RESPONSE TO SUBMISSIONS ON THE RISK-FREE RATE AND THE MRP

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EXECUTIVE SUMMARY

This paper has reviewed a wide range of submissions to the QCA relating to the risk free rate and the MRP. The MRP submissions form two broad categories: those that allege error in the QCA's approach or calculations, and those that propose alternative methods for estimating the MRP that might complement the four approaches currently used by the QCA. In respect of alleged errors, I do not concur with any of these submissions. In respect of alternative methods for estimating the MRP, I consider that the survey-based MRP estimates should draw upon those from recent reports by independent valuation experts as well as from the Fernandez surveys with averaging over the results from these two sources. In addition, I consider that the set of methodologies considered by the QCA should be augmented by one involving estimating the expected real market cost of equity from the historical average actual real return and then deducting the current real risk free rate (or converting the estimate of the expected real market cost of capital to its nominal counterpart and then deducting the current nominal risk free rate). The other methods proposed in the submissions have such serious shortcomings as to be unviable.

In respect of the risk free rate, the submissions primarily relate to the appropriate term to be used and whether the spot rate should be used. In respect of the use of the spot rate, a number of submissions favour historical averaging coupled with a long-term estimate for the MRP of 6%. However this approach will overestimate the cost of equity for businesses with equity betas less than 1, wrongly assumes that the QCA's MRP estimate of 6% is an estimate of the long-term MRP, embodies no rationale for using the particular historical period chosen for averaging the risk free rate, and sacrifices an observable, relevant and significant parameter in the form of the current risk free rate.

In respect of the term of the risk free rate, the QTC claims that matching this to the regulatory period so as to satisfy the NPV = 0 principle embodies a number of unrealistic assumptions. None of these claims are true. A number of other submissions also argue for the ten year risk free rate to reflect the life of the regulated assets or the investment horizon of investors, but do not assess whether the NPV = 0 principle would be violated (which it would be).

The principal submissions on the appropriate term of the risk free rate are from SFG, and my conclusions on these are as follows. Firstly, SFG's belief that matching the risk free rate term to the regulatory term ('term matching') is not necessary to satisfy the NPV = 0 principle is false; their error arises from invoking a valuation equation that applies a risk free rate to an uncertain future cash flow and by assuming that the expectations hypothesis concerning the term structure of interest rates prevails, which is both empirically false and even recognized as such by SFG. Secondly, SFG's belief that the expectations hypothesis is a necessary condition for term matching to satisfy the NPV = 0 principle is incorrect; term matching is required to satisfy the NPV = 0 principle regardless of how the term structure of interest rates is determined. Thirdly, SFG's belief that if term matching satisfies the NPV = 0 principle there is a 'free lunch' available to consumers (in the form of lower output prices by reducing the regulatory cycle) is not correct; output prices would be lowered (on average) with a shorter regulatory cycle but there are disadvantages to this including shortening the period for which regulated businesses retain the benefits from efficiency gains, and greater volatility in output prices. Fourthly, SFG's belief that using the five rather than the ten year risk free rate to estimate the MRP must reduce the MRP estimate is not correct; the impact of this change is lost in the rounding of the MRP estimate to the nearest 1%. Finally, SFG's belief that a regulator should use the ten year risk free rate in order to produce output prices that match those of an otherwise identical unregulated business operating in a competitive market is not correct; even if the output prices of the latter firms did reflect the ten year risk free rate, due to the use of ten-year debt that was not swapped into another term, regulation should instead seek output prices that cover costs including the cost of capital, and the latter depends upon the particular form of regulation.

In respect of whether the QCA's practice of combining a 'spot' risk free rate with an MRP estimated using a variety of methods and data from a variety of periods is consistent with the NPV = 0 principle, satisfying the NPV = 0 principle requires use of the 'spot' risk free rate rather than a historical average and the prevailing MRP. Since the latter is unobservable, one should therefore employ the 'best' method for estimating it. The usual formalization of this is minimal MSE of the estimator, and this is likely to be achieved by averaging over a number of individual estimators some of which may involve the use of long-run historical data. So, combining a ‘spot’ risk free rate with an MRP estimated using a variety of methods and data from a variety of periods is consistent with the NPV = 0 principle.

In respect of whether the QCA’s practice of combining a ‘spot’ risk free rate with an MRP estimated using a variety of methods, and data from a variety of periods, is consistent with the CAPM, the QCA’s practice of using the ‘spot’ risk free rate is entirely consistent with the CAPM. In fact, using a historical average would be inconsistent with the Markowitz model that underlies the CAPM and therefore also inconsistent with the CAPM. In respect of the MRP, the CAPM requires only that the MRP estimate reflect prevailing market conditions and apply to the future period corresponding to the average investment horizon of investors, and the latter cannot be reliably estimated. So the crucial CAPM requirement is that the MRP estimate reflects prevailing market conditions. The QCA’s practice of estimating the MRP using a variety of methods, and data from a variety of periods, is entirely consistent with this. The only apparent conflict between the QCA’s actions and the CAPM version that they adopt lies in the fact that they apply a one-period version of the CAPM to a regulatory problem that is multi-period in nature. However all models make simplifying assumptions and the usual consequence of invoking a model with more realistic assumptions is to aggravate difficulties in estimating parameters. Thus, regulators and others must exercise judgement in making the trade-off. So far as I am aware, all regulatory applications of the CAPM, the overwhelming majority of submissions to regulators, and most other applications of the CAPM involve a one-period version of the model presumably in recognition of this trade-off.

Finally, in respect of the reasonableness of the QCA’s approach under current market conditions, I concur with the QCA’s use of a risk free rate prevailing at the commencement of the regulatory period, to ensure that the present value of the regulated entity’s future cash flows matches its initial investment. In relation to the estimated MRP, I favour an approach that minimises the MSE and this leads to averaging over the results from a wide range of methodologies. These methodologies should include the historical averaging of excess returns (6.2%), the historical average of excess returns modified for the great inflation shock in the 20th century (5.0%), the Cornell approach (7.0% - 9.5%), and the use of surveys (6.1%), with the latter averaging over those of Fernandez and those from independent valuations. The median of these four approaches is 6.1%. A wide range of other methodologies are available and some of them have been presented in submissions. These alternatives include estimating the expected real market cost of equity from the historical average real market return, converting this to nominal terms using prevailing expected inflation and then deducting the prevailing nominal risk free rate, yielding 7.5%. Relative to the Ibbotson methodology, this approach assumes that the expected real market cost of equity rather than the MRP is constant over time, and therefore will be superior to the Ibbotson approach if the expected real market cost of equity is more stable over time than the MRP. The evidence on this question, whilst favouring the Ibbotson approach, is not decisive, and therefore provides some support for use of this methodology as well as the Ibbotson methodology. Adding the 7.5% result from this methodology to the earlier four results, the median of these five approaches increases marginally to 6.2%. Evidence from foreign markets should also be considered. For the first, second and fourth of the five methods described above, the cross-country averages are 5.9%, 4.0% - 5.0%, and 5.8%. Substitution of these results for the Australian results would reduce the median to 5.9%. With rounding to the nearest 1%, all three of these medians are 6% and therefore suggests that 6% is an appropriate MRP estimate for Australia. This matches the QCA's view. So I consider that the QCA's use of the spot risk free rate and an MRP estimate of 6% is reasonable under current conditions.

1. Introduction

This paper seeks to review a number of submissions to the QCA, listed under tasks 2A, 2B and 2C in the Terms of Reference (see Appendix). The paper then reviews submissions from SFG on the term of the risk free rate, involving the claims that matching the risk free rate term to the regulatory term

- is not necessary to satisfy the NPV = 0 principle
- only holds under the assumption that the expectations hypothesis characterizes the term structure of interest rates
- implies that the regulatory term should be minimized
- implies that the MRP estimate should be lower than that currently used by the QCA
- implies that the regulated output price is inconsistent with that which would prevail in a competitive market.

Finally, the paper assesses whether the QCA's current approach of using the spot risk free rate along with an MRP estimated in a variety of ways, and using data from a variety of periods, is

- consistent with the NPV = 0 principle
- consistent with the CAPM
- reasonable in current market conditions

2. Review of Submissions under Task 2A

2.1 Asciano

The submission from Asciano (2013) does not contain any specific comments on the risk free rate or the MRP.

