

IRG – Regulatory Accounting

**Principles of Implementation and Best Practice for WACC
calculation**

February 2007

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1. Executive Summary

National Regulatory Authorities (NRAs) implement the regulatory framework laid down in European Union (EU) and national legislation. According to article 13 of the Access Directive, NRAs, when imposing obligations relating to cost recovery and price controls, should take into account the investments made by the operators and allow them a reasonable rate of return on adequate capital employed. The correct determination of the cost of capital is, therefore, a crucial element in the regulatory process, as it has an impact on the regulated firm revenues, as well as on the tariffs other operators must pay for access.

This document has the objective of providing guidance to NRAs for estimating the cost of capital by identifying principles of implementation and best practice (PIBs), some of which take the form of methodological statements. The purpose of this document is also to share experiences on the cost of capital calculation and to discuss, among other things, the pros and cons of adopting a divisional cost of capital for regulatory purposes.

Moreover it analyses the various methodologies developed up to now for cost of capital determination and identifies the problems most commonly encountered by NRAs when implementing them.

As a future development, it may be of interest to analyze new approaches in methodologies for calculating the cost of capital, such as the Real Option Theory, that is so far a still debated issue for which best practice is not yet developed.

PIB 1:

IRG acknowledges that the WACC is a widely accepted methodology to calculate the cost of capital, understood by both the finance community and the industry, and already used by many regulators. In calculating WACC NRAs should consider the relative merits of pre-tax vs. post-tax.

PIB 2:

In the view of IRG, the level of gearing should be determined using a method consistent with the relevant cost base and the availability of information, although some adjustments may be introduced, if required.

PIB 3:

IRG acknowledges that the cost of debt can be calculated: i) using accounting data, such as the current loan book to derive the interest rate; ii) by the regulator calculating an efficient borrowing level and the associated cost of debt; iii) using the sum of the risk free rate and the appropriate company specific debt premium. These approaches should consider the quality and relevance of the information available in order to obtain an estimate as appropriate as possible.

PIB 4:

IRG observes that there are empirical shortcomings in the CAPM methodology. On the other hand, alternative models also have their own problems such as weak empirical foundations and empirical challenges. Therefore, at the moment CAPM is widely used for the purpose of calculating cost of capital.

PIB 5:

IRG acknowledges that the use of CAPM as a method to estimate the cost of equity is supported by its relatively simple implementation and by its wide use among regulators and practitioners.

PIB 6:

IRG considers that the return on freely traded investment-grade government bonds can generally be used as a proxy for the risk free rate.

The relevant market, the maturity of those bonds and the kind of information to use (current/historical values, average, short/long period...) should be defined considering the circumstances of the local markets.

PIB 7:

Estimating the equity risk premium can be made through the use of one or more of the following approaches:

- historical premium
- adjusted historical premium
- survey premium
- benchmark
- implied premium

These approaches should be balanced considering the quality and relevance of the information available in order to obtain an estimate as appropriate as possible.

PIB 8:

The estimation of the firm's beta can basically be made through the use of historical information, benchmark or through the definition of a target beta.

The choice of the approach depends on local market conditions, whether the firm is quoted and on the amount and quality of information available.

PIB 9:

Estimation of the tax rate should give due consideration to the company's effective tax rate and any specific attributes which give rise to a likely permanent difference to the headline tax rate.

PIB 10:

IRG recognizes that in theory the adoption of a differentiated WACC is reasonable from a regulatory point of view. However, the lack of capital market information at divisional level makes the theoretically correct determination of beta in some cases difficult.

PIB 11:

IRG is of the opinion that every proposed methodology to calculate a divisional WACC has its pro and cons. Therefore, the best approach for NRAs is to compare the results obtained using the different methodologies prior to selecting a final value.

PIB 12:

IRG believes that, when estimating the cost of capital for non-quoted companies or companies which did not issue debt securities, or when estimating cost of capital in young financial markets, NRAs should use proxies, benchmarks and peer group analysis, taking into account country specific conditions. A number of issues should be considered, including:

- what the appropriate comparator companies are, considering a number of relevant criteria for selection;
 - performing a high/low scenario approach and sensitivity analysis to average out possible errors in individual parameters' estimation.
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2. Introduction

The purpose of this document is to share experiences on the cost of capital calculation and to discuss, among other things, the opportunity to adopt a divisional cost of capital for regulatory purposes. Moreover the document discusses how to identify a proper way to calculate the cost of capital for companies whose equity shares are not quoted on a stock exchange and publicly traded or when the national financial market is not mature enough to estimate reliably the equity risk premium.

The determination of the cost of capital is a crucial element in the regulatory process. When regulators set price limits for services or products supplied in those parts of industries where regulated firms have significant market power, they need to decide what would constitute a “fair” rate of return on the capital employed in the production of the regulated services. To do this, regulators need to assess the return that investors in these firms expect to earn in a competitive market.

The key objective in setting an appropriate rate of return is to ensure that the regulated firm achieves a return sufficient to recover the opportunity cost of the capital employed in the production of the regulated services. This provides efficient price signals to market participants and to consumers and provides firms with the incentive for efficient investment in relevant infrastructure and services. Setting a rate of return below the opportunity cost of capital in the market could make investment unattractive to investors. Similarly, setting it too high would allow the regulated company to earn an excessive return, which would affect the competitiveness of the market and distort pricing signals to customers and investors, resulting in misallocation of resources.

Unfortunately there is no perfect theoretical answer to the problem of setting an appropriate rate of return on investments made by an operator. The WACC methodology, as defined below, is a widely accepted method for calculating the cost of capital. It is understood by both the finance community and the industry, and is consistent with the methodology used by many regulators.

3. The Weighted Average Cost of Capital

3.1 Introduction to WACC and its parameters

The WACC methodology, as defined below, is a widely accepted method for calculating the cost of capital. It is understood by both the finance community and the industry, and is consistent with the methodology used by many regulators.

The WACC for a company is a weighted average of the cost of debt and the cost of equity¹, with the weightings determined by the relative levels of debt and equity in the company's asset base:

$$\text{WACC} = \text{Cost of Debt} \times \text{Gearing} + \text{Cost of equity} \times (1 - \text{Gearing})$$

The tax burden, to which operators are subject to, due to the leverage effect that they cause, should be considered when calculating the weighted average cost of capital. Therefore, the post-tax WACC is:

$$\text{WACC} = \text{Cost of Debt} \times (1 - t) \times \text{Gearing} + (\text{Cost of equity}) \times (1 - \text{Gearing})$$

where t is the tax rate.

The WACC may be measured either in nominal terms or in real terms. A nominal WACC is expressed in current terms, while a real WACC is expressed in constant terms. Hence, the real WACC shows the WACC excluding the impact of inflation. The WACC should be consistent with the choice of price base. Therefore if prices are regulated in real/nominal terms, the cost of capital should be expressed respectively in real/nominal terms. It is important to note the transformation of the WACC between Pre and Post Tax, and real and nominal terms is not commutative with a given effective tax rate i.e. the order in which transformation take place can lead to errors in WACC estimates. The most common response to this issue is to transform a nominal WACC between pre and post tax.

Most of the parameters used to calculate the WACC are unobservable and have to be estimated or inferred from observable data, therefore one should bear in mind that the rate obtained will be an estimation based on assumptions and judgements about the theory and the data used in the calculation.

Throughout the rest of the chapter the various parameters used to calculate the WACC will be analysed in detail.

PIB 1:

IRG acknowledges that the WACC is a widely accepted methodology to calculate the cost of capital, understood by both the finance community and the industry, and

¹ The formula reflects the fact that companies can raise capital either through debt or equity. Further, the returns required by the market for each of these two elements are likely to be different because debt holders enjoy a prior claim on a company's earnings stream, therefore facing different levels of risk from equity holders.

already used by many regulators. In calculating WACC NRAs should consider the relative merits of pre-tax vs. post-tax.

