Review and Determination of Weighted Average Cost of Capital for rail infrastructure operated by WestNet Rail and Western Australian Government Railway Commission

Draft report for the Office of the Rail Access Regulator by the Network Economics Consulting Group

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Contents

Tables

Figures

1 Executive Summary

The Office of the Rail Access Regulator (ORAR) has asked the Network Economics Consulting Group (NECG) to review and determine the appropriate methodology for calculating the weighted average cost of capital (WACC) for the below-rail operations of WestNet Rail (WNR) and Western Australian Government Railways Commission (WAGR) and to develop estimates of the necessary parameters.

As part of this review we have been required to consider a number of framework and parameter issues.

Framework issues

NECG recommends that ORAR sets a WACC in post-tax and nominal terms using what is commonly termed a vanilla WACC. This approach avoids the need for transformation and also brings ORAR's regulation into conformance with some other regulators. NECG recommends using the CAPM to estimate the cost of equity capital.

Parameter values

In our view, the risk free rate should be determined by reference to the 10-year bond rate. While NECG favours using the rate of the day, rather than averaging for estimating the risk free rate, we invite companies to submit arguments for limited averaging if that is supported by their funding practices.

The Market Risk Premium (MRP) is a very contentious issue in financial economics. Historical data supports a range of 6-8%. Using a benchmark approach we estimate that a forward-looking MRP is 7%. We believe, consistent with these findings, that the appropriate MRP for Australia at this time is 7% recognising that if the Regulator feels constrained by regulatory precedent then a MRP of 6% or 6.5% could be applied.

We support a value of 0.50 for the value of imputation credits (gamma). There is significant uncertainty over the estimation of gamma. What we are increasingly seeing is a polarisation of views with empirical studies finding either relatively low (close to 0) or relatively high (close to 1) values for gamma. While there is a strong case for a gamma of zero for larger companies, the evidence is still ambiguous, especially for smaller companies. Therefore, we

believe it is best for regulators to stick to the norm of valuing gamma at 0.50 at least for WNR and WAGR.

WNR and WAGR chose not to provide information on their gearing. As a result, we have benchmarked their gearing against other similar companies at 50%.

We have estimated that an appropriate debt risk premium is 111 basis points for WAGR and WNR. As the companies chose to provide no information we have benchmarked their notional credit rating at 'A', which currently supports a debt risk premium of 110-120 basis points.

We also believe that the costs to the companies of issuing debt are most conveniently reflected in the cost of debt capital, even though technically they are transactions costs and should therefore be reflected in the cash flows. Recent regulatory decisions have supported this position, with estimates of the cost between 0.05% and 0.125%. In our opinion, this could underestimate the debt issuance costs, perhaps significantly, but in the absence of any information from the companies, we support an estimate at the higher range of the precedents that are available in Australia – that is 0.125%.

We have estimated the asset beta of WAGR at 0.30 and WNR at 0.45, which translate into corresponding equity betas of 0.60 and 0.90 respectively. For WNR the asset beta is a weighted average of beta estimates of its major traffics, namely:

- bulk traffic (0.40);
- intermodal traffic (0.55);
- grain (0.45); and
- passenger (0.45).

Our asset beta estimate for WAGR reflects the predominance of passenger traffic, but is lower than that component of WNR because of the nature of the contractual relations between WAGR and the Government and the fact that WAGR serves more income inelastic urban passengers.

In this report, we have not provided any allowance in the WACC for asymmetric risk. Increasingly it is being acknowledged that regulated firms face a number of risks that are asymmetric – positive and negative outcomes are not balanced. We believe that the risk is best viewed as an insurance issue and that estimates of actuarially-fair insurance premiums should be recognised as imputed cash flows. However, given the difficulty in quantifying,

we believe the onus should be on the businesses to provide supporting evidence for such allowance.

Finally, we regard it as important to reward innovative tax approaches by allowing a regulated business to secure a defined portion of the benefit that it secures from doing so. A simple and transparent approach that seems reasonable would be to rule that all tax gains from accelerated depreciation are granted by government as tax incentives and require no innovation. All other tax efficiencies would be regarded as attributable to innovations by companies, and they should be allowed to retain a significant portion of the economic benefit. This is an issue that we recommend ORAR give further consideration.

Proposed WACC value

Based on market parameters as of 17 March 2003, we estimate that the post-tax nominal (vanilla) WACC for WNR is 9.00% and for WAGR is 7.96%.

2 Introduction

The Office of the Rail Access Regulator (ORAR) has asked the Network Economics Consulting Group (NECG) to review and determine the appropriate methodology for calculating the weighted average cost of capital (WACC) for the below-rail operations of WestNet Rail (WNR) and Western Australian Government Railways Commission (WAGR) and to develop estimates of the necessary parameters.

ORAR has sought this review due to the requirement under Schedule 4 of the Code for the WACC to be determined for the urban and freight networks as at 30 June each year.[1] The Regulator has determined that a review of the assumptions and methodology for the assessment of WACC is appropriate on account of the fact that the framework was determined prior to the Regulator's appointment. As part of this process, the Regulator is interested in the responses of stakeholders to the proposals outlined in this paper.

The current WACC methodology applied to the urban and freight network was derived from a review undertaken by Macquarie Bank for the Western Australian Department of Transport in August 1999.

Interested parties are encouraged to provide submissions to this draft report by 9 May 2003. A final report will be issued by 23 May 2003.

The remainder of this report is structured as follows:

- section 3 considers framework issues;
- section 4 assesses individual parameter values; and
- section 5 sets out our conclusions.

[1] Clause 3 (1)

3 Framework issues

Schedule 4 of the Code does not prescribe any particular approach to the determination of a WACC. Consistent with this requirement, NECG has been asked by ORAR to determine both the framework and parameter values for a WACC to apply to the freight and urban rail networks for the year from 1 July 2003.

An important aim of a regulatory decision is to set the revenue of a regulated firm at a level that allows the firm to earn a reasonable *post-tax real rate of return*[2] on the capital invested (after its operating costs and net tax obligations) and to recover its investment.

However, a regulator may choose to regulate the WACC in nominal terms and/or pre-tax terms. It is not unusual for a regulator, for instance, to declare a real pre-tax rate of return or a nominal post-tax rate of return.

The critical point is that a regulator always needs to ensure that whatever form of WACC is used (nominal/real, pre/post-tax), its corresponding real post-tax WACC is such that investors are fully compensated for their investment and are given incentives to invest in the regulated firm as needed.

To avoid distorting investment incentives, the regulated firm must be able to recover its tax cost and to be compensated for inflation. The firm can recover its tax cost by either allowing a separate item in the revenue stream while using a post-tax WACC or by incorporating the tax cost into a pre-tax WACC. The firm can be compensated for inflation by either using a real WACC (which means there will be no need to adjust for any inflationary effects) or by using a nominal WACC but adjusting the underlying cash flows to take account of inflation changes (since nominal WACC has its real value decline with inflation).

Currently a pre-tax real WACC is applied, as recommended by Macquarie Bank in its review of the WACC to apply to the rail operators in July 1999. An overview of the approach adopted and key parameters included in Macquarie's decision is shown in Figure 1.

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[2] In practice, a firm wants a real return and it is that return that can be cited without qualification. In contrast, a nominal return is context specific and can't really be evaluated without reference to the inflation rate.

Figure 1: Key features of WACC recommended by Macquarie Bank in 1999 review

Specification of WACC
■ pre-tax real WACC
■ use of CAPM to determine cost of equity capital
■ adoption of statutory corporate tax rate in transformation to pre-tax WACC
■ estimation of inflation using mid point of Reserve Bank of Australia's target range
■ transformation from (nominal) post-tax WACC to real pre-tax WACC using both market and reverse transformation methods, with range determined from mid-point of each approach
Market parameters
■ 20-day average of 10 year Commonwealth bond used as basis of bond maturity in risk free rate
■ Range of 5.0-6.0% for the market risk premium (MRP)
■ Range of 0.40 to 0.50 for the value of imputation credits (gamma)
Company specific values
■ Gearing between 50-60% for freight and 60-70% for urban infrastructure
■ Cost of debt of 1.1% and 1.3% above the risk free rate for the urban and freight networks respectively
■ Equity beta with the ranges 0.8-1.0 for the freight network and 0.3-0.4 for the urban network.
Final decision
■ Pre-tax real WACC of 5.1% for the urban network and 8.2% for the freight network
■ Note rates subsequently revised to 4.9% and 7.8% respectively for 2002-03 based on changes to the risk free rate and the statutory corporate tax rate.

NECG believes that a key requirement of this review is to put in place a framework for the WACC that maximises the social welfare from investing in long-term assets such as rail networks. Such a framework should ensure that appropriate incentives are put in place for network operators to invest in the network and for users to receive benefits from innovation and growth.

The current pre-tax real approach to the WACC is one attempt to meet these aims. However, it is not the only approach. While continuation of the current approach would have the advantage of being well known and understood by all parties, this should not preclude adoption of a different approach if there are significant benefits that outweigh any costs of shifting position.

3.1 Appropriate specification of WACC

The WACC model is the predominate method for estimating an appropriate cost of capital for businesses. There are a number of formulations of the WACC, in particular depending on whether the result is to be in nominal or real terms[3] and whether it is to be expressed in before or after tax rates. Similarly, there are alternative approaches to measuring costs and the valuing the asset base. A very important issue with respect to these choices is that the definition of costs (i.e., the implicit cash flows) and the measurement of the asset base must be completely consistent with the definition of the WACC model.

In this report, we focus on the measurement of WACC and assume that the issues of conformance and consistency of approach in costs and the asset base are dealt with properly.

In the two following sections, we deal briefly with the two issues of real v nominal and pre v post tax approaches to WACC. We then discuss the transformation processes in moving between approaches. Finally, we state our conclusion on the specification of WACC.

3.1.1 Real v nominal measurement

In determining the allowed revenues of a regulated firm, a regulator has to compensate the firm (amongst other things) for inflationary effects and allow it to recover its cost of tax. Compensating for inflation is relatively less contentious when compared with the methodologies adopted to compensate for the cost of tax.

In the ordinary course of business, amounts and rates of return are stated in nominal terms. Therefore, to define the WACC in real terms requires an adjustment. Similarly, costs and the asset base must be measured in real terms to be consistent with a real WACC. In principle, the process of converting measurements from nominal to real is straightforward. In general terms, for a given nominal interest rate (r) and inflation (i) the Fisher equation allows us to calculate the real interest rate (R) as:

$$R = (1 + r) / (1 + i) - 1$$

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[3] Amounts or rates of returns stated in nominal terms are in current amounts or rates. This contrasts with amounts or rates stated in real terms, which means they have been adjusted to reflect the effect of inflation.

Applying this approach requires an estimate of the inflation rate for the periods at issue. There are two main sources of data for inflation: information in the financial markets and government (or other) estimates.

The first method involves considering yields on nominal and capital indexed government bonds of similar maturity. By using the Fisher equation, an estimate of inflation can be determined. The alternative approach is to refer to inflation forecasts of the major market participants such as the Reserve Bank of Australia (RBA). This was the approach adopted by Macquarie Bank in converting to a pre-tax real WACC.

NECG supports the use of the first approach for two main reasons:

- the inflation forecasts issued by organisations such as the RBA are by their nature short term in nature, and may only reflect expectations for a much shorter period than the regulatory term. As we will see later in this report, the measurement of some parameters in the WACC requires long-term estimates, generally to ten years. We do not know of any forecasts out to ten years that are public and highly regarded; and
- by considering the yield on nominal and capital indexed bonds, an inflation forecast consistent with the CAPM parameters can be determined.

Assuming long term bond rates should be applied for current purposes (an issue to which we return below), the current yield on an index linked Commonwealth bond of 10-year maturity can be approximated by the average of the yield of bonds maturing in August 2010 and August 2015. As of 17 March 2003 this average was 3.185%. Using a nominal risk free rate of 5.25% and the Fisher equation produces an estimate of inflation of 2.00%.

3.1.2 Pre-tax v post-tax measurement

As tax liabilities always should be properly assessed, there is no necessary advantage in choosing between a post-tax and a pre-tax formulation of WACC. Some commentators, including Macquarie Bank in its 1999 report, advocate a pre-tax WACC as a way to avoid dealing with the tax specifics of the company. Amounts that are expressed in post-tax terms are "grossed up" using the statutory tax rate. Proponents of the post-tax WACC argue that since the standard formulation for estimating the cost of equity capital yields a post-tax (nominal) WACC there is no real benefit in re-scaling it once the tax liability is known. Also a post-tax WACC does not need to be updated if new tax liabilities are estimated.

A continuing issue is whether tax parameters in the WACC should be measured using statutory tax rates or effective tax rates. In our view, in estimating the tax liability of the firm a regulator should account for various complications such as the difference between regulatory depreciation and tax depreciation, timing differences between tax payment and tax revenues, and imputation credits.

As we will discuss below, since 2000 some Australian regulators have moved all of the tax issues out of the WACC estimation and into the measurement of cash flows. We support this approach but note that it creates a problem in identifying when a firm makes efficiency gains in the management of its tax liability.

3.1.3 Transformations between real/nominal and pre/post tax

There are two common methods that can be used to convert between a nominal post-tax WACC and a real pre-tax WACC.

To convert from nominal post-tax WACC, $r_{post,}$ to a real pre-tax WACC, $R_{pre,}$ the most commonly used approach, known as the 'market approach', involves the following steps:

1. Gross up the nominal post-tax WACC, r_{post}, by (1-T) where T is the estimated company tax rate. This gives the nominal pre-tax WACC $r_{post}/(1\text{-}T)$.

