The Allen Consulting Group

Electricity Networks Access Code 2004:

Advance Determination of a WACC Methodology

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Report to Economic Regulation Authority, Western Australia

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Chapter 1

Introduction and Summary

Background and scope

The Western Australian Economic Regulation Authority engaged The Allen Consulting Group to provide advice on an appropriate methodology for determination of a weighted average cost of capital (WACC) to be applied in a service provider's proposed access arrangement under Western Australia's *Electricity Networks Access Code 2004*.

The Authority has requested that this advice include recommendations as to assumptions that should be made in deriving a WACC, and a determination of a WACC on the basis of the recommended methodology and these assumptions.

Choice of WACC methodology

A determination on the general methodology for determining the WACC by necessity involves a determination on two "steps" in calculation of the WACC:

- the methodology to be used in estimating the required return on equity; and
- the methodology to be used to calculate the WACC taking into account the return on equity.

There are a range of financial models that may be used to estimate the required return on equity. Of these, only the Capital Asset Pricing Model (CAPM) has to date been adopted in Australia for the determination of rates of return in utility regulation. There is thus a substantial precedent for use of the CAPM for determination of a WACC under the Code. The use of the CAPM in all regulatory determinations to date causes the CAPM methodology to have the advantage over other approaches that it is widely used and understood by both the finance community and industry; and there is a substantial amount of information available that can be drawn upon to assist in the application of the CAPM, which is not generally the case for the other models of asset returns. It also appears that use of the CAPM is generally supported by the regulated businesses, as no regulated utility business in Australia has yet proposed use of a different financial model.

For these reasons, it is recommended that the Authority determine that the CAPM methodology be used to determine the rate of return on equity as a component of determination of the WACC.

After estimation of the return on equity, the WACC is derived as a weighted average cost of equity and debt, taking into account the effects of inflation and taxation. Determinations and specifications of the WACC may vary in terms of:

- specification as a pre-tax or post-tax figure;
- different formulas that may be used to calculate the WACC (if the WACC is to be specified in post-tax terms); and
- specification in real or nominal terms.

There is no clear regulatory precedent in Australia for determination and specification of a WACC, with different regulators (and service providers) having variously used pre-tax and post-tax specifications and real and nominal specifications, and having applied different formulas in determination of the WACC. As such, it is necessary for the Authority to make a determination on each of these aspects of the WACC determination according to a view on what is most appropriate to apply to the electricity networks in Western Australia.

It is recommended that:

- in the absence of a broader consideration by the Authority of the merits of using a post-tax analysis in all regulatory sectors, the Authority adopt a pre-tax WACC consistent with past determinations for gas pipeline and rail access;
- the Authority be prepared to accept either a nominal or real specification of the WACC depending upon the service provider's preferences for the calculation of target revenue.

In regard to the last of these recommendations, it is noted that use of a real or nominal WACC is a secondary issue to whether an "historical-cost" or "inflation-indexed" approach is used for the determination of regulated prices, with the two approaches having different implications for the inflation risk borne by the regulated business. Under either approach, financial modelling may be undertaken in either nominal or real terms (with nominal or real WACCs, respectively) which are mathematically equivalent. The Allen Consulting Group recommends that the inflation-indexed approach be adopted for the determination of regulated prices, which is consistent with all regulatory determinations of the Authority to date and has the effect of sheltering the regulated business from inflation risk.

CAPM and WACC parameters and WACC estimate

Assumptions for the CAPM and WACC determination by the methodology recommended above are set out in Table 1.1, together with the WACC values calculated from these assumptions. Values of market variables recommended by The Allen Consulting Group (risk free rates of return and expected inflation) are average values for the 20 trading days to 8 December 2004, and the Group recognises that these values may be updated to a later date according to the market values of parameters these at the time of a WACC determination.

Table 1.1
CAPM WACC ESTIMATION – RECOMMENDED PARAMETER ASSUMPTIONS AND WACC ESTIMATES

CAPM Parameter	Notation/ Determination	Recommended Value
Nominal risk free rate of return (%)	R_{fn}	5.33
Real risk free rate of return (%)	R_{fr}	2.71
Market risk premium (%)	MRP	6.0
Equity beta	β_e	1.0
Debt margin (%)	DM	1.12
Corporate tax rate (%)	t	30
Franking credit value	γ	0.50
Debt to total assets ratio (%)	D/V	60
Equity to total assets ratio (%)	E/V	40
Nominal pre-tax cost of debt (%)	$R_{fn} + DM$	6.45
Nominal post-tax cost of equity (%)	$R_{fn} + \beta_e \times MRP$	11.33
Expected inflation (%)	π_e	2.55
Nominal post-tax WACC (%)		6.4
Nominal pre-tax WACC (%)		**9.2**
Real pre-tax WACC (%)		**6.5**

Chapter 2

Requirements of the Electricity Code

The Electricity Networks Access Code (the "Code") was gazetted in Western Australia on 30 November 2004.

Under section 4.1 of the Code, the service provider of a covered electricity network is required to submit a proposed access arrangement that establishes policies for third-party access to the network, and establishes reference services and prices controls for those reference services.

Under section 6.2 and 6.3 of the Code, the price controls for the first access arrangement reference services are required to be set in accordance with a target revenue established by reference to the total costs of the service provider as approved by the Authority.

Under section 6.43 of the Code, the totals costs of the service provider include a return on the capital base of the covered network calculated by applying a weighted average cost of capital (WACC) to a capital base established for the network.

It is the determination of the WACC under section 6.43 that is the subject of this report.

The WACC is defined in section 1.3 of the Code:

> "weighted average cost of capital", in relation to a covered network, is expressed as a percentage and means a weighted average of the cost of debt and the cost of equity as calculated under section 6.64.

Sections 6.64 to 6.69 set out the requirements for determining the WACC, and provide for the Authority to make a determination of the methodology by which the WACC should be determined.

> **Calculating weighted average cost of capital**
>
> 6.64 An access arrangement must set out the weighted average cost of capital for a covered network, which:
>
> (a) if a determination has effect under section 6.65:
>
> (i) for the first access arrangement for the covered network that is covered under section 3.1 — may use any methodology (which may be formulated without any reference to the determination under section 6.65) but, in determining whether the methodology used is consistent with this Chapter 6 and the Code objective, regard must be had to the determination under section 6.65; and
>
> (ii) otherwise — must use the methodology in the determination under section 6.65 unless the service provider can demonstrate that an access arrangement containing an alternative methodology would better achieve the objectives set out in section 6.4 and the Code objective, and
>
> (b) if a determination does not have effect under section 6.65 – must be calculated in a manner consistent with section 6.66.

Authority may make a determination of a methodology for calculation of weighted average cost of capital

6.65 The Authority may from time to time make and publish a determination (which subject to section 6.68 has effect for all covered networks under this Code) of the preferred methodology for calculating the weighted average cost of capital in access arrangements.

6.66 A determination under section 6.65:

(a) must represent an effective means of achieving the Code objective and the objectives in section 6.4; and

(b) must be based on an accepted financial model such as the Capital Asset Pricing Model.

6.67 Before making a determination under section 6.65, the Authority must consult the public in accordance with Appendix 7.

6.68 A determination under section 6.65:

(a) may be revoked or amended by a further determination under section 6.65; and

(b) has effect for the period specified in the determination, which must not be more than 5 years, unless earlier revoked by a further determination; and

(c) subject to section 6.69, does not have effect in relation to the approval or review, as applicable, of an access arrangement if the determination is published less than 6 months before the submission deadline (as extended under section 4.66(a)) or revisions submission date, as applicable.

6.69 For the covered network that is covered under section 3.1, a determination under section 6.65 has effect in relation to the approval of the first access arrangement if it is published at least 3 months before the submission deadline.

The objectives of section 6.4 of the Code referred to in section 6.64 are as follows.

Price control objectives

6.4 The price control in an access arrangement must have the objectives of:

(a) giving the service provider an opportunity to earn revenue (target revenue) for the access arrangement period from the provision of covered services as follows:

(i) an amount that meets the forward-looking and efficient costs of providing covered services, including a return on investment commensurate with the commercial risks involved;

plus:

(ii) for access arrangements other than the first access arrangement, an amount in excess of the revenue referred to in section 6.4(a)(i), to the extent necessary to reward the service provider for efficiency gains and innovation beyond the efficiency and innovation benchmarks in a previous access arrangement;

plus:

(iii) an amount (if any) determined under section 6.6;

plus:

(iv) an amount (if any) determined under section 6.9;

plus:

(v) an amount (if any) determined under an investment adjustment mechanism (see sections 6.13 to 6.18);

plus:

(vi) an amount (if any) determined under a service standards adjustment mechanism (see sections 6.29 to 6.32);

and

(b) enabling a user to predict the likely annual changes in target revenue during the access arrangement period; and

(c) avoiding price shocks (that is, sudden material tariff adjustments between succeeding years).

Methodologies for estimating the WACC for an electricity networks business are described and a preferred methodology identified in sections 3, 4 and 5 of this report. To facilitate consideration of the preferred methodology the Allen Consulting Group has estimated the WACC using this methodology and applying parameter values determined by reference to current evidence from financial markets. The parameter values and WACC estimate are described in sections 6 and 7.

Chapter 3

Cost of Capital and Economic Regulation

3.1 What is the cost of capital?

The cost of capital that is associated with an asset is the return that investors would expect to receive from a project in order to justify committing funds to that investment. That is, it is a level of return on invested capital that is just sufficient to motivate the capital investment in a particular asset and attract the capital away from alternative investments. In this sense, the cost of capital is an *opportunity cost* of capital – the return on capital available to investors in the next-best investment opportunities, taking into account considerations of expected return and risk.

Capital, i.e. investment funds, can be regarded as a tradeable commodity with price determined by supply and demand. The cost (price) of capital is dependent upon the aggregate demand and supply of investment funds, and the risk in cash flows potentially generated by the asset relative to the risk associated with other assets. The cost of capital for an asset or activity is not unilaterally determined by the owner of the asset, the provider of the capital or, in the case of regulated utilities, by a regulator – it is a market price for investment funds.

In practice, assets that are employed by a firm are normally financed in part by debt, with the residual portion financed by the equity holders. Of the returns that flow from a particular asset, part is paid to the debt providers and part to the equity holders. Hence, the term ‘weighted average cost of capital’ is often used to refer to the average cost of debt and equity capital, weighted to proportions of debt and equity finance to reflect financing arrangements for assets.

3.2 What risks are reflected in the cost of capital?

As indicated above, the cost of capital for an activity reflects not only an aggregate supply and demand for investment funds, but also the risk in cash flows able to be generated by an asset. An important issue when estimating the cost of capital is to distinguish between classes of risk reflected in the cost of capital and those that are not.

A cornerstone of modern financial economics is that much of the risk that is associated with the returns to a particular asset can be eliminated at no cost, merely by holding that asset together with a broad portfolio of other assets. The act of combining assets into a portfolio in order to reduce the volatility of average returns is known as diversification.

However, diversification cannot eliminate all risk. This is because part of the volatility in expected returns may arise from economy-wide events that affect all assets similarly, albeit some more than others. This portion of the risk is often referred to as "non-diversifiable" or "systematic" risk. The degree of non-diversifiable risk associated with a particular asset depends upon the extent to which the returns expected from that asset are affected from these economy-wide events, such as unexpected changes in real GNP, inflation, market risk aversion and long term real interest rates.[1]

It is the non-diversifiable risk – that an investor cannot eliminate at no cost – which the investor should be compensated for through a return on capital investment, and therefore which should be reflected in the cost of capital.

3.3 What is the role of the cost of capital in economic regulation?

In order to understand the role of the cost of capital in relation to economic regulation, such as in determining regulated prices for access to electricity networks, it is necessary to understand how the capital-related costs of an asset operator are determined under the "building-block" approach to price regulation, and the rationale for this treatment.

One of the objectives of any economic regulator is to ensure that investment funds continue to be drawn into the regulated industry, so that the services that are valued by customers continue to be provided. Another primary objective of any economic regulator, however, is to ensure that customers pay the lowest price commensurate with the ongoing provision of the service and an efficient level of new investment. The logical reconciliation of these objectives is for the regulatory regime to create the expectation that investors will receive a return equal to the cost of capital associated with the regulated activities.

