REPORT TO QUEENSLAND RESOURCES COUNCIL

REVIEW OF AURIZON NETWORK'S DRAFT ACCESS UNDERTAKING

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October 5, 2013.

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Preamble

In relation to the QCA's review of Aurizon Network's draft access undertaking for the forthcoming period (referred to as UT4), we have been asked by the Queensland Resources Council to provide a written report that addresses the following issues:

1. Please comment on Aurizon Network's proposed approach of adopting the upper bound of a range of estimates for each WACC parameter. Do you consider this approach to be economically sound, having regard to reasons given by Aurizon Network for adopting this approach?

2. Do you consider Aurizon Network's proposed value for the market risk premium (MRP) of 7% to be reasonable, having regard to the relevant empirical evidence on this parameter?

3. Do you consider Aurizon Network's proposed value for the equity beta of 1.0 to be reasonable, having regard to the relevant empirical evidence and Aurizon Network's risk profile?

4. Do you consider Aurizon Network's proposed value for gamma of 0.25 to be reasonable, having regard to the relevant empirical evidence on this parameter?

In the report that follows reference to Aurizon means Aurizon Networks.

In answering these questions, we have engaged with the relevant academic literature and other research as well as the following key documents:

- Aurizon (2013) *Draft Access Undertaking, Volume 3: Maximum Allowable Revenue and Reference Tariffs*, April.
- Aurizon (2013b) *Analyst Briefing – Aurizon Network's UT4 Submission*, April 2013.
- Bishop and Officer (2013) *Review of Debt Risk Premium and Market Risk Premium February*, Value Advisor Associates.
- SFG Consulting (2013) *Testing the reasonableness of the regulatory allowance for the return on equity*, *Report for Aurizon Network*, 11 March.
- SFG Consulting (2012) *Systematic risk of QR Network*, 31 August.
- SFG Consulting (2012b) *Estimating gamma, Report for QR National*, 25 January
- Synergies Economic Consulting (2013) *Aurizon Network's Commercial and Regulatory Risks, Report for Aurizon Network*, April

Executive Summary

The general thrust of Aurizon's submission is that applying the cost of capital approach that applied under the previous regulatory regime (UT3) to the next regulatory period will result in a cost of capital estimate that is too low. Consequently, Aurizon argues for changes in the inputs to the cost of capital calculation. In particular, Aurizon argues that where there is a possible range in the input parameters then the values in the high end of the range should be used. We review the arguments they present and find no merit in the proposal to use high end parameters. By definition the use of high end parameters for the WACC will result in a WACC that is upwardly biased.

In evaluating Aurizon's approach, we note that is the standard CAPM model that most regulators and corporates choose when estimating the cost of capital. This choice necessarily implies that the risk to be compensated under WACC is the systematic component of total risk as measured by beta. A closer examination of the theoretical determinants of beta, leads us to the conclusion that Aurizon most likely has an equity beta of less than one. The empirical evidence on beta for Aurizon depends heavily on the peer group chosen and we find that US railroads are not a good peer group. They have considerably higher betas than other railways around the world (including SFG's (2012) estimate for Australia). Further, SFGs (2012) choice to use a range of models to broaden the sample of beta estimates opens a veritable Pandora's Box as to what model should be used. Thus, we see no support for any increase in beta. In contrast Aurizon's proposal is for an equity beta of one, which would be an increase on the value set for the previous undertaking period. In our opinion the evidence does not support Aurizon's proposal.

The CAPM requires information on the MRP. Surveying the evidence from a range of sources leads us to conclude that, even if conditions did exist during the GFC to justify changing the MRP, these conditions have substantially abated and it is reasonable to believe that the long term MRP of 6% prevails once more. We also find no real support for the argument of an inverse relation between the risk free rate and the MRP. The argument for a 7% MRP does not even seem to be supported by the historical data presented by Aurizon's consultants, Bishop and Officer (2013). Consequently we find no merit in Aurizon's argument for an increase in the MRP.

Aurizon also argue for a reduction in the value of gamma. We note that the estimation of gamma is extremely difficult and we review the evidence available. On the basis of this review our conclusion is that the QCA should not reduce gamma to 0.25. Indeed, the evidence is not so compelling as to even suggest the QCA depart from its prior value of 0.5.

1. Aurizon's Overall Approach to the Rate of Return.

In assessing Aurizon's overall approach to the rate of return, we first discuss some fundamental principles of rate of return measurement. We also discuss some of the models used to estimate the required rate of return, particularly the CAPM and its risk parameter beta. This discussion will reveal some important lessons that bear directly on Aurizon's submission and the accompanying consultant's reports.

The expected return on capital is determined by the risk of the assets that constitute the investment. This risk is typically unobservable and the commonly adopted solution is to look to the cost and risk of the portfolio of securities that has been used to finance the portfolio of assets. This is an important point and it should be remembered that in estimating the WACC, the objective is *not* to determine the firm's financing costs, but rather to determine what rate of return investors would require if the assets were directly traded in the capital market. One implication of this is that the transactions costs of the firm's financing should not be accounted for in the WACC.

Assuming only two sources of finance, debt and equity, the expected return on the investment can be written as:

$$WACC_{\text{vanilla}} = w_e \times r_e + w_d \times r_d$$

This is the 'plain vanilla' WACC (Weighted Average Cost of Capital), where:

w_e = the market value weight for equity,

r_e = the current market required return on equity,

w_d = the market value weight for debt,

r_d = the current market required return on equity,

Both the cost of debt and the cost of equity should be measured as *expected equilibrium* (required) returns. However as a matter of practical convenience the cost of debt is typically measured as the promised yield to maturity on the debt. This results in an overstatement of the cost of debt. This overstatement is small when default risk is low, however, when default risk is substantial the overstatement can be significant. One consequence is that comparisons between the cost of equity and the cost of debt may not reveal the true difference in expected returns.[1] As Cooper and Davydenko (2007, p.90) observe:

[1] Bishop and Officer (2013) expend some effort in constructing arguements to dismiss this point, but their analysis either implies an implausibly high risk premium or an implausibly high beta. For example, see paragraph 136 of their report.

"In extreme cases, the use of the promised yield as the cost of debt could even result in the estimated cost of debt exceeding the cost of equity."

An important point is that if we take the credit spread and assume it is composed of systematic (beta) risk and default risk, then for a given credit spread there is a trade-off between the two sources of risk. Increasing the systematic risk component will lead to a narrowing of the spread between debt and equity. On the other hand, if the default risk component of the credit spread is substantial, then making inferences about the cost of equity from the credit spread is problematic.

Historically, the Dividend Growth Model (DGM) was used to estimate the expected return on equity, in particular in the USA where it is still used for regulatory purposes. These days, however, the CAPM is the most commonly used a model for estimating the cost of equity. For example, Table 1, provides a survey of models used by regulators to estimate the cost of equity for six countries and the CAPM is used in five of these countries. While different versions of the CAPM exist, it is the standard model (the Sharpe, Lintner, Black or SLB model) that reigns supreme for both regulators and corporates when estimating the cost of capital.

Table 1
Models used by Regulators to Estimate the Cost of Equity

	Australia	**Germany**	**New Zealand**	**USA**	**Canada**	**UK**
Regulator	AER	FNA	CC	NYSPUC	OEB	Ofgem
Primary model	CAPM	CAPM/RPM	CAPM	DDM	RPM	CAPM
Secondary model				CAPM		
Other use of DDM	Cross-check on MRP		Cross-check on MRP		Cross-check on MRP	Cross-check*

Source: Sudarsanam, Kaltenbronn and Park (2011)
*Notes: * - on the overall cost of equity but not for individual firms, RPM = Risk Premium Model, DDM = Dividend Discount Model.*

Attempts have been made to use other models, such as the arbitrage pricing theory, when estimating the cost of capital for regulated utilities, but they have not caught on. There have been a few attempts, to use the Fama and French (F&F) model to estimate the cost of capital for utilities (for US evidence see Schink and Bower, 1994, and Chetrien and Coggins, 2008, and in the UK see Europe Economics, 2007 and 2009). The F&F model has not proven to be particularly useful however, particularly where the factor premiums frequently change sign and are often not significantly different from zero. Europe Economics (2007, p.47) conclude:

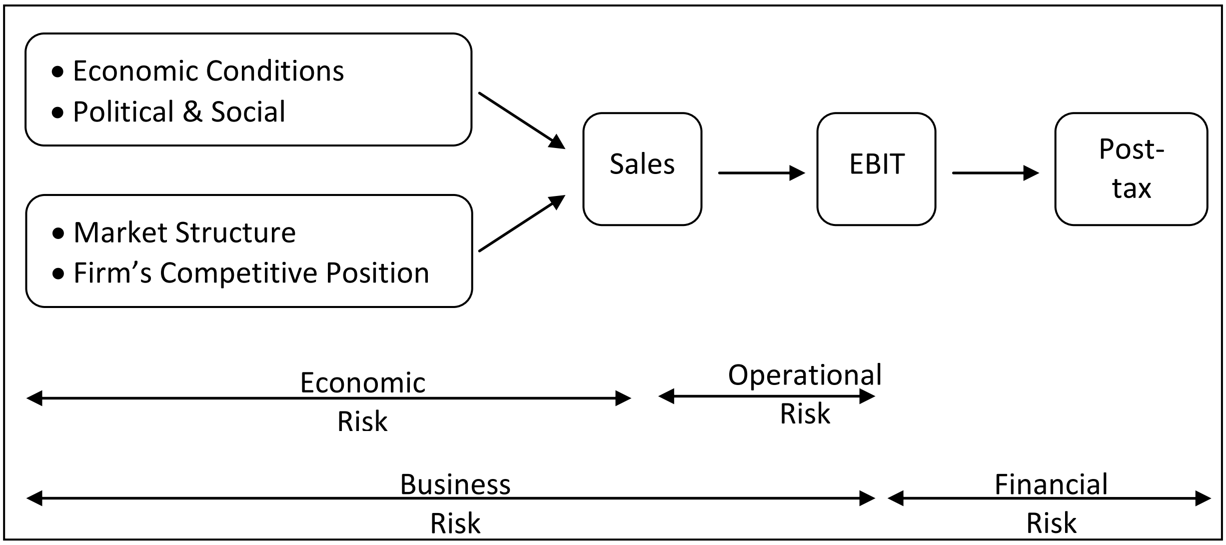
"The results of the investigation are not encouraging for the use of the Fama and French model in regulatory price review setting."