2. Use the Fisher equation defined above to convert the nominal pre-tax WACC to a real pre-tax WACC.

3. This can be summarised in the following sequence: nominal post-tax (that is, after tax and imputation)→ [gross up by tax] → nominal pre-tax → [minus inflation] → real pre-tax. Consequently, the real pre-tax WACC will be given by

$$R^{H}{}_{pre} = \frac{r_{post} - i + iT}{(1-T)(1+i)}$$

An alternative method changes the sequence of conversions as follows: nominal post-tax → [minus inflation] → real post-tax → [gross up by tax] → real pre-tax. In equation form this is:

$$R^{A}{}_{pre} = \frac{r_{post} - i}{(1-T)(1+i)}$$

As can be readily seen the two approaches do not yield the same result, with the difference being that the first equation has the additional term $iT/(1\text{-}T)(1+i)$. The market method

allows for an inflation adjustment on the tax liability as it converts from nominal to real terms after adjusting for tax. However the second method does not adjust for the influence of inflation on the tax rate. The additional term will generally decrease R_{pre} as inflation is generally greater than zero. Therefore, the market approach of adjusting for tax first will give a higher real pre-tax rate.

The recent trend in Australian regulation has been to adopt the market method, which means that in practice it has been more common to adjust the tax rate for inflation. However, some commentators and regulatory bodies have considered both methods. For instance, IPART in its final review on the access regime of the NSW Rail[4] used a combination of the two methodologies to obtain an intermediate estimate of a real-pre tax WACC, although more recently, IPART has announced its intention to adopt the market transformation method.[5] The method used by Macquarie Bank in its 1999 report also resulted in an averaging of the two approaches.[6]

Because the transformations treat the conjunction of tax and inflation differently, the effectiveness of the methods will differ across businesses depending upon the tax patterns that are created by the tax policies of a business over time. The most precise approach to the conversion of a nominal post-tax WACC to a real pre-tax WACC is to model the forecasted tax cash flows of the business. However, this alternative is a substantial task that largely defeats the purpose of attempting to model cash flows in pre-tax terms.

As can be seen above, the market approach assumes that the interaction between inflation and taxes impacts upon the real rate of interest. In the absence of being able to model the tax cash flows, we support using the market approach. There are two main reasons for this preference. In the current tax environment in Australia, there are few sources of tax timing differences, so the tax liability for accounting purposes will approximate tax paid. That is, the effective tax rate will approximate the statutory tax rate. Therefore, this liability

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4 Aspects of the NSW Rail Access Regime, IPART, Final Report, 28 April 1999.

5 IPART, Issues Paper DP58: *Regulatory arrangements for the NSW Distribution Network Service Providers from 2004*, November 2002.

6 For more rigorous critique of both approaches see "Access Arrangements and Discount Rates: Real Pre Tax and Nominal Post Tax Relationship," K. Davis, 19 May 1998; http://www.reggen.vic.gov.au/docs/gas/davis.pdf

warrants adjustment for inflation. Also, as is mentioned elsewhere in this report, we believe that it is socially preferable to err on the side of over estimating WACC rather than under estimating it - the market approach will generally be higher than the alternative method.

3.1.4 Recent trend in the formulation of the WACC model

Recent regulatory decisions of the ACCC and some other Australian regulators have moved to defining costs in nominal terms and on an after corporate tax basis. The effect of corporate tax is then incorporated in the costs, just like any other cost faced by the regulated business. Most recently regulators have moved to adopt what is referred to as a "vanilla" WACC. In this formulation the tax impact of interest expense is also included in costs. This approach results in a nominal post-tax WACC defined as:

$$WACC = R_e (E/V) + R_d (D/V)$$

where

R_e = cost of equity capital,

R_d = cost of debt capital,

E = market value of equity,

D = market value of debt, and

V = market value of the firm (E+D).

In our opinion, this model is the most effective in providing a WACC that allows a business to meet its tax obligations over the life of its assets. We noted above that there are a number of approaches to transforming WACCs from nominal/post to real/pre. The approaches give different results, and the appropriate choice is not definitive. When the vanilla model is used, there is no need to do any transformations between real and nominal or between pre and post-tax. All tax issues are dealt with in the cash flows.[7]

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[7] Care will need to be taken to ensure that the change in the approach taken for the determination of the discount rate (ie going from a pre-tax formulation to a post-tax formulation) does not adversely affect parties' interests in relation to the annuity applied to

3.2 Estimating cost of equity capital

3.2.1 Approaches to estimating cost of equity

There are a number of alternatives for estimating the cost of equity capital. These include the following approaches:

- Capital Asset Pricing Model
- International Capital Asset Pricing Model
- Dividend Discount Model
- Arbitrage Pricing Theory Model

Although there are alternatives available in principle, regulators in Australia, including ORAR in previous decisions, have consistently decided that the Capital Asset Pricing Model (CAPM) is the preferred approach.

We continue to be of the opinion that the CAPM is the best available approach. Therefore, we have estimated the cost of equity capital using a domestic version of the CAPM. Under the CAPM the required return on equity is expressed as a premium over the risk free return as follows:

$$E(R_e) = R_f + \beta * [E(R_m) - R_f]$$ [8]

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the asset valuation. In particular, it is recommended that the outstanding principal under the annuity be determined at the time the methodology changes by applying the general approach set out in the Regulator's approved set of *"Costing Principles to Apply to WestNet Rail"* (19 December 2002) and that this value (ie the outstanding principal at that time) be used for subsequent regulatory assessment should the Regulator adopt the post-tax nominal approach.

8 Note that this is the same equation as used by Macquarie Bank, where on page 12 they define the return on equity (k_e) as $k_e = r_f + (r_m \times \beta)$. In the Macquarie report r_m refers to the market risk premium, which is the same as the market returns less the risk free rate in our formulation.

where

R_e = cost of equity capital;

R_f = risk free rate of return;

R_m = market rate of return;

E(.) = indicates the variable is an expectation; and

β = systematic risk parameter ("equity beta").

The CAPM assumes that returns are normally distributed around the mean.[9] Where this assumption is violated then estimating the required return on equity using the CAPM may either over- or under-estimate the required return on equity. Most specifically where the business is subject to regulatory or market arrangements that limit the distribution of returns above the mean then investors will require compensation for holding such assets.

We believe that the CAPM provides a more robust basis for estimating the cost of equity capital than other available approaches. Given the well-established support for the domestic version of the CAPM we believe there is a need to demonstrate that alternative models have significantly improved empirical properties before shifting from the CAPM. There have been suggestions that an international version of the CAPM would be more consistent with the existing conditions in Australian securities markets. We address this issue in the following section.

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9 The CAPM is based on a set of assumptions that can be stated as follows.

a) All investors are risk averse and maximise their expected utility of wealth and all have the same one period horizon.
b) All investors make their portfolio decisions based on the expected returns and standard deviations of the portfolios (this is equivalent to assuming returns are normally distributed).
c) All investors have the same expectations about the expected return and standard deviation of portfolios.
d) Taxes and transactions costs are irrelevant.
e) All assets are infinitely divisible.
f) All investors can borrow and lend at the risk free rate of interest.
g) All information is freely and instantly available to investors.

3.2.2 Potential use of International CAPM

The most cited alternative to the CAPM is its international version (ICAPM). ICAPM models aim to reflect the integrated nature of the world economies by measuring the appropriate return on equity capital against the world market. These models generally require estimation of an international market risk premium and risk free rate, plus estimation of the systematic risk of the security in question to the world market. Examples include:

- a single factor approach – as associated with Solnik[10] and Grauer, Litzenberger and Stehle[11], which takes the simplest approach to reflecting integrated markets by using the standard CAPM structure and defines the market risk premium (MRP) as a world parameter rather than a domestic parameter;
- inclusion of exchange rate risk – as attributed to Solnik[12] and Sercu[13]. In their models there is one world market risk premium and numerous currency risk premiums; and
- ICAPM with addition of factors that have explanatory factors in addition to the MRP– as attributed to Fama and French and others. The models most commonly used are ratios to capture market value to book value and earnings to price. In principle, any factor could be introduced, and the factors could be added to either of the models above (or other versions). However, as such models are ex-post in nature they have little, if any, practical application.

ICAPM models fail to provide benefits over the CAPM for a number of reasons:

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10 B. Solnik, 1974, "An Equilibrium Model of the International Capital Market," *Journal of Economic Theory* 8, 500-524.

11 F. Grauer, R. Litzenberger and R. Stehle, 1976, "Sharing Rules and Equilibrium in an International Capital Market Under Uncertainty", *Journal of Financial Economics* 3(3), 233-256.

12 B. Solnik, 1983, "International Arbitrage Pricing Theory," *The Journal of Finance* 38, 449-457.

13 P. Sercu, 1980, "A Generalisation of the International Asset Pricing Model," *Revue de l'Association Française de Finance* 1, 91-135.

- ICAPM models fail to provide additional explanatory power over the CAPM. For example, a recent empirical test by Koedijk, Kool, Schotman and van Dijk[14] investigates to what extent international and domestic asset pricing models lead to different estimates of the cost of capital for an individual firm. They find that "even though the ICAPM is theoretically preferable to the domestic CAPM, a firm's beta calculated using the domestic CAPM does not necessarily provide a worse estimate of the cost of capital."[15] They conclude: "the marginal contribution of all global factors is very limited, which indicates strong country factors."

- more broadly, and consistent with the above findings, there is extensive documentation of "home bias". Thus, although there is opportunity for investors to hold portfolios that are fully diversified internationally, it does not seem that investors actually hold such portfolios;[16]

- the majority of Australian listed companies have overseas operations and have revenues and expenses that are significantly influenced by world prices. Therefore, an investor in Australian equities will achieve a significant degree of international diversification. This is likely to be at least a partial explanation of the home bias mentioned above;

- in the single-factor ICAPM there is a need to reliably estimate the world MRP. However, at the most we have 20 to 25 years of data for this purpose – a period that is well accepted as being too short period for an acceptable estimate of MRP; and

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14 K. Koedijk, C. Kool, P. Schotman and M. van Dijk, 2001, "The Cost of Capital in International Financial Markets: Local or Global," Working Paper No. 3062, Centre for Economic Policy Research.

15 These tests are of the standard CAPM against the Solnik-Sercu ICAPM with exchange rate risk. In an earlier version of the paper (1999) they also included tests of the single-factor ICAPM, and found that it performed significantly worse than the CAPM against the multi-factor ICAPM.

16 However, the existence of widespread home bias does not preclude that the marginal investors in companies in Australia (and elsewhere) are effectively pricing securities according to an international asset pricing model.

- to achieve a significant improvement it is necessary to apply an ICAPM that incorporates exchange rate risk. To achieve this we must estimate a firm's sensitivity to exchange rate risk across all countries in the world economy. We are far from having a reasonable basis for this estimation.

There is no disputing that securities markets in Australia are international markets, although they may not be fully integrated with all world markets. Therefore, the pertinent question to ask is - How should we estimate the cost of equity capital given that we operate in an international market? In our opinion, the standard formulation of the CAPM, as set out above, is the approach that is most likely to capture the return on equity that will be demanded by investors in Australian equities.

3.2.3 Other approaches to estimating cost of equity capital

The other potential alternatives to the CAPM are arbitrage pricing theory and the dividend discount model.

Arbitrage Pricing Theory model

The Arbitrage Pricing Theory (APT) was developed as an alternative approach to estimating expected returns to an asset.[17] As with any theory, the APT requires a set of assumptions about the behaviour of investors and markets. The basic idea is that security returns result from the linear influence of a set of factors that are common across securities. The factors are not specified, but two approaches have been used to empirically apply the model. One approach is to use factor analysis to identify factors, but the factors are statistical artefacts and not necessarily identifiable. In Australia, Robert Faff[18] has shown that a small number of factors are important in explaining security returns. An alternative approach is to speculate on macroeconomic variables that might influence security returns and then test them in regressions similar to those used to estimate beta in the CAPM. The best known of these empirical tests found that the variables that showed influence were the long-term risk free

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17 S. Ross, "The Arbitrage Theory of Capital Asset Pricing," *Journal of Economic Theory*, 1976, vol 13, 341-360.

18 R. Faff, "An Empirical Test of the Arbitrage Pricing Theory on Australian Stock Returns 1974-85," *Accounting and Finance*, 1988, vol 28, 23-43.

rate, changes in expected inflation, unexpected inflation, industrial production and investor risk aversion.[19]

Although the APT has contributed to discussions on asset pricing, it has had no impact on the practical task of estimating the expected return on securities. The first problem is that the model does not specify the factors, so operationalising the model is necessarily empirical and ad hoc. There are other difficulties. When factors are identified, as in the case of the macroeconomic variables mentioned above, the variables are not measured with the precision and frequency that is possible with stock prices and returns. Finally, the tests that have been conducted do not demonstrate that the APT model has empirical power to warrant serious consideration as an alternative to the CAPM. We are not aware of any substantial applications of the APT in practice.

Dividend Discount Model

The Dividend Discount Model (DDM) uses stock price (P), current dividend (Div) and estimates of dividend growth (g) to estimate the cost of equity. The original model assumes that there is a constant and perpetual growth rate:

$$Re = [Div * (1+g) / P] + g$$

Subsequent refinements have allowed for multiple phases of growth rates. Clearly, this approach would only be practical if growth was assumed to change over time.