2.2 SFG: *Response on the Risk-free Rate and the MRP*

SFG (2013a, paras 35-36) argues that the QCA's current approach to estimating the MRP places 75% weight on estimation procedures that are "very slow-moving over time." Included in this set is survey estimates, on the grounds that (acceptable) surveys are only periodically updated. However the surveys that the QCA relies upon (Fernandez) have recently been updated annually. Thus SFG's claim is false.

SFG (2013a, paras 38-39) argues that on account of placing 75% weight on estimation procedures that move very slowly over time the QCA's current approach is essentially fixed at 6%. However, as explained in the previous paragraph, the premise here is false. Furthermore, even if the premise were true, the conclusion would not follow. Consider historical averaging of the Ibbotson type. There is ongoing debate about the appropriate historical period to use, whether to also draw upon estimates from foreign markets, which foreign markets to use, which data sources to rely upon, and whether corrections to the data are required. Any of these factors could materially alter the estimate of the MRP, and recent work by Brailsford et al (2008) has reduced the Ibbotson-type estimate.

SFG (2013a, paras 50-51) observes that the allowed cost of equity arising from the methodology currently used by the QCA (involving the prevailing nominal five-year government bond rate, an MRP of 6%, and an equity beta of 0.8) is currently lower than at any time since 1973, with the numbers ranging from the current value of about 7% to as much as 21% in 1982. By implication, the currently allowed rate is too low. However the comparison is spurious because about half of the period examined (1973-1990) was characterized by much higher inflation rates than at present, leading to high nominal risk free rates and therefore high nominal allowed costs of equity, but mitigated by the higher growth in the value of the regulatory asset base. In particular, inflation averaged 9.2% from 1973-1990 compared with a more recent average of about 2% (Brailsford et al, 2012).

SFG (2013a, paras 59-65) notes that the (observed) debt risk premium (DRP) has risen significantly since 2008, that the QCA's estimate of the MRP (6%) has not changed, and that this is implausible. I agree; even if most of the DRP increase were attributable to an increase in the probability of default and the allowance for the inferior liquidity of corporate relative to government bonds rather than an increase in the allowance for systematic risk on bonds, changes in the default probability are likely to be positively correlated with changes in the MRP because the MRP is compensation for bearing equity risk (Merton, 1980), equity risk (volatility) seems to be greatest in depressed economic conditions (French et al, 1987, Figure 1a and 1b), and the default probability also rises sharply in depressed economic conditions. However, it is not enough merely to believe that the MRP has risen. It is also necessary to reliably determine whether it has risen and, if so, to estimate the extent of the increase. Since the MRP is not observable, and all estimation methods have their shortcomings, the QCA (reasonably) considers estimates from a variety of methodologies, averages over their results, and then rounds the result to the nearest 1%. Some of the methodologies used by the QCA are likely to respond quickly to changes in the true MRP (the forward-looking and survey methods), and therefore will reflect SFG's DRP argument to the extent that it is valid, whilst the other methodologies used by the QCA do not respond quickly to changes in the true MRP (the Ibbotson and Siegel methods), and the latter methods exert a dampening effect on the QCA's estimate of the MRP. In fact, if the (unobservable) MRP rises and therefore equity returns fall, the short-term effect of the MRP rise will be a *fall* in the estimated MRP from the Ibbotson or Siegel methods, and this magnifies the dampening effect. In addition the QCA's practice of rounding the estimate of the MRP to the nearest 1% also exerts a dampening effect upon its estimate of the MRP. Thus, to the extent that SFG's DRP argument is valid, it will be reflected in the QCA's estimate of the MRP, but dampened by recourse to results from the Ibbotson and Siegel methods, and by rounding to the nearest 1%. Of course, SFG might object to these dampening effects. If so, these arguments need to be presented. It is not enough merely to observe that the QCA's estimate of the MRP does not respond quickly to changes in circumstances that are likely to raise the true MRP.

Furthermore there is a significant asymmetry in SFG's line of argument, in that they focus only upon circumstances in which the MRP is liable to have risen. In particular, their Figure 2 reveals that the DRP approximately halved from 2001 to 2006 and therefore it is likely that the MRP fell during this period. However I am not aware of any submission from them to an Australian regulatory body in which they argued for a reduction in the estimated MRP during this period.

SFG (2013a, paras 62-63) quotes from McKenzie and Partington (2011) and attributes to them the view that higher DRPs imply a higher MRP. However, McKenzie and Partington (ibid, paras 130-136) conclude their paper by identifying a number of methodologies that should be used to estimate the MRP, these methodologies do *not* include recourse to DRPs, and their only concluding comment upon such an approach is to state that one such analysis (Bishop and Officer, 2009) is "erroneous". So, SFG have misrepresented McKenzie and Partington.

SFG (2013a, paras 66-72) claim that the cost of debt is 6.74%, the cost of equity is 7.46%, the latter figure reduces to 6.14% for foreign investors, and it is implausible that foreign investors would accept less than debt holders. However this analysis contains a number of errors. Firstly, the cost of equity is an expected rate of return whilst the cost of debt is a promised rate, and therefore the comparison is spurious. Secondly, even when focusing on the expected rate of return on debt so that the comparison with the cost of equity is sensible, part of the expected rate of return on debt is compensation for the inferior liquidity of corporate bonds relative to government bonds and this compensation may be greater than for equities. Thirdly, the figure of 7.46% is based upon a risk free rate of 2.66% (ibid, para 45) and SFG refer to a DRP of 3.67% (ibid, footnote 21), which collectively imply a cost of debt of 6.33% rather than the figure of 6.74% claimed by SFG. Fourthly, the conversion of 7.46% to 6.14% presumes that there are no expected capital gains, i.e., expected returns to equity holders take the form of only dividends and imputation credits. However, the empirical evidence refutes this assumption and the result is that the figure of 6.14% would be substantially higher. Finally the cost of equity figure of 7.46% arises inter alia from the QCA's estimate for the MRP of 6%, this latter estimate is based upon four methodologies of which two (the Ibbotson and Siegel methods) are only minimally affected by imputation credits because they employ historical average returns and most of these are drawn from the period prior to the introduction of imputation. So, even if there were no expected capital gains, SFG's adjustment to the figure of 7.46% would be excessive.

To quantify the last two effects, we start with the Ibbotson method. Using this approach, Brailsford et al (2012, Table 1, Table 3) reveals that the impact of imputation credits on the MRP estimate using all available historical data is 0.30% when the utilization rate on the credits is 1. Consequently, using the QCA's preferred estimate of 0.625 for the utilization rate, the impact of imputation credits on the MRP is only 0.19%. So, with an equity beta of 0.8 (SFG, 2013a, para 45), the impact of imputation credits on the cost of equity would be only 0.15%. The same applies to the Siegel method. In respect of forward-looking estimates of the MRP, the relevant parameter values are the prevailing ones. So the impact of imputation credits on the cost of equity is the product of the current cash dividend yield (4.9%: see NERA, 2013, section 6.2), the current maximum franking rate (3/7, with a corporate tax rate of 30%), the current proportion of dividends that are fully franked (0.75: see Brailsford et al, 2008, footnote 23), and the utilization rate (0.625). The result is 1.0%. Averaging this figure of 1% and the above figure of 0.15%, the impact of imputation credits on the cost of equity is only about 0.60%. Thus, starting with 7.46% and removing the effect of imputation credits, the result would be 6.86% rather than the figure of 6.14% claimed by SFG.

SFG (2013a, paras 73-75) claims that the cost of equity for unlevered rail businesses is 5.36%, the cost of debt is higher (presumably 6.74%), which implies that the optimal capital structure involves no debt, and this suggests that the QCA's methodology or parameter estimates are deficient. Again this analysis contains a number of errors. Firstly, the cost of equity is an expected rate of return whilst the cost of debt is a promised rate, and therefore the comparison is spurious. Secondly, even when focusing on the expected rate of return on debt so that the comparison with the cost of equity is sensible, part of the expected rate of return on debt is compensation for the inferior liquidity of corporate bonds relative to government bonds and this compensation may be greater than for equities. Thirdly, the cost of debt implicitly referred to by SFG (6.74%) is before the corporate tax deduction. However, the corporate tax deduction on debt must be included in order to form a sensible conclusion about optimal capital structure. Fourthly, the cost of debt implicitly referred to by SFG (6.74%) is based upon a leverage ratio of 55% rather than minimal leverage, the latter cost of debt would be considerably lower than 6.74%, and only this lower number could be sensibly compared with the unlevered cost of equity. Fifthly, the figure of 6.74% should be 6.33% as discussed in the previous paragraph. Lastly, SFG implies that optimal capital structure is that which minimizes WACC. However the academic literature has identified a wide range of additional considerations that are not referred to by SFG, including the signalling value of debt in the presence of asymmetric information (Ross, 1977), the reduction of underinvestment problems springing from the use of equity finance (Myers and Majluf, 1984), the reduction of agency costs springing from the use of equity finance (Jensen and Meckling, 1976), the disciplinary effects of debt (Jensen, 1986), and the financial flexibility arising from debt.

