Counting the cost

Europe

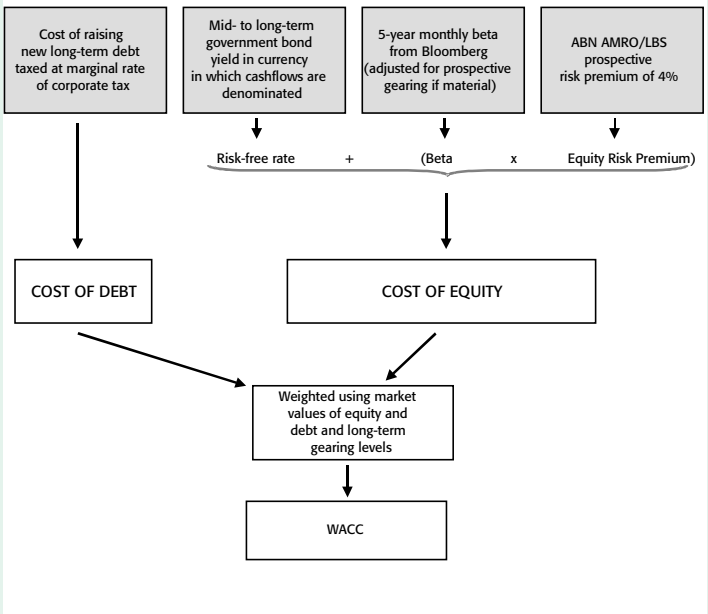
Accounting and valuation issues

2 April 2001

A cost of capital guide

- **The sensitivity of contemporary equity valuation techniques to the cost of capital demands the use of an appropriate, transparent, consistent and theoretically rigorous methodology in arriving at WACC.**
- **This note details the assumptions used in ABN AMRO WACC calculations and explains the theoretical background to our methodology.**
- **The key inputs to and assumptions underlying WACC are summarised in the following diagram.**

ABN AMRO European WACC



Source: ABN AMRO

- **This note is the first in a series of ABN AMRO valuation guides.**

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A cost of capital guide

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Summary

Contemporary equity valuation techniques are extremely sensitive to WACC

The Weighted Average Cost of Capital (WACC) represents the weighted average of the returns required by providers of debt and equity finance to a company. WACC is critical to many contemporary equity valuation techniques. Enterprise values obtained from discounted cash flow (DCF) or Economic Value Added (EVA) models are extremely sensitive to the WACC that is used to discount the forecast cash flows and EVAs. For example, a company with a free cash flow in year 1 of 100m, followed by growth of 8% for four years, 6% for two years, 5% for three years and terminal growth of 4% will demonstrate the following sensitivity around a central case WACC of 9%.

Sensitivity to WACC - % reduction in enterprise value as WACC increases

WACC (%)	9.0	9.25	9.50	9.75	10.0
Reduction in EV (%)	-	4.9	9.4	13.4	17.1

Source: ABN AMRO estimates

DCF and EVA models require an estimation of investors' required rates of return. This is an imprecise science. Because of the inevitable uncertainty of the future, there is no correct forecast WACC, but it can certainly be incorrect due to a failure to apply appropriate methodology and assumptions that are consistent with other forecast figures in a model.

It is essential that ABN AMRO European Analysts apply an appropriate, transparent, consistent and theoretically rigorous methodology in arriving at WACC.

Assumptions, inputs, theory and disclosure requirements are addressed in this note

This note:

(i) prescribes the key assumptions and inputs that should be used in all elements of the WACC calculation;

(ii) explains the theoretical background to all elements of the WACC calculation; and

(iii) specifies the disclosure requirements that are required for WACC-based calculations.

Definition

WACC is the weighted average of the costs of debt and equity financing.