The use of the CAPM when estimating the WACC means that the risk to be compensated is the non-diversifiable, or systematic, component of total risk (in simple terms, that risk which cannot be eliminated by holding assets in a well diversified portfolio). This risk is measured by beta, which reflects the covariance of returns on the asset with returns on the market for capital assets. Since it is not necessary to be exposed to risks that can be diversified away, investors are not rewarded for bearing such risk. So the equilibrium expected return depends only on the systematic (undiversifiable) risk. Of course the idiosyncratic (diversifiable) risks may affect firm value by changing investors' expectations of future cash flows from the firm, but they do not affect the investors required returns. For example, regulatory risk is generally not systematic and so does not form part of the investors' required returns, but can lead to reductions in their estimate of expected cash flows and may affect their assessment of the credit risk of debt.

To understand beta, it is useful to think conceptually about the systematic risk of the firm and its three main components – economic, operational and financial risk. Figure 1 shows the relationship between each of these different aspects of systematic risk and their relationship to the firm.

Figure 1

Dimensions of Systematic Risk



Source: Adapted from Hawawini and Viallet (1999)

The economic (or intrinsic) risk factors collectively determine how the business cycle impacts on the firm. The sales of some firm's will be highly sensitive to the business cycle – growing through the expansionary phase and contracting through the recessionary phase. For other firms however, their sales will hardly vary through the business cycle. The implication is that firm's whose earnings are more sensitive to the business cycle will have higher systematic risk. This effect can be captured by a revenue beta. Given that Aurizon has considerable revenue protection in the form of its regulated monopolistic position, take or pay contracts, a revenue cap with price adjustment to accommodate changes in volume, annual adjustments to system allowable revenue and the possibility of a mid-period tariff review, (see Figure 2) it seems very likely that the revenue beta is low.

Figure 2

Revenue Protection under UT3

TAKE OR PAY (CONTRACTUAL)	▪ Calculated first and allows Network to recover revenue shortfalls directly from the access holder ▪ These agreements result in a charge levied on Aurizon or Pacific National by Aurizon Network, if either customer does not rail a minimum volume of coal
REVENUE CAP (REGULATORY)	▪ In the event that take or pay mechanisms do not recover a revenue shortfall, the remaining shortfall is recovered two years later through a CPI adjusted tariff ▪ In the event that revenue collected exceeds the MAR, the revenue cap mechanism will return the surplus revenue two years later through an adjusted tariff
SYSTEM ALLOWABLE REVENUE (SAR)	▪ Annual adjustments made to System Allowable Revenue (SAR) for: – Revenue cap adjustments; – Updated volumes; – Maintenance difference between actual and forecast maintenance cost index; – Opex difference between actual and forecast CPI; and – EC costs and electricity network charges.
TARIFFS REVIEWED MID-PERIOD	▪ Tariffs reviewed mid-period in specific (limited) circumstances, e.g.: ▪ Change in law or taxes; ▪ Material change (>2.5%) in approved and efficient maintenance costs; and ▪ Material force majeure costs (>$1m).

Source: Extracted from Aurizon (2013b)

The operational risk of the company is reflected in the firm's operating leverage, ie. the firm's proportion of fixed to variable costs.[2] Recall that variable costs directly scale in proportion to sales, while fixed costs do not. Thus, as the firm's sales vary during the business cycle, their variable costs will also vary. Their fixed costs however, do not vary and must continue to be met. Therefore, the higher are the firm's fixed costs, the higher will be the variability of the firm's earnings for a given change in sales. Thus, operating leverage intensifies the effect of the business cycle on a company's earnings and this higher risk translates into a relatively higher asset beta. Note that in many references, the economic and the operational risk of the firm are frequently referred to as the business risk of the firm.

Business risk is captured in the firm's asset beta, which is in turn determined by the combination of the revenue beta and the operating leverage. It would reasonably be expected that Aurizon would have high operating leverage. However, the effect of high operating leverage can be offset by a low revenue beta, as reflected in the report by Deloitte (2013, p.22):

> "Typically investments with a relatively high fixed cost base will be more exposed to economic cycles and therefore have higher systematic risk

[2] Strictly speaking in a CAPM framework it is the ratio of the present value of fixed costs to the present value of variable costs.

> compared to those with a more variable cost base. However, in the case of regulated businesses with strong take or pay contracts and/or revenue caps these risks are often mitigated."

The financial risk of a company relates to the indebtedness (leverage) of the firm. The interest charge on debt is another form of fixed cost and just as the fixed costs of operations cause EBIT to vary with changes in sales, so too the fixed financing costs created by debt cause profit after interest and tax to vary with changes in EBIT.

Each of these three different components - economic, operational and financial risk - come together to form the systematic risk for the firm's equity. Although a theoretical trade off exists between (operational and financial) leverage and the revenue beta, in practical terms, the empirical evidence suggests that it is the asset risk of the firm which is the primary driver of its systematic risk.[3] Consistent with this, the SFG (2012) submission on systematic risk reports that there is a negative correlation between equity betas and the level of financial leverage. At first sight this is a surprising result, since other things equal higher financial leverage implies higher, not lower, equity betas. However this result makes perfect sense if given that firms with low beta assets can safely support more leverage (operating and financial). Thus, firms with low asset betas use more financial leverage, but not enough to fully offset the effect of the low asset beta. Consequently, low asset beta firms have more leverage, but at the same time they still have low equity betas.

The foregoing discussion of CAPM and beta as a measure of systematic risk provides us with the initial context to comment on Aurizon's overall approach to the rate of return. Following that discussion we will consider some issues in relation to the individual components of the WACC. Before proceeding, however, we make the following observation: On the basis of the foregoing discussion it does not seem probable that Aurizon would have an equity beta of one, which is an equity risk comparable to the average share on the ASX. It seems much more probable that Aurizon would have an equity beta less than one.

We also note the following comment by CEPA (2013, p46) in their analysis of the cost of capital for UK railways:

> "Analysis of MARs suggests that the traded values of utility companies have generally exceeded their RABs by 10-30% since 2004 (see Figure A1.0.1 below). This is a strong indication of outperformance against the allowed WACC, as it is highly unlikely as outperformance on incentives and cost would contribute any more than 10% of premium. The Chairman of Ofwat supported this position in a March 2013 lecture, stating that:

[3] Indeed, the implication is that business risk fundamentally drives both the equity beta and the debt beta.

> *— The continuing trend for water companies to be sold for prices around 130% of RAV only suggests that the regulator's adopted cost of capital is too high and the premia reflect excess demand for these assets. —*
>
> The MAR analysis clearly shows the continuing appetite for regulated assets, which are perceived by many investors to have bond-like characteristics and may be evidence that the cost of capital allowed by regulators has been sufficiently generous for regulatory determinations."

Of course the results for the UK may not apply in Australia. However, this quote does suggest that regulators should exercise caution in accepting arguments that regulatory returns are going to be too low. A compelling standard of evidence should be demanded before accepting such arguments.

Commercial and Regulatory Risks

We begin by stating that we agree with Aurizon (2013, p. 104) that**:**

> "… the question of whether or not the return is seen as commensurate (or 'at least' commensurate) with the relevant risks can only be answered by investors …."

Indeed, this is the perspective taken when constructing the WACC using the CAPM. For example, in estimating the cost of equity capital, it is the equilibrium expected market risk premium that is required. It is this equilibrium expected risk premium that makes the *marginal investor* indifferent between investing in average risk stocks and the risk free asset. Suffice to say that when estimating the cost of debt and equity, the goal is to estimate the required rate of return that investors will demand to invest in a company's assets.

Section 7.2.3 of the Aurizon report discusses a number of reasons why the Aurizon network is exposed to greater commercial and regulatory risks than businesses operating in similar regulatory regimes. The key differences between Aurizons regulatory regime and other comparative regimes are listed as (Aurizon, 2013, p. 107-8):

- The ACCC has not imposed an X factor on the Australian Rail Track Corporation (ARTC).
- Aurizon Network is the only business that bears inflation risk on its revenues during the course of the regulatory period
- The reviews by the QCA and AER are more detailed (and intrusive) than the other regimes.

- Aurizon Network's capital expenditure is subject to a detailed ex post review by the QCA
- Aurizon Network and ARTC are both in the process of developing service quality incentive regimes.
- Aurizon Network is exposed to a maximum 10% loss in annual revenue for failing to make the network available due to its own breach or negligence.
- Aurizon Network is the only service provider that has a commitment to fund investment (under the 2010 Undertaking).
- TPI's WACC is reviewed annually for changes in the risk-free rate, inflation and debt margin.
- Aurizon Network is exposed to the risk of optimisation for a material reduction in demand, the possibility of actual bypass and a deterioration in asset condition.

The Aurizon report is correct in commenting that the WACC discount rate does not incorporate the non-systematic risks included in this list. Priced risks are those that validly enter the determination of the discount rate. Some risks are not priced because they can be diversified away, but they do affect value through the expected cash flow. For example, there may be some risk of an idiosyncratic event, such as a change in the regulations governing an industry, which will create substantial costs that reduce the expected cash flows to the assets. The correct approach is to account for such events in the expected cash flow. If the probabilities of these scenarios occurring cannot readily be measured, as Aurizon suggests, and it is not worth the effort to try to assess the probability of these risks, then it is our view that they likely have a low probability weighting at the margin.

In any event, it is no solution to difficulties of measurement to arbitrarily increase the discount rate. As a general rule, it is a bad practice to add adjustment factors to discount rates. Such discount rate adjustments add an extra risk premium to allow for 'risks' that have not been accounted for when estimating the expected cash flow. In other words, the expected cash flow is not really the expected cash flow, as it is upwardly biased, and increasing the discount rate attempts to compensate for this.

One reason that adding these types of fudge factors to discount rates is bad practice is because it drives a wedge between the theoretically correct discount rate and the discount rate actually used. It is also likely to lead to error - a discount rate adjustment will be non-linear in its effect, because adjustments to the discount rate compound through time. Thus, any errors in the original adjustment increase exponentially. Furthermore, the correct cash flow adjustments may well be linear in nature and possibly declining, rather than increasing, through time, or they may be once-off cash flow effects. For these reasons any adjustment to the discount rate should be checked by working out the equivalent cash flow adjustment at each date.

