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Valuation Multiples: A Primer

Valuation Primer Series   Issue 1

- This is the first in a series of primers on fundamental valuation topics such as discounted cash flow, valuation multiples and cost of capital.

- This document explains how to calculate and use multiples commonly used in equity analysis.

- We discuss the differences between equity and enterprise multiples, show how target or 'fair' multiples can be derived from underlying value drivers and discuss the ways multiples can be used in valuation. For each multiple, we show its derivation, discuss its strengths and weaknesses, and suggest appropriate use.

❋ UBS Warburg

Contents page

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For research, valuation models and more on equity analysis go to the Global Valuation Group website...

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Section 1

An Introduction to Multiples

This document is intended to be a reference manual for the calculation of commonly used valuation multiples. We explain how multiples are calculated and discuss the different variations that can be employed. We discuss the differences between equity and enterprise multiples, show how target or 'fair' multiples can be derived from underlying value drivers, and discuss the ways multiples can be used in valuation. For each multiple, we show its calculation and derivation from underlying DCF fundamentals, discuss its strengths and weaknesses, and suggest appropriate use.

This document will be maintained online and any changes will be posted to our website at **www.ubswarburg.com/research/gvg**.

What Is a Multiple?

A valuation multiple is simply an expression of market value relative to a key statistic that is assumed to relate to that value. To be useful, that statistic – whether earnings, cash flow or some other measure – must bear a logical relationship to the market value observed; to be seen, in fact, as the driver of that market value.

Two basic types: enterprise and equity multiples

There are two basic types of multiple – enterprise value and equity:

■ **Enterprise multiples** express the value of an entire enterprise – the value of all claims on a business – relative to a statistic that relates to the entire enterprise, such as sales or EBIT.

■ **Equity multiples**, by contrast, express the value of *shareholders'* claims on the assets and cash flow of the business. An equity multiple therefore expresses the value of this claim relative to a statistic that applies to shareholders only, such as earnings (the residual left after payments to creditors, minority shareholders and other non-equity claimants).

Advantages/Disadvantages of Multiples

Disadvantages. There are a number of criticisms levied against multiples, but in the main these can be summarised as:

■ **Simplistic:** A multiple is a distillation of a great deal of information into a single number or series of numbers. By combining many value drivers into a point estimate, multiples may make it difficult to disaggregate the effect of different drivers, such as growth, on value. The danger is that this encourages simplistic – and possibly erroneous – interpretation.

■ **Static:** A multiple represents a snapshot of where a firm is at a point in time, but fails to capture the dynamic and ever-evolving nature of business and competition.

■ **Difficult to compare:** Multiples are primarily used to make comparisons of relative value. But comparing multiples is an exacting art form, because there are so many reasons that multiples can differ, not all of which relate to true

differences in value. For example, different accounting policies can result in diverging multiples for otherwise identical operating businesses.

Advantages Despite these disadvantages, multiples have several advantages.

- **Usefulness:** Valuation is about judgement, and multiples provide a framework for making value judgements. When used properly, multiples are robust tools that can provide useful information about relative value.

- **Simplicity:** Their very simplicity and ease of calculation makes multiples an appealing and user-friendly method of assessing value. Multiples can help the user avoid the potentially misleading precision of other, more 'precise' approaches such as discounted cash flow valuation or EVA[1], which can create a false sense of comfort.

- **Relevance:** Multiples focus on the key statistics that other investors use. Since investors in aggregate move markets, the most commonly used statistics and multiples will have the most impact.

These factors, and the existence of wide-ranging comparables, help explain the enduring use of multiples by investors despite the rise of other methods.

Table 1: Advantages and Disadvantages of Valuation Multiples

Advantages	Disadvantages
▪ Useful – multiples can be robust tools that provide useful information about relative value	▪ Simplistic – combine many value drivers into a point estimate. Difficult to disaggregate the effect of different value drivers
▪ Simple – ease of calculation and wide availability of data make multiples an appealing method for assessing value	▪ Static – Multiples measure value at a single point in time and do not fully capture the dynamic nature of business and competition
▪ Relevant – Multiples are based on key statistics that investors use	▪ Difficult to compare – Multiples differ for many reasons, not all relating to true differences in value. This can result in misleading 'apples-to-oranges' comparisons among multiples

Source: UBS Warburg

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[1] 'Economic Value Added' is a registered trademark of Stern, Stewart & Co.

Enterprise versus Equity Multiples

In the table below we have summarised the relative advantages of using enterprise value (EV) versus equity multiples and vice versa. For more details please see page 25 below.

Table 2: Enterprise Value versus Equity Multiples

Enterprise value multiples	Equity multiples
■ Allow the user to focus on statistics where accounting policy differences can be minimised (EBITDA, OpFCF)	■ More relevant to equity valuation
■ Avoid the influence of capital structure on equity value multiples	■ More reliable (estimating enterprise value involves more subjectivity, especially in the valuation of non-core assets)
■ More comprehensive (apply to the entire enterprise)	■ More familiar to investors
■ Wider range of multiples possible	
■ Easier to apply to cash flow	
■ Enables the user to exclude non-core assets	

Source: UBS Warburg

Why Multiples Vary

There are four primary reasons why multiples can vary:

- **Differences in the quality of the business (ie differences in value drivers)**
- **Accounting differences**
- **Fluctuations in cash flow or profit (ie they are unrepresentative of the future)**
- **Mispricing**

1. Differences in the Quality of the Business

All things equal, higher-quality businesses deserve higher valuation multiples. This is another way of saying that there are qualitative differences in the fundamental underlying drivers of valuation, such as quality of management, available investment opportunities, strategy and branding. These can be distilled down to four quantitative valuation drivers: return on capital, cost of capital, growth and duration of growth.

As investors, we are interested in how to allow for differences in these value drivers. How much is growth worth? What is the impact of a change in return on capital? We consider these issues in *Target Valuation Multiples*, starting on page 13.

2. Accounting Differences

Differences in accounting policies that do not affect cash flow do not affect value

Differences in accounting policies that do not affect cash flow do not affect value. But accounting policy differences do affect profit multiples and, as a result, differences in multiples can paint a misleading picture of relative valuation.

For example, consider two identical companies with 20 of goodwill on the balance sheet and 10 in pre-goodwill profit. Company A does not amortise goodwill while Company B amortises over 10 years (amortisation of 2 per year).

Table 3: Goodwill Amortisation and Earnings Multiples

	Company A	Company B
Net income	10	8
Share price	200	?
Price to earnings multiple	20x	?

Source: UBS Warburg

Since both companies have identical cash earnings they have the same value and should trade at the same share price (same number of shares assumed). This implies an earnings multiple of 25x for Company B. But it clearly would be wrong to conclude that Company A is cheaper than Company B. In fact, there is no information content whatsoever in the difference between the two multiples.

Accounting differences are not a trivial issue

There are many different factors that cause differences in profit measurement; a recent study comparing US GAAP with international accounting standards identified over 250 such differences. Not all of these affect profit measurement, and many would not have a material effect, but accounting differences are clearly not a trivial issue. However, it appears that a few key issues dominate – depreciation, goodwill (and other aspects of business combinations), provisioning and deferred tax, to name some of the most important.

While it is virtually impossible to completely eliminate the impact of different accounting methodologies, there is still much that the analyst can do to mitigate their impact and produce data relevant to equity analysis. In particular, one can:

■ **Restate accounting data to a common format**

■ **Focus on key statistics that are less affected by accounting differences**

Restating Accounting Data

In Table 4 below we examine some of the adjustments to accounting data that can be made to ensure greater data comparability.

Table 4: Key Adjustments to Ensure Comparable Presentation

Item	Issue	Adjustment
Depreciation	A major item in many company accounts and one where there can be significant differences in accounting policies. Depreciation can be largely unrelated to economic consumption of an asset. Note also that depreciation can be affected by asset revaluation. Revaluation is permitted under IAS and a number of national accounting policies, but not under US GAAP.	Some UBSW sector teams standardise the depreciation charge, but for the database as a whole we take a different approach. All UBSW analysts are required to estimate 'maintenance capital expenditure'. This is a 'standardised depreciation' measure that has the advantage of being cash flow-based and forward-looking, as well as unaffected by accounting differences. Maintenance capital expenditure is a component of UBSW operating free cash flow, a key component to our approach to cross-border equity analysis (see page 32).
Goodwill amortisation	Differences in goodwill accounting affect profit measures, asset values and related ratios such as return on capital. We consider the issue of goodwill more fully in our report *Equity Analysis InsideOut No 2: Goodwill in Equity Analysis*, July 2001.	While we believe goodwill is an important asset that should be charged against profit in appropriate periods, *systematic amortisation* does not provide any useful information to investors and may even be misleading. Goodwill amortisation should be excluded from performance statistics including operating income, net income and EPS. However, the investment of capital in goodwill should be included in capital employed (including previously amortised and written-off goodwill) for ROIC calculations.

Item	Issue	Adjustment
Provisions	IAS 37 defines provisions as liabilities of uncertain timing or amount which should be recognised when an enterprise has incurred a present obligation that will result in a probable, reliably estimable outflow of resources. In a number of markets (notably in continental Europe) standards are more generous in permitting companies to make provisions that may not meet IAS criteria	Where material, non-conforming provisions should be reversed out of the profit and loss account. For a more detailed discussion of provision accounting, see our report *Valuation and Accounting Briefing No. 2: Provision Accounting*, December 1998.
Pensions and post-retirement health benefits	For companies with defined contribution plans, no adjustments are necessary. For companies with defined benefit plans (both pension and post-retirement health plans, for which the accounting is similar), some adjustments may need to be made. In most accounting systems all pension charges, including the impact of surpluses and deficits and the interest cost of obligations, are treated as operating items, which we believe is incorrect. For a more detailed discussion, see our report *Equity Analysis InsideOut No. 6: Pension Obligations*, November 2001.	EBIT should reflect only ongoing service costs. Remove financial items such as the spread between the return on pension assets and the interest cost of the corresponding obligation, and non-operating gains and losses as a result of surpluses and deficits. Allocation of prior gains/losses should be removed from performance measures. The unfunded portion of a post-retirement obligation (or a net funded deficit) should be added to enterprise value, whilst any funded recoverable surplus should be deducted. The interest cost relating to this liability should be removed from EBIT measures used in conjunction with enterprise value in valuation.
Leases	There are major international differences in the treatment of leases in company accounts, mainly involving differences in the classification of capital (finance) leases. A capitalised lease is an on-balance sheet debt obligation with a corresponding interest charge; the leased asset is considered purchased. An operating lease, by contrast, does not create a liability; the leased asset is considered rented, not purchased, and the leasing cost is treated as an operating, not financing expense.	Comparability would be improved, particularly with respect to balance sheet and enterprise value ratios, by consistently capitalising all lease obligations. Capitalisation is possible, but as disclosure is inconsistent adjustments may be highly subjective. As a result we do not automatically adjust for leases in our database unless leasing is highly material; the airlines sector is a good example of where adjustments are made.
Income from associates	Equity accounting is used almost universally to account for associates. This means that the group's share of associate net income is included in the group income statement. However, the manner in which this is achieved can differ from country to country.	It is important to ensure consistent treatment, particularly in the measurement of EBIT. Generally, associates are classified as peripheral assets and are therefore excluded from UBSW 'core EBIT' figures.
Unusual items	Unusual or non-recurring gains and losses are given a variety of names such as extraordinary, exceptional or abnormal. Unfortunately both the type of item included in this category and its presentation in the income statement varies.	All such 'exceptional' items should be excluded from EBIT and adjusted net income figures. These 'exceptionals' would include gains and losses on capital transactions and all truly one-off operating items such as the cost of restructuring.

Source: UBS Warburg

Focus on Key Statistics Less Affected by Accounting Differences

Some accounting statistics are more comparable than others…

Since it is not possible to eliminate all accounting differences, investors and analysts should also seek to use valuation statistics that are least likely to be distorted by accounting. This essentially means focusing more on cash flow, rather than profit data, and where profit measures are used, taking them from higher up the income statement. However, keep in mind that there is a danger that key aspects of company performance can be missed when this is done; these statistics should be interpreted with care and preferably not in isolation.

…but most are incomplete or subjective in other ways and should be used with care

■ **Cash flow:** The advantage of cash flow as a basis for valuation is that, when calculated properly, it is entirely independent of accounting methodology. The problem, though, is that, particularly on a historical basis, cash flow naturally varies and a single year's cash flow is not necessarily a good basis for predicting the future. This is mitigated by using forecast cash flows since this volatility diminishes, but even so cash flow is more suited to DCF valuations than to performance measures and valuation multiples.