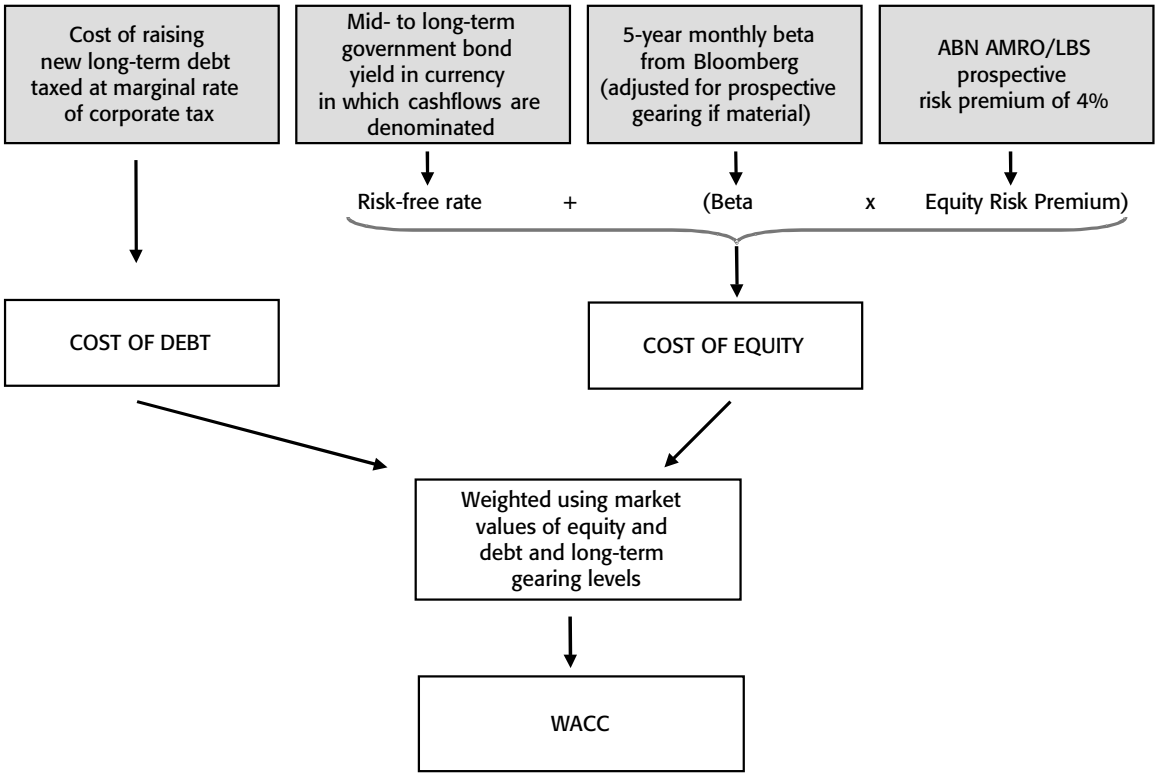
WACC = Ke x E/(D+E) + Kd(1-t) x D/(D+E)

where

Ke	=	Cost of equity
Kd	=	Cost of debt (pre-tax)
E	=	Market value of equity
D	=	Market value of (net) debt or book value if market value is unavailable
t	=	marginal rate of corporate tax attached to the company's debt

The ABN AMRO assumptions and standardised inputs can be summarised by the following diagram.

ABN AMRO European WACC



Source: ABN AMRO

Cost of equity (Ke)

Capital Asset Pricing Model (CAPM)

A risk-premium model

CAPM is our preferred method of calculating the cost of equity. It is the most widely used model and mathematically simple to use. The CAPM is a risk-premium model that assumes that anyone holding a risky security will demand a return in excess of the return they would receive from a risk-free security and that the additional return is proportional to the amount of risk faced.

Systematic and unsystematic risk

Risk is the degree of variability anticipated in expected future returns.

Systematic risk affects the returns of all companies and is non-diversifiable

Systematic (also known as non-specific or non-diversifiable risk) is the uncertainty of future returns due to factors that affect the market as a whole. This risk is largely caused by macroeconomic factors such as inflation, interest rates, GDP growth or political events, which affect the returns of all companies. This risk cannot be diversified away. As the ultimate proof of this, an investor who holds all stocks in an index will still be subject to the variability in that index's returns. Investors must accept systematic risk unless they choose to invest entirely in risk-free investments. In return for accepting systematic risk, an investor will expect to earn a return that is higher than the return on a risk-free investment.

Unsystematic risk is company-specific and is diversifiable

Unsystematic risk (also known as specific or diversifiable risk) is the uncertainty of future returns due to characteristics of the industry or the individual company. Company-specific characteristics include the quality of management, the product type and mix, location of the business, etc. Unsystematic risk can be diversified away. If investors diversify their investments in a suitably wide portfolio, the investments that perform well and those that perform badly due to specific risk factors should tend to cancel each other and much risk will be diversified away.

Assumptions of CAPM

Only systematic risk is relevant to CAPM

One of the key assumptions of CAPM is that investors are fully diversified. Therefore, the only risk relevant to CAPM is systematic risk. CAPM assumes that investors require a return in excess of the risk-free rate as compensation for accepting systematic risk. Systematic risk varies between companies and rational investors will require a higher return from companies where the systematic risk is greater. In CAPM investors do not require an additional premium for unsystematic risk because they have diversified this away and are not subject to this risk. Therefore, if CAPM theory is being applied, it is incorrect to risk-load the beta or equity risk premium (described below) to reflect risk due to company specific factors because this is inconsistent with the basic assumptions of CAPM.

