest	i		11.76	11.83	12.19	12.56	12.94
Less: tax relief on interest	t. i		(2.94)	(2.96)	(3.05)	(3.14)	(3.23)
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)		8.82	8.87	9.14	9.42	9.70
Debt at start of peri	D		150.00	150.88	155.49	160.15	164.95
Effective rate			5.88 %	5.88 %	5.88 %	5.88 %	5.88 %
D/E prior period			41.10 %	37.68 %	36.70 %	36.70 %	36.70 %
ROIC - K_{dt}			14.88 %	8.68 %	6.51 %	6.51 %	6.51 %
D/E x (ROIC - K_{dt})			6.11 %	3.27 %	2.39 %	2.39 %	2.39 %
ROIC			20.76 %	14.56 %	12.40 %	12.40 %	12.40 %
ROE			**26.87 %**	**17.84 %**	**14.79 %**	**14.79 %**	**14.79 %**

Method 7 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 5 would be sufficient. It is shown here based on the example in Part 1:

DIVIDEND DISCOUNT MODEL		Forecast Year				
		1	2	3	4	5
Geared Cost of Equity (K_{eg})		11.03%	11.03%	11.03%	11.03%	11.03%
Discount rate		0.9007	0.8112	0.7306	0.6580	0.5927
Dividends		62.67	48.13	49.94	51.44	52.98
PV of dividends	197.22	56.45	39.04	36.49	33.85	31.40
Dividend growth rate (g)						3.00 %
Year 6 dividend (= D_1)						54.57
Perpetuity value = D_1 / (K_{eg} - g)						679.61
PV of perpetuity (x yr 5 disc. factor)	402.78					
Equity Value	**600.00**					
ROE		26.87%	17.84%	14.79%	14.79%	14.79%
Sustainable growth (BVE growth)		9.70%	5.82%	3.00%	3.00%	3.00%
ROE - g		17.17%	12.02%	11.79%	11.79%	11.79%
x opening book value of equity =		62.67	48.13	49.94	51.44	52.98
PV at cost of equity	197.22	56.45	39.04	36.49	33.85	31.40
Year 6 : ROE - g						11.79%
Year 6 : Ke - g						8.03%
Price : Book Multiple =(ROE - g) / (Ke - g)						x 1.5
x year 5 book value of equity						679.61
PV of terminal value	402.78					
Equity Value	**600.00**					

Multiples

Introduction

An enterprise or equity multiple can be determined from acquisition prices ('Transaction' multiple) or quoted prices ('Trading' multiple) and used to value a business by applying the multiple to the equivalent earnings or assets measure. Providing the multiple relates to businesses that are a good proxy for the business being valued (comparable companies – same sector, size, growth and risk) and has been adjusted to remove the effects of any abnormality ('normalised'), they could be treated as a 'benchmark' multiple to compare to the business ('relative' valuation), and are a useful measure to support a DCF valuation, particularly when analysing the perpetuity cash flow derived terminal value.

As value and price are forward-looking, the underlying financial measure in an earnings multiple (revenue, EBIT, EBITDA, FCFF or net income) should ideally be the amount expected over the next 12 months ('forward multiple') rather than the last 12 months ('trailing multiple'). Expected future growth in the underlying measure will be incorporated in the price, which should change as expectations change (the growth and the risk associated with the growth).

Types of Multiple

The Enterprise Value (EnV), being the market value of all financial capital (equity, net debt, preferred etc), relating to a company, quoted or acquired, is used together with operating, pre-financing earnings (revenue, EBITDA, EBITA, EBIT, NOPAT or FCFF) to calculate the EnV multiple. When applied to the same earnings for the business being valued, the EntV is estimated and the Equity Value (EqV) calculated after deducting the value of all non-equity financial capital). The EqV can be estimated directly by applying an equity multiple (the P / E, using price and earnings per share EPS, being widely used) to a financial measure that is after all financing and tax costs have been deducted (FCFE or profit after tax). EqV can also be based on asset multiples applied to the Equity Book Value (the Price-to-Book multipe).

Adjustments

Issues relating to debt financing, different effective tax rates and capital expenditures, can be ignored when using EBITDA. Growth in EBITDA requires investment, however, and deducting depreciation allows for some of the capital expenditure to be considered (depending on the capex / depreciation ratio), meaning EBIT might be more suitable if the business is more capital intensive (with depreciation being used as proxy for 'maintenance' capex).

Debt financing effects and tax can be factored in when calculating the P / E multiple. An increase in leverage due to capital investment requirements will increase financial risk, but this would be decreased by the economic benefits from those investments (if RONIC exceeds WACC). As the P / E is based on EPS as determined under accounting rules (using weighted average shares), the equivalent measure based on all the whole firm might be preferred to a per share calculation.

Size, growth and risk should be considered when selecting the sample of proxy companies, as these should reflect the business being valued. Regression techniques can be used to investigate the correlation between the multiple and 'value driver' financial measure, such as revenue growth and operating margins, and hence adjust the average (median) multiple from the sample to estimate what would be more suitable for the financial measure of the business being valued.

In all multiples, earnings and assets need to be adjusted to remove any non-recurring items and correct any differences in accounting treatment, particularly aggressive practices involving revenue timing / amount and / or expense classification (such as R&D). Non-operating items need to be excluded so the multiple applies to core operations (these items would not be valued using a multiple, but by using other fair value estimation techniques),

Multiples also need to be adjusted to take account of the 'control premium' incorporated in an acquisition price (acquirers will pay more when they will have the ability to control the business via shareholder voting power and extract benefits from synergies that might be available with that level of control). This would reduce the multiple ('minority holding discount'). Similarly, a second downwards adjustment would be required when the multiple reflects trading in a liquid public market that wouldn't apply for the business being valued (discount for non-marketability or 'illiquidity discount').