SFG (2013a, paras 76-85) notes that the Ibbotson approach to estimating the MRP produces an estimate of the average MRP over the historical period used in the estimation rather than one that is commensurate with prevailing conditions, and they imply that it should not then be used. It is uncontroversial that the Ibbotson approach to estimating the MRP produces an estimate of the average MRP over the historical period used in the estimation rather than one that is commensurate with prevailing conditions, and clearly would not be suitable if it were the only means by which the MRP were estimated by the QCA. However the QCA averages over the results from a number of methods and the result from doing so may be superior to relying only upon results from methodologies that reflect current market conditions. This involves a trade-off between bias and variance in the estimator and is discussed further in section 6.1.

SFG (2013a, paras 86-91) refers to the Siegel approach to estimating the MRP, involving modifying the Ibbotson estimate (the historical average nominal market return net of the historical average nominal risk free rate) by adding back the historical average real risk free rate (part of the historical average nominal risk free rate) and instead deducting the expected long-term real risk free rate.[1] The rationale for this method is that unexpected inflation in the 20th century depressed the real yield on government bonds but not the real return on the market, and therefore induced an upward bias in the Ibbotson methodology (as observed by Siegel, 1992). SFG claims that the QCA uses an estimate of the expected long-term real risk free rate of 4% in the course of implementing the Siegel methodology, based upon an estimate from Lally (2004a), argues that this can be estimated using the yield on inflation-indexed government bonds, notes that such rates have been consistently below 4% since 2004, and therefore that the estimate of 4% is too high. However, I understand from the QCA that their estimate of this parameter is in fact 3.8%, based upon the average yield on inflation-indexed government bonds since they were first issued in July 1986 until October 2012. Furthermore, since this parameter is the expected long-run real-risk free rate (Lally, 2004a, pp. 46-47; QCA, 2012, page 22), an estimate of it should be based upon the longest available data series (as the QCA have done, yielding 3.8%) rather than only data since 2004 (as SFG favour, which would yield 2.4%).[2] So SFG's criticism is unwarranted.

[1] SFG mistakenly describes the expected long-term real risk free rate as the "expected future real risk-free rate".

[2] See http://www.rba.gov.au/statistics/tables/index.html#interest_rates.

SFG (2013a, para 92) also argues that the current yield on inflation-indexed government bonds should be used. Presumably they are suggesting an MRP estimate that comprised the historical average real return on equities less the current real risk-free rate. However, such a result would necessarily be expressed in real terms whilst all other MRP results considered here are expressed in nominal terms. To obtain a result in nominal terms, it would be necessary to convert the historical average real return on equities to its nominal value, using current expected inflation, and then deduct the current nominal risk free rate. Like the approach described in the previous paragraph, such an approach would address the concern that unexpected inflation in the 20th century depressed the historical average real risk free rate below that expected and therefore induced an upward bias in the Ibbotson estimate of the MRP. In comparing these two variants of the Siegel approach, SFG's favoured approach presumes that the real expected market return is constant over time (and therefore should be estimated using the historical average real return on equities) whilst the approach discussed in the previous paragraph presumes that the nominal MRP is constant over time (and therefore should be estimated in the manner described in the previous paragraph). To assess which of these two approaches is better, one could consider the time series of 30-year rolling-average real equity returns and Ibbotson estimators, as shown in Lally (2013a, Figure 1). The visual evidence is that the Ibbotson estimator is more stable over time than the average real return on equities, and this is consistent with the statistical evidence, i.e., the standard deviation of the Ibbotson estimator series is considerably less than for the series of average real equity returns (ibid, page 13). Although this type of evidence is imperfect, because it treats these 30-year sample averages as if they were the true values of the underlying expectations, it suggests that the Ibbotson estimator (modified in the way described in the previous paragraph) is a better approach to dealing with the problem identified by Siegel (1992) than the approach favoured by SFG.

SFG (2013a, para 93) claims that no one else uses the Siegel approach. This is not correct. The New Zealand Commerce Commission (Commerce Commission, 2010) uses the approach favoured here and used by the QCA, whilst the Siegel variant favoured by SFG is widely used by UK regulators (Wright, 2012).

SFG (2013a, paras 94-98) cite a Cornell-type estimate of the MRP of 7.5%, from Nelson et al (2012), and then modify it to allow for the value of imputation credits to yield an MRP estimate of 8.5%. There are three problems with this. Firstly, there is an error in the calculations; using the parameter values and the model presented by SFG, the MRP estimate should be 9.75% rather than 8.5%. Secondly, the process for adjusting for imputation credits presumes that there are no expected capital gains, i.e., expected returns to equity holders take the form of only dividends and imputation credits. However, the empirical evidence refutes this assumption and the result is that the modified MRP estimate using this approach would be too high. Thirdly, the analysis carried out by Nelson et al (2012) is very similar to that by CEG (2012) and shares all of the same concerns raised by me about CEG's analysis in Lally (2012a, section 4.2). In particular, the analysis unreasonably assumes that the long-run expected growth rate in dividends per share (DPS) is equal to the long-run expected growth rate in GDP, it unreasonably assumes that the expected return on equities is the same for all future years, it assumes that the current value of the market portfolio equals the present value of future dividends (reasonable but potentially problematic), and it is prone to error in the presence of both short-term and long-term fluctuations in the market's earnings retention rate. None of these concerns are addressed by SFG.

SFG (2013a, paras 108-120) raises a number of concerns with the Fernandez et al (2011) survey relating to the MRP. These comprise the fact that the survey was not undertaken in 2012, concerns about the uses that respondents made of the estimate, whether it was a long-run estimate to couple with a long-run risk free rate, and the fact that it involved only 40 respondents. The first and last concerns are dealt with by reference to the 2012 survey by the same authors (Fernandez et al, 2012), involving 73 respondents (both academics and a wide range of practitioners), and yielding an almost identical average result (5.9% for 2012 and 5.8% for 2011). The second concern is somewhat vague but SFG do offer one example, in which a stockbroker might use an MRP estimate "to assist them in making a case that their clients should buy shares in a particular firm" (ibid, para 116). However my experience with stockbrokers is that the firm will adopt the same estimate for all purposes and that their estimates are not unusual amongst practitioners in general. In respect of SFG's final concern, as to whether the MRP estimate offered by a respondent is a long-run or medium-run estimate, I am not aware of any survey that addresses this problem and therefore the best one can do is to acknowledge it as a potential shortcoming, which would impart a downward bias to the medium-run estimate that is sought. A further concern, which is not mentioned by SFG, lies in the fact that some respondents will have provided responses for an MRP defined against bonds and others against bills. Since the interest here is with an MRP estimate defined against bonds, and bond yields both currently and typically exceed bill yields, the estimates provided by respondents who define the MRP against bills will be too high. Accordingly, the average response of 5.9% will be too high for the present purposes. These last two problems will be at least partly offsetting. Finally, it should be noted that the Fernandez surveys cover a wide range of countries, and this permits results from other countries to be used for the present purposes. This is a distinct advantage to this survey.

SFG (2013a, paras 121-125) argues that survey responses on the MRP do not incorporate the effect of imputation credits, that such an adjustment should therefore be made, and the correct process is as indicated in their para 123. However, as discussed earlier, this adjustment formula presumes that there are no expected capital gains (i.e., expected returns to equity holders take the form of only dividends and imputation credits), the empirical evidence refutes this assumption and the result is that the modified MRP estimate using this approach would be too high. In respect of whether survey responses incorporate the effects of imputation credits, the only evidence presented by SFG is a quotation from the AER (2009, page 407) concerning market practitioners. However the Fernandez survey includes academics as well as market practitioners, and academics represent 40% of the respondents (Fernandez et al, 2012, Table 3). Furthermore, even if practitioners in general do not take account of imputation in the sense of explicitly allowing for it in their modeling, they are likely to have been influenced to some degree by the 6% estimate generally used by Australian regulators and this estimate does incorporate the effects of imputation. Consistent with this the average response amongst the practitioners is exactly 6.0% (ibid, Table 3).