■ **Revenue:** Revenue has often been advocated as a suitable basis for analysis and valuation on the grounds that it is largely comparable across different accounting systems. There are two problems with this:

— Sales are not as unaffected by accounting policies as is commonly thought; they can be substantially affected by different interpretations of accounting standards, although the problems are not as acute as for profit measures (see the discussion of the enterprise value/sales multiple on page 28).

— Revenue is an incomplete measure of performance given its lack of focus on profitability and cash flow. Revenue as a performance measure and basis for valuation should be a last resort if other more relevant profit measures are unavailable or unreliable.

■ **EBITDA:** EBITDA has become the most common measure of performance and value that supposedly overcomes the problem of accounting differences. This is partly true, in that the measure is unaffected by differences in depreciation methods, goodwill accounting and deferred tax. Although there are other accounting problems that do affect EBITDA (revenue and cost recognition issues, pensions accounting, etc), it provides a useful and comparable measure.

A crucial failing of EBITDA, however, is that it ignores the very real costs of capital expenditure and taxation that should (and do) affect value.[2]

OpFCF is not perfect but is our preferred approach to improving comparability

■ **Operating free cash flow (OpFCF):** OpFCF is a modified version of EBITDA designed to retain the benefits EBITDA provides in accounting comparability but avoid the problem of ignoring differences in capital intensity (capex).

OpFCF = EBITDA – maintenance capex – maintenance increase/(decrease) in net working capital. 'Maintenance capex' is the amount an analyst estimates must be spent on fixed assets to maintain the profitability and competitive position of the company in real terms. It is cash-based, forward-looking and unaffected by accounting, unlike the related depreciation charge. OpFCF is, therefore, a more relevant measure to use in analysis and valuation, although less reliable due to the estimations required (see page 32).

3. Fluctuations in Profits

Multiples are only meaningful if the profit statistic used is representative of the future. Profit fluctuations can have a substantial impact on multiples. Consider a company that has a steady earnings trend but takes a one-off restructuring charge:

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[2] The problems of EBITDA are explored in more detail in our publications *EBITDA Multiples and Capital Intensity*, February 1999, and *...But it Looks Cheap on EV/EBITDA*, September 1999, available at ubswarburg.com/research/gvg.

Table 5: Fluctuating Earnings and the PE Multiple

	1999	2000	2001	2002E	2003E
Earnings	10	12	14	3	17
Average price	200	220	260	?	?
Historical priced PE multiple	20.0x	18.3x	18.6x	?	?

Source: UBS Warburg

Single-point multiples can be misleading…

Since earnings will recover in 2003, it is unlikely that the price will collapse in 2002 simply because of a temporary drop in earnings; investors will 'look through' 2002 earnings and the earnings multiple for 2002 is therefore likely to be very high. A naive comparison of this multiple with that of peers or the sector will not be illuminating and is unlikely in itself to provide an opportunity to identify mispricing.

…notably for cyclicals, for which cash flow can be highly volatile

The market appears to price cyclical earnings efficiently. A real-life example is provided by General Motors, the US automobile manufacturer (see Chart 1 below). Automobile manufacturers, with their high fixed costs, have notoriously cyclical earnings. During the Volcker anti-inflationary recession of 1980-1982 and again during the Gulf War recession of 1990-1991, earnings fell and then turned negative (largely because of restructuring provisions), but rose sharply as the economy recovered.

The spot PE ratio for these periods is not very informative. GM's PE ratio rose from approximately 8x into the high 90s in late 1980 before earnings recovered, and similarly rose into the mid 30s in 1994. For a cyclical company such as GM, earnings at any given time are probably not a good proxy for future cash flow; a normalised figure better represents the company's earnings power.

Chart 1: General Motors Price/Earnings Multiple versus Earnings per Share
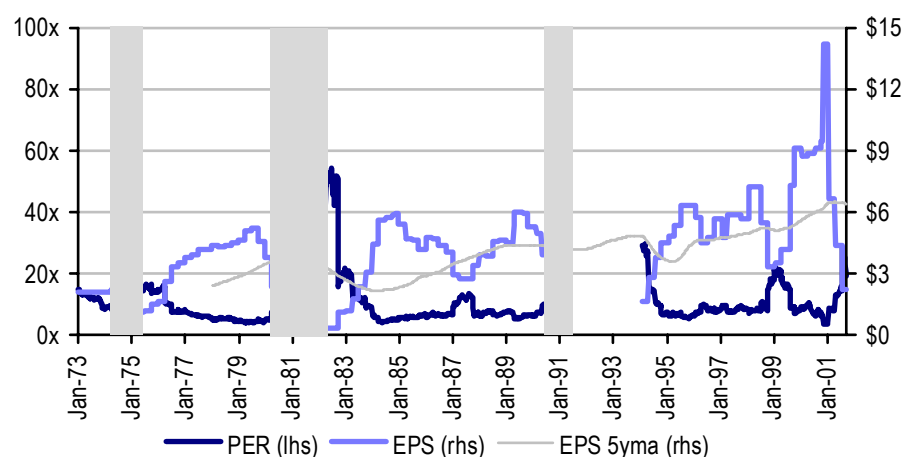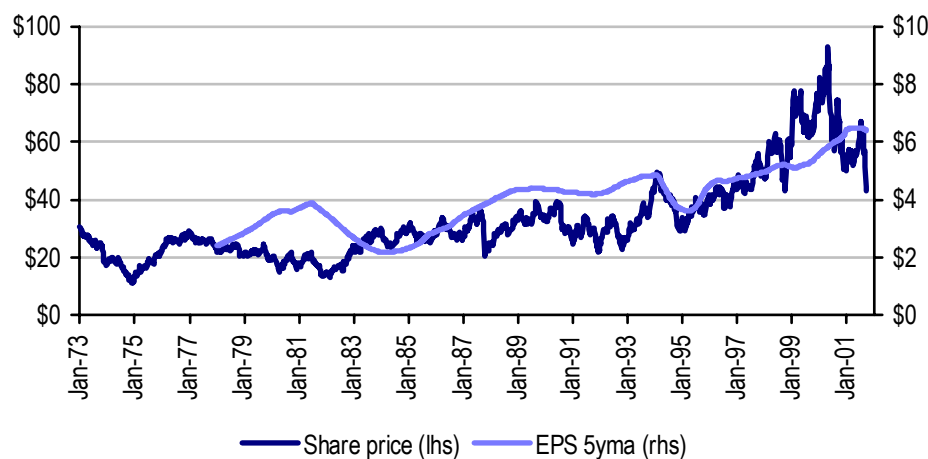

Source: Primark Datastream

Note: shaded areas = US recessions

Investors value look-through cash flows

Investors recognise this. GM's share price during the period mirrors the upward secular trend in earnings rather than the peaks and valleys (Chart 2). On average, after removing outliers, GM has traded at a normalised PE ratio averaging 9x.

Investors have been willing to pay a certain multiple of a normalised, growing earnings stream, but not much more on average because of the volatility of GM's realised earnings. The result has been a fairly steady climb in GM's share price through several business cycles, in line with the secular earnings trend.

Chart 2: General Motors

Source: Primark Datastream

Dealing with Profit Fluctuations

A multiple is only meaningful if the profit on which it is based is indicative of future profit potential. Where this is not the case, one should:

■ **exclude exceptional items if using historical profits; or**

■ **use forecast rather than historical profits.**

If current/subsequent years' profits are still unrepresentative of the longer term, then one should (a) use normalised profit or cash flow; or (b) consider using 'forward-priced' multiples. We discuss forward-priced multiples below.

4. Mispricing

If differences in multiples are not fully explained by differences in business quality, accounting differences or profit fluctuations, then the stock may simply be mispriced. It is the analyst's task to identify mispricing; the analyst's skill is in distinguishing between differences arising from underlying fundamentals – and therefore justified – and those arising from mispricing.

Choosing the Pricing Date

Three pricing dates can be used to calculate a multiple

Which pricing date should one use when calculating a multiple? There are three valid alternative prices that can be used in multiples – historical, current and forward. In practice a fourth, partial-forward approach is applied to enterprise values, but is less than ideal.

Table 6: Alternative Pricing Bases for Multiples

Pricing basis	Calculation	Profit or cash flow used	Use in valuation
Historical	Average price or enterprise value for a period	Historical profit for the same period	Establishes a historical trading range
Current	Current price or enterprise value	Any historical or forecast profit	Investigation of current value – best to use current year forecast profit
Forward	Forward price or enterprise value	Forecast profit for a period related to the forward price date	Investigation of current value – superior to current-priced multiple for forecasts beyond one year
Partial-forward	Current market cap plus forecast net debt (applies to enterprise value only)	Forecast profit for a period related to the forward price date	Investigation of current value but the partial-forward price is inconsistent and difficult to interpret

Source: UBS Warburg

- **Historical-priced multiples:** Comparison of historical price or enterprise value with historical profits (cash flow, etc). 'Historical' price is generally the average for year. Historical-priced multiples are used to establish a trading range.

- **Current-priced multiples:** Comparison of current price or enterprise value with historical or forecast profits – generally one year of historical and two years of forecast profits. Current-priced multiples are used to investigate current value. Current-priced multiples based upon current-year earnings can be compared with historical- and forward-priced multiples.

- **Forward-priced multiples:** Comparison of a forward price or enterprise value with forecast profits. Forward-priced multiples are used to investigate current value. Effectively a forward-priced multiple is a partial DCF valuation expressed as a multiple. Forward-priced multiples are particularly useful for growth stocks, especially where the current profit or cash flow is negative, and they can be compared over time, unlike current-priced multiples. A forward price is that price necessary for an investor to earn a satisfactory return on the investment, ie a current price adjusted for the cost of carry:
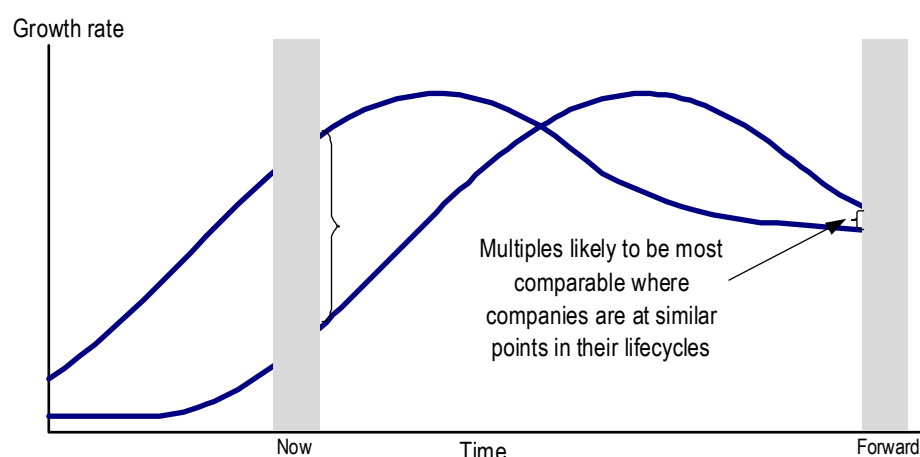
Forward price @ t_1 = (Price at t_0) × (1+cost of capital) – investor cash flow @ t_1

Forward multiples are based on the concept that companies are more comparable at maturity

The concept behind the use of forward multiples is that companies are more comparable when they have reached a mature phase and differences between them are most likely to be the result of true differences in value rather than where they sit on the lifecycle curve.[3]

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[3] For a more detailed discussion, see our report *Forward-priced Multiples*, September 1998, available at ubswarburg.com/research/gvg.

Chart 3: Multiple Comparisons and Lifecycles

Growth rate

Multiples likely to be most comparable where companies are at similar points in their lifecycles

Now

Time

Forward

Source: UBS Warburg

- **Partial-forward multiples:** In a partial-forward approach, a current equity value is combined with a forecast net debt figure in calculating enterprise value to be compared with forecast profit and cash flow measures. Other components of enterprise value, such as minorities and pension provisions, may be included at either forecast or current value. While this approach does not have the consistency of the pure forward-priced method above, it does take account of at least part of the future cash flow that affects value. For example, a company that is forecast to have lower cash flow than another in the coming years would have a higher net debt and therefore a higher partial-forward EV. Poor cash flow is effectively penalised by a higher multiple.