Suggested reading

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Growth and Returns

We can break down the P/E (price / earnings per share) to extract key value drivers for growth, returns and risk, starting with the simplest of valuation models: the Dividend Discount Model (DDM). 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 (using the growing perpetuity formula introduced in Part 1 of this series) should be a fair value for the share price, 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:

$$\text{Price} = \frac{D_1}{K_u - g}$$

The dividend paid per share will depend on the proportion of net income (EPS on a per share basis) that the company decides to retain and reinvest ('Retention Ratio' / 'RR') rather than payout ('Payout Ratio' / 'PR', where RR + PR = 100%). In a growing perpetuity model, we can replace the dividend at time 1 with EPS x PR or EPS x (1- RR):

$$\text{Price} = \frac{EPS_1}{K_u - g}(1 - RR)$$

$$\therefore \quad P / E = \frac{1 - RR}{K_u - g}$$

PR is similar to the NOPAT reinvestment rate (RR):

$$\text{Growth}_{\text{NOPAT } t} = \text{RONIC}_t \times RR_{t-1}$$

$$\therefore \quad \frac{\text{Growth}_{\text{NOPAT } t}}{\text{RONIC}_t} = RR_{t-1}$$

So it is for the P/E RR:

$$\frac{\text{EPS growth}}{\text{ROE}} = RR$$

Return on Equity is Net Income per Share / Book Value of Equity per Share, so

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

$$= \frac{ROE - g}{ROE\,(K_u - g)}$$

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

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

(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)

The Residual Income model growing perpetuity formula (discussed above under method 6) is:

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

where BVE = book value of equity per share
EPS = ROE x BVE (replacing BVE with EPS / ROE)

This can be derived from the above P / E multiple formula

$$\frac{P}{EPS} = \frac{1}{ROE} \left(\frac{ROE - g}{(K_u - g)}\right) \quad \text{Since} \quad ROE = \frac{EPS}{BVE}$$

In a finite period we use the PV formula mentioned in Part 1 of this series:

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

where

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

In a 'steady state' scenario (see Part 2 of this series), BVE grows at a constant rate g in perpetuity, if ROE and the reinvestment rate RR grow at this same g. Over one period this is:

$$g = \left\{\frac{BVE_1 - BVE_0}{BVE_0}\right\} - 1$$

$$= \left\{\frac{(BVE_0 + EPS \times RR) - BVE_0}{BVE_0}\right\} - 1$$

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

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

Returns and Risk

ROE increases because of the effects of leverage, but with this higher return there is greater risk, as measured in the geared cost of equity (K_g) as D/E increases (see Part 2):

$$K_g = R_f + \beta_a \left(1 + \frac{D}{E}(1 - t)\right) ERP$$

(ignore 1 – t if leverage is constant)

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

NOPAT	x
Less: net interest expense x (1 – tax rate)	x
Profit after tax	x

$$ROIC_t = \frac{PAT_t + i(1 - t)}{BVE_{t-1} + Debt_{t-1}}$$

$$= \frac{ROE_t + \left(\frac{i(1-t)}{BVE_{t-1}}\right)}{1 + \frac{Debt_{t-1}}{BVE_{t-1}}}$$

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

$$\therefore \quad ROE_t = ROIC_t + ROIC_t \left(\frac{D_{t-1}}{E_{t-1}}\right) - i(1-t)$$

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

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

Where K_d = Pre-tax cost of borrowing %

And $ROIC_t$ =

see Part 1

$$\frac{\text{NOPAT margin}}{\frac{\text{Net PP\&E}_{t-1}}{\text{Revenues}_t} + \frac{\text{Working Capital}_{t-1}}{\text{Revenues}_t}}$$

see Part 2 but with $t = n + 1$ $= \text{Prior year } ROIC_{t-1} \left(\frac{1 + g_{NOPAT\,t}}{1 + g_{ICt-1}} \right)$

Multiples based on return measures

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

$$IC_n = \frac{NOPAT_{n+1}}{ROIC_{n+1}}$$

$$= \frac{EBITDA_{n+1} \times (1 - \text{tax rate } t) \times (1 - \text{Depreciation / EBITDA})}{ROIC_{n+1}}$$

$$\frac{TV_n}{EBITDA_{n+1}} = \left(\frac{1}{ROIC_{n+1}} \right) \left((1 - t) \times (1 - \text{Depreciation / EBITDA}) \right) \times \left(\frac{ROIC_{n+1} - g^*}{r - g^*} \right)$$

Taking the example from Part 1 of this series and referred to in this paper, for the terminal value:

Terminal value multiple:

$$= \frac{1}{ROIC_{n+1}} (1 - \text{tax rate}) \times \left(1 - \frac{\text{Depreciation}}{\text{EBITDA}}\right) \times \left(\frac{ROIC_{n+1} - g}{WACC - g} \right)$$

$$= \frac{1}{12.40\%} (1 - 25.00\%) \times (1 - 44.78\%) \times \left(\frac{12.40\% - 3.00\%}{10.00\% - 3.00\%} \right)$$

$$= 8.067108 \times 75.00\% \times 55.22\% \times 1.34$$

$$= \times 4.48$$

849.52	TV
189.43	First year EBITDA
x 4.48	Forward EBITDA x

This is the enterprise value equivalent version of the price-book multiple, which can be written as follows:

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