Economic Value Added (EVA™)

EVA™: Use and abuse

EVA™ is increasingly used for corporate and management appraisal and evaluation. The approach has gained so much popularity that it is now influencing the style, content and focus of sell-side research. While EVA™ can provide some useful insights into companies, as can many other techniques, it has shortcomings that should not be overlooked.

- **EVA™ is based on a very simple concept; if a company earns a return that is greater than expected, then value has been added.** In each year, the EVA™ is the difference between the actual and expected return (return spread) multiplied by the invested capital. The return spread and EVA™ are used as performance indicators. In addition, the total value added is the sum of all future annual EVA™s (in present value terms) and if this is added to the invested capital, it gives the total value of the company.

- **In practice, the returns earned and the invested capital are based on accounting data where as the return demanded by investors is based on market (or economic) data. Consequently, EVA™ measures the difference between accounting and economic data and can, therefore, be influenced by different accounting practices and by management 'adjustments' to accounting information.** Management may be incentivised to do this given that reward structures may be linked to EVA™. In an attempt to address these problems, a multitude of adjustments need to be made to the accounting data but these are often judgmental and restricted by the level of accounting disclosure. **Furthermore, accounting and economic data will deviate because of 'macro' factors** that are not adjusted for in an EVA™ analysis: investment profile, exchange rates and inflation. For example, rising investment depresses EVA™ while rising inflation has an enhancing effect.

- **An EVA™ valuation suffers less from the problems affecting annual EVA™.** Accounting anomalies tend to cancel out: overstated invested capital leads to understated EVA™ and vice versa and macro changes usually reverse if the forecast period is long enough. However, an EVA™ valuation is subject to the same forecasting difficulties associated with a DCF, to which it is mathematically identical, the same problems estimating the cost of capital but greater problems estimating terminal value. Moreover, the standard approach to EVA™ valuations systematically understates value.

- **Given the multitude of micro and macro factors that affect EVA™, comparisons between time periods, companies and managements must be undertaken with care,** and considerable caution should be exercised in drawing conclusions about management and corporate performance. These factors, together with the forecasting difficulties, mean that EVA™ valuations should also be interpreted with great care. Consequently, while EVA™ can provide some useful insights into companies, as can many other techniques, it has shortcomings that should not be overlooked.

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Part 1: Practical guide

Overview of EVA (and MVA)

Simple in concept

Simple concept: if achieved return is greater than required, value has been added

Economic value added (EVA) is based on a very simple concept; if any investment achieves a return that is more than the investor requires then value has been added to the investment. The magnitude of the added value is the difference between what is achieved and what is required. For example, say a company can raise capital at 11% to fund investment in a new production plant but actually achieves a return of 12% from the plant, then value would have been added. The magnitude of the value added in each year is the product of the premium return, 1% (12% - 11%), and the invested capital (invested capital is simply capital employed with some adjustments). Thus, EVA is simply expressed as follows:

EVA™ = (actual return - required return) × invested capital

Economic value added = (actual return - required return) × invested capital.

The returns delivered by a company vary each year and so too does EVA; therefore, it is calculated on an annual basis.

The development of the concept of economic value added (EVA) is usually attributed to Stern Stewart & Co in the early 1990s although, many years earlier, Rappaport and others talked of a shareholder value concept that was similar.

EVA as a management tool

Management should focus on improving the market premium (MVA) over invested capital

Stern Stewart & Co recognised that management's goal should be to maximise the market value of company but also that this could not be done in isolation from the capital invested in the company. Thus, management should aim to maximise the difference between the market value and the invested capital (debt + equity); this is known as market value added or MVA. However, higher MVA is the result of management action and not a tool in itself. What was needed was a tool that management could use to assess whether a particular action should, or should not, be taken. Stern Stewart saw EVA as the appropriate tool.

Maximising EVA will maximise MV; thus EVA aligns shareholder and management interests

EVA was promoted as a management tool that aligned the interests of management with those of shareholders; management could be incentivised/rewarded for maximising EVA and, in turn, this would be to the benefit of shareholders in that it should also maximise MVA.

Management reward can be linked to EVA and this is thought better than linking to EPS growth

In comparison to traditional methods of rewarding management, such as earnings growth, EVA does not rely on a stock market price and was therefore proposed as a tool that could be used effectively across the operating divisions of a company as well as at the corporate level to improve performance and evaluate and reward management. Moreover, given the simplicity of EVA, it was seen as a concept that could penetrate deep into an organisation and certainly beyond the reach of the traditional measures. In this respect, EVA has appealed to many management teams and has been held up as offering better metric than traditional approaches, such as earnings growth.

Valuing companies using EVA

Total economic value added is the sum of all future EVAs (in present value terms)

As EVA is the value added each year to the invested capital, if all future EVAs are added together, this will give the total future value added to the invested capital. Thus, if the total EVA is added to the invested capital, the result will be the fair value for the project, or for the company if the analysis is undertaken on a company-wide basis. Thus, we can write:

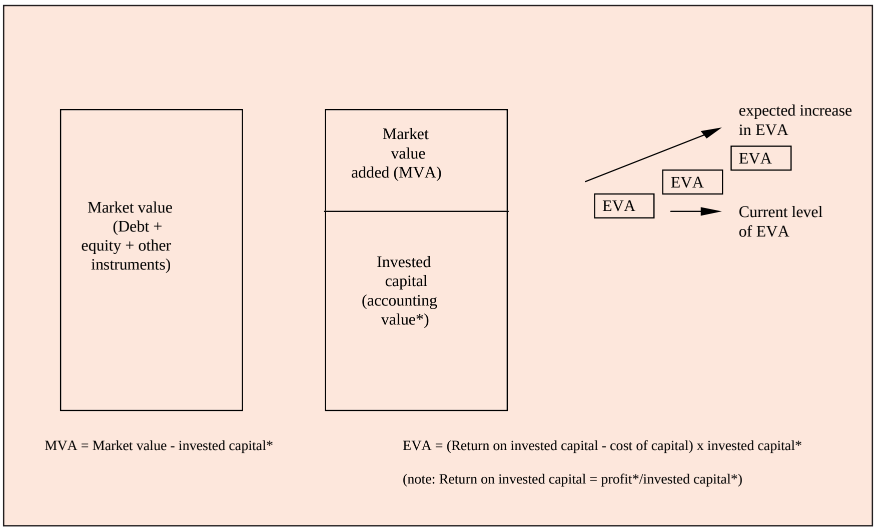
Fair value = total value added + invested capital

Fair value = invested capital + sum of all future annual EVAs

To actually sum all the annual EVAs, they need to be brought onto a comparable basis by discounting to the same year, that is to say the total EVA is the cumulative present value of all future EVAs.

The relationship between annual EVA and MVA is shown schematically in Chart 1. A full derivation of the relationship is provided in Part 2.

Chart 1: the relationship between MVA and EVA



* Adjusted accounting data.

For a fairly valued company, total EVA = MVA

Clearly, when the market fairly values a company, it takes into account all future expected annual EVAs and these will equal the MVA:

MVA = sum of all future EVAs = total EVA

Clearly, if the MVA does not equal the sum of all future EVAs then the company is mis-valued (or the analyst has mis-forecast!).

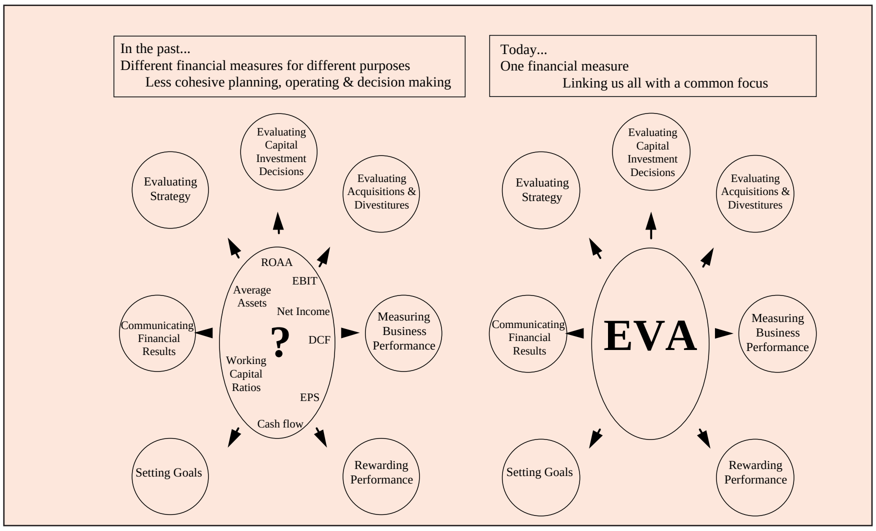
The popularity of EVA

EVA is popular because it is a tool that incentivises management to do the best for shareholders...

...and shareholders can use it to measure management performance and to value

EVA is marketed as a tool that will align management and shareholders' interests, that can be used as the basis of management reward, that can be used by management to assess the value impact of decisions and therefore lead to better decisions and that can be used for project appraisal or complete corporate valuations. Thus, EVA appears to be a panacea for all corporate problems; as an example, Chart 2 indicates the importance placed on EVA by some companies.

Chart 2: EVA appears to be a panacea for all corporate problems



Source: Perkins Group Ltd. 1997.

Not surprisingly, the idea that EVA could be used to measure management performance and to value companies has led many analysts and fund managers to embrace the concept, often to the exclusion of other techniques.

A reality check

In practice EVA has shortcomings, for example...

Chart 3 plots annual EVA (1995/6) for the top companies in the UK market against their MVA (November 1996) using data provided by Stern Stewart (each point represents a different company). This chart indicates that while the relationship between EVA and MVA is simple in concept, it is complex in practice. In fact, there is not a discernible relationship between EVA for a single year and MVA.

...the vast majority of companies have positive EVA - but not all companies add value

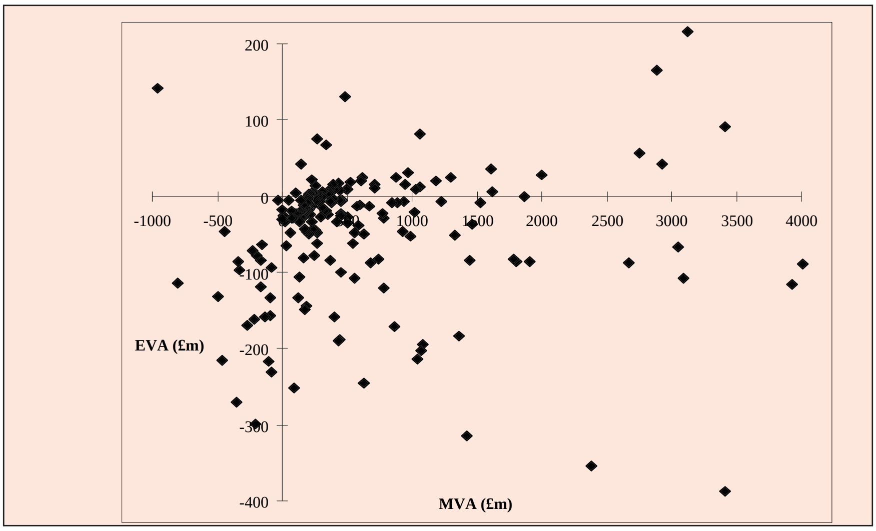
Another noticeable feature of Chart 3 is that virtually all companies have positive MVA. Given that MVA is, for a fairly valued company, equivalent to the sum of all future EVAs, the chart appears to suggest that either most managements are adding value or that most companies are overvalued. Neither one of these is a reasonable proposition; management, on average, neither destroys nor creates value and in an efficient market, the majority of companies will trade at fair value. This observation may, in itself, convince many analysts and fund managers that the concept of EVA measuring ‘value added’ is in error and that it would be wrong to base reward structures on annual EVA.

The problem lies in the basis of the calculation of return on invested capital and cost of capital

In fact, the concept is not in error; it is the calculation and comparison of the variables where the problem lies. Return on invested capital is an accounting-based measure and suffers from all the problems of such measures: manipulable by management, impacted by accounting conventions and changes therein and impacted by macro variables such as inflation (balance sheet assets understate real asset value), currencies (changing currency rates can affect profits and asset values), etc. In contrast, the required return (taken as the cost of capital) is based on the return an investor demands on the investment in the company's equity and debt; in other words, cash return on market value. Thus, rather than measuring 'value added' EVA, as it is generally calculated, measures the differences between the basis of the calculation of return on invested capital and the cost of capital.