Do not risk-load beta for company specific factors

The other key assumptions of CAPM are detailed in Appendix 1.

CAPM formula for the cost of equity

The CAPM cost of equity can be estimated using the following formula:

Cost of equity	=	Risk-free rate + (Beta x Equity risk premium)
i.e. Ke	=	Rf + βRp

The risk-free rate

Yield on government bond is a proxy for Rf

Under CAPM, the risk-free rate represents the return available from a security or portfolio of securities that has no default risk. It is impossible to find such a perfect security so the yield on a government bond is used as a proxy.

Maturity

Use medium- to long-term government bonds

It is preferable to use a medium- to long-term government bond because this will come closest to matching the pattern of cash flows of the company being valued. Short-term bonds will not achieve this. They will also fluctuate considerably more than longer-term bonds and this would introduce distortions into the cost of capital.

Currency

Reflect the currencies of the company's cash flows

The risk-free rate should reflect the currency(ies) in which the cash flows of the company are denominated. In this way, the cost of capital reflects the inflation rate and interest rate which are implicit within the forecast cash flows.

Inflation

Create a nominal cost of capital

The risk-free rate includes inflation. Therefore, if the cost of capital is being used to discount future cash flows, these cash flows must also reflect the effect of inflation, ie we create a nominal cost of capital that must be used to discount cash flows that are also in nominal terms.

Beta

The nature of beta

Quantification of a linear relationship between risk and return

CAPM calculates the cost of equity as the risk-free rate of return plus a premium for risk where that premium bears a linear relationship to the risk being faced by a diversified investor. For example, if a stock displays a level of market risk twice that of the market, then its risk premium will be twice that of the market. Beta quantifies this linear relationship.

Beta reflects systematic risk factors only

The beta of the market as a whole is 1.0. If returns from a company tend to vary twice as much as returns from the market as a whole, then an excess market return (market return less risk-free return) of 4% will produce an expected excess return from the company of 8%. The company's beta will be 2.0. Similarly, if the market return rises by 1%, a company with a beta of 1.5 would be expected to generate a rise of 1.5% (1.5 x 1%) in response to the same conditions that have caused the return on the market to change. The actual change in return from the company may be different from 1.5%, but the change due to market conditions will be 1.5% and any additional rise or fall will be due to unsystematic risk factors attributable to the company or its sector. Therefore, a volatile stock will not necessarily produce a high beta. If the volatility is not caused by factors that have affected the market as a whole, the stock will, in fact, have a low beta.

As discussed above, CAPM assumes that unsystematic risk can be diversified away. Therefore, in a diversified portfolio, gains and losses from unsystematic risk on different investments will cancel out. This results in diversified portfolio returns being dependent only on changes in the market return and the betas of shares in the portfolio.

The source of beta

Measurement of excess returns on a stock relative to excess returns on the market

Several data suppliers produce estimates of historical betas. Estimates are generally based on measurements of excess returns (dividends and capital gains/losses in excess of the risk-free rate) on a stock relative to excess returns on the market index.

Appendix 2 illustrates the calculation and interpretation of beta.

Betas from different sources may not agree due to the choices made for the following key variables:

(i) the time period over which measurements are made;

(ii) the frequency of measurements within the chosen time period;

(iii) the risk-free rate;

(iv) the market index.

Use five-year monthly beta from Bloomberg

ABN AMRO betas should be obtained from Bloomberg. The five-year monthly beta is preferable to betas measured over a shorter period because it is generated from a greater number of monthly measurements. This generally produces a more stable beta as it helps to reduce the impact of unusually high or low returns.

If a beta is unavailable for a stock or if the value appears unreliable because it unexpectedly falls outside the typical or expected range (discussed below), a value can be estimated by using a beta from a company in the same sector with similar operating characteristics. This beta may require adjustment to reflect the appropriate level of gearing, as discussed below.

Adjustment of historical betas for gearing

Gearing increases beta

Betas are affected by a company's gearing. The risk to equity investors in a geared company is higher than in an ungeared company because the costs of debt financing must be met before a return can be made to equity investors. This financial risk is part of systematic risk and is reflected in a company's beta.

Consider adjustment of historical beta to reflect forecast gearing

A historical beta will reflect the capital structure during the measurement period. This beta should be adjusted if it is to be used in DCF and discounted EVA models when the forecast capital structure is materially different from the historical capital structure. This can have a significant impact on the cost of equity because the beta is multiplied by the equity risk premium in the CAPM cost of equity calculation. Forecast changes in the capital structure can be accommodated by:

(i) creating a single stage model, using one WACC which reflects the average forecast capital structure to discount each period; or

(ii) creating a multi-stage model, using a different WACC at each stage to reflect the forecast average capital structure in each stage. This should be considered if there is a significant and persistent change in capital structure at one or more points in time.