Under the 'building-block' approach to regulation, price controls are designed to deliver a stream of revenue equal to the sum of:

- a return on the value of the assets for regulatory purposes (the regulatory asset base) equal to the regulator's view of the cost of capital associated with the regulated activities (the regulated rate of return);
- a return of the value of regulated assets over time through regulatory deprecation (equivalent to a return of the principal on a loan); and
- the operating and maintenance costs associated with the regulated activities.

Under this approach, investors should expect to earn a rate of return equal to the cost of capital on capital expenditure from the time that it is spent, and to receive a return of their funds over time through the regulatory depreciation allowance. Thus, investors should expect to get a return on, and return of, their capital over time, and investment should proceed. Clearly, however, the objective that investment funds continue to be attracted to the industry, but customers pay no more than is necessary, is dependent upon the rate of return employed by the regulator (the regulated rate of return) being an unbiased estimate of the actual cost of capital associated with the regulated activities.

[1] Chen, N., Roll, R., and Ross, S., 1986. Economic forces and the stock market, *Journal of Business* 59: 383–403.

3.4 How is the cost of capital estimated?

As already indicated above, the cost of capital is a market price, dependent upon a supply and demand for capital funds. As with the market price for any good or service, the market price for capital cannot be calculated *a priori*, but is determined by transactions within the market. In judging what the cost of capital might be for a particular project, the best source of information is historical evidence on costs of capital for other, similar, projects and businesses.

There have been a number of approaches developed for estimating the cost of capital for particular projects or businesses. These are described below.

Capital asset pricing model (CAPM)

The CAPM specifies a linear relationship between the expected return on a risky asset and a risk parameter, “beta”:[2]

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

where $E(R_j)$ is the expected rate of return on asset j, R_f is the rate of return on a risk free asset, $E(R_m)$ is the expected rate of return on the market portfolio of risky assets, and β_j is the ratio of the covariance Rj and R_m to the variance of R_m.

In effect, the CAPM is a “building block” approach to determining the cost of capital, starting with a cost of capital for a risk-free asset (indicating the time value of money) and adding a component to reflect risk. The “risk component” is determined as an incremental cost reflecting the risk of the market portfolio of assets, scaled according to the risk for the asset in question relative to the risk for the market portfolio (the market-average risk). The beta parameter is the scaling factor.

The CAPM is the most widely used methodology for estimation of costs of capital, including in regulatory applications, and is explicitly indicated in section 6.66 of the Code as a financial model that may be used for the determination of the WACC. For this reason, a more detailed description of the CAPM is provided in the next chapter.

Arbitrage Pricing Theory

Arbitrage pricing theory specifies a linear relationship between the expected return on a risky asset and returns on a range of portfolios of other assets for which returns vary with a set of factors, typically macroeconomic variables:

$$E(R_j) = E(R_z) + b_{j1}[E(R_{p1}) - E(R_z)] + \ldots + b_{jk}[E(R_{pk}) - E(R_z)]$$

[2] Lally, M., 2000. *The Cost of Equity Capital and Its Estimation*, McGraw-Hill Series in Advanced Finance Volume 3, Sydney: McGraw-Hill, p 2.

where $E(R_z)$ is the expected rate of return on a portfolio of assets uncorrelated with all factors (a risk free rate of return), $E(R_{pi})$ is the expected rate of return for a portfolio of assets with unit coefficient on the ith factor.[3] Compensation for non-diversifiable risk is reflected in the regression parameters (sensitivity coefficients) for the observed return on the asset against the differences in observed returns between asset portfolios and the risk-free asset.

Fama–French Model

The Fama–French model is an augmentation of the CAPM with two additional explanatory variables with explanatory power over cross sectional variation in equity returns:

$$E(R_j) = R_f + [E(R_m) - R_f]\beta_j + s_j E(SMB) + h_j(HML)$$

where *SMB* is the differential return between a portfolio of small capitalisation stocks and one of large capitalisation stocks, and *HML* is the differential return on a portfolio of stocks with high book to market equity ratios and one of stocks with low book to market equity ratios.[4] Compensation for non-diversifiable risk remains reflected in the beta value for the stock.

Dividend growth model

The dividend growth model derives an estimate of the cost of equity from observed stock price and dividend per share and an assumed rate of dividend growth:

$$k_e = \frac{D_0(1+g)}{P} + g$$

where k_e is the cost of equity, D_0 is the observed current dividend per share, P is the observed stock price, and g is an assumed constant growth rate in expected dividends per share.[5]

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[3] Lally, M., 2000. *The Cost of Equity Capital and Its Estimation*, McGraw-Hill Series in Advanced Finance Volume 3, Sydney: McGraw-Hill, pp 41,42.

[4] Lally, M., 2000. *The Cost of Equity Capital and Its Estimation*, McGraw-Hill Series in Advanced Finance Volume 3, Sydney: McGraw-Hill, pp 42.

[5] Lally, M., 2000. *The Cost of Equity Capital and Its Estimation*, McGraw-Hill Series in Advanced Finance Volume 3, Sydney: McGraw-Hill, pp 42,43.

Chapter 4

The Capital Asset Pricing Model

4.1 General formulation

The CAPM is the most common methodology adopted to estimate a cost of capital. The CAPM is used widely by regulators and industry and has broad industry acceptance.

In its simplest form, the CAPM provides a direct estimate of the required return for a project (or asset):

$$R_a = R_f + \beta_a \left(R_m - R_f\right)$$

where R_a is the required return on assets, R_f is the risk free rate, β_a is the asset beta, and $(R_m – R_f)$ is the return over the risk free rate (the market or equity risk premium) that investors would need to expect in order to invest in a well-diversified portfolio of assets.

Thus, under the CAPM, the required return for any asset depends upon the return that could be earned from an investment that is risk free as well as a required return to compensate for the risk premium that an investor would require over the risk free rate. This risk premium is a function of two inputs:

- An estimate of the return that investors would require in order to hold a widely diversified portfolio of assets, which is also the return that an investor would require in order to hold an asset which has an "average" level of risk.
- A ranking of the risk associated with the particular asset in question relative to the risk associated with the well-diversified portfolio of assets –the beta of the asset.

The risk premium that investors would require in order to hold a particular asset is calculated by scaling up, or scaling down, the risk premium required for the well-diversified portfolio of assets according to the beta measure of that asset's relative risk.

In practice, asset betas cannot be observed or measured directly. Estimating a beta requires historical information on the economic returns to an asset (comprising the value of the returns plus the change in the market value of the asset), and on economic returns to the well-diversified portfolio of assets. This type of information is only available on assets that are traded on a stock exchange, which only comprises trading in the equity share of an asset. Therefore, in practice, the CAPM is used to estimate the required return to the equity share of an asset, and stock market indices are used as a proxy for the market portfolio. Accordingly, the more common formulation of the CAPM is the following expression relating to the return on equity:

$$R_e = R_f + \beta_e (R_m - R_f)$$

where R_e is the required return on equity and β_e is the equity beta.

Once a return on equity has been determined, a proxy for the cost of debt financing is then normally taken from observed or estimated debt financing costs. The WACC is estimated by observing or assuming a level of gearing for the entity and calculating the weighted average of the costs of equity and debt:

$$WACC = R_e \frac{E}{V} + R_d \frac{D}{V}$$

where R_d is the cost of debt, and E/V and D/V are the shares of equity and debt, respectively, in the financing structure.

There are, however, a number of different expressions for a post-tax WACC that can be presented as the Regulator's "target" return. The different expressions for the WACC are derived by transferring one or more particular costs (in particular taxation) or benefits (in particular the benefits of dividend imputation) from the cash-flows to the WACC. The different forms of WACC that are commonly used as regulatory targets are as follows.

- Post-Tax (Vanilla) WACC

  This form of WACC is an estimate of the total return that the asset owners demand, and requires all potential costs and benefits to be reflected in the cash-flows. Consequently, it is the simplest form of WACC, and is synonymous with the WACC expression above.

- Post-Tax (Officer) WACC

  This form of WACC is an estimate of the post-tax (cash) return on assets that the company needs to generate.

$$WACC = R_e \frac{E}{V} \frac{1 - T_c}{\left(1 - T_c\left(1 - \gamma\right)\right)} + R_d \frac{D}{V}\left(1 - T_c\right)$$

  where T_c is the corporate tax rate and γ is the value of franking credits created (as a proportion of their face value).

  This form of WACC overstates taxation liability because it assumes that all of the return on assets is taxed (whereas the portion that is distributed to debt providers is not taxed), and it provides shareholders with additional benefits through the dividend imputation system. Consequently, the Officer WACC is lower than the Vanilla WACC.

- Post-Tax (Monkhouse) WACC

  This form of WACC is an estimate of the post-tax return on assets that the company needs to generate, where the value of franking credits is counted as part of that return.

$$WACC = R_e \frac{E}{V} + R_d \left(1 - T_c\left(1 - \gamma\right)\right)\frac{D}{V}$$

  The Monkhouse WACC is higher than the Officer WACC as it includes the value of franking credits in measuring the required return.

Of the different WACC expressions, the Officer WACC is the most widely cited as the target post-tax WACC because this definition of WACC is commonly used for asset valuation and project evaluation. Many finance practitioners advocate the use of the Vanilla WACC as the regulatory target as it is the easiest to understand, and because it focuses on the total return that investors require, regardless of the source of the benefit. The Vanilla WACC is also often used in asset valuation exercises. The ACCC, on the other hand, focuses on the post-tax return on equity given that this measure of return appears to be the most widely understood by equity investors and is the measure of return that regulators in the USA generally consider.

The choice of WACC expression is only a relevant issue if a post-tax form of the WACC is to be used. The expressions are equivalent for a pre-tax WACC.

4.2 Accounting for Taxation

The CAPM and WACC models generally deliver an estimate of the required after-tax (or "post tax") return to providers of funds. In contrast, however, the revenue benchmarks that are used to determine price controls for regulated entities generally reflect a pre-tax revenue stream. As a result, regulators need to make assumptions about the expected taxation liabilities of the regulated entity and correct either the rate of return or the revenue benchmarks to reflect these liabilities.

There have been two broad approaches adopted by Australian regulators to date.

- The first approach is to transform the after tax WACC into a pre tax WACC (reflecting an assumption about the effective tax rate of the entity), thus making an allowance for tax by using a higher regulated WACC.
- The second approach has been to include an allowance for the cost of tax directly in the cash flows (or revenue benchmarks) of the regulated entity, based upon an explicit projection of the taxation liabilities for the regulated activity. It has also been typical practice to base the projections of company tax liabilities upon benchmark assumptions, for example, assumptions as to the applicable tax depreciation rates, and calculating the interest deduction based upon the benchmark financing arrangements (i.e. capital structure and cost of debt).

The first methodology has the benefit of computational simplicity. It does, however, have a number of problems, the most important of which is that no simple transformation method can capture the complexities of the Australian tax system. There has been substantial controversy about which of the numerous alternative transformation methods provide the best estimate. Moreover, it is very difficult to deduce the assumptions made about the taxation system from the simple transformations, which has further exacerbated the controversy. In addition, there has been an impression amongst regulators that the simple transformation generally proposed by regulated entities (that has become known as the forward transformation) is likely to overstate the taxation liabilities of infrastructure firms.

The second methodology, in contrast, requires an explicit statement of the assumptions being made about the taxation system, and thus is more transparent. In addition, the estimate of the taxation liabilities could reflect a range of assumptions about the taxation system – at one end of the scale, attempting to replicate the actual taxation position of the regulated business, and at the other end, adopting high-level benchmarks about the taxation system. However, the second methodology is more demanding in the amount of information required.

4.3 Accounting for Inflation

The choice to use either a real or nominal WACC depends upon the choice of modelling in real or nominal terms.

Under a nominal approach, values of all costs (including asset values) are expressed in "money of the day" terms, with forecasts of costs accommodating the forecast of inflation. A nominal WACC is used to calculate returns on assets.

Under a real approach, values of all costs are expressed in constant price terms and a real WACC is used to calculate returns on assets.

All other things being equal, the two approaches are mathematically equivalent and the choice is one of preference for modelling in real or nominal terms (utilising real or nominal forecasts of costs).