EVA simply measures this difference and not 'value added' by management

Chart 3: Annual EVA and MVA (UK market)



Source: Stern Stewart data carried by the Sunday Times.

As a partial solution, many adjustments, some subjective, can be made to accounting data...

But what can be done to remove this problem? In reality, the problem cannot be removed; it can only be reduced. The key is to bring the basis of calculating return on invested capital as close as possible to that of the cost of capital. Stern Stewart proposes that this is achieved by applying many, and often subjective, adjustments to capital values and profits. However, it is difficult and rarely achieved. In fact, Chart 3 bears out this statement; Stern Stewart & Co were unable to achieve a calculated capital base that resulted in roughly equal numbers of companies with positive and negative MVA.

...but it is only a partial solution

Read on for more...

The following sections provide a more detailed critique of EVA.

The chart does not present the full data set, as some points lie outside the scale that we have chosen. Including these data points will not change the conclusions but would obscure some of the detail in the chart.

Critique of EVA

What influences EVA?

EVA is defined as the difference between the return on invested capital[1] and the cost of capital (the return spread) multiplied by the invested capital, ie:

EVA = (return on invested capital - cost of capital) × invested capital

EVA is influenced by the level of return on invested capital, cost of capital and capital value and...

Thus, it stands to reason that the principal factors affecting EVA will be the calculation and resulting level of return on invested capital (in turn dependent upon NOPAT and invested capital[1]) and cost of capital (WACC).

Each of the accounting data items are, of course, subject to the accounting policies of the company and the WACC is affected by bond rates, market returns, risks faced by the company and the capital structure of the company.

Assessing the WACC is by no means an easy process and it is quite likely that material differences will emerge between different analysts examining the same company.

Quite apart from the specific accounting variables that influence EVA, there are several factors that will have a more general influence:

Investment (or asset age)

...rate of investment: increased investment reduces EVA and vice versa...

As a company increases investment to grow the business, so EVA will tend to reduce, and vice versa. This is because accounting returns on undepreciated assets (newer assets) are lower than on depreciated assets (older assets) and because profits generally lag investment which results in depressed returns.

Inflation

...inflation: rising inflation increases EVA and vice versa...

High inflation tends to increase EVA. Rising inflation will depress the current price of historical assets and therefore improve accounting returns. At a recent conference, a representative of Stern Stewart & Co. stated that it had not found any evidence of the inflation effect. However, the effects of inflation are difficult to measure as rising price inflation in a particular product tends to lead to increased investment and therefore the effects tend to cancel out. As an example, oil companies tend to lift investment as oil prices rise and therefore the effects of rising price inflation (increasing EVA) are offset by the effect of rising investment (reducing EVA).

[1] In the previous section we refered to return on invested capital and invested capital. These are very similar to return on capial employed and capital employed respectively. However the return on invested capital uses operating profit stated after tax (NOPAT or net operating profit after tax) and capital employed stated after several adjustments to give invested capital.

Exchange rates

...exchange rates: changing exchange rates play havoc on EVA

Exchange rates can affect returns in many ways. For example, if assets are priced in dollars, say commercial aircraft, but the purchasing company reports in another currency, the asset cost will change over time as a result of exchange rates. This can be further complicated if the product is priced in a currency that is different from the currency in which profits are reported. For example, in Europe, steel is priced in DM; consequently British Steel©, with assets predominantly located in the UK but with large non-UK earnings, will suffer falling returns if the DM weakens against sterling and vice versa.

What influences EVA valuation?

EVA valuation is the sum of the invested capital and all future EVAs (in present value terms)

The EVA value of the company is simply the present value of all future EVAs added to the invested capital:

Fair value = invested capital + sum of all future annual EVAs

To actually sum all the annual EVAs, they need to be brought onto a comparable basis by discounting to the same year. The discount rate used is the cost of capital.

EVA valuation is less affected by the problems that plague EVA because...

Thus, while it may seem reasonable to assume that, as for EVA, the principal factors affecting EVA valuation will be the value of return on invested capital, cost of capital and value of invested capital, this is not the case.

To understand this phenomenon, it is useful to restate the definition of EVA (by multiplying the return on invested capital by the invested capital and the cost of capital by the invested capital):

EVA = net operating profit after tax - cost of capital × invested capital

...overstated invested capital results in understated EVA, and vice versa; therefore, ...

...most accounting and macro factors cancel out...

...leaving forecast errors and errors in the discount rate as the only influence

Clearly, for a given net operating profit after tax (NOPAT), an over-estimate of the invested capital will result in an underestimate of annual EVAs (see above equation), and vice versa. However, when the invested capital is summed with the EVA, an over-estimate in one balances an understatement of the other and, thus, errors cancel out. As a result, EVA valuations are only subject to forecast errors in NOPAT and errors in the cost of capital. Unfortunately, forecast errors can have a very material effect on the valuation. It is important to bear in mind that while the analyst is often concerned about the accuracy of forecasts over the explicit forecast period, value beyond the forecast period (terminal value) often accounts for 50% or more of the total value and is therefore a significant component. In addition to the difficulties of forecasting accurately, estimating WACC is also very difficult.

Most EVA valuations break down because operating profit forecasts are poor, terminal value calculations are inappropriate and discount rates are not calculated correctly.

[1]In the previous section we refered to return on invested capital and invested capital. These are very similar to return on capial employed and capital employed respectively. However the return on invested capital uses operating profit stated after tax (NOPAT or net operating profit after tax) and capital employed stated after several adjustments to give invested capital.

Where should EVA be used?

Be careful using EVA and EVA valuations where...

...operating profits are cyclical or suffer dislocations...

...capital expenditure changes significantly...

...asset values are low or where significant intangibles exist

EVA and EVA valuation is applicable to any company. However, it is difficult to use where operating profits are cyclical or suffer from dislocations or appear to grow at a high rate for a long period. These factors affect the reliability of forecasts or of the cost of capital calculations. Moreover, the approach may give misleading results where capital expenditure is changing rapidly from historical levels, where price inflation is high or where several different currencies influence the company. These factors influence the value of invested capital in relation to the profits and lead to changes in rates of return. Finally, the results of an EVA analysis for companies that do not have large asset values (service companies) or have significant intangible assets (branded goods companies or highly acquisitive companies) should be treated with extreme caution. The results should also be treated with caution where the accounts of a company are opaque.

EVA and EVA valuations are most suited to stable companies with significant asset backing with low asset price inflation

The easiest companies/industries to analyse using an EVA analysis are those with stable, forecastable profits, high fixed asset values, stable capital expenditure, risks that are easily defined, good accounting disclosure, and that operate in low inflation countries.

How should EVA be used?

EVA is used for...

EVA is used in two ways:

...performance assessment and...

- Assessing, comparing and contrasting management and corporate performance.

...valuation

- Valuation.

Taking each of these in turn:

Performance assessment using EVA

Performance is assessed by...

In assessing management or corporate performance, EVA is used in two ways:

- Absolute level of annual EVA.
- Change in EVA year-on-year (or ΔEVA).

...comparing EVA to historical levels or examining trends in forecast EVA...

As might be expected, higher EVAs are better than lower EVAs and therefore trends in forecast EVA, or even current EVA, are usually compared with historical data. For comparisons between companies or against market data, EVA is of no use as it is affected by size (invested capital) and consequently comparisons are generally made on the basis of return spread (return on invested capital less cost of capital).

...comparing changes in EVA to historical levels or examining trends

Often, change in EVA (referred to as ΔEVA) is viewed as a better performance indicator as increasing ΔEVA indicates increasing rate of value added and vice versa. Thus, comparisons of current or forecast ΔEVA are usually made with historical trends. As for EVA, comparisons between companies or with markets are not really possible as ΔEVA is affected by size (invested capital) and consequently comparisons are generally made on the basis of return spreads.

EVA is ill suited to inter-company or inter-market comparisons

Thus, EVA and ΔEVA are used for comparing performance of a single company over time and not for comparing performance across companies or markets. Cross-company comparisons are generally undertaken by comparing return spreads. For cross-border comparisons, returns spreads are usually used although they will be affected by different macro factors.

Of course, the micro and macro factors that influence EVA need to be taken into consideration when drawing conclusions on management performance from an EVA-based analysis.

Valuation based on EVA

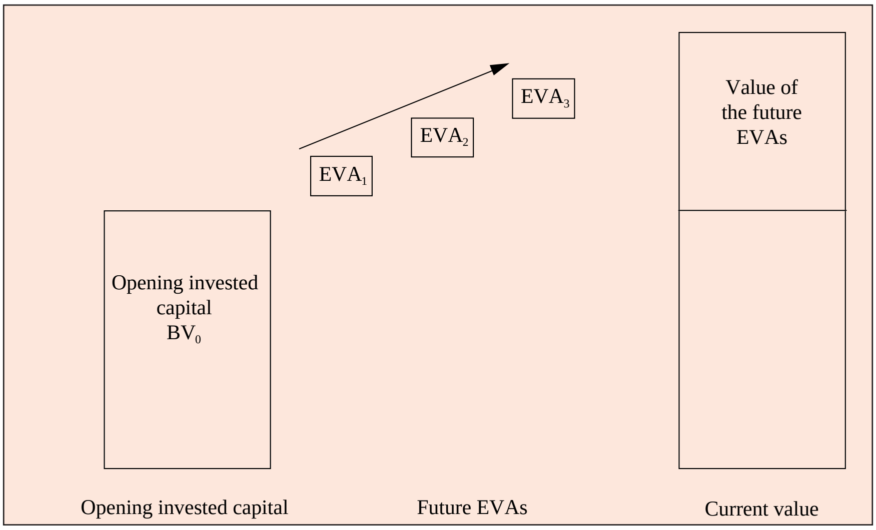
EVA valuation is undertaken in two ways:

The second aspect of EVA, that of using the approach to value a company, is of far more importance to us. As a valuation tool, EVA valuations always give an absolute value and therefore the issue of comparators does not exist as it does with many other techniques. There are two common approaches to an EVA valuation. The first uses forecasts of annual EVAs while the second uses forecasts of the year on year difference in EVAs.

First by adding the cumulative present value of forecast EVAs to current invested capital

The approach using annual EVAs requires the cumulative present value of the annual EVAs to be calculated over the explicit forecast period, and a terminal value to be calculated at the end of the explicit forecast period. These two components are added to the opening value of invested capital to give the total value of the company; this is illustrated in Chart 4 and described more fully in the next section, *UBS approach to EVA,* and Part 2 of this report.

Chart 4: Schematic of an EVA valuation



Note: terminal value is not illustrated on this schematic.

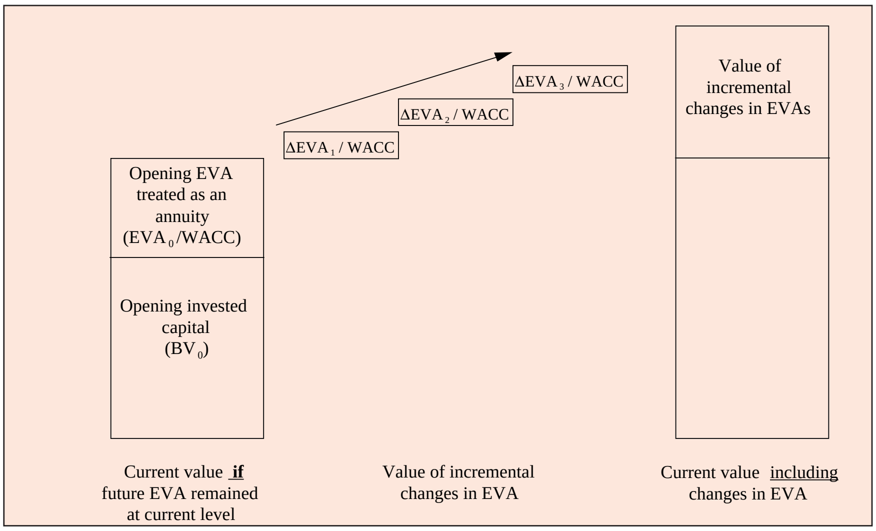
Second, by adding the cumulative present value of EVA differences with each difference treated as an anuity...

...to the current invested capital...