The stock price and current dividend are generally observable for publicly listed companies, so the key to effectively applying the model is the estimate of the growth rates. Experience in applying the DDM demonstrate that the estimates of cost of equity are highly sensitive to the assumptions about the magnitude and timing of growth, and that estimates from the model are frequently outside economically plausible rates (e.g., below the risk free rate or above the risk free rate at a level that is inconsistent with comparable companies). Although the DDM has been used in practice in some situations, we are not aware of any use of the approach in Australian regulation, and believe it does not provide an alternative to the CAPM.

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[19] N. Chen, R. Roll and S. Ross, "Economic Forces and the Stock Market," *Journal of Business*, 1986, vol 59, 383-403.

Conclusion on alternative models

For the reasons expressed above, we do not believe APT or DDM provide viable alternatives for the assessment of the WACC for regulatory purposes at this time and accordingly, it is recommended that the Regulator apply the CAPM. However, in making this recommendation, it is important that the limitations of the CAPM be acknowledged. The CAPM is far from a perfect model – amongst other things, it does not adequately address asymmetric risk – yet it provides in our view the most effective and reliable means of estimating the cost of equity given available alternatives.

4 Parameter values

This section of the report assesses the appropriate values for the various parameters that are included in the CAPM and WACC. With the exception of the level of undiversifiable risk (beta) exhibited by each of the businesses, we have assumed that the same WACC parameters are appropriate to both entities. Whilst the application of similar parameters is obvious for factors such as the risk free rate, the market risk premium and the valuation of imputation credits, it is perhaps less obvious for the assumed capital structure and debt margin.

For both of these parameters, NECG contacted the respective businesses seeking advice as to the actual values for these parameters. Both companies declined to provide this information. Hence, whilst there may be good reason for these values to be different for the respective companies, the commercial circumstances are not considered such as to warrant materially different values being assumed at this time. Of course, different values may be applied for capital structure and debt margin as a result of the consultation process.

In this section we have made point estimates of the various WACC parameters rather than specifying a range. This is consistent with regulatory practice, which is increasingly shifting towards adoption of point estimates. We believe this is the most appropriate approach, given there is a need for judgement to be exercised at all levels of analysis.

4.1 Risk free rate

The risk-free rate of return is required for determining the cost of equity capital in the CAPM, and also the appropriate premium for debt finance. The risk-free rate of return in the CAPM is generally derived from government bond rates. The key issues for the risk free rate are twofold: the appropriate bond maturity to adopt and the period over which any averaging of the rate takes place.

4.1.1 Bond maturity

There is substantial evidence in the literature that non-regulated companies investing in long-lived assets generally finance those assets with debt of similar maturities.[20] This allows the company to service its debt from the revenue generated by the assets without being exposed to any risk of being unable to maintain its necessary funding. While both the assets and debt will generally have some potential to be liquidated before maturity, it is normally the intention of management to keep both in place through to the end of their lives.

The question then arises over whether the optimal policy of an efficient company changes under price regulation. One view argues that the maturity of the bond from which the risk free rate is approximated should be that rate which corresponds to the length of the regulatory period. Since the Code requires that the cost of capital be updated on an annual basis, the effective period would be one year. This view would have the debt of rail companies refinanced annually and the maturity of the risk free rate determined from the rate on one year government bonds.

The alternative view is that the Code regulation does not obviate the compelling motivation to maintain a debt maturity balanced with the life of the assets. The maturities for the risk free rate and the companies' debt should be 10-years.

A recent paper by Associate Professor Lally[21] argues that the appropriate term of the risk free rate is the period of the regulatory cycle. He reached his conclusions by developing a regulatory model under which "the only source of uncertainty is in future real interest rates." In this model, it is optimal for the business to finance its debt based on maturity equivalent to the duration of the regulatory period, given that by structuring its debt on this basis, the *ex-ante* value of future cashflows to the business matches the initial capital investment.

In our view the model developed by Associate Professor Lally to prove his position is too limited and restrictive to be useful for policy purposes. If the key assumptions are relaxed,

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20 Actually a company would match 'duration' of debt and assets, but this does not change the conclusions.

21 Ibid, p5.

the optimal policy for the Regulator would be to base the bond maturity on the longest dated bond, consistent with standard commercial practice.

Conceptually Associate Professor Lally's argument relies on implausible logic. Arguing that the presence of regulation allows a business to reduce its financing costs by structuring its finance based on a shorter-term bond maturity implies that either the Regulator is able to provide the business with an arbitrage opportunity that is not available to unregulated businesses, or unregulated businesses are adopting sub-optimal capital structures.

We dispute that the first possibility exists. Despite an element of certainty over price for the regulated period, regulated businesses still face uncertainty over operating costs and demand, and on the approach the regulatory authority will adopt at subsequent reviews in relation to price and past profit – reviews that typically impact on the majority of the asset value in net present value terms.

Similarly, it appears implausible that unregulated businesses are not taking advantage of arbitrage opportunities in their finance activities. In reality, there are many capital intensive unregulated businesses that reset their prices regularly. For example, companies such as electricity generators set prices on a half hourly basis. However such businesses generally finance their assets based on long-term bonds rather than the overnight rate as implied by Associate Professor Lally's arguments.

We believe that the bond maturity used in the WACC calculations should reflect the relevant opportunity costs associated with the investment in the physical asset. In turn, the relevant opportunity cost is likely to be reflected in the decision that an efficient firm would reach in choosing its capital structure. The imposition of price regulation will not result in an efficient business changing its financing practice, nor will it change the fundamental nature of the opportunity cost of investment in rail infrastructure.

In this case, modifying debt management practices to coincide with the regulatory period would require that the company turn over its entire debt every year. This would expose the firm to uncertainty as to its ability to maintain necessary funding. It would also impose substantial annual transactions costs on the company. We do not believe that this would be a sensible or efficient debt management policy even with the annual resetting of the WACC for changes in the risk free rate.

Similarly, while the interest rate used in the WACC is a driver of price, it does not by itself reflect the appropriate interest rate for business capital financing. Adopting a shorter bond maturity with a lower yield by the regulatory authority implies that the presence of regulation introduces arbitrage opportunities that are otherwise not available to unregulated businesses. We dispute this is the case – even if the transactions cost of debt finance are low.

Therefore, we believe that the review period for an investment is not relevant to return expected from holding an asset over its life. This has been demonstrated by the following example from Hathaway: [22]

> The point about the review period governing the risk free rate, I think that is a totally silly point, and the easiest way to demonstrate that is imagine you were running a 10-year bond portfolio and every 30 days you valued that portfolio. You would go to the market and use the prevailing 10-year bond rate. You certainly would not use the prevailing short rate to value that bond portfolio. So the interest rate you use has got nothing to do with the review period; the rate you use is the rate consistent with the life of the asset and particularly the risk in your equity risk premium. Anything else gives you an inconsistency.

Therefore, we recommend adoption of the 10-year bond maturity for the risk free rate. This position is consistent with the position adopted by Macquarie Bank and with the position of most jurisdictional regulators in Australia.[23]

An additional consideration in setting the bond maturity is that a key assumption of the CAPM is the need for consistency in the term of the market risk premium (MRP) and the risk free rate. This can be demonstrated through simple algebra.

If we apply the CAPM for a company that has a beta of one we find:

$$E(R_e) = R_f + 1 * [E(R_m) - R_f] = E(R_m) + [R_f - R_f]$$

Since the company has the same beta as the market, it must be that - $E(R_e) = E(R_m)$. But this can only be the case if $[R_f = R_f] = 0$, which of course implies that $R_f = R_f$ – namely the risk free rate applied to estimating the MRP must be the same risk free rate as used in determining the base risk free rate.

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22 ACCC and ORG, Public Forum on the weighted average cost of capital in the Victorian Gas Access Arrangements, 3 June 1998, page 79.

23 The only exception is the Australian Competition and Consumer Commission (ACCC) who adopts a bond maturity based on the length of the regulatory period. While the ACCC has gone into considerable detail to justify its position, we believe it is logically flawed for the reasons outlined in this section.

If R_f is not the same in both places that it appears in the CAPM, then a firm with a beta of one would not have the same expected return as the market. More pointedly, if R_f is not the same in both instances, the model being used is not the CAPM.

Given that all major estimates of the MRP are based on the 10 year bond, adoption of a maturity other than 10 years for the risk free rate will result in the assumptions of the CAPM being violated, absent any adjustment to the MRP, which by its nature would be ad hoc.[24]

4.1.2 Period of averaging

In theory the risk free rate in the CAPM should reflect on-the-day rates. However, averaging may provide benefits to a business in overcoming market illiquidity by facilitating issuance of any necessary debt around the date of the final decision – providing that period is stated to the business in advance.

As averaging introduces measurement error (or noise) into the estimation of the risk free rate, the period of averaging should be short. Current regulatory practice is to adopt an averaging period of 10 or 20 days.[25] Provided that an averaging procedure is used consistently through time, the resulting estimates of the risk free rate should have some measurement error but not have any bias.

Our preference is for setting the risk free rate as the rate on the date that the regulated period begins. However, we recognise that some regulated businesses may feel that it is not practical to put all of their debt and hedging instruments into place on a single day. In that case, and if requested by the regulated business, we will accept averaging of the rates on the appropriate government bonds over the ten trading days up to the beginning of the regulated period.

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24 For example, the Reserve Bank of Australia has information on the difference between the yield of 5-year and 10-year bonds going back to 1983. However, it is not clear that this difference would necessarily be directly reflected in an MRP estimated on a 5-year basis. In addition, estimates of MRP are based on a considerably longer time period than data on 5-year bond yields is available.

25 Note that the ACCC traditionally adopted a 40-day averaging period, but recently adopted a 10-day averaging period in its SPI and ElectraNet decisions.

As of 17 March 2003, the yield on the 10-year Commonwealth bond was 5.25%.

4.2 Market risk premium

The market risk premium (MRP) is the amount an investor expects to earn from an investment in the market above the return earned on a risk-free investment. The MRP in the CAPM is the term $[E(R_m) - R_f]$. The key difficulty in estimating the MRP arises from it being an expectation and therefore not being directly observable. As a result the choice of an appropriate rate is inevitably *ad hoc*. Generally a range of plausible values is identified and the MRP is chosen within the range, most commonly at the midpoint. It is important to recognise however that in all likelihood the MRP varies over time – the difficulty is that we have no robust means of identifying or quantifying these shifts. We believe that this uncertainty is a material consideration in the assessment of the MRP.

In determining the appropriate MRP to apply, we consider:

- use of historical data to generate a range; and
- the assessment of an appropriate point in that range.

4.2.1 Historic evidence

In assessing historical evidence, the generally accepted range among corporate finance professionals in Australia has been 6% to 8%.[26] This range is largely favoured because of empirical evidence of the historical, realised MRP in Australia dating as far back as 1882. In the absence of additional evidence, the midpoint of 7% was often picked as the point estimate. In 1999, Davis presented a range for MRP of between 5% and 8%, and noted that the midpoint of 6.5% "is not unreasonable."[27] Section 3.2 of Schedule 6.1 of the National Electricity Code also notes that the MRP has averaged 6.6% since 1952.

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26 For example, see R. Officer, "Rates of Return to Shares, Bond Yields and Inflation Rates: An Historical Perspective," in *Share Markets and Portfolio Theory*, 2nd ed, 1989 University of Queensland Press, St Lucia, 1989, pp. 207-11.

27 K. Davis, "Comments on the Cost of Capital: A Report prepared for the ACCC," April 1999.

Recently, Dimson, Marsh and Staunton[28] undertook a comprehensive study of financial market performance for sixteen countries from the end of the nineteenth century to the beginning of the twenty-first, finding that the MRP for the Australian economy was 7.0% over this period. The authors noted that the better performing equity markets were those of resource rich economies such as Australia.

Historical estimates of MRP are given in Table 1.

Table 1: Historical estimates of MRP

Source	Market risk premium (%)
Officer (based on 1882-1987)[29]	7.9
Hathaway (based on 1882-1991)[30]	7.7
Hathaway (based on 1947-91)[31]	6.6
NEC (based on 1952-99)[32]	6.6
AGSM (based on 1964-95, including October 1987)[33]	6.2
AGSM (based on 1964-95, excluding October 1987)[34]	8.1
Dimson, Marsh, Staunton (based on 1900-2000)[35]	7.0

28 E. Dimson, P. Marsh and M. Staunton, "Triumph of the Optimists: 101 Years of Global Investment Returns," Princeton University Press, 2002.

29 R. Officer, op cit, pp. 207-11.

30 N. Hathaway, "Market Risk Premia," unpublished manuscript.

31 Ibid.

32 National Electricity Code, schedule 6.1, section 3.2.

33 IPART, "Regulation of New South Wales Electricity Distribution Networks," section 5.4.2, Table 5.4, December 1999.

34 Ibid.

35 Op cit.

The historic data set out above is consistent with a range of 6.0% to 8.0%.

4.2.2 Appropriate point within the range

In considering the appropriate point for the MRP within this historical range, we will consider the following issues:

- recent (short term) estimates of the MRP;
- benchmarking approaches to MRP;
- forward-looking estimations of the MRP; and
- the relevance of surveys of MRP at the present time.

Estimates of MRP based on recent data

A number of regulators have justified adopting a MRP at the bottom end of the historical range based on data showing a reduction in the ex-post MRP in Australia. However, recent data also shows a substantial increase in volatility in the historical MRP. The increase in risk reflected in the volatility of returns would generally be regarded as indicative of a higher level of expected returns rather than a lower level. The relationship between changes in the ex ante MRP and resultant contrary changes in the ex post MRP is a confounding factor in explaining recent market movements, even if they are not transitory. Given the need for long time series data to provide statistically robust results, such data should be treated with care.