Degear and regear beta using these formulae if material

The relationship between geared and ungeared betas is as follows:

$$\beta u = \beta g \times Eg/(Vg - Dt) \qquad \text{Formula 1}$$

or rearranged this becomes

$$\beta g = \beta u + \beta u \times D(1 - t)/Eg \qquad \text{Formula 2}$$

where

βu	=	beta of an ungeared company
βg	=	beta of a geared company
Eg	=	market value of equity in a geared company
D	=	market value of debt in a geared company or book value if market value is unavailable
Vg	=	value of the geared company (debt and equity)
t	=	marginal rate of corporate tax on the company's debt

To regear a beta from one level of gearing to another, it is necessary to:

(i) degear the beta, ie calculate βu using formula 1 above and then

(ii) regear the beta to the appropriate level of gearing, ie calculate βg using formula 2 above.

An example of degearing and regearing a beta is shown in Appendix 3.

The typical range of beta

Consider adjustment of unusually high or low betas over a forecast period

Most betas fall within the range of 0.6 to 1.5. If a company's beta falls outside this range, then its returns appear to be extremely sensitive (high beta) or insensitive (low beta) to factors that affect the returns of the market as a whole over the measurement period. The conditions that are causing this are unlikely to persist. Therefore, analysts should consider whether it is appropriate to change the beta over the forecast period towards the mid-point range.

The equity risk premium

ABN AMRO's estimation of the equity risk premium is based on the ABN AMRO/LBS Millennium Book II

The equity risk premium is the excess return above a risk-free rate that investors demand for holding risky securities. The risk premium in the CAPM is the premium above the risk-free rate on a portfolio with a beta of 1.0. Numerous estimates exist for the risk premium. Differences will arise due to the methodology used and the assumptions that are made. ABN AMRO's estimation is based on *The Millennium Book II – 101 Years of Investment Returns,* published in February 2001 by ABN AMRO and London Business School.

Ex post analysis

Different assumptions and inputs will affect a historical risk premium

Ex post or historical analysis is a common method for estimation of the risk premium. This historical analysis will produce different results depending on the proxy used for a risk-free rate, the use of geometric or arithmetic mean calculations and the time period of measurement.

Proxy for a risk-free rate

Long-term bonds are the preferred proxy for a risk-free rate

Treasury bills or long-term government bonds are typically used as the risk-free benchmark. Long-term bonds are riskier than bills. They offer a fixed income and the likelihood of default is remote, but they are more sensitive to changes in real interest rates and to inflationary pressures. Therefore, a risk premium established from bonds will be lower than the premium relative to bills. However, long-term bond prices reflect future interest rate expectations, which is appropriate if the cost of capital is being used in long-term forecasts.

Geometric and arithmetic means

The equity risk premium can be measured as a geometric or an arithmetic difference between the equity return and the risk-free return.

Geometric mean is an annually compounded rate

The geometric mean is calculated by adding 1 to the excess return for each period, calculating the product, taking the root of the number of periods and subtracting 1 at the end. This produces an annually compounded rate of excess return.

Arithmetic mean is a straightforward average

The arithmetic mean is calculated by adding the excess returns for each period and dividing by the number of periods.

The difference can be illustrated by considering a non-dividend-paying stock with a share price of 10 that rises to 20 after one year and falls back to 10 after another year. The arithmetic average return is 25% ((100% - 50%)/2). The geometric average return is 0% because it is the unique compound rate of return that equated the beginning and end values.

Geometric mean is preferable for measurement of historic premia

If the equity risk premium is to be estimated from historical returns, we prefer the use of the geometric average because it gives a better estimate of investors' expected returns over long periods of time. Additionally, the arithmetic average is affected by the measurement periods. For example, an arithmetic average of monthly returns will be higher than an arithmetic average of annual returns, but a geometric average will be unaffected because it is a single estimate for the entire period.

The time period of measurement

The equity risk premium is very variable on a year-to-year basis. Therefore, it is appropriate to look at long time periods if any conclusions are to be made about an average equity risk premium.

The ABN AMRO/LBS Millennium II study calculated the average equity risk premium over a period of 101 years for 15 countries. In some countries, certain periods of time have been excluded because they produced unusual returns due to, for example, hyperinflation.