...and the current value of EVA

The approach using differences in annual EVA requires that each EVA difference is treated as an annuity, and the cumulative present value of these annuities is added to the last actual EVA, also treated as an annuity, and the value of invested capital to give the total value of the company. This approach is illustrated in Chart 5 and is described more fully in the next section, *UBS approach to EVA,* and in Part 2 of this report. One often stated advantage of this approach is that a terminal value does not need to be calculated (it is implicit in the treatment of the differences in EVA as annuities). This, however, is not correct and the terminal value of the ΔEVAs beyond the explicit forecast period needs to be taken into account.

Chart 5: Schematic of a ΔEVA valuation



Note: terminal value is not illustrated on this schematic.

Advantages and disadvantages of EVA

EVA provides a way of assessing management...

EVA is calculated by adjusting accounting profits and balance sheet data and therefore suffers from accounting anomalies and analyst specific adjustments (these adjustments are discussed in Part 2). Stern Stewart & Co make quite clear that the adjustments to accounting values will be specific to each company and, quite possibly, subjective. Moreover, as EVA is based on accounting data, it is relatively easy for management to alter accounting practices to flatter EVA. Finally, EVA will be affected by macro factors that are beyond the control of the management. These points, along with many others, limit the usefulness of EVA as a tool for making quality or competency judgements about management.

Offsetting this are accounting distortions and macro-economic distortions

Analysts should be particularly wary of EVA figures published by companies unless a complete explanation of each of the components of EVA (profit, capital and cost of capital) and a reconciliation of profit and capital to accounting data are given. This is because the adjustments to accounting data are extremely subjective but can have a material impact on EVA.

Table 1: Advantages and disadvantages of EVA

Advantages	Disadvantages
• Relatively easy to calculate • Can be used as a management tool to help improve performance • Can be used for compensating management	• Highly subject to accounting anomalies and analyst adjustments • Does not necessarily measure shareholder value added • Requires an accurate estimate of after tax cost of capital • Very easily abused by deceitful or ignorant users. • Takes no account of the effects of inflation, investment profile or currency effects on accounting value of capital and accounting profit.

As a method of valuation, EVA is mathematically identical to a discounted cash flow analysis...

...but obscures some of the features captured in cash flow data

As a tool for valuing companies, EVA valuations are mathematically identical to DCF valuations; however, they will not give the same insights into a company. This is largely because EVA relies very heavily on accounting data which will tend to blunt or obscure the financial messages captured in cash flow data. After all, it is from cash flow that the capital providers are remunerated, not from accounting profits.

Advocates of EVA would dispute this statement and in Stern Stewart's book " The Quest for Value" (Harper Business, 1990), many examples are given of the benefit of EVA relative to free cash flow measures. A less biased review of EVA could show that there are situations where positive EVA was recorded annually but that the company was destroying value. Typically, this situation occurs when accounting returns are in excess of economic returns (this will always give positive EVA) but where the invested capital used in the accounting return calculation is too low.

Table 2: Advantages and disadvantages of EVA valuations

Advantages	Disadvantages
• Gives intrinsic value in the same way as a DCF • It forces the analyst to be rigorous in modelling future financial profile	• Accurate forecasts are required (this includes forecasts of capital spend on assets, investments or acquisitions). • Requires accurate estimate of the (after-tax) cost of capital • Little consensus between users of the technique on cost of capital • Often seen as inaccessible by anyone other than the valuer • Terminal value techniques are approximations to true value and, as commonly used, will systematically undervalue companies • Easily abused by unscrupulous users

Interpreting EVA and EVA valuations

Care needs to be taken in interpreting EVA and EVA valuations

Once the EVA analysis is complete comes the onerous task of interpreting the results. Some pointers as to the interpretation that should be placed on the results are given in Table 3.

Table 3: Interpreting the results of an EVA analysis

EVA measure	Magnitude	Conclusion / comments
Annual EVA rel to previous years or change in year-on-year EVA difference	High/(Low)	• Management has developed practices or procedures that are improving (destroying) shareholder value. • Management is using the full latitude of accounting practices to artificially enhance EVA (accounting changes have occurred that result in a year-on-year reduction of EVA) • Capital investment has been reduced (increased) • Inflation has increased (reduced) • Currency distortions are present • Adjustments to accounting profit and capital have changed as the result of changed business circumstances, ie changed R&D spend • Profit forecasts are optimistic (pessimistic)
EVA rel to comparator company or sector	High/(Low)	• Company is larger (smaller) • Company has reduced (increased) investment • Company has different accounting policies • Company has reduced (increased) capital expenditure • Assets and profits are derived from different countries (exchange rates and inflation effects) • Profit forecasts are optimistic (pessimistic)
EVA value relative to current price	High/(Low)	• Optimistic (pessimistic) forecasts • Discount rate too low (high) • Company is cheap (expensive)

UBS approach to EVA

Adjusting accounting data

An EVA analysis requires accounting data to be adjusted

The first rule that can be applied is to adjust accounting capital employed for any conceivable element of value that is not already present in the balance sheet. The second rule is that year-on-year changes in these adjustments should be applied to the profit and loss account (remember that a year-on-year increase in asset adjustment will require the increase to be added to profits and vice versa).

...this is necessarily subjective

The third rule is to recognise that many of the adjustments are subjective and therefore that there are no hard and fast rules on the adjustments! Indeed, anyone who believes the adjustments are not subjective probably doesn't understand EVA.

Calculating capital employed and profit

Capital employed is the starting point for calculating invested capital and therefore before moving beyond this point we should combine capital employed, the UBS definition is given below:

Table 4: Calculating accounting capital employed

Asset approach	Liabilities approach
+ Fixed tangible assets	+ Shareholders' funds
+ Associates	+ Minorities interests
+ Other investments	+ Provisions **
+ Current assets*	+ Debt***
+ Trade creditors	+ Other creditors****

*Stocks, work in progress, trade and other debtors, cash and other liquid investments.
** Including deferred tax and pension provisions where these are on balance sheet (including TFR for Italian companies).
***Total debt, NOT net debt.
****Including tax and dividend.

It is worth noting that traditionally 'other short-term creditors' were excluded from the liability approach and subtracted from the asset approach. This gives a lower value for capital employed. This approach was justified some years ago as companies did not then have efficient treasury operations and simply had cash sitting on deposit at very low interest rates ready to be used to meet the short-term creditors. This is not the case any more. Nowadays, companies efficiently manage their working capital and it is therefore reasonable to treat other short-term creditors as part of the capital employed in the business.

On the basis of the capital employed given above, the only adjustment that needs to be made to operating profit to ensure consistency is to add interest received to the operating profit. However, as a matter of practice, we always add back to (subtract from) profits any losses (gains) on asset disposals and non-recurring losses (gains); this is shown in Table 5. It should be noted that if the non-recurring losses (gains) are substantial, they should be added to (subtracted from) capital employed.

Table 5: Adjusting accounting operating profit

Adjustments to accounting operating profit
+ Accounting operating profit
+ (-) Loss (profit) on disposal of assets
+ (-) non-recurring loss or charge (profit or credit)
= UBS trading profit
+ Interest received
= Pre-tax trading profit for ROCE calculations

Calculating invested capital and NOPAT

Any element of value not already on the balance sheet should be added to accounting capital employed...

The purpose behind adjusting the capital employed is to move it towards the economic value (market value) of the enterprise. As a result of adjusting the capital employed, the profit also needs to be adjusted. Moreover, the profit needs to be struck after tax to compare with the after tax WACC. To remove the capital structure effects on tax and for consistency with the WACC, the tax charge is taken as if there was no debt (ie tax charge = P&L tax + tax shield from interest paid). The final adjustment to profits is to add back the reclaimable withholding tax; again this is for consistency with the WACC in which a gross cost of equity is used. The main adjustments to be made to capital employed and operating profit are given in Tables 6 and 7.

Table 6: Capital and profit adjustments

Adjustments to capital (add to capital)	Adjustments to operating profit (add to profit)
Deferred tax not provided for	Increase in deferred tax additions to capital
Capitalised R&D spend	R&D spend
Capitalised operating lease payments	Operating lease charge
Cumulative goodwill amortised/written off*	Goodwill amortised
Pension provisions**	
Capitalise interest payments on WIP***	Interest on WIP***

* For non-depreciable assets, add back all goodwill. For assets with finite economic life, write goodwill off on the basis of reduction in economic value.
** Add pension provisions where a material number of employees are governed by Swedish, German, or Italian employment law.
*** Interest payments associated with capital prepayments or work in progress.

Table 7: Tax adjustments to trading profits to obtain NOPAT

Tax adjustment to pre-tax trading profit to obtain NOPAT
Subtract tax shield (ie interest payable times marginal tax rate)
Add reclaimable withholding tax (assume all dividends paid to gross funds)
Add interest received from cash balances

Valuation based on annual EVAs

The definition that we present below for EVA valuation is largely the same as that proposed by Stern Stewart except that we include a terminal growth in EVA.

Valuation based on annual EVAs require the present value of future EVAs to be added to invested capital

An EVA valuation requires a long-term financial forecast to be constructed (Table 8). The financial forecast should extend to the point at which the analyst is confident that steady state conditions exist. Typically, at least five years of forecast data should be produced. For each year of the forecast, the operating profit less tax is expressed as a percentage of the opening invested capital for that year. This figure represents the after tax return on invested capital (ROIC) achieved by the company. The weighted average cost of capital (WACC) is subtracted from the ROIC to give a return spread. This spread is multiplied by the beginning capital for the year to give the EVA. The EVA for each year is brought out into present value terms using the WACC as the discount rate and then summed over all years to give the total EVA (in the final forecast year, a terminal EVA is calculated). The opening invested capital for the first year is added to the total EVA to give the total value. The outstanding debt of the company is subtracted from the total value to give the equity value and this is divided by the number of shares to give the equity value per share, in other words the fair price of the stock. Table 9 illustrates the EVA valuation process and each part of the process is described in more detail below.

Table 8: EVA valuation based on a forecast of annual EVAs

Component of EVA	1996A	1997F	1998F	1999F	2000F	2001F	Value
UBS trading profit (£m)	160	185	233	306	348	373	
+ Interest income (£m)	2	2	3	3	3	3	
+ Profit adjustments	2	3	0	0	0	0	
- Actual tax	45	50	61	80	91	101	
- Tax shield	5	7	10	12	15	18	
+ Reclaimable withholding tax	9	10	12	14	17	19	
Adjusted op prof - tax, NOPAT (£m)	123	143	177	231	262	276	
Opening capital employed	850	950	1500	1953	2100	2200	
Capital adjustments[1]	150	300	0	0	0	0	
Opening invested capital (£m)	1000	1250	1500	1953	2100	2200	
After tax ROIC (NOPAT/IC)	12.3%	11.4%	11.8%	11.8%	12.5%	12.6%	
WACC	10.0%	10.0%	9.8%	9.7%	9.7%	9.7%	
Return spread	**2.3%**	**1.4%**	**2.0%**	**2.1%**	**2.8%**	**2.9%**	
Annual EVA (£m)	**23**	**18**	**30**	**42**	**58**	**63**	
Present value (pv) factor		0.909	0.829	0.757	0.691	0.629	
Pv of EVA (£m)		16	25	31	40	39	
Cumulative pv of EVA (£m)		**16**	**41**	**72**	**113**	**152**	**152**
Terminal growth in EVA						4%	
Terminal value (£m)						1142	
Pv of terminal value (£m)						718	718
Starting adjustment[2] to pv EVA (£m)		0					0
Total pv of EVA (£m)							**870**
Opening invested capital (£m)	1000						1000
Starting adjustment[2] to opening cap. (£m)	0						0
Total value of firm (£m)							**1870**
Value not attributable to equity[3] (£m)							-820
Value of equity (£m)							1050
Outstanding shares							124.23
Target share price (p/share)							**846**

Note: data is for illustrative purposes only.
1. Adjustments are made to the accounting capital employed to better represent the true capital invested in the business. These adjustments were explained earlier and are also explained in Part 2 of this report. In an EVA valuation, the adjustments should always be explained in a footnote to the valuation table or in some other part of the document.
2. This reflects the fact that the discounting process assumes even time intervals between all accounting data but that the starting point is likely to fall between accounting periods.
3. Principally debt but could also include the present value of operating lease payments and balance sheet pension liabilities (Germany, Sweden and Italy).

Valuation based on differences in annual EVAs

Valuation based on annual EVA differences require...