Note: Standard enterprise value multiples that appear in UBS Warburg research reports are historically priced for historical periods and partially-forward priced for forecast periods.

Section 2   Target Valuation Multiples

Multiples are primarily used for relative comparisons: for a stock relative to its historical trend, relative to other companies, relative to its sector, and so forth. But it is also possible to derive a 'fair' or target multiple.

What Is a Target Multiple?

A target multiple is the maximum multiple (of earnings, EBITDA, etc) that you could pay, given certain underlying value drivers,[4] and receive a fair return on your investment. 'Fair return' in this context means your required return on either equity or capital, depending on which measure you are applying.

A fair multiple results in a net present value of zero

A fair multiple is that multiple paid which results in the investment having a net present value of zero, ie, the reciprocal of the internal rate of return: 1/IRR.

Example With perfect foresight, what multiple could you have paid for Microsoft in 1990 and still have received a fair return on your investment?

High multiples can be fair multiples…

Ex post, we estimate that you could have paid an EV/sales multiple of 42x in 1990.

The calculation is simple: we assume a cost of equity of 14.5% based on the ten-year Treasury note rate at that time of 9.5% plus a 5% equity risk premium, and discount back today's price (adjusted for cumulative dividends) at that rate to 1990, giving us a 'fair' price curve. That is, the 'fair' share price at the end of each year equals the previous year's share price × 1.145. We then divide sales for each period by the 'fair' price at the end of that period to get a fair EV/sales multiple.

An investor with perfect foresight could have paid 42x sales, more than eight times the price at that time, and received an average 14.5% return through today. (The fortunate investor who bought in 1990 and held received a 44% compound return.)

Chart 4: *Ex-post* fair EV/Sales Multiple – Microsoft
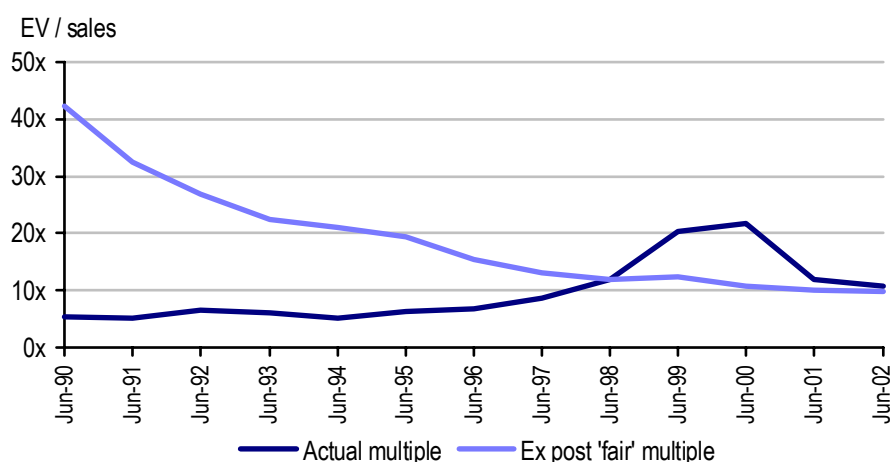
Source: UBS Warburg

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[4] Primarily return on capital (or equity), cost of capital (or equity), growth and duration of growth.

We do not need to know what the actual value drivers were in order to estimate a retrospective fair multiple, as we can work backward from a known share price.

…if supported by the underlying value drivers

But it is precisely those value drivers – particularly Microsoft's high return on capital and high growth rate requiring minimal reinvestment – that drove the share price. In 1990 Microsoft's future success was neither apparent nor impounded in the share price. But an investor who did see Microsoft's potential and translated that potential into value driver estimates would have been willing to pay a much higher multiple.

These fair or target multiples can be calculated, based on underlying drivers of return on capital, cost of capital and growth, using a discounted cash flow-equivalent approach. The Global Valuation Group's 'target multiple' model can be used to quickly obtain a range of target multiples for a different input values. This model can be found at **www.ubswarburg.com/research/gvg**.

Chart 5: UBS Warburg Global Valuation Group Target Multiple Calculator

The target multiple calculator model, along with other models, can be found at:
www.ubswarburg.com/research/gvg

Source: UBS Warburg

Single-stage Target Multiples

Ex-ante fair multiples can be derived from underlying value drivers

We have summarised key multiples and their underlying formulas below. A derivation of the key formulas can be found in the Appendix.

A word of caution, however! These are based on limiting assumptions and should be used with care. For example, margins, depreciation, taxation and rate of investment are all assumed to remain constant, and growth is assumed to continue into perpetuity. As a result, multiples obtained using these formulas are likely to over- or understate fair value.

These formulas are most useful in identifying which factors have the greatest impact on a multiple for which you already have a value.

Table 7: 'Fair' or Target Multiples

Multiple	Basic formula
EV / sales	$\dfrac{ROIC - g}{ROIC \times (WACC - g)} \times (1 - T) \times M$
EV / EBITDA	$\dfrac{ROIC - g}{ROIC \times (WACC - g)} \times (1 - T) \times (1 - D)$
EV / EBIT	$\dfrac{ROIC - g}{ROIC \times (WACC - g)} \times (1 - T)$
EV / NOPLAT	$\dfrac{ROIC - g}{ROIC \times (WACC - g)}$
EV / invested capital	$\left(\dfrac{ROIC - g}{ROIC \times (WACC - g)} \times ROIC \right) or \ \dfrac{ROIC - g}{WACC - g}$
EV / capacity unit	$\dfrac{EV}{Unit} = \dfrac{ROIC - g}{ROIC \times (WACC - g)} \times \dfrac{NOPLAT}{Unit}$
Price to earnings	$\dfrac{ROE - g}{ROE \times (COE - g)}$
Price to book value	$\left(\dfrac{ROE - g}{ROE \times (COE - g)} \times ROE \right) or \ \dfrac{ROE - g}{COE - g}$
PE to earnings growth	$\dfrac{ROE - g}{100 \times g \ \times ROE \times (COE - g)}$

Source: UBS Warburg

Note: ROIC and ROE = incremental post-tax return on incremental total investment and equity, respectively; g = assumed long-term growth rate; WACC = weighted average cost of capital; COE = cost of equity; T = effective tax rate; D = depreciation and amortisation as a % of EBITDA; M = operating margin

Two-stage Target Multiples

More realism is introduced by using a two-stage approach

The assumption in the formulas above that value-adding growth will continue into perpetuity is suspect. Competitive pressures and the size effect invariably check growth rates. To cope with this, we can use a two-stage model, constituting:

1. An initial growth period with a specified level of growth and return on equity over a limited time horizon, followed by

2. A terminal phase in which no further value is added (that is, cash flows are discounted at the cost of capital in perpetuity).

The two-stage version of the PE target multiple formula is:

$$\frac{P}{E} = \frac{ROE - g}{ROE \times (COE - g)} \times \left(1 - \frac{(1+g)^n}{(1+COE)^n} \right) + \frac{1}{COE} \times \frac{(1+g)^n}{(1+COE)^n}$$

Initial growth period   Perpetuity, no additional value added, discounted back to today

Two-stage formulas are used in the Global Valuation Group (GVG) target multiple model. The derivation of the two-stage formula can be found in the Appendix.

Examples

Fair value multiples should be based on = 1/cost of capital

- **Simple model, no value added:** Suppose you are in investor with a required return on equity (cost of equity) of 10%, contemplating investing in a company with a return on equity of 10% and a growth rate of 5% into perpetuity. There is no value added (that is, the company does not generate any surplus return above your cost of equity), and therefore the rate of growth is irrelevant. This investment is identical to a bond paying 10% in perpetuity, and the maximum you would pay is (1/.10) or 10x the coupon. The fair PE multiple is 10x regardless of the company's growth rate.

Surplus return over cost of capital generates value; higher growth = more value

- **Simple model, value added:** Now consider a company with a return on equity of 12% and a growth rate of 5% to perpetuity. Because the company generates a return above your cost of equity, you will pay a higher PE ratio; the higher the growth rate, the more value added and the higher the PE you will pay. The fair PE ratio in this instance is:

$$\frac{P}{E} = \frac{.12 - .05}{.12\,(.10 - .05)} = 12x$$

All things equal, finite growth means a lower multiple than in the perpetual-growth case

- **Two-stage model, value added in first stage:** Now let's assume that instead, the company grows at 5% pa but for ten years only. Thereafter any cash flows are discounted at the cost of equity of 10%. In this case the fair PE ratio is

$$\frac{P}{E} = \frac{.12 - .05}{.12(.10 - .05)} \times \left(1 - \frac{1.05^{10}}{1.10^{10}}\right) + \frac{1}{.10} \times \frac{1.05^{10}}{1.10^{10}} = 4.3 + 6.3 = 10.6x$$

which is between the 10x multiple of the simple no-value added case and the 12x multiple of the perpetuity value-added case. This is the basic formula used in the GVG target multiple model.

The first term is the value added in stage one, and the second term the value added in the stage two. The second term is the unitary value of the terminal cash flow (ie 1×1.05^{10}) converted to a perpetuity (ie divided by 0.10) and then discounted back to the present (divided by 1.10^{10}).

The factor in brackets is the weight assigned to the first stage multiple. Its corresponding weight is assigned to the perpetuity multiple; the sum of the two weights equals one. The longer the growth period, the larger the first term; the higher the growth rate, the larger the second term.

In effect, this model states a discounted cash flow calculation as a multiple.

- **Two-stage model, value added both stages:** The formula can be further extended to allow for value-adding growth in the perpetuity or second stage. This formula is stated as

$$\frac{P}{E} = \frac{ROE - g}{ROE \times (COE - g)} \times \left(1 - \frac{(1+g)^n}{(1+COE)^n}\right) + \frac{ROE_{LT} - g_{LT}}{ROE_{LT} \times (COE_{LT} - g_{LT})} \times \frac{(1+g)^n}{(1+COE)^n}$$

where ROE_{LT} = the long-term return on equity, COE_{LT} = the investor's long-term required return on equity and g_{LT} = the long-term (steady state) growth rate.

Note that the discount factor in the final term is based on the *first-stage* growth rate and cost of equity. The numerator grosses up the current unitary cash flow (that is, 1) to a terminal cash flow at the end of the initial growth period, using the initial-period growth rate. This is then multiplied by a cash flow exit multiple (the PE formula using long-term value drivers) to give us the terminal value at the end of the first stage. This terminal value is then discounted back to today using the current cost of equity.

These formulas restate a discounted cash flow calculation as a multiple

In other words, the two terms of the equation are equivalent to the explicit forecast period and terminal value in a discounted cash flow calculation.

Applying the same assumptions as above, and assuming that return on equity and cost of equity remain the same but growth falls to 2% pa, fair value PE is:

$$\frac{P}{E} = \frac{.12 - .05}{.12(.10 - .05)} \times \left(1 - \frac{1.05^{10}}{1.10^{10}}\right) + \frac{.09 - .02}{.09\,(.08 - .02)} \times \frac{1.05^{10}}{1.10^{10}} = 4.3 + 8.1 = 12.5x$$

Although the growth rate has fallen, even this lower growth adds value (12.5x – 10.6x = 1.9x earnings) because the return on equity is higher than the required return.

Different valuation approaches using similar assumptions should give the same answer

What should be apparent is that **different valuation approaches using similar assumptions should give the same answer**. A multiple-based valuation approach is simply another way of formulating a discounted cash flow valuation, where the same assumptions are used in both.

Assumptions Used in Target Multiple Formulas

The assumptions used in these formulas must be given careful thought to ensure that they are consistent. The user should also be aware of the limitations of these formulas.

Higher quality businesses/ lower required capital reinvestment result in a higher surplus return

■ **Excess return on capital:** This is the difference between the return on capital (or equity) and the weighted average cost of capital (or cost of equity): cost of capital + excess return = return on capital. For capital-intensive companies in competitive industries that do not have strong franchises, use a figure close to the cost of capital. The higher the quality of the business and the lower its (tangible asset) capital intensity, the greater this premium should be.

■ **Cost of capital:** The standard weighted average cost of capital (or cost of equity). This is the long-term required return of investors in the company and should reflect estimates of long-term risk and long-term target level of gearing.

Growth drivers assumed to be constant over the growth period

■ **Growth rate:** This is the annual compound growth forecast for the growth period. This rate is assumed to apply to revenues, profit and cash flow during this period since the model assumes that margins, depreciation, taxation and the rate of investment all remain constant.