The advantage of adjusting the cash flow is that it makes the adjustment clearly visible and hence transparent. It is also more amenable to auditing ex-post (it can be difficult to audit individual components of the cash flow, so it may only be feasible to audit some of the adjustments). Further, it is feasible to compare the forecast of the overall expected cash flow with that actually obtained. Of course, if there are efficiency gains the actual cash flow will somewhat exceed the forecast.

The Aurizon paper makes reference to an asymmetric risk in the form of stranding risk. The report identifies a number of different sources of stranding risk, including a material and sustained reduction in demand. Aurizon argues that this particular source of stranding risk can have a systematic component and, in our view, this is likely to be the case. However, this does not require any adjustments. Recall from our previous discussion that beta measures how the business cycle impacts on the firm and this will include such factors as stranding risk in the event that it is related to the state of the economy.

Aurizon (2013, p. 110) refers to a discussion by Ergas et al (2001), stating that:

> "… regulatory risk is arguably also not diversifiable because no other firms will clearly gain when the regulated firm loses."

This comment misses the point of what diversification achieves. The principle of diversification does not rest on the presumption that the losses on one asset give rise to gains on another. Rather, the principle of diversification only requires that assets are imperfectly correlated. Thus, asset values might all be positively correlated (that is they all *tend* to go up and down together), but as long as they do not move *exactly* in lock step (their correlations are less than one), then there will be gains from diversification.[4] The effect of the correlation between assets is measured by their covariance. It is well understood that in a large portfolio it is the covariance between assets, not their variance, that determines the risk of the portfolio. With a sufficient number of assets in the portfolio, an idiosyncratic price change for any one asset has no substantive impact on the overall portfolio performance.

To make the point another way, imagine that you hold all the shares listed on the ASX. Also imagine that the weights on each share in your portfolio are the proportions that each share represents of the total market value. With such a portfolio, the only risk you are exposed to is that the market moves up or down. Thus, you are only exposed to market risk. What matters is the market risk each share contributes to the portfolio (measured by beta), as their other risks have been diversified away.

[4] The lower the correlation between the assets, the greater the benefits of this diversification are for a portfolio of a given size.

Error and Building an Upward Bias into the WACC

Aurizon (2013, p. 114) states:

> "To the extent that none of the alternatives are clearly superior (including the CAPM) and each approach has its strengths and weaknesses, a sensible alternative to reduce the risk of error would be to reference more than one model in estimating the WACC."

We fundamentally agree with this comment and believe that it is important to recognise that the estimation of the WACC is prone to both model and estimation error. Furthermore, most authors do not provide a single estimate, but rather a range of several alternative estimates, so there are plenty of MRP values to choose from. The same is true of beta as evidenced by the SFG report (2012). Given the standard errors typical in such estimates, it is doubtful if we could conclude that many, or possibly any, of them are significantly different.

It is precisely for this reason that we argue in favour of triangulation across a range of sources. For example, many overseas regulators use different models for the purposes of cross-checking and validating their model estimates (see Table 1). See also our discussion on the estimation of the MRP below.

Where we disagree with Aurizon however, is in their insistence that estimates of the expected rate of return at the upper end of the range should be chosen. This logic suggests that Aurizon believe there to be some form of systematic downward bias in the parameters used to estimate the cost of capital and we know of no reason to believe this is the case. If anything, the historic average MRP estimates may tend to be upwardly biased because of the well known effect of survivorship bias and also because of the effect of unanticipated inflation (see Siegel, 1999, and Gregory, 2011).[5]

We note that Accepting Aurizon's arguments and upwardly biasing the cost of capital parameters in order to give an incentive to the regulated entity to invest more and provide "headroom" gives rise to monopoly rents. Furthermore, it is not unambiguously clear that stimulating more investment by regulated monopolists is always socially desirable. For example, the current complaint about regulated electricity utilities is excessive investment, the "gold-plating" of the networks and the extra costs imposed on consumers as a consequence.

Another argument advanced in the submissions in favour of an upward bias in the allowed WACC is that the changing market conditions may lead to a changed WACC over the regulatory period. It is true that the WACC may change, but it could go down as well as up. There is merit in the argument that the required return on new investment should be revised to reflect changes in the required return that arise at the time the investment is

[5] When there is subsequently unanticipated inflation, a comparison of bond yields with equity returns that have some protection from inflation is likely to overstate the MRP.

undertaken. However, there is no merit in the argument that such changes should apply to the whole of the regulated asset base. Indeed, this is quite wrong from an economic perspective.

Current regulatory arrangements already provide substantial protection against increases in the WACC and this may not be well recognised. In the regulatory scheme of things, the WACC applies to the regulated asset base, which is essentially a book value. In financial markets, the WACC applies to the market value of the assets. The nature of the relationship between the WACC and the market value of the assets is that if the WACC goes up, then the market value of the assets goes down. So, the required higher WACC is then to be earned on a reduced market value for the asset. In the regulatory regime, as we understand it, there is no reduction in the regulated asset base as a consequence of an increase in the WACC. So in the event of a WACC increase, the regulatory WACC is understated, but the regulatory value of the assets on which the WACC is to be earned is an overstatement of their market value. These two effects will tend to offset each other in determining the magnitude of the cash flow required to service the investment.[6]

Financial Market Environment

Current financial market conditions

There is also considerable discussion in the Aurizon submission and their consultants' reports about matching the period over which the MRP is measured with the period over which the risk free risk free rate is measured. They argue that this will be achieved by taking a long term average for the risk free rate. For example, in section 7.3.3.2, Aurizon (2013) argue in favour of using a long term average of the risk free rate to address the issue of the low current levels of the risk free rate. However the averaging period that they suggest, 10 or 17 years, is very much shorter than the hundred years or so usually used to estimate the average MRP. As will become apparent, given the discussion below, a long term average risk free rate extending beyond recent decades is more in keeping with current rates than the rates observed in recent history. In the light of the long term history of interest rates, it is not current rates that are abnormally low, but rather the rates in recent history that have been abnormally high.

Aurizon (2013, p. 118) observe that sovereign bond yields are "historically low". Such statements beget the question as to which history they are referring to. Given the 8 years of data presented in Figure 20, this is a correct statement – since the mid-90s, interest rates have progressively been getting lower. If we take a longer term perspective however, we note that current interest rates in Australia are below average, but not unusually so.

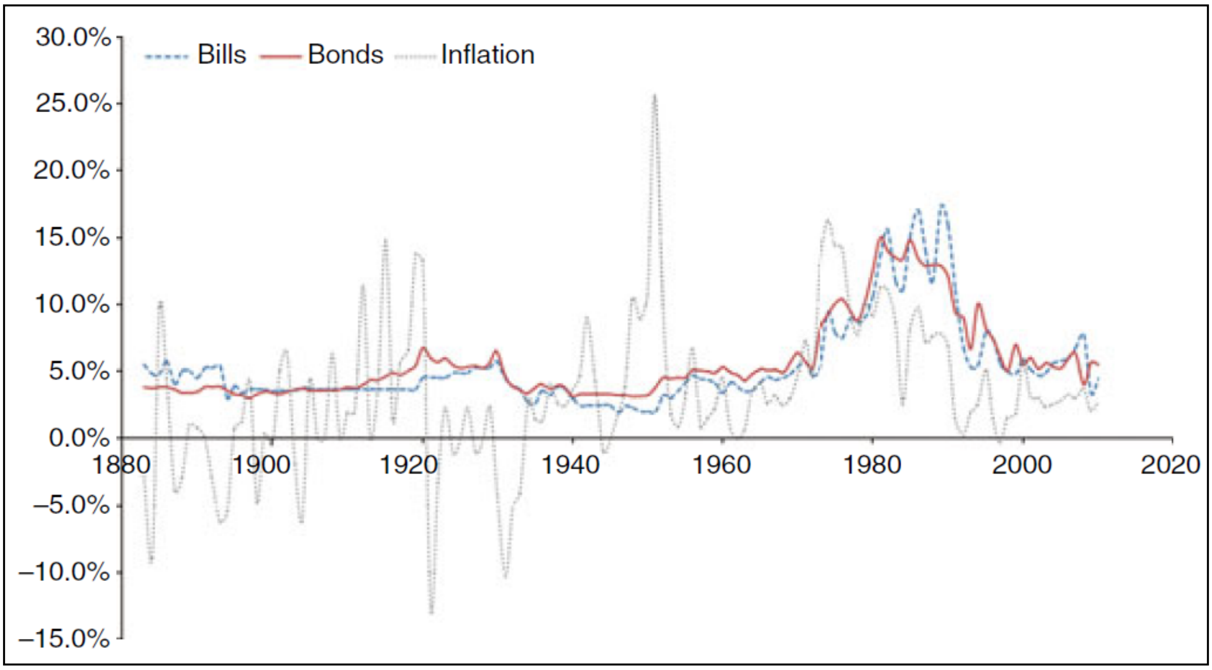
[6] In the case of perpetuity these effects would offset each other exactly. Consequently, in the perpetuity case, the required cash flow to service the required return on the assets would be unchanged from that originally allowed by the regulator.

Perhaps the best known global financial history database is provided by Dimson, Marsh and Staunton (DMS), which is published annually as the Credit Suisse Global Investment Returns Yearbook. The 2009 report covered the period up to the onset of the financial crisis (1900 to 2008), and shows the compound geometric rate of return earned by investors in Australian 10 year government bonds has been 5.5% in nominal terms. The most recent 2012 report includes the period of heavy government intervention in the cash rate and shows that the long run rate of return to 10 year Australian government bonds is unchanged in nominal terms at 5.5%.

Brailsford et al (2012) updates their Australian long run financial data series first introduced in Brailsford et al (2008). They report average nominal government bond yields of 5.65%, over their entire sample period of 1883 to 2010. They also present Figure 3, which highlights that the period following the mid-1970's is anomalous relative to historical interest rates observed over a much longer time horizon. From the beginning of the sample period until 1972, the average nominal yield was 4.23%.

Figure 3

Australian Nominal Government Bond and Bill Yields



Source: Figure 1 in Brailsford et al (2012)

We stated at the beginning of this section that for an interest rate to be unusually low, it must be relative to some benchmark, for example, interest rates over the last 10, 20 or 100 years. If we take the benchmark to be the very long run, then the nominal average government bond return as reported in Brailsford et al (2012) is 5.65%. If we exclude the high interest rates of recent decades, the average return over the period 1883 to 1972 in Brailsford et al (2012) is 4.23%. At the time of writing the nominal interest rate on 10 year government bonds, using Reserve Bank of Australia data and averaging over 20 days, is

4.02%, which is reasonably close to the long run average (4.23%) excluding the recent period, and is not a long way below the long run average using all the data.