A valuation based on differences in annual EVAs follows the same approach as the previous valuation to the level at which annual EVAs are calculated. Once annual EVAs are calculated, the next stage is to calculate the differences in annual EVAs. These differences are treated as annuities and their future values are calculated by dividing by WACC. Each of these annuity values is brought into present value terms. The terminal value of the EVA differences that occur beyond the explicit forecast period are

...the cummulative present of EVA differences, with each treated as an anuity...

...added to the invested capital...

...and the current value of EVA

calculated and brought into present value terms. The present value of the annuities occurring over the explicit forecast period are summed with the present value of the terminal EVA differences. This sum is added to the opening book value and the value of the last actual EVA treated as an annuity, ie value = EVA/WACC. This gives the total value of the firm. The procedure for calculating the equity value now follows that of the previous valuation. It should be noted that this method, while dealing with terminal value in a more appropriate way, is still not perfect and, as a result, the ΔEVA valuation understates value (refer to Part 2 of this report).

Table 9: EVA valuation based on forecast of differences in annual EVAs

Component of ΔEVA	1996A	1997F	1998F	1999F	2000F	2001F	Value
UBS trading profit (£m)	160	185	233	306	348	373	
+ Interest income (£m)	2	2	3	3	3	3	
+ Profit adjustments[1]	2	3	0	0	0	0	
- Actual tax	45	50	61	80	91	101	
- Tax shield	5	7	10	12	15	18	
+ Reclaimable withholding tax	9	10	12	14	17	19	
Adjusted op prof - tax, NOPAT (£m)	123	143	177	231	262	276	
Opening capital employed	850	950	1500	1953	2100	2200	
Capital adjustments[1]	150	300	0	0	0	0	
Opening invested capital (£m)	1000	1250	1500	1953	2100	2200	
After tax ROIC	12.3%	11.4%	11.8%	11.8%	12.5%	12.6%	
WACC	10.0%	10.0%	9.8%	9.7%	9.7%	9.7%	
Return spread	**2.3%**	**1.4%**	**2.0%**	**2.1%**	**2.8%**	**2.9%**	
Annual EVA (£m)	**23**	**18**	**30**	**42**	**58**	**63**	
DEVA (£m)		**-5**	**12**	**12**	**17**	**4**	
ΔEVA as an annuity (£m)		-55	134	131	189	49	
Present value (pv) factor		0.909	0.829	0.757	0.691	0.629	
Pv of ΔEVA as an annuity (£m)		-50	111	99	131	31	
Cumulative pv of ΔEVA annuity (£m)		-50	61	160	291	322	322
Opening EVA as an annuity (£m)	23						230
Closing ΔEVA as an annuity/WACC (£m)						501	
Pv of closing ΔEVA annuity (£m)						315	315
Total value of EVA (£m)							**867**
Starting adjustment[2] to pv EVA (£m)		0					0
Opening invested capital (£m)	1000						1000
Starting adjustment[2] to opening cap. (£m)	0						0
Total value of firm (£m)							**1867**
Value not attributable to equity[3] (£m)							-820
Value of equity (£m)							1047
Outstanding shares							124.23
Target share price (p/share)							**843**

Note: Data is for illustrative purposes only

1. Adjustments are made to the accounting capital employed to better represent the true capital invested in the business. These adjustments were explained earlier and are also explained in Part 2 of this report. In an EVA valuation the adjustments should always be explained in a footnote to the valuation table or in some other part of the document.

2. This reflects the fact that the discounting process assumes even time intervals between all accounting data but that the starting point is likely to fall between accounting periods.

3. Principally debt but could also indicate the present value of operating lease payments on balance sheet pension liquidity (Germany, Sweden and Italy).

Detailed description of the UBS approach

Value based on annual EVAs

UBS trading profit

The UBS trading profit is a measure of the ongoing, sustainable, profit before interest and tax. It can be calculated by making adjustments to the published operating profit. The purpose of these adjustments is to remove any one-off effects or any P&L items that are better treated as balance sheet items (for example, profit on asset disposals would be added back).

Interest income	Interest received on cash deposits.
Profit adjustments	Adjustments to trading profit and to capital employed to obtain net operating profit from which tax is subtracted to obtain NOPAT. These adjustments should be consistent with those made to capital employed to obtain invested capital.
Actual tax	Tax charge as shown in the P&L.
Tax shield	The effect of the tax deductibility of interest payments. It is the interest paid multiplied by the marginal corporate tax rate.
Reclaimable withholding tax	The WACC is calculated on the basis of a tax exempt investor ie gross dividends and gross interest are used in the calculation of the cost of equity and cost of debt. Thus, for consistency, the reclaimable withholding tax must be added back to profits available to capital providers. In the UK, the withholding tax is ACT.
Adjusted operating UBS trading profit less tax (NOPAT)	The UBS trading profit plus interest received less actual tax less the tax shield plus reclaimable withholding tax plus any year-on-year changes that occur in the adjustments made to balance sheet data.
Opening capital employed	The capital employed in the business at the beginning of each year. It is, of course, identical to the closing capital employed for the prior year. The capital employed can be either calculated from the liabilities side or the asset side of the balance sheet; both approaches should give an identical value. Taking the liabilities approach, capital employed is calculated as the sum of the shareholders' funds, minority interests, provisions (including deferred tax provision), debt (including finance leases) and tax and dividend shown in the balance sheet as creditors and other creditors. Taking the asset approach, capital employed is identical to the sum of the fixed tangible assets, associates, other investments, current assets (stocks and work in progress), trade creditors, trade and other debtors, cash and other liquid assets).
Capital adjustments	Adjustments are made to the accounting capital employed in an attempt to bring it closer to the economic value of the firm and therefore bring the basis of ROIC (an accounting measure) to that of WACC (an economic measure) and hence give meaningful return spreads (ROIC - WACC). Typically, the adjustments will include writing back goodwill amortised or written off against reserves, capitalising operating leases, capitalising R&D expenses and other adjustments.
Opening invested capital	Sum of opening capital employed and capital adjustments
After tax ROIC	Denotes the return on invested capital and is simply the adjusted UBS operating profit less tax for the period divided by the opening invested capital for the period. Do not use a period average or period end invested capital.
WACC	Denotes the after tax weighted average cost of capital. This figure is so crucial to many types of valuation technique that we dedicated a complete report to it and the reader should refer to this report (UBS valuation series: *Cost of equity and capital* for further information.
Return spread	This is simply the ROIC less WACC.

Annual EVA	The product of the return spread and the opening invested capital for each forecast year. It represents the amount by which the accounting profit exceeds the level required by the capital providers.
Present value factor	Multiplier that for each year brings the EVA into present value terms. It is calculated as the reciprocal of 1 + WACC raised to the power of the forecast year being considered. For example, for the third forecast year, the present value factor = 1/((1+WACC)^3). Refer to *Appendix B* for more details.
Present value of EVA	Product of the present value factor and the annual EVA.
Cumulative present value of EVA	Sum of all prior year EVAs.
Terminal growth in EVA	The expected long-run growth in EVA. This will be the same as growth in invested capital providing the return spread is constant, which it should be for steady state (ie terminal) conditions (*Appendix A*). It can be calculated as follows: growth = increase in assets over final year of forecast × return spread / final forecast EVA.
Terminal value	This is the terminal value based on the last forecast EVA it is given by EVA (1 + g) / (WACC - g) (*Appendix A*).
PV of terminal value	This is the terminal value multiplied by the present value factor for the final year of the forecast.
Starting adjustment to present value EVA	An adjustment to the present value of EVA to reflect the fact that the analysis was undertaken part way through the year. Refer to *Appendix B* for more details. *Note: Many users make a part year adjustment to reflect the incidence of cash flows at the mid-year rather than year-end. We prefer to assume cash flows occur at financial year-end but that the starting point of the analysis might be part way through a year, hence our starting year adjustment.*
Total present value of EVA	This is the sum of the present value of annual EVAs, the terminal value and starting year adjustment.
Starting year adjustment to opening capital	An adjustment to the starting invested capital to reflect the fact that the analysis was undertaken part way through the year. The adjustment assumes that the invested capital grows linearly from the opening position in year 0 to the opening position in year 1. Thus, if the analysis date is ¼ way through the financial year, the adjustment will be: (opening capital year 1 - opening capital year 0) x ¼
Total value of firm	Sum of the cumulative present value of the EVAs and the adjusted starting capital.
Value not attributable to equity	The market value of all debt and debt-like instruments (loans, debentures, overdrafts, convertibles, etc). This should represent the value of those instruments at the time the analysis is undertaken. For convenience, the cash/ net debt position of the firm can be assured to change linearly between year ends. In addition to debt any other non-equity claim on the value of the firm such as pension liabilities in Germany on the present value of operating leases.
Value of equity	Total value of firm less value not attributable to equity.
Outstanding shares	Total number of shares currently in issue (do not dilute the shares as the conversion of share options and convertible loan notes should have been taken into account in the cash flows or terminal value used to calculate the EVA).

Target share price Value of equity divided by outstanding number of shares.

Value based on differences in EVA

The following section provides the description of the terms used in this approach that are in addition to those already described.

ΔEVA The difference between current year EVA and previous year EVA.

ΔEVA as an annuity Each ΔEVA is valued as an annuity, ie value = ΔEVA / WACC.

PV of ΔEVA as an annuity The product of each ΔEVA as an annuity and the present value factor.

Cumulative PV of ΔEVA Sum of all prior year present values of ΔEVA as an annuity.

Opening EVA as an annuity The value of EVA in the last actual year divided by WACC.

Closing ΔEVA as an annuity / WACC The last forecast ΔEVA treated as an annuity (ie ΔEVA / WACC) and then divided by WACC again (refer to *Appendix A*).

PV of closing ΔEVA as an annuity The closing ΔEVA as an annuity / WACC multiplied by the present value factor for the final forecast year.

Worked example: Siemens

EVA analysis and valuation of Siemens

An EVA analysis requires balance sheet and operating profit data to be adjusted for value that may not be recognised in the statutory accounts. These adjustments are given below.

Another important part of an EVA analysis is the calculation of the weighted average cost of capital (WACC). The WACC calculation is also given below.

Calculating invested capital

Balance sheet data should be adjusted for hidden value

The calculation of the capital employed by Siemens together with adjustments is given in table 10 below.

Table 10: Calculating invested capital

	1996A	1997F	1998F	1999F	2000F	2001F
Equity	22,491	24,426	25,934	27,518	29,631	32,677
Pension provisions	17,747	17,500	17,750	18,000	18,000	18,500
Other provisions	20,471	19,693	19,193	18,693	18,193	17,693
Present value of operating leases	1,262	1,267	1,270	1,270	1,270	1,270
Cumulative goodwill amortisation 1994 onwards	96	154	212	270	328	386
Cumulative goodwill written off pre 1994	8,957	8,957	8,957	8,957	8,957	8,957
Gross debt	5,141	5,141	5,141	5,141	5,141	5,141
Total capital	76,165	77,138	78,457	79,849	81,520	84,624

In addition to the standard UBS calculation for capital employed the invested capital includes cumulative goodwill written off pre-1994 and the cumulative goodwill amortisation post-1994. The reason for including goodwill in an EVA analysis is that goodwill was once purchased and therefore the cash invested in that goodwill needs to earn a return, if it does not then, according to an EVA analysis, management have destroyed value.

At UBS we believe that in reality goodwill will reduce over time in line with the reduction in the economic value of the original purchase. Despite this view we undertake our EVA analyses following the established practice of adding back all goodwill.

Calculating UBS trading profit

To calculate UBS trading profit we subtract (add) to reported operating profit, the profits (losses) on asset disposals. The reason for this adjustment is that profits on asset disposals are really a balance sheet transaction: the expenditure did not go through the P&L so why should the profit.

Table 11: Calculating UBS operating profit

	1996A	1997F	1998F	1999F	2000F	2001F
Reported operating profit*	2,307	2,480	2,590	3,520	3,493	3,470
Profit on net asset disposals	(150)	(150)	(150)	(150)	(150)	(150)
UBS trading profit	2,157	2,330	2,440	3,370	3,343	3,320

*Includes an estimate of the cost of pension capital.

It should be noted that, unlike many German companies, Siemens has included an estimate of the cost of pension capital in its reported operating profit since 1993.

Calculating trading profit adjustments

Profits also need to be adjusted

Given that we have made adjustments to the accounting capital employed to arrive at the opening invested capital, it is only right to alter profits for changes in these balance sheet adjustment. These alterations are shown in table 12 below.