■ **Growth period:** The estimated period over which the initial growth rate and the excess return on capital are expected to persist. In the simpler version of the model, it is assumed that at the end of the initial growth period the excess return on capital changes to zero (in the GVG target multiple model this can be modified in the two-stage model for which value is added in both stages).

The Effect of Growth on Value

Growth is seen to have the greatest impact on value…

If asked which value driver has the greatest impact on multiples, analysts and investors are likely to answer 'growth'. This is broadly true, but the impact of growth depends on its source and nature. There are several different sources of growth and each will have a different effect on value creation and thus share prices.

…but this depends on the source of growth

The four primary sources of growth are:

■ **Growth due to reinvestment at the cost of capital**

■ **Growth due to reinvestment at a premium to the cost of capital**

■ **Growth due to inflation**

■ **Growth due to efficiency gains[5]**

Reinvestment at the cost of capital Growth as a result of reinvestment at the cost of capital does not add value, and neither the share price nor the PE ratio is affected. In this case the PE formula reduces to:

$$\frac{1}{COE}$$

Reinvestment may or may not add value depending on excess return on capital

Reinvestment at a premium to the cost of capital Growth as a result of reinvestment at an incremental return higher than the cost of capital will produce value-adding growth. (Conversely, if the company reinvests at an incremental return that is below the cost of capital, value is destroyed.) The formula is the same as that for the single-stage PE target multiple discussed above:

$$\frac{ROE - g}{ROE \times (COE - g)}$$

Inflation-driven growth results in a *lower* multiple

Inflationary growth Growth resulting from a general increase in the price level (which produces higher earnings) results in a lower multiple (although not necessarily lower value, because of the higher nominal value of earnings). This is because the replacement value of fixed assets and working capital rises, requiring more investment to fund that increase in value.

$$\frac{ROE_r - g_r}{(ROE_r + \Pi) \times (COE_r - g_r)}$$

The subscript 'r' denotes real rather than nominal. Π = inflation

Efficiency gains can be a valuable source of growth

Efficiency gains Productivity gains not requiring additional investment, such as those resulting from cost control or higher market share, are a valuable source of growth. Even small gains can produce large increases in the PE ratio.

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[5] For a more detailed discussion of the impact of growth on multiples, see our report *Price Earnings Growth: A PEG for Your Valuations*, November 1997, available at ubswarburg.com/research/gvg.

$$\frac{ROE - (g - g_{eff})}{ROE \times (COE - g)}$$

g = total forecast growth; g_{eff} = growth achieved from efficiency gains

In reality efficiency gains are likely to be eroded quickly

Implicit in the above formula is the assumption that efficiency gains are achieved in perpetuity. Because efficiency gains are likely to be eroded fairly quickly, a more realistic multiple would lie between this multiple and the fair value PE ratio under an assumption of normal reinvestment.

The chart shows sensitivity of multiples to growth rates for different growth types.

Chart 6: Effect of Different Sources of Growth on the PE Ratio
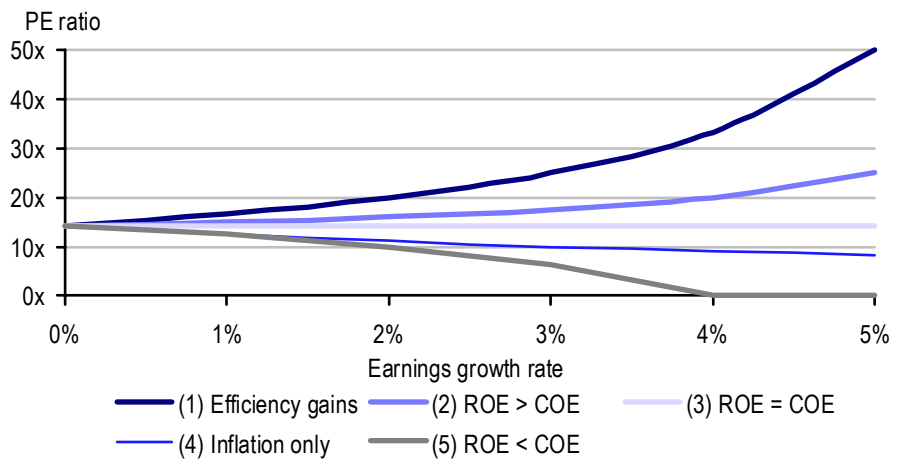
Source: UBS Warburg

Note: Assumes perpetual growth arising from: (1) perpetual efficiency gains = the long-term growth rate; (2) and (5) reinvestment at a 3% premium/discount to COE; (3) reinvestment at COE; (4) inflationary growth only

Section 3   Using Valuation Multiples

Relative Valuation – Observed Multiple versus Comparable

There are several ways one can apply multiples in valuation. The common approach is to compare the current multiple to a historical multiple measured at a comparable point in the business cycle and macroeconomic environment. An alternate approach is to compare current multiples to those of other companies, a sector or a market, and compare the current spread between them to a historical spread.

Relative Valuation – Observed Multiple versus Target Multiple

Where is the current multiple relative to a 'fair' or target multiple?

However, one can also compare a stock's current multiple to a calculated fair or target multiple. At different points in the business cycle the 'fair' and observed multiples are likely to differ. In Chart 7 below, the current multiple cycles around the fair multiple, with the multiple at any point in the cycle mean-reverting over time to the long-term fair multiple. A simple investment strategy would be to sell when the current multiple is above the fair multiple and buy when it is below.

Chart 7: Relative Valuation – a Stylised Example
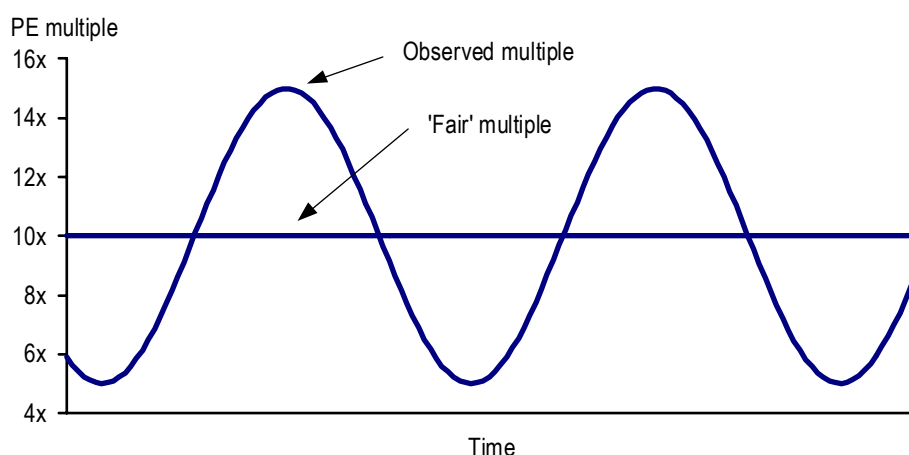
Source: UBS Warburg

Linking Multiples and Value Drivers

Multiples are commonly plotted relative to growth or return on capital

A more common way to look at multiples is to plot them relative to various value drivers. The most frequent comparisons are multiples versus growth in an underlying statistic and multiples to return on capital.

■ **Multiple to growth:** This includes such comparisons as PE ratio to earnings growth (the PEG ratio), EV/EBITDA to EBITDA growth and so forth. A low multiple to growth indicates potential undervaluation.

Care must used in comparing multiples to growth rates, as not all growth adds value

But not all growth adds value, as we discuss above; this type of comparison ignores profitability, which determines whether growth adds or subtracts value. One should at the least consider long-term growth potential, the sustainability of short-term growth and cash flow reinvestment required to generate growth.

Chart 8: Multiple to Growth

PE
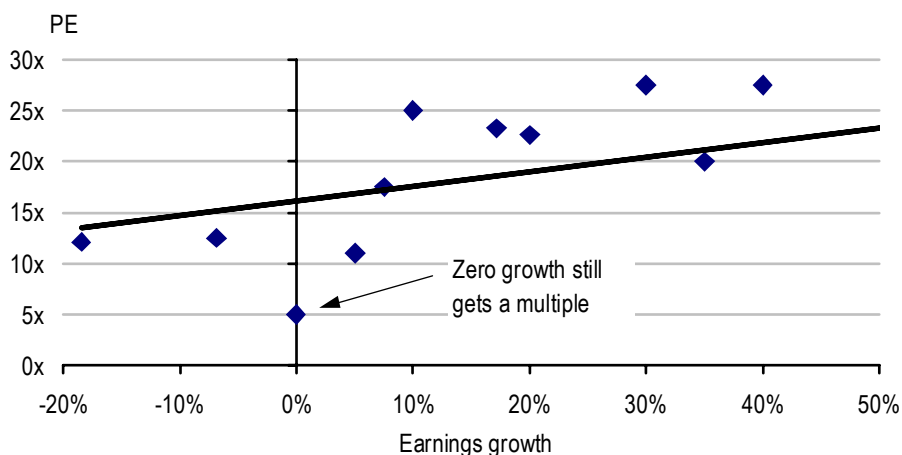
Source: UBS Warburg

A caveat This type of plot presumes a linear relationship between multiples and growth. But a non-linear relationship is more likely (see Chart 6 on page 19). This suggests that these relationships may not be statistically significant and you may not be able to confidently 'eyeball' stock values relative to the regression line. The actual relationship will depend on other factors such as return on capital. You should be careful not to apply a simple multiple-to-growth relationship (see *Price/Earnings Growth*, page 39) or you risk overvaluing high-growth stocks and undervaluing low-growth stocks. This is particularly true of low-growth companies – note that zero-growth companies will not trade at a zero multiple!

The linkage between multiples and profitability makes for more meaningful comparisons

■ **Multiple to return on capital:** This includes such comparisons as P/BV compared to ROE, EV/invested capital compared to return on capital, or, alternatively, a comparison of the return on capital to the cost of capital. Essentially this is a decomposition of a price to earnings or EV/net operating profit multiple. The line on the chart usually represents a regression line or, alternatively, it could be drawn to represent a certain multiple.

Chart 9: Multiple to Return on Capital

EV/IC
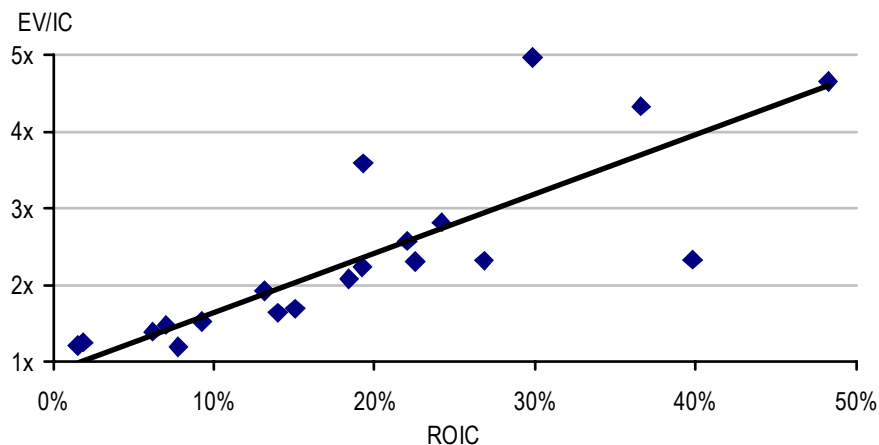
Source: UBS Warburg

■ **Asset multiple to excess return multiple:** A variant of the above chart is to compare an asset-based multiple (such as enterprise value/invested capital or price/book) to return on capital or equity or to an 'excess return multiple'. (In the example, this is return on equity divided by cost of equity, scaled by growth. See the formula for target price to book value on page 38, below.)

This approach provides a clear picture of over- and undervaluation, since it directly ties the market's valuation of an asset to the excess return earned over and above the cost of that asset, in a linear fashion. All key value drivers are shown and related to market value in a single chart.