The evidence provided by the data suggests that it is the more recent history of high interest rates that is not truly representative of the long run in this market. For the Australian markets, the evidence suggests that bond yields were stable at relatively low levels in the long run.

The more recent history is anomalous and the high interest rates observed during this period are clearly not representative of the longer time series. As such, one conclusion may be that the current environment is nothing more than a return to the 'normal' long run interest rate regime. In any event, in the light of history current bond rates are below average, but are not abnormally low.

Current values for market parameters

Aurizon (2013, p. 120) state that estimating the regulated rate of return:

> "… involves combining a spot estimate of the risk-free rate with a long run average MRP. While this has not necessarily been an issue in more stable market conditions, it can cause issues in a more difficult market environment, as is presently the case."

The implication of this statement is that when in a stable environment, the long term historical average value most likely equals (or is reasonably close to) to current market value. In changing conditions however, the use of a mix of current and historical values will impact on the estimated values.

Recall that we discount the expected future cash flows from the investment at the *current* equilibrium expected return, which is determined by the risk of the investment. The word 'current' is important here - in any required return calculation, we should be using current values as they contain the best information available on future values and it is the current values that investors are using in their valuations. Therefore, historic values for the rate of return on equity, or interest rates, are not relevant *except* to the extent that they help us estimate the *current* rates.

As current interest rates are readily observable, historic interest rates typically have no place in determining the interest component of the required rate of return. Estimating the current market risk premium, however, presents a problem as there is no reliable way to identify exactly what it is. The most commonly used method is long term averages of historical data (a discussion of this and other estimation methods follows later).

We believe that Aurizon's argument rather misses the point. The objective is not to have the MRP and risk free rate averaged over some period. What matters is getting the best estimate of the current risk free rate and the best estimate of the current market risk premium. The estimate of the MRP based on long term averages of historical data is one of the most widely used methods of estimating the current MRP. Of course, this method does suffer rather obvious and well documented limitations. As stated earlier we believe that all parameter estimates should be based on a broader set of evidence. In this case, that would mean triangulation of the empirical MRP estimates with other data such as survey data and perhaps forward looking implied estimates from security prices.

Inverse Relationship between the risk free rate and MRP

Aurizon (2013, p. 121) refer to an independent expert report by Officer and Bishop (2013), to support the proposition that:

> "… there tends to be an inverse relationship between the risk-free rate and MRP."

However, the case for this is less than compelling. We agree with Bishop and Officer (2013) that the relation between the risk free rate and MRP could be positive, negative, or non-existent. As they say on page 45 of their report:

> "However, a number of scenarios can be constructed which show that there is potential for the relationship to be positive, negative or none at all. Consequently establishing the relationship in practice is really an empirical matter. "

Bishop and Officer's (2013) empirical evidence is unconvincing. They report a small negative correlation (-0.15) between the risk free rate and the realised market risk premium in Australia. No statistical significance level is reported for this correlation. However, for a two tailed test the correlation would only be significant at the 10% level, which would generally be considered a weak result. Furthermore, if the inverse relation is really there, it has minimal explanatory power. A correlation of -0.15 means that changes in the risk free rate only explain 2.25% of the total variation in the realised market risk premium. Thus, for every one percent rate of return variation in the market risk premium we could only explain 2.25 basis points of this variation in terms of the change in the risk free rate.

Bishop and Officer's (2013) particular evidence for a negative relation between the risk free rate and the market risk premium is weak and viewing the broader evidence, it is an open question whether such a relation exists at all. For example, Bekaert, Hoerova and Scheicher (2009) find no evidence of a negative relationship between short term risk free rates and the equity risk premium.

Bishop and Officer (2013) cite a report by CEG (2010) and also the work of Damodoran (2011) to support the proposition of an inverse relation between the risk free rate and the market risk premium. CEG (2012a,b) also make claims to support the inverse relation. Lally

(2012) and McKenzie and Partington (2013) have been critical of the basis of CEG's arguments and we give them no weight.

It is possible that the relationship between the market risk premium and the risk free rate could oscillate over time, being positive in some periods and negative in others. For example, De Paoli and Zabczyk (2012) develop a model in which the MRP can be either inversely related to the economic cycle, or positively related to the economic cycle, depending on investors' assessment of future prospects. In their model, if investors believe that changes in economic conditions are persistent, the MRP is likely to move inversely with the business cycle.

Damodoran (2013) does make a case that the current market risk premium in the USA is high relative to the interest rate, but his MRP estimate is conditional on his implied cost of capital estimate being correct. He also writes:

> "While the relationship between the level of the ERP and the risk free rate has weakened over the last decade, the two numbers have historically moved in the same direction: as risk free rates go up (down), equity risk premiums have risen (fallen)."

Thus, Damodoran makes the case that history shows the MRP and interest rates to move in the same direction, but the current period is an exception. We do not suggest whether his argument is right or wrong, but it does serve to highlight the conflicting views on the relation between the MRP and interest rates.

Bishop and Officer (2013) present a diagram of the relation between the risk free rate and the MRP based on Damodaran's work, but it only covers a few years. Figure 4 presents similar information but over a much longer time period. One interesting feature of this time series is that the estimated MRP at the time of the highest risk free rate and at the time of the lowest risk free rate are identical to the first decimal place, at 5.73% and 5.78% respectively. We caution that these MRPs rest on an estimate of the implied cost of capital for the market and this could be subject to error. Triangulation of Damodaran's estimate (see the discussion of the MRP below) shows that his current MRP estimate is noticeably higher than that obtained from other methods.

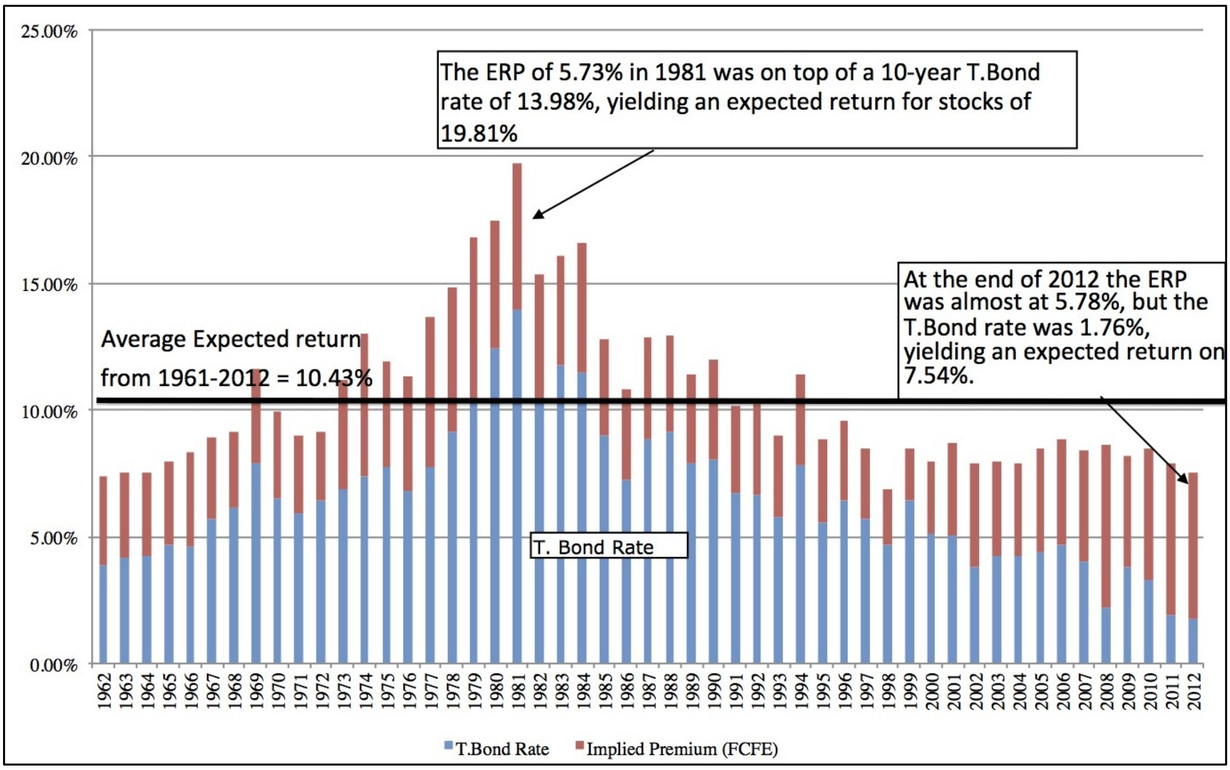
Based on the foregoing discussion, we conclude that the relation between the MRP and the level of interest rates remains an unresolved question and the range of possibilities is wide open. The correct MRP adjustment for a change in the risk free rate might be zero, it might be positive, or it might be negative. The relation between the risk free rate and the MRP, if any, is not sufficiently well established to form the basis for a regulatory adjustment to the MRP.

In summary, Aurizon present various arguments about why the WACC should be adjusted upwards and in particular that high end parameter values should be used in computing the

WACC. Aurizon's arguments include matters such as adjustments for estimation error, adjustments for unsystematic and stranding risks and adjustments arising from current conditions in financial markets. In the light of our foregoing analysis none of these arguments are convincing and in particular we see no merit in using the upper bound of a range of estimates for each WACC parameter.

Figure 4

Expected Returns on Stocks, Implied ERP and Risk Free Rates



Source: Reproduced from Damodoran (2013)

2. The Market Risk Premium

The equity market risk premium (MRP) is simply the difference in returns between the risk free asset and the return on an average risk equity investment. Despite its apparent simplicity, the MRP is extremely difficult to accurately measure. The reason for this is simple - the MRP is an expectations based metric and measuring the expectations of investors is fraught with difficulty.

A number of approaches have been developed for estimating the equity market risk premium. The main methods are estimates based on historical returns, the use of survey data and implied cost of capital methods (sometimes called forward looking methods). These latter methods back out the MRP from a model of the relation between forecast cash flows and stock prices. The dividend growth model is a simple model that has been used for this process. However, the dividend growth model has significant problems. Hathaway

(2005, p. 3), for example, obtains some estimates of the MRP with negative values from the dividend growth model and comments that:

> "It is a perpetuity model that has constant assumptions but it is applied in an ever changing world. The poor thing is not up to the task."