3.2 The gearing ratio

The weighting used in the WACC formula is the company's gearing. The gearing is a measure of the ratio of debt to company value (the latter being equivalent to the sum of debt (D) and equity (E)) and is defined as:

$$\text{Gearing} = \frac{D}{D + E}$$

There are a number of ways to determine the gearing level, each with a direct effect on the cost of capital:

- a) Based on book values: the gearing is calculated using the accounting value of the company's debt and equity. This is a transparent method, easy to check and audit. The downside with the use of book value is that it is not forward-looking and does not reflect the company's true economic value. Besides, book values are dependent on the operator's strategic and accounting policy and so they may vary substantially with changes in the accounting principles, provided general accounting rules are respected;
- b) Based on market values: the gearing can be calculated on the basis of the observed market value of the company's debt and equity, namely its market capitalisation, which in theory will reflect the true economic value of the company's capital structure. The market value of equity can be obtained by multiplying the number of shares with their current price. The market value of debt can be difficult to obtain directly since besides bonds firms generally have other forms of non-traded debt, such as bank debt. However, book values can be converted into market values by treating the entire book debt as one coupon bond.² This coupon bond would be valued at the current cost of debt for the company. However, the problem with the use of market values is that they are dependent on several market factors, namely volatility, investors' expectations and speculation and so they can be subject to serious fluctuations, negatively affecting market stability.
- c) Optimal or efficient gearing: is based on an optimal capital structure defined by the regulator. The reason for using this method is to ensure that firms that over-borrow or borrow at too high a rate are not rewarded for this financial decision. This efficiency adjustment can be done by taking into account the capital structure of an efficient operator rather than the structure of actual operators.³ However, establishing an optimal ratio is a subjective issue.

² The coupon should be set equal to the interest expenses on all the debt and the maturity set equal to the weighted average maturity of all debt.

³ The definition of an optimal capital structure has to take into account several factors such as market risk, tax advantages, credit ratings, investment levels, and so on.

The choice of a relevant gearing ratio can be based on any one of these approaches. Issues of data availability and the cost basis of the cash flows to which the cost of capital is to be applied are relevant considerations.

Circumstances may arise when none of these ways are appropriate and adjustments may have to be introduced in order to remove some inefficiency presented in the company's capital structure.

PIB 2:

In the view of IRG, the level of gearing should be determined using a method consistent with the relevant cost base and the availability of information, although some adjustments may be introduced, if required.

3.3 The cost of debt

The cost of debt reflects the cost the company has to sustain in order to get capital to finance its activity, either from financial institutions or through loans from other companies. It corresponds to the weighted average of the costs of the various long-run loans of the company and it is strongly correlated to the current interest rate's level, the company's financial capacity and risk and even to the country's fiscal policy.

The cost of debt can be calculated using accounting data or the current loan book in order to derive the interest rate the company registers in its accounting books. This is a transparent method, easy to audit, and that considers the costs the company actually paid.

A factor to be considered in calculating the cost of debt is to look at the firm's credit ratings as an indication of borrowing costs.

Another method to ascertain the cost of debt is to calculate an efficient borrowing level. This could be done where firms over borrow or borrow at too high a rate and therefore the level of debt and associated interest cost are adjusted back to an efficient level by the regulator so that the firm is not rewarded for this financial decision.

Another method to estimate the cost of debt is the following:

$$\text{Cost of Debt} = \text{Risk Free Rate} + \text{Company Specific Debt Premium}$$

The risk free rate is analysed in more detail in chapter 4.5 of this document.

The company specific debt premium increases with the company's gearing reflecting the company's higher financial risk, considering that more cash flow needs to be generated in order to meet interest payments. It can be obtained by observing published credit ratings⁴ that specialist credit rating agencies assign to that company.

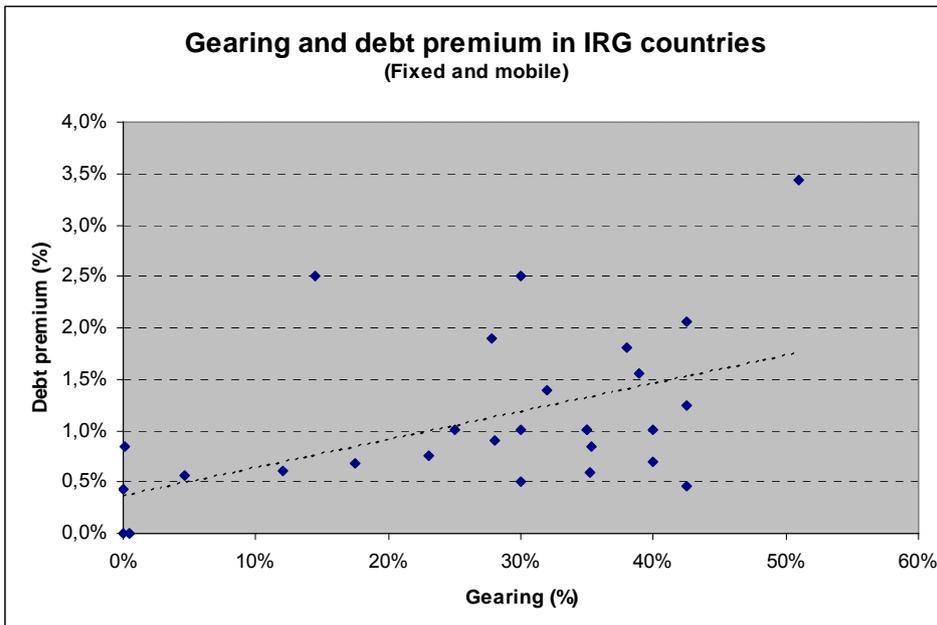
Although it is more complex to calculate, this approach ensures that the cost of debt is forward-looking and, therefore, avoids transitional effects, such as temporary holdings of debt.

⁴ Credit ratings are based on financial fundamentals such as market capitalisation, earnings volatility and business risks specific to the company. Companies pay attention to their ratings, because they affect the market's perception of the company's risk of default and therefore, the cost at which they can obtain funds in the market.

PIB 3:

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In the following graph, the relationship between the gearing ratio and debt premium in some IRG member states is illustrated. From finance theory it is known that an increasing debt will increase the risk and therefore the risk premium. As can be seen from the graph, benchmark data from IRG members supports this relationship, even though there are country-specific issues (including differences in calculation period, maturity of the financial markets etc.) causing a large variability around a possible linear relationship.



Source IRG Regulatory Accounting WG data collection (last update January 2007).

3.4 Different methodologies to calculate the cost of equity

The second main component of the WACC formula is the cost of equity. Economic theory has developed different approaches to calculate the cost of equity, for example the Capital Asset Pricing Model (CAPM), the Dividend Growth Model (DGM), the Arbitrage Pricing Theory (APT), the Fama and French Three Factor Model.⁵ All these models share a common assumption about how investors make financial decisions: investors are assumed to be able to reduce total risks by holding diversified portfolio. Total risk is made up of two components: systematic (or undiversifiable) risk and specific (diversifiable or idiosyncratic) risk; the former is a measure of how the value of an asset co-varies with the economy and cannot be diversified away by investors, since it usually has some impact on nearly all firms within the economy; the latter is the risk specific to a particular company that can be diversified away by investors and hence is not priced into investor's required rates of return or cost of capital estimates. The different models are briefly analysed below. CAPM is also analysed in more detail in the next chapter.

3.4.1 The dividend growth model

The most common version of the DGM assumes that a company will pay a dividend that grows at a constant rate over time, independent of any shock that might hit the economy. The cost of equity using the simplest DGM version is:

$$R_e = D_0 (1 + g) / P_0 + g$$

Where:

R_e	=	Cost of equity
D_0	=	The dividend paid at time zero
P_0	=	The current price of companies' shares
g	=	The expected growth rate of dividends

The cost of equity is the discount factor that leaves investors indifferent between receiving the share price today and the stream of dividends that will accrue if they own the share. While two of the three elements on the right hand side of the equation are easily observed, regulators using DGM will have to form a view about investor's expectations of future dividend growth (g).

Despite the difficulties a number of regulators have referred to results from the DGM when estimating the cost of equity; for example ORR, OFWAT and OFGEM.

⁵ Recent economic literature on Real Option Theory, focusing on the role of options in investment evaluation, may affect cost of capital calculation. However, being an area in which best practice has not yet been determined, it is not analysed in this document.

3.4.2 The arbitrage pricing theory

The APT assumes that the rate of return on any asset is a linear function of k factors (such as for example, the industrial production index, the short term real interest rate, the inflation rate and the default risk). These factors should be common to all stocks and should be weighted by β_{jk} , which measures the sensitivity of security j to factor k .