Equity risk premia relative to bond returns, 1900-2000

Equity premium	Geometric mean
Australia	6.3
Belgium	3.0
Canada	4.5
Denmark (from 1915)	2.2
France	5.0
Germany (99 years ex 1922-3)	6.7
Ireland	4.0
Italy	5.0
Japan	6.3
Netherlands	4.7
Spain	3.2
Sweden	5.5
Switzerland (from 1911)	2.7
UK	4.4
USA	5.0

Source: Millennium Book II, ABN AMRO/LBS

The use of the historic risk premium

A prospective risk premium is preferable for forecast models

An estimation of the prospective risk premium is required for use in a cost of capital that is being used to discount future cash flows or EVAs. Estimates of the historic risk premium are used frequently as a proxy for the prospective risk premium. However, historic returns have been influenced by many events that are unlikely to recur. Consequently the ABN AMRO/LBS study decomposes our historic risk premium to provide an estimate of the prospective risk premium.

The ABN AMRO Prospective Risk Premium

Historic risk premium less unanticipated cash flows less fall in required risk premium = prospective risk premium

The ABN AMRO/LBS study removes the impact of unanticipated cash flows and a fall in the required risk premium from our estimate of the historic risk premium. This leaves an estimate of the risk premium demanded by investors. This is assumed to remain constant and becomes our estimate of the prospective risk premium.

The impact of unanticipated cash flows is estimated by comparing the year's real dividend growth to the real growth rate that would have been projected at the beginning of the year. These unanticipated changes in dividend growth are compounded to produce an estimate of their annualised impact over the last 100 years.

The fall in the required risk premium is estimated by examining the price/dividend ratio. This ratio has increased over the last 100 years and we assume that this is attributable only to a fall in the required risk premium.

Arithmetic mean is preferable for forecast periods

This analysis produces an expected risk premium across an index of 15 countries of 3–4% on a geometric mean basis and 4–5% on an arithmetic mean basis. The arithmetic mean should be used in a prospective risk premium because it calculates the average expected return for the future as a whole. The countries in the study included Belgium, Denmark, France, Germany, Ireland, Italy, the Netherlands, Spain, Sweden, Switzerland and the UK, and the 15 countries represent over 87% of global stock market capitalisation.

Our pan-European prospective equity risk premium is 4%

Our historical analysis shows that differences in risk have existed between countries and some of these differences may continue to exist. However, some historical variations have been caused by non-recurring, country-specific events and there is clearly increasing globalisation in capital markets. Therefore, within Europe we will use a single pan-European prospective equity risk premium of 4%.

Cost of debt

The current cost

Use cost of raising new debt

The relevant cost of debt for the WACC calculation is the current cost of raising new debt finance, because this reflects the return required now by providers of debt finance. It is common practice to base this estimate on the company's debt instruments already in existence.

The yield to maturity

Calculate the current yield to maturity

The cost of debt can be estimated by calculating the current yield to maturity on the company's own outstanding debt. If the rate of interest the company is currently paying is not a current market rate, then an estimate will have to be made of a market rate that is appropriate for that company's capital structure and operational activity. An estimate could be based on the risk free-rate plus a premium.

Long-term debt

Use long-term debt instruments

The rate on long-term debt is relevant for the cost of debt calculation. This is because the WACC will usually be used to discount future cash flows or EVAs and it is important to match time horizons. Additionally, long-term rates will incorporate inflation expectations, but short-term rates do not.

The weighted average of all types of debt

Consider all interest-bearing liabilities in the cost of debt

All types of interest-bearing liabilities should be included in an estimation of the company's cost of debt. This includes convertible debt, leases, non-equity share capital and unfunded pension liabilities.

Appendix 4 provides examples of the estimation of the cost of debt derived from these different instruments.

The overall cost of debt will be the weighted average of all the debt instruments weighted by their market value (or book value if market value is unavailable).

Marginal rate of taxation

Use marginal rate of tax to provide tax relief

The interest on debt capital is an allowable deduction for corporate tax purposes in virtually all countries. The tax relief on interest needs to be recognised in DCF and discounted EVA models and it is conventional to recognise it in the WACC calculation by the use of a post-tax cost of debt. The marginal tax rate should be used. This is the rate that applies to the highest tax band into which the company's income falls. This may be different from the statutory rate due to, for example, tax losses. If the WACC is to be used in a DCF or discounted EVA model, an estimate should be made of the tax rates that will be applicable over the forecast period.

The weighting of debt and equity

Market values

Weight debt and equity using market values

Market values, despite their volatility, should be used for weighting the costs of debt and equity. Rates of return required by debt and equity holders will be based on market values instead of book values, which are vulnerable to different accounting treatments between companies. However, if the market value for debt is unavailable, the book value should be used.