SFG (2013a, paras 127-153) cites IPART's view that there is a negative relationship between the MRP and the risk free rate, and therefore it is not sensible to couple a current risk free rate with a long-term estimate of the MRP. Accordingly IPART raised its estimate of the cost of equity capital and this is equivalent to an increase in its MRP estimate. This argument has been raised previously by CEG (2012a) and addressed by Lally (2012a). In particular, whilst the proposition of a negative relationship between the MRP and the risk free rate is entirely plausible, no persuasive evidence was presented that there is a *strong* negative relationship between the ten year risk free rate and the MRP, the primary evidence presented by CEG is pre-disposed to that result, and many Australian regulators including the QCA do not estimate the long-term MRP but instead estimate a MRP that reflects both prevailing and longer-term factors. Furthermore, the more important issue is to compensate regulated businesses for their cost of capital over the life of their regulated assets rather than only the next few years, and therefore a process for estimating the cost of equity that is biased under some economic conditions but most accurate over the life of the regulated assets might still be preferred. Finally, CEG and apparently SFG suggest that the generally employed methodology should be abandoned only when conditions are unusual; this approach is highly subjective, may lead to variations only when they favour regulated firms, and therefore is not desirable.

In respect of the point that a process for estimating the cost of equity that is biased under some economic conditions but most accurate over the life of regulated assets might still be preferred, as argued in Lally (2012a, section 4.4), SFG (2013, para 157) argues that this might (at times when the allowed cost of equity is too low) lead consumers of the regulated service to seek less efficient sources of energy and regulated firms to underinvest. However, precisely because these kinds of decisions are long-term, these parties are likely to be more concerned with the MRP estimated by the QCA over the long term rather than at the present time and SFG is clearly not arguing that the QCA's estimate of the MRP is wrong in the long term. Furthermore, an MRP estimate that did fluctuate over time in the way that SFG favours is likely to be estimated in a very subjective fashion and this is likely to cause much more anxiety amongst regulated firms and consumers than the current approach adopted by the QCA.

2.3 ARTC

ARTC (2013, pp. 13-14) favours a term for the risk free rate that corresponds to the financing behavior of firms rather than to the regulatory cycle, on the basis that the latter compels firms to refinance at this frequency (five years or less) and this increases their refinancing risk. This claim is not correct. A firm can borrow for a longer term than the regulatory cycle, and align the risk free rate component of its cost of debt with the regulatory cycle via the use of interest rate swap contracts. Furthermore, this is standard practice amongst private-sector regulated firms in Australia (AER, 2009, pp. 152-153; QTC, 2012, Attachment 1, pp. 27-29).

ARTC (2013, page 15) also favours an MRP of 6.5-7.0%, but provides no analysis in support of this claim.

2.4 Bowman

Bowman (2013) favours an MRP estimate of 7% by adjusting a long-term MRP estimate of 6% to reflect the current long-term government bond rate of 3.41% relative to the historical average long-term government bond rate of 5.7% and Bowman's belief that there is an inverse 2:1 relationship between changes in the long-term risk free rate and the MRP (based on Harris and Marston, 1992):

$$MRP = 6.0\% - .5(3.41\% - 5.7\%) = 7.15\%$$

This analysis suffers from several difficulties. Firstly, the Harris and Marston (1992) paper uses US rather than Australian data. Secondly, this paper uses data from 1982-1991 (ibid, page 65), and is therefore over 20 years old. Thirdly, Bowman implicitly places 100% weight upon the result from one methodology. So, even if the approach is unbiased, it is likely to have high variance and therefore to be less satisfactory than the QCA's approach, in which results from four different methodologies are considered. Furthermore, one of these methodologies considered by the QCA is a forward-looking approach very similar to that of Harris and Marston. So, in effect, the QCA considers Bowman's approach but assigns it a weight of 25% rather than 100%. Finally, the Harris and Marston methodology assumes that, at any point in time, the expected return on equities is the same for all future years; this assumption is also made by CEG (2012) in the course of estimating the MRP through a similar methodology and (as discussed in Lally, 2012a) is both unreasonable and is likely to overestimate the MRP when the risk free rate is low, as at present.

2.5 DBCT

The submission from DBCT (2013) does not contain any specific comments on the risk free rate or the MRP.

2.6 Origin

Origin (2013) believes that the market cost of equity is stable, despite recent declines in the risk free rate, and therefore favours a five-year average for the risk free rate coupled with a long-term estimate for the MRP of 6%. This approach is very similar to one of the approaches proposed by CEG (2012), and suffers from most of the same difficulties. In particular, the approach will overestimate the cost of equity for businesses with equity betas less than 1 (because use of a higher risk free rate in compensation for an MRP that is believed to be too low over compensates when beta is less than 1)[3], wrongly assumes that the widely employed MRP estimate of 6% is an estimate of the long-term MRP, embodies no rationale for using the particular historical period chosen for averaging the risk free rate (the last five years for Origin), and sacrifices an observable, relevant and significant parameter in the form of the current risk free rate.

In support of their belief that the market cost of equity is stable over time, Origin presents a time series of the forecast earnings yield of the market. However Origin does not explain whose forecast it is and wrongly describes it as the forecast dividend yield (twice). In addition, all earnings yields are sensitive to the way in which earnings are defined by accountants. Finally, it is implicit in this evidence that the earnings yield is the same as the market cost of equity. To assess the conditions under which this is true, suppose that the expected growth rate in dividends (g) is the same for all future years. Letting k denote the expected rate of return on the market, the value of all equities would be as follows:

$$S = \frac{E(DIV_1)}{k - g}$$

[3] To illustrate this point, suppose that the current risk free rate is 3%, the historical average is 5%, and $E(R_m)$ is believed to be constant at 11%. Consequently the current MRP is believed to be 8% and the historical average MRP is believed to be 6%. Thus, for a firm with an equity beta of 1, the cost of capital is believed to be 11%, comprising the current risk free rate (3%) and the estimate for the current MRP (8%). This estimated cost of equity could also be obtained by adding the historical average risk free rate (5%) to the estimate for the historical average MRP (6%), because the error in overstating the risk free rate is perfectly offset by the error in understating the MRP. However, for beta less than 1, the two effects do not offset. For example, if beta is 0.5, the firm's cost of equity will be believed to be 7% using the current risk free rate of 3% and the estimate for the current MRP of 8%. By contrast, the estimate obtained using the historical average risk free rate of 5% and the estimate of the historical average MRP of 6% will be 8%, and therefore 1% higher than the analyst believes it to be.

Dividends are earnings net of retention. So, letting *EAR* denote market earnings and *y* the retention rate:

$$S = \frac{E(EAR_1)(1-y)}{k-g}$$

So, the forecast earnings yield is then as follows:

$$\frac{E(EAR_1)}{S} = \frac{k-g}{1-y}$$

Thus, the forecast earnings yield is equal to *k* only if

$$k = \frac{k-g}{1-y} \quad \Rightarrow g = ky$$

In turn this would require zero inflation and the expected rate of return on new investment to equal *k* on average, i.e., new investment to be zero NPV on average (see Lally, 1988).[4] The first condition is empirically false and the second condition may be. So, if *k* fell over time, and the expected rate of return on new investment fell faster, the forecast earnings yield might remain constant. Thus, observing that the forecast earnings yield is constant over time does not imply that the market cost of equity also is.

Origin's view that the market cost of equity is stable, despite changes in the risk free rate, implies that the market cost of equity is more stable than the MRP. However Lally (2013a, Figure 1) plots 30-year rolling-average real equity returns and Ibbotson estimators, and this reveals that the Ibbotson estimator is more stable over time than the average real return on equities. This contradicts Origin's view that the market cost of equity is more stable than the MRP.

[4] If the expected rate of return on a project equals its cost of capital, the NPV of the project will be zero.

2.7 QTT

The submission from QTT (2013) does not contain any specific comments on the risk free rate or the MRP.

2.8 QRC

The QRC (2013) considers that the QCA's estimate for the MRP is too high because the Cornell estimate for the MRP is biased upwards, and this arises from the assumption that the long-run expected growth rate in dividends per share is equal to the long-run expected growth rate in GDP, i.e., no allowance is made for new share issues and the formation of new companies. However, the QCA (2012, Appendix B) recognizes this point and therefore describes their Cornell-estimate of the MRP as an upper bound. Furthermore, Lally (2012a, section 4.2) provides an estimate of the appropriate deduction for new share issues and the formation of new companies, and this will be invoked in section 6.3.