Macquarie Bank proposed a range for the MRP of 5.0% to 6.0% based on the position of the ACCC at that time. While the ACCC have consistently applied a MRP of 6.0% in its decisions, it made a number of statements at the time suggesting that the MRP may be closer to 5%. However, the view expressed at the time was based on evidence from much shorter time horizons than is typically adopted to estimate the MRP.

Therefore, we believe that all but the upper point of Macquarie's range can be discounted. Discounting values below 6% is consistent with recent statements of the ACCC, even though they have previously speculated that the MRP might have declined. For example, in its SPI Powernet decision it noted:

> The Commission recognises that the market risk premium has fallen over recent years, however the Commission is wary that this may reflect short-term market trends.[36]

Recently a report for the joint regulators in the UK[37] argued that an appropriate market risk premium derived from UK and US data was of the order of 4-5%. We dispute that this report has any significant implications for the setting of an MRP in Australia or even the UK.

First the statistical assumptions underpinning the UK results are questionable. The authors subtracted 2.5% from the equity return for the real risk free rate, whereas a value of 1% is commonly applied for the historic risk free rate in the US. A study of investment returns for twelve countries by the London Business School[38] reports that over the period 1900-1999 the real return on bills in the UK was 1.2% using arithmetic measurement. The authors of the cost of capital report note that their estimate has a margin of error of 2 percentage points at the 95% confidence level – implying that the study could support an MRP of both 2% and 7% assuming all other assumptions in the report apply.

Second, the UK results have been derived from an international market. However, given problems in applying the ICAPM we do not believe the authors have demonstrated that their results are superior to those utilising domestic data – or that other parameters such as beta can be better estimated under the ICAPM. The authors have undertaken this approach partly due to perceived problems in historic risk free rate estimates in the UK. This supposed problem appears linked to the 'equity risk premium puzzle' of Mehra and Prescott, which showed that the gap between the risk free rate and market risks was larger than predicted by theory. However, such a puzzle can be explained by introducing any of a number of factors such as one year time horizon for investors, transactions costs or a variety

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36 ACCC, Victorian Transmission Network Revenue Caps 2003-2008, Final Decision, December 2002, p27.

37 S. Wright, R. Mason, D. Miles, "A Study into certain aspects of the cost of capital for regulated utilities in the UK," February 2003.

38 E. Dimson, P. Marsh and M. Staunton, "The Millennium Book: A Century of Investment Returns," London Business School, 2000.

of alternative utility functions. Also, Professor Mehra has recently stated,[39] "Over the long horizon the equity premium is likely to be similar to what it has been in the past and the returns to investment in equity will continue to substantially dominate those in bonds for investors with a long planning horizon." We do not believe that the report on the cost of capital in the UK reaches valid conclusions and do not believe it is a valid reason to move away from the standard approach to estimating MRP.

Third, to apply the UK estimate to the Australian context would require adjustment for country specific factors. As noted in figure 2, investors require compensation for the lower credit rating of Australia compared with countries such as the UK and the US.[40] Note also that additional compensation may be required based on other factors such as taxation.

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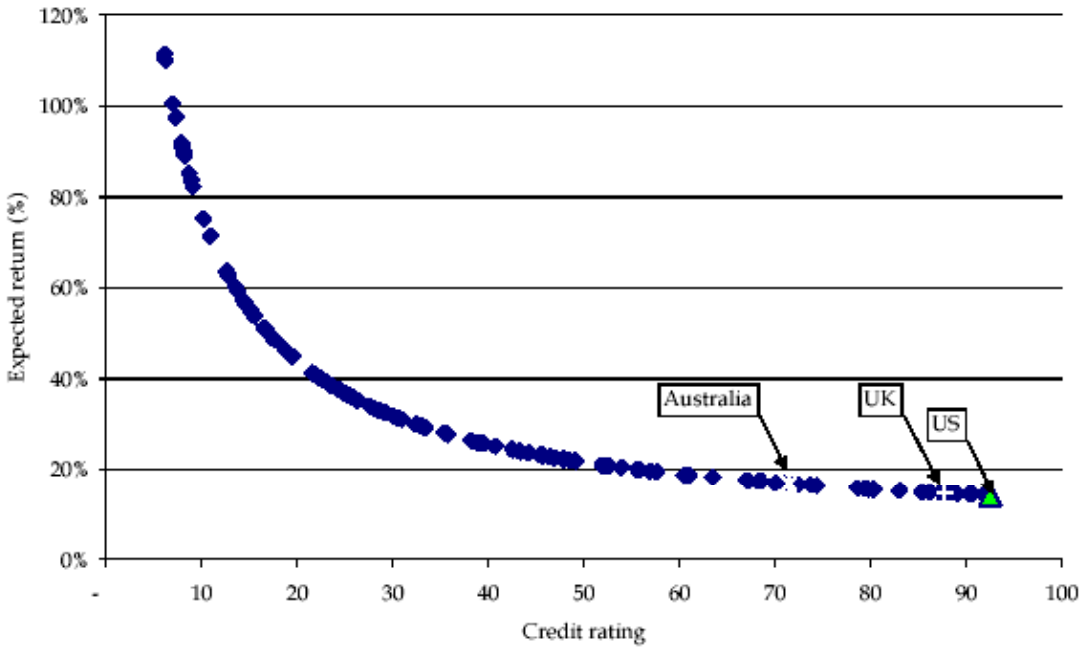
39 R. Mehra, "The Equity Premium Puzzle," University of Chicago working paper, April 2001, p 9.

40 For example, Australia's credit rating for much of the decade between the mid 80's and mid 90's was AA+ rather than the AAA credit rating it now enjoys.

Figure 2 Relationship between country risk and returns



Source: C. Erb, C. Harvey, T. Viskanta, *Expected returns and volatility in 135 countries*, Journal of Portfolio Management, Spring 1996, pp. 46-58.

Benchmarking approach to MRP

An alternative way of setting a MRP is through a benchmarking approach. Australia is an open economy. Investment funds move freely into and out of the country and the currency. As of September 2000 non-resident investors owned 37.5% of the value of the Australian Stock Exchange, the largest single shareholder group by far. In addition, as of 31 March 2002, non-residents held over 33% of all Commonwealth government securities.[41]

41 Reserve Bank of Australia, "Bulletin Statistical Tables" http://www.rba.gov.au/Statistics/Bulletin/EO3hist.xls

The Australian debt and equity markets have only been integrated into world markets for around 20 years. Prior to deregulation, market prices (and in turn the MRP) were significantly affected by government intervention, in particular the restrictions on foreign ownership of shares and exchange rate controls. This resulted in prices of shares and government bonds being predominantly determined by domestic (rather than international) factors. Given these circumstances, it is unlikely that the *ex post* MRP in this market provides the best estimate of an *ex ante* MRP in the current (international) market.

In the absence of sufficient relevant historical information from the current market, an alternative approach to estimating the MRP is through a benchmarking approach. With this approach, a benchmark country is chosen based upon it having a reliable estimate of MRP. Then the potential differences between the MRP in that country and the MRP in Australia are evaluated. These could include taxation, country risk, market composition differences and estimation time horizon.[42]

Ibbotson Associates suggest that the US market risk premium is 7.76% and that based on Australia's country credit rating, the expected return on the Australian market is 1.53% to 2.26% higher than for the U.S.[43]

In assessing the available literature and evidence, including data from Ibbotson, we believe a reasonable range for the US MRP, using the standard CAPM and a short time horizon, is 5% to 8% with a mid-point estimate of 6.5%.

In assessing MRP averages, it needs to be recognised that comparative tax regimes is a very complex area. Arguments can be made for adjustment of the US MRP results in either direction. The magnitude of adjustments to MRP from taxation could be substantive, but we do not see any clear basis for predicting the direction. Therefore, we do not recommend adjusting the US MRP before applying it as a benchmark for estimating the MRP in Australia.

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42 This approach is explained is detail in R. Bowman, "Estimating the Market Risk Premium," JASSA, issue 3, Spring 2001, pp 10-13. We understand that Professor Bowman has since revised his estimate of the US MRP, and as a result his benchmarked estimate of the MRP in Australia is now 7%.

43 Ibbotson Associates, (2001), "International Cost of Capital Report 2001," www.valuation.ibbotson.com

There are a multitude of differences between the equity market and index in the US and Australia, but the overriding difference is the relative size of the companies. Australian index companies are far smaller than US index companies. It is well documented that size is negatively related to risk, both total risk and systematic risk. An intuitive way to quantify the difference that size would make to the MRP is to think of it in terms of systematic risk. If the firms in the Australian market were listed on an exchange with the Standard & Poor's 500 firms, what would be the average beta of the Australian firms? In our opinion, the average beta would likely be in the range of 1.25 to 1.5. To convert this to a rate of return, we can assume an MRP of 7% and apply the beta estimate in excess of one to get an addition to the benchmark MRP of 1.75% to 3.5%.

The incremental risk of a country is often referred to as "country risk". This risk is related to the risk that a government will abruptly alter its policies with respect to investments in the country (including expropriations), shifts in monetary or fiscal policy, regulatory changes, defaults and tax changes. The literature and empirical evidence support the conclusion that political risk is priced domestically. Earlier in this section we cited Ibbotson as increasing the US MRP based on Australia's country credit rating. However, we believe it is likely that the country risk premium for a developed country such as Australia is priced in the risk free return such that there is no additional premium necessary in the MRP.

It is important to ensure that the risk free rate used in the CAPM is defined consistently in all places of the CAPM and WACC calculations. If a long time horizon is used in defining the risk free rate, then the MRP must be similarly measured. The US evidence on MRP used to develop the MRP estimate above is based upon the difference between equity returns and the returns on Treasury bills. Over the period used in the data, there was an average annual return premium of about 1.5% for intermediate-term government bonds over Treasury bills. Therefore, in our opinion the risk free rate should be defined over a long horizon and the MRP estimate above should be reduced for this premium.

The US MRP is estimated in the range 5% to 8% with a midpoint of 6.5%. Adjusting this to the long-term rate reduces the range to 3.5% to 6.5% with a midpoint of 5%.

The analysis of the three areas where the Australian MRP might differ from the US MRP indicates that an adjustment to the US MRP could be as low as an increase of 1.75% with an upper bound of a premium of 3.5%. Rather than choose the mid-point of this range, we consider it appropriate to consider the possible downward influence of relative taxation and to choose a conservative premium of 2.0%.

The long horizon US MRP is estimated as 5.0% and the premium of 2.0% is added to that. In our opinion, a conservative estimate of a long horizon MRP for Australia is 7.0%.

Survey data

A number of regulators including ESC, IPART and ACCC have recently made reference to a number of survey studies of MRP. These include:

- two studies by Welch[44,45] – who surveyed academics finding MRP of 7.1% and 5.5% respectively;
- Graham & Harvey[46] – who surveyed 1107 CFO's between 2000 and 2001, resulting in a range for the MRP of 3.6-4.7%;
- Mercer Investment consulting[47] – who surveyed brokers finding a range of 3.0-6.0%, noting that in its own advice it adopts a figure of 3.0%; and
- Jardine Fleming Capital Markets[48] – who surveyed 61 respondents in Australia, of which 35 were non-academics, finding an average expected MRP in Australia of 4.73%.

On face value, surveys have a substantial advantage over historical estimates of MRP. Properly constructed, they should provide actual forward-looking opinions. However, there are a number of critical dimensions to their validity:

- the nature of the participants in the survey;

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44 I. Welch, 2000, "Views of Financial Economists on the Equity Premium and other Issues," The Journal of Business 73(4), 501-537.

45 I. Welch, 2001, "The Equity Premium Consensus Forecast Revisited," Working Paper, Yale University.

46 J. Graham and C. Harvey, 2001, "Expectations of Equity Risk Premia, Volatility and Asymmetry from a Corporate Finance Perspective," working paper, Duke University.

47 Mercer Investment Consulting, Victorian Essential Services Commission Australian Equity Risk Premium, 1 July 2002.

48 Jardine Fleming Capital Partners Limited, The Equity Risk Premium – An Australian Perspective, Trinity Best Practice Committee, September 2001.

- the biases the participants may have with respect to the issue being surveyed; and
- the time horizon the participants may considered.

Considering each of the studies against these dimensions raises a number of critical flaws.

Welch surveys

The surveys by Ivo Welch were to be based upon views of the US markets. The intention of the first survey was that the participants would be professional financial economists, primarily academics. The second survey was "by invitation" and was restricted to professors of finance and economics.

A key concern with the findings of Welch's surveys is the role that Welch himself took. His first survey was open to everyone who visited his website, the second survey was by invitation only. Welch disclosed that the results of the first survey were higher than his personal view, which casts doubt on the validity of the results of the second survey. Accordingly, it is thought that the first survey provides an inherently more credible estimate of the MRP and therefore ought to be preferred.

Graham and Harvey

Graham and Harvey surveyed CFOs in the US on their estimates of the forward-looking MRP at various horizons. They found that:

> "the one-year risk premium is highly variable through time and 10-year expected risk premium is stable. In particular, after periods of negative returns, CFOs significantly reduce their one-year market forecasts, disagreement (volatility) increases and returns distributions are more skewed to the left (i.e., low). We also examine the relation between ex ante returns and ex ante volatility. The relation between the one-year expected risk premium and expected risk is negative. However, our research points to the importance of horizon. We find a significantly positive relation between expected return and expected risk at the 10-year horizon." (taken from the abstract).