Net debt

Be consistent in the use of net or gross debt figures within an entire model

Weightings can be based on gross or net debt. It is important to ensure consistency between the components of the WACC and its use within a model. For example, if gross debt is used in WACC within a DCF, then cash flow forecasts prior to the costs of financing gross debt must be prepared. This requires forecasting of interest receivable. We recommend the use of net debt because it avoids the necessity to forecast any interest receivable. It also recognises the fact that cash balances may be held to discharge debt so that a net debt figure is more representative of the capital structure.

Forecast capital structure

Use forecast (net) debt and equity figures

If WACC is being used in a DCF or EVA model, the weighting of (net) debt and equity should reflect forecast levels of (net) debt and equity. If significant changes in capital structure are anticipated, analysts should consider the use of multi-stage models where different WACCs are used in different time periods.

Disclosure

Components of WACC

Disclose elements of the WACC calculation

If WACC-based models constitute the key part of the valuation methodology, it is essential that the key components of WACC are disclosed in a note, together with their sources.

Example of WACC disclosure

Cost of equity:	Source	
Risk-free rate (Rf)	10 year gilt yield	4.7%
Beta (β)	5 year monthly - Bloomberg	1.2
Equity risk premium (Rp)	ABN AMRO/LBS prospective risk premium	4.0
Cost of equity (Rf + βRp)	CAPM	9.5%
Cost of debt:		
Cost of long term debt (kd)	ABN AMRO estimate	6.0
Marginal tax rate (t)	ABN AMRO estimate	30%
Post-tax cost of debt ((1-t)kd)	ABN AMRO estimate	4.2%
Forecast weighting of net debt/equity	ABN AMRO estimate	45/55
WACC		7.1%

Source: As indicated above

Sensitivity analysis

Sensitivity analysis is essential in DCF or discounted EVA models

Derived enterprise values in DCF and discounted EVA models are extremely sensitive to WACC. Therefore, it is essential to present a sensitivity analysis. A good sensitivity analysis in a DCF analysis combines WACC and terminal growth rates. This is because a significant proportion of the derived enterprise value is dependent on the terminal value, where the growth rate is critical.

Example

A company with a free cash flow in year 1 of 100m, followed by growth of 8% for four years, 6% for two years, 5% for three years, and a central case terminal growth rate of 4% and WACC of 9% will produce an EV of 2.4bn. It will demonstrate the following sensitivity to WACC and terminal growth rates.

Example: Sensitivity of EV to WACC and terminal growth rate

		Terminal growth rate				
		3.0%	**3.5%**	**4.0%**	**4.5%**	**5.0%**
	8.0%	2,585	2,781	3,027	3,343	3,764
	8.5%	2,340	2,494	2,683	2,919	3,222
WACC	**9.0%**	2,136	2,259	**2,407**	2,589	2,815
	9.5%	1,964	2,064	2,183	2,325	2,498
	10.0%	1,817	1,899	1,995	2,109	2,245

Source: ABN AMRO estimates

Appendix 1

Assumptions of the CAPM

CAPM makes numerous assumptions

CAPM provides a theoretical framework as to how investors will behave if certain assumptions are applied. Not all of CAPM's assumptions hold in the real world, but CAPM remains the most widely used model for estimating the cost of equity.

The principal assumptions of the CAPM are:

1. Investors are risk-averse, ie investors seek to minimise risk for any given level of return.
2. Rational investors hold fully diversified portfolios.
3. All investors have identical expectations about variables such as expected rates of return and risk.
4. There are no transaction costs.
5. There are no investment-related taxes.
6. The market has perfect divisibility and liquidity.

Several studies question its assumptions, but CAPM remains the most widely used model

Clearly, these assumptions may not hold perfectly, but they are generally considered to be sufficiently true for the model to have validity. However, several studies have generated criticism of CAPM including:

1. There is no linear relationship between beta and expected returns.

Several studies, most famously the study of Fama and French in 1992, have indicated that there has been, at best, a weak relationship between returns and beta over some lengthy time periods.

2. The CAPM does not adequately describe the risk and return relationship.

Various studies have been carried out that indicate that some stocks consistently produce higher or lower returns than would be predicted by CAPM. These stocks must be abnormally sensitive to systematic risk. One of the identified anomalies is the 'size effect' that indicates that investors in small-cap stocks would have achieved materially higher returns than those predicted by CAPM if they had invested over certain time periods.

Appendix 2

Plotting beta

Plot excess returns on a stock and excess returns on the market, derive the line of best fit and beta = gradient of line

Beta can be measured by comparing the excess return on an individual stock relative to the excess return on the market index. The excess return is the total return (dividend and capital gains/losses) over the return available on a risk-free investment.