We also caution that the dividend growth model relies heavily on terminal value or terminal growth assumptions. There is also a neglected problem of dividend reinvestment plans (DRPs). The issue is that valuations should be based on dividends net of contributions and withdrawals of capital by shareholders. The DRP represents a contribution of capital to the business and thus reduces the cash flow to shareholders, resulting is a smaller net dividend. With DRP participation rates running at about 30 percent, this represents a substantial reduction in the current dividend yield. Depending on how the dividend growth model is applied, the effect of the DRP may also flow through into the estimated dividend growth rate.[7]

Failure to account for DRPs may significantly upwardly bias the implied cost of capital. For example one procedure is to take the dividend yield, say 5% and allow for growth at the forecast rate of GDP, say 3%, giving an expected market return of 8%. However, if 30 percent of the current dividend is immediately returned to the firm via the DRP then the net dividend is only 3.5% giving an expected market return of 6.5%.[8]

The triangulation of the market risk premium across historic, implied and survey estimates is neatly summarised for the USA by Damodoran (2013):

> "There are three ways of estimating an equity risk premium. One is to look at the difference between the average historical return you would have earned investing in stocks and the return on a risk free investment. This historical premium for the 1928-2013 time period would have stood at about 4.20%, if computed as the difference in compounded returns on US stocks and on the 10-year US treasury bond... ...The second is to survey portfolio managers, CFOs or investors about what they think stocks will generate as returns in future periods and back out the equity risk premium from these survey numbers. In early 2013, that survey premium would have yielded between 3.8% (from the CFO survey) to 4.8% (portfolio managers) to 5% (analysts). Finally, you can back out a forward looking premium, based upon current stock prices and expected cash flows, akin to estimating the yield to maturity on a bond. That is the

[7] It may also affect the estimated size and frequency of future share issues and accounting for share issues is another neglected aspect of dividend growth models.

[8] In the USA the problem is much less significant as the cash is not retained within the firm, but instead is generally used to purchase shares in the market to supply the shares for the DRP. This means that the cash gets distributed to investors and so effectively the dividend is not reduced.

> process that I use at the start of every month to compute the ERP for US stocks, and that number stood at 5.45% on May 18, 2013."

This suggests that the current market risk premium is less than 6% in the USA.

In considering the equivalent evidence for Australia, we immediately strike a problem as we are not aware of any estimates of implied market risk premiums in Australia that we would consider to be reasonably reliable and objective. We agree with Bishop and Officer's (2013, p19) observation that:

> "An alternative approach to estimating an MRP from historical data is to use forward looking approaches. As noted there is no generally agreed and robust method of estimating this. Consequently some form of triangulation is recommended to inform what is essentially judgemental."

Truong and Partington's (2007) results suggest that the estimates of the implied cost of capital are very sensitive to the model you choose and assumptions about the growth rate (see Table 2). In estimating the cost of capital using implicit methods, we recommend the use of composite forecasts of cash flow. Composite forecasts are a combination of analysts' forecasts and time series forecasts and they tend to have better forecast accuracy than analysts' forecasts alone. In terms of picking a model, the empirical tests undertaken by Truong and Partington suggested a modification of the dividend growth model called the finite Gordon model (DDM2 in Table 2) was the best choice, but not compellingly so.

Our key point on this issue is that model choice is an open question and the result that you get is rather sensitive to both model choice and the assumptions about growth. Given these problems and the lack of reliable estimates, we do not consider Australian implied cost of capital estimates.

Empirical Estimation

Historical Evidence

Estimates of the Australian arithmetic MRP has been reported as low as 4.5% (see Hathaway, 2005), while the latest geometric return estimate in Dimson et.al (2013)is 6% from 1900 to 2012, but only 3% from 1963 to 2012. A substantial problem is determining whether there are real differences between the estimates because of the relatively high standard error of the estimates.

Table 2 : Implied Market Risk Premiums and Utility Industry Risk Premiums (1995 to 2004)

Models	Equations	Key Assumptions	Implied MRP (utilities RP) Analysts forecasts	Implied MRP (utilities RP) Composite forecasts
DDM1	$P_0 = \frac{dps_1}{k_e - g}$	g is assumed equal to the long-term growth rate obtained from the IBES database.	8% (8%)	7% (5%)
DDM2	$P_0 = \sum_{t=1}^{4}\left[\frac{dps_t}{(1+k_e)^t}\right]+\left[\frac{eps_5)}{k_e(1+k_e)^4}\right]$	Earnings per share of year 5 is assumed to be earned in perpetuity.	3% (3%)	2% (0%)
OJM	$P_0 = \frac{eps_1}{k_e} + \frac{eps_2 - eps_1 - k_e(eps_1 - dps_1)}{k_e(k_e - g_p)}$ $k_e = A + \sqrt{A^2 + \frac{eps_1}{P_0}\left(\frac{\frac{eps_2 - eps_1}{eps_1} + g_{IBES}}{2} - (\lambda - 1)\right)}$, $A = \frac{1}{2}\left((\lambda - 1) + \frac{dps_1}{P_0}\right)$	The first equation is the general form of the Ohlson-Juettner model. After some rearrangement and given the perpetual growth rate g_p equals λ -1, the second equation where k_e can be estimated directly is obtained. The perpetual growth rate $g_p = \lambda$ -1 is assumed equal to the ten-year government bond rate less 3% which is taken to approximate the inflation rate.	7% (6%)	4% (2%)
RIM	$P_0 = bps_o + \sum_{t=1}^{4}\frac{eps_t - k_e bps_{t-1}}{(1+k_e)^t} + \sum_{t=5}^{12}\frac{(ROE_t - k_e)bps_{t-1}}{(1+k_e)^t} + \frac{(ROE_{12} - k_e)bps_{11}}{k_e(1+k_e)^{12}}$	Four years of explicit forecasts are used. From year 5 to year 12, the return on equity of a firm is assumed to revert linearly to the median return on equity of its respective industry.	10% (7%)	4% (1%)

Notation: *Po* is the current share price, dps_t is the forecast dividend at time *t*, k_e is the required return on equity, *g* is the forecast growth rate in dividends earnings, g_p is the perpetual growth rate, g_{IEBS} is the five year forecast growth rate in earnings, eps_t is the forecast earnings at time *t*, bps_t is the book value per share at time *t*, and ROE_t is the return on the equity at time *t*.

Composite forecasts are a combination of analysts' forecasts and time series forecasts.

DDM1 Dividend Discount Model 1 is the basic Gordon growth model, commonly known as the dividend growth model

DDM2 Dividend Discount Model 2 is the finite Gordon model developed by Gordon and Gordon (1997)

OJM is the Ohlson-Juettner Model, which is derived from DDM2 and estimated following the method of Gode and Mohanram (2003)

RIM is a residual income model following Gebhardt, Lee, and Swaminathan (2001).

Source: Truong and Partington (2007)

This problem of high standard errors gets worse as the estimation period shortens, because the standard error of the estimate gets bigger. For example, Handley (2011) estimates the following arithmetic mean risk premiums:

- 6.0% (with a standard error of 1.5%) for 129 years from 1883 to 2011;
- 5.5% (with a standard error of 2.3%) for 75 years from 1937 to 2011;
- 4.3% (with a standard error of 3.8%) for 24 years from 1988 to 2011.

This suggests a declining MRP over time, but given the standard errors in these estimates, we cannot conclude that there is any statistically significant difference between them. In the light of the historical evidence, the general consensus in regulation has been to use an MRP of 6% and this value is commonly used in corporate practice. The thrust of the academic literature is that the MRP estimated as an average of the historical risk premium may be too high and a number of reasons (such as survivorship bias) have been advanced to support this proposition.[9] This literature is discussed in McKenzie and Partington (2011 and 2012). In contrast, the consultants to regulated entities have generally argued for a higher MRP, initially on the basis of higher risk due to the GFC and increasingly on the basis that the risk free rate is too low.

In relation to Aurizon's submission and the use of the historical MRP, Bishop and Officer (2013, p.19) argue that:

> "A number of different views have been presented around the most appropriate historical period over which to estimate the MRP. We have consistently argued for use of a simple average MRP estimated over the longest period for which data is available (1883 to the present) and have noted its sensitivity to the period selected. This is apparent from Figures 1 and 2 below which highlight the basis of our recommendation for 7% as reflective of the historical MRP."

The use of a long measurement period has some merit, but we are somewhat puzzled by the concluding recommendation of this statement. The recommendation for 7% seems to be contradicted by Bishop and Officer's (2013) Figure 2, which is reproduced below as Figure 5. This figure suggests that from 1990 to 2011 the average MRP has been generally been close to and occasionally at 6%. The middle line representing the MRP with partial valuation of franking credits hits 6% at the end of the series in 2011. So, if we literally applied the statement:

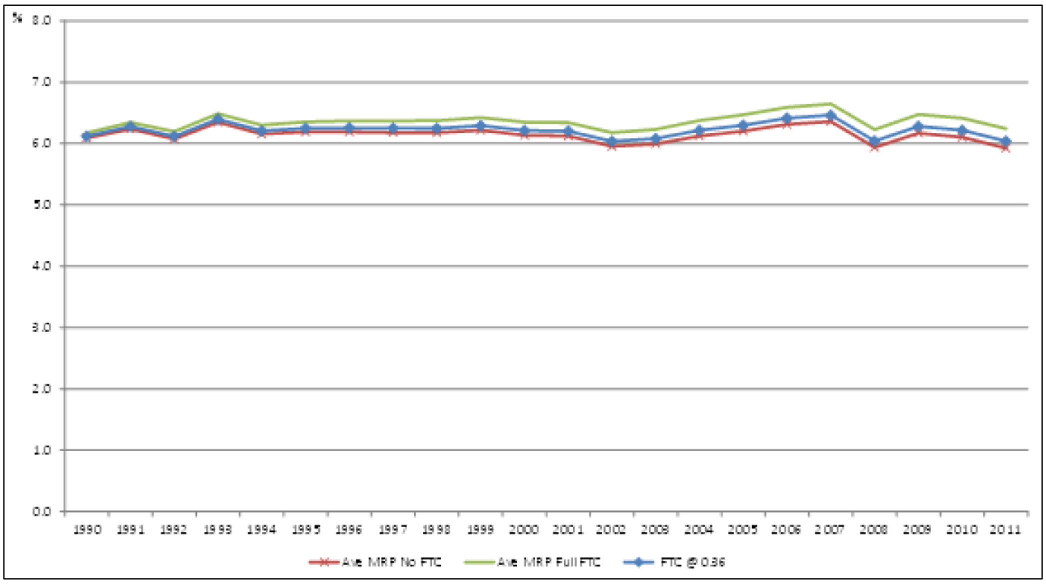
> "We have consistently argued for use of a simple average MRP estimated over the longest period for which data is available (1883 to the present)..."