2.9 QTC

The QTC (2013, pp. 5-6) contests the proposition that the appropriate risk free rate must match the regulatory period, in order to satisfy the NPV = 0 test, on a number of bases. Their first argument is that this proposition assumes that the resetting process at the end of each regulatory cycle (typically five years) must be such as to equate the market value of the firm's equity with its regulatory book value at that time, and this is not possible because share prices of regulated businesses are influenced by factors beyond the regulatory period. However the QTC seem to be conflating the share price of a regulated business with the share price of the company that carries out the regulated activities, and only the latter exists. For example, suppose a company undertakes some regulated business and this is its only existing activity but it also possesses some growth options, i.e., potential opportunities to engage in NPV positive projects outside the regulated business at some future point. Its share price will reflect the value of these opportunities and will therefore change as the market's perception of those options changes. However, this has no bearing on the appropriate risk free rate for the regulated activities that it undertakes.[5]

[5] The market value of the regulated business may also differ from the RAB if the market's perception of expected costs (inclusive of any efficiency gains) differs from the costs allowed by the regulator.

QTC's second argument is that firms that operate a regulated business tend to simultaneously operate a number of regulated businesses, with different regulatory periods, and this would also prevent the market value of the firm from matching its (presumably aggregate) RAB at any point in time. This argument reflects a belief that the proposition in question (that the appropriate risk free rate is that matching the regulatory cycle) applies to the firm rather than to each regulated business, and this is false. The proposition applies to each of the regulated businesses rather than to the portfolio of them. Thus, it does not matter whether these individual businesses have regulatory periods that commence at the same time or even are of the same length.

QTC's third argument is that the proposition in question (the appropriate risk free rate is that matching the regulatory cycle) assumes that the regulated business will be sold at the end of the regulatory cycle. However, no such assumption underlies the proposition (see Schmalensee, 1989; Lally, 2004b), either explicitly or implicitly. A proposition that rests upon a number of assumptions can be critiqued on the grounds that the assumptions are very unrealistic but it cannot be critiqued on the basis of assumptions that are never made. Furthermore the usual practice in critiquing an assumption that is believed to underlie a model is to cite the reference to the alleged assumption in the original work or to demonstrate that it has implicitly been made. QTC do neither of these.

The QTC (ibid, pp. 5-6) also argues that the appropriate risk free rate is the ten year rate because this reflects the extra compensation to equity investors for committing funds beyond the regulatory period, and they believe that the ten-year rate satisfies the NPV = 0 test. However they do not provide any formal analysis in support of this belief. Vaguely-worded assertions are no substitute for a formal analysis.

The QTC (ibid, page 6) also argues that a ten-year term is relevant to unregulated businesses in competitive markets, and that regulation should seek to replicate the behavior of such businesses. No evidence is presented for the first claim. Furthermore the second claim is true only in the sense that unregulated prices in competitive markets just cover costs, including the cost of capital, and regulation should seek to do likewise. However, even if both types of firms have output prices that just cover their costs, it does not follow that every detail about them is or should be identical. Nor is it possible for every detail to be identical because regulated firms are by definition regulated, in recognition of circumstances that differ from those of unregulated firms in competitive markets, and there are a variety of regulatory models. For example, one might regulate prices or revenues, and one might reset these at high or low frequency, and one might allow some costs to be passed-through. All of these regulatory choices affect the cost of capital of a regulated firm. So, having made the choice and therefore determined the cost of capital of the regulated firm, the cost of capital allowed by the regulator must compensate for it rather than match the cost of capital as an otherwise identical unregulated firm in a competitive market. Expressly alternatively, the cost of capital reflects risk, regulation affects the risk of regulated firms, and therefore the cost of capital for a regulated business may differ from that of an otherwise identical unregulated firm in a competitive market.

The QTC (2013, pp. 8-10) favours a long-term average of the risk free rate in conjunction with a long-term estimate of the MRP. The merits of this argument have been dealt with in section 2.6.

The QTC (2013, page 10) argues that, when there is a wide range (as at present) in the results from the MRP estimation methods that are generally used, it is desirable to augment the set of estimates with results from a range of other methodologies, such as “credit and liquidity spreads, dividend yields, and the slope of the CGS yield curve.” However they present no evidence that the spread in outcomes from different methodologies is unusually wide at the present time. Furthermore the QTC does not cite specific studies whose methodologies they favour. Finally, their proposal is premised upon the belief that similarity in results from different methodologies is an indicator that all such results are close to the true MRP. This is dubious; the results from different methodologies are each a drawing from a probability distribution, and correlations between outcomes from different methodologies is generally low. So, similarity in results would then be due to chance.

The QTC (2013, page 11) recommends that the MRP also be estimated by assuming that the expected real market cost of equity is constant over time, estimating this parameter from its historical average value, converting this to a nominal value using current inflation expectations, and then deducting the current risk free rate. The QTC's resulting estimate is 8.1%. This methodology derives from Siegel (1992). Like the 'Siegel' methodology adopted by the QCA, this approach is a response to unexpected inflation in the 20th century significantly depressing the real yield on government bonds but not the real return on the market, and therefore inducing an upward bias in the Ibbotson methodology (as observed by Siegel, 1992). The relative merits of the two Siegel approaches have been discussed earlier (see section 2.2) and the approach adopted by the QCA is favoured.

The QTC (2013, pp. 11-12) argue that there is considerable uncertainty surrounding the appropriate adjustment to the Ibbotson estimate of the MRP in order to deal with unexpected 20th century inflation. I agree but all methods are imperfect and recourse to results from a variety of methods is a response to that problem.

The QTC (2013, page 12) argues that only a small proportion of investors are influenced by Siegel in support of their MRP estimate, and therefore this method should not be adopted by the QCA. In support of the first claim, they note that only a small proportion of respondents to the Fernandez surveys (Fernandez et al, 2011, 2012) cite Siegel in support of their view (9 out of 1653). However, the respondents to these surveys are academics, analysts and managers rather than investors per se. Furthermore, many of the respondents cite articles or books that are only reviews of the original work rather than original work per se, such as "Damodaran" (which is the largest individual category) and these reviews would have to be deleted from the total. In addition reference to Siegel appears in a miscellaneous category involving 273 respondents, and respondents in a variety of other categories including "historical data" (102 respondents) and "experience" (77 respondents) may also have been influenced by Siegel or the same concerns underlying Siegel's work (Fernandez et al, 2012, Table 5). Finally, it is inconsistent of the QTC to argue against the QCA using a methodology that derives from Siegel (1992) whilst simultaneously recommending a variant of it (as described in the penultimate paragraph).

The QTC (2013, page 14) cites a report by Ernst and Young (2012), who examined the market costs of equity in 17 reports by "independent valuation experts" in 2012, yielding an average market cost of equity (of 10.7%) in excess of that arising from the AER's (and QCA's) methodology (an MRP of 6% coupled with the prevailing CGS yield). Appendix C of the Ernst and Young Report reveals that the valuers used an average risk free rate of 4.4% and an average MRP estimate of 6.3% whilst the rates that would have arisen from the regulatory methodology on dates matching those of the valuers' reports would have been an average (ten-year) risk free rate of 3.5% and an MRP estimate of 6.0%. The QTC (ibid, page 15) conclude that the average MRP estimate used by the valuers relative to the prevailing ten-year risk free rate is 7.2% (10.7% - 3.5%). Furthermore, since the QCA uses the five-year risk free rate rather than the ten-year rate, and the former averaged 3.1% at the dates in question, then the QCA ought to be using an MRP estimate of 7.6% in order to match the average market cost of equity of 10.7% used by the valuers.

This line of argument presumes that the QCA is engaged in the same exercise as the valuers and therefore ought to be using the same parameter values. However the two exercises are fundamentally different, and this readily explains the difference in rates. The QCA resets the risk-free rate every few years (typically five years) and therefore need only be concerned with the prevailing risk-free rate for the next five years. By contrast these valuers are conducting DCFs for businesses with infinite-life cash flows and therefore would be interested in the prevailing term structure of risk-free rates for terms out to infinity.[6] Since observed rates exist only out to ten years, these valuers would have to speculate upon the rest of the term structure, and then invoke an average rate if they used only one rate (as they do). Since the term structure is currently markedly upward sloping, the term structure beyond the five year term invoked by the QCA will be in excess of this regulatory rate and therefore the average rate invoked by the valuers over the entire term structure would be in excess of the five-year rate invoked by the QCA.[7]

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[6] Brotherson et al (2013) survey a range of practitioners in the US, where government bonds with maturities up to 30 years exist, and enquired into the risk free rates used for DCF purposes. The shortest maturity bonds used were ten-year bonds and many practitioners used 30-year bonds (ibid, Table 2).