While CFOs of large corporations might be expected to be familiar with the issue being surveyed, the results of the survey are not internally consistent and in some respects are contrary to a fundamental principle of economics that expected risk and expected return are positively related. At the one-year horizon, these CFOs believe that risk and return are

negatively correlated. Although the survey does not shed light on this anomalous belief, we presume that it results from their focus being excessively short term and influenced by recent historical outcomes. Clearly this survey has little credibility as a basis for estimating a MRP.

Mercer

Mercer Investment Consulting surveyed brokers. While it can be argued that the survery respondents would be both knowledgeable and interested in the topic, NECG has a number of concerns in basing MRP estimates on the views of brokers:

- they are not likely to be particularly knowledgeable of the theoretical and empirical research on the issue; and
- their assessments, which are intended to be forward-looking, are strongly correlated with the recent past but have no predictive power.

Jardine Fleming Capital Markets

The results of the Jardine Fleming survey do not appear to match with the risk profile of the Australian and US equity markets. The survey makes two unusual conclusions: firstly that past MRP was higher in the US than Australia by about 40 basis points; and secondly that the expected MRP in Australia is about equal to that in the US. For these to be true, Australia's equities would have to be no less risky than equities in the US. This seems unlikely. For example in its PSTN decision, the ACCC stated that the Australian market is "... a higher risk, more resource-based, economy [than the UK economy]".[49] Given that the UK market would not be expected to be any less risky than the US, then it follows that the Australian market is riskier than that of the US.

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[49] Australian Competition Consumer Commission, "A report on the assessment of Telstra Corporation Limited, Undertaking for the Domestic PSTN Originating and Terminating Access services," July 2000.

Conclusion on surveys

In general, surveys are interesting, but NECG believes they may tell us more about the people being surveyed than about the issues being surveyed. As a result, the biases created reduce the validity as an appropriate estimator of a forward-looking MRP.

4.2.3 Conclusion on MRP

Many regulatory bodies have adopted a MRP of 6%, at least in part, on the basis of market trends. However, the most recent data suggests that the MRP has been increasing over the past year in *ex post* terms. For the reasons outlined above, we believe the critical issue is the long-term average for the assessment of the MRP.

As noted above, the historical range for the MRP favoured by finance professionals has been 6.0 to 8.0%. Evidence on benchmarking approaches to the MRP also suggests a figure at the mid-point of the range. Such findings are consistent with the recent findings of Dimson, Marsh and Staunton noted earlier, who found that the MRP for the Australian economy was 7.0% over the last century.

Empirical evidence indicates that the *ex post* MRP demonstrates some time varying behaviour. However, there is little evidence of predictability of this variation. A number of commentators have suggested that the *ex ante* MRP has declined over the past decade or so. It is noteworthy that such comments began during the mid-1990s in the US, with the evident catalyst being the very strong sharemarket performance at the time. Obviously sharemarket conditions have changed dramatically, and the strength of the support for a downward adjustment to the forward-looking MRP has diminished. In our view, evidence suggesting short term declines in MRP does not provide substantive support for policy setting.

It is clear that regulatory precedent in Australia favours a MRP of 6%. Yet longer term historical data and the benchmarking approach both suggest that a MRP of 7% is more appropriate. In addition, given that any estimate of MRP is a matter of judgement, the asymmetric consequences of regulatory intervention favour choosing a rate that is tilted to overestimating the MRP rather than under estimating it. Accordingly, we recommend that a forward-looking MRP of 7% be adopted, recognising that if the Regulator feels constrained by regulatory precedent then a MRP of 6% or 6.5% could be applied.

4.3 Gamma

The dividend imputation mechanism used in Australia is intended to ensure that profits are taxed only once for Australian resident taxpayers but this benefit is not intended for foreign shareholders. Dividends that are paid out of after-corporate-tax profits can be accompanied with a 'franking' credit to the extent of the corporate tax paid. The value of franking credits is represented with the parameter gamma (γ).

The value of franking credits will be determined at the level of the investor and will be influenced by the investor's tax circumstances. As these will differ across investors, the result will be a value of the franking credit between nil and full value (i.e., a gamma value between zero and one). There has been an increasing body of literature focused on estimating the value of gamma. The early literature generally found a value of around 0.5. Since this time, debate has become increasingly polarised between those arguing for zero and those arguing for one.

Regulators have responded to this uncertainty by setting a value within the range of 0.30 to 0.50. The adoption of a range of 0.40 to 0.50 by Macquarie Bank is consistent with regulatory practice in Australia.

The market value of distributed franking credits should be established at the market level, not the firm level. So for regulatory purposes, we agree with current regulatory practice that treats firm specific shareholding, including for Government owned businesses such as WAGR, as irrelevant.

Some of the key issues in determining a gamma for the WACC revolve around:

- the identity of the marginal investor; and
- the net impact of recent taxation changes.

To some extent, the polarisation of empirical evidence can be explained by reference to these two sets of issues – the marginal investor suggests a low gamma whereas the impact of recent tax changes suggests a high gamma. The following sections consider these cases and are followed by our conclusion on the issue.

4.3.1 Identity of the marginal investor

The gamma used in the CAPM is generally derived as a market average. Nevertheless, it is the *marginal* rather than *average* value of gamma that is likely to be more appropriate for

setting a forward-looking value consistent with the aims of the CAPM. This is because share prices are set by price setting (marginal) investors.[50]

This set of investors may have little relationship to the shareholder mix of a company at a point in time. For publicly listed Australian companies, the marginal investor is likely to be an international investor. This can be seen in light of the extent of foreign ownership of Australian companies and the relative size of the Australian market in global terms.

Foreign shareholders own over 28% of Australian companies[51], non-resident investors own around 37.5% of the value of the Australian Stock Exchange, the largest single shareholder group by far[52].

It is therefore clear that foreign investors exert substantial influence on Australian stock market prices. Indeed, once it is recognised that Australia is a net importer of capital and that Australian equities only represent approximately 1% of the global market, we draw two conclusions:

- the levels of foreign ownership in Australian equity markets are significant and that this can affect imputation assumptions since a foreign shareholder will at best experience considerable difficulty accessing imputation credits; and[53, 54]

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50 Officer RR (1994) "The Cost of Capital under an Imputation Tax System", Accounting and Finance, 34, 1-18.

51 ABS statistics, 5302.0 Balance of Payments and International Investment Position, September Quarter 2001.

52 Information provided by Australian Stock Exchange. Figures for 19 September 2001.

53 This holds irrespective of whether or not Australian residents are the first to invest in these companies – such investors are merely inframarginal but do not set equilibrium security prices. See also Officer (1988), "A note on the Cost of Capital and Investment Evaluation for Companies under the Imputation Tax", Accounting and Finance, 28, 65-71.

54 In addition, recent tax changes require an investor to hold a stock for 45-days to be eligible for the franking credits. This effectively eliminated arbitraging and dividend stripping, resulting in the end of the secondary market for the credits and eroding the value of franking credits for foreign investors. Accordingly, the only way that foreign investors

- international ownership levels are well below those assumed in fully integrated world sharemarkets.

Taken together, this suggests that an international investor, who cannot secure the benefit of imputation credits, sets the price for Australian securities. This is the case irrespective of the benefit that Australian investors can secure from imputation credits. The fact that Australians hold the bulk of securities is irrelevant here on account of the significance of international investment (all but the 1% of global investment attributed to Australia) and the impact it thereby exerts (evidenced by the material presence already in the Australian market) in price setting. These factors suggest that gamma may be as low as zero. This is consistent with a recent study by Cannavan, Finn and Gray,[55]which showed that for companies with substantial foreign ownership, the market value of tax credits is close to zero.[56]

Recently Associate Professor Martin Lally has suggested that the appropriate value for gamma should be one (1) based on his view that the model used to assess imputation credits does not accommodate market segmentation.[57] His argument begins with the proposition that the Officer model for the assessment of imputation assumes a segmented market. Therefore, he asserts that the application of an international capital asset pricing model market has been rejected. Since markets are assumed as segmented by the choice of models for estimating WACC, all analysis must be constrained to assuming that the marginal

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could secure any benefit from imputation credits would be through practices of dubious legality – to the extent that such "black market" activities exist (by their nature they are not well known) are likely to be accompanied by very high risk and transactions costs, which would seriously discount any such benefit derived.

55 Cannavan D., Finn F. and Gray S. (2001) "The Value of Dividend Imputation Tax Credits," unpublished working paper, Department of Commerce, The University of Queensland.

56 Nevertheless, it is recognised this area is not settled and that the result of dividend drop-off studies have indicated higher values for gamma. Nevertheless, more recent studies still suffer from selection bias, high standard users and create streaming effects in the data analysis that affect the results.

57 Lally, M.(2002), "The cost of capital under dividend imputation," a report prepared for the Australian Competition and Consumer Commission.

shareholder is an Australian taxpayer. We reject Associate Professor Lally's analysis on this point. Indeed, it is noted that Professor Officer (whose model Associate Professor Lally uses for his analysis) has recently supported the adoption of a gamma value of 0.50.[58]

In spite of any theories, it is an objective fact that the Australian sharemarket and the pricing of Australian securities is in an international market. The Australian markets are not segmented. Theoretical assumptions cannot sweep this fact aside.

We believe that the appropriate approach to these issues is as follows:

- to ignore foreign investors is to ignore the realities of our market environment so we accept that we operate in an integrated (i.e., not segmented) market;
- this suggests that we should use a version of the international CAPM (ICAPM). However, as current versions of the ICAPM do not provide an appropriate basis for the estimation of the cost of capital for regulatory purposes and are unlikely to do so for the foreseeable future, the Officer model is the best available proxy for the ICAPM. Our use of the Officer model does not require that we assume segmented markets;
- consistent with our assumption that we operate in integrated markets, and consistent with the facts regarding the activities of foreign investors in the price setting process in Australia, we extend our view of integrated markets to the valuation of dividend imputation credits.

We also note that in a recent forum, Professor Officer (whose model was applied by Associate Professor Martin Lally) suggested that there was no case to move away from current gamma settings at this time.[59]

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58 Conference convened by SPI PowerNet and ElectraNet 24 June 2002, Melbourne *Key WACC issues in the regulation of electricity and gas transmission - Question & Answer segments*; Panel discussion.

59 Key WACC Issues in the Regulation of Electricity and Gas, Transmission, an open forum sponsored by SPI PowerNet, ElectraNet SA and GasNet, Monday 24 June 2002.

4.3.2 Recent changes to taxation law

To the extent that Australian domestic conditions are relevant to the setting of gamma, it is possible that a gamma of one could apply on account of the ability of Australian resident shareholders to extract the full benefit of imputation credits, irrespective of their individual tax paying status.

NECG believes that it is too early to assess whether changes to capital gains tax and the full flow through of imputation credits has had any impact on the valuation of gamma for regulatory purposes. For example, there is good reason to suggest there would be little or no change to the valuation of imputation credits based upon the impact of the tax changes on the marginal (that is, foreign) investor. The tax law change will only impact gamma to the extent that the impacted investors play a part in the determination of equilibrium security prices, that is, they are marginal investors. Accordingly, to the extent that the marginal investor on the Australian market is a foreign shareholder, these recent changes will have no impact on gamma.[60]

This view is shared by the QCA who note that the taxation effects are at best uncertain:

> While the changes to capital gains tax and the changes which allow the full flow through of imputation credits to resident taxpayers may have an impact on these levels, there is currently no clear indication of their impact. Further, the influences may be offsetting as the New Tax System may tend to reduce the level of dividend distribution, but may increase the utilisation rate.[61]

4.3.3 Conclusion on gamma

There is considerable uncertainty associated with the value of gamma and that this uncertainty is unlikely to be definitively resolved in the near term. A gamma of 0.50 or

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60 It is noted for example that tax and imputation considerations are but one factor influencing valuation decisions.

61 Queensland Competition Authority, Draft Report for Consultation, Burdekin Haughton Water Supply Scheme: Assessment of Certain Pricing Matters relating to the Burdekin River Irrigation Area, September 2002, p84.

below is well established in Australian regulatory decision-making. We do not believe there is a basis for any increase in gamma above 0.50, but the case for adopting a gamma value below 0.50 is not yet definitive. Therefore, we support adoption of a gamma of 0.50.

4.4 Capital structure

A key financing issue is whether to adopt actual or target company gearing or whether a benchmark figure should be utilised.

We believe that a company has an economic incentive to structure its capital optimally, as the value of the company is affected by capital structure. Given that a wide range in gearing is consistent with a stable cost of capital, we believe that in the first instance the Regulator should assume the company's actual gearing is efficient, and that this should only be altered for pricing purposes if it can be demonstrated by the Regulator that actual gearing is not efficient. In general, we do not favour the Regulator choosing a level of debt that is contrary to that chosen by a company, so long as it falls within a reasonable range. We also do not generally favour a blanket setting of gearing for all companies in an industry as the circumstances across companies may vary sufficiently that the optimal levels of gearing also vary.

In collecting information for this Report NECG, via ORAR, requested information from WNR and WAGR on their actual and target gearing levels. The companies declined to supply such information, principally on the basis that the gearing levels should be based on observations of similar companies in the same market. ORAR has advised that it may seek such information from WNR and WAGR in future. Nonetheless, for the purpose of this exercise NECG has benchmarked gearing levels against the relevant regulatory and industry standards.

In the absence of information from the rail companies, the approach preferred by WNR must be followed.

The approach taken in rail decisions is set out in Table 2.