[9] We do not wish to give the impression that this is an entirely uncontested view, but in our opinion it reflects the main thrust of the literature.

the estimate that meets this requirement is 6% and not the 7% argued for by Bishop and Officer.

Figure 5

Historical MRP from 1883 including and excluding Imputation Tax



Note : The historical MRP From 1883 to 1990 is the first data point, and further points are generated by successively adding a year to the data.

Survey Evidence

Australian survey evidence is more limited than in the USA and suggests a risk premium of about 6% (see KPMG, 2005, Truong, Partington and Peat, 2008, Bishop, 2009, Fernandez, 2011, and Asher, 2011).[10] A common feature of SFGs submissions to regulators has been that surveys should ask what people do, rather than what they predict/think about the future, see for example SFG (2013, p20). We, therefore, note that some of the surveys cited above cover what people think and others cover what they do.

SFG (2013) argue that surveys should be timely and as such, we consider some more contemporary evidence. The most recent Australian survey evidence comes from Fernandez (2013) who conducted a global survey of academics, financial analysts and company managers and got 17 responses from Australia. The median MRP was 5.8%, compared to 5.5% for the U.S. (2394 responses). In comparison to the survey of the previous year, the Australian median MRP was 6.0 (73 responses). Taken at face value the median MRP has gone down, however, the small sample size means the results must be treated with great caution. For example, the maximum response of the MRP for Australia was 25.0%, whereas the previous year it was only 10% and this outlier is the principal cause of the higher mean estimate in the current survey (6.8%) compared to the previous survey (6.0).[11]

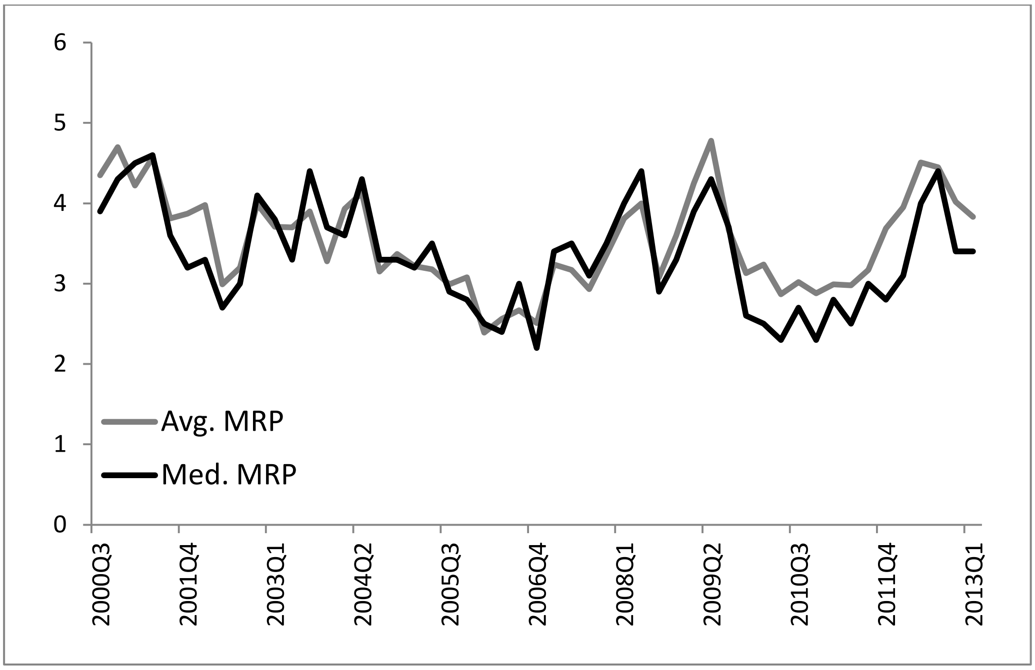
[10] We note that Asher (2011) suggests a MRP of less than 6%.

[11] Had the maximum response been the same as the previous year the mean in the current survey would have been 5.92%.

On the assumption that there is some commonality between the Australian and US capital markets, we can triangulate these Australian results with recently reported survey results for the US. Graham and Harvey (2013) published the results of their latest annual survey of CFOs. Figure 6 summarises their data and the latest survey reveals that the MRP peaked in 2009 and is currently falling. We can think of no reason why this same trend would not be in evident in Australia. We do note, however, that the US survey data in Fernandez (2013) shows that the median MRP estimate is 0.1% higher.

It is clear from the foregoing, that survey evidence cannot be used as a sole arbiter of the market risk premium. Like all the methods for estimating the MRP survey methods are far from perfect, but in our opinion confidence in their results can be strengthened by triangulation across surveys. Therefore we argue that surveys can provide evidence that may usefully be weighed in the balance with estimates of the MRP from other methods.

Figure 6
CFO Survey Based Estimate of the MRP



Source: Graham and Harvey (2013)

Damodoran's Method

Damodoran (2013) computes MRPs across countries by taking his estimate of the US MRP[12] and adjusting it for risk differences between the US and foreign markets. He uses differences in sovereign default risk (sovereign ratings and CDS spreads) to proxy for differences in country risk and scales this up to allow for differences in volatility between

[12] The MRP is based on an implied cost of capital estimate, so is subject to our earlier comments on the problems with such methods.

stock and bond markets. His current (June 2013) MRP estimate for Australia ranges from 5.75% to 6.28%.[13]

Based on our previous research (see Mckenzie and Partington, 2011, 2012) and the additional evidence presented in this report, we see no reason to change our view that even if conditions did exist during the GFC to justify changing the MRP, these conditions have substantially abated and it is reasonable to believe that the long term MRP of 6% prevails once more. Further, while 6% is a justifiable estimate of the MRP, our opinion is that, if anything, 6% is more likely to be too high rather than too low.

3. Equity Beta

Our opening discussion provides a conceptual understanding of what it is that beta is trying to measure. To recap, while there are three components to a firms systematic risk, the evidence suggests that is the intrinsic risk that is most important and it captures how the business cycle impacts on the firm.

The question of the appropriate comparator, or peer group, for Aurizon comes down to which other firms are likely to share Aurizons experience as the business cycle evolves. You could argue that as an export oriented business, primarily engaged in the provision of coal transportations services, it is foreign economic activity that is important to determining the demand for the required transport services necessary to get the coal to port. In this case the beta with respect to the domestic market is likely to be low.

How low is a function of how closely Australia's economic fortunes are tied to the global economy. Given the robust performance of Australia and the poor performance of the US and Europe, you could say that the link is not very strong. But of course, China (and India) are the key here given their demand for Australia's resource products. If they encounter difficulties, there is every reason to expect economic problems in Australia. This could inflate Aurizon's beta.

It is also possible that other infrastructure assets may experience the same plight. A downturn in China means less exports and a weakening domestic economy, in turn causing a drop in demand for domestic infrastructure services. If returns on these assets are highly correlated, then the argument that domestic infrastructure assets constitute Aurizon's peer group has some merit.

While all of this is mere conjecture, it does serve to highlight the complexity of the issue. Regulators in Australia and in the UK have typically taken the view that regulated utilities are the appropriate comparators for railroads and the empirical evidence worldwide is that that utilities typically have low asset betas and low equity betas.

[13] See http://people.stern.nyu.edu/adamodar/New_Home_Page/data.html

Another approach is to take the comparators for Aurizon to be railways from around the world. Table 3 presents estimates for equity betas and unlevered (asset) betas for railroads around the world, as estimated by Damodoran (2013a). The global equity beta for railways is estimated to be 0.68. It is clear, from Table 3 that, with the exception of the USA, railroads have relatively low equity betas ranging from 0.33 to 0.86, and low asset betas ranging from 0.15 to 0.69.[14]

In respect of Australian railways, SFG (2012) report the beta estimates for QR National as follows:

> "The OLS beta estimate for QR National Limited is 0.58, the predicted value from the pooled regression is 0.86 and the fitted estimate is also 0.86. These estimates for QR National have been presented for completeness and should be given little weight in isolation, as there is substantial estimation error for an individual stock."

SFG's comment about the estimation error for individual stocks is appropriate. However, comfort can be taken from the fact that the estimates for QR National triangulate reasonably well with the estimates for railways from the rest of the world, with the exception of the USA.

The one exception to the rule of relatively low railroad betas is the USA where the equity beta and the asset beta are substantially higher than anywhere else. It is also evident that the US railways have lower levels of financial leverage relative to other developed economies. So, there is clearly something about American railways that makes them different to the rest of the world.

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[14] We note that applying the QCA unlevering formula would result in even lower asset betas than those given in Table 3. This is because Damodoran uses the Hamada formula for unlevering the equity beta and this formula assumes that the debt beta is zero, whereas the QCA take debt betas to be equal to 0.12.

Table 3

Equity and Asset Betas for Railways around the World.

Country/Region	*Number of Firms*	*Average Beta*	*Market D/E Ratio*	*Tax Rate*	*Unlevered Beta*
Global	56	0.68	65.38%	21.56%	0.45
Europe	9	0.86	101.28%	16.74%	0.47
Japan	19	0.33	156.93%	27.21%	0.15
Emerging Markets	13	0.83	23.48%	16.91%	0.69
USA	12	1.32	23.46%	28.60%	1.13

Source: Industry beta spreadsheet data from Damodoran (2013a)

SFG (2012) summarises its beta estimates on page 2 of their report (this covers estimates for QR National Limited, and for comparator firms: Australian-listed energy networks and Australian-listed industrial transportation) and all of the reported beta estimates are less than one. SFG also provides estimates for United States-listed Railroads that are less than one, but only just so at 0.99.