[7] For Australia the current (July 2013 average) rates on five and ten year CGS are 3.09% and 3.75%. To gain some sense of what the (unobservable) Australian term structure beyond ten years might be at the present time, consider US Treasury Bonds, which have maturities up to 30 years. Currently (July 2013 average) the rates for 10, 20 and 30 year bonds are 2.58%, 3.31% and 3.61% respectively (http://research.stlouisfed.org/fred2/data).

To illustrate this point, suppose a company is expected to deliver dividends of \$100m in 10 years, \$163m in 20 years, \$265m in 30 years, and \$432m in 40 years (embodying an expected growth rate of 5% per year). The current ten-year risk free rate is 3.5%, the ten-year MRP is 6%, the former is expected to revert to its long-run average of 6% in ten years, the MRP is not expected to change over time, and the expectations hypothesis characterizes the term structure of interest rates.[8] Accordingly, the prevailing 20 year risk free rate would be 4.74% as follows:

$$R_{f20} = \sqrt[20]{(1.035)^{10}(1.06)^{10}} - 1 = .0474$$

Similarly, the prevailing 30 year rate would be 5.16% and the prevailing 40 year rate would be 5.37%. Coupled with an MRP of 6.0%, the resulting discount rates would be 9.5% for cash flows in 10 years, 10.74% for cash flows in 20 years, 11.16% for 30 years, and 11.37% for 40 years. Invoking these discount rates, the value now of the dividends would be

$$S = \frac{\$100m}{(1.095)^{10}} + \frac{\$163m}{(1.1074)^{20}} + \frac{\$265m}{(1.1116)^{30}} + \frac{\$432m}{(1.1137)^{40}} = \$78.4m$$

If the single risk free rate were used, the rate would have to be R as follows:

$$\$78.4m = \frac{\$100m}{(1+R+.06)^{10}} + \frac{\$163m}{(1+R+.06)^{20}} + \frac{\$265m}{(1+R+.06)^{30}} + \frac{\$432m}{(1+R+.06)^{40}}$$

The solution is R = 4.6%. So, if the current ten-year risk free rate is 3.5%, and is expected to revert to its long-run average of 6% in ten years' time, the appropriate risk free rate to apply to a very long-term series of dividends with an expected growth rate of 5% is 4.6%. This closely parallels the actions of the valuers who, faced with a prevailing (but low) ten-year risk free rate of 3.5%, have used the higher risk free rate of 4.4% to conduct their valuations.

In summary, when conducting valuations of equities at a time when the term structure of risk free rates is upward sloping (as at present), it is entirely appropriate to use a risk free rate in

[8] This assumption is adopted to simplify the example and not in the belief that it is correct.

excess of even the prevailing ten year rate. This has no implications for the QCA, who are and should be using the five-year risk free rate, because QCA (unlike the valuers) will periodically revise its rate. Thus, far from these valuers' reports revealing an effective MRP estimate of 7.6%, they instead reveal an average MRP estimate of 6.3% (which is consistent with the QCA's rounded estimate of 6.0%).

The QTC (2013, pp. 17-19) argue that liquidity margins on Australian state-government debt rose during the GFC, which implies that liquidity margins on equities should also have risen, these are part of the MRP (at least empirically), and therefore the MRP must have risen. This argument is plausible. However it is not enough merely to believe that the MRP has risen. It is also necessary to reliably determine whether it has risen and, if so, to estimate the extent of the increase. Since the MRP is not observable, and all estimation methods have their shortcomings, the QCA (reasonably) considers estimates from a variety of methodologies, averages over their results, and then rounds the result to the nearest 1%. Some of the methodologies used by the QCA are likely to respond quickly to changes in the true MRP (the forward-looking and survey methods), and therefore would reflect this liquidity effect to the extent that it exists, whilst other methods do not respond quickly to changes in the true MRP (the Ibbotson and Siegel methods). Thus, to the extent that the QTC's liquidity argument is valid, it will be reflected in the QCA's estimate of the MRP, but dampened by recourse to results from the Ibbotson and Siegel methods, and by rounding to the nearest 1%. Of course, the QTC might object to these dampening effects. If so, these arguments need to be presented.

In respect of the point that a process for estimating the cost of equity that is biased under some economic conditions but most accurate over the life of regulated assets might still be preferred, as argued in Lally (2012a, section 4.4), the QTC (2013, pp. 20-21) argues that this approach is likely to impart greater volatility to the prices faced by consumers, and consumers are unable to hedge this risk. Accordingly, if there is evidence that the market cost of equity is more stable than the prevailing CGS yield coupled with a long-run MRP estimate, then the former option should be investigated. It is not clear from these comments which estimation methodology is being suggested by the QTC. They might be suggesting that the real market cost of equity is stable over time, and therefore should be estimated from its historical average, followed by conversion to an MRP estimate using the current inflation forecast and CGS rates, or alternatively that a historical average of the risk free rate should be coupled with a long-run estimate of the MRP. Both of these proposals have already been presented by the QTC, and have already been addressed earlier in this section. In addition the QTC might also be suggesting that low volatility in prices is the paramount consideration. If so, I do not agree. I consider that the paramount issue is to obtain the 'best' estimate of the cost of capital for the regulated entity and, even if it induces more volatility in prices to consumers than other estimates of the cost of capital. Furthermore, volatility in prices (from cycle to cycle) can be dampened by 'transitioning' mechanisms and this has been done on some occasions. Effectively this involves variations from straight line depreciation during the asset life in order to dampen volatility in prices.

2.10 Queensland Urban Utilities

The QUU (2013a, page 6) disputes that the QCA's approach to estimating the MRP is forward-looking, despite the QCA estimating the MRP from a variety of approaches including both forward-looking and involving historical average returns, because the QCA's approach has always yielded an estimate of 6%. This point has also been raised by SFG (2013a), but in greater detail, and is addressed in the first three paragraphs of section 2.2.

2.11 Rio Tinto

Rio Tinto (2013) recommends that the weighting given by the QCA to the Cornell method for estimating the MRP should be reduced in view of the fact that the methodology is biased upwards. This upward bias arises from the assumption that the long-run expected growth rate in dividends per share is equal to the long-run expected growth rate in GDP, i.e., no allowance is made for new share issues and the formation of new companies. However, as discussed in Lally (2012a, section 4.2), this issue can be addressed using an appropriate deduction for new share issues and the formation of new companies. If this is done, and will be in section 6.3, the argument for lowering the weighting on the Cornell method evaporates.

2.12 NERA

NERA (2013, sections 3.1-3.3) notes that two US surveys of inflation expectations one year ahead reveal that there is no systematic tendency to underestimate or overestimate inflation because the period in which inflation is underestimated (up to 1980) is countered by the subsequent overestimation. Consequently, the premise that underlies the Siegel estimate of the MRP is false, and therefore the Siegel estimate should be dismissed.

NERA's argument has two shortcomings. Firstly, one of the two surveys (by Livingston) shows net underestimation of 0.517% per year (ibid, Table 3.2). NERA may consider that this should be treated as zero because it is not statistically significant (ibid, Table 3.2). However, given that the standard error of the estimate is 0.526%, the underestimation could have been as much as 1.1% and still not be statistically significant. Consequently, the most one could conclude here is that the mean underestimation is no more than 1.1%.

More importantly, the risk free rate data underlying the Siegel analysis invoked by the QCA is ten years and therefore the relevant period for assessing inflation forecast errors is ten years rather than the one year used in the two surveys. To illustrate why this matters, suppose that

(a) the historical data used in the Siegel estimate is 100 years, involving no inflation in the first 60 years, then inflation at 10% for the next 20 years, and finally no inflation in the last 20 years.
(b) investors forecasted inflation one year ahead using the actual rate in the prior year, in which case the one-year ahead inflation forecasts are on average correct.
(c) investors forecasted inflation ten years ahead using the actual rate in the prior year, with the exception of the high inflation period during which they consistently (but inaccurately) forecasted that the prevailing inflation rate of 10% would last only for two further years after which it would revert back to zero.
(d) the nominal risk free rate for a particular term and at a particular point in time is the inflation forecast at that time for that term coupled with a real margin of 4%.