Chart 10: Asset Multiple to Excess Return Multiple
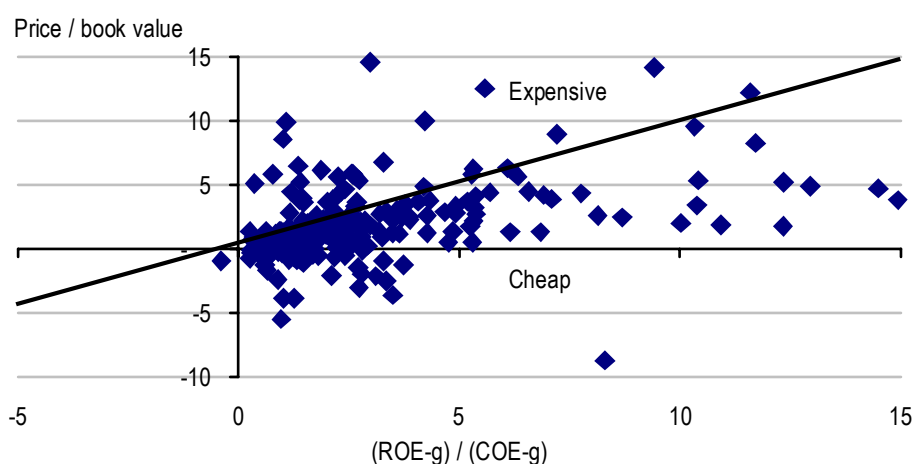
Source: UBS Warburg

■ **Multiple to interest rate:** A less common approach is to compare a yield measure with interest rates or the cost of capital. The earnings yield ratio is the most commonly used of this type of comparison. Another approach is to compare a multiple to the reciprocal of the cost of capital, eg PE:(1/cost of equity) or EV/NOPLAT:(1/WACC).

Choosing the Right Multiple

Multiples should be useful, relevant and economical

This is a matter of individual judgement and common sense. Multiples used should be relevant and useful and result in the least overlap. Economy of effort is also important: there is an inevitable trade-off between cost/time involved in adjusting multiples and improved comparability. We recommend that multiples be tested for statistical significance, using at least one business cycle of time-series data.

For example, the UBS Warburg European telecom team favours using EV to operating free cash flow (see page 32 and charts below) over EV/EBITDA when looking at multiples versus growth because they feel that the relationship over time has been more significant and is more useful in predicting future performance.

Chart 11: European Telecom Sector – 'babycoms' – EV/EBITDA
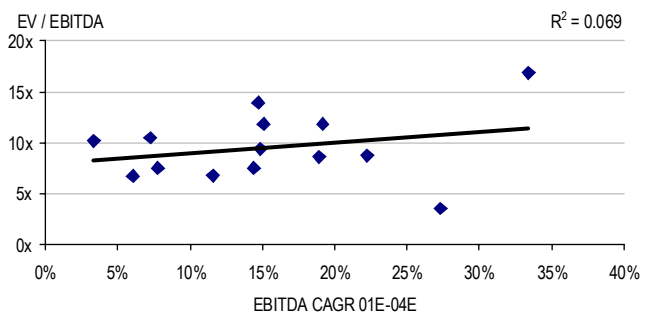
Source: UBS Warburg

Chart 12: European Telecom Sector – 'babycoms' – EV/OpFCF
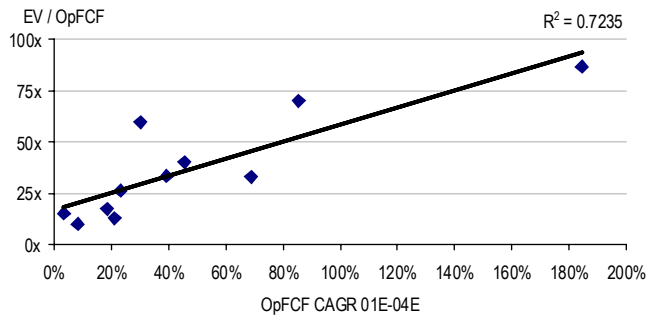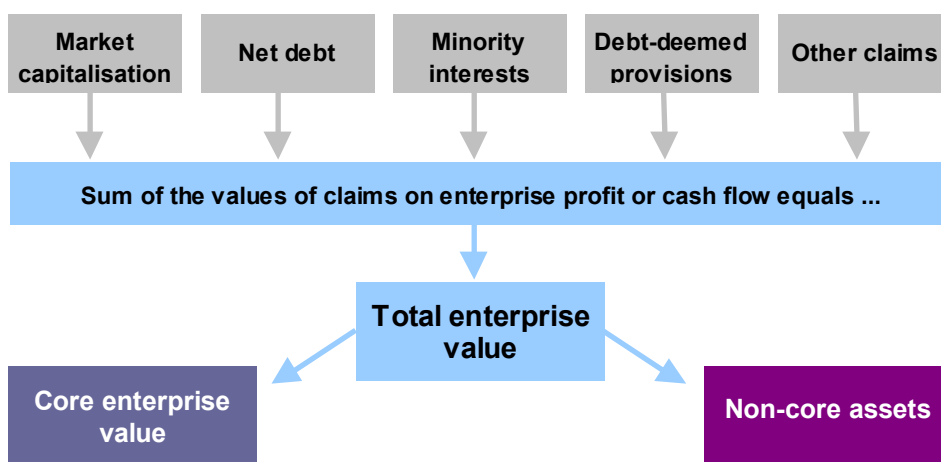

Source: UBS Warburg

Section 4 Enterprise Value Multiples

What Is Enterprise Value?

The right to an enterprise's cash flow or the value of claims on that cash flow

- Enterprise value or EV is the cost of buying the right to the whole of an enterprise's core cash flow.

- It is equal to the estimated value of the operations of an enterprise as represented by the value of the various claims on cash flow and profit.

- EV equals market capitalisation plus seasonally adjusted net debt (see page 26), pension provisions, the value of minorities and other provisions deemed debt.

Chart 13: Enterprise Value Components

Source: UBS Warburg

Three types of EV: total, operating and core

Enterprise value comes in three flavours: total, operating and core EV, as described below. UBS Warburg valuation measures are based on core enterprise value.

Table 8: Description of the Various Types of Enterprise Value

Type	Description
Total	The value of all the activities of the business. Includes the value of investments and associates, and non-core assets
less	Estimated market value of non-operating assets (investment and usually associates)
= Operating	The value of all operating activities. Total enterprise value less non-operating assets at market value
less	Non-core assets (non-operating assets and operating assets not a core activity of the business)
= Core	Total enterprise value less the value of non-core assets – those operations not regarded as part of core activities and which are desirable to exclude from the calculation of valuation multiples
	■ Non-core assets include non-operating assets but may also include other trading operations which are very different in nature to the core activities of the enterprise
	■ The exclusion of non-core assets makes the calculation of enterprise value more subjective (in most cases there is no market-determined value for the non-core assets) but it does result in more meaningful and comparable valuation multiples

Source: UBS Warburg

Chart 14: Enterprise Value Typology

Source: UBS Warburg
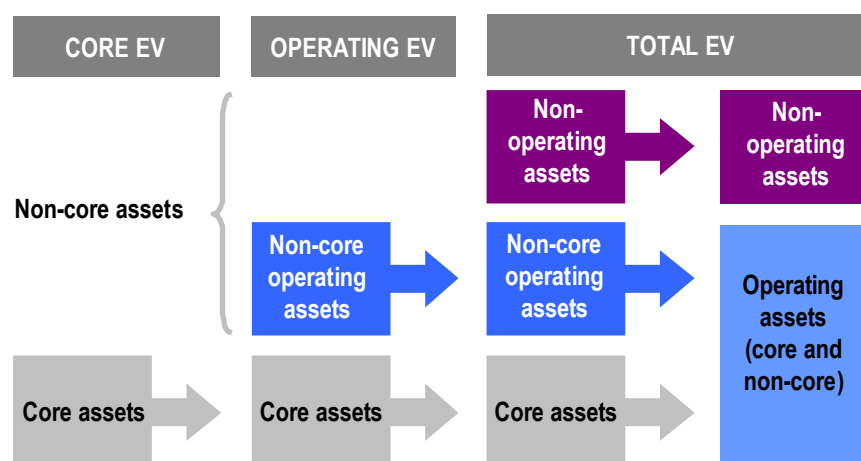
Why Use Enterprise Value Multiples?

Enterprise value multiples more comparable than equity multiples

As summarised in Table 2 above, there are a number of reasons for using enterprise rather than equity multiples.

■ **Comprehensiveness:** Enterprise value measures the business as a whole. As a result, enterprise multiples are more comprehensive than equity multiples, which focus only on the value of the equityholders' claims.

■ **Less affected by capital structure:** EV multiples are less affected by capital structure differences, as they measure the unlevered value of an enterprise.

— In the table below (based on actual figures), Company B trades at a price-earnings ratio above that of Company A but in line with the sector average. However, the PE ratio is significantly distorted by B's high net cash balance, which accounts for almost half of market capitalisation. Both Company A and the sector as a whole, by contrast, are levered approximately 30%.

— Stripping out the excess cash balance, B trades at low relative multiple of EBITDA to 'core' EV. B's core business is valued at a significant discount to those of its peers. This discount may be justified, but its existence is significant. The analyst should investigate and understand the discrepancy.

Table 9: Benefits of Using Enterprise Value – Leverage

	Sector	Company A	Company B
PE	14.3	10.9	14.6
EV/EBITDA	8.8	8.1	3.0
Net cash as % of market capitalisation	-	-	46%
Net debt as % of total EV	28%	31%	-

Source: UBS Warburg

■ **Less affected by accounting differences:** EV multiples allow for the use of statistics, such as EBITDA, that are less affected by accounting differences.

■ **Less distorted by non-core assets:** EV multiples allow the exclusion of non-core assets, whereas the statistics used in equity multiples incorporate the net assets and earnings attributable to non-core assets.

As a result, enterprise value multiples are more comparable among companies than equity multiples.

Potential Problems in Calculating EV

EV calculations have pitfalls for the unwary

A number of potential problems arise in the calculation of enterprise value.[6]

■ **Is enterprise value complete?**

■ **Is enterprise value measured at market values?**

■ **Does net debt reflect seasonal variations and changes in group composition?**

■ **Have non-operating and non-core assets been treated correctly?**

1. Completeness

EV should include all claims on the company, not just market cap and net debt

Enterprise value should include all claims on the company, not just market capitalisation and net debt. This includes claims relating to deemed debt (provisions having the characteristics of interest-bearing debt, such as unfunded pension liabilities), options, preferred shareholdings and minority interests.

2. Use of Market Values

Enterprise value should include the value of claims at market, not book values. Debt should be adjusted to reflect market value. Minority shares in a subsidiary should be quoted at market value; otherwise a valuation multiple should be applied to earnings or net assets. Quoted options should be valued at market and, where unquoted, at fair value ideally, or as a minimum at intrinsic value.

3. Seasonality

EV should reflect an average level of net debt

EV should reflect an average level of debt which is adjusted to reflect seasonal variations and for changes in the composition of the group. This is important, as net debt is usually the largest component of EV after market capitalisation, and using the stated balance sheet amount can result in large errors.

4. Treatment of Non-operating and Non-core Assets

Non-operating assets are investments and other activities that do not form part of the firm's trading (day-to-day business) operations. Non-core assets include non-operating and any other trading activities that are so different in nature that failure to exclude them from core EV would seriously distort multiples. Income produced by non-core assets is not part of core EBIT.

Non-operating assets typically include net cash balances, other investments and, usually, associates. Non-operating associates should be deducted from total

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[6] For a more detailed discussion of issues involved in calculating enterprise value, see our report *Valuation and Accounting Briefing No. 1: Enterprise Value*, December 1998 (reprinted November 2000), available at ubswarburg.com/research/gvg.

enterprise value at market value (if necessary, estimated by applying a group earnings multiple to the group's share of associate income).

If operating associates' contributions are included, adjustments may be needed

But associates may straddle the operating/non-operating line. Where associates are considered part of operating activities, this can lead to problems with multiples:

■ If the post-interest profit of the associate is included in EBIT then the result is a mixed multiple, with both pre- and post-interest earnings combined in the denominator.

■ But if the associate profit included in EBIT is pre-interest – this is not often available in accounts – then the parent share of associate net debt should be included in the parent's enterprise value.

■ In calculating EBITDA multiples, the group's share of associate depreciation and amortisation must be added back to EBITDA.

It is generally best to treat associates as non-operating (excluded) assets…

It is generally best to treat associates as non-operating assets (effectively investments) in calculating operating and core enterprise value. This means excluding the associate share of profit from core and operating EBIT (thus the respective multiples are core EV/core EBIT and operating EV/operating EBIT).

…but include associate profit if using total (not core) EV

But if total EV is used, then associate profit must be included in EBIT when calculating EV/EBIT. Ideally, the parent share of associate pre-interest operating profit should be included in total EBIT. However, this figure is generally not available outside the UK, so a practical alternative is to use the parent share of *pre-tax* profit grossed up for estimated tax. We look at an example below.