The substantive issue in accounting for inflation is whether an "historical-cost" or "inflation-indexed" approach is used for the determination of regulated prices, with the two approaches having different implications for the inflation risk borne by the regulated business.

Under the inflation-indexed approach, prices (and hence revenue) and asset values are indexed to actual inflation. Thus, if realised inflation differs from the forecast, revenue also adjusts, and the target real return in assets is preserved (all else constant). Thus, the asset owner is largely protected from inflation risk. Under an historical cost approach, prices are determined based on a forecast of inflation and the regulated business bears the risk of actual inflation departing from the forecast.

This is the reason why the inflation-indexed approach is generally used where price controls are set for a period of time (in order to provide incentives for efficiency). By protecting the asset owner from inflation risk – which historically has been a significant risk in Australia and other countries – a commitment to retain a price control for a period of time without review is more credible.

Returns on equity and debt can be converted from real to nominal values (and vice versa) using the Fisher Equation.[6]

[6] Brearley, R., Myers, S., Partington, G. and Robinson, D., 2001. *Principles of Corporate Finance* 1st Australian Edition, Roseville: McGraw-Hill, p 135.

Chapter 5

Choice of WACC Methodology

5.1 Precedent regulatory decisions

Electricity Distribution

Regulatory determinations for electricity distribution systems made in Queensland, New South Wales, Victoria and South Australia provide regulatory precedents in determining a regulated rate of return. A summary of the general methodologies used to determine rates of return is provided in Table 2.1.

Table 5.1

METHODOLOGIES APPLIED IN WACC DETERMINATIONS OF RATES OF RETURN FOR REGULATED ELECTRICITY DISTRIBUTION BUSINESSES

Regulatory Determination	Financial Model	WACC Formulation	Treatment of Taxation
Victoria electricity distribution systems, 2000[7]	CAPM	Vanilla Real post-tax	Allowance for taxation liabilities included in revenue benchmarks, determined by modelled tax liabilities, scaled to reflect value of imputation credits
Queensland electricity distribution systems, 2000[8]	CAPM	Vanilla Nominal post-tax	Forecast cost of tax by the service provider with carry forward of difference between forecast and actual to the next regulatory period.
New South Wales electricity distribution systems, 2004[9]	CAPM	Officer Real pre-tax	Adjustment of a post tax WACC to a pre-tax WACC, by the forward transformation method and with an assumed corporate tax rate and value of dividend imputation.
South Australia electricity distribution systems, 2004[10]	CAPM	Monkhouse Real pre-tax	Adjustment of a post tax WACC to a pre-tax WACC, by the forward transformation method and with an assumed corporate tax rate and value of dividend imputation.

[7] Office of the Regulator-General, Victoria, September 2000, Electricity Distribution Price Determination 2001-05, Volume 1 Statement of Purpose and Reasons.

[8] Queensland Competition Authority, May 2001, Final Determination: Regulation of Electricity Distribution.

[9] Independent Pricing and Regulatory Tribunal of New South Wales, June 2004, NSW Electricity Distribution Pricing 2004/05 to 2008/09 Final Report.

[10] Essential Services Commission of South Australia, November 2004, Draft 2005-2010 Electricity Distribution Price Determination, Part A – Statement of Reasons.

All of price determinations summarised in Table 5.1 for electricity distribution businesses have used the CAPM for estimation of a return to an asset.

In South Australia, unlike the other jurisdictions, the regulatory code (the Electricity Pricing Order) requires the use of the CAPM.[11] The Electricity Pricing Order also requires use of a real pre-tax WACC (derived by the forward transformation method).

In Queensland, New South Wales and Victoria, the methodology used to determine the rate of return on assets is a matter to be determined as part of the process of making the price determinations. The three regulators have variously indicated that the reasons for use of the CAPM are that:

- it is widely used and understood by both the finance community and industry;
- it is consistent with the methodology used by all Australian regulators in regulation of monopoly utility businesses, and is also used in the United Kingdom;
- use of the CAPM is generally supported by the regulated businesses (and indeed is the only methodology yet to be proposed by a regulated utility business to a regulator in Australia); and
- there is a substantial amount of information available that can be drawn upon to assist in the application of the CAPM, which is not generally the case for the other models of asset returns.

The use of the CAPM methodology for estimation of required returns to assets is not peculiar to regulation of electricity distribution businesses. Rather, it is ubiquitous across all of the regulated utility and "essential service" industries in Australia, including gas pipelines, railways, ports, airports and telecommunications.

While the use of the CAPM is ubiquitous across regulators and regulated industries, the formulation of the WACC used is not. For the determinations on prices for electricity distribution businesses summarised in Table 5.1, three different WACC formulations have been applied.

The Victorian and Queensland regulators opted to use a post tax WACC, while the New South Wales and South Australian Regulators opted to use a pre-tax WACC. The Victorian and Queensland regulators both determined to allow for the cost of taxation in the revenue benchmark revenues for the regulated businesses rather than through the WACC. Reasons indicated for this approach are:

- conversion of a post-tax to pre-tax WACC is complex and non-transparent, and is subject to error in estimating the costs of taxation (or an appropriate benchmark cost of taxation) for the regulated businesses; and
- allowing for the cost of corporate income tax in the benchmark revenues for the businesses allows tax to be treated like any other cost, and for the WACC to be presented as a post-tax measure of return that is more relevant to investors.

[11] Electricity Pricing Order (South Australia), clauses 7.2 and Schedule 10.

Notwithstanding the common preference for use of a post tax WACC, the Victorian and Queensland regulators adopted different approaches to the estimation of costs of taxation. The Victorian regulator determined taxation costs based on "simplified" benchmark assumptions for the assessment of taxation liabilities, including in relation to depreciation, gearing, interest costs and the value of franking credits. The reason for this approach was indicated to be to avoid creating distorting incentives financing decisions. The Queensland regulator used forecasts provided by the regulated businesses of actual taxation payments and included provision for carryover to the next regulatory period of "unders" and "overs" relative to actual payments.

The New South Wales and South Australian regulators did not indicate in their determinations the reasons for using a pre-tax form of WACC, although it is noted that the South Australian regulator is required under the Electricity Pricing Order to use a real pre-tax form of WACC. It is considered, however, that use of the pre-tax form of WACC reflects concerns about the information requirements necessary to explicitly estimate a cost of tax for inclusion in the benchmark revenue, in particular the requirements for the regulated businesses to provide the information necessary to estimate taxation liabilities for the regulated activities as a stand alone business.

The regulators also differ in their choice of using a nominal or real WACC. The Queensland regulator used a nominal WACC, whereas the Victorian, New South Wales and South Australian regulators used a real WACC.

The Queensland regulator indicated the following reasons for use of a nominal WACC:

- transparent determination of depreciation allowances;
- interest and other non-inflationary cash flows require specific correction when modelling in real terms;
- facilitates reconciliation of regulatory accounts with taxation and statutory accounts;
- a nominal WACC is directly comparable with other financial benchmarks such as the nominal rate of return on other investments; and
- the nominal approach is the preferred approach of academics and financial market participants.

The Queensland regulator acknowledged the following advantages of a real WACC:

- consistency with most other regulatory decisions, allowing comparisons between decisions;
- there is no need to deflate the asset values, as is required in applying a nominal WACC.

It is notable, however, that while the Queensland regulator has opted to use a nominal WACC, this is only a financial modelling issue. The Queensland Regulator still implements inflation-indexed prices which is equivalant to a "real" approach to price determination.

Other Utility Services and Essential Services

As with electricity distribution systems, Australian regulators have without exception adopted the CAPM methodology for determination of required returns on assets for other utility businesses and essential services, and the WACC methodology for determination of a regulatory rate of return. However, as with the regulation of electricity distribution businesses, different formulations of the WACC have been adopted, differing in the WACC formula used and presentation in pre-tax and post tax terms, and nominal and real terms. A summary of the methodologies adopted in rate of return determinations for gas pipelines is provided in Table 5.2.

Table 5.2

METHODOLOGIES APPLIED IN WACC DETERMINATIONS OF RATES OF RETURN FOR GAS PIPELINE BUSINESSES

Regulatory Determination	Financial Model	WACC Formulation	Treatment of Taxation
ACCC gas transmission pipelines[12]	CAPM	Vanilla WACC: nominal post-tax	Revenue requirements include a forecast of taxation liabilities determined on the basis of assumptions as to the tax position of the regulated business.
Victoria gas distribution systems[13]	CAPM	Vanilla WACC: real post-tax	Revenue requirements include a forecast of taxation liabilities for a "benchmark" efficient company
New South Wales gas distribution systems[14]	CAPM	Officer WACC: real pre-tax	Adjustment of a post tax WACC to a pre-tax WACC, by the forward transformation method and with an assumed corporate tax rate and value of dividend imputation.
South Australia gas distribution system[15]	CAPM	WACC formulation not stated: real pre-tax	Not stated
Western Australia gas transmission and distribution	CAPM	Officer WACC: real pre-tax with exception of the Goldfields Gas Pipeline for which a nominal pre-tax WACC was used.	Adjustment of a post tax WACC to a pre-tax WACC, by the forward transformation method and with an assumed corporate tax rate and value of dividend imputation.

12 ACCC, 2 October 2003, *Final Decision: East Australian Pipeline Limited Access Arrangement for the Moomba to Sydney Pipeline System*.

13 Essential Services Commission, October 2002, *Review of Gas Access Arrangements: Final Decision*.

14 Independent Pricing and Regulatory Tribunal, December 2004, *Draft Decision: Revised Access Arrangement for AGL Gas Networks*.

15 South Australian Independent Pricing and Access Regulator, December 2001, *Final Decision: Access Arrangement for Envestra Limited's South Australian Natural Gas Distribution System*.

5.2 Choice of WACC methodology

A determination on the general methodology for determining the WACC by necessity involves a determination on two "steps" in calculation of the WACC:

- the methodology to be used in determining the required return on equity; and
- the methodology to be used to calculate the WACC taking into account the return on equity.

Return on assets

As indicated in Chapter 3, there are a range of financial models that may be used to calculate a return on equity. Of these, only the CAPM has to date been adopted in Australia for the determination of rates of return in utility regulation.

There is substantial precedent for use of the CAPM for determination of a WACC under the Code. This use of the CAPM in all regulatory determinations to date causes the CAPM methodology to have the advantage over other approaches that it is widely used and understood by both the finance community and industry; and there is a substantial amount of information available that can be drawn upon to assist in the application of the CAPM, which is not generally the case for the other models of asset returns. It also appears that use of the CAPM is generally supported by the regulated businesses, as no regulated utility business in Australia has yet proposed use of a different financial model.

For these reasons, it is recommended that the Authority determine that the CAPM methodology be used to determine the rate of return on equity as a component of determination of the WACC.

WACC

As indicated in Chapter 4, there are a range of different approaches that may be applied in determining and specifying a WACC. In particular, determinations and specifications of the WACC may vary in terms of:

- different formulas that may be used to calculate the WACC;
- specification as a pre-tax or post-tax figure; and
- specification in real or nominal terms.

There is no clear regulatory precedent in Australia for determination and specification of a WACC, with different regulators (and service providers) having variously used pre-tax and post-tax specifications and real and nominal specifications, and having applied different formulas in determination of the WACC. As such, it is necessary for the Authority to make a determination on each of these aspects of the WACC determination according to a view on what is most appropriate to apply to the electricity networks in Western Australia.

WACC formula

Of the different WACC formulas, the Officer WACC is the most widely cited as the target post-tax WACC because this definition of WACC is commonly used for asset valuation and project evaluation. Many finance practitioners advocate the use of the Vanilla WACC as the regulatory target as it is the easiest to understand, and because it focuses on the total return that investors require, regardless of the source of the benefit (i.e. regardless of whether benefits arise from actual returns, tax deductibility of returns to debt or dividend imputation).

The Officer WACC has been used by the Authority and its predecessor agencies in all rate of return determinations for gas-pipeline and railway access to give an indication of the value of the post-tax WACC. However, as the Authority and its predecessor agencies have consistently used a pre-tax WACC, the determination of the post-tax WACC has been irrelevant in determination of regulated prices. If the Authority determines to continue to estimate the WACC in pre-tax terms, then the choice of post-tax WACC formula is irrelevant.