As it will be shown in the next chapter, measuring beta and the factors is not straightforward, even under the CAPM. For every additional factor introduced in the model the regulator would need to calculate an additional beta which leads usually to more practical problems than encountered when using the CAPM.

3.4.3 The capital asset pricing model

The CAPM is a one-factor model where systematic risk is a function of the correlation between the returns to the firm and the returns to the stock market. The model does not compensate investors for company specific risk, but only for systematic risk.

The CAPM is the model most commonly used by regulators to estimate the cost of equity given that it has a clear theoretical foundation and its implementation is simple. However there are different views on the use of this methodology among the finance practitioners mainly because of its simplifying assumptions.

3.4.4 The Fama and French three factor model

The Fama and French three-factor model can be thought of either as a special case of APT or as an enhancement of CAPM. The model has three factors: market factor, company size factor, and book/market value factor.

While this model has been, to some extent, supported by the results of certain empirical studies, there has been a considerable debate on whether the risk premium associated with the two additional factors (company size and book/market value) are statistically significant.

PIB 4:

IRG observes that there are empirical shortcomings in the CAPM methodology. On the other hand, alternative models also have their own problems such as weak empirical foundations and empirical challenges. Therefore, at the moment CAPM is widely used for the purpose of calculating cost of equity.

3.5 The regulatory risk

A common concern among regulated firms is that the regulator itself can introduce risk through intervention.

In theory, regulatory risk exists whenever regulation affects the cost of capital of the regulated firm. In practice it is advisable to distinguish between two different forms of regulatory risk. The first depends on factors external to the firm and the regulator, such as a macro-economic shock, which may impact the regulatory scheme employed. The second depends on factors under the regulator's control.

According to asset pricing theory only factors that co-vary with some systematic risk factor (such as the market portfolio in the CAPM) affect the regulated firm's cost of capital,

therefore “regulatory risk” arises when the regulator’s actions lead to the return of the firm correlating with the systematic risk factor. This may occur for example if a regulator tightens a price cap in response to a macro-economic shock that increases the profit of a firm. As a result of observing a higher profit the regulator will attach a higher probability to the firm’s marginal cost being low and, therefore he will tighten a price cap. In this case the firm’s return may co-vary negatively with the market depending on how much the regulator tightens the cap.

This type of systematic regulatory risk is more likely to occur when the regulator has a large discretion in adjusting the price cap, in terms of frequency and degree of adjustment.

4. Estimating the Cost of Equity under CAPM

4.1 The cost of equity

As illustrated in the previous chapter, the cost of equity reflects the return on equities (through dividends and through an increase in the value of shares) that is required to attract investors.

Despite its limitations, the CAPM approach is the methodology widely used by finance practitioners and regulators for determining the cost of equity. The cost of equity is a necessary input for the WACC calculation. The CAPM has a clear theoretical foundation and its implementation is relatively simple. It asserts that the required rate of return on a risky asset is a function of the risk free rate of return (R_f) plus a risk premium that reflects the return on a well-diversified portfolio of risky assets over the risk free rate ($R_m - R_f$), scaled by the “beta” of the risky asset⁶:

$$E(R_j) = R_f + \beta_j [E(R_m) - R_f]$$

PIB 5:

IRG acknowledges that the use of CAPM as a method to estimate the cost of equity is supported by its relatively simple implementation and by its wide use among regulators and practitioners.

4.2 The risk free rate

The risk free rate is the expected return on an asset, which bears in theory no risk at all⁷, i.e. whose expected returns are certain. In practice, it is not possible to find an investment that is free of all risks. However, freely traded investment-grade government bonds can generally be regarded as having close to zero default risk and zero liquidity risk.

When defining the risk free rate, the relevant market has to be chosen⁸. The relevant market for the definition of the risk free rate, may be confined to the domestic market, although other country’s government bonds can also be used as a proxy for the risk free rate. The choice of

⁶ The principle of CAPM is that there is a direct relationship between the price of an asset and its return and risk. The risks borne by an investor can be divided into company specific (diversifiable) risk and systematic (non-diversifiable) market risk. This model is based on the theory that the required return on an asset is related to its systematic risk, that is, the degree of co-movement between the company’s returns and the market returns, given that specific risk can be diversifiable by holding a broad portfolio of assets. Therefore, CAPM calculates the return required by investors for accepting the (systematic) risk associated with a specific company, by reference to the volatility of returns on the particular company relative to those of the market portfolio as a whole.

⁷ For an investment to be risk free, two conditions have to be met: there can not be any default risk which usually implies that the security has to be issued by a government; there can be no uncertainty about reinvestment rates, which implies that there are no intermediate cash flows, as with zero coupon bonds.

⁸ First, the cost of capital should be estimated with reference to the financial market that best represents the company’s investment opportunity set. However, this will depend upon matters such as exchange rate risk, taxation barriers, transaction costs of transferring capital between markets and capital controls.

the relevant market has to be consistent with the market considered in estimating the other parameters.

The maturity of the government bonds also has to be defined. The choice can be based on:

- a) The investment horizon: taking into account that investors expect to be compensated for making long term investments. Therefore, the risk free rate should reflect investors' expectations over the relevant time period. However, there is little or no evidence of the length of the investment horizon of an average equity holder.
- b) The planning horizon: the average life of the group of assets making up the investment project that is being assessed with the cost of capital. It is a rational financial management principle to measure liabilities with long-term maturities against assets with long term investment horizons. In such circumstances, matching the duration of the risk-free asset to the cash flows being analysed implies the use of a time period of at least 10 years.
- c) The time horizon of the regulatory review period: this would make the cost of capital consistent with the cash flows to which it is being applied. Thereby, asset owners are protected from movements in market interest rates during the regulatory period, whereas the returns may be re-set after the regulatory period.

The last important consideration when defining the risk free rate is the kind of data to use: current or historical values. When evaluating a past historical cost of capital over a certain period of time, it is logical to consider the average risk free rate over that period.

When evaluating a forward looking cost of capital (if capital markets were perfectly efficient), current yields would reflect all expectations of future earnings and should be the appropriate measure of the risk free rate. However, in practice, capital markets are volatile and the rates observed on a particular day could be temporarily influenced by market anomalies and prone to significant cyclical variations.

Therefore, considering that at any point in time current yields will still reflect the best available information on future yields, the averaging of recent historical rates has been standard practice in regulatory determinations. This method allows the minimisation of any short-term fluctuations in rates while capturing the most up to date information and expectations.

PIB 6:

IRG considers that the return of freely traded investment-grade government bonds can generally be used as a proxy for the risk free rate.

The relevant market, the maturity of those bonds and the kind of information to use (current/historical values, average, short/long period...) should be defined considering the circumstances of the local markets.

4.3 The risk premium

The market risk premium represents the additional return over the risk-free rate that investors require as compensation for the risk they expose themselves to by investing in equity markets. It is essentially a measure of investors' appetite for risk and it is a market factor, rather than a company-specific factor.

Determining the risk premium can be a highly contentious issue in regulatory decision-making because this forward-looking measure is not directly observable. The tools available may be inadequate since they derive a forecast of what the risk premium is expected to be based on actual equity returns rather than the premium that investors demand as compensation for investing in risky assets, which is the appropriate premium for the purposes of the CAPM.

To estimate the risk premium we can use ex-post estimations (based on historical investment returns) or ex-ante estimations (based only on forward-looking considerations). These approaches are analysed below.

4.3.1 Historical premium

The most common approach to estimating the risk premium used in financial asset pricing models is to use historical data, the so-called ex-post approach. The traditional historic approach considers the past data as a reliable indicator of how the market will behave in the future⁹.

This approach relies primarily on the results obtained from the analysis of the average difference over the long term between realized returns on the market portfolio and those on a risk free asset (government bond yields). There are several methodological issues involved in determining this difference:

- a) Arithmetic versus geometric mean: The choice of approach basically depends on the predictability of returns over longer time periods and the distribution of these returns. The more unpredictable returns are considered, the better the case for using the arithmetic average.¹⁰
- b) Relevant indices: The choice of the relevant index to use (world or domestic) depends upon the degree to which capital markets are integrated and how internationally diversified investors are. The most common approach is to use a domestic index, but the estimation of a world premium, considering that there are many more data points, allows a more robust estimation.