Considering the evidence from overseas railways and SFG's initial beta estimates, we find no support for Aurizon having a beta of one. The argument for a beta of one comes from Table 1 of SFG (2012) where the comparator firm betas, all of less than one, are unlevered then relevered. The first point to make about this is that since the relevered betas are higher than the original betas, this implies that the assumed level of leverage used in relevering is higher than the actual level of leverage in the original comparator firms. We also note that the assumed level of leverage is 60%, whereas we understand the appropriate level in the current case is 55%, so this will impart a modest upward bias to the relevered beta.

If we confine the analysis to the Australian energy network comparators, the relevered betas are all less than one and only represent a modest increase on the original betas. Consequently, the assumed debt level is only modestly higher than the actual leverage for these comparator firms. However, the relevered betas for the Australian industry transportation and US railroads have jumped substantially, which suggest a big difference in actual and assumed leverage.

From Table 3, the level of leverage for a sample of US railroads is 23.5%, so relevering to 60% is a big jump in leverage, which is of concern to us. Although there may be modest differences across individual firms, the leverage ratios across firms in the same industry tend to cluster together. Thus, a big difference in leverage ratios between the comparator firms and the assumed leverage for Australian railroads suggests that the comparator firms are different from the railroads in some fundamental respect. If so, the comparison is likely to be inappropriate.

It is already apparent from Table 3 that US railroads differ from other railroads around the world, add to that the leverage differences and you end up with a big question mark over attaching any weight to the US railroad betas. The large difference in leverage ratios also creates a question mark over the weight to be attached to Australian industrial transportation betas. If these comparator industries are given a low weight then not much remains of the case for Aurizon having a beta of one.

Aurizon argue that equity beta estimates are very susceptible to estimation error. We agree and a recent paper by Lewellen, Nagel and Shanken (2010) highlights the importance of this issue in the context of a multifactor CAPM. It is for this reason that we approach empirical evidence of changes in beta with caution. Small changes in sample and estimation technique can produce dramatic differences in the outcome irrespective of the fact that it is the same firm that is being analysed. SFG (2012) very clearly demonstrate this with respect to the changes in beta that arise from changing the sample starting point for the estimation of beta.

To our minds, SFG's analysis (2012) analysis serves to do little more than to reinforce the point that beta estimation can be sensitive to how you do it and that the choice made can be problematic. Firstly, SFG (2012, p. 12) observe that:

> "The most troubling aspect of the industry analysis is that it ignores firm characteristics which empirical evidence and theory implies are associated with equity returns. The two most commonly-used firm characteristics used to benchmark firms according to risk are market capitalisation and the book-to-market ratio. On average, small firms and high book-to-market firms earn higher returns than large firms and firms with low book-to-market ratios. This result is not specific to any individual market."

There are a number of issues with this statement. The inclusion of market capitalisation and book-to-market factors comes from the model popularised by Fama and French (1993). This particular model has no theoretical basis and was inspired by well-known capital market anomalies. It is true that a considerable literature exists which has attempted to economically interpret the meaning of these factors (liquidity and financial distress being the two most popular), but a consensus does not exist. Adding to the confusion is the fact that the size and significance of these factors are inconsistent and examples are often found of insignificant parameters and parameters with the opposite sign to that expected (for evidence in the Australian context see Haliwell, Heaney and Sawaki, 1999, Faff, 2004, and Brailsford, Guant and O'Brien, 2012). In our opinion, a number of important and unresolved questions remain as to whether the substantial estimation required to estimate factor risk premiums and factor loadings is worth it in terms of producing an improved estimate of the cost of capital relative to the simpler CAPM. As mentioned earlier in this report, the three factor model has not proven to be useful in a regulatory context.

SFG (2012) attempt to resolve the sample size issue and lack of reference to firm characteristics by cross referencing a number of different methods and samples. As we suggest above the resulting beta estimates are not supportive of Aurizon's case. The primary problem with the analysis, however, is that the extended models do not necessarily provide estimates of systematic risk on factors that are priced. To understand why, we note the following comment by Aurizon (2013, p. 138):

> "SFG's analysis shows why firm characteristics are relevant. If they had no role in informing systematic risk, then the coefficients on those variables would be zero."

This is not correct and to understand why one must recall our earlier discussion about risks being priced. Just because a factor is significant in a regression of realized returns on "factor premiums", does not mean that it is a priced risk factor. There is a wide variety of variables that could be used beyond those highlighted in SFGs report – in point of fact, Subramanyam (2010) documents over fifty variables that have been used to explain asset returns. Smith and Walsh (2013) provide an excellent discussion on this point and explain why it is that the use of factors (such as size and book to market) to construct portfolios *ex post* does not mean that those factors are 'priced' *ex ante*.

To clarify the issue, Smith and Walsh (2013, p. 75) recount the parable of Ferson et al (1999) in which:

> "… an empirical anomaly, based on the position in the alphabet of the names of companies, is used to create a factor that is used in asset pricing. The use of anomalies such as this gives a workable method of coming up with ex post efficient portfolios. However, this says nothing about asset pricing as there are an infinite number of ex post efficient portfolios … this method of constructing ex post efficient portfolios is in effect picking the low lying fruit. Armed with a vector of ex post average returns and a historical variance–covariance matrix, any competent analyst could derive the entire range of ex post efficient portfolios…"

The point is that just because a factor may be used to identify an *ex post* efficient portfolio, does not mean that the factor is priced (and this includes other factors such as momentum). Thus, the analysis of SFG is combining an estimate of systematic risk (albeit imprecisely estimated) with another parameter that captures the *ex post* ability of certain factors to explain a given sample of returns.

This point notwithstanding, if we take the SFG approach as given, it does raise the issue of which models should we use. For example, the equation which distinguishes between an up and a down market is a very basic form of conditional equation that allows beta to vary across time. There is a considerable literature which has looked at whether beta changes and possible approaches to estimating a conditional beta (see *inter alia* Ferson, Sarkissian and Simin, 2008). The general issue is simply which models do we choose. SFG has selected three out many, each with its own idiosyncrasies and biases. It is not immediately clear whether they are even comparable in the sense that averaging across them makes any sense. To head down this path opens up a veritable Pandora's box in terms of which models to average across.

There is another problem and that is the lack of a clear linking back of the estimation equations to the underlying theory of the CAPM. The inclusion of additional explanatory variables for return, for example, is inconsistent with the CAPM. Without the theoretical link it is not at all clear what the estimated beta's actually represent in terms of the CAPM and so it is not clear what their relation is to the CAPM beta.

To sum up, we see no evidence to support Aurizons' proposed adjustment of beta to a value of one.

4. Gamma

Gamma (γ) is used to convert the face value of imputation credits created (corporate tax paid) to an effective value and is often written as:[15]

$$\gamma = \mathrm{F}\theta \tag{1}$$

where the imputation payout ratio (F) is the ratio of imputation credits distributed to imputation credits created, and is sometimes called the access fraction. Theta (θ) is the value to the investor of the imputation credits distributed, expressed as a fraction of face value. There is considerable debate about what the magnitude of this variable should be and how it should be measured.

There is less debate about the magnitude of the access fraction as this can be measured reasonably well from taxation statistics and a value of 70% is widely accepted as the proportion of credits created that are distributed. For example, this was the value recently proposed in the AER (2013) cost of capital guidelines. However, adopting equation (1) to estimate gamma assumes that only the imputation credits that are currently distributed have value. Imputation credits that are undistributed are implicitly assumed to never be distributed and thus are of no value. This is only true if the probability is 100% that such credits will never be distributed and this seems to us to be an extreme assumption. In our opinion the probability of a distribution is positive rather than zero. This probability is likely to vary across firms and may be very close to zero in some cases. It is also clear that the value of undistributed credits will be less than the value of distributed credits, since not only must they be weighted by the probability of distribution, they must also be discounted for

[15] The use of this formula is typically accompanied by the assumtion that the value of undistributed imputation credits is zero.

the expected time lag before distribution. How small these undistributed credit values are is an open question. However, as long as they are positive in aggregate then the use of equation (1) will result in a downward biased estimate of the value of gamma. It is not known how large this understatement is.

To define theta, we draw on Officer's (1994, p4) seminal paper, which states:

> "A proportion (γ) of the tax collected from the company will be rebated against personal tax... Thus γ is the proportion of tax collected from the company which gives rise to the tax credit associated with a franked dividend."

This implies that gamma depends on the utilisation of the credits in obtaining tax rebates and hence, theta should measure utilisation. This value can be obtained from taxation statistics and Handley and Maheswaran (2008) provide estimates across two sub-periods of 0.67 and 0.81.

Officer (1994), goes on to conclude his definition by saying:

> " ... γ can be interpreted as the value of a dollar of tax credits to the shareholder."

and in a footnote he suggests using market prices, and in particular dividend drop-off ratios, in order to form an estimate of gamma for the marginal shareholder. This implies that theta should be measured as a market value. Thus, there is ambiguity in the definition of gamma and theta. Should these parameters s be based on utilisation or market values?

AER (2013) proposes to employ the utilisation rate as a part of its determination of theta, but the estimate of theta is triangulated across several sources of evidence. These sources include the extent to which shares are held by Australian residents who can utilise the credits, the estimates of utilisation from taxation statistics, the evidence from studies of market value (including ex-dividend studies) and other supporting evidence that suggests investors place a positive value on franking credits (although this latter evidence does not provide an estimate of the magnitude of that value). In the light of this evidence, the AER concludes, that an appropriate estimate of the value of theta is 0.7. In our opinion they make a reasonable case for this theta estimate.

The standard practice has been to measure the market value of theta, in which case the value of theta might vary between zero and one. In the former case the marginal investor attaches no value to the imputation credit, presumably because they can neither use nor sell the credit. In the latter case the marginal investor fully values the credit presumably because they can immediately use each dollar of credits either to save a dollar of personal tax, or get a dollar cash refund from the tax office.

The question then is how to measure the market value of the imputation credits? Two problems immediately arise, the first is how to measure the combined value of dividends and credits since they come as a package. The next problem is how to separate the value of the dividends from the value of the credits.

For over fifty years, academics have been trying to satisfactorily measure the market value of dividends. So far we have not reached a generally agreed consensus on the value or the method of measurement, which indicates the difficulty of the task. Thus, the basic task of measuring the package value of dividends and franking credits is a major challenge.