Pre-tax or post-tax WACC

The choice of a pre-tax or post-tax WACC is a matter of the accuracy with which the Authority wishes to incorporate the cost of tax of the service provider into the determination of target revenue, either as the actual cost of tax arising from the regulated activity, or as an appropriate benchmark for the activity.

This necessarily involves a trade off between the additional information requirements and analysis necessary for the determination of target revenue using a post-tax WACC (i.e. for the explicit determination of a cost of tax as a component of target revenue) and the potential errors that may arise in incorporating the cost of tax into the WACC through a transformation of post-tax to pre-tax WACC.

To date, the Authority and its predecessor regulatory agencies has used a pre-tax WACC in regulation of access to gas pipeline systems and railways. There is no reason why any decision of the Authority to depart from this practice and use a post-tax WACC for electricity networks should not also apply to the other industry sectors that it regulates. A position taken by the Authority in respect of determination of pre-tax or post-tax WACCs would, ideally, be taken in respect of all of the Authority’s price determinations rather than just for the electricity networks. In the absence of such a general determination and change in practice by the Authority, it is recommended that a pre-tax specification of the WACC be applied to the electricity networks.

The Authority has in the past applied the “forward transformation” methodology, under which the nominal post tax WACC is grossed up by one minus the statutory corporate tax rate to obtain the pre-tax nominal WACC, and this is then adjusted for inflation using the Fisher Equation. An alternative approach is the “reverse transformation”, under which the post-tax nominal WACC is first deflated to obtain a post-tax real WACC, and then converted to a pre-tax real WACC by grossing by a factor of one minus the tax rate. The reverse transformation would result in a lower WACC and lower target revenue to a Service Provider.

Since about 2000, the Authority's predecessor agencies and other Australian regulators have used the forward transformation for reason that this more adequately reflects the taxation effects of the Ralph Taxation Review, with the forward transformation having become a less biased estimate of the target post-tax nominal return (i.e. where asset lives are aligned for regulatory and tax purposes). There would not appear at this time to be reason for the Authority to alter this approach.

Real or nominal WACC

The decision to use a real or nominal specification of the WACC relates not to the merits of the different WACC specifications per se, but rather the merits and preferences for determining the target revenue by a calculation in real or nominal terms.

There are not necessarily any differences in target revenue and price outcomes for the network service provider, although depending upon the details of a methodology adopted, a nominal calculation (if undertaken in historical-cost terms involving depreciation of capital assets on an historical cost basis) may bring forward the return of capital relative to a real calculation, resulting in higher initial service prices.

The Authority has generally undertaken cost and revenue calculations for regulated businesses in real terms and taken an inflation-indexed approach to determination of regulated prices. This approach has some advantage, particularly in transparency of trends in cost forecasts, revenues and prices. However, this advantage is not considered sufficiently great to preclude use of a nominal calculation, particularly if that is preferred by the service provider.

As indicated in section 4.3, the substantive issue in accounting for inflation is whether an "historical-cost" or "inflation-indexed" approach is used for the determination of regulated prices, with the two approaches having different implications for the inflation risk borne by the regulated business. The Allen Consulting Group recommends that the inflation-indexed approach be adopted for the determination of regulated prices, which is consistent with all regulatory determinations of the Authority to date and has the effect of sheltering the regulated business from inflation risk.

Chapter 6

CAPM Parameter Values

6.1 Parameter values requiring estimation

In order to use the CAPM to estimate the rate of return it is necessary to make a number of assumptions about the following inputs:

- the risk free rate;
- the equity or market-risk premium;
- the equity beta;
- the benchmark financing structure;
- the benchmark debt margin; and
- the value of dividend imputation.

6.2 Risk free rates

In recent years, Australian regulators have all adopted very similar approaches to deriving a proxy measure of nominal and real risk-free rates of return, based on one or other of the following methods.

- Deriving the nominal risk free rate from a recent average (20, 30 or 40 days) of the yields on Commonwealth bond rates, the real risk free rate from a recent average of the yields on Commonwealth index-linked bonds over the same period, and calculating the inflation forecast as the difference between these yields.
- Using the yield on bonds with either 5 year or a 10 year yield to maturity.

This averaging approach has been applied extensively by other regulatory bodies in Australia, including the Australian Competition and Consumer Commission, Essential Services Commission of Victoria, the Independent Pricing and Regulatory Tribunal of New South Wales, the Queensland Competition Authority and the predecessor agencies to the Economic Regulation Authority in Western Australia. Variations in this approach (with different averaging periods and different terms to maturity) normally would not have a material effect on the proxy real risk free rate.

The difference between the two rates (calculated using the Fisher equation[16]) provides an inflation forecast over the relevant period. This is a common approach amongst regulators to provide a measure of inflation. The use of Commonwealth capital indexed bonds has the advantage that it permits a market-based expectation of inflation to be taken into account.

Using this approach with bond terms of 10 years and a 20 trading day averaging period yields the following estimates of risk free rates and inflation as at 8 December 2004:

[16] Brearley, R.A. and Myers, S.C., 1996. *Principles of Corporate Finance*, fifth edition, New York McGraw–Hill, pp 642, 643.

- Nominal risk free rate 5.33%
- Real risk free rate 2.71%
- Implied forecast inflation 2.55%

6.3 Market risk premium

The market risk premium is the expected average return of the market above the risk free rate.

Based on the observed historical equity premiums, Officer and Hathaway (who have researched the historical equity premiums in Australia) express a preference for using an equity premium in the range of 6 to 7 percent. However, the estimate of the market risk premium to be used in the CAPM is a forecast, and hence is unambiguously forward looking. There has been recent debate that the current forward looking equity premium is lower than that implied by point estimates of long-term historical averages. The historical data and views on the current and future market risk premium are summarised as follows.

Historical data

Australian historical data on the realised historical market risk premium that have been compiled by Professor Robert Officer are shown in Table 6.1. The averages have a relatively large standard error of the mean. With a standard error of 1.55 percent, the 95 percent confidence interval for the realised market risk premium lies between 4.3 percent and 10.4 percent. It is apparent that more recent measurements of the realised market risk premium have been lower than in earlier periods.

Table 6.1

HISTORICAL REALISED MARKET RISK PREMIUM IN AUSTRALIA[17]

Time Period	Equity Premium: Returns	Standard Deviation	Standard Error of the Mean
1882-2001	7.19%	16.97%	1.55%
Differing Ending Point			
1882-1950	8.00%	11.11%	1.34%
1882-1970	8.16%	13.70%	1.45%
1882-1990	7.40%	17.33%	1.66%
Different Beginning Point			
1900-2001	7.14%	17.94%	1.78%
1950-2001	6.51%	22.60%	3.13%
1970-2001	3.37%	24.38%	4.31%

[17] Essential Services Commission, October 2002, Review of Gas Access Arrangements: Final Decision, pp 322 – 336.

There are several difficulties inherent in inferring the appropriate forward-looking market risk premium from historical data of stock market returns. First, at different times the stock market may be a better or worse proxy for the returns generally available in an economy. Second, the size of the market risk premium is dependent on the absolute level of risk represented by the stock market proxy, which will be determined in large measure by the industrial structure of stock market's composition. One hundred years ago the Australian stock market was much more highly dominated by resources stocks.

There have been numerous factors suggesting a decline in the market risk premium over the past century. These factors are discussed at length in a recent study by The Allen Consulting Group commissioned by the ACCC.[18] Given the changing structure of Australian industry over the past century, the marked reductions in transaction costs and the globalisation of Australia's financial sector in the past twenty years, it is not appropriate to rely simply on the historical record to estimate the current forward-looking market risk premium.

Evidence from the Dividend Growth Model

An alternative approach of deriving an estimate of the market risk premium is from use of the dividend growth model.

Australian studies deriving point estimates of the market risk premium using the Dividend Growth Model have been undertaken by Professor Kevin Davis (4.5 percent to 7 percent), Associate Professor Martin Lally (5.7 percent) and Professor Stephen Gray (5.63 percent to 5.93 percent). These estimates may, if anything, be conservatively high. All of these studies all assume that real dividend per share growth can be proxied by the real GDP growth rate. Each study assumes that the average forward-looking GDP growth rate for Australia will be around 3.5 percent. It is likely that due to the issue of new shares required to fund GDP growth, the real growth rate of dividends per share will be considerably lower than the real GDP rate. Hence the average values obtained in these studies could be over-estimates of the forward-looking market risk premium applying the dividend growth model approach.

In the US, Fama and French applied a related methodology to estimate the expected capital gain in the US over a 129 year period using historical data found market risk premium estimates of 4.4 percent and 3.8 percent for the periods 1872-2000 and 1951-2000 respectively. They concluded as follows:

> Our main message is that the unconditional expected equity premium of the last 50 years is probably far below the realized premium.[19]

[18] The Allen Consulting Group (March 2004), *Review of Studies Comparing International Regulatory Determinations*, Report to the Australian Competition and Consumer Commission.

[19] Fama, Eugene F. and Kenneth R. French (April 2002), "The Equity Premium," *Journal of Finance*, Vol. LVII, No. 2, pp. 658.

Inter-country comparisons

International comparisons of historical market risk premiums highlight the problem of adopting the historical market risk premium as an indicator of the forward-looking (or expected) market risk premium. For example, Canada's stock market has roughly the same composition of resources stocks as Australia, and its historically realised market risk premium over the last 101 years has been lower than that of Australia and the US. Canada also has a sizeable information technology sector, which would tend to make it a still riskier stock market.

Historical outcome do not necessarily reflect expectations. It is doubtful, for example, that at the beginning of 1900 investors in Denmark expected that the realised market risk premium in the Danish market over the next 101 years would be only 3.3% or that having realised such an market risk premium, Danish investors today expect to earn only 3.3% on their investments.

With the changing structure of the Australian stock market, we should expect to see different levels of expected returns on average over time. In recent decades the Australian stock market has become more diversified, with a relatively lower dependence on the resources sector.

Table 6.2 below is drawn from further work of Dimson *et al*,[20] which contains the most comprehensive international comparison of long-term realised historical market risk premiums. The record shows that historical performances of economies vary considerably over time. During the first half of the century both Australia and Canada, which were relatively more dependent on resources at the time, outperformed both the US and the UK. During the second half of the century the UK and US both outperformed Australia and Canada. Thus, in the US and UK, where leading academics, business practitioners and regulators have argued that the prospective market risk premium has fallen over recent decades, the realised historical market risk premium has been rising. In fact, one reason for the rising realised market risk premium is precisely that the forward-looking market risk premium (and therefore the equity discount rate) has been falling.

[20] Dimson, Elroy, Paul Marsh and Mike Staunton (2002), "Triumph of the Optimists: 101 Years of Global Investment Returns, Princeton University Press, Princeton New Jersey and Oxford.

Table 6.2

HISTORICAL EQUITY PREMIUM OVER BONDS (GEOMETRIC)[21]

	Australia		United States		United Kingdom		Canada	
From	**1900**	**1950**	**1900**	**1950**	**1900**	**1950**	**1900**	**1950**
To								
1909	11.3		7.5		2.0		6.1	
1919	10.1		4.7		5.3		7.3	
1929	10.1		5.5		3.8		7.4	
1939	7.5		2.8		2.0		4.4	
1949	6.6		3.4		2.1		4.5	
1959	8.1	16.3	5.8	18.3	4.3	16.4	6.1	14.8
1969	8.4	12.9	5.9	12.4	4.9	12.2	6.3	10.4
1979	7.4	8.8	5.3	8.5	4.6	9.1	6.0	8.5
1989	7.2	8.1	5.1	7.2	4.9	8.6	5.2	6.1
2000	6.3	6.1	5.0	6.6	4.4	6.8	4.5	4.5

Other evidence on the market risk premium

Views of practitioners and market participants

What is most important for the pricing of equity in the market is what practitioners and the market participants, including institutional investors, believe the market risk premium to be and factor into investment decisions. However, it may be difficult to derive what market risk premium is factored into analyses undertaken in the market as the vast majority of this work is confidential. The Victorian Essential Services Commission cites a Jardine Capital Partners survey of professional market participants' market risk premium views.[22] The average of participants' views on the historical market risk premium was 5.87 percent, with expectations about the future market risk premium about 1 percent below this level.