The ten-year nominal risk free rates will then be 4% during the first 60 years, 4% during the last 20 years, and 6% during the high inflation period as follows:

$$R_f = (1.04)\left[\sqrt{(1.10)^2(1+0)^8} - 1\right] = .060$$

The ex-post real yields on these ten-year bonds are then 4% for the first 60 years, 4% for the last 20 years, and -3.6% for the high-inflation period as follows:

$$R_f^r = \frac{1.06}{1.10} - 1 = -0.036$$

So, across the entire 100 years, the average real yield on these ten-year bonds is then 2.5%. This is 1.5% less than the real yield of 4% that was expected by investors. Thus the inflation shock has reduced the average real yield on long-term bonds significantly below its expectation despite the one-year ahead inflation forecasts being correct on average. If equities have not been subject to the same problem, which is plausible, then the average return on equities net of the risk free rate will be significantly above its expectation, and this is the rationale for the Siegel approach.

This example demonstrates that the problem identified by Siegel in respect of long-term bonds may still be present even if one-year ahead inflation forecasts are on average correct. Remarkably, NERA quotes Siegel on this very point: “The inflationary process, although increasingly subject to long-term uncertainty, has been quite persistent and inertial in the short run.” (ibid, page 27). Nevertheless the example above might still be faulted on the grounds that it does not allow for inflation being persistently overestimated in the years after the inflation shock has subsided. However the evidence indicates that the underestimation of the future ten-year inflation rate during the high inflation period persisted for much longer than the overestimation once the inflation rate subsided, with the result that there was little compensation in bond yields at the end of the high inflation era for the inadequate compensation during much of the high-inflation era. The explanations for the rapid reduction in long-term expectations are various but include the commencement of inflation-targeting by the RBA (in 1993) shortly after the end of the high inflation era. This asymmetry in forecast errors is shown in Lally (2013a, Figure 1), in which the 30-year moving average real yield on ten-year bonds averages about 3.0% up to 1950, turns sharply down at that point because inflation rises, does not recover to the 3.0% level for 50 years and then exceeds that level only modestly for ten years.

NERA (2013, section 3.4) also claims that the QCA's computation of the Siegel estimate is in error, and that it should have been 4.11% rather than the 4.32% reported by the QCA (2012, page 11). However I understand from the QCA that their figure of 4.32% was generated by starting with an Ibbotson-type estimate of 6.21%, using data from Brailsford et al (2012), adding back the historical average real bond yield of 1.9% from Dimson et al (2002, Table 18-1) as reported in Lally (2004a), and then deducting an estimate of the long-term expected real bond yield of 3.79%, based upon the average yield on Australian government inflation-indexed bonds from July 1986 to October 2012, as follows:

$$M\hat{R}P = .0621 + .019 - .0379 = .0432$$

So, NERA's claim of computational error is incorrect. However, the first two figures here (6.21% and 1.9%) have been drawn from different periods (1883-2012 and 1900-2002 respectively) despite the need for compatibility because the second figure is intended to add back the average real risk free rate embodied in the first figure. If the Brailsford et al (2012) data (1883-2010) are used to generate the Ibbotson estimate (of 6.21%), the historical average real long-term bond yield over the same period should be used, and this is 2.4% rather than 1.9%.[9] In respect of the long-term expected real risk free rate, one possible estimate for this is the average real ten-year risk free rate figure of 3.5% over the period from 1883-1939, i.e., the period preceding the high inflation period of 1940-1990. A second possibility is the average real yield on Australian inflation-indexed bonds over the period since their issue (July 1986 to July 2013), and the result is 3.7%.[10] Using the average of these two figures, of 3.6%, along with the QCA's Ibbotson estimate of 6.2%, the Siegel estimate should be 5.0% as follows:

$$M\hat{R}P = .062 + .024 - .036 = .050$$

[9] The figure of 2.4% is obtained by converting the nominal bond yields reported in Brailsford et al (2012) to real yields using their inflation series, augmenting these results with those for 2011 and 2012 (using Reserve Bank data from their Tables F2 and G2) and then averaging over this time-series of real bond yields. For 2011 and 2012 the bond yields are 3.83% and 3.23% (December averages) and the inflation rates are 3.1% and 2.2% respectively. All tables are at http://www.rba.gov.au/statistics/tables/index.html.

[10] Data from the RBA website (http://www.rba.gov.au/statistics/tables/index.html#interest_rates).

NERA (2013, section 4) examines the MRP estimates used in a set of "independent expert reports" over the period 2008-2012, with a particular focus upon the 2012 reports. The crucial MRP estimates are 6.75% (unadjusted) and 7.22% (adjusted) as shown in their Table 4.2. In respect of the unadjusted MRP figures, an expert who reports using an MRP estimate of 6.0% and a risk free rate of 4% at a time when the prevailing ten-year CGS is 3% is treated by NERA as having estimated the MRP at 7.0% relative to the prevailing CGS yield. This matches the QTC's (2013) interpretation of the Ernst and Young (2012) report, as discussed in section 2.9, and is not appropriate. However the expert has instead estimated the MRP at 6.0% and has used a higher risk free rate than the prevailing ten-year rate because they are conducting a DCF on a perpetual cash flow stream, they are interested in prevailing rates out to infinity, and most of these rates will be above the prevailing ten-year rate because the term structure is currently sharply upward sloping.

In respect of NERA's adjusted MRP figures, these arise from reports in which the expert uses a higher WACC than indicated by their underlying parameter values, and NERA assigns this WACC increment to the MRP estimate that it attributes to the expert. However, this is entirely speculative; the appropriate parameter to adjust could be the risk free rate or some mixture of the two. Consequently NERA's adjusted MRP results should not be considered. The correct interpretation of these 2012 expert reports, as discussed in section 2.9, is that the experts invoke an average MRP estimate of 6.30% (which is consistent with the QCA's rounded estimate of 6.0%) and an average risk free rate that is higher than the five-year rate used by the QCA because of the difference in purposes of the two exercises.

NERA (2013, pp. 40-44) also adds about 0.50% to these MRP estimates from "independent expert reports", to account for imputation credits, on the grounds that the 'experts' do not include imputation credits in their MRP estimates and this should be done. However it is an exercise in cherry-picking to present these people as "experts" but then choose to amend their MRP estimates.

NERA (2013, section 6.2) generates an MRP estimate of 8.03% using a Discounted Dividend Model (DDM). The expected nominal growth rate in DPS is 7% for the first two years, after which the expected growth rate in DPS is 5.6% (comprising expected inflation of 2.5% and an expected real growth rate of 3.07% based upon the historical average rate over the period 1981-2011). This MRP estimate is problematic on four grounds. Firstly, the basis for the expected real DPS growth rate of 3.07% is the average annual real growth rate in DPS over the period 1981-2011, and the annual data are sufficiently volatile that the 95% confidence interval is from -1.30% to 7.44% (ibid, page 56). This leaves little grounds for confidence in the estimate. Secondly, indefinite extrapolation of this rate should be subject to the restriction that it cannot exceed the long-run expected real GDP growth rate, and should be less in recognition of new share issues and the formation of new companies. In respect of the long-run expected real GDP growth rate, Lally (2013b, page 17) estimates this at about 3% and estimates the deduction from this to reflect new share issues and new companies at 0.5% - 1.5%. Thus the expected real growth rate in DPS should be 1.5% - 2.5% rather than the 3.07% invoked by NERA. Furthermore, estimates in this range of 1.5% - 2.5% are not statistically significantly different from the historical average of 3.07% presented by NERA. Thirdly, NERA's approach assumes that the expected growth rate of 7% in the first two years converges immediately to the long-run expected growth rate, and the effect of this is to understate the MRP estimate. Fourthly, NERA's approach estimates an expected market cost of equity that is assumed to be the same for all future years; this is both implausible and likely to overestimate the MRP when the risk free rate is low, as at present (see Lally, 2013b, section 8).

NERA (2013, section 6.4) examines an example in Lally (2012b, pp. 15-16) designed to demonstrate that, when the risk free rate is unusually low, the application of the Cornell methodology (which assumes the same market cost of equity for all future years) is liable to overestimate the market cost of equity for the next ten years. To test whether this example is sensible, NERA presents a series of parameter values drawn from the AER and determines the term structure for the expected market return that is consistent with these AER parameter values. The result is a term structure that rises and then falls (NERA, 2013, Figure 6.3), which NERA considers to be implausible. By implication, the Lally scenario is implausible.