⁹ This is supported by the belief that investors' expectations are influenced by the historic performance of the market and that future market conditions do not differ substantially from those in the past.

¹⁰ Strong arguments can also be made for the use of geometric averages. First, empirical studies indicate that returns on stocks are negatively correlated over time. Although one-year correlations are low, the five-year serial correlations are strongly negative for all size classes, so the arithmetic average would overstate the premium. Second, while asset pricing models may be single period models, the use of these models to get expected returns over long periods (such as five or ten years) suggests that the single period may be much longer than a year.

The selected index should be consistent with the one selected for estimating beta.

c) Time period: If there has been a permanent shift in the size of the risk premium, by attaching equal weights to old and recent observations, a too long time period may bias the estimation. On the other hand, a too short time period may place too much weight on single events and therefore may mislead estimates of the “true” premium. In practice the correct time period to use when analysing historic data cannot be defined exactly, therefore the relevant time period has to be estimated considering the expectations investors have on the market and risk tendencies¹¹.

As we can see, the historic approach is not totally objective and there are reasons to believe that it overestimates the return required by investors considering that recent estimates suggest a decline in the market participants’ expectations over the last few years. Yet, considering that estimating the risk premium on a forward-looking basis will always be somewhat speculative, historic returns can be used as a proxy for the expected forward-looking returns.

4.3.2 Adjusted historical risk premium

There have been several arguments¹² to suggest that changes in the level of risk associated with the equity market may mean that the risk premium will be lower in the future than it was the case in the past.

In this case, the use of an historical risk premium may lead to its overstatement, which justifies the introduction of a downward adjustment to historical risk premium.

This adjustment can be made taking into account the differences observed between real premium and that which investors sought ex ante. This involves identifying returns, which are likely to have exceeded expectations. The risk premium can also be adjusted for significant re-rating of equities that have occurred over the period.

4.3.3 Survey premium

Another different approach that can be used to estimate the risk premium is surveys. Survey evidence is one way in which forward-looking expectations of market participants can be observed. In fact, since the risk premium is an average of the premium demanded by investors, surveying investors about their expectations for the future can be another valid approach. The most important issue in this approach is to ensure that the questions posed to respondents are properly framed, in order to avoid ambiguous or not meaningful answers.

¹¹ Long-term averages of returns are most appropriate if it is assumed that the equity risk premium is constant over the measurement period and will remain constant in the future. Shorter periods should be used if the risk aversion of the average investor is expected to change over time.

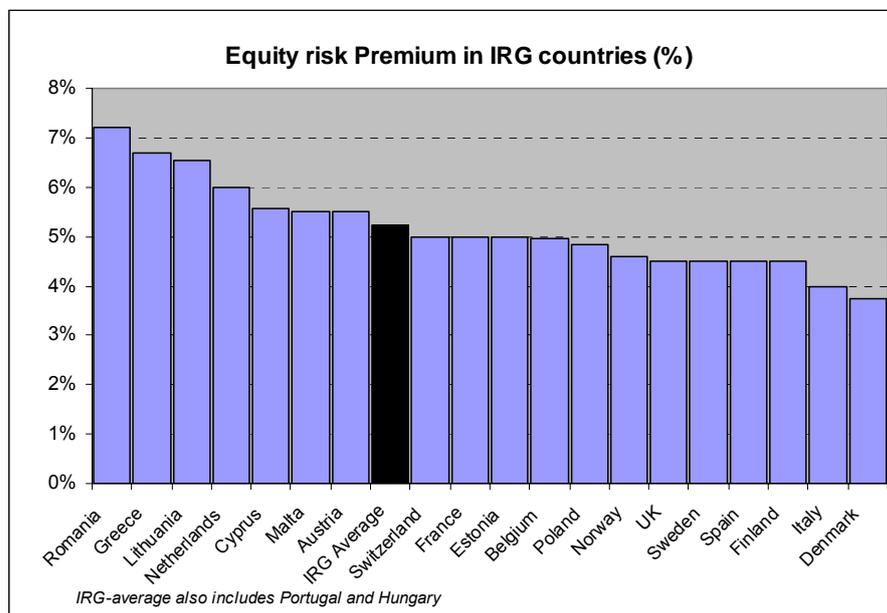
¹² These include the fact that the risk premium is associated with a less risky portfolio given that the equity market is more diversified and international diversification is now easier and the fact that investor confidence has grown and they are requiring a lower risk premium. Besides, there are improved regulatory and legal infrastructures to protect investors on an equity market.

The usual problem with surveys is that there are no constraints on reasonability and on how respondents' expectations can be influenced by recent market movements. Further, these kinds of estimates tend to be short term. The answers can also vary with the sample of investors chosen. In fact, while pension fund managers tend to suggest low values, personal financial advisors and equity analysts might not.

4.3.4 Benchmarking

A further alternative for estimating the risk premium is through benchmark. This can be done by selecting a foreign market and adjusting for differences in the economies of the local and benchmark country. These differences can relate to the nature and size of the companies, differences in taxation and differences in country risk.

The figure below shows the level of the equity risk premium in some IRG member states. The average value is 5,3 %. As can be seen from the graph, there are significant differences among IRG countries. These differences can be caused by different calculation methods, but also by country specific reasons (maturity of stock markets, differences in country risk, etc.)



Source IRG Regulatory Accounting WG data collection (last update January 2007).

4.3.5 Implied premium (and the dividend growth model)

There are alternative ways to estimating risk premium that do not require historical data, usually called the ex-ante approaches. A total ex-ante approach calculates the risk premium as the difference between the current observable expected returns and observable current expected yields on a proxy for a risk free asset.

Other ex-ante measures of the risk premium consist of the analysis of certain financial indicators regarded as having the ability to predict equity returns such as interest rates, the dividend to price ratio, dividend yield or earnings yields.

One methodology commonly used to infer the ex-ante risk premium is the dividend growth model.¹³ The risk premium is estimated by using market data of actual share prices and earnings per share, in conjunction with forecasts of the growth in earnings, to derive an implied cost of equity.

The advantage of this approach is that it is market-driven and does not require historical data. However, the estimated market risk premium derived in this manner is itself the sum of three components, one of which is an estimate and therefore, subject to some degree of uncertainty. The major methodological drawback with using the dividend growth model is that it relies upon the highly questionable assumptions that the financial market is efficient and correctly valued and that the dividend yields, the growth in dividends and the expected inflation are constant into the infinite future. In addition, the approach purports to derive a forecast of what the market risk premium is expected to be from forecasts of future dividend yields and growth rates, rather than the premium that investors demand as compensation for risk.

4.3.6 Conclusion

At this stage, after having recognized the advantages and problems of all kind of approaches to capture the expected risk premium, one possible alternative is to balance the different methodologies in order to try to minimize the problems. In fact, the referred adjustments and surveys may be used to correct the historical risk premium. At the same time, benchmark information provides an additional reference that can be used along with the other methods, or when there isn't enough historical information to generate a robust estimate.

An important issue to note in assessing the market return is whether data from the stock market of the jurisdiction of the NRA is to be the only data used. Some stock markets in smaller countries may be not that developed, and/or may be strongly influenced by larger markets in neighbouring countries. This trend will strengthen as economies become more closely integrated with each other, and as capital flows freely between different jurisdictions. Accordingly, attention should be given to consider whether other markets or some index based on a number of stock markets should be used when assessing the market return.

PIB 7:

Estimating the equity risk premium can be made through the use of one or more of the following approaches:

- **historical premium**
- **adjusted historical premium**
- **survey premium**
- **benchmark**
- **implied premium**

These approaches should be balanced considering the quality and relevance of the available information in order to obtain an estimate as appropriate as possible.

¹³ Through this model, the value for a share is given by the net present value of the dividend stream using a discount rate, which reflects the cost of equity as describe in section 3.4.

4.4 Beta estimation

Beta is a measure of the risk of the risky asset relative to the market risk. In theory, the only risk that is captured by beta is systematic risk, which is the risk that cannot be eliminated by the investor through diversification.