21 Dimson, Elroy, Paul Marsh and Mike Staunton (2002), "Triumph of the Optimists: 101 Years of Global Investment Returns, Princeton University Press, Princeton New Jersey and Oxford.

22 Essential Services Commission, October 2002, Review of Gas Access Arrangements: Final Decision, pp332-356, citing Jardine Fleming Capital Partners Limited, (September, 2001) *The Equity Risk Premium – An Australian Perspective*, Trinity Best Practice Committee.

Conclusion

There is a divergence of opinions among academics and market practitioners about the appropriate level of the forward-looking market risk premium. Historical evidence on the market risk premium varies over time, and between countries. From the analysis of Dimson *et al*, who present the most comprehensive study of market risk premiums across 16 countries for 101 years, it is apparent that Australia's relatively large historically *realised* market risk premium, like that of the US, is a result of past successes that may not be repeated. During the first half of the 20th century Australia's market was dominated by successful resources stocks, and its realised market risk premium has fallen during the last 50 years. The successful performance of the US market during the last 50 years has been driven by technology stocks and branded capital and consumer goods. The past exceptional performances of the US and Australia cannot be construed to indicate that forward-looking required returns in these economies should be much higher than in the bulk of the other 16 countries analysed by Dimson *et al* (eg Denmark's realised market risk premium of 3.3%). For example, Dimson *et al* propose a current forward-looking market risk premium of 3.7 percent for the UK and 5.4 percent for the US, which are lower than their respective historical market risk premiums.

There are numerous factors indicating that the market risk premium should have fallen over time. This suggests that application of market risk premiums historically experienced in Australia and the US are likely to over-estimate the forward-looking market risk premium. On the other hand, there is insufficient robust market evidence to conclude that the market risk premium is significantly below 6 percent, as suggested by alternative models such as the Dividend Growth Model. Adopting a market risk premium of 6 percent is consistent with regulatory precedent in Australia, and there is no firm justification for departing from this precedent.

6.4 Asset and equity betas

The beta value for any entity j is defined as the covariance between its return R_j and the return of the market portfolio R_m, divided by the variance of the return of the market portfolio. Under standard econometric assumptions, the beta value is the slope coefficient in a regression of the entity's return on that of the market:[23]

$$R_j = \alpha_j + b_j R_m + e_j$$

where α_j is the intercept and e_j is a mean zero residual uncorrelated with R_m.

Where the capital of the entity if financed by a mix of equity and debt, the beta value observed from the stock market is an equity beta.

[23] Lally, M., 2000. *The Cost of Equity Capital and Its Estimation*, McGraw-Hill Series in Advanced Finance Volume 3, Sydney: McGraw-Hill, p 26.

The estimation of equity betas requires continuous information on the economic returns from a particular equity, that is, dividends and any returns of capital, and the change in the market value of the equity. In practice, this information is only available for entities that are listed on a stock exchange. There is thus a practical problem in estimating a beta value for the equity of a regulated business or activity where that equity is not traded on a stock exchange. This is the case for most regulated utility activities where the regulated business is a subsidiary company of a listed entity, or the regulated activity comprises only a part of the total activities of a listed entity or is an unlisted entity. In such cases, an equity beta cannot be observed directly from stock exchange data and it is common to derive a proxy equity beta, which is based upon estimated equity betas for other, listed, entities that have similar assets and that are considered to face similar levels of systematic risk.

Systematic risk

A cornerstone of modern financial economics is that much of the risk that is associated with the returns to a particular asset can be eliminated at no cost, merely by holding that asset together with a broad portfolio of other assets (diversification).[24] However, a portion of the risk associated with an asset cannot be eliminated through diversification, as no extent of diversification can shield investors from events that have an affect on all assets. It is this remaining risk – the non diversifiable risk – that affects the returns that a (rational) investor would require to invest in a particular asset.

Intuition would suggest that the factors that should have the most effect on an asset's beta are market wide factors, that is, factors that tend to have an impact on all or most assets, and therefore do not cancel out across assets, which turns out to be correct. This intuition is correct – it can be shown that, under a number of assumptions, the beta of an asset can be expressed as a linear function of the sensitivity of its returns to each market wide factor multiplied by the sensitivity of the overall market return to that factor. That is:

$$\beta_j = b_{1,j}\frac{Cov(F_1, R_m)}{Var(R_m)} + b_{2,j}\frac{Cov(F_2, R_m)}{Var(R_m)} + \ldots$$

where b_{ij} is the sensitivity of the return to asset j to factor i, F_i refers to factor i, and the other terms are as defined above.[25]

As these factors are also inputs into an alternative asset pricing model, the Arbitrage Pricing Theory – research has been undertaken into the identity of these economy-wide factors, with the likely factors including unexpected changes in real aggregate income, inflation, proxies for risk aversion and long term real interest rates.[26]

24 The benefits from diversification were first formalised Markowitz in 1952, for which be later earned a Nobel prize, although the concept of diversification was earlier commented upon by Bernoulli and earlier still by Shakespeare: see Rubenstein, M., 2002, 'Markowitz's "Portfolio Selection": A Fifty-Year Retrospective', *The Journal of Finance*, Vol. LVII, No. 3, pp.1041-1045.

25 Dybvig, P. and S. Ross, 1985, 'Yes, the APT is Testable', *The Journal of Finance*, Vol.XL, No.4, p.1181.

26 Chen, N., Roll, R., and Ross, S., 1986. Economic forces and the stock market, *Journal of Business* 59: 383-403.

In addition, there is a large empirical literature on the characteristics of assets that may affect their level of non-diversifiable risk. Some of the more important of which include the following.[27]

- *Presence of regulation* – firms with regulated prices tend to have lower sensitivity to shocks in real income because prices (and hence revenues and returns) are less likely to change in response to changes in demand.[28]
- *Nature of a firm's output* – the returns of firms producing products with low sensitivity to economic shocks (i.e. with low income elasticity of demand), should have lower sensitivity to economic shocks than firms producing products with high sensitivity to economic shocks (high income elasticity of demand). All other things being equal, the greater the similarity between the products produced by a set of firms and their markets for those products, the more similar should be the beta values for those firms.
- *Degree of monopoly power* – some studies have suggested that increased market concentration gives rise to lower beta values, although results are mixed and inconclusive.
- *Durations of a firm's contracts with suppliers and customers* – firms with greater duration of contracts should have lower exposure to economic shocks, because input and output prices will not respond as quickly (or at all) to such shocks.
- *Operating leverage* – firms with greater operating leverage (higher ratios of fixed expenses to total costs) should have greater sensitivity to real income fluctuations because net revenues and returns are more sensitive to changes in demand and output.
- *Real Options of Firms* – the existence of real options permitting expansions of the firm (adopting a new product, expanding existing operations) should increase the firm's sensitivities to real income shocks because the values of growth options should be more sensitive to real income shocks than the equity value exclusive of them, and conversely for firms with options permitting contractions of the firm.
- *Market weight* – the greater a firm's weight in the market, the more the individual firm will influence the market proxy against which the firm's beta is defined, and so the closer the firm's beta will be to a value of one.

A further characteristic that explains the degree of systematic risk, but can be adjusted for rigorously – is the degree of financial leverage, which is discussed separately below.

[27] This summary of the characteristics of assets that may affect their non-diversifiable risk is taken from Lally, M., 2000. *The Cost of Equity Capital and Its Estimation*, McGraw-Hill Series in Advanced Finance Volume 3, Sydney: McGraw-Hill, pp 27–29.

[28] Regulated prices tend to be set at a level that is lower than otherwise would be charged, and so there is less likelihood that a regulated entity would find it profit maximising to reduce prices during a downturn.

Electricity distribution businesses have a number of characteristics that would suggest that they should have a lower level of non-diversifiable risk, relative to other firms. They are price regulated and sell a product that is essential in nature, so that revenue would be expected not to vary substantially with aggregate demand. In addition, regulated firms would not be expected to have substantial "real options" as the application of cost-based regulation reduces substantially the value of such options.

However, notwithstanding a theory that predicts the types of events that would give rise to non-diversifiable risk, and empirical research exists on the characteristics of firms that may explain differences in systematic risk across firms, it is difficult for intuition alone to provide any reliable guidance as to the reasonable range for the beta for a particular asset. In practice, it is impossible to tell whether or not a particular event would be characterised as giving rise to diversifiable or non-diversifiable risk, or to the division between the two. Moreover, while much may be known of the characteristics of assets that tend to explain systematic risk, in practice, the characteristics that may affect systematic risk for a particular are so numerous that not much of a practical guide may be offered.

The only reliable guide for beta of a particular asset is empirical estimates for the asset in question (if possible) and similar assets. That said, an understanding of the characteristics that are relevant to systematic risk is important for the selection of the set of 'comparable entities', which is discussed below. In addition, when comparing the risk of a regulated business to that of average firms and using this to make inferences about the beta of the regulated asset, it is essential that a fair comparison be made. In particular, as Australian regulators have adopted a benchmark for gearing of 60 per cent debt-to-assets – which is approximately *double* that of the average firm listed on the Australian stock exchange –an adjustment for the difference in gearing is required. This issue is discussed next.

Adjusting for Gearing and Comparisons with Assets of Average Risk

The risk associated with the equity investor's share of an asset comprises two parts, which are:

- the risk associated with the variation in revenue and cost to the project as a whole; and
- the additional risk that the equity investors bear as a result of the level of gearing that the firm chooses to undertake.

It follows that the risk that is borne by the equity investors in two identical projects will differ if the projects have differing gearing levels. As the betas that are estimated in practice reflect the beta (risk) of the equity investors, adjustments are required to ensure that differences in gearing between projects do not lead to inappropriate comparisons. In practice, the method of ensuring an appropriate comparison is to convert all observed betas into the betas that are consistent with a standard level of gearing. In this report, all of the reported betas are converted into betas that are consistent with the regulatory-benchmark level of gearing, which is 60 per cent debt-to-assets.

It also follows that when making a comparison of a particular equity beta with the average beta of 1 across the market, an adjustment is also required for differences in gearing between the average firm that is listed on the market and the assumed level of gearing for the firm in question.

- The current average level of gearing for the firms that are listed on the Australian share market is 29.92 per cent (debt-to-assets).[29] This compares to the level of gearing that is assumed for regulated firms of 60 per cent debt-to-assets.
- The average equity beta of 1 for the average firm listed on the share market with an average level of gearing of 29.92 per cent implies that the average equity beta for the market would be 1.75 if the average level of gearing was the same as that for the regulated firm.[30] Accordingly, a fair comparison between the equity beta for a regulated firm and the average beta for the market would compare the beta for the regulated firm to a beta of 1.75.

Selection of a Proxy Group and the Relevance of Foreign Firms

Selection of the Proxy Group

The estimation of equity betas requires continuous information on the economic returns for a particular equity, which restricts the estimation of betas only to stocks that are traded on an exchange. Accordingly, where the target firm is not listed – or even where it is listed, but the activity for which an estimate of the cost of capital is required is not its sole activity – then the common practice is to derive a proxy equity beta, which is based upon estimated equity betas for other, listed, entities that have similar assets and that are considered to face similar levels of systematic risk.

Moreover, the statistical precision of individual equity beta estimates is typically very low – indeed, theory predicts that the beta for many stocks should only explain a small part of its total risk.[31] The average standard error across the equity betas for Australian stocks, as estimated by the Risk Management Service of the AGSM, is approximately 0.37 (using the March 2002 estimates), which would imply that the 95 per cent confidence interval for the true beta would, on average, be the point estimate, plus or minus 0.74 (that is, if the point beta estimate were one, then the 95 per cent confidence interval would be between 0.26 and 1.74).

Accordingly, even where a particular activity is listed, it is common practice to combine individual beta estimates with other information, such as beta estimates for comparable entities, in order to improve the precision of the estimated beta for a particular activity. The simplest means of combining beta estimates is to take the simple average of the beta estimates across a set of comparable entities, with the precision rising as a larger set of comparable entities is used.[32]

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29 Data obtained from Bloomberg.