Table 2: Rail regulatory decisions - gearing

Date	Regulator	Business	Gearing	Approach
1999	Macquarie/Dept of Transport	WNR	50-60%	Benchmark gearing
		WAGR	60-70%	Benchmark gearing
1999	IPART	Rail Access Corporation, NSW	50-60%	Benchmark gearing
2001	QCA	Queensland Rail	55%	Actual gearing
2001	ACCC	ARTC	60%	Benchmark gearing

Based upon experience with other regulated companies with substantial infrastructure investments, we believe a gearing of 50% debt is reasonable for the rail companies. This level of gearing is within the range the regulatory decisions shown in table 2 and is broadly consistent with overseas observations. For example the average gearing of US rail companies that currently have statistically significant beta values is 43% and those of Japanese companies 64%.[62] Generally for small changes the estimation of WACC is not sensitive to the estimated gearing. If the rail companies have a different view on their gearing, they are invited to make submissions on the issue.

It is important that all other variables in the WACC are assessed on the basis of the assumed gearing chosen. This requires the cost of debt and the equity beta to be estimated on a consistent basis.

4.5 Cost of debt

The cost of debt capital is generally calculated as the risk free rate plus a margin for the risk of the debt. As we will discuss in a section below, we also believe it is necessary to recognise

[62] The US figures includes 7 major integrated or below rail operators, while the Japan estimate is based on 25 companies, including East Japan and West Japan Railway Companies.

that the company incurs transactions cost when it issues debt. There must be provision in either the WACC or the allowable costs for the recovery of these costs. Recognising the costs in WACC gives the following formula for estimating the cost of debt capital:

$$R_d = R_f + DRP + DIC$$

where the parameters are the cost of debt (R_d), the risk free rate R_f), the debt risk premium (DRP) and the debt issuance cost (DIC). We discuss each of the parameters in the following sections.

4.5.1 Debt risk premium

The cost of debt capital for a company will be related to market rates of interest on debt, the appropriate maturity of debt, the assumed capital structure and the company's credit rating. The cost of debt finance is typically set as a margin above the risk free rate.

As with gearing, the rail companies stated that they were not prepared to provide actual or prospective data on debt margins. Thus, our assessment is based upon our perception of the credit worthiness of the companies. We also consider evidence from prior regulatory decisions.

Table 3 sets out the debt risk premiums provided in regulatory decisions over the recent past.

Table 3: Debt risk premiums allowed in recent regulatory decisions (excluding transaction costs)

Date	Regulator	Business	Margin (bp)	Notes (if any)
Dec-02	ACCC	SPI Powernet	110	Firm with "A" credit rating would require margin of 110 basis points for 5-year borrowing
Dec-02	ACCC	ElectraNet	111	Based on "A" credit rating
Dec-02	ACCC	NT Gas/ABDP	154	40 day average of corporate issue rates for BBB+ debt
Nov-02	ACCC	GasNet	146	Based on corporate issue rates for (benchmark) BBB+ rating
Oct-02	ESCOSA	APT	120	No benchmark credit rating stated
Oct-02	ESC	Victorian gas distributors	165	Estimate of market cost of raising debt based on BBB+ rating
May-02	ACCC	ARTC	120	Estimate of market based cost of raising debt based on A+ rating
Nov-01	ACCC	Powerlink	120	Not stated
Nov-01	QCA	Gladstone Area Water Board (draft)	180	Estimate of market based cost of raising debt based on BBB rating
Oct-01	Offgar	Tubridgi	120	Not stated.
Oct-01	QCA	Queensland gas distribution	155	Estimate of market based cost of raising debt based on BBB+ rating
July-01	QCA	QR	120	Estimate of market based cost of raising debt based on A rating

While this is a relatively limited sample, these decisions have resulted in the following ranges being set for the debt margins (excluding any transactions costs):

- for BBB credit rating a debt premium of 180 basis points;
- for BBB+ credit rating a debt premium of 130-165 basis points; and
- for A credit rating a debt premium of 110-120 basis points.

In our opinion the regulated operations of WNR and WAGR have low credit risk and our assumed gearing level of 50% would not jeopardise that assessment. The possibility of default is low. Hence, we expect that the companies would have solid credit ratings. We judge that the companies would be able to raise debt capital with a credit rating of A.[63]

Data from CBA Spectrum[64] suggests that as of 17 March 2003, an appropriate debt margin for debt with an A credit rating is 111 basis points, based on a maturity period of 10-years, consistent with that of the risk free rate.

4.5.2 Debt issuance costs

In order to adhere to the principle of financial capital maintenance, it is necessary that regulated businesses be compensated for all transactions costs associated with the raising of debt and equity. The cost of raising debt includes a number of services such as arrangement, placement fees, dealer swap margins, credit rating, agency and legal costs.[65]

The yield on an issue of debt to the investor is based upon the full issue price, whilst the cost of debt to the issuer is based upon the lower net proceeds that are received. Therefore, the cost of debt to the issuer is higher than the yield to the investor. The issuance costs of debt are a part of the cost of debt capital.

There is increasing regulatory precedent for allowing transactions costs of debt issuance to be recovered through the WACC as shown in table 4 (although each of the rail decisions cited in table 3 did not separately consider the issue of transactions costs for debt).

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63 It is possible to estimate the credit rating that would be ascribed to WNR and WAGR based upon assumed gearing by undertaking cash flow modelling.

64 www.cbaspectrum.com

65 ACCC, Victorian transmission network revenue caps: Decision, pp21-22.

Table 4: Transactions costs of debt issuance included in WACC - regulatory decisions

Date	Regulator	Business	Margin (bp)	Notes (if any)
Dec-02	ACCC	SPI Powernet	10.5	Based on advice of Westpac that appropriate range 10.5 to 12.5. Chose 10.5 due to A credit rating.
Dec-02	ACCC	ElectraNet	10.5	As per SPI decision.
Nov-02	ACCC	GasNet	12.5	Based on advice from Westpac.
Oct-02	ESC	Victorian gas distributors	5.0	Estimate of non-margin establishment costs.

In our view, the total cost of issuing debt could exceed the amounts granted by regulators to date. However, again the companies have provided no information to assist with estimating this cost. Therefore, we recommend that a premium for the transaction costs of issuing debt be provided at the high end of previous regulatory decisions, which is 0.125%.[66]

4.5.3 Conclusion on cost of debt capital

As shown at the beginning of this section on the cost of debt capital, the appropriate equation is:

$$R_d = R_f + DRP + DIC$$

In the sections above we developed our estimates of the variables as follows:

- debt risk premium 1.11%
- debt issuance costs 0.125%

[66] It is recognised that it is theoretically correct for these costs to be recognised as cash flows rather than as an increment to the cost of capital on account of the fact that they represent transactions costs. Regulatory practice in Australia has been to include these costs in the cost of capital as it has proven to be more convenient to do so and accordingly, that is the approach that has been adopted in this paper.

Final determination of the cost of debt capital will depend upon the setting of the risk free rate.

4.6 Systematic Risk, Leverage and the Cost of Equity Capital

The systematic risk (β or beta) of a firm is the measure of how the changes in the returns to a company's stock are related to the changes in returns to the market as a whole. It is the only risk factor incorporated in the CAPM. There are three basic approaches to estimating systematic risk:

- direct estimation;
- comparable companies – this approach begins by identifying a set of comparable (listed) companies. Using share price information for the companies, their equity betas are estimated. Then additional information about the companies is used to convert the measure of systematic risk of the equity to a measure of the systematic risk of the firm as if it was an all equity firm that had no debt. Here, we will also include beta information from relevant regulatory decisions; and
- first principles - this approach requires thinking about the factors that impact on the sensitivity of a firm's returns to movements in the economy/market. The following firm characteristics should provide indications of a firm's sensitivity to unexpected changes in real gross national product (GNP):
  - operating leverage;
  - income elasticity;
  - terms of contractual arrangements; and
  - nature of regulatory regime.

Ideally all three approaches should be considered in the estimation and should reinforce each other. However, direct estimation of the betas for WNR and WAGR is not possible as they are not separately listed companies. Before going through the other two approaches, we discuss the impact of leverage on financial risk and approaches to be used to the treatment of debt betas and adjustments to equity betas.

4.6.1 Adjusting beta for the effect of leverage

The estimates of systematic risk must properly reflect the leverage of the firm. Leverage gives a higher expected return to the shareholders, but at the cost of higher risk. To utilise equity beta estimates of comparable firms in developing estimates of the equity beta for the rail companies, the differences in leverage must be taken into account. To do this an observed equity beta is converted to what is called an asset beta by removing the effect of leverage. This process is referred to as de-levering. The result is an estimate of what the beta of the firm would be if it had no debt.

After we have developed our estimate of the asset betas for the two companies, we will re-lever the asset betas using the leverage ratios for the companies to obtain an estimate of their equity betas. The equity betas will then be used in the CAPM to estimate the cost of equity.

There are a number of different approaches used for the de-levering and re-levering calculations. Perhaps the most popular approach in Australia uses what is referred to as the Monkhouse formula.

$$\beta_e = \beta_a + (\beta_a - \beta_d) * \{1 - [R_d / (1 + R_d)] * (1 - \gamma) * T \} * (D/E)$$

where

β_e = equity beta,

β_a = asset beta,

β_d = debt beta,

R_d = cost of debt capital,

T = tax rate,

γ = value of imputation credits

D = market valuation of the company's debt; and

E = market valuation of the company's equity capital.

Another common approach that incorporates the value of imputation credits is:

$$\beta_e = \beta_a (1 + (1-T(1-\gamma)) (D/E)) - \beta_d (D/V)$$

where the variables are defined as above.

Internationally, the standard formula that is used is:[67]

$$\beta_e = \beta_a (1 + (1-T) (D/E)) - \beta_d (1-T) (D/E)$$

This formula does not include consideration of the effect of dividend imputation, but has the advantage of extensive scrutiny and exposure on a worldwide basis. Also, many countries including the US do not have dividend imputation so this is the appropriate formula. The UK has a form of partial dividend imputation, but it is not accepted practice there to recognise this in computations of WACC, CAPM or de-levering.

We will use the Monkhouse formula for our de-levering calculations.

4.6.2 Debt beta

The technique of de-levering requires estimating the systematic risk of the debt of the company. This is referred to as the debt beta. There are three common approaches to estimating the debt beta.

An approach that is often used including by Australian regulators is to assume that the debt beta is zero. Generally there is little or no justification for the assumption other than that it is simple (as the debt beta does not then enter into the de-levering calculation).

A second approach is to estimate the debt beta using the structure of the CAPM:

$$\beta_d = (R_d - R_f) / (R_m - R_f)$$

This has the appeal of using a familiar relationship between a beta and the market risk premium ($R_m - R_f$). The approach attributes all of the debt risk premium ($R_d - R_f$) to systematic risk. It is well known that a substantial determinant of the cost of debt is default risk. It is unlikely that this is strongly correlated with movements in the market, so an assumption that all the debt risk premium is reward for systematic risk is unappealing.

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67 This formula was developed by T. Conine ("Corporate Debt and Corporate Taxes: An Extension," *The Journal of Finance*, September 1980, pp 1033-1037). It builds upon the work of R. Hamada ("The Effect of the Firm's Capital Structure on the Systematic Risk of Common Stocks," *The Journal of Finance*, May 1972, pp 435-452) by not requiring that debt is riskless.

A third approach is to actually consider the systematic risk component of the company's debt. To this end, it is useful to decompose the cost of debt capital again, similar to what was done in the section on the cost of debt capital.

$$R_d = R_f + R(\text{default risk}) + R(\text{systematic risk}) + R_{DIC}$$

where

R(default risk) = return for default risk,

R(systematic risk) = return for systematic risk, and

R_{DIC} = return for debt issuance costs.

In our opinion, this is the best approach, and the one we will use. The difficulty is that there is virtually no evidence available to assist in estimating either the default risk or the systematic risk component of the return to debt. However, because the return to debt is contractually fixed, the major risk relates to the risk of default. Attempts in the literature to estimate systematic risk of debt indicate that even with companies that have little apparent risk of default, the returns to the debt are virtually independent of the returns on the market index.

In our opinion, the return for systematic risk of debt will be very low although perhaps not zero. Rather than arbitrarily assume some very low value for the debt beta, we will assume that it is zero.[68] This is consistent with the approach of most regulators in Australia. In practice, the assumption is not material if a consistent approach is adopted for the debt beta in the levering and de-levering of beta values, although care must be taken when comparing asset betas estimated by reference to different debt betas.

4.6.3 Adjustment mechanisms for assessing betas

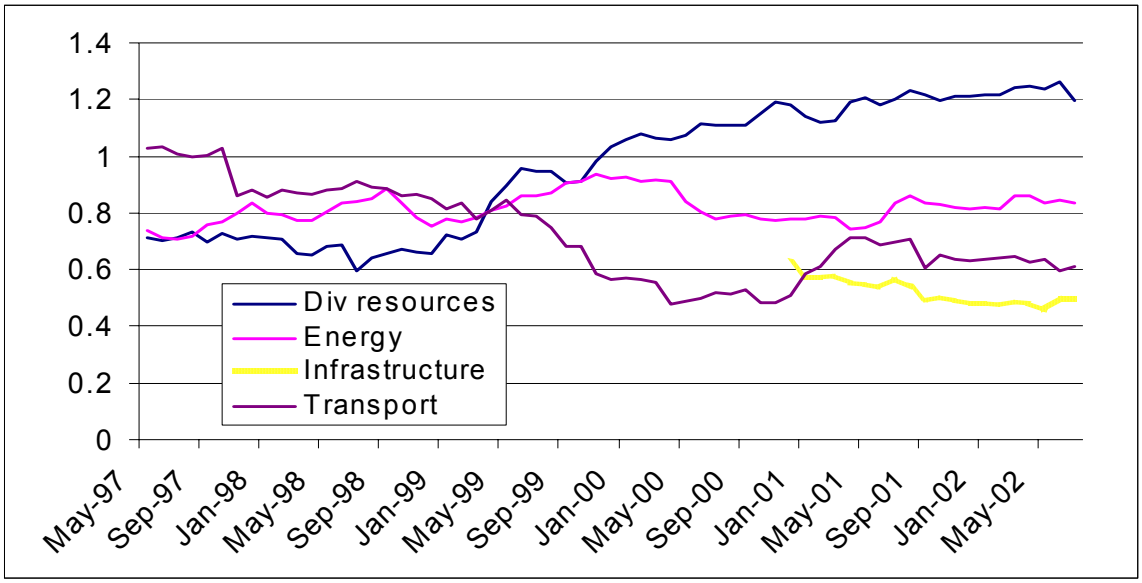
Beta estimation is not a precise process. For example, we frequently observe:

- beta measures are subject to high levels of dispersion – the average dispersion is over 0.30;

[68] The validity of this assumption may be more vulnerable for higher levels of gearing.