The beta reflects the extent to which possible future returns are expected to co-vary with the expected returns on a broad portfolio of assets, i.e. the degree of co-movement between the company's returns and the market returns. The higher the value of beta, the greater the systematic risk faced by holders of the firm's equity. Forward-looking estimates of returns on particular stocks and on the market as a whole are not readily available; therefore estimating beta is not an easy task. Several approaches can be used in estimating beta:

4.4.1 Historical beta

Beta estimates are generally obtained through regression analysis of historical evidence of the relationship between the company returns and the market returns.

Thus, for publicly traded firms betas can be estimated by regressing stock's returns (R_j), including both dividends and price appreciation, against the market returns (R_m):

$$R_j = a + b R_m$$

Where "a" is the Intercept from the regression and "b" is the slope of the regression, which corresponds to the covariance (R_j, R_m) / $\sigma^2 (R_m)$ and is the beta of the stock. There are a number of services that provide such estimates including London Business School, Bloomberg, DataStream, Standard & Poor's and Value Line.

However, using historic returns to estimate future values of beta raises the question of what is the correct estimation period and frequency. In respect to the estimation period, as we have seen before, the most recent period possible is likely to embody market expectations about future returns. On the other hand, the values of beta fluctuate over the business cycle. Therefore taking only a recent period risks missing information and biasing the results, suggesting that betas should be calculated over as long a period as possible. There is therefore a trade-off between the relevance of the estimation period and the need for a sufficiently long time period to ensure the regression results are robust. Most estimate services use period ranging from 2 to 5 years for the regression.

The relevant frequency should be defined in order to have a data set of a reasonable size, which can generate a statistically significant estimate of the value of beta.

A beta calculated through regression analysis of historical information provides an approximation. However, estimation errors are likely because betas may vary significantly over time. Therefore, the estimation of the relevant beta from historical information may need to be complemented with other forward-looking approach.

4.4.2 Adjusted historical beta

Considering the limitations of estimating beta through regression analysis of historical evidence, it may be helpful to adjust the raw beta through various formulae, using Bayesian¹⁴ e.g. (ordinary least square), Blume¹⁵ or log adjustment.

4.4.3 Bottom-up beta

Beta can also be estimated by the construction of a bottom-up beta. A bottom-up beta is estimated through benchmark from the betas of specific firms. It has the advantage of eliminating the need for historical stock prices and reducing the standard error created by regression betas.

The first step in estimating a bottom-up beta is to identify the business and a set of comparable established companies. Choosing the comparable betas has to consider that the beta can be different according to the several characteristics that influence the covariance of a company's returns with the market returns. These include the nature of the regulatory and competitive environment, the size of the companies, taxation and so on.

Since financial leverage can vary across industries, countries and firms, and, furthermore, financial leverage is a determinant of beta, it is common to de-lever (i.e. stripping out the gearing component) comparable betas to arrive at an un-levered beta then to re-lever at the target financial leverage considered appropriate for the business in question. The asset beta is obtained with the following formulas:

$$\text{Miller Formula: } \beta_{\text{asset}} = \beta_{\text{equity}} / (1 + D/E)$$

or

$$\text{Modigliani - Miller Formula: } \beta_{\text{asset}} = \beta_{\text{equity}} / (1 + (1-t) \cdot (D/E))$$

Where β_{asset} corresponds to the un-levered β and the β_{equity} to the levered β .

The impact of using either formula is small, however the Miller Formula is simpler because it does not require estimation of forward-looking effective tax rates for telecommunications companies.

Therefore, when conducting a comparison with a portfolio of companies, after obtaining the several levered beta for each company, these can be un-levered to find the asset beta, using the debt to equity (D/E) of each company of the sample portfolio. The chosen bottom-up

¹⁴ The Bayesian adjustment is based on the assumption that the average firm in the market has a β of one and β estimates on individual stocks will be estimated with error. Therefore, considering that the larger the variance on the estimated beta, the more weight one should attach to the average of 1, the Bayesian adjustment adjusts betas to take account of differences in the degree of sampling error for individual firm betas through this general formula: $\beta_{\text{adjusted}} = W \times \beta_{\text{OLS}} + (1 - W) \times 1$.

Where $W = \text{var}_{\beta} / (\text{var}_{\beta} + \text{var}_{\text{OLS}})$; β_{OLS} is the ordinary least squares (OLS) estimate of beta or raw beta; var_{OLS} is the variance of the OLS estimate of beta and var_{β} is the variance of beta across the sample of firms for whom average beta is unity.

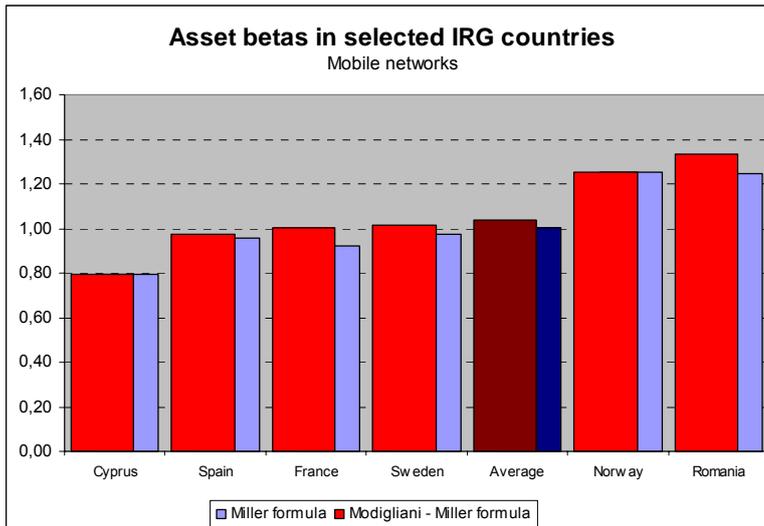
¹⁵ The Blume adjustment is a special case of the Bayesian adjustment which uses this formula:

$\beta_{\text{adjusted}} = (0.67) \times \beta_{\text{OLS}} + (0.33) \times 1$. It assumes a constant weighting scheme to shrink the betas across all the stocks, and consequently shrink all estimates independent of how unreliable they are.

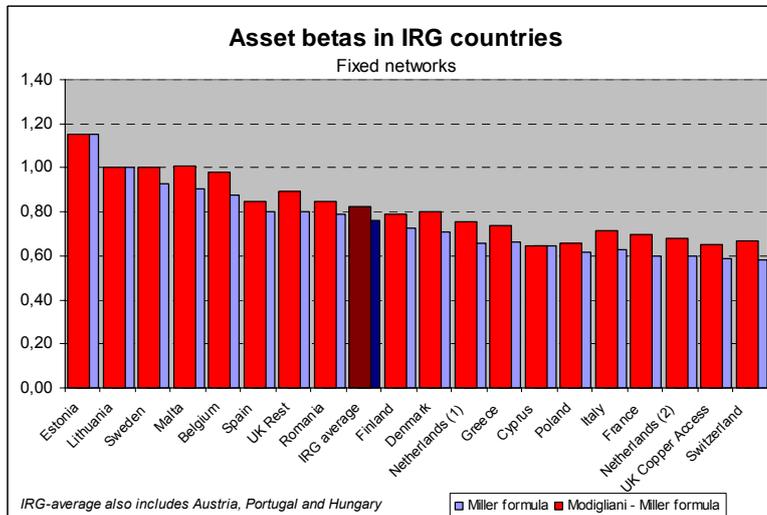
asset beta can then be re-levered taking into account the relevant company's financial structure¹⁶.

This approach might be particularly useful for non-quoted companies, when the firm has been restructured substantially or when the standard error of the beta from the regression is high. The usual problems associated with the calculation of betas from accounting data is that they can be influenced by accounting factors, such as changes in some accounting principles, and the available results are not daily, nor even monthly, and therefore building a significant database can be difficult and be subject to general accounting rules.

In the following graphs is illustrated the asset betas in the different IRG countries.



Source IRG Regulatory Accounting WG data collection (last update January 2007).



Source IRG Regulatory Accounting WG data collection (last update January 2007).

¹⁶ As the debt equity ratio may have changed over the estimation period, beta should in principle be un-levered on the basis of the average debt-equity over the estimation period, while it should be re-levered on the basis of the current debt-equity ratio.

4.4.4 Target beta

For a NRA, the purpose of beta evaluation is to find a proper measurement of risk, typically when evaluating costs of regulated companies. In this context, the use of historical beta can give a short-term signal that is not always relevant for a long-run efficient evaluation of costs. Finding a bottom up beta is a more forward-looking approach that aims at capturing the risks of the activity (un-levered beta) and of financial leverage. Operators, which have similar activities, would be expected to have a similar un-levered beta.