Table 12: Calculating profit adjustments

	1996A	1997F	1998F	1999F	2000F	2001F
Increase in operating provisions	(778)	(500)	(500)	(500)	(500)	(500)
Interest component of op leases	50	50	50	50	50	50
Goodwill amortisation	58	58	58	58	58	58
Profit adjustments	(670)	(392)	(392)	(392)	(392)	(392)

Calculating WACC

A full explanation of the calculation of WACC is given in the UBS Valuation Series: Cost of equity and capital.

Calculating a forward looking β

Rather than use a historical β, which is a common approach, we prefer to estimate a forward looking β. The estimation is based on the systematic business risk faced by the company and on the financial risk resulting from the company's capital structure. A full explanation of our approach to β is given in UBS Valuation Series: *Cost of equity and capital*.

Systematic business risk

Siemens is a large diverse German engineering company.

Despite a wide product range Germany remains a key market...

The company's extremely wide product range tends to smooth out volatility in the various sectors in which it operates although Germany remains a key market.

...but costs are highly dependent upon local factors...

Siemens is one of Germany's largest 'local' companies; the bulk of the company's production facilities are located in Germany. Therefore, employee costs are heavily influenced by local macro-economic conditions. Materials are sourced from a number of geographic locations although Germany is most dominant. Financial costs are again dominated by German factors as the bulk of the company's debt is fixed rate DM denominated and its cash deposits are also DM denominated.

...resulting in above average systematic risk

Siemens geographically diverse revenue base but localised cost base introduces 'more than average' systematic business risk. Consequently, we would place the company in the second quintile relative to the market, in other words we would increase the market β of 1.0 by 0.2 for the systematic risks faced by Siemens.

Financial risk

The economic gearing is below the market and therefore financial risk is below the market

With the exception of 1997, Siemens will be cash generative over the next five years. Thus, economic gearing is falling. Moreover, Siemens currently has a large net cash position and therefore this will simply get larger. based on this the financial risk adjustment to β should be -0.2.

Forecast β

The forecast β remains constant at 1.0 over the forecast period

The resulting forecast β is given in table 13. Over the forecast period β remains constant at 1.0.

Table 13: Calculating a forward looking β

	1996A	1996E	1997E	1998E	199E	2000E
Economic gearing for Siemens*	-42%	-42%	-42%	-42%	-42%	-42%
Market β	1.0	1.0	1.0	1.0	1.0	1.0
Systematic business risk	-0.2	-0.2	-0.2	-0.2	-0.2	-0.2
Financial risk	0.2	0.2	0.2	0.2	0.2	0.2
Forward looking β	1.0	1.0	1.0	1.0	1.0	1.0

*As an approximation, forecast economic gearing is based on the forecast accounting gearing for each of the forecast years multiplied by the ratio of the economic gearing in 1996/accounting gearing.

The forecast β is very close to the historical β of 1.029 (as measured by Datastream). In recent years Siemens share price only once moved strongly against the market after a profit warning in November 1996.

Calculating the cost of equity (COE)

COE remains constant over the forecast period at 8.5%

Based on a risk free rate of 5.8% for Germany the UBS European Strategy unit calculate an equity market risk premium of 2.7% over government bonds. This calculation is based on the total return expected from the German market less the risk free rate and is explained in the UBS Valuation Series: *Cost of Equity and of Capital*. The forward looking β was calculated in the previous section. The product of the β and the equity market risk premium, when summed with the risk free rate gives the cost of equity as shown in Table 14.

Calculating the Return on cash

Return on cash remains constant at about 20 basis points below the risk free rate

Siemens has considerable cash balances and is likely to receive a return on these that is very close to, but below, the risk free rate. A typical discount to the risk free rate would be 20 basis points (refer to UBS Valuation Series: *Cost of equity and capital*). This is shown in table 14.

Calculating the weighted average cost of capital (WACC)

The WACC is constant at 7.2%

The cost of equity and return on cash can be combined by weighting each according to its share of the assets. This calculation is shown in table 14. The cost of capital calculated in this way should be used to discount profit stated after tax paid less the tax shield on interest payments (if appropriate, withholding tax that is reclaimable should be added to profit, however, as the COE was calculated on the basis of a net dividends withholding tax should not be added back).

Table 14: Calculating the weighted average cost of capital

	1996A	1997F	1998F	1999F	2000F	2001F
Economic gearing (%)	(42)	(42)	(42)	(42)	(42)	(42)
Risk free rate (%)*	5.8	5.8	5.8	5.8	5.8	5.8
Market risk premium (%)*	2.7	2.7	2.7	2.7	2.7	2.7
Forward looking β	1.0	1.0	1.0	1.0	1.0	1.0
Cost of equity (%)	8.5	8.5	8.5	8.5	8.5	8.5
Marginal tax rate (%)	45.0	45.0	45.0	45.0	45.0	45.0
Cash discount to risk free rate (%)**	0.4	0.4	0.4	0.4	0.4	0.4
Return on cash (%)	5.4	5.4	5.4	5.4	5.4	5.4
WACC (%)	7.2	7.2	7.2	7.2	7.2	7.2

* Source: UBS European Strategy Unit (refer to the European Equity Market Indicators publication).

Calculating EVA and EVA value

Based on the data given above we can forecast the annual EVA. However, to undertake an EVA valuation an estimate the long run growth potential of Siemens needs to be made. Historically, Siemens has grown at about 0% pa. however we assume the growth rate will improve somewhat in the long term to 3%. This is largely driven by the company's heavy bet on the semiconductor industry, which accounted for one third of capital expenditure in 1996.

The results of the calculation of annual EVA and the EVA valuation are given below and discussed in the nest section.

Table 15: Calculation of annual EVA and EVA valuation

Component of EVA	1996A	1997F	1998F	1999F	2000F	2001F	Value
UBS trading profit (DM m)	2,157	2,330	2,440	3,370	3,343	3,320	
+ Interest income (DM m)	1,578	1,625	1,560	1,625	1,625	1,625	
+ Profit Adjustments[1]	(728)	(450)	(450)	(450)	(450)	(450)	
- Actual tax	(767)	(827)	(881)	(1,154)	(1,147)	(1,141)	
- Tax shield	(422)	(450)	(363)	(405)	(405)	(405)	
+ Reclaimable withholding tax	0	0	0	0	0	0	
Adjusted op prof - tax, NOPAT (DM m)	4,195	4,782	4,794	6,104	6,070	6,041	
Opening capital employed	65,850	66,760	68,018	69,352	70,965	74,011	
Capital adjustments1	10,315	10,378	10,439	10,497	10,555	10,613	
Opening invested capital (DM m)	76,165	77,138	78,457	79,849	81,520	84,624	
After tax ROIC (NOPAT/IC)	5.5%	6.2%	6.1%	7.6%	7.4%	7.1%	
WACC	7.3%	7.3%	7.3%	7.3%	7.3%	7.3%	
Return spread	**-1.8%**	**-1.1%**	**-1.2%**	**0.4%**	**0.2%**	**(0.1%)**	
Annual EVA (DM m)	**(1,351)**	**(835)**	**(919)**	**290**	**134**	**(121)**	
Present value (pv) factor		0.932	0.869	0.810	0.755	0.704	
PV of EVA (DM m)		(778)	(799)	235	101	(85)	
Cumulative PV of EVA (DM m)		**(778)**	**(1,577)**	**(1,342)**	**(1,241)**	**(1,326)**	**(1,326)**
Terminal growth in EVA						3.0%	
Terminal value (DM m)						(2,907)	
PV of terminal value (DM m)						(2,045)	(2,045)
Starting adjustment[2] to PV EVA (DM m)		(121)					(121)
Total PV of EVA (DM m)							**(3,492)**
Opening invested capital (DM m)	76,165						76,165
Starting adj[2] to opening cap. (DM m)	2,724						2,724
Total value of firm (DM m)							**75,397**
Value not attributable to equity[3] (DM m)	25,188						25,188
Value of equity (DM m)							50,209
Outstanding shares (m)							560
Target share price (DM/share)							**90**

1. Adjustments are made to the accounting capital employed to better reflect the true value of invested capital. These adjustments are principally for goodwill, capitalised value of operating lease payments.
2. The starting adjustments reflect the fact that the first interval in the discounting process is 6 months not one year.
3. For 1996, financial debts amount to DM 6,179m, the present value of operating leases amount to DM 1,262m and pension liabilities amount to DM 17,747m.

Interpreting the EVA analysis

The most notable feature of the EVA analysis is that the cumulative present value of EVA has only a minor impact on the calculated fair value of DM 90 per share. The bulk, some 96%, of this value is driven by the invested capital. The simple interpretation of this is that Siemens is neither creating nor destroying value.

Much of the cumulative present value of future EVAs results from the terminal value and, in turn, this is very sensitive to the final forecast annual EVA. Given that we forecast annual EVA turning negative in the final forecast year it is important to consider the sensitivity of the share price to a continuation of positive EVAs. The reduction in profits in 2000 and 2001 might seem contentious given our previous comments on semiconductor growth. We contend that cyclicality of the semiconductor industry will introduce volatility to Sieman's earnings, and of course the weight of history suggests that at some point in the future, yet another part of the Siemans empire will disappoint. Had the improving trend in EVAs also been seen in the final year a higher fair price would have been calculated. For example, if an EVA figure of DM 200m was achieved in 2001 this would have resulted in a present value of the terminal value of DM 3373m, This would have an overall effect of lifting the fair value by DM10 per share (approximately 11%). Thus, overall, on the basis of this analysis a fair value of DM90 per share perhaps up to DM100 is reasonable. This compares to a current price of DM99.

As regards management performance, we do not believe EVA is a particularly good measure however at face value the analysis indicates management are improving (reducing value destroyed) over the course of the forecast period with the exception of the final year. However, the value creation is so small as to be negligible.

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Part 2: Theoretical guide

Dynamics of EVA and EVA valuations

In this section, we look in more detail at the general factors that influence annual EVAs. The company specific factors, ie the adjustments that Stern Stewart recommends should be made to accounting data, were addressed in the previous section.

The three main factors we examine, together with our reasoning, are:

- Return spread (ROIC - WACC): this is the key determinant of economic value added.
- Changing level of capital expenditure: changes in the level of capital expenditure will affect the ROIC and therefore could affect the value of EVA.
- Effects of inflation: while NOPAT will generally rise with inflation, invested capital, which is measured on an historical cost accounting basis, will not. Thus inflation could affect the ROIC.

Thus, these factors are largely concerned with the measurement of annual EVA. The latter two factors, capital expenditure and inflation, will be taken together.

Return spread (ROIC - WACC)

Return spread is a key determinant of value added...

A fundamental concept of EVA is that the return spread (ROIC - WACC) is the key determinant of value added. Management should aim to widen this spread. However, there are some problems. These problems lie not in the concept but in the measurement of the returns. ROIC is an accounting based return where as WACC is an economic (or market based) return. Thus, the two cannot be compared. We examine the problem below:

Accounting returns are defined as:

$$ROIC_1 = NOPAT_1 / BV_0 \qquad (1:1)$$

We can also define the intrinsic market value, (MV) as:

$$MV_0 = \frac{FCFF_1}{WACC - g_{FCFF}} \qquad (1:2)$$

This formula is based on a simplification of the DCF model (FCFF) (denotes free cash flow to the firm) with constant free cash flow growth (g_{FCFF}). While equation (1:2) provides an equation for market value , this value can be written in terms of accounting value (BV) and a premium (PR) to the accounting value, ie:

$$MV_0 = BV_0 + PR_0 \qquad (1:3)$$

In addition, FCFF, can be written in terms of $NOPAT_1$ as follows

$$FCFF_1 = NOPAT_1 - \Delta A_1 \qquad (1:4)$$

Equations (1:1) through (1:4) can be combined to give:

$$ROIC_1 = (1 + PR_0 / BV_0)(WACC - g_{FCFF}) + \Delta A_1 / BV_0 \qquad (1:5)$$

Equation (1:5) can be simplified by making two substitutions. The first is based on asset growth;

$$\frac{\Delta A_1}{BV_0} = \frac{BV_1 - BV_0}{BV_0} = g_{BV} \qquad (1:6)$$

where g_{BV} is the asset growth.