30 The converted beta is affected by the debt beta that is assumed. If a debt beta of 0.2 were assumed, then the equivalent equity beta for the market with the regulatory benchmark level of gearing would be 1.60.

31 This follows because the theory assumes – and observation confirms – that much of the risk associated with individual assets can be removed through diversification.

32 Where there are 'n' equity beta estimates, the standard error of the average of those betas is given by the following formula:

$$\frac{1}{\sqrt{n}}\sqrt{\frac{\sum_{i=1}^{n} SE(\beta_i)^2}{n} + 2\sum_{i=1}^{n}\sum_{j=1, i\neq j}^{n} COV(\beta_i \beta_j)}$$

If the errors in the beta estimates are unrelated and all beta estimates have the same standard error, then the standard error of the average falls in the proportion $1/\sqrt{n}$. However, typically, the residuals of beta estimates for similar firms would be positively correlated, and so the improvement in precision from adding firms would be somewhat lower.

The actual selection of comparable entities requires a degree of judgement, however. While the objective is to estimate the beta for a firm whose only activity is the regulated activity, almost all listed firms undertake numerous other activities – some of which may be higher risk and some of which may be lower risk.[33] Moreover, even the regulated components of different firms would be unlikely to be identical, but where it is impossible to know for sure whether the differences between the firms would imply higher or lower risk, and by how much. In practice, the selection of comparable entities leads to a trade-off, on the one hand, of maximising the number of comparable entities (ie maximising the precision of the beta estimate) and minimising the potential for the unrelated activities to create a material bias in the beta estimate.

In this note, the following criteria are used to decide upon the firms in the set of comparable entities.

- First, a hierarchy of activities is adopted, which (in order) are: electricity distribution, gas distribution, electricity transmission, gas transmission and then price-regulated water and sewerage services.
- Secondly, firms are only included if a substantial portion of their activities relate to one of the relevant activities.

For the Australian market, this led to six firms being used – AGL, Envestra, United Energy (now delisted), Australian Pipeline Trust, Alinta and GasNet. The relevant activities of these firms are as follows:

- AGL – gas distribution and electricity distribution;
- Envestra – gas distribution;
- United Energy (now delisted) – electricity distribution;
- Australian Pipeline Trust – gas transmission;
- Alinta – gas distribution; and
- GasNet – gas transmission.

Out of these firms, Envestra, Australian Pipeline Trust and GasNet's relevant activities comprise almost their whole activities, whereas AGL, United Energy (now delisted) and Alinta have other substantial unregulated activities.

For the US market, the set of comparable entities comprises twelve firms, all of which have electricity distribution as a substantial part of their activities. The much larger number of utility firms listed on the US stock exchanges implied that it was unnecessary to select firms from lower down in the hierarchy.

Relevance of Foreign Firms

An important question when estimating betas is the issue of whether beta estimates for overseas firms calculated against the relevant local market are relevant for Australia. Given the much larger set of relevant, exchange-listed firms in the US, if US betas could be held to be relevant to Australia, then the available market evidence from which to estimate betas would be much enlarged.

[33] In principle, econometric techniques could be used to remove the effects of the firms' other activities on beta. In practice, however, the lack of sufficient data and imprecision of the resulting estimates effectively precludes such adjustments.

As discussed above, betas are a measure of the strength of the relationship between returns to individual stocks and the share market as a whole. Therefore, an implicit assumption when using beta estimates for foreign firms (measured against their home index) as a proxy for a domestic firm is that the strength of this relationship between the returns to an electricity distributor and the market as a whole is approximately constant across share markets.

While this may seem a reasonable assumption, there are a number of factors that may influence the strength of the relationship between the returns to a regulated electricity transmission and distribution provider and the overall market, which may vary across markets. Differences in the weights of the different market sectors may affect the covariance of the return of any asset to the market as a whole. Even apart from market weight effects, the sensitivity of the returns to a regulated electricity transmission and distribution entity to macro-economic shocks may differ across countries – for example, reflecting institutional factors within each country (including the policies of governments), and betas also may be affected by differences in taxation regimes, as well as differences in market-average levels of gearing. In practice, it is difficult to adjust for all of these factors.

Accordingly, it is generally accepted that caution needs to be exercised when using betas estimated in one market for firms in another for the reasons set out above. However, it is also accepted that placing some weight on foreign comparators is inevitable where there are limited listed entities in the relevant domestic market – which is the case for Australia. This is consistent with the views reached recently by Professor Davis in advice to the ACCC:[34]

> Ideally the comparison would involve firms whose stocks trade in the same capital market as the target firm, since this would provide a measure of systematic risk relative to the relevant market portfolio.
>
> In practice, this is often not feasible, and betas are calculated for comparator firms operating in other countries and using the market portfolio of that country. It is then assumed that the systematic risk characteristics observed in that country are similar to those which would apply here. Although this approach, and assumptions involved, can be debated, there is no obvious preferable alternative, unless there is a significant portfolio of comparator stocks trading in the local market.

Beta estimates are presented in this report for listed US firms in order to provide some check on the estimates obtained for Australian firms. The US beta estimates also provide further evidence of the impact of the recent technology stock-related "boom and bust" for the betas of utility stocks, which is discussed next.

[34] Davis, K, 2003, Report on Risk Free Rate and Equity and Debt Beta Determination in the WACC, Report to the ACCC, August 2003. p.19.

Empirical estimates of betas and the impact of 'unusual events'

Technique for estimating betas

The beta value for equity *j* is defined as the covariance between its return R_j and the return of the market portfolio R_m, standardised by dividing by the variance of the return of the market portfolio.[35] Under standard econometric assumptions, the beta for an equity can be estimated as the slope coefficient in a regression of the entity's return on that of the market:[36]

$$R_j = \alpha_j + b_j R_m + e_j$$

where α_j is the intercept and e_j is a mean zero residual.

A point that immediately follows from the standard method for calculating betas is that while the CAPM is inherently forward-looking – and so the beta that is required is the beta that is expected over the future period – betas can only be estimated for a historical period.

As with all econometric exercises, the estimation of betas requires a number of methodological choices to be made, which may have a material effect on the results. Some of the choices include whether to use discreet or continuously compounded returns, raw or excess returns, nominal or real returns, whether dividends are included in returns, and the definition of the market index.[37]

Potentially the most important decisions, however, are the interrelated decisions of the length of the sampling period and the frequency with which observations are taken. The selection of the length of the period for estimation involves a trade-off between the need for a sufficiently large data sample to increase the statistical significance of results, and the potential for the older observations to be less relevant to the future. While it may appear that a shorter time period could be used without losing any accuracy in the results just by increasing the frequency of observations (for example, using daily or even intra-day returns), in practice the use of shorter time periods may create econometric problems. In particular, where a particular stock is not traded as actively as the average for the shares listed on the market, a change in its underlying value may not be detected as frequently as changes in the value of the market overall, and lead to a downward bias in the beta estimate.

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[35] Dividing the covariances by the variance of the market portfolio implies that the average beta (which is the beta of the market portfolio) will be one, with assets with a lower than average covariance having a beta of less than one, and assets with a higher than average covariance having a beta greater than one.

[36] Lally, M., 2000. *The Cost of Equity Capital and Its Estimation*, McGraw-Hill Series in Advanced Finance Volume 3, Sydney: McGraw-Hill, p 26.

[37] In this note, the following methodological choices were made (in order): continuously compounded returns; raw returns; nominal returns; dividends included; and the ASX200 Accumulation Index as the Australian market portfolio.

Many of the commercial beta estimation services use either four or five years of monthly return observations when calculating betas[38] and hence beta estimates are provided in this report measured over five years using monthly observations.[39] However, the evidence presented below suggests the recent 'boom and bust' in technology-related stocks that was experienced worldwide may have had a dampening effect on betas in Australia, similar to what has been observed in other countries. Betas estimated over a historical period of four or five years would have been influenced by this effect. Accordingly, beta estimates are also presented using a shorter estimation period (60 weeks) using higher frequency data (weekly observations). It is noted that there *may* be some risk that the latter set of results provide downward biased beta estimates given the generally less frequent trading of some of the utility stocks.[40] That said, it is reasonably common amongst market practitioners to use weekly observations when estimating betas, and to use shorter or longer intervals than the standard or four or five years, particularly if there are good *a priori* reasons to think the beta may have changed or, conversely, is likely to be stable. A recent report to the UK energy and water regulators, OFWAT and OFGEM, concluded that there was no necessary reason to use monthly sampling intervals for all firms, and suggested that weekly – or even daily – observations may have substantial advantages, subject to the thin trading and other problems of more frequent sampling either not being substantial or being dealt with through econometric techniques.[41]

Accordingly, while the use of more frequent observations over a shorter time period may not be consistent with the approach taken in the standard "beta books", it is nonetheless common practice to vary from such "standards" where the circumstances warrant. The impact of the technology-related "boom and bust" discussed below would appear to necessitate such a more refined approach to estimating betas for utility firms, even in Australia.

Impact of the technology-related "boom and bust"

As discussed above, the techniques for estimating the *expected* beta for an asset involves estimating the *historical* relationship between the returns to that asset and the market as a whole. Accordingly, an implicit assumption is that the historical relationship between an asset (or a particular type of asset) and the market as a whole is an accurate predictor of the expected (future) relationship.

In the late 1990s to the early 2000s, many of the world's major share markets experienced a substantial rise in the share of technology-related stocks and with it their markets as a whole, followed by a later substantial fall in these stocks and the markets as a whole. In parallel with the rise in technology related stocks, the value of safe types of assets – such as utilities – initially fell (as investors substituted 'old economy' stocks for 'new economy' stocks) and then experienced a rise when the prices of technology stocks fell, as investors sought safe investments.

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38 The Australian Graduate School of Management Risk Management Service, which is the most widely used service in Australia, uses four years of monthly data; Ibbotson in the US uses five years of monthly data and the London Business School in the UK uses five years of monthly data.

39 All except one of the Australian firms listed in the past seven years, and so betas using monthly observations have been calculated as soon as 20 observations were available in order to maximise the sample size. It is noted that shorter estimation periods do not imply that beta estimates are biased, but rather that the estimates generally will be less efficient (that is, have higher standard errors).

40 There are econometric techniques for addressing thin trading bias, but it was not possible to use these other techniques in the time available.

41 Wright, S., R. Mason and D. Miles, 2003, A Study into Certain Aspects of the Cost of Capital for Regulated Utilities in the U.K., Study for the Joint Regulators, February, pp.103-104.

The effect of utility stocks moving contrary to the general movements in the share market over an extended period would have been to depress the beta estimates. Whether the lower beta estimates are likely to be accurate estimates of the expected (future) betas then depends upon whether the technology 'boom and bust' is considered a normal or abnormal event. It is now generally accepted that events over this period were extraordinary, and that the beta estimates obtained over this period may be biased downwards. By way of example:[42]

> Sharp recent declines in telecom, media and technology valuations suggest that the past three to five years were truly extraordinary.
>
> …
>
> But in assessing future values for betas, most practitioners look to the equity returns of the recent past – and the most recent three to five-year averages and correlations of returns to shareholders are of course quite extreme. By excluding the bubble years entirely, it is possible to calculate betas that are more consistent with the long-term historical results and indicate more accurately the relative risk borne by companies in other sectors. In the absence of such a correction, data drawn from the bubble years may generate artificially low betas for the next couple of years.

Unlike many of the other share markets – and particularly the US – the Australian share market did not experience a substantial rise overall during this period, and equally did not experience a substantial later correction, but rather experienced a sustained period of side-ways movement. However, while the share market as a whole appeared largely unaffected by the technology boom and bust that affected many other share markets, there were sizeable impacts on the sectors of the market.