The beta for a particular stock can be calculated by plotting its excess return against that of the market return and deriving the line of best fit.

Example: Returns on the market and returns on an example stock

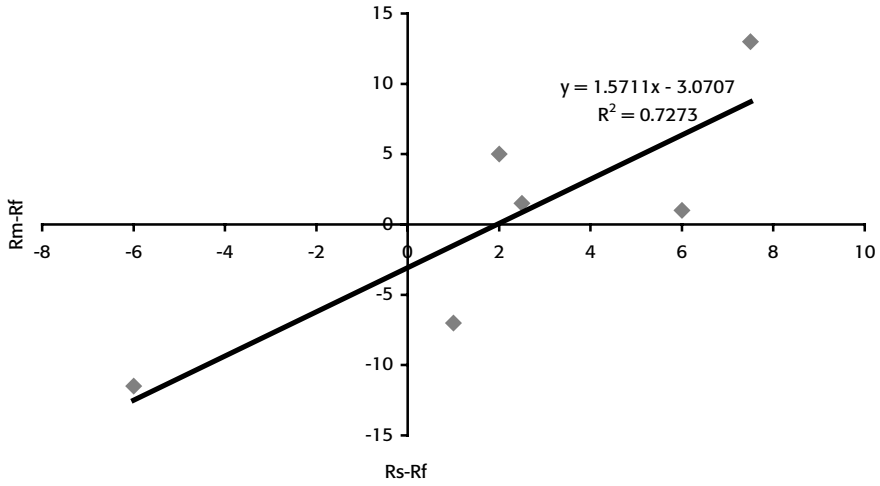
Time period	RM	RS	RF
1	7	10	5
2	7.5	6.5	5
3	6	-2	5
4	-1	-6.5	5
5	12.5	18	5
6	11	6	5

Source: ABN AMRO estimates

RM = Returns on the market
RS = Returns on the stock
RF = Risk-free rate

The excess returns on the market (RM-RF) can be plotted against the excess returns on the stock (RS-RF).

Calculation of Beta



Source: ABN AMRO estimates

Note the following:

(i) the return from the example stock is higher or lower than the market return. This is because the systematic risk of the example stock differs from that of the market as a whole.

(ii) The R squared of the line is 0.73. This indicates that 73% of the variability in the example stock's returns is explained by factors that have affected the market as a whole. The remainder of the variability must be due to unsystematic risk.

The calculation of beta

Beta is the gradient of the line. It can be calculated by the following formula:

Beta	=	cov(x,y)/var(x) where
cov(x,y)	=	the covariance of the returns on a stock, y, and returns for the market as a whole (x)
var(x)	=	the variance of returns for the market as a whole. The variance is the square of the standard deviation

Example continued: Beta calculation

Time period	ERM	ERS	ERM-Mmean	ERS-Smean	(ERM-Mmean) squared	(ERS-Smean) squared	(ERM-Mmean)* (ERS-Smean)
1	2	5	-0.17	4.67	0.03	21.78	-0.78
2	2.5	1.5	0.33	1.17	0.11	1.36	0.39
3	1	-7	-1.17	-7.33	1.36	53.78	8.56
4	-6	-11.5	-8.17	-11.83	66.69	140.03	96.64
5	7.5	13	5.33	12.67	28.44	160.44	67.56
6	6	1	3.83	0.67	14.69	0.44	2.56
	Mean 2.17	Mean 0.33			SD 4.31	SD 7.94	COV 29.15

Source: ABN AMRO estimates

ERM	=	Excess return from the market (RM-RF)
ERS	=	Excess return from example stock (RS-RF)
Mmean	=	Mean excess return from the market
Smean	=	Mean excess return from example stock
SD	=	Standard deviation = √[(Excess return – mean excess return)/no. of time periods]
COV	=	Covariance = [(ERM – Mmean)*(ERS – Smean)]/no. of time periods

Beta is calculated as $\text{cov}(x,y)/\text{var}(x) = 29.15/4.31^2 = 1.57$

Appendix 3

Example of degearing and regearing beta

Historical betas should be degeared and regeared to reflect forecast capital structures

Beta is affected by a company's capital structure. A historical beta will reflect the capital structure that was in place when the beta was measured. If WACC is being used to discount a forecast cash flow or EVA model with a materially different forecast capital structure, the beta should be degeared and then regeared to the weighting of debt and equity.