- volatility in beta measures – figure 3 illustrates this volatility by comparing industry average betas over time. Note that individual company betas can be expected to exhibit greater volatility than industry averages.

Figure 3 Volatility in industry average betas over time



In addition, it is a well-documented empirical result that conventional ordinary least squares estimates of beta for securities have a strong tendency to regress toward the mean of all betas of one. The seminal research in this area is attributed to Marshall Blume.[69] Betas that are estimated to be greater (less) than one in a period, tend to be lower (higher) in the subsequent period.

There are at least two explanations of why this is observed: measurement error and non-stationarity of the true betas. The tendency for measurement errors to contribute to mean reversion is clear and a standard result in statistics. A case can be made to support non-stationarity contributing to mean reversion, but it is more problematic.

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69 Blume, M., 1971, "On the Assessment of Risk," The Journal of Finance 26, 1-10 and Blume, M., 1975, "Betas and Their Regression Tendencies," The Journal of Finance 30, 785-795.

This lack of precision inherent in the measurement of beta highlights that care should be taken in estimating this parameter for the purpose of setting maximum prices. The importance of the issue is only magnified when it is noted that it is not possible for regulated businesses to hedge against this volatility or the regulatory risk involved in beta estimation. This is in contrast, to say, uncertainty in the 10-year bond rate, where regulated businesses have an opportunity to hedge their exposure to movements in that parameter.

A standard approach has developed to correct for measurement error in estimated betas. This approach makes use of a weighted average of the estimated beta and the assumed mean beta. Analytically this is:

$$\beta^{adj} = \omega * \beta^{raw} + (1-\omega) * \beta^{mean}$$

where ω is the weight given to the estimated beta (β^{raw}). It is standard practice to assume that $\beta^{mean} = 1$.

This approach has significant support in practice as several beta providers, including three of the world's most prominent and reputable purveyors of beta estimates apply a weighting for the estimation of beta valuation. The companies and their weighting factors are:

Bloomberg	$\omega = 0.67$
Merrill Lynch	$\omega = 0.65$
Value Line	$\omega = 0.67$

The effect of the adjustment is to adjust the raw beta so that the adjusted beta is closer to the market-wide mean of one. The following table shows the result of using this approach with a weighting factor of 0.67 and a mean beta of one. Accordingly, our approach involves measuring both the adjusted and unadjusted equity beta for use in the assessment of WNR's and WAGR's betas for regulatory purposes.

We now turn to a consideration of the betas for WNR and WAGR respectively. Given the absence of direct comparators for either company, we assess the systematic risk on the basis of comparable companies and first principles.

4.6.4 Listed rail network and infrastructure businesses

Table 5 sets out estimates, using Bloomberg data of the beta values of listed below-rail operators in Europe, New Zealand, the United States and the major rail companies in Japan.

The companies chosen are those listed in the above-mentioned countries that have a statistically significant beta value at the 95% confidence level.

Table 5: Equity and asset betas – below rail operators overseas

Company	Country	Raw equity beta	Adjusted equity beta	D/E ratio	Adjusted asset beta	Unadjusted asset beta
Eurotunnel	UK	0.85	0.90	4.81	0.16	0.15
Tranz Rail Holdings	NZ	0.58	0.72	0.80	0.40	0.33
Jungfraubahn	Switzerland	0.03	0.36	0.12	0.32	0.03
East Japan Railway	Japan	0.37	0.58	2.00	0.20	0.13
West Japan Railway	Japan	0.59	0.73	1.27	0.32	0.26
Florida East Coast	US	0.92	0.95	0.34	0.71	0.69
Union Pacific	US	0.81	0.88	0.34	0.66	0.61
BNSF	US	0.61	0.74	0.51	0.49	0.41
Kansas City Southern	US	0.65	0.77	0.70	0.46	0.39
Norfolk Southern	US	1.08	1.06	0.79	0.59	0.61
Rail America Inc	US	0.99	0.99	0.96	0.51	0.51
CSX Corp	US	0.91	0.94	1.07	0.46	0.45
SIMPLE AVERAGE		0.73	0.82	1.14	0.44	0.39
WORLD AVERAGE		0.61	0.74	1.52	0.30	0.24

Source: Bloomberg. World Average includes statistically significant comparators in Hong Kong, India, China and other comparators in Japan.

The average beta of this group is 0.44 (0.39 if the Bloomberg adjustment is not included). If statistically significant comparators from China, Japan, Hong Kong and India are included (30 in total), the average asset beta falls to 0.30 (0.24 without the Bloomberg adjustment).[70]

[70] Railtrack has been excluded from this sample given its delisting. Prior to its delisting it had an adjusted equity beta value of 0.74, which when combined with gearing of 50% and a debt

While there are no listed Australian rail comparators, there are listed infrastructure providers, for which current beta values are provided in table 6. The adjusted asset beta values of these companies are within a range of 0.39 to 0.47.

Table 6: Equity and asset betas – Australian infrastructure providers

Company	Raw equity beta	Adjusted equity beta	D/E ratio	Adjusted asset beta	Unadjusted asset beta
Hills Motorway	0.36	0.57	0.49	0.39	0.24
Transurban	0.69	0.79	0.76	0.45	0.39
Macquarie infrastructure group	0.39	0.59	0.27	0.47	0.31

Source: AGSM Risk Management Service December 2002 (beta), Bloomberg (debt/equity ratio)

4.6.5 WAGR

WAGR's network serves predominately passenger traffic. Apart from the regulatory assessment of ARTC's operations, there has not been any explicit assessment of the undiversifiable risk associated with this type of operation.

Beta information for the major listed British passenger operations are set out in table 7:[71]

beta of zero produced an adjusted asset beta of 0.37, broadly consistent with other comparators.

[71] There are also a number of privatised rail passenger service providers in Japan. However, the Japanese companies tend to be far more diversified than the UK companies and hence we have relied on the latter.

Table 7: Equity betas – UK rail operators

Company	Raw equity beta	Adjusted equity beta	D/E ratio	Adjusted asset beta	Unadjusted asset beta
Arriva Plc	0.43	0.62	0.48	0.42	0.29
National Express Group Plc	0.49	0.66	0.55	0.42	0.32
Stagecoach Group Plc	0.73	0.82	0.92	0.43	0.38

These comparators show an average adjusted asset beta of around 0.42. We also have considered, using Bloomberg data, the adjusted asset betas of other all transport operators throughout the world with statistically significant beta values. The average adjusted asset beta of this group was 0.37 (0.32 with no adjustment). For Japan, which has a large number of privatised rail providers , the average adjusted asset beta was 0.27.[72]

Perhaps, the most significant factor affecting WAGR's level of undiversifiable risk relates to the nature of its contractual relations with the State Government. In particular, it is understood that these arrangements substantially remove cost, price and volume risk from WAGR on account of the State Government re-imbursing WAGR for any loss it suffers in consideration of WAGR delivering the rail infrastructure services. It is also noted that WAGR officers have commented on their perceptions of a low beta being applicable to their operations. Consequently, it is thought that WAGR's asset beta would be lower than applicable providers above and a value of 0.30 has been adopted as the asset beta for the purposes of this exercise.

[72] Note, however, that these figures need to be treated with care as a number of Japanese transport operators are heavily diversified into other sectors of the economy. The most significant rail providers in Japan are East Japan and West Japan whose adjusted betas are 0.20 and 0.32 respectively (unadjusted betas being 0.13 and 0.26 respectively).

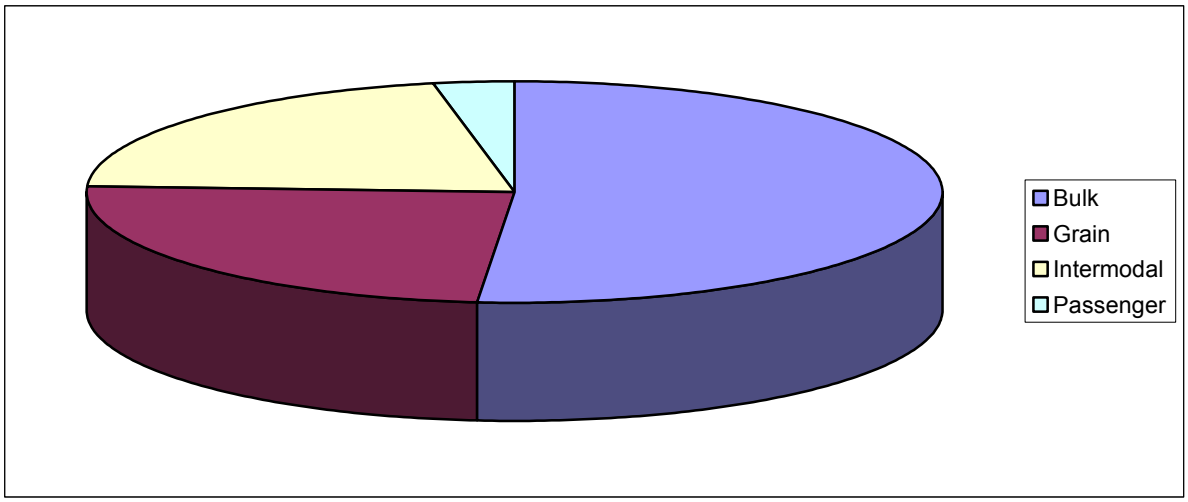
4.6.6 WNR

WNR's network serves the following traffics:[73]

- bulk which includes alumina, iron ore and other bulk;
- intermodal traffic (both intrastate and interstate);
- grain; and
- passenger.

WNR has provided a breakdown of revenue by traffic for each of these categories. Figure 4 depicts the proportionate revenue earned by each traffic class over the last two financial years.

Figure 4: WNR - Breakdown of Revenue Sources



[73] In order to preserve confidentiality about WNR's mix of traffic and revenue, we have aggregated the data into 4 broad categories.

We now turn to a consideration of the systematic risk of each business component. Since the Code contemplates a single beta estimation for the whole of WNR, we weight each estimate of asset beta for each component by the free cash flow that component of the business contributes to WNR.[74]

Bulk traffic

Unfortunately, there are few truly reflective comparable companies for the nature of the risk faced by the bulk traffics. One approach involves assessing WNR's risk by reference to the risk associated with its customers' businesses. However the efficacy of this comparison is undermined by the fact that the nature of the risk for WNR in relation to bulk traffics is such that they bear relatively low price risk (and typically volume risk).

Consequently, the risk profile associated with serving these customers is likely to materially depart from the risk profile of the customers themselves. WNR enjoys a degree of market power in the relevant markets and rail access normally constitutes a relatively small proportion of total expenditure.[75] Moreover, demand for rail access for bulk products is unlikely to be correlated with the domestic economy – for example, WNR's intermodal operations. WNR have advised that it does not have take or pay provisions in bulk products contracts.

One aspect of the regulatory arrangements that potentially affects the cost of capital is the fact that the overpayment rules can operate in a way that prevents WNR recovering its revenue limit on line sections – for example, because for a dedicated line shortfalls in the maximum revenue in one year may not be able to be made up in subsequent years (ie there is the capacity for temporary breaches of the overpayment rules, up to a 10% breach of the ceiling, to be retained and used to offset any unders within each successive 3 year period of the rules). This type of risk is asymmetric in nature (and hence does not increase beta) but nevertheless, in our view, represents a risk that warrants consideration in the regulatory

74 Although we have used revenue as a proxy for free cash flow.

75 Albeit with a relatively high operating leverage.

arrangements. However, we have not been able to quantify the impact of such a risk at this time.[76]

In addition, there have been two regulatory decisions on similar traffics in recent years – IPART's 1999 review of the Rail Access Corporation's (now Rail Infrastructure Corporation) asset beta in respect of its coal business and the QCA's review in 2001 of the systematic risk associated with QR's coal business. IPART estimated a range of 0.29 to 0.55. The QCA estimated that QR's asset beta for bulk traffic was in the order of 0.45.

It should be noted however that the QCA's approach to de-levering and re-levering asset betas differs materially from that proposed in this report. In particular, the QCA assumed that the DRP reflected the systematic risk of debt. This in turn results in relatively high asset beta being estimated. If a debt beta of 0 is assumed (as we have assumed in this report) then the value of the asset beta for the current exercise would be in the order of 0.35.