It is well understood that the market value of the package of dividends and franking credits mixes together not just dividends and credits, but the effects of income and capital gains taxes, transactions costs, discounting for time and risk and possibly market microstructure effects as well. This leads to what we call the allocation problem. That is how we attribute the value consequence of these effects between the value of dividends and the value of franking credits. All methods of splitting up the package value of dividends and franking credit involve an explicit or implicit allocation. The problem with allocations is that by their nature they are arbitrary. Thus, separating out the estimated value of the franking credits is also a major challenge.

One approach to the estimation of the value of dividends and franking credits is to measure the price drop when the stock goes ex-dividend. It is on the basis of one such study by SFG that theta was taken to be 0.35 and hence the value of gamma is given by 0.7 x 0.35, which rounded up furnishes a value of 0.25 or 25%.

We have several problems with this estimate of gamma. First, given the difficulties in estimating theta, the estimate of theta and hence gamma should not be based on one study, or on one method. Rather, it should be triangulated across multiple studies and multiple methods. In particular the estimate of theta should not just be reliant on ex-dividend studies, which are afflicted with many problems. This issue is discussed extensively in McKenzie and Partington (2010). In this paper, we argue that it is very unlikely that an accurate and reliable estimate of the value of franking credits will come out of a traditional ex-dividend study due to a number of problems including the extremely noisy data (it is not unusual to have a price movement up or down of more than twenty times the dividend on the ex-dividend day). Results are also sensitive to data filtering, the choice of estimation method and whether the ex-dividend day price is measured at the open or close of trading. Biased results can also arise from market microstructure effects such as bid-ask bounce. There are also abnormal volumes and abnormal returns about the ex-dividend day, which clearly indicate that trading is abnormal about the ex-dividend date. Consequently, it is an open question whether an ex-dividend study gives a dividend and franking credit valuation that reflects the clientele of investors normally holding the stock. Finally, there are conceptual and econometric problems. For example, multicolliniarity in the regression equation used to separate the value of the dividends and franking credits. Reflecting the inaccuracy of the ex-dividend method and associated regression technique, the standard errors of the estimates from the regression equations are typically quite large.

A reasonably comprehensive sample of studies estimating theta is presented by the AER (2013). We reproduce their results as Table 4 below. The first half of the table contains ex-dividend studies and the second half of the table contains studies where the valuation of the dividend can be inferred from the value of securities that trade almost simultaneously.

The first study in the simultaneous trading section of Table 4 is an ex-dividend study (Walker and Partington, 1999). Unlike a traditional ex-dividend study, where trades ex-dividend are separated from trades cum-dividend by at least the overnight close of the ASX, the trades in Walker and Partington's study are separated by a minute or less. This resolves some of the difficulties found in a traditional ex-dividend study and as a consequence the results are much more precise. These results suggest that franking credits are close to fully valued. However, this study involves a specialised form of trading, so like a traditional ex-dividend study, it is questionable whether the values obtained are representative of the normal clientele of investors that hold the stock.

It is clear that there are diverse values for theta in the Table 4, but most are positive and about two thirds of the estimates suggest a value for theta above the SFG estimate of 0.35. The question is how to combine the information in these estimates. You might weight the studies by timeliness, or by perceived quality, or by precision, or by the extent to which they are independent of each other. With no obvious answer to these questions, we have chosen to give them equal weight. Where a range of values are given, we take the mid-point of the range and where there is no separate estimate of theta, we allocate a value of one dollar to the dividend and take the balance to be the value of the franking credit.[16] This latter value can then be expressed as a fraction of the face value of the franking credit to give an estimate of theta. Taking an average across all the studies gives an estimate for theta of 0.53.

A theta of 0.53 and an access fraction of 0.7 results in a gamma value of 0.37. It is clear from Table 4 that the studies in which we have been involved give a higher theta than 0.53, and naturally we would tend to give our own studies greater weight. All the more so as they are each conducted in very different settings and tend to give clean estimates of the value of the dividend and franking credit package. Taking an average across our studies, the estimate of theta would be 0.83. With an access fraction of 0.7, this gives a gamma value of 0.58. Alternatively using the AER' (2013) estimate for theta of 0.7 (based on market and utilisation studies) we get 0.49 for gamma, which the AER rounds up to 0.5.

[16] This allocation may downward bias the estimate of theta, but it is consistent with the assumption of the standard CAPM that dividends are fully valued.

Our conclusion is that the QCA should not reduce gamma to 0.25 as the evidence is not strong enough to justify this. Indeed, the evidence is not so compelling as to even suggest the QCA depart from its prior value of 0.5.

Table 4

AER Summary of Research Relevant to Determining Theta

Study	Estimated value (range) of theta	Comments
Brown and Clarke (1993)[17]	0.80	Estimated yearly annual drop off ratios
Bruckner, Dews and White (1994)[18]	0.69	Using data from 1991–1993.
Hathaway and Officer (2004)[19]	0.49	Using data between August 1986 and August 2004. The observations were partitioned by market capitalisation (large, mid, small). Find that the results vary by market capitalisation, against expectations of the authors.
Bellamy and Gray (2004)[20]	0.36 (0 to 0.6)	The authors use a simulation exercise to support an optimal model specification. They find results between 0 to 60 per cent depending on this specification, and recommend 0.36.
Beggs and Skeels (2006)[21]	0.57	The AER relied on this estimate in the WACC review. Professor Skeels subsequently endorsed the 2011 SFG study.
Truong and Partington (2006)[22]	0.32–1.14	Using a series of different regression model specifications for data from 1995 to 2005. This paper uses partitioning and filtering extensively.
SFG (2011)[23]	0.35	The Tribunal relied on SFG's study to set theta. At the time, the AER raised a number of concerns with SFG's study, but the Tribunal did not accept these concerns.
SFG (2013)[24]	0.35	SFG updated its 2011 study to include additional years of data. (table continues)
ERA (2013)[25]	0.35 – 0.55	The ERA's study largely mirrors SFG's methodology and data-set, though the ERA tests other specifications and input assumptions for sensitivity. (table continues on the next page)

[17] P. Brown and A. Clarke, 'The ex-dividend day behaviour of Australian share prices before and after dividend imputation', *Australian journal of management*, June 1993, Vol. 18, p. 34.

[18] P. Bruckner, N. Dews and D. White, 'Capturing Value from Dividend Imputation: How Australian Companies Should Recognize and Capitalise on a Major Opportunity to Increase Shareholder Value', *McKinsey and Company report*, 1994.

[19] N. Hathaway and B. Officer, *The value of imputation tax credits—Update 2004, Capital research Pty Ltd report*, November 2004.

[20] D.E Bellamy and S. Gray, 'Using stock price changes to estimate the value of dividend franking credits', *Working paper series: University of Queensland Business School*, March 2004.

[21] D.J. Beggs and C.L. Skeels, 'Market arbitrage of cash dividends and franking credits', The economic record, Vol. 82, pp. 239–252.

[22] G. Truong and G. Partington, 'The value of imputation tax credits and their impact on the cost of capital', *Accounting and finance association of Australia and New Zealand Conference,* 2006.

[23] SFG, *Dividend drop-off estimate of theta*, March 2011.

[24] ENA, *Response to the AER's rate of return guidelines consultation paper, Attachment 13: Updated dividend drop-off estimate of theta*, SFG, 28 June 2013.

[25] Economic Regulation Authority, *Explanatory statement for the draft rate of return guidelines: Meeting the requirements of the National Gas Rules*, August 2013, pp. 201–205.

		Simultaneous Price Studies
Walker and Partington (1999)[26]	0.88 – 0.96	Based on matched pairs of trades separated by no more than one minute from January 1995 to March 1997. This included 93 ex-dividend events for 50 securities.
Chu and Partington (2001)[27]	1.5 combined drop off	This study did not include a specific estimate of the utilisation rate. However, even if we assumed dividends were fully valued (1.0), this suggests that investors fully value imputation credits.[28]
Cannavan, Finn and Gray (2004)[29]	0 – 0.15	Sample finds dividends are fully valued, which is inconsistent with much of the available evidence.
Chu and Partington (2008)[30]	1.29 combined drop off	Based on a specific trading instance for a single listed entity. This study did not include a specific estimate of theta. However, even if we assumed dividends were fully valued (1.0), this suggests a utilisation rate of approximately 0.68.
Cummings and Frino (2008)[31]	0.52	The authors extend the method used in Cannavan, Finn and Gray and find a significantly higher estimate of the utilisation rate. The authors attribute this to the more recent sample period including the reduction in capital gains tax and law change to allow for cash refunds of excess franking credits.
Feuerherdt, Gray and Hall (2010)[32]	1.00 combined drop off	The authors assume dividends are fully valued and find that theta is 0.

Source: AER (2013) Appendix K

[26] S. Walker and G. Partington, 'The value of dividends: Evidence from cum-dividend trading in the ex-dividend period', *Accounting and Finance*, Vol. 39, Iss. 3, November 1999, pp. 293–294.

[27] H. Chu and G. Partington, 'The value of dividends: evidence from a new method', *Paper presented at the Accounting Association of Australia and New Zealand Annual Conference, Wellington,* 2001.

[28] The dividend drop off ratio is the drop in price as a proportion of the face value of the dividend. The maximum face value of attached imputation credits that can be embodied in this ratio is limited to the total value of Australian corporate tax paid. For example, suppose a company earns $100 in pre-tax operating profit and is subject to the Australian standard corporate tax rate of 30 per cent. The company will therefore pay $30 in tax, which it can distribute as franking credits. Further, its maximum dividend payout is $70 (100-30). So, if it pays out all of its post-tax profit as dividends and fully franks its imputation credits, fully valued imputation credits would be approximately 43 per cent (30/70) of the face value of the dividends. Therefore, a dividend drop off ratio of 1.43 or higher suggests that investors fully value both dividends and franking credits.

[29] D. Cannavan, F. Finn, S. Gray, The value of dividends: Evidence from cum-dividend trading in the ex-dividend period, *Accounting and finance*, Vol. 39, pp. 275–296.

[30] H. Chu and G. Partington, 'The market valuation of cash dividends: The case of the CRA bonus issue, *International review of finance*, Vol. 8, Iss. 2, June 2008, p. 19.

[31] Cummings and Frino, 'Tax effects on the pricing of Australian stock index futures', *Australian Journal of Management*, Vol. 33, No. 2, December 2008, pp. 391–406.

[32] Feuerherdt, S. Gray and Hall, 'The value of imputation tax credits on Australian hybrid securities', *International review of finance,* Vol. 10, No. 3, pp. 365-401.

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