Figure 6.1 shows the ASX 200 share market index over the period since 1 January 1996 to the present, along with the relevant indices for telecommunications stocks and infrastructure stocks, all re-based at one as at the start of the period.[43]

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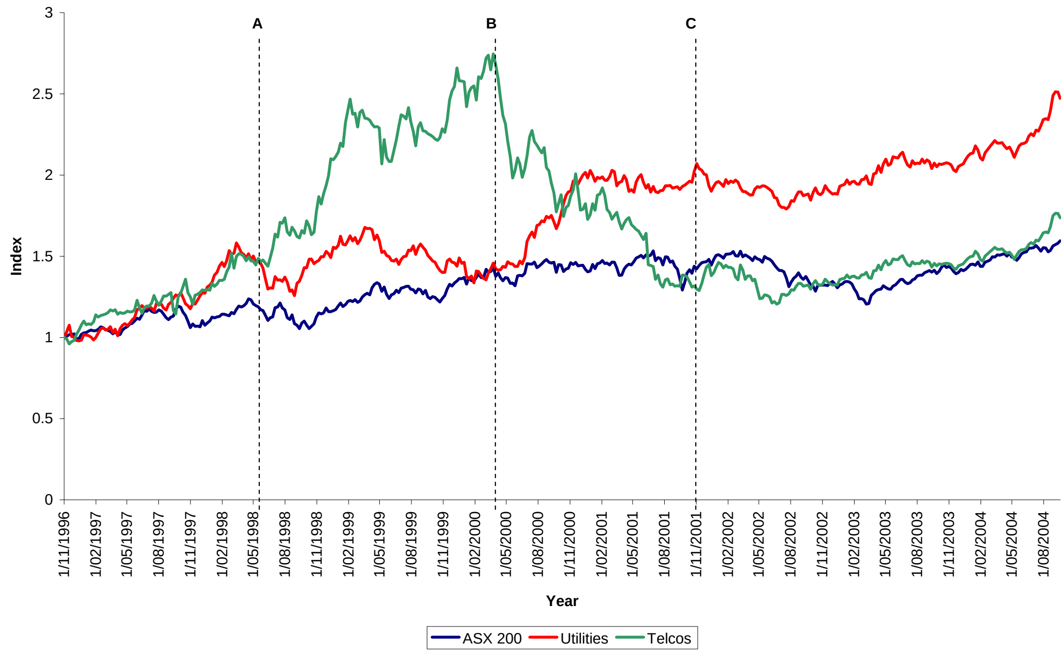
[42] Annema A. and M. Goedhart, 2003, 'Current Research – A Better Beta', *McKinsey Quarterly*, No.1, p.8. The authors classified the abnormal period for the US market as between January 1998 and December 2001.

[43] The relevant sectoral indices were the telecommunications and infrastructure and utilities indices until 5 July 2002, and then telecommunications services and utilities indices thereafter (the original indices were not published after this date). The new indices were 'spliced' to the old to create a continuous series.

Figure 6.1

EFFECTS OF THE TECHNOLOGY 'BUBBLE' IN AUSTRALIA ON STOCK MARKET RETURNS



Source: Data obtained from Bloomberg.

While the behaviour of the Australian market as a whole over the period was largely unexceptional, there were substantial differences in the relative performance of some of the sectors. In particular, the telecommunications sector (the proxy for the 'new economy') experienced substantial growth over the period from mid 1998 (indicated by line A), and then an equally substantial decline (indicated by line B). In contrast, the utilities sector moved largely counter to the telecommunications sector and counter to the market as a whole – particularly during the subsequent decline in the telecommunications sector between about mid 2000 and the end of 2001 (in the period indicated by lines B and C), when the utilities experienced substantial growth and the price index for the market as a whole barely changed.

The current beta estimates for Australian utility firms over a four or five year period would include observations from the unusual market periods discussed above. In particular, the current 60 month beta estimates include the period after August 2000, and so include much of the period of the new economy bust / utility boom. Figure 6.1 provides reason to question whether estimates of betas that include the period before about the end of 2001 would deliver an unbiased estimate of the expected (future) beta for these stocks.

Accordingly, beta estimates are also provided over a shorter interval (60 weeks) using more frequent sampling (weekly) in order to avoid the possible effects of the 'bubble'. The 60 week beta estimates would have been free of the effects of the utility boom after about February 2003.[44]

[44] That is, estimates of betas using 60 weeks of weekly observations in February 2003 would have used observations back to about January 2002, which would have excluded the 'bubble' observations.

Results of Empirical Analysis

Australian Evidence

Table 3 shows the latest estimates of betas for the five Australian comparable entities that are still listed of the Australian stock exchange for both the 60 months (five years) of monthly observations and 60 weeks of weekly observations.

Table 6.3

RE-LEVERED BETA ESTIMATES: AUSTRALIAN PROXY GROUP (60% DEBT TO ASSETS)

Company	October 2004 (monthly data)		November 2004 (weekly data)	
	Average gearing	Re-levered beta	Average gearing	Re-levered beta
AGL	29%	-0.30	35%	0.66
Alinta	29%	0.69	33%	1.73
Australian Pipeline Trust	53%	0.67	45%	0.65
Envestra	73%	0.09	76%	0.58
Gasnet	67%	-0.10	66%	0.62
Average	**50%**	**0.21**	**51%**	**0.73**

Source: Bloomberg.

For all of the firms, the "weekly" beta estimates are approximately equal to or higher than the "monthly" estimates, which provide some support for the proposition that the technology-bubble may have had an artificial dampening effect on betas in Australia that were measured over the "bubble period". The more recent evidence (60 week beta estimates) suggests that if exclusive reliance were to be placed on the current market evidence, a beta of 0.73 would be considered appropriate for a regulated Australian electricity distributor.

The results set out above suggest that there is a material risk that the beta estimate that would be provided by the use of observations over the past 5 years (which include the "bubble") may materially understate the expected (future) beta for this activity.

USA Evidence

Table 6.4 shows the latest estimates of betas for the US comparable entities that are still listed for both the 60 weeks of weekly observations, and 60 months (five years) of monthly observations.

Table 6.4

RE-LEVERED BETA ESTIMATES: USA PROXY GROUP (60% DEBT TO ASSETS)

Company	October 2004 (monthly data)		November 2004 (weekly data)	
	Average gearing	Re-levered beta	Average gearing	Re-levered beta
Centrepoint Energy	78%	0.64	65%	0.62
Clesco Corporation	53%	0.88	50%	1.14
DTE Energy Corporation	57%	0.05	55%	0.37
Empire District Electric Company	46%	0.02	48%	0.79
El Paso Electric Corporation	49%	-0.00	53%	0.99
Entergy Corporation	40%	-0.08	48%	0.64
Elexon Corporation	42%	0.04	43%	0.45
First Energy Corporation	51%	0.03	55%	0.44
FPL Group	45%	0.23	39%	0.41
MGE Energy	30%	0.20	27%	1.26
Progress Energy	50%	0.19	50%	0.54
Westar Energy	62%	0.61	71%	0.59
Average	**50%**	**0.23**	**50%**	**0.69**

Source: Bloomberg

The pattern in the US estimates is very similar to that observed in Australia. The weekly beta estimates for all but one firm are higher than the monthly estimates, and the average of the group using the weekly estimates is also substantially higher than the past. The estimate of the beta that is obtained using the 'weekly' methodology is 0.69, which is very similar to the average of the beta estimate for the Australian comparable entities.

Conclusion

The derivation of a beta estimate for an asset is an inherently imprecise task and the exercise of a degree of judgement is inevitable. The exercise is more difficult in Australia given the limited number of local entities that are comparable to an electricity distributor listed on the stock exchange (exchange listing is a prerequisite for being able to estimate a beta).

The material provided in this paper suggests that there is a strong risk that the recent "technology bubble" would have a dampening effect on beta estimates for utility firms that are estimated using data from that period. Such estimates may materially understate the expected (future) beta for utility assets. Accordingly, the more standard beta estimates that use four to five years of monthly observations may provide unreliable beta estimates at this time as they include a substantial number of observations from the bubble period. The estimates presented in this paper using a standard approach are 0.21 and 0.23 for Australia and the US respectively, re-levered to be consistent with an assumed gearing level of 60 per cent debt to assets.

More reliable beta estimates at this point in time are likely to be provided by betas estimated over a shorter period of observations, with more frequent sampling of observations to retain the same precision in the estimate. The beta estimate for the Australian comparable entities using data observations from the most recent 60 week period is 0.73, re-levered to be consistent with an assumed gearing level of 60 per cent debt to assets. This beta estimate is very similar to the beta estimate for the set of 12 US comparable entities of 0.69, estimated using the same methodology and also re-levered to be consistent with an assumed gearing level of 60 per cent debt to assets.

The issue remains as to the judgement should be made in light of the empirical information that has been presented in this paper.

The Allen Consulting Group undertook a major study into proxy betas for gas transmission companies in 2002 for the Australian Competition and Consumer Commission (ACCC). The best estimate for the beta that we could derive from the empirical information available was 0.70 for the regulatory benchmark level of gearing of 60 per cent debt-to-assets, which was based upon monthly return observations over a four year period (using Australian Graduate School of Management information) for a set of four Australian firms. This compared to the norm of regulators decisions on betas at the time of approximately one (a number of decisions were above 1, and a number were below).

The Allen Consulting Group's advice to the ACCC at the time was as follows (footnotes omitted):[45]

> Exclusive reliance on the latest Australian market evidence would imply adopting a proxy equity beta (re-levered for the regulatory-standard gearing level) of 0.7 (rounded-up). Moreover, regard to evidence from North American or UK firms as a secondary source of information does not provide any rationale for believing that such a proxy beta would understate the beta risk of the regulated activities. Rather, the latest evidence from these markets would be more supportive of a view that the Australian estimates overstate the true betas for these activities.
>
> That said, however, we would caution against exclusive reliance upon the latest market evidence at this point in time.
>
> To date, most Australian energy regulators have used a proxy equity beta in the range of 1 (for the regulatory-standard gearing level of 60 per cent debt-to-assets) when assessing or setting regulated charges, and a substantially higher assumption has been adopted in a number of decisions (including those of the Commission). The use of a proxy beta of 0.7 would represent a substantial reduction in the estimates of the costs of capital compared to the assumptions previously adopted. While such a revision would be warranted in the face of reliable, objective evidence, it cannot be concluded definitively that this quality of evidence exists at this time.
>
> First, the primary source of evidence – which derives from the listed Australian entities – consists of a group of only four firms. Moreover, only two of the firms have been in existence for long enough to permit the AGSM's-preferred four years of observations to be used, with the beta estimate of one of these – the Australian Pipeline Trust – being based upon only 21 observations (just above the cut-off that the AGSM Risk Management Service applies for providing beta estimates).

[45] The Allen Consulting Group, 2002, Empirical Evidence on Proxy Beta Values for Regulated Gas Transmission Activities, Final Report to the ACCC, July, pp.42-43.

> Secondly, we are concerned about the magnitude of the beta estimates derived for firms operating in other countries. The re-levered equity betas for the US firms, in particular, are substantially lower than the estimates that have been obtained from past time 'sampling windows'. It could be hypothesised that the recent events on US share markets – such as the large surge in the values of high-technology stocks and then their subsequent fall – may have affected the beta estimates, and which may have biased the estimate of the forward-looking beta risk of these firms if those events were not considered by investors to be normal events. However, it is impossible to prove or disprove such a conjecture.
>
> Accordingly, while it inevitably is a matter for the Commission to decide how it exercises its discretion, it is recommended that, in the near term, it adopt a conservative approach, and not assume a proxy equity beta that is too far from the range of previous, relevant regulatory decisions. As noted above, these decisions typically have assumed a proxy beta (for the regulatory standard gearing assumption) of around 1. That said, this report has demonstrated that no implication can be drawn from current market evidence that the proxy betas that Australian regulators have adopted are likely to understate the 'true' beta – rather, as noted above, the current evidence suggests regulators systematically have erred in the favour of the regulated entities.
>
> In the future, however, it should be possible for greater reliance to be paced upon market evidence when deriving a proxy beta for regulated Australian gas transmission activities. There are currently six firms listed on the Australian Stock Exchange that could be used as comparable entities when deriving a proxy beta – AlintaGas, AGL, the Australian Pipeline Trust, Envestra, GasNet and United Energy. Beta estimates are already available from the AGSM Risk Management Service for four of these entities, and estimates will be available for all six within a couple of years. Moreover, should any of the currently-mooted stock market listings of energy utilities proceed, then the information available from Australian capital markets will expand even further.