The second substitution is based on the assumptions underlying the constant growth DCF. For free cash flow growth to be constant, ROIC must be constant and asset growth must be constant and equal to free cash flow growth, ie:

$$g_{FCFF} = g_{BV} = g \qquad (1:7)$$

substituting equation (1:6) and (1:7) in (1:5) gives:

$$ROIC = WACC + \frac{PR_0}{BV_0}(WACC - g) \qquad (1:8)$$

...but return spreads are affected by many accounting factors

Equation (1:8) shows very clearly that if a company trades on a premium (PR_0) to its accounting value, then ROIC will always be greater than WACC. However, equation (1:8) also begs a question: is the existence of a premium due to ROIC in excess of WACC or is it that BV does not represent the true value of capital invested in the business? We would argue that the premium represents the fact that the book capital understates the true capital; some of the reasons for this are:

- Many forms of capital are not included on a balance sheet; for example; human capital, brand value, operating leases, off-balance sheet capital.
- Capital is often understated on a balance sheet, for example, fully depreciated but not obsolete assets; inflation erodes the real value of assets (this effect is considered below).

Changing capital expenditure and inflation effects

Levels of capital expenditure and inflation affect return spread

The reason for examining the influence of capital expenditure on inflation is that rising expenditure depresses ROIC and vice versa, while rising inflation increases ROIC. Thus either of these factors could influence the measurement of annual EVAs. This could have a knock-on effect on management desire to invest capital or its desire to locate in high inflation environments. Equally, it will affect comparisons that the investment community makes between companies. We examine these effects below.

We can write the equation for EVA as:

$$EVA_1 = NOPAT_1 - WACC \times BV_0 \qquad (1:9)$$

In an inflationary environment, we could take $NOPAT_1$ to be equal to the prior year figure ($NOPAT_0$) plus an inflation component (i) plus a component for profits associated with new investment (I), ie:

$$NOPAT_1 = NOPAT_0\,(1 + i) + I \qquad (1:9)$$

Moreover, BV_0 can be replaced by the prior year asset value plus net capital expenditure (capital expenditure less depreciation = NCX), ie:

$$BV_0 = BV_{-1} + NCX_o \quad (1:10)$$

Thus, by substituting equators (1:9) and (1:10) in (1:8), we get:

$$EVA_1 = NOPAT_o (1 + i) + I - WACC (BV_{-1} + NCX_o)$$

or

$$EVA_1 = EVA_o + i \times NOPAT_o + I - WACC \times NCX_o \quad (1:11)$$

Equation (1:11) indicates quite clearly that, if all other things are equal, then an increase in inflation will lift EVA and an increase in net capital expenditure will reduce EVA. While there are many flaws with the assumption's underlying equation (1:11) the general tenet is valid.

While equation (1:11) considers the effect of future inflation, another influence is the difference between historical and future inflation. As ROIC is based on current profits divided by historical assets, high historical inflation will tend to lead to high ROIC (depressing historical cost assets in current money terms). In contrast, WACC is forward looking and while it will include inflation, this will be at the prospective long-run level. Thus, high historical inflation and low forecast inflation will automatically lead to large differences in the return spread and high annual EVA.

Valuations based on EVA

EVA valuations are equivalent to discounted cash flow valuations

Start with discounted cash flow

To derive the technique for an EVA valuation, we begin from an established valuation approach; that of discounted cash flow (DCF) valuation. A DCF valuation, which gives true or intrinsic value, is expressed as follows:

$$V = \sum_{n=1}^{n=\infty} \frac{FCFF_n}{(1 + WACC)^n} \qquad \text{DCF}$$

Where V is the value of the firm (enterprise value), $FCFF_n$ is the after-tax free cash flow to the firm (free cash flow is stated after capital expenditure) in year 'n', WACC is the after-tax weighted average cost of capital and the symbol 'Σ' denotes the sum of all the values as 'n' increments from 1 to infinity.

Replace cash flows

We can express the free cash flow available to the firm in terms of NOPAT (net operating profit after tax) as shown in Table 16.

Table 16: Simplified cash flow statement

	Cash flow item		
+	After tax operating profit (NOPAT)*		
+	Depreciation	}	
-	Capital expenditure	}	Net increase in assets** (=DA)
-	Increase in operating working capital	}	
=	After-tax free cash flow to the firm		
-	Tax shield on interest payments		
-	Cash interest		
-	Cash dividend		
=	Change in net debt		

* The tax charge is taken as P&L tax plus the interest tax shield
** Net increase in asset is the same as net new investment or change in invested capital

Thus, we can write:

$$FCFF_n = NOPAT_n - \Delta A_n \qquad (2:1)$$

However, $NOPAT_n$ can be expressed in terms of accounting return on invested capital ($ROIC_n$) and opening invested capital (BV_{n-1}), ie:

$$NOPAT_n = ROIC_n \times BV_{n-1} \qquad (2:2)$$

Substituting equation (2:1) and (2:2) in the DCF gives:

$$V = \sum_{n=1}^{n=\infty} \frac{ROIC_n \times BV_{n-1} - \Delta A_n}{(1 + WACC)^n} \qquad (2:3)$$

Equation (2:3) can be split into its component parts:

$$V = \sum_{n=1}^{n=\infty} \frac{ROIC_n \times BV_{n-1}}{(1 + WACC)^n} - \sum_{n=1}^{n=\infty} \frac{\Delta A_n}{(1 + WACC)^n} \qquad (2:4)$$

Equation (2:4) can be expanded by making the following substitution; verification of this key substitution is given on the next page.

$$\sum_{n=1}^{n=\infty} \frac{\Delta A_n}{(1 + WACC)^n} = \sum_{n=1}^{n=\infty} \frac{WACC \times BV_{n-1}}{(1 + WACC)^n} - BV_0 \qquad (2:5)$$

Thus equation (2:4) becomes:

$$V = \sum_{n=1}^{n=\infty} \frac{ROIC_n \times BV_{n-1}}{(1 + WACC)^n} - \sum_{n=1}^{n=\infty} \frac{WACC \times BV_{n-1}}{(1 + WACC)^n} + BV_0 \qquad (2:6)$$

Equation (2:6) can be simplified as follows:

$$V = \sum_{n=1}^{n=\infty} \frac{(ROIC_n - WACC) \times BV_{n-1}}{(1 + WACC)^n} + BV_0 \qquad (2:7)$$

Value in terms of EVA

Equation (2:7) can be simplified further by recognising that:

$$EVA_n = (ROIC_n - WACC) \times BV_{n-1} \qquad (2:8)$$

Substituting equation (2:8) into equation (2:7) gives value in terms of EVA:

$$V = BV_0 + \sum_{n=1}^{n=\infty} \frac{EVA_n}{(1 + WACC)^n} \qquad (2:9)$$

Equivalence of EVA and DCF valuations

The process described above takes a DCF value and derives from this the standard EVA valuation. Thus, not only can we establish the validity of the EVA technique in this way, but also that an EVA valuation is equivalent to a DCF valuation.

Verifying the key substitution

On the previous page (see equation 2:5), the following substitution was made:

$$\sum_{n=1}^{n=\infty} \frac{WACC \times BV_{n-1}}{(1+WACC)^n} \qquad BV_0 + \sum_{n=1}^{n=\infty} \frac{\Delta A_n}{(1+WACC)^n}$$

The validity of this equation is proved below.

The right-hand side of the above equation can be expanded as follows (note that we have substituted 'W' for 'WACC' simply to save space):

$$\sum_{n=1}^{n=\infty} \frac{W \times BV_{n-1}}{(1+W)^n} = W \times \left[\frac{BV_0}{(1+W)^1} + \frac{BV_1}{(1+W)^2} + \frac{BV_2}{(1+W)^3} + \ldots \right] \quad (2:10)$$

We will set 'S' equal to the terms in the square brackets, in other words:

$$S = \left[\frac{BV_0}{(1+W)^1} + \frac{BV_1}{(1+W)^2} + \frac{BV_2}{(1+W)^3} + \ldots + \frac{BV_{n-1}}{(1+W)^n} \right. \quad (2:11)$$

and therefore equation (2:10) becomes:

$$\sum_{n=1}^{n=\infty} \frac{W \times BV_{n-1}}{(1+W)^n} = W \times S \quad (2:12)$$

If we now multiply 'S' by (1 + W), we obtain:

$$S \times (1+W) = \left[\frac{BV_0}{(1+W)^0} + \frac{BV_1}{(1+W)^1} + \frac{BV_2}{(1+W)^2} + \ldots + \frac{BV_n}{(1+W)^n} \right] \quad (2:13)$$

If equation (2:11) is subtracted from equation (2:13), we are left with an expression for $S \times W$, ie:

$$S \times W = BV_0 + \left[\frac{BV_1 - BV_0}{(1+W)^1} + \frac{BV_2 - BV_1}{(1+W)^2} + \ldots + \frac{BV_n - BV_{n-1}}{(1+W)^n} \right]$$

This can be simplified further by substituting the increases in assets (ΔA_n) for $BV_n - BV_{n-1}$, ie:

$$S \times W = \sum_{n=1}^{n=\infty} \frac{\Delta A_n}{(1+WACC)^n} \quad (2:14)$$

Equation (2:14) can be substituted in equation (2:12) to give:

$$\sum_{n=1}^{n=\infty} \frac{}{(1 + WACC)^{n}} \qquad BV_0 + \sum_{n=1}^{n=\infty} \frac{\Delta A_n}{(1 + WACC)^{n}} \qquad (2:15)$$

Equation (2:15) is identical to equation (2:5) and therefore the equality is validated.

Valuations based on EVA differences

Replace EVA with differences in EVA

This method of valuation is derived from the valuation based on annual EVAs (ie equation (2:9)). However, the present value of annual EVAs is rewritten in terms of differences in annual EVAs, starting from the expansion of the present value of future assessed EVAs, ie:

$$\sum_{n=1}^{n=\infty} \frac{EVA_n}{(1+WACC)^n} = \frac{EVA_1}{(1+WACC)^1} + \frac{EVA_2}{(1+WACC)^2} + \text{etc.} \qquad (3:1)$$

We can write:

$EVA_1 = EVA_0 + EVA_1 - EVA_0 = EVA_0 + \Delta EVA_1$

$EVA_2 = EVA_1 + EVA_2 - EVA_1 = EVA_0 + \Delta EVA_1 + \Delta EVA_2$

$EVA_3 = EVA_2 + EVA_3 - EVA_2 = EVA_0 + \Delta EVA_1 + \Delta EVA_2 + \Delta EVA_3$

etc..

The subscript '0' refers to the last actual year whereas '1' refers to the first forecast year.

Thus the right hand side of equation (3:1) becomes:

$$\sum_{n=1}^{n=\infty} \frac{EVA_0}{(1+WACC)^n} \quad \sum_{n=1}^{n=\infty} \frac{\Delta EVA_1}{(1+WACC)^n} \quad \sum_{n=2}^{n=\infty} \frac{\Delta EVA_2}{(1+WACC)^n} + \text{etc.} \qquad ...(3:2)$$

Each of the terms of equation (3:2) is an annuity beginning in progressively future years. These annuities are easily valued (*see Appendix A*) although each future annuity needs to be brought into present value terms.

Thus equation (3:2) can be written as:

$$\sum_{n=1}^{n=\infty} \frac{EVA_n}{(1+WACC)^n} = \frac{EVA_0}{WACC} + \frac{\Delta EVA_1 / WACC}{(1+WACC)^1} + \frac{\Delta EVA_2 / WACC}{(1+WACC)^2}$$

Or;

$$\sum_{n=1}^{n=\infty} \frac{EVA_n}{(1+WACC)^n} = \frac{EVA_0}{WACC} + \sum_{n=1}^{n=\infty} \frac{\Delta EVA_n}{WACC \times (1+WACC)^n} \qquad (3:3)$$

Equation (3:3) can be substituted in equation (2:9) to give value in terms of EVA differences:

$$V = BV_0 + \frac{EVA_o}{WACC} + \sum_{n=1}^{n=\infty} \frac{\Delta EVA_n}{WACC \times (1 + WACC)^n} \qquad (3:4)$$

Calculating terminal value

The concept of terminal value

EVA valuations rest heavily on terminal value

In the previous sections, we showed that value could be based on either annual EVAs or the differences in annual EVAs. However, both approaches required EVA to be forecast for all time. Clearly, such a prospect is impractical. The usual approach is to undertake an explicit forecast covering a number of years and then to calculate the value of the EVAs or EVA differences that occur beyond this explicit forecast period. The value that occurs beyond the explicit forecast period is referred to as the terminal value (TV). Based on the two methods of EVA valuation, we can write value, including an explicit forecast and terminal value, as:

For valuations based on EVA:

$$V = BV_0 + \sum_{n=1}^{n=a} \frac{EVA_n}{(1 + WACC)^n} + TV(EVA) \quad (4:1)$$

For valuations based on EVA differences (ΔEVA):

$$V = BV_0 + \frac{EVA_0}{WACC} + \sum_{n=1}^{n=a} \frac{\Delta EVA_n}{WACC \times (1 + WACC)^n} + TV(\Delta EVA) \quad ...(4:2)$$

Where ‘a’ typically lies between 5 and 10, in other words an explicit forecast period of 5 to 10 years.