In certain circumstances, however, it may appear that homogenous samples of companies have heterogeneous un-levered beta

In such cases, NRAs may want to determine a target un-levered beta, which should represent the activity risk.

PIB 8:

The estimation of the firm's beta can basically be made through the use of historical information, benchmark or through the definition of a target beta.

The choice of the approach depends on local market conditions, whether the firm is quoted and on the amount and quality of information available.

4.5 Headline versus effective tax rate

As noted previously, the WACC may be estimated post-tax or pre-tax. The post-tax WACC is the WACC adjusted to allow for corporate tax payments. When applied to the capital base, it indicates the (post-tax) operating profit required to finance tax and interest payments, while providing shareholders with their required return.

To estimate an ex-ante post-tax WACC, a decision has to be made as to which tax rate to utilise for the calculation.

At its simplest, in the long run, a profitable company operating in one country may be expected to face the headline rate of tax. However, there are many occasions where a company may pay an effective rate of tax which varies from the headline rate. Examples of items which cause a divergence between the headline and effective rates of tax payable include the utilisation of capital allowances and other timing differences, relief from past losses or the impact of operating in a number of countries, each with different tax rates and tax regimes. In these circumstances, in estimating the appropriate tax rate for use in WACC estimation, it is important to consider the reasons for the differences between the headline and effective rates of tax. An appropriately normalised tax rate will adjust the effective rate to remove the impact of short term or transitory effects which are unlikely to endure, but will incorporate any adjustments to the headline rate which appear likely to represent a permanent difference between the headline and effective rate. In this way, the estimation of the tax rate will not reflect short term fluctuations in the amount of tax payable by the company, but will reflect any aspects particular to the company which give rise to an effective tax rate which is structurally different from the headline rate.

A further point to consider is that the difference between effective and headline rate derives from the tax allowance regime and the capital structure that the company chooses.¹⁷ This choice should be reflected in the allowable cost of capital, namely when there are different tax rates for equity and debt.

PIB 9:

Estimating of the tax rate should give due consideration to the company's effective tax rate and any specific attributes which give rise to a likely permanent difference to the headline tax rate.

¹⁷ Regarding the tax allowance regime the NRA must check on whether this still gives the right economic signals as tax allowance schemes may pursue other objectives and can distort decisions.

5. The divisional cost of capital

5.1 Reasons for calculating a divisional cost of capital

In theory the adoption of a differentiated WACC, that takes into account the different level of risk that each business unit (or project) faces, is reasonable both for the company and for the regulator.

As seen in the previous chapter beta is a measure of the systematic risk and a company's overall equity beta may be thought of as a weighted average of the betas of the various business or activities in which the company is engaged:

$$\beta = w_1\beta_1 + w_2\beta_2 + \dots + w_n\beta_n$$

Where:

β = company's overall beta

β_1, \dots, β_n = value of the different business' betas

w_1, \dots, w_n = weighting factor calculated as the market or economic value of each business or activity

For example, incumbent fixed operators, provide a wide range of retail and wholesale services, ranging from well established services, such as voice call origination and termination, to new services such as services offered on New Generation Networks (NGNs) which may include services different from traditional electronic communication services (for example TV services, IT management support). These services may be characterized by widely varying cost and demand conditions, hence by varying risk conditions.

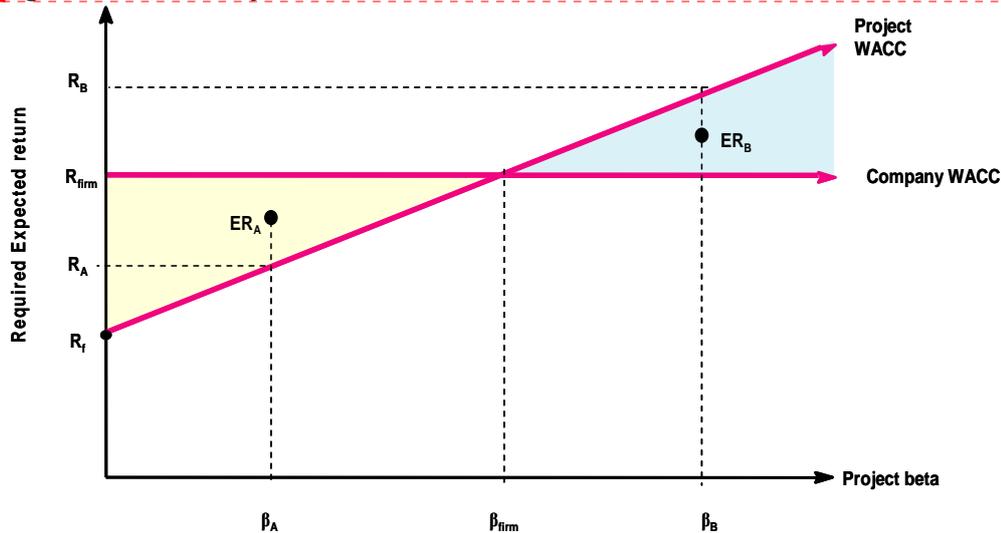
If the risks faced by incumbents across various regulated products are materially different, the use of a single rate of return may have an adverse impact on the ability of NRAs to simultaneously encourage efficient investments and protect customers from excessive pricing.¹⁸ On the other hand, if the systematic risk faced by a firm only slightly differs across its different products, it may not make a significant difference to WACC estimation and NRAs may appropriately use a single beta at company level.

The figure below shows the implications of calculating a single rate of return at the company level for a multi-product firm involved in projects bearing a different level of risk, represented by the different values of beta reported on the horizontal axis.

¹⁸ In this regard, Ofcom notices that if "the company WACC and expected cash flows are used as a basis for investment appraisal or regulated charge setting (rather than the allowed return reflecting the systematic risk of the particular project), then there is a possibility of sub-optimal market decision being made", (Ofcom consultation document on the approach to risk in the assessment of the cost of capital).

Figure 1. The security market line and the WACC

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These implications can be analysed both from the point of view of the company and of the regulator.

From the company's point of view, if the company WACC is used for making investments appraisal decisions, all services/products, rather than a project WACC, i.e. the WACC reflecting the systematic risk and expected return of the particular services/products, there is a possibility of sub-optimal decisions being made: for example, a firm will accept some higher risk projects (e.g. project B in figure 1) which should be rejected because the return they are expected to yield (E_{R_B}) whilst higher than the company's WACC (R_{firm}) is lower than the project WACC (R_B). Conversely, the firm will reject some lower risk project (e.g. Project A) which should be accepted – because the return they are expected to yield (E_{R_A}) whilst lower than the company's WACC (R_{firm}) is higher than the project WACC (E_{R_A}).

From the regulatory point of view, the figure may be interpreted as showing the actual different level of risk (beta) associated with different regulated products on the horizontal axis and the corresponding expected rate of return, on the vertical axis. NRAs should evaluate whether rewarding projects with a different level of systematic risk is consistent with regulatory best practice. In fact, the use of differentiated betas, by preventing excessive returns being earned on low risk products, will discourage inefficient investments and promote efficient investments, and, at the same time, improve consumers' welfare with regard to such products, by promoting downstream competition.

However, the lack of capital market information at divisional level makes the theoretically correct determination of the proper risk premium difficult. And the estimates used for listed companies are not applicable as company divisions are usually not traded on the stock market and therefore do not have a share price. Moreover, the problem of how to calculate the weights in the beta disaggregating formula should be addressed, as market values may

not be observable. The best proxy, where available, might be the present value of future cash flows associated with each project.

In the electronic communication market it should also be taken into account that usually notified telecommunication firms are vertically integrated operators providing so large a number of regulated and non regulated products that it would be too cumbersome for the NRAs to disaggregate the group beta in as many betas as the number of products provided. Therefore, for divisional WACC calculation a limited disaggregation is likely to be more appropriate so that NRAs can focus on easily identifiable parts of the company for which the level of systematic risk are likely to vary substantially.

For these reasons, setting the appropriate level of rewards for the different company's activities is a difficult and controversial process that may also cause an excessive regulatory involvement in the investment decision process.