Since that time, United Energy has de-listed, and so the sample has only increased to five – but still with all but one of those firms having formed in the last 10 years. Subsequent analysis has also suggested that the dramatic reduction in beta estimates that was being observed in other countries and that has been attributed above to the technology stock bubble is also a factor that appears to have had a similar dramatic effect on the beta estimates of Australian stocks. In addition, since that report, other work undertaken by The Allen Consulting Group that draws upon market evidence from outside of the CAPM framework to test the proposition of the whether price caps have been too low or too high.[46] This work indicates that, while there is no strong evidence that regulators are systematically under-compensating regulated entities for the costs and risks they bear, neither is there strong evidence to suggest that regulated entities are being rewarded to an inappropriate degree, particularly given the importance of attracting the substantial investment funds into the industry to provide reliable service over the long term.

Accordingly, the caveat expressed in The Allen Consulting Group's advice to the ACCC remains today:

> [w]hile such a revision [from the regulatory norm of approximately 1] would be warranted in the face of reliable, objective evidence, it cannot be concluded definitively that this quality of evidence exists at this time' remains valid today.

[46] A major piece of work involved comparing the market values of regulated entities to their regulatory values, drawing on transactions and share price data: The Allen Consulting Group 2003, Review of the Gas Code: Commentary on Economic Issues, report to BHPBilliton, August (Attachment to the BHPBilliton submission to the Productivity Commission).

Hence, the advice that was provided to the ACCC at that time remains the current view of The Allen Consulting Group, that is:

> Accordingly, while it inevitably is a matter for the Commission to decide how it exercises its discretion, it is recommended that, in the near term, it adopt a conservative approach, and not assume a proxy equity beta that is too far from the range of previous, relevant regulatory decisions. As noted above, these decisions typically have assumed a proxy beta (for the regulatory standard gearing assumption) of around 1.

6.5 Gearing

The estimation of a WACC requires an assumption about the financing structure, or gearing, of the regulated entity. The standard practice amongst Australian and UK regulators for deriving this assumption is to adopt a benchmark financing structure, based upon a view of a standard or efficient capital structure for that type of entity. This means assuming a financing structure that reflects the structure that an efficient and privately owned business would adopt for the particular asset in question, rather than the financing structure that is actually in place for the regulated business.

The main reasons for adopting a benchmark financing structure, rather than the actual financing structure, are that:

- adopting of a benchmark financing structure will ensure that customers will not bear the cost associated with inefficient financing structures, and
- using a benchmark assumption that is consistent with the assumption adopted for other regulated businesses, and other regulators, improves the comparability of regulatory decisions.

Information on gearing of comparable Australian companies presented in Table 6.3, above, indicates average levels of gearing in the five years to September 2004 of about 50 percent debt to assets.

Companies with unregulated assets will generally have lower gearing due to the higher volatility of cash flows. Since some of the companies for which gearing data is presented in Table 6.3 have significant unregulated assets (in particular Alinta and AGL), it is reasonable to expect the gearing relating to regulated activities to be higher than observed for the whole company. Hence, it would appear that based on the evidence, maintaining an assumption of a gearing of 60 percent debt to assets, consistent with regulatory precedent, is appropriate.

6.6 Cost of debt

There are three general options for estimating the cost of debt:

- a weighted average of the existing cost of debt of the regulated business;
- the marginal rate at which a comparable company can raise debt finance; and
- a margin over and above the risk free rate for the regulated business or a comparable entity.

Regulators have conventionally presented the cost of debt as a margin over the risk free rate, and have estimated a benchmark margin on the basis of the weighted average cost of debt for a typical debt portfolio. Regulators have also tended recently to consider the debt margin in terms of two components: an interest rate premium over the risk free rate, and an allowance for transaction costs incurred in arranging the debt facilities. These two components are further considered below, taking into account empirical evidence on costs of debt.

Interest rate premium over the risk free rate

Ideally the interest rate premium should be obtained from observing actual market transactions (corporate bond issuances) from the market. This is a problematic approach to adopt in Australia as the debt market for utility businesses is thin, observed margins change quickly and margins tend to be transaction specific. This results in observed market yields varying significantly between companies depending upon their unique circumstances.

Notwithstanding these difficulties, however, observations of yields on corporate bonds traded in Australia remains the principal source of information used by regulators to estimate a debt premium.

The determination of a debt premium from observed yields requires characterisation of the regulated business in terms of credit rating, and then selection of observations on yields for corporate entities that are comparable in terms of activities and credit rating.

A regulated utility with 60 percent gearing is most likely to be rated at BBB+. This is corroborated by advice obtained by SPI PowerNet from investment bank UBS Warburg.[47, 48]

Sources of information on yields on corporate bonds include:

- CBASpectrum and Bloomberg estimates;
- evidence based on recent BBB+ and BBB rated bond issues; and
- evidence drawn from other bond issuing options in the Australian market..

The evidence around 27 October 2004, for bond market data, is displayed in Table 6.5.

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[47] Letter from Nick Wade, Director, Credit Research, UBS Warburg to Jim Lamborn, Treasurer, SPI PowerNet, 28 November 2001.

[48] The Allen Consulting Group is aware of the decision of the Australian Competition Tribunal in the Tribunal's review of the decision of the ACCC on revisions to the access arrangement for East Australian Pipeline Limited ([2004] ACompT8). In this decision the Tribunal upheld the application for review of the ACCC's decision in respect of the ACCC's decision to determine a cost of debt on the basis of an assumed credit rating of BBB+ rather than BBB. The Allen Consulting Group is of the view, however, that the Tribunal's decision in this instance was made on the basis of the arguments made by the ACCC in its decision and not on the basis of substantive information relevant to making an appropriate assumption as to the credit rating and hence debt margin. As such, The Allen Consulting Group does not consider the Tribunal's decision on this matter to be informative in a rigorous consideration of the debt margin for a regulated business.

Table 6.5

BON SPREADS FOR BBB+ RATING AT 27 OCTOBER 2004

Maturity	CBA Spectrum	Bloomberg	CSR	Investa	Snowy Hydro
5 years (at 27 October 2004)	95.9	94.5	86.7	98.1	
5 years (20-day average)	95.3	91.7	84.3	96.9	
10 years (at 27 October 2004)	100.7	129.3			127.1
10 years (20-day average)	100.7	127.3			125.7

Source: CBA Spectrum; Bloomberg

The evidence summarized in Table 6.5 indicates yields on corporate bonds rated BBB+ of between 85 and 100 basis points for five year bonds and 100 to 130 basis points for ten year bonds.

This yield of 85 to 100 basis points for five year bonds is consistent with some recent transactions in the market. In September 2003 the Australian Pipeline Trust completed an issue of US and Australian bonds at an average tenor of 11 years at an "all in" cost of BBSW+94 basis points.[49]

If anything the debt premium evident from CBA Spectrum service and recent transactions in Australia may be a high estimate of the cost of debt. The assumption that all debt is raised in the Australian market, which is implicit in the use of a margins produced by the CBA Spectrum or similar service to derive the benchmark debt margin, may be questioned. There is ample evidence that Australian companies are approaching US and European bond markets, and that this is driven primarily by the fact that this provides a lower cost of funds.[50]

Debt issuance costs

The typical fee structures experienced with the different forms of debt fall into four categories, some of which should be included in the benchmark of transaction costs for a stable utility business that is re–financing debt, and others that should be excluded for various reasons. The categories of costs are:

- Gross underwriting or arrangement fee: These fees should be included as a major component of transaction costs.
- Other direct costs: These fees include legal, roadshow and credit rating fees and should be included as a component of transaction costs.
- Credit wrapping fees and swap costs: These costs are not transaction costs, but rather costs that are applied to obtaining a lower cost of debt, or to manage risk exposure and the capital structure. They are more properly seen as a potential component of the debt premium.

[49] See APT, September 10, 2003, *Press Release – Australian Pipeline Trust completes US $325 million placement.*

[50] See Philip Baker, (3 April, 2003) "Why funds want to crash private placement market" Australian Financial Review: "Europe, Asia and, of course, the local market are all available to local corporations — but for competitive pricing and the chance to lock in long term debt, its impossible to bypass the market also known as the US Regulation D market. 'The pricing that these issues go at simply cannot be replicated in most other markets,' says Westpac's head of credit market research, John Lynam."

- Liquidity, commitment and cancellation fees: These costs cannot be included as part of transaction costs because they relate to facilities (such as an acquisition line or commitment of funding for a construction or acquisition project) that are not required as part of a re–financing of debt.

The Allen Consulting Group has examined debt raising costs by:

- a review of recent international empirical research assessing debt and equity raising costs;
- a review of regulatory practice in Australia and internationally;
- analysis of data gathered from company prospectuses and databases such as Bloomberg and Basis Point; and
- interviews with market participants, including bankers, investment bankers, market analysts and stockbrokers.

Debt raising costs for utility businesses evident from this study, expressed as a markup to the annual debt premium, are between 8 and 12 basis points. A value at the upper end of this range (12 basis points) may be an appropriate assumption.[51]

Debt Margin

Allowing for a debt premium of 100 basis points and debt raising costs of 12 basis points indicates a total debt margin of 112 basis points.

6.7 Value of imputation credits

The value of imputation credits (gamma) measures the value of a dollar of imputation tax credit to shareholders. Within the Officer Model employed by Authority, "gamma" is an important driver of the Reference Tariff required to provide an adequate rate of return to investors. A low gamma implies that shareholders do not obtain much relief from corporate taxation through imputation and therefore require higher pre-tax income to earn a sufficient return to justify investment. In this case the Reference Tariff would therefore need to be higher. On the other hand, other things being equal, a lower pre-tax income (and therefore lower Reference Tariff) would be adequate to attract investment if gamma was higher.

In Australia, regulators have generally adopted a gamma of 50 percent, although the ESC in Victoria and the ACCC have both argued that this represents a minimum value given that most of the empirical research supports values in excess of 50 percent. Regulators have in the past referred to results of studies have provided widely varying estimates of gamma ranging from zero to close to 1, but based decisions on the most commonly cited study of Hathaway and Officer that used the dividend drop-off methodology to derive an estimate of gamma at close to 0.50.[52]

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[51] The Allen Consulting Group is aware of the decision of the Australian Competition Tribunal in the Tribunal's review of the decision of the ACCC on revisions to the access arrangement for GasNet Australia (Operations) Pty Ltd ([2003] ACompT 6). In this decision the Tribunal allowed debt issuance costs of 25 basis points. However, the Tribunal did not publish reasons for this allowance and as such The Allen Consulting Group does not consider that the Tribunal's decision informs an examination of debt issuance costs.

[52] Hathaway N. and R.R. Officer (1999), *The Value of Imputation Tax Credits*, Unpublished Manuscript, Graduate School of Management, University of Melbourne.

The Allen Consulting Group considers that if a domestic Australian CAPM is used to estimate the WACC, then the most appropriate assumption for the gamma value is 50 percent, consistent with regulatory precedent. A value lower than this can be considered internally inconsistent in the context of a domestic CAPM model.

Chapter 7

WACC Determination

Assumptions for the WACC estimation by the methodology recommended above are set out in Table 7.1, together with the WACC values calculated from these assumptions. Values of market variables recommended by The Allen Consulting Group (risk free rates of return and expected inflation) are average values for the 20 trading days to 8 December 2004, and the Group recognises that these values may be updated to a later date according to the market values of parameters these at the time of a WACC determination.

Table 7.1

CAPM WACC ESTIMATION – RECOMMENDED PARAMETER ASSUMPTIONS AND WACC ESTIMATES

CAPM Parameter	Notation/ Determination	Recommended Value
Nominal risk free rate of return (%)	R_{fn}	5.33
Real risk free rate of return (%)	R_{fr}	2.71
Market risk premium (%)	*MRP*	6.0
Equity beta	β_e	1.0
Debt margin (%)	*DM*	1.12
Corporate tax rate (%)	*t*	30
Franking credit value	γ	0.50
Debt to total assets ratio (%)	*D/V*	60
Equity to total assets ratio (%)	*E/V*	40
Nominal pre-tax cost of debt (%)	$R_{fn} + DM$	6.45
Nominal post-tax cost of equity (%)	$R_{fn} + \beta_e \times MRP$	11.33
Expected inflation (%)	π_e	2.55
Nominal post-tax WACC (%)		6.4
Nominal pre-tax WACC (%)		**9.2**
Real pre-tax WACC (%)		**6.5**