The relationship between geared and ungeared betas is as follows:

(1) $\beta u = \beta g \times Eg/(Vg - Dt)$ or rearranged this becomes
(2) $\beta g = \beta u + \beta u \times D(1 - t)/Eg$

where

βu	=	beta of an ungeared company
βg	=	beta of a geared company
Eg	=	market value of equity in a geared company
D	=	market value of debt in a geared company or book value if market value is unavailable
Vg	=	value of the geared company
t	=	marginal rate of corporate tax on the company's debt

To regear a beta from one level of gearing to another, it is necessary to:

(i) degear the beta, ie calculate βu using formula 1 above and then

(ii) regear the beta to the appropriate level of gearing, ie calculate βg using formula 2 above.

Example:

Beta	=	1.4
Marginal corporate tax rate	=	30%
Equity value	=	150
Debt value	=	120

To ungear the beta, use the formula

βu	=	$\beta g \times Eg/(Vg - Dt)$
βu	=	$1.4 \times 150/(270 - (120 \times 0.3))$
βu	=	0.89

To regear the beta to the forecast capital structure of 25% debt and 75% equity, use the formula

βg	=	$\beta u + \beta u \times D(1-t)/Eg$
βg	=	0.89 + 0.89 X (25 X 0.7)/75
βg	=	1.1

With a risk free rate of 5% and the ABN AMRO/LBS prospective risk premium of 4%, the cost of equity changes from 10.6% (with a beta of 1.4) to a cost of equity of 9.4% (with a beta of 1.1).

Appendix 4

Cost of debt calculations

Cost of debt can be estimated by considering all interest-bearing liabilities

The basic principle

The cost of debt is the current cost of raising new long-term debt. This can be determined by calculating the yield to maturity on a company's debt instruments currently in existence. The overall cost of debt will be the weighted average of all the debt instruments (weighted by market value or book value if market value is unavailable).

Non-redeemable debt

The yield to maturity on non-redeemable debt that is paying a fixed interest rate into perpetuity will be:

Interest rate/market value

For example, if the instrument has a nominal value of 100 with a fixed interest rate of 10% and a market value of 90, the yield will be 10/90, ie 11.1%.

Redeemable debt

The yield to maturity, (i), on redeemable debt will be the percentage that equates an annual interest payment up to the time of redemption, (time n), plus the redemption payment to the current market value

Interest rate/$(1 + i)$ + interest rate/$(1 + i)^2$ + ...(nominal value + interest rate)/$(1 + i)^n$ = market value.

For example, if debt has a nominal value of 100, an interest rate of 10%, a market value of 92 and will redeem in 10 years, the yield to redemption will be

$10/(1 + i) + 10/(1 + i)^2 + \ldots\ldots\ldots\ldots\ldots 110/(1 + i)^{10} = 92$ i.e. 11.4%.

Convertible debt

Convertible debt is a combination of non-convertible debt plus a warrant that comprises the conversion feature. The value of the warrants can be estimated from option pricing techniques. It is inappropriate to ignore the cost of the conversion feature and simply determine the yield to maturity using the interest rate because this rate will typically be lower than on straight-debt equivalents due to the value of the conversion feature.

Leases

Accounting practice divides leases into two types: finance (also known as capital leases) and operating leases. Finance leases transfer the risks and rewards of ownership to the lessee and consequently the asset and its lease obligations are recognised on the balance sheet. Since the finance lease is interest-bearing debt, its cost should be calculated in accordance with the guidelines above. Consideration should also be given to the inclusion of operating leases as debt if they represent long-term, unavoidable and material obligations. The cost of debt on an operating lease can be determined by calculating the interest rate implicit in the lease. If operating

leases are treated as part of the cost of debt in a WACC calculation, they must also be considered when weighting debt and equity in the WACC calculation. Consideration should also be given to regearing the beta to reflect this off-balance-sheet debt.

Non-equity shares

Non-equity shares frequently have the characteristics of debt as they pay a fixed dividend that has to be paid before a return can be made to equity shareholders. The cost of preference shares that are perpetual, non-convertible and non-callable can be determined by:

Dividend/market value

If the market price is unavailable, the yield on a similar instrument can be used as a proxy.

If the non-equity shares are redeemable, their cost should be determined in accordance with the guidelines above on redeemable debt. If the non-equity shares are convertible, their cost should be determined in accordance with the guidelines above on convertible debt.

Foreign currency debt

The local currency nominal rate of return for foreign-currency-denominated debt is usually an inappropriate indication of the cost of capital due to the inherent currency exposure. The cost of debt should be the cost of repaying the principal and interest in the company's local currency. When considering the cost of raising new long-term debt, assumptions should be based on appropriate rates in a company's domestic currency.

Unfunded pension liabilities

Unfunded pension liabilities represent commitments that a company is obliged to pay. Therefore, they are tantamount to debt and should be considered in determination of the cost of debt. The relevant cost of debt is the actuarial rate at which the future pension liabilities are discounted.

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