It has to be noticed that, even if the debate on the opportunity to adopt a divisional WACC is quite strong among European NRAs, due to the problems related with its implementation its use is not so common. Currently only Ofcom in UK uses a divisional WACC for the incumbent operator BT, whereas France used it in the past.

PIB 10:

IRG recognizes that in theory the adoption of a differentiated WACC is reasonable from a regulatory point of view. However, the lack of capital market information at divisional level makes the theoretically correct determination of beta in some cases difficult.

5.2 How to disaggregate the different parameters

There is a generalised consensus among economist on the theoretical correctness of using a divisional cost of capital. However, given the practical problems caused by the lack of data for divisional beta calculation, there is not a unique view on how to implement it.

The methods developed in the economic literature to calculate a divisional WACC may be grouped as follows:

- The pure play competitor approach
- Full information approach
- The subjective approach

All these approaches were originally developed for non-regulated multi-division companies. As explained in the following paragraphs, each methodology has its drawbacks whose effect have to be taken into account when using a divisional WACC in a regulated context.

5.2.1 Pure play competitor approach

As observed in the previous paragraphs, usually the beta for a specific firm's activity is unobservable in the market place. To overcome this problem, the pure play comparator approach identifies a proxy beta derived from (a) publicly traded firm(s), whose operation(s) and risk profile(s) are as similar as possible to the relevant activity and to use it/them as the measure of the activity's systematic risk.

Therefore the basic assumption of this methodology is that the pure play comparator's cost of capital (or the benchmark of several pure play comparators' cost of capital if more than one sufficient comparable pure play comparator is available) is equal to the unobservable cost of capital of the activity considered.

The validity of the pure play approach may be threatened by differences between the *pure play* comparator and the analysed activity regarding: *i*) systematic risk as the matching process is not simple, hence, in some cases, it would be naive to suppose that the cost of capital of the pure-play would correspond precisely to that of the analysed division; *ii*) capital structure, as the "similar" company may have different amounts of debt, thus equity risk is different. In order to remove the impact of financial leverage the equity beta is usually un-levered through the calculation of the un-levered or asset beta.

Fuller & Kerr (1981)¹⁹ provided empirical validation for using the pure play approach examining a sample of multi-division firms and pure-plays comparators associated with each division. Potential pure plays were selected after screening a large number of firms, analysing their characteristics and ensuring the best possible match-ups with the relevant division. They showed that an appropriately weighted average of the betas of the pure-play firms closely approximates the beta of the multi-division firm. They concluded that the pure-play technique is a valid procedure for estimating the beta of a division.

As for vertical integrated and multi-products incumbents in the electronic communication markets, if it is NRA's opinion that the level of risk underpinning the services offered over the incumbents' access network is lower than that faced by the incumbent as a whole, it will be, therefore, necessary to identify a proper pure play competitor whose beta can be used as a proxy for the incumbent access activity. However in practice is not so easy to identify proper pure play comparators of the incumbent access activity, as they should be telecommunications operators involved just in the access activities. A possible solution could be either benchmarking the equity's beta of the country's largest not diversified utility companies or the equity betas of telecom companies involved mainly, if not solely, in access activities.

Benchmarking against the betas of other utilities: Some characteristic of telecommunications incumbents are similar to those of other utility companies such as gas, electricity or water companies. In fact, demand for products sold by these companies tends to be not strongly correlated with aggregate demand, which implies a low level of beta. NRAs intending to calculate a disaggregated beta should therefore evaluate whether the value of other regulated domestic utilities 's beta could be similar to that of the incumbent's access activity, considering also that the degree of systematic risk faced by a firm increases with the level of financial leverage. To make utility's beta comparable with the incumbent's beta it will be necessary to un-gear the equity's beta.

¹⁹ Fuller R. and H. Kerr, 1981, "Estimating the divisional Cost of capital: An analysis of the Pure-Play Technique", *Journal of Finance*, vol. XXXVI, n.5.

Benchmarking against the betas of telecommunication companies: In this case it would be advisable to know the beta of telecom companies involved only in access activities. However, as Ofcom observed in its public consultation on cost of capital, there are no examples of such kind of companies and the sole example of firm close to an access only telecom company are the Local Exchange Carriers in the USA.

5.2.2 Full information approach

The full information approach to estimating the divisional cost of capital has been recommended by academics and consultant, where pure play firms are not available.

The full information approach is based on the theoretical observation that the beta of a multi-divisional firm should be equal to the market value weighted average of the divisional betas. Assuming that the market values of the divisions are known, the full information approach aids in solving the simultaneous equations relating firm betas to the divisional beta and divisional market values, using market values as independent variables. With the multi-divisional firm betas as dependent variable, cross-sectional analysis is then used to estimate divisional betas. In this way all firms that are engaged in the relevant line of business, both pure play and multi-divisional, may be included in the sample. This is the justification for the name given, full information approach.

The implementation problems that this approach presents are however even greater than those encountered with the pure play comparator approach. First, in the pure play comparator approach, the estimation technique used does not adjust for the effects of capital structure, and then it implicitly assumes that all of the sample firms finance their division in the same way. Second, since the weights by definition must add to one, every independent variable is linearly related to the other independent variables, resulting in perfect multicollinearity.

In addition to these general problems, in the case of electronic communication service divisional WACC calculation, in order to adopt such approach NRAs should be able to determine exactly the market value of each incumbent's activity.

5.2.3 The subjective or heuristic approach

The so called heuristic based approach provides a possible solution to the problems encountered in calculating the divisional cost of capital from the total cost of capital, given the lack of capital market information at divisional level. These techniques use the total cost of capital of a multi-divisional company and then takes into account data on various idiosyncratic, accounting and fundamental risk factors to obtain a risk-adjusted estimate used as a proxy for the true divisional cost of capital.

PIB 11:

IRG is of the opinion that every proposed methodology to calculate a divisional WACC has its pro and cons. Therefore, the best approach for NRAs is to compare the results obtained using the different methodologies prior to selecting a final value.

5.3 Divisional WACC in practice

5.3.1 The UK experience

Traditionally Ofcom (previously Oftel), assessed the cost of capital at company level. However in a consultation that started on January 2005 Ofcom proposed, for the first time, to disaggregate its estimate of BT's (fixed incumbent operator) equity beta in order to reflect the different levels of systematic risk faced by different parts of BT's business.

Stakeholder responses to this proposal were divided. On one side, BT and the cable companies were opposed to estimating the risk of BT's copper access business on a standalone basis. The strongest argument cited by stakeholders against estimating an equity beta for BT's copper access business was that, in the absence of pure play comparators, a beta for BT's copper access business could not be estimated with any reliability. On the other side, competitors and customers of the incumbents were, broadly speaking, in favour of assessing risk at a disaggregated level and therefore estimating a distinct equity beta for BT's copper access business.

Ofcom, after having examined and discussed all the responses to the public consultation, remained of the view that it is appropriate to apply a disaggregated approach to beta estimation in relation to BT's copper access business.

Ofcom assembled a wide range of evidence in support of its proposals, including:

- Benchmarking the equity betas of the UK's largest utility companies, and drawing a parallel between the level of risk faced by these companies with that faced by BT's copper access business;
- Benchmarking the equity betas of US telecoms companies;
- Using previously conducted studies to compare estimates of the income elasticity of demand for retail access services (e.g. line rental) with that of other telecoms services (calls).
- An analysis of the regulatory precedents for the use of a disaggregated approach to quantifying risk at a project-specific level;
- Two types of quantitative regression analysis, namely:
 - A cross-sectional analysis of telecoms companies across the world, examining the relationship between companies' equity beta estimates and the proportion of their business that is accounted for by different types of activities, e.g. "information and communications technology" (ICT), and traditional fixed lines activities;
 - A time series analysis of BT's equity beta, examining the relationship over time between its equity beta and the proportion of its business accounted for by different types of activity.

In light of these factors Ofcom's view was that a figure of 0.9 represented an appropriate estimate of the equity beta of BT's copper access business at its current gearing level. Ofcom estimated that the corresponding value for the rest of BT's services was 1.23, based on group betas of 1.1.

Ofcom in its final statement, published in August 2005, concluded that the correct estimate of the weighted average cost of capital ("WACC") for BT's two component parts on a pre tax nominal basis was the following:

- Copper access network business –10.0%; and
- The rest of BT – 11.4%.