Table 10: Associates Example – Nestlé

Profit & Loss extract	FY 00	Notes
Operating income	9,600	■ EBIT in this example does not equal operating income
Net interest	(746)	■ Total EBIT must include share of pre-tax profit of associates
Non-operating income/(expense)	(99)	
Profit before tax	8,755	$9,600 + 395/(1-0.33) = \mathbf{10,190}$
Taxation @ 33%	(2,761)	■ Non-operating expenses must be examined: are they truly exceptional?
Equity in net earnings of associates	395	
Goodwill amortisation	(414)	
Net income before minorities	5,975	
Minorities	(212)	
Net income	5,763	

Source: UBS Warburg

Non-core operating assets tend to be few, typically operations to be divested or discontinued

Non-core assets include both non-operating assets plus any trading operations deemed to be non-core (see chart on page 25.) Non-operating assets are a subset of non-core assets. Typically there are few trading operations that would be treated as non-core; these might be operations to be discontinued or divested.

Enterprise Value Multiples

The multiple denominator must represent a flow to all claimants

There are many different enterprise value multiples that can be calculated, depending on the circumstances. What is most important is that the denominator represent a flow to all claimants on enterprise cash flow.

Adjustments should be made to both enterprise value and the denominator where necessary (and possible) to ensure that apples are being compared with apples.

EV/Sales

Definition: Core EV/sales.

Formula: $\dfrac{EV}{Sales} = \dfrac{ROIC - g}{ROIC \times (WACC - g)} \times (1 - T) \times M$

When to use it

Crude but least susceptible to accounting differences

■ EV/sales is a crude measure, but least susceptible to accounting differences; it is equivalent to its equity counterpart, price to sales, where a company has no debt.

■ EV/sales is useful when accounting differences among comparables are extreme, or where profit or cash flow figures are unrepresentative or negative. It is frequently used for unprofitable or cyclical firms where there are problems in measuring profit or cash flow further down the P&L. As a proxy for cash flow, sales has the virtue of being stable and relatively unaffected by accounting policies.

Useful in identifying restructuring potential

■ EV/sales is also useful in identifying restructuring potential. Net margin is a key driver of this measure; low profitability (low net margin) would result in a low value for a given level of sales.

■ Be careful that the sales figure is representative; generally EV/sales should not be used for companies with variable, periodic sales, such as property developers.

Caveats There are three caveats in using this multiple:

■ **Sales volatility:** EV/sales is frequently applied to technology firms, which are likely to have negative cash flow and/or earnings while they are in their initial growth phase. But these companies frequently have highly volatile sales as well.

Sales can be affected by accounting policies

■ **Revenue recognition policies:** Sales are not unaffected by accounting policies. Sales can be substantially affected by different interpretations of accounting standards in such areas as:

— Use of gross versus net revenue in recording sales on agency transactions

— Treatment of sales where a customer has the right of return

— Long-term contracts accounted for under percentage of completion or completed contract methods

Care must be taken in ensuring that, when making comparisons using this multiple, sales are determined on a consistent basis.

Sales multiples cannot be compared where operating margins differ

■ **Margin differences**. Sales multiples cannot be directly compared across businesses where operating margins differ. Rough comparability can be obtain by adjusting the sales multiple to

$$\frac{\text{(Benchmark company sales multiple) x (target company sales multiple)}}{\text{Benchmark company operating margin}}$$

where the target company is the one being valued.

EV/EBITDA

Definition: Core EV/earnings before associates, interest, tax, depreciation, amortisation, non-cash changes in provisions and before reported exceptional items.

Formula: $\dfrac{EV}{EBITDA} = \dfrac{ROIC - g}{ROIC \times (WACC - g)} \times (1 - T) \times (1 - D)$

When to use it

■ EBITDA is a proxy for operating cash flow, and EV/EBITDA – probably the most popular EV multiple – is a price to cash flow multiple. Its popularity stems from the fact that it is unaffected by differences in depreciation policy and appears unaffected by differences in capital structure.

EBITDA does not include the cost of replacing capital

■ However, while EBITDA is closer to cash flow than other profit measures it is not a true cash flow, as it does not incorporate either asset depreciation or capital expenditure. Also, EBITDA is a pretax measure, whereas management can potentially add value through skilled tax management.

■ EV/EBITDA is affected by a firm's level of capital intensity (measured as depreciation as a percentage of EBITDA). All things being equal, higher capital intensity results in a lower EV/EBITDA multiple.[7]

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[7] For further discussion, see our report *Valuation and Accounting Briefing No. 3: EBITDA Multiples and Capital Intensity*, February 1999, available at ubswarburg.com/research/gvg.

Chart 15: Theoretical Relationship between EV/EBITDA and Capital Intensity
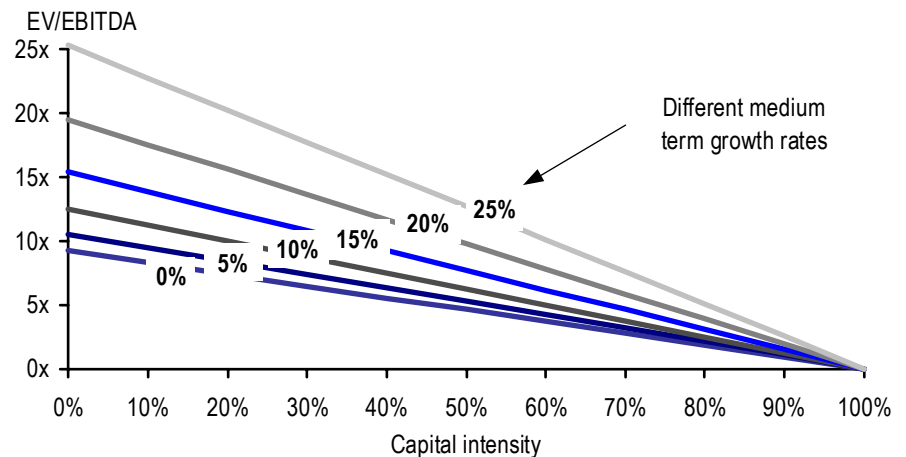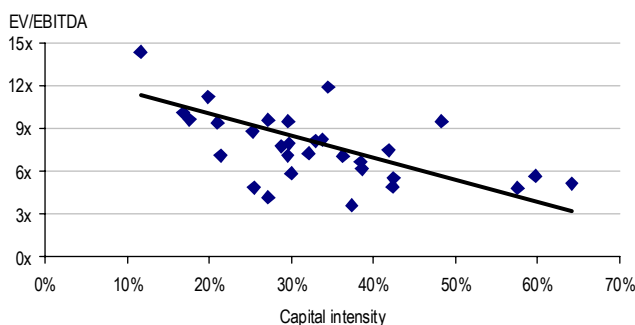

Source: UBS Warburg

Note: These relationships were derived from the GVG target multiple model using an ROIC of 11.5%, a WACC of 7.5%, a 10-year medium-term growth period and a tax rate of 31%.

**Use with comparables having similar levels of capital intensity**

- EV/EBITDA is most useful in comparing companies with a selected peer group that has a comparable level of capital intensity; comparisons of a stock with a sector average can also be useful as long as there is not a large variation in capital intensity within the sector.

- On the other hand, comparisons of a stock with the market, comparisons across sectors and comparisons of a sector with the market are unlikely to be meaningful.

- In the charts below, we contrast the European retail and oil sectors. The more diverse retail sector displays a wide range of capital intensities, whereas the oil sector displays a greater degree of homogeneity, in part reflecting the truly global nature of the oil and gas business.

Chart 16: European Retail Sector

Source: UBS Warburg

Chart 17: European Oil Sector
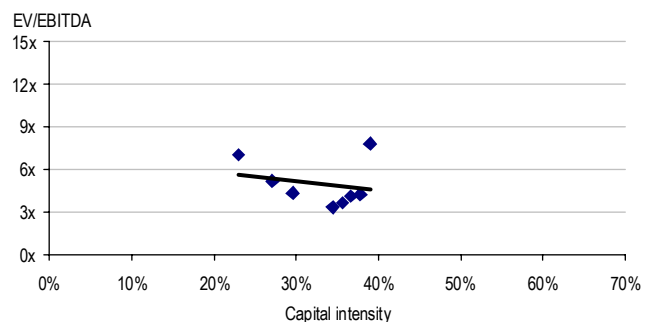
Source: UBS Warburg

- EV/EBITDA multiples could be used for relative valuation of oil companies, but without adjustment would be less meaningful for the retail sector. EV/operating free cash flow may be a more useful valuation multiple in this case (see page 32).

■ EV/EBITDA cannot be used when current cash flow is negative. Use normalised EBITDA, or a forward multiple, instead.

EV/EBIT

Definition: Core EV/core earnings before goodwill amortisation (but after amortisation of other intangibles), associates, interest and taxes. It is stated pre reported exceptional or extraordinary items.

Alternatively, this multiple may be defined as total EV/total EBIT (instead of core EV/core EBIT).

Formula: $\dfrac{EV}{EBIT} = \dfrac{ROIC - g}{ROIC \times (WACC - g)} \times (1 - T)$

When to use it

■ EBIT is a post-goodwill figure. However, we believe that goodwill amortisation is not an economic charge and should properly be added back to operating profit.

■ EBIT is a better measure of 'free' (post-maintenance capital spending) cash flow than EBITDA, and is more comparable where capital intensities differ.

Most useful where comparables' depreciation policies are similar

■ EBIT is, however, affected by accounting policy differences for depreciation. EV/EBIT is most useful where there are relatively small differences in accounting treatment of depreciation among comparables.

■ Alternatively, you can normalise depreciation. The example below demonstrates how a simple depreciation adjustment would work.

Table 11: Adjusting EBIT for Differing Depreciation Policies

Gross fixed assets	300	Unadjusted posttax EBIT	32
Depreciable life	10	Add back: excess depreciation	10
Actual depreciation (no salvage)	-30	Adjusted posttax EBIT	42
Normal depreciable life	15		
Normalised depreciation	-20		
Excess depreciation	-10		

Source: UBS Warburg

Note: We have not adjusted net profit for the 'additional' tax that theoretically would be paid as a result of lower depreciation expense. First, depreciation for tax purposes is typically calculated separately from book depreciation. Second, tax is a real expense that cannot be affected by analytical adjustments.

■ Note that the goodwill adjustment does not apply to financial statements reported under US GAAP. Recently-published Financial Accounting Statement 142, *Goodwill and Other Intangible Assets*, stipulates that effective 1 January 2002 (for calendar year companies), goodwill is no longer to be amortised. [8]

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[8] For a detailed discussion of goodwill and its treatment in equity valuation, as well as recent developments in accounting for goodwill under US GAAP, see our report *Equity Analysis InsideOut No. 3: Goodwill in Equity Analysis*, July 2001, available at ubswarburg.com/research/gvg.

EV/NOPLAT

Definition: Core EV/normal operating profit less adjusted tax.

NOPLAT is often stated after adjustments to better reflect economic profit

NOPLAT is post-tax EBIT. However, as commonly used, NOPLAT (or NOPAT) refers to EBI after adjustments to accounting profit to better reflect economic profit.

Some adjustments include adding back goodwill amortisation, LIFO reserve increase, implied interest expense on operating leases, increases in bad debt and capitalised R&D, and the adjustment of reported tax to a cash basis.[9]

Formula: $\dfrac{EV}{NOPLAT} = \dfrac{ROIC - g}{ROIC \times (WACC - g)}$

When to use it

- NOPLAT is a more sophisticated and complete form of EBIT that allows for differences in tax efficiency and effective tax rates. If the company were all equity-financed, NOPLAT would equal earnings.

- However, the calculation of NOPLAT introduces a measure of subjectivity. This makes it harder to compare to other parties' calculations of NOPLAT.

EV/NOPLAT is equivalent to a degeared PE

- The NOPLAT multiple is effectively a degeared PE and is a perfectly reasonable statistic to use provided it is measured on a consistent basis across companies. EV/NOPLAT can be used as a substitute for EV/EBIT.

EV/OpFCF

Definition: Core EV/operating free cash flow (OpFCF). ROIC is calculated using OpFCF in the numerator.

OpFCF is core EBITDA less charges for capital usage and for the effect of inflation on working capital needs. OpFCF should be measured before goodwill amortisation. A calculation of operating free cash flow is shown below.