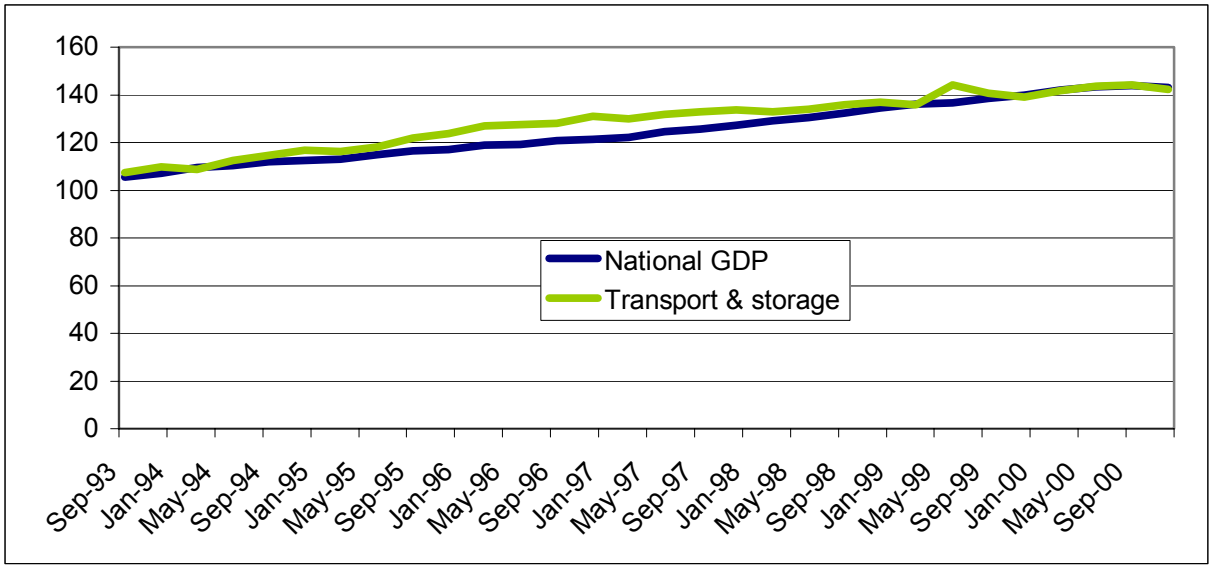
Accordingly, we estimate that the most appropriate asset beta for WNR's bulk traffic to be 0.40.

Intermodal traffic

A higher beta would be expected for intermodal traffic relative to bulk traffic as volumes for intermodal traffic are likely to highly correlated with the economy – as illustrated by figure 5 below.

[76] In section 4.7 we consider the treatment of asymmetric risk. In our view, the most appropriate approach involves making an adjustment to the cash flows to address this risk factor.

Figure 5 :Transport and Storage output and GDP (89/90=100)



Source: BTE Working Paper 40

In addition, intermodal traffics face competition from road (although perhaps more in the intrastate market than the interstate market). Whilst competitive pressures are of themselves largely diversifiable in nature, especially for a rail network provider, the impact of competition can result in a greater vulnerability to economic cycles than might otherwise be the case and mean that WNR is likely to enjoy less market power in intermodal traffic than is the case in its bulk traffic. Both of these impacts are likely to result in a higher asset beta for this activity than for bulk traffic.

This is borne out in asset betas for comparable companies. In contrast to bulk traffic, there are comparable companies from which an assessment can be made of the undiversifiable risk associated with WNR's intermodal traffics. Relevant comparators from Australia are set out in table 8 below.

Table 8: Equity betas – transport operators (debt beta = 0)

Company	Raw equity beta	Adjusted equity beta	Debt/ equity ratio	Adjusted asset beta	Unadjusted asset beta
CTI Logistics Ltd	0.21	0.47	2.34	0.14	0.06
Brambles Industries	0.66	0.77	0.49	0.52	0.44
Heggies Bulk Haul Ltd	0.39	0.59	1.48	0.24	0.16
K&S Corporation Ltd	1.13	1.09	0.78	0.61	0.64
Patrick Corporation	1.33	1.22	0.13	1.08	1.18
Qantas Airways	0.38	0.59	0.69	0.35	0.23
Toll Holdings Ltd	1.46	1.31	0.17	1.12	1.25
Wridgeway Australia	0.25	0.50	0.10	0.45	0.23
SIMPLE AVERAGE	0.73	0.82	0.77	0.56	0.52

Source: AGSM Risk Management Service, Dec 2002 (betas), Bloomberg (gearing)

This higher asset beta is also supporting in regulatory decision making precedents. ESCOSA recently adopted an asset beta of 0.55 (debt beta of 0.06) for the Alice Springs to Darwin rail line. Also, in its assessment of ARTC's undertaking, the ACCC accepted ARTC's submission of an asset beta of 0.58 for the interstate network. However, given this was based on a debt beta of 0.33, an equivalent asset beta based on a debt beta of 0 would be between 0.45 and 0.50.

Accordingly, it is proposed that an asset beta of 0.55 be adopted for this component of WNR's operations.

Grain traffic

Whislt WNR's grain traffic faces intermodal competition, it is thought it is exposed to relatively low levels of undiversifiable risk on account of the variation of output being largely diversifiable in nature (dependent upon rainfall, increased yield from improved grain etc). Accordingly, the non-diversifiable risk profile of the grain traffic is in our view more closely aligned with bulk traffic than intermodal traffic.

This is to some extent corroborated by the listed comparators on the ASX. The only grain related company with a statistically significant beta estimate is Graincorp - whose adjusted and unadjusted asset betas are 0.44 and 0.32 respectively.[77]

Accordingly, we estimate that the most appropriate asset beta for WNR's grain traffic to be 0.45.

Passenger traffic

WNR's exposure to passenger traffic is thought predominantly to relate to the country passenger and tourist markets.

The tourist market is considered to experience higher income elasticity than would be the case for, say, WNR's country passenger traffic, on account of the latter being driven at least in part by passenger movements that are subsidised by the State Government. That having been said, even in relation to WNR's tourist related traffic, it is unlikely that WNR, as an infrastructure provider, would be fully exposed to fluctuations in passenger numbers on account of the nature of the charging structure. WNR's risk is more likely to be related to the termination of services. In light of the higher income elasticity of the tourist market, for the purposes of this review, we have assessed the asset beta for this type of activity for WNR at 0.45. This asset beta estimate is materially higher than that applied to WAGR on account of the absence of contractual relations and the intrinsically higher systematic risk of WNR's passenger traffic, which is based on tourism rather than urban passenger movements.

WNR Asset beta

Based on the assessment of asset betas for each significant component of WNR's operations, we have assessed its asset beta at 0.45. This is derived from a single average of each asset beta weighted by the revenue earned by that component of the business.

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77 AWB and ABB Grain did not have statistically significant betas. The beta estimates for Graincorp are slightly higher than a global survey of statistically significant agricultural betas.

4.6.7 Conclusion on asset betas and equity betas

Considering the comparable company and first principles analysis above, we believe it indicates asset betas for the companies as follows:

WNR	0.45
WAGR	0.30.

We now convert the asset betas to equity betas using the Monkhouse equation. In our opinion the appropriate point estimates of the forward-looking equity betas for companies are:

WNR	0.90
WAGR	0.60

4.7 Asymmetric risk

Regulated companies are exposed to a range of risks where the possible outcomes in one direction are different than the possible outcomes in the opposite direction. These include:

- assets becoming stranded as customers change consumption patterns and competitors change strategies. Arguably, WNR is particularly exposed since a relatively high proportion of its revenues are derived from a relatively small number of customers;
- the inability to earn revenue equal to the ceiling for a route section for particular years; and
- when extreme events occur, the regulated firm may bear the costs when they are negative but not be allowed to commensurately benefit when the gains are positive.[78]

[78] It is recognised that the regulatory arrangements including the overpayment rules partly address this issue – for example, the monies from temporary breaches of the ceiling (up to 10%) can be applied to subsequent unders for each successive 3 year period of the rules.

These risks can have a number of characteristics that differentiate them from other risks faced by the company:

- the risks are unavoidable and asymmetrical, i.e., they are inherent to the business and the possible negative outcomes are significantly larger than the possible positive outcomes. Therefore they are risks that cannot be diversified away by the company. There are no investment opportunities that the company could make that would have opposing risk profiles, where an unfavourable development in one area of its business was matched by a favourable development in another area of its business;
- insurance against these risks is not commercially available to the company;
- these are risks that cannot be diversified away by investors in the company. The reason that they cannot be effectively diversified away is that the counter-parties to the risks are not public companies in which investors can invest. The principal economic counter-parties in each of the cases are consumers. Ultimately it is consumers that will benefit from lower charges for the service; and
- these risks are not accommodated in the CAPM.[79]

Since it has no alternative but to bear the risk of losses, there is an issue as to whether the regulated firm should be permitted a return that explicitly includes the actuarially-fair premium for insuring against this risk. The second point above, that insurance is not available to cover these risks, is an important point. It also provides an intuitive explanation of why this risk needs to be recognised and how regulators should handle it. If insurance was available, the company could take out insurance coverage. Of course, if it did so, the expense of the insurance could be recognised in the cost base.

Since insurance coverage is not available, the company is forced to self-insure. Companies could still deal with the issue if they were allowed to use accrual accounting for the self-insurance in determining their costs. They would record an expense for the actuarially-fair self-insurance premium. Again, if this accounting were permitted by accounting rules, it would be an expense that regulators should accept as a legitimate part of doing business and as being recoverable through revenue. Unfortunately, accounting practice in Australia does

[79] The CAPM is based upon returns being normally distributed.

not allow the accrual of costs related to self-insurance. Accounting practice requires that self-insurance is accounted on a cash basis as the adverse events occur.

There are two questions that need to be answered. It is clear that these asymmetric risks exist in at least some circumstances. Therefore, the first question is to establish whether WNR or WAGR face asymmetric risks. It is just as clear that when they exist, they should be recognised in the regulatory process. Therefore, the second question is, how should the risk be reflected in the regulatory process?

The rail companies face at least some asymmetric risks that meet all of the tests set out above. To appropriately deal with the asymmetric risks faced by the companies, the magnitude of the exposure needs to be determined. This is a substantial task that we do not attempt in this report.

The second question is, how should the risk be reflected in the regulatory process? There are three approaches to consider:

- the risk can be reflected as an actuarially-fair insurance premium and that amount imputed to the costs of the company;
- the risk can be reflected in the WACC so that the result is equivalent to recovering the actuarially-fair insurance premium; or
- the risk can be handled as in accounting - when the adverse event occurs, the cost is recoverable through prices.

The third approach has a major drawback – there remains the risk that the regulated business is unable to fully recover the costs when the adverse event actually does occur. This risk arises, for example, because a regulator is not able to bind its successors. In addition, the approach has a significant drawback because of the lumpiness that would result in prices. In general everyone involved, companies, consumers and regulators, prefer smoothed and predictable prices.

Regulators in Australia have recognised that asymmetric risks are a valid issue that must be incorporated into the regulatory process. However, the procedure used to reflect the economic impact of asymmetric risk is still evolving. Generally, we consider the first option properly reflects the issue as an insurance problem and is in our view the most appropriate approach to be taken, although it is recognised that the second approach provides a viable practical alternative.

4.8 Tax

The final issue to consider is the treatment of tax expense. We have in this report advocated the post tax nominal approach to the recognition of tax liabilities. One disadvantage of this approach is that it removes any incentive for the regulated business to pursue innovative tax planning approaches that minimise or defer the incidence of tax liabilities.

An option to address this concern is to recognise innovative tax approaches by allowing the regulated business to secure a defined portion of the benefit that it secures from doing so. This benefit could be defined in terms of a relatively high proportion of the savings the regulated business secures above a benchmark (perhaps in turn defined by the statutory rate less any benefit from accelerated depreciation).

In essence, this approach is little different to the benefit sharing that arises under the CPI-x mechanism – although we consider that a higher rate of retention of the benefit for the regulated business is appropriate than normally allowed, especially if the regulated business is to take the risk of subsequent adverse tax rulings.

5 Conclusions - calculation of WACC

Using the information in this report on the individual WACC parameters we are almost able to calculate the "vanilla" WACC for WNR and WAGR. One last parameter must be estimated, to complete the calculations – the risk free rate.

We discussed how this parameter should be estimated in an earlier section. There we chose to use the ten-year government bond yield and the rate on the day. The risk free rate should be estimated as of the beginning of the regulatory period, in this case 1 July 2003. The Regulator will make the final determination of the rate.

To facilitate an evaluation of the procedures and parameter values that we have recommended, we will use the rate as of the close of business on 17 March 2003 as the estimate of the risk free rate. This rate is 5.25%. Because we are using this rate rather than the rate that will actually be used in setting WACC, the risk free rate, the cost of debt capital, the cost of equity capital and the WACC in the table below are preliminary.

Table 9 summarises our parameter estimates, which result in a nominal, post-tax "vanilla" WACC for WNR of 9.00% and for WAGR of 7.96%.

Table 9: WACC rates

WACC/CAPM parameters	WNR	WAGR
Risk free rate	5.25%	5.25%
Debt proportion	50%	50%
Equity proportion	50%	50%
Debt risk premium	1.11%	1.11%
Debt issuance costs	0.125%	0.125%
Cost of debt	6.485%	6.485%
Market-risk premium	7%	7%
Asset beta	0.45	0.30
Debt beta	Nil	Nil
Tax rate	30%	30%
Franking credits – gamma	50%	50%
Equity beta	0.90	0.60
Indexed bond rate	3.185	3.185
Inflation	2.00	2.00
Nominal post-tax cost of equity	11.52%	9.43%[80]
Nominal post-tax "vanilla" WACC	9.00%	7.96%
Equivalent nominal pre-tax WACC	10.02%	8.79%
Equivalent pre-tax real WACC	7.86%	6.66%

[80] Note that in making these and subsequent calculations, earlier WACC parameter values have not been rounded.