General approaches to terminal value

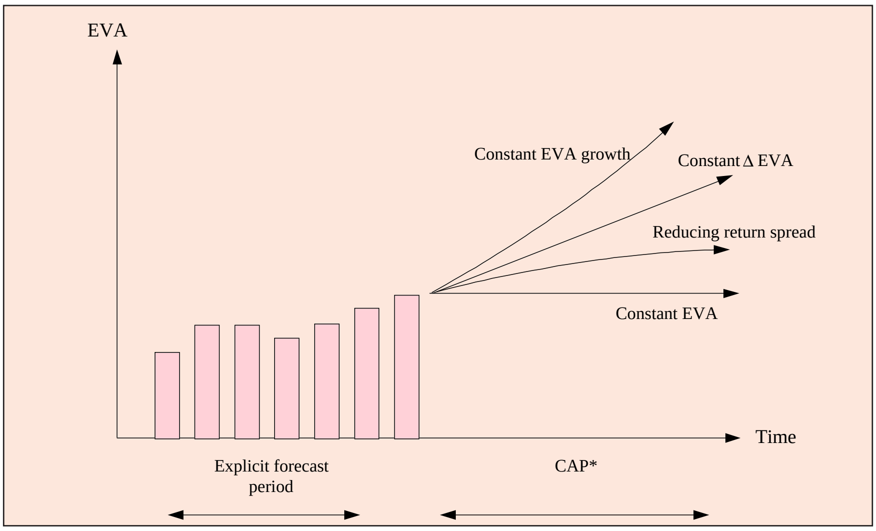
There are four approaches to terminal value...

Terminal value calculations should only be undertaken once the explicit forecast has achieved steady state conditions. Under these circumstances, key P&L, balance sheet and cash flow ratios will be identical for all future years. This permits simplifications of the standard discounting equations. The approaches that we consider for calculating terminal value in EVA valuations are:

- EVA is constant (ΔEVA = 0); the common approach.
- Reducing return spread over the competitive advantage period (CAP).
- ΔEVA is constant.
- EVA grows at a constant rate.

The first of these approaches is merely a special case of the final approach, i.e. EVA growth = 0. These four methods are shown diagramatically, and discussed in the following sections.

Chart 6: Approaches to terminal value



*CAP denotes the 'competitive advantage period' and this is, in turn, the time period over which the return spread (ROIC - WACC) reduces to zero.

Constant EVA

...constant EVA, this understates value

For EVA to be constant, either the return spread and invested capital must be constant or the return spread must be falling at the same rate as invested capital is rising. Neither of these situations is feasible. While it is quite possible for the return spread to be constant (indeed it is a necessary condition for steady stable conditions (ie ROIC = constant)), it is not possible for invested capital to be constant. If invested capital was constant, it would be very unusual for ROIC to be constant; in general, it would rise as the asset base matured. Similarly, if invested capital was rising, a very likely situation, but ROIC was falling, steady state conditions could not be in existence. Consequently, the notion of constant EVA is far from reality.

Reducing return spread over the CAP

...reducing return spread, this too understates value

The idea behind reducing return spread (and therefore EVA) over the CAP is very appealing; over time, excess returns will be competed away and therefore returns will reduce to the cost of capital. This is entirely reasonable. However, it is economic return premiums that are competed away, not accounting premiums. In reality, there will always be a difference between ROIC and WACC. Thus, if return spread was to be reduced, it should fall to a base level not necessarily to zero.

Constant ΔEVA

...constant EVA difference, again this understates value

By assuming that ΔEVA remains constant beyond the explicit forecast period, we are implicitly assuming growth in EVA progressively reduces towards zero. Thus, this valuation approach provides a terminal value between the conservative approach of constant EVA and the aggressive approach of constant EVA growth, and is similar in some respects to the reducing spread over the CAP.

Two caveats are necessary if ΔEVA is taken to be constant. First, if growth beyond the explicit forecast period is expected to be lower than in the final year of the explicit forecast, base the constant ΔEVA on the lower growth rate. Secondly, do not use constant ΔEVA if the ΔEVA in the final year of the explicit forecast period is negative.

Constant EVA growth

...and constant EVA growth, this is our preferred approach

For EVA growth to be constant, the return spread would need to be constant but the invested capital would need to be growing. These conditions are likely and are self consistent. Steady state conditions require constant ROIC (and by implication constant return spread) and a growing invested capital.

Calculating terminal values

The terminal value calculations given below rely on general valuation principles, given in *Appendix A*.

Constant EVA

If EVA is taken to be constant beyond the explicit forecast period, then the terminal value can be based on an annuity, ie:

$$\text{Cummulative value in year 'a'} = \frac{EVA_a}{WACC} \qquad (4:3)$$

In present value terms, equation (4:3) becomes cumulative value today =

$$TV(EVA) = \frac{EVA_a}{WACC\,(1 + WACC)^a} \qquad (4:4)$$

Constant EVA growth

From equation (A:6 in *Appendix A*) we can see that if the long-term growth rate in EVA is 'g', then the cumulative value at the end of the explicit forecast period is:

$$\text{Cummulative value in year 'a'} = \frac{EVA_a \times (1 + g)}{(WACC - g)} \qquad (4:5)$$

Some practitioners would find equation (4:5) to be too aggressive. In present value terms, equation (4:5) becomes

$$TV(EVA) = \frac{EVA_a \times (1 + g)}{(WACC - g)\,(1 + WACC)^a} \qquad (4:6)$$

Constant ΔEVA

If we take ΔEVA as a constant equal to ΔEVAa (ie the last ΔEVA of the explicit forecast period), the terminal value is the solution to the following equation (refer to equation (4:2)).

$$TV(\Delta EVA) = \sum_{n=a+1}^{n=\infty} \frac{\Delta EVA_a / WACC}{(1 + WACC)^n}$$

Or, rewriting this equation as:

$$TV(\Delta EVA) = \frac{1}{WACC}\sum_{n=a+1}^{n=\infty}\frac{\Delta EVA_a}{(1+WACC)^n}$$

By applying equations (30) through (36), this becomes:

$$TV(\Delta EVA) = \frac{\Delta EVA_a}{WACC^2(1+WACC)^n} \tag{4:7}$$

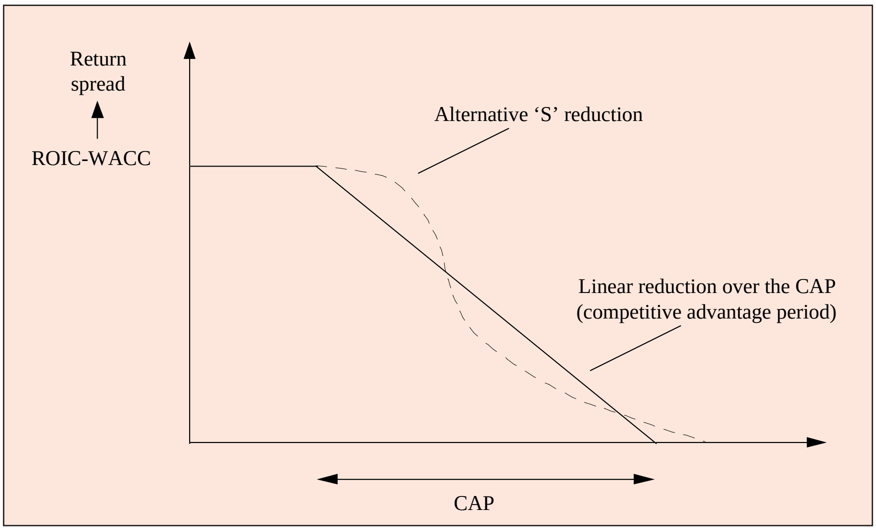
Reducing return spread over the CAP

The appeal of reducing return spread of over the competitive advantage period (CAP) is that it superficially appeals to the notion that in a competitive market, a company's return will be driven towards its cost of capital. Of course, the problem with this approach is, as we have shown in the section on 'Dynamics of EVA and EVA valuation', there is no reason to suppose that a company's accounting return (ROIC) will equal its WACC (market based return). In fact, in general, the ROIC will be greater than the WACC.

However, if we assume that the return spread linearly reduces to zero over the CAP (see chart 7) the terminal value is given by:

$$TV(EVA) = \frac{EVA_a}{CAP + a - 1}\sum_{n=a+1}^{n=CAP}\frac{CAP + a - n}{(1+WACC)^n} \tag{4:8}$$

Chart 7: Reducing return spread over the CAP



Preferred approach: constant growth in EVA

While many commentators would view the assumption of constant growth in EVA as too aggressive, if at the end of the explicit forecast period steady state conditions have been achieved, then this approach is perfectly valid. In fact, it is the only approach that is consistent with the notion of steady state conditions.

Once steady state conditions have been achieved, the return spread will be constant and therefore EVA will grow in line with growth in the asset base.

We can write the growth in the asset base as:

$$g_{BV} = \frac{BV_1 - BV_0}{BV_0}$$

but we can replace $BV_1 - BV_0$ with ΔA_1 and:

$$BV_0 = \frac{EVA_1}{(ROIC - WACC)}$$

Thus

$$g_{BV} = \frac{\Delta A_1}{EVA_1}(ROIC - WACC)$$

Equation (4:3) can be used to estimate the terminal growth rate.

On this basis the EVA valuation is:

$$V = BV_0 + \frac{EVA_a(1 + g_{BV})}{(WACC - g_{BV})(1 + WACC)^a} + \sum_{n=1}^{n=a} \frac{EVA_n}{(1 + WACC)^n} \quad (4:9)$$

Where 'a' typically lies between 5 and 10, in other words, an explicit forecast period of 5 to 10 years and 'g' is the growth in EVA beyond the explicit forecast period.

The assumption that the return spread remains constant could be an aggressive assumption. While at the end of the explicit forecast period, steady state conditions should have been reached if they have not, the return spread will tend to be overstated (or possibly understated if annual EVAs have been moving from negative to positive during the explicit forecast period)

Implications of the correct terminal value

To examine the implications of the different approaches to terminal value, care needs to be taken with the ΔEVA approach as it already captures part of the terminal value in the treatment of ΔEVAs as annuities during the explicit forecast period. Consequently, it is useful to consider total value, but with the explicit forecast period collapsed to zero and the opening book value (BV_0) taken as zero. This approach allows us to focus only on the components affecting the terminal value.