5.3.2 The France experience

Divisional WACC was also used in France from 2001 to 2003, but ARCEP's experience was that divisional WACC enhances greatly sensitivity of parameters to samples, and that the increase in the number of parameters needed puts at risk the significance of results. Divisional WACC was put on hold in France, and further decisions were based on a less volatile approach.

6. Other practical problems in estimating the cost of capital

6.1 Introduction

There may occur circumstances in which the approaches introduced and explained in the previous chapters to estimate the cost of capital cannot be used. This may be the case when the cost of capital of a non-listed firm has to be estimated; in fact, when shares are not listed, there is no information available to estimate the company's beta. Similar types of problems may arise when a company has not issued debt securities, when a domestic financial market is not mature enough to estimate the equity risk premium reliably, or when the financial market volatility raises concerns over the company specific parameters.

This chapter presents some alternative approaches that can be used in the aforementioned circumstances in order to alleviate the uncertainty of WACC estimation in the absence of sufficiently reliable information from the financial market. In all of these cases some additional measures can be adopted in order to avoid errors in WACC estimation. One option is to use good comparator companies and another one is to use the high/low-method and sensitivity analysis.

a) Comparator companies

In case some of the parameters of the WACC can not be estimated reliably as a consequence of data unavailability, a useful approach is to base the estimation of the parameters, or of the WACC itself, using comparator companies, as in the case of divisional WACC calculation. When selecting companies, which have to serve as a comparison, the following aspects should be considered:

- The comparator company, or companies, should be comparable in size with the company being evaluated. The size can be measured for example in revenues or in total market capitalization; the latter is not applicable in case of unlisted firm.
- Further, it is preferable that the comparator companies are selected from countries which are similar to the country of the relevant company, for example in terms of income per capita, as the risk of telecom business is likely to differ depending on the income level of the country in which companies operate. In fact, in countries with a higher income level, the use of a phone is likely to be less sensitive to changes in income, whereas in lower income countries, telephone services are likely to have higher income elasticity.
- The penetration rate could also be a criterion for selecting the most appropriate comparator companies. For example, a low penetration rate could be an indication that phone services are used predominantly by businesses, since the urban population is likely to be more sensitive to the economy.

- If a parent company is listed, information from the parent company could give an indication for the value of the different parameters to be used for the WACC calculation of the unlisted subsidiary; available market reports could reference certain input parameters (out of which cost of debt is most likely to be one, as usually loan facilities are detailed in filings).

b) High/low scenario approach and sensitivity analysis

The high/low scenario approach is useful when it is possible to produce various estimates, using different methods, but none of these estimates is clearly more reliable than the others. This is done in practice by identifying the highest and lowest level for each of the envisaged parameters and calculate a range of cost of capital outcomes. The main purpose of the high/low scenario approach is to average out errors made in individual parameter estimation.

In addition to the high/low scenario approach, sensitivity analysis could be used. This means that after making the best estimate of a parameter, one calculates the WACC using this best estimate. In order to determine whether the WACC is vulnerable to errors in the estimation of this parameter, one can also use the highest and the lowest values of this parameter, produced in the analysis, and incorporate them in the WACC calculation as well and determine the effect on the WACC. If the effect is large, one should consider spending more time and effort to increase the reliability of the estimation of this one parameter.

6.2 Gearing ratio

Gearing relates to the relative values of the company's debt and equity. In section 3.2, three different methods which can be used to estimate gearing have been illustrated: the first is based on book values, the second on market values and the third uses optimal or efficient gearing. The pro and cons of the three methods have also been explained in the same section.

When a company is not listed on the stock exchange and/or when the company has not issued debt securities, it is not possible to estimate gearing based on market values. In this case one of the other two methods can be used.

An alternative may be to use the gearing data from a parent company, if the company is part of a larger conglomerate, or to use gearing data from a group of peers such as other listed telecommunication companies, which may be available from other countries. When estimating the cost of capital of the (former) incumbent, one can also use data from national public utilities.

6.3 Cost of debt

As described in section 3.3, the cost of debt is the cost that companies have to sustain in order to raise capital to finance their activities. Three methods to estimate the cost of debt were presented: the first consists in using the interest payments made by the company, the

second the regulator calculates an efficient borrowing level and associated cost of debt, and the third consists in estimating the company specific risk premium and add this to the risk free rate.

In case a company has not issued debt securities the second method cannot be used, because a credit rating of the company's debt securities will not be available.

Alternatively to the first method, applicable in the case of a company who has not issued any bonds, notes, nor it is rated by rating agencies, one can estimate the debt premium of comparable companies' prevailing yields on debt securities (corporate Eurobonds) with similar risk or maturity.

Again, as in the case of gearing estimation, if the company is part of a wider conglomerate, the debt premium of the parent company could be used or look at the "true" cost of debt for the regulated company from available filings to stock exchange of the listed parent company or from its borrowing facilities and the interest expanses in its financial accounts. It is likely that the lower end of the interest rates would apply to loans bearing parent company's guarantee, while the upper range of the interest rates would represent the interest rates at which banks would be willing to lend money to the company, based on its own creditworthiness.

6.4 Beta evaluation

Beta is a measure of the risk of a risky asset relative to the market index. In section 4.4 four methods to estimate beta were introduced: historical beta, adjusted historical beta, bottom-up beta and target beta.

When a company does not have a stock listing, the first two methods cannot be used. On the contrary, as described in more detail in sub-section 4.4.3, the bottom-up beta approach is particularly useful in the case of non-listed companies.

For the selected group of peers, it is necessary to collect information upon total debt, market capitalisation, effective tax rate (to adjust for tax shield) and equity beta. Further, asset beta should be derived, to account for differences in leverage among peer group companies. Depending on the spread of results, the arithmetic or geometric average or even the median could be used as a proxy for the asset beta of the regulated company.

Alternatively, betas of similar size companies (such as utility companies in the same country) could be used as a proxy for determining beta for the regulated company.

6.5 Risk free rate

The risk free rate is the expected return on an asset, which bears no risk at all, or in other words, whose returns are certain.

In section 4.2 it was explained that freely traded government bonds can generally be regarded as having close to zero default risk and grade zero liquidity risk and thus can be used for the purpose of determining the risk free rate.

However, when a mature or liquid government bond market is not present, or when government bonds in a specific country are not perceived to be risk free, it is not possible to estimate the risk free rate based on the domestic financial market. In such case a number of approaches are deemed to be appropriate. These are, but not limited to: deriving the risk free rate from bond ratings of first class rated companies in the domestic bond market or using the risk free rate that is found on a broader market, for example in the Eurozone. The risk free rate derived from a wider financial market should be considered representative if the wider market is accessible for investors from the country of the company which's cost of capital should be estimated. If no suitable government bonds at the European level are available to base the risk free rate on, then the relevant market for the definition of the risk free rate may be confined to the domestic market.

6.6 Equity risk premium

The equity risk premium represents the additional return over the risk-free rate that investors require as a compensation for the risk they expose themselves to by investing in equity markets.

Section 4.3 discussed five methods to estimate the equity risk premium: historical premium, adjusted historical premiums, survey premiums, benchmark, and implied premium.

The first two methods use historical data, which may not be available in stock markets which have not reached maturity yet, or which are mature but do not have a long history to be capable of estimating the equity risk premium reliably. Therefore, one, or combinations, of the other four methods have to be used.

In deciding which method, or combination of methods, to use, one should consider the shortcomings of each method (e.g. when the equity risk premium is solely based on survey data, one can adjust the outcome for known over- or underestimations). When more methods are used simultaneously, the use of the high/low scenario approach is recommended.

Estimates of global equities' return over bonds' return, taken from the international financial market, can also be used as a benchmark for deriving risk premium in the case of operators acting in emerging financial markets.

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IRG believes that, when estimating the cost of capital for non-quoted companies or companies which did not issue debt securities, or when estimating cost of capital in young financial markets, NRAs should use proxies, benchmarks and peer group analysis, taking into account country specific conditions. A number of issues should be considered, including:

- **what the appropriate comparator companies are, considering a number of relevant criteria for selection;**
 - **performing a high/low scenario approach and sensitivity analysis to average out possible errors in individual parameters' estimation.**
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