Table 12: Components of Operating Free Cash Flow

Item	Note
Earnings before interest and taxes	Before non-core earnings (associates, investments and other)
Plus: depreciation	Per cash flow statement
Less: maintenance capital spending	Estimated annual reinvestment requirement
Less/plus: net working capital inflation	Estimated annual reinvestment requirement (working capital is current cost, so this would normally equal expected inflation in working capital items). Working capital is assumed to be at an appropriate level relative to sales; adjustment may be needed
Equals: operating free cash flow	

Source: UBS Warburg

Formula: $\dfrac{EV}{OpFCF} = \dfrac{ROIC - g}{ROIC \times (WACC - g)} \times (1 - T)$

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[9] Stewart, G.B. III, *Quest for Value*, Harper Collins (1991).

When to use it

- EV/OpFCF is a price to cash flow measure similar to EV/EBIT. OpFCF is not a true cash flow, however, as it does not include actual capital expenditure or change in working capital; it is a normalised EBIT or a smoothed cash flow.

OpFCF is a suitable basis for valuation than either EBITDA or EBIT

- OpFCF is more comparable than EBITDA and less susceptible to accounting distortions than EBIT, and is therefore a more suitable basis for valuation multiples. OpFCF does, however, add another layer of subjectivity via the calculation of maintenance capital spending and net working capital inflation.

- EV/OpFCF is preferable to EV/EBITDA for comparing companies within a sector, or for comparing companies across sectors or markets where companies have widely varying degrees of capital intensity.

Multiples using OpFCF easier to interpret than those using free cash flow

- Operating free cash flow is a smoothed measure of free cash flow to the firm, for which historical figures can be highly volatile. Because of this, multiples using OpFCF can be easier to interpret than those using free cash flow.

- This multiple cannot be used when current cash flow is negative. Use normalised OpFCF or a forward-priced multiple instead.

EV/Enterprise Free Cash Flow

Definition: Core EV/normalised after-tax core enterprise free cash flow (or FCF, also known as free cash flow to the firm). ROIC is calculated using after-tax FCF in the numerator.

Formula: $\dfrac{EV}{FCF} = \dfrac{1}{(WACC - g)}$

Enterprise Free Cash Flow

FCF is the cash available to all providers of finance

Enterprise free cash flow is the cash available to the providers of finance. FCF = debt cash flow + equity cash flow. It may be used:

- **To pay interest or repay debt**
- **To build cash balances or other investments**
- **To pay dividends or buy back shares**

Free cash flow must be after tax and all investment expenditure needed to support the future cash flow forecast.

Table 13: Enterprise Free Cash Flow Calculation

EBIT (normal operating profit)	X
Tax on normal operating profit	(X)

NOPLAT (normal operating profit less adjusted tax)	X
Depreciation and amortisation	X

Gross cash flow	**X**
Capital expenditure	(X)
Change in working capital	(X)/X
Non-cash changes in operating provisions	(X)/X

Enterprise free cash flow	**X**

Source: UBS Warburg

FCF Should Include Effective Cash Flows

Some transactions result in effective cash flows that should be included in FCF

Errors can arise if FCF only reflects strict cash movements. Some transactions have operating and financing effects but no actual cash movement; typically this would involve equal and offsetting effective operating and financing flows. The operating effect of a non-cash transaction should be included in FCF even though there is no actual cash movement. Some examples might include

- **Share option schemes**
- **Capital (finance) leases**
- **Unfunded pensions**
- **Investment where the consideration is in securities**

Thus, for example, the grant of share options to employees is a non-cash transaction. However, such a grant can be considered as two distinct cash flows:

- **An *operating* cash outflow (representing employee compensation)**
- **A *financing* cash inflow (representing its reinvestment into share options)**

While the net cash flow is zero, the transaction has a valuation impact, since only the operating cash flow is included in the valuation.

When to use it

- FCF is similar to OpFCF but is calculated using actual working capital changes, capital spending and other non-cash adjustments.

Historical FCF can be problematic in valuation because of its volatility

- Use of historic FCF can be problematic, because fluctuations in cash flow items can cause it to be highly volatile, making EV/FCF a less useful multiple.

- One underappreciated benefit of accounting is that the revenue/cost matching principle results in an allocation of costs and benefits, however imperfectly. This means that profit may be a better predictor of future cash flow than any single cash flow. Since cash flow may be more 'lumpy' (if, for example, a company has made a substantial investment, which will depress current cash flow), the user must be careful that it is representative or otherwise 'normal'.

■ Cash flow is better used – in fact is essential – in a discounted cash flow valuation because multi-period cash flow is used instead of a point estimate. We prefer the use of a smoothed cash flow figure such as OpFCF, provided the assumptions underlying the calculation are sensible.

EV/Invested Capital

Definition: core EV/invested capital.

Items included in EV and capital must be consistent

Invested capital, measured from the asset side of the balance sheet, is the sum of net tangible and intangible assets and net working capital. Invested capital excludes non-core investments and other assets, and to ensure comparability these must also be excluded from enterprise value.

Alternative calculations are possible:

■ **Total capital employed:** Total capital employed is invested capital plus investments and associates. Return on total capital employed differs from return on invested capital in that the numerator for return on total capital employed includes income from non-core operating investments and other assets. To ensure comparability, enterprise value must also include the value of these assets.

■ **Adjusted capital employed:** This is total capital employed adjusted to bring book capital closer to economic capital. These adjustments (to assets; from Stern, Stewart) include adding back accumulated goodwill amortisation, LIFO reserve and cumulative write-offs of special items, among others.

■ **Replacement capital employed:** Capital employed at replacement value, intended to better approximate the cost of replacing the capital base at current prices and therefore the return on assets at market value. This can be roughly approximated by adding back accumulated depreciation in addition to making the other adjustments noted above.

Formula: $\dfrac{EV}{\text{Invested capital}} = \left(\dfrac{ROIC - g}{ROIC \times (WACC - g)} \times ROIC \right) \text{or} \dfrac{ROIC - g}{WACC - g}$

When to use it

Invested capital, unlike book value, excludes non-operating cash

■ The enterprise equivalent of price to book value, EV/invested capital is equal to EV/NOPLAT × ROIC (whereas price to book is equal to PE × ROE).

■ Note that invested capital measures only *operating* assets whereas net book value includes the value of the firm's cash holdings. Net income includes return on cash, but NOPLAT does not. NOPLAT is in this respect a better indication of core profitability than net income.

■ This is a useful measure for sectors where tangible assets are key. Because of its close linkage to return on capital, it is useful to view this measure together with return on capital.

■ Items included in invested capital or total capital employed must be consistent with items included in enterprise value.

EV/Capacity Measure

Definition: Core EV/units of capacity (such as tonnes of cement capacity) or another revenue-generating unit (such as subscribers).

Formula: $\dfrac{EV}{Unit} = \dfrac{ROIC - g}{ROIC \times (WACC - g)} \times \dfrac{NOPLAT}{Unit}$

When to use it

EV multiples can be used to compare crossborder implied market values of revenue-generating units

■ Enterprise value multiples are often used to compare the implied value of productive assets (eg tonnes of cement capacity, fixed telephone lines) to enable comparison across firms operating within the same industry.

■ This value can be compared to the cost of replacing the asset on a gross basis or after factoring in depreciation to adjust for the remaining life of the asset in use.

■ A common variant is to look at the implied market value of each revenue-generating unit such as subscribers. Thus the value per, say, customer that the market ascribes to the firm can then be compared to the amount of revenue or profit the customer generates.

■ These measures tell us nothing about the relative underlying profitability of the assets nor do they give any other clues about the drivers behind differences in value. They do not tell us *why* the (unit of capacity, customer, etc) is valued as it is, nor what the appropriate value should be.

■ Ultimately, the market value of a firm is determined not by the amount of capacity it has but by the economic value it creates. There may be wide relative differences in EV per widget between companies – and these may be deserved.

Differences in per-unit profitability will determine differences in valuation

■ The way to gauge these differences is to estimate a fair EV per unit multiple by determining the sustainable NOPLAT per unit.

■ Consider, for example, a cement firm with a return on capital of 12% growing at 3% pa. It if earns US$10 per tonne in operating profit than an investor with a required return on capital of 10% will be willing to pay up to US$107 per tonne of capacity:

$$\frac{EV}{Tonne} = \frac{.12 - .03}{.12(.10 - .03)} \times US\$10 = 10.7 \times US\$10 = US\$107 \text{ per tonne}$$

Section 5   Equity Multiples

What Are Equity Multiples?

An equity multiple, as the name suggests, is the expression of the market value of equityholders' stake in an enterprise, relative to a key statistic relating to that value.

Equity multiples reflect residual claims

As we have noted earlier, the statistic must relate to the value being measured. Since shareholders are subordinate to all other claimants of the cash flow and assets of a business, any statistic used in an equity multiple must be one that represents residual profit, cash flow, assets or another residual measure. All senior claims must have been deducted first.

Equity Multiples

Price/Earnings

Definition: Current market capitalisation/net income attributable to common shareholders or alternatively, price per share/attributable earnings per share.

Formula: $\dfrac{\text{Market cap}}{\text{Net income}} = \dfrac{\text{ROE - g}}{\text{ROE x (COE - g)}}$

When to use it

■ The PE ratio is the most commonly used equity multiple (it was first introduced in the 1930s). Data availability is one reason why: earnings, both historical and forecast, are easily available.

Use earnings before exceptional items and goodwill amortisation

■ Earnings are, however, subject to different accounting policies. We recommend using adjusted earnings in calculating the ratio; UBS Warburg defines 'adjusted' earnings as earnings before exceptional items and goodwill amortisation.

■ Price to earnings multiples cannot be used when earnings are negative. As an alternative, use normalised earnings or calculate a forward-priced multiple (see page 10).

■ Use this multiple when earnings are representative of future earnings and the trend in those earnings. For example, if there are significant write-offs in a year, earnings are unlikely to be representative. Use pre-exceptional or pre-extraordinary earnings instead.

■ As far as possible, use for comparisons of companies, sectors and markets that have similar accounting policies. Alternatives are to adjust earnings to a common basis across sectors and markets; or to use earnings before the most material distorting items such as depreciation and goodwill amortisation.

Gearing will affect the PE multiple

■ Different capital structures will affect multiples because of the gearing effect on earnings; two companies with identical operating profit may have widely different earnings. One alternative approach is to use NOPLAT or tax-adjusted earnings before interest.

- An important weakness of the PE ratio is that it does not explicitly take into account balance sheet risk (although it is implicitly incorporated into the underlying cost of equity[10]).

- Furthermore, the PE ratio does not explicitly take into account the amount of investment required to support future growth. You can, however, take this into account indirectly (see *The Effect of Growth on Value,* page 18).

Price/Cash Earnings

Definition: Market capitalisation/net income attributable to common shareholders plus depreciation, amortisation and changes in non-cash provisions.

Formula: $\dfrac{\text{Market cap}}{\text{Cash earnings}} = \dfrac{\text{ROE - g}}{\text{ROE} \times (\text{COE - g})} \times \dfrac{\text{Earnings}}{\text{Cash earnings}}$

When to use it

- Cash earnings are usually defined as simply net profit plus depreciation & amortisation. This is a rough and frequently misleading measure of cash flow, as it ignores the many other factors that affect cash flow, including changes in net debt, changes in working capital and so forth.

- This problem is magnified when using prospective cash earnings, because of the additional complications involved in forecasting changes in net debt; the estimated capital structure can have a large impact on forecast earnings. Furthermore, historical cash flow can be a very volatile.

- As a result, price to cash earnings is difficult to use as a base valuation measure.

Best used as a supplement to other measures

- Price to cash earnings should be used as a supplement to other measures, particularly in conjunction with multiples that are unadjusted for accounting differences between comparables, where those differences are material.

Price/Book Value

Definition: Market capitalisation/book value (alternatively price per share/book value per share).

Formula: $\dfrac{\text{Market cap}}{\text{Book value}} = \left(\dfrac{\text{ROE - g}}{\text{ROE} \times (\text{COE - g})} \times \text{ROE} \right) \text{ or } \dfrac{\text{ROE - g}}{\text{COE - g}}$

When to use it

A useful measure where tangible assets are key

- Price to book value is a useful measure where tangible assets are the source of value generation. Because of its close linkage to return on equity (price to book is PE multiplied by ROE), it is useful to view price to book value together with ROE.