Thus the three formula are:

EVA = constant

$V1 = EVA_0 / WACC$

EVA = constant growth

$V2 = EVA_0 (1 + g) / (WACC - g)$

ΔEVA = constant

$V3 = EVA_0 / WACC + \Delta EVA_0 / WACC^2$

We can now examine the ratio of the different terminal value approaches to the correct approach (V2). For convenience, we have replaced WACC with 'W'. From the above equations, we can see that:

$$V1 / V2 = (W - g) / (W (1 + g)) \qquad (4:10)$$

and

$$V3 / V2 = (W - g) / (W (1 + g)) + \Delta EVA_0 (W - g) / (W^2 . EVA_0 (1 + g))$$

The equation for V3 / V2 can be simplified by noting that:

$$\Delta EVA_0 = EVA_0 - EVA_{-1}$$

and

$$EVA_0 = (1 + g) EVA_{-1}$$

Combining these equations, and taking 'g' as the first year growth in EVA, gives:

$$\Delta EVA_0 / EVA = g / (1 + g)$$

Therefore, we can write:

$$V3 / V2 = (W - g) / (W (1 + g)) + g(W - g) / (W^2 (1 + g)^2)$$

or

$$V3 / V2 = (W - g) / (W (1 + g)) (1 + g / (W(1 + g)))$$

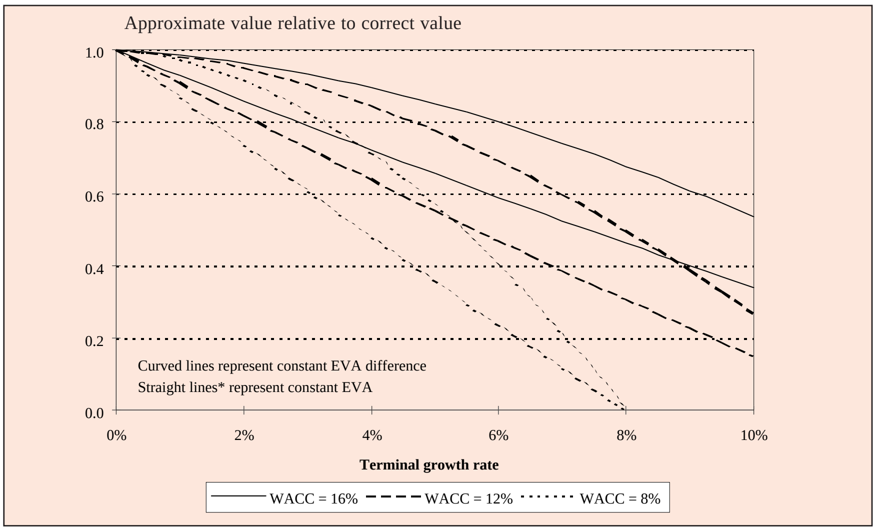
or

$$V3 / V2 = V1 / V2 \times (1 + g / (W(1 + g))) \qquad (4:11)$$

Equations (4:10) and (4:11) are plotted in Chart 8 and show quite clearly that:

- Assuming constant EVA can lead to very significant errors. Error increases as the terminal growth increases.
- Assuming constant ΔEVA is closer to the correct value than assuming constant EVA for all values of growth and WACC.

Chart 8: Implications of correct terminal value



*Lines are not actually straight but the curvature is almost imperceptible.

Therefore, the effect of the common approach to EVA valuation, that of assuming EVA is constant beyond the explicit forecast period, systematically undervalues companies as does the less often used 'ΔEVA = constant' approach.

Reward and assessing management

EVA has grown rapidly as a method of assessing the performance of management. Performance assessment is usually based on:

- Absolute level of EVA.
- Change in the absolute level of EVA.

Advocates of EVA generally propose that management bonuses should be based on a percentage of these two measures.

However, in our opinion, great caution should be exercised in using EVA in either of these ways. We base this opinion on the analysis given in the previous sections and summarise our key concerns below.

Reward as a % of EVA: EVA represents the value added to the accounting value of the firm. As such, it is affected by the accounting policies of the firm and the specific adjustments made to the data. Thus, it can be influenced by management in a similar way to the earnings growth or other traditional reward measures. Not only can EVA be manipulated by using the full latitude of accounting policies but management could also shift investment to areas of higher inflation or slow the rate of capital spend. Unlike the accounting changes, these latter two factors could negatively, rather than positively, influence the value of the company. Finally, factors over which management have no control, such as inflation or exchange rates, can also influence EVA and therefore management reward.

Thus, absolute EVA and ΔEVA will not necessarily reflect any changes in management competencies or improvements in the business, and therefore using either of these measures to reward management or, more generally, to assess corporate performance, may be inappropriate.

Part 3: Appendices

Appendix A: Terminal value

The what and why of terminal value

In all discounting methods of valuation, it is necessary to forecast the quantity being valued (EVA, dividend, free cash flows, etc) for all time. Quite clearly, forecasting over an infinite time period is impractical. In fact, if such an analysis was undertaken, eventually the forecast would settle down to steady state conditions or trend. Fortunately, we can simplify the discounting process if steady state conditions have been achieved. This simplified discounting process provides a terminal value. **Thus, a terminal value is calculated once steady state conditions have been achieved, and such conditions will signal the end of the explicit forecast period.**

Calculating terminal value in general

The general form that a discounting approach to valuation takes is:

$$V = \sum_{n=1}^{n=\infty} \frac{Z_n}{(1 + DR)^n} \quad \text{(A:1)}$$

Where 'Z' is the quantity being discounted (it could be EVA, dividend or free cash flow or a number of other measures), 'n' denotes the year and DR is the discount rate (usually either the weighted average cost of capital or the cost of equity or whatever is consistent with the quantity being discounted).

When steady state conditions have been achieved, rates of return will be constant, as will growth rates.

With constant returns, growth rates will be driven by the growth in invested capital or in equity. It is common practice to take these growth rates as the long-run growth in the stock market unless there is a clearly justifiable reason for adopting a different growth rate. In the next section on terminal value for EVA calculations, we show how to calculate the terminal growth rate from the conditions at the end of the explicit forecast period. If the growth so calculated is different from that of the market or from expectations, steady state conditions may not have been reached.

Under conditions of constant growth:

$Z_n = Z_0 \times (1 + g_Z)^n$

Where g_Z is the year-on-year growth rate of Z. Thus equation (A:1) becomes:

$$V = \sum_{n=1}^{n=\infty} \frac{Z_0 \times (1 + g_Z)^n}{(1 + DR)^n} \quad \text{(A:2)}$$

If we now expand equation (A:2), we obtain:

$$V = \frac{Z_0 \times (1 + g_Z)^1}{(1 + DR)^1} + \frac{Z_0 \times (1 + g_Z)^2}{(1 + DR)^2} + \frac{Z_0 \times (1 + g_Z)^3}{(1 + DR)^3} + \ldots \qquad (A{:}3)$$

If we now multiply each side of equation (A:3) by (1 + gZ)/(1 + DR), we obtain:

$$V \times \frac{(1 + g_Z)}{(1 + DR)} = \frac{Z_0 \times (1 + g_Z)^2}{(1 + DR)^2} + \frac{Z_0 \times (1 + g_Z)^3}{(1 + DR)^3} + \ldots \qquad (A{:}4)$$

The next step is to subtract equation (A:4) from equation (A:3) to give:

$$V - V \times \frac{(1 + g_Z)}{(1 + DR)} = \frac{Z_0 \times (1 + g_Z)^1}{(1 + DR)^1} \qquad (A{:}5)$$

Equation (34) can be re-written as:

$$\frac{V \times (1 + DR) - V \times (1 + g_Z)}{(1 + DR)} = \frac{Z_0 \times (1 + g_Z)}{(1 + DR)}$$

or, simplifying further:

$$V = \frac{Z_0 \times (1 + g_Z)}{(DR - g_Z)} = \frac{Z_1}{DR - g_Z} \qquad (A{:}6)$$

Equation (A:6) is the general formula used for terminal value purposes. Remember that when using this formula, Z0 refers to the last value of Z in the explicit forecast period and V is the value of all future values of Z beyond the explicit forecast period. Consequently, V needs to be converted to a present value by multiplying by the present value factor for the last forecast year ($=1/(1+DR)^a$) where ‘a’ typically lies between 5 and 10 and represents the explicit forecast period, ie between five and 10 years.

A special case of equation (A:6) is for gZ = 0, which gives:

$$V = \frac{Z_0}{DR} = \frac{Z_1}{DR} \qquad (A{:}7)$$

This is known as the value of an annuity.

Appendix B: Present value calculations

Calculating present value

If an investor had the choice between £15k now or £20k, guaranteed, in four years' time, which would he choose? Hopefully, the investor would calculate the amount that would be returned in four years' time if the £15k was invested in a totally safe (guaranteed) scheme. For example, a government bond might pay 7% interest and if the interest was reinvested, the £15k would become:

Table 17: Over time, capital increases in value

Year	Value at start of year (£k)	Increase in value	Value at end of year (£k)
1	15.00	15.00 ´ 1.07	16.05
2	16.05	16.05 ´ 1.07	17.17
3	17.17	17.17 ´ 1.07	18.38
4	18.38	18.38 ´ 1.07	19.66

On the basis of the calculation above, the investor should opt for the £20k in four years' time.

Another way of interpreting Table 17 is to say that a guaranteed payment of £19.66k in four years' time is equivalent to £15k now, ie:

£15k = £19.66k / (1 + 7%)^4 = £19.66k / 1.311

Where '^4' means raised to the power of 4 (or multiplied by itself 4 times, ie (1 + 7%) × (1 + 7%) × (1 + 7%) × (1 + 7%))

The process of bringing the future cash payment into an equivalent money of today (or present value) is known as **discounting**. The **discount rate** is 7% and the **present value factor** is 0.763 (=1 / 1.311).

The example given above presupposes that that the investor would invest the £15k in something that would give the same level of security that was offered by the £20k payment in four years' time. What if the investor had the opportunity to invest now in a speculative venture that might, in four years time, have a realisable value of £65k? While the investor has potential to make a lot more money, there is no guarantee that the potential will be realised. The most sensible thing to do is to consider the return that would be available from some alternative investment opportunity of similar risk. Assume that this analysis was done and that, typically, similar investment opportunities returned 35% pa. The investor would complete the analysis as follows:

Discount rate	35%
Present value factor	1 / ((1 + 35%)^4) = 0.301
Present value of £65k	£19.57k

Clearly, the investor should not invest in the speculative venture as it is described above.

In this example, the **discount rate** is 35% and this is a **risk adjusted** discount rate that represents the **opportunity cost of capital**.

Discounting a stream of income

The previous example considered a single payment at some time in the future. Discounting a stream of income simply treats the incidence of each payment as a single payment and adds the present value of these together. This is illustrated in Table 18.

Table 18: Discounting a stream of income

Year	Cash payment	Formula for present value factor	Discount rate (DR)	Present value factor	Present value	Cumulative present value
1	15.0	1/(1+DR)^1	11%	0.901	13.5	13.5
2	27.0	1/(1+DR)^2	11%	0.812	21.9	35.4
3	42.0	1/(1+DR)^3	12%	0.731	30.7	66.1
4	12.0	1/(1+DR)^4	12%	0.636	7.6	73.8
5	9.0	1/(1+DR)^5	12%	0.567	5.1	78.9

Discounting cash flows over uneven time periods

So far, we have assumed that the first cash payment is one year away from today and that every other payment follows at intervals of one year. We need to consider two alternative possibilities:

- First payment is less than a year away but payments thereafter are at intervals of one year.
- The intervals between payments are all different.

First payment less than a year away

If an annual discount rate has been determined, which is usually the case, we first need to reduce it into a past year discount rate. This is straightforward; if the annual discount rate is ‘DR’, then the monthly discount rate ‘dr’ would be related to it as follows:

$$\frac{1}{(1 + dr)^{12}} = \frac{1}{1 + DR}$$

or $(1 + dr) = (1 + DR)^{1/12}$

In other words, the present value factor for a single payment after one year based on annual discount rates must be equivalent to the present value factor for a single payment in 12 months time based on monthly discount rates.

If we now had cash payments of ‘a’, ‘b’, ‘c’... occurring after 3, 15, 27, ...months respectively, the cumulative present value (cum pv) would be given by:

$$\text{Cum pv} = \frac{a}{(1 + DR)^{1/12}} + \frac{b}{(1 + DR)^{15/12}} + \frac{c}{(1 + DR)^{27/12}} + \ldots$$

or

$$\text{Cum pv} = \frac{1}{(1 + DR)^{-9/12}} \left(\frac{a}{(1 + DR)^{1}} + \frac{b}{(1 + DR)^{2}} + \ldots \right)$$

Thus, if a series of annual cash flows begin in 'm' months' time, then we can calculate the cumulative present value as if the first payment occurred in 12 months' time and multiply this cumulative present value by (1 + DR) ^((12 - m) / 12). We term this adjustment as **'starting adjustment to present value'.**

Mathematical note: When one number 'raised to the power of ...' is multiplied by the same number raised to a different power of ... the two 'powers' are added, eg

$4^2 \times 4^3 = (4 \times 4) \times (4 \times 4 \times 4) = (4 \times 4 \times 4 \times 4 \times 4) = 4^5$

When one number 'raised to the power of ...' is divided by the same number raised to a different power, the two 'powers' are subtracted, eg:

$4^2 \times 4^3 = (4 \times 4) / (4 \times 4 \times 4) = 1/4 = 4^{-1}$

Different intervals between payments

In effect, the previous section dealt with this issue. If, for example, we had 3 payments a, b and d occurring 4, 7 and 35 months from now, the cumulative present value would be:

$$\text{Cum pv} = \frac{a}{(1 + DR)^{4/12}} + \frac{b}{(1 + DR)^{7/12}} + \frac{c}{(1 + DR)^{35/12}}$$

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