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[10] The cost of equity is related to the degree of financial leverage through the equity beta:

$$\beta \text{equity} = \beta \text{asset} + \dfrac{D}{E} \left(\beta \text{asset} - \beta \text{debt} \right)$$

- Using this measure with industrial companies requires care because net assets are based on historical cost book value, an unreliable indicator of economic value.

- Book values are not directly comparable where accounting policies cause them to deviate markedly from economic substance, nor are they directly comparable among companies with differing accounting policies. For example, book value would not be comparable between a company that revalues its assets (permitted under international accounting standards) and one that does not (revaluation is not permitted under US GAAP).

Book value should be adjusted to remove accounting distortions

- Ideally, book value should be adjusted for these differences. Some adjustments that might be made include:

  — Stripping out revaluation surpluses on the basis that it is more practical than attempting to revalue all comparables

  — Restoring excess depreciation (or deducting inadequate depreciation)

  — Restoring accumulated goodwill amortisation and written-off goodwill

  — Restoring the LIFO reserve, etc

- This ratio is most widely used in valuing financials, especially banks, which squeeze a small spread from a large base of assets (loans) and multiply that spread by utilising high levels of leverage (deposits). Return on equity is therefore an important criteria in valuing bank stocks.

Price/Earnings Growth

Definition: The 'PEG' ratio is the prospective PE divided by average forecast earnings growth. It is most widely used to value growth companies where it is assumed that growth opportunities arise from reinvesting at a premium rate of return or from efficiency gains.[11]

Formula: $\dfrac{PE}{Growth} = \dfrac{ROE - g}{100 \times g \ \times ROE \times (COE - g)}$

When to use it

The PEG is based on the assumption that a PE ratio is positively linearly correlated to the expected growth rate in earnings, ie PEG is constant. Unfortunately, however, there is no linear relationship between the PE ratio and earnings growth. Nevertheless, PEGs can be used for relative valuation in certain circumstances:

PEGs most suitable for valuing high-growth companies…

- Notably, at higher rates of growth PEG ratios are stable and less sensitive to changes in growth than PE ratios (see chart below), which makes PEG ratios more suitable for valuing high-growth companies – for which they are typically

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[11] For a more detailed discussion of PEG ratios, see our report *Price Earnings Growth: A PEG for Your Valuations*, November 1997.

used. The range of growth rates for which PEG valuations are suitable is also larger than that for PE ratios.

Chart 18: Variation of PEG with Growth and ROE
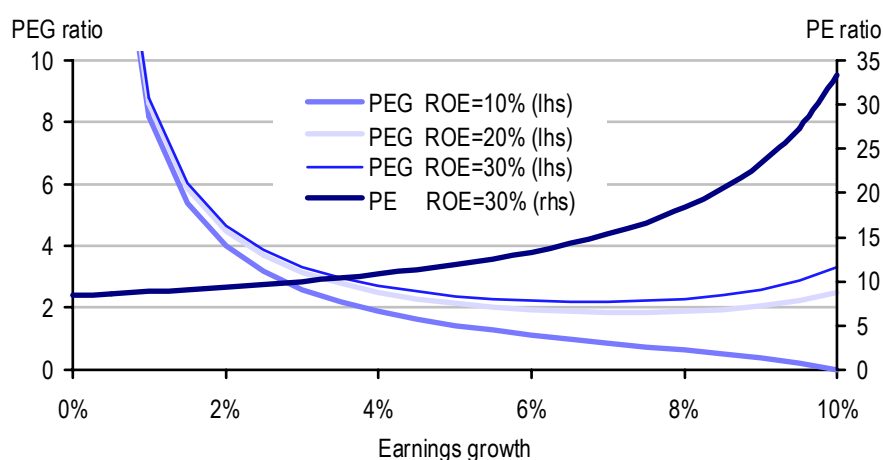
Source: UBS Warburg

Note: Based on a COE of 12%

…particularly within the same sector

■ This particularly applies to companies within sectors, making it more suitable for intrasector PEG ratios. It is less suitable for comparisons of companies with sectors, companies with markets, sectors with markets and across sectors.

■ PEG ratios are most useful for comparisons of companies with value-adding growth as opposed to inflationary growth.

■ Relative PEG valuations are best suited to companies with returns and growth rates close to the market.

■ As growth rates decline, variation in PEG ratios increases, making them less useful. (For PE ratios, the opposite is true; variation in the PE rises with the growth rate.)

One can also calculate enterprise value multiples to enterprise earnings growth, although this is uncommon.

Dividend Yield

Definition: Forecast dividend/current market capitalisation.

■ Dividends are the ultimate cash flow that the investor receives. The dividend yield is the market's rate of capitalisation of cash paid out to investors, and can be compared to the market's required yield to determine how a stock should be priced.

Use the 'dividend multiple' or (1/market required yield)

■ Share value can be obtained by multiplying forecast dividends by the 'dividend multiple' (ie, 1/market's required dividend yield).

■ Corporate financiers frequently use market dividend yield as a benchmark for capitalising dividends in order to estimate the appropriate value for a stock in an initial public offering.

When to use it

Useful for estimating a floor value for a stock

■ Dividends are the ultimate 'in pocket' cash flow to investors. They are useful for estimating a floor value for a stock, since both dividends and market yields can be observed.

But dividend yields are not comparable across different tax regimes

■ Keep in mind, however, that actual dividends are subject to corporate dividend policy as well as withholding and franking tax policies. Thus nominal dividend yields are not comparable across different tax jurisdictions. When valuing a stock, the sustainability of the dividend cash flow must also be considered.

Appendix: Derivation of Target Multiple Formulas

Valuation is a function of value drivers – growth, return on capital, investor required return, etc. The following formulas show how value drivers can be used in a 2-stage model to derive target enterprise value multiples (for equity multiples, use ROE instead of ROIC, COE instead of WACC, equity FCF instead of FCF, and earnings instead of NOPLAT). The target multiple calculator model is available on our website: www.ubswarburg.com/research/gvg.

EV/Sales Multiple

$$\frac{EV}{Sales} = \frac{ROIC - g}{ROIC \times (WACC - g)} \times \left(1 - \frac{(1+g)^n}{(1+WACC)^n}\right) + \frac{1}{WACC} \times \frac{(1+g)^n}{(1+WACC)^n} \times (1-T) \times M$$

EV/EBITDA Multiple

$$\frac{EV}{EBITDA} = \frac{ROIC - g}{ROIC \times (WACC - g)} \times \left(1 - \frac{(1+g)^n}{(1+WACC)^n}\right) + \frac{1}{WACC} \times \frac{(1+g)^n}{(1+WACC)^n} \times (1-T) \times (1-D)$$

EV/EBIT Multiple

$$\frac{EV}{EBIT} = \frac{ROIC - g}{ROIC \times (WACC - g)} \times \left(1 - \frac{(1+g)^n}{(1+WACC)^n}\right) + \frac{1}{WACC} \times \frac{(1+g)^n}{(1+WACC)^n} \times (1-T)$$

EV/NOPLAT Multiple

$$\frac{EV}{NOPLAT} = \frac{ROIC - g}{ROIC \times (WACC - g)} \times \left(1 - \frac{(1+g)^n}{(1+WACC)^n}\right) + \frac{1}{WACC} \times \frac{(1+g)^n}{(1+WACC)^n}$$

■ ■ ■ ■ ■ ■ ■ ■ ■ ■ ■ ■ ■ ■ ■ ■

The Proof

Each formula is based upon a standard DCF model which has a constant growth rate in free cash flow of g% for a period of 'n' years and a terminal value at the end of that period.

The link between NOPLAT, FCF and the reinvestment rate (r):

$$FCF = NOPLAT \times (1 - r)$$ 1

The link between growth (g), post-tax return on invested capital (ROIC) and reinvestment rate (r):

$$g = ROIC \times r \quad \text{or} \quad r = g / ROIC$$ 2

The value (EV) of a perpetuity of cash flow (FCF) growing at a constant rate (g) and discounted at the weighted average cost of capital (WACC):

$$EV = \frac{FCF_1}{(WACC - g)}$$ 3

Formula 3 above can be modified to apply to a growing annuity of cash flows which stops after n years:

$$EV = \frac{FCF_1}{(WACC - g)} \times \left[1 - \frac{(1+g)^n}{(1+WACC)^n} \right] \qquad \text{..... 4}$$

Substituting equations 1 and 2 into 3 gives:

$$EV = \frac{NOPLAT_1 \times \left(1 - \dfrac{g}{ROIC} \right)}{(WACC - g)} \qquad \text{..... 5}$$

and rearranging:

$$EV = \frac{NOPLAT_1 \times (ROIC - g)}{ROIC \times (WACC - g)} \qquad \text{..... 6}$$

In calculating a terminal value at the end of the growth period, it is assumed that ROIC equals WACC (ie conditions of zero value-adding growth). Therefore equation 6 becomes:

$$EV = \frac{NOPLAT_1}{WACC} \qquad \text{..... 7}$$

Formulae 1 and 2 can also be substituted into equation 4. Following rearrangement this becomes:

$$EV = \frac{NOPLAT_1 \times (ROIC - g)}{ROIC \times (WACC - g)} \times \left[1 - \frac{(1+g)^n}{(1+WACC)^n} \right] \qquad \text{..... 8}$$

Putting it Together

Equation 8 represents the value of cash flows in the growth period. Equation 7 can be used to value subsequent cash flows, although $NOPLAT_1$ needs to be replaced by $NOPLAT_{(n+1)}$ and this 'terminal value' must be discounted to a present value. The overall value then becomes:

$$EV = \frac{NOPLAT_1 \times (ROIC - g)}{ROIC \times (WACC - g)} \times \left[1 - \frac{(1+g)^n}{(1+WACC)^n} \right] + \frac{NOPLAT_1 \times (1+g)^n}{WACC} \times \frac{1}{(1+WACC)^n} \qquad \text{..... 9}$$

Dividing by $NOPLAT_1$ gives the formula for the EV/NOPLAT multiple:

$$\frac{EV}{NOPLAT_1} = \frac{(ROIC - g)}{ROIC \times (WACC - g)} \times \left[1 - \frac{(1+g)^n}{(1+WACC)^n} \right] + \frac{1}{WACC} \times \frac{(1+g)^n}{(1+WACC)^n} \qquad \text{..... 10}$$

If the effective rate of corporation tax is T%, depreciation as a percentage of EBITDA is D% and the EBIT margin is M%, then the following links can be derived:

$$\text{Sales} \times M = \text{EBIT} \qquad\qquad ..... 11$$

$$\text{EBIT} \times (1 - T) = \text{NOPLAT} \qquad\qquad ..... 12$$

$$\text{EBITDA} \times (1 - D) = \text{EBIT} \qquad\qquad ..... 13$$

Substituting equation 12 into equation 10 gives the formula for the EV/EBIT multiple:

$$\frac{EV}{EBIT} = \frac{ROIC - g}{ROIC \times (WACC - g)} \times \left(1 - \frac{(1+g)^n}{(1+WACC)^n}\right) + \frac{1}{WACC} \times \frac{(1+g)^n}{(1+WACC)^n} \times (1 - T) \qquad\qquad ..... 14$$

Substituting equations 13 into equation 14 gives the formula for the EV/EBITDA multiple:

$$\frac{EV}{EBITDA} = \frac{ROIC - g}{ROIC \times (WACC - g)} \times \left(1 - \frac{(1+g)^n}{(1+WACC)^n}\right) + \frac{1}{WACC} \times \frac{(1+g)^n}{(1+WACC)^n} \times (1 - T) \times (1 - D) \qquad\qquad ..... 15$$

Substituting equations 11 into equation 14 gives the formula for the EV/sales multiple:

$$\frac{EV}{Sales} = \frac{ROIC - g}{ROIC \times (WACC - g)} \times \left(1 - \frac{(1+g)^n}{(1+WACC)^n}\right) + \frac{1}{WACC} \times \frac{(1+g)^n}{(1+WACC)^n} \times (1 - T) \times M \qquad\qquad ..... 16$$

Note: In using these formula there is a problem where WACC is exactly the same as g as this produces a 'divide by zero' error. However, the formula works for any values of WACC and g where these are different even if they are very close in value. To avoid the 'divide by zero' problem the formula actually used in the GVG target multiple model have a very small number (0.0000001) added to the input value of g. This has no material effect on the multiples produced but does virtually ensure that the 'divide by zero' error will not arise, even if the user happens to choose the same values for WACC and g.