This analysis has a number of shortcomings. Firstly, what NERA has actually achieved is to demonstrate that the combination of parameter values that they use, and attribute to the AER, has an implausible feature. This combination of parameter values is quite different to those used by Lally (2012b, pp. 15-16) and therefore NERA's analysis has no implications for the analysis in Lally. In particular, Lally uses an expected market cost of equity for the first ten years of 10%, an expected market cost of equity thereafter of 12% (to match the long-run value), and an expected growth rate in dividends of 5% (all nominal). By contrast, in respect of the last two such values, the corresponding nominal parameters invoked by NERA are 11.2% and 6% respectively.

Secondly, NERA describes the set of expected market returns in the Lally (2012b) example as a term structure, rejects them as implausible because they are a "step function" and instead opts for a smooth function of the Nelson-Siegel (1987) type (NERA, 2013, page 63). However the set of expected market returns in the Lally example are *not* a term structure; the expected market cost of equity for the first ten years of 10% is part of the term structure but the expected market cost of equity thereafter of 12% is a 'forward rate' rather than being part of the term structure. These two numbers allow a term structure to be developed beyond ten years, and it rises monotonically from 10% to 12% over that range. For example, the expected market rate of return for 15 years is 10.7% per year as follows:

$$E(R_{m15}) = \sqrt[15]{(1.10)^{10}(1.12)^{5}} - 1 = .107$$

The fact that this term structure is smooth undercuts NERA's rationale for substituting a smooth term structure for the one in the Lally example.

Thirdly, since the term structure in the Lally example is monotonically increasing rather than 'humped', it does not suffer from the implausible feature in the term structure that NERA derives from the AER parameters. Finally, NERA's example uses an expected real dividend growth rate of 3.41%, notes a number of ways to resolve the implausible term structure that arises from their parameters including a reduction in this expected real growth rate, and asserts that they "know of no data available as of September 2012 to suggest that any of these conditions were satisfied" (ibid, page 65). However one such source of data is their own forward-looking analysis a few pages earlier, which uses an expected real dividend growth rate of 3.07% (ibid, page 56). In addition, Lally (2013b, section 8) uses rates from 1.5% - 2.5%.

2.13 Unitywater

Unitywater (2013a, pp. 5-6) disputes that the QCA's approach to estimating the MRP is forward-looking, despite the QCA estimating the MRP from a variety of approaches including both forward-looking and those involving historical average returns, because such an approach has always yielded 6%. This point has also been raised by SFG (2013a), but in greater detail, and is addressed in the first three paragraphs of section 2.2.

2.14 EMCS

EMCS (2013, para 24) claims that, if rate determinations occur at a time of low risk free rates and these risk free rates then rise during the regulatory period, regulated businesses will be not be covering their cost of capital. This is only true in respect of finance that is raised during the regulatory period in order to fund new investment. Lally (2010, section 3.4) examines this issue and concludes that the adverse effect is trivial. Furthermore, over a series of regulatory periods, the average effect tends to zero.

EMCS (2013) reviews the pros and cons of a number of alternative methods for estimating the MRP. However they only appear to recommend two such methods. The first is the DDM (ibid, para 32), of which the Cornell methodology used by the QCA is a particular case. The second methodology (ibid, paras 35-48) involves estimating the MRP for the next regulatory period by coupling an estimate of the one-year ahead MRP with reversion to the long run value over the rest of the regulatory period. In addition, following Merton (1980), the one-year ahead MRP is modeled as being proportional to market variance for that period:

$$MRP = Y_1\sigma^2$$

with the coefficient Y_1 estimated from the historical average excess market return divided by the historical average market standard deviation, and the standard deviation for the next year estimated from the implied volatility of one-year options on the ASX. In addition, EMCS recommend that this approach only be used under "unusual economic circumstances such as the GFC and its aftermath" (EMCS, 2013, para 36). Clearly EMCS's definition of the approach (involving variance) is inconsistent with their references to standard deviation in the estimation of Y_I. In addition the approach has a number of shortcomings. Firstly, it is highly imprecise; Boyle (2005) finds dramatic variation in results from this methodology. Secondly, and in respect of whether to apply the approach using market variance or standard deviation, Merton (1980) shows that the results from these two approaches are often markedly different and EMCS are unclear as to which version they prefer. Thirdly, despite citing Merton, the method used by EMCS to estimate Y_I does not accord with Merton's approach, EMCS do not offer any explanation for this divergence, and the two approaches will in general yield different results. Fourthly, the process by which the one-year ahead MRP estimate reverts to the long-run MRP estimate over the rest of the regulatory period involves a transition period being chosen for reasons unrelated to the actual speed of mean reversion in the MRP. Fifthly, since regulatory periods differ across regulatory situations, EMCS would presumably apply different reversion speeds according to the regulatory situation. Again such variations in EMCS's choice of the reversion period are unrelated to the actual speed of mean reversion in the MRP. Even if EMCS's transition model were replaced by one that reflected the empirical behavior of the MRP, the appropriate choice of transition rule is far from clear. Finally, the recommendation to invoke the method only under GFC-type circumstances would lead to higher MRP estimates in these cases but not lower MRP estimates when market volatility was unusually low, with the result that the average MRP estimate over time would be too high. For all of these reasons I do not favour this approach.

2.15 Vale

Vale (2013) notes that some of the methodologies used by the QCA to estimate the MRP are biased upwards and therefore should be adjusted for this. In respect of the Cornell methodology, the upward bias arises if no correction is made for new share issues and the formation of new companies, and this issue will be addressed in section 6.3.

Vale (2013) also refers to the upward bias to the Ibbotson and Siegel methodologies, due to errors in assessing the dividend yield of Australian stocks prior to 1958. The QCA (2012, page 21) relies upon results from Brailsford et al (2008, 2012) and these results embody an attempt to address the problem (Brailsford et al, 2008, pp. 79-82). I consider that the adjustments made are entirely reasonable, and therefore address this source of bias. However the Ibbotson results are still likely to be biased upwards because of unexpected inflation in the 20th century, and the Siegel approach is an attempt to deal with this. Nevertheless, because the Ibbotson estimates are still used, they impart upward bias. A possible solution to this would be to substitute the Siegel results for the Ibbotson results rather than merely complement them, but this would imply that the bias in question here was certain and this is too strong a conclusion.

3. Review of Submissions under Task 2B

3.1 Aurizon

In respect of issues relating to the risk free rate and the MRP, Aurizon (2013) merely summarises the views of SFG and Value Advisor Associates, and these are dealt with below.

3.2 SFG: Testing the Reasonableness of the Regulatory Allowance for the Return on Equity

SFG (2013b) contains a considerable amount of material that is replicated in SFG (2013a), and therefore dealt with in section 2.2 above. Additional points are as follows:

SFG (2013b, paras 62-78) estimates the cost of equity using a firm-level version of the DDM, along with an adjustment for imputation credits. As discussed in Lally (2012a, section 4.1) this firm-level version of the DDM unreasonably assumes that the expected return on equities is the same for all future years, it assumes that the current value of the market portfolio equals the present value of future dividends (reasonable but potentially problematic), it is exposed to fluctuations in the firms' earnings payout rate, there are incentives for the firms in question to manipulate their earnings payout rate, and it implicitly (and wrongly) assumes that the entire firm's activities are regulated. None of these concerns are addressed by SFG. In respect of the imputation adjustment, this matches that in SFG (2013a) and is critiqued in section 2.2 above.

SFG (2013b, para 119) presents time-series information on the ASX dividend yield, notes that the current yield is high, and that this indicates that the required return on equity should also be high. However this information is included in the DDM based estimate of the MRP that SFG (2013a, paras 94-98) presents and which is discussed in section 2.2 above.

SFG (2013b, paras 121-122) presents time-series information on the ASX Price-Earnings ratio, notes that the current ratio is low, and that this indicates that the required return on equity should be high. However, all Price-Earnings ratios are sensitive to the way in which earnings are defined by accountants and this definition changes over time. Furthermore, it is implicit in this evidence that the inverse of the PE ratio (the earnings yield) is the same as the market cost of equity. However, as discussed in section 2.6, this is not correct.

3.3 Value Adviser Associates

VAA (2013, paras 77-82) recommends an MRP estimate of 7% (ibid, para 77) using historical data because the historical averages have generally been between 6% and 7% for terminal dates from 1990 to 2011 (ibid, para 81). However, even if this type of evidence were considered reasonable, it would support 6-7% rather than 7%. Furthermore, whilst it not clear how far back in time one should draw historical data from, the data series should terminate at the most recent point in time. Accordingly, as per VAA's Figure 1 and Figure 2, the estimate should be 6.0%.

VAA (2013, paras 96-122, paras 134-143) argue that the DRP on BBB bonds has risen by about 2.0% since the GFC, that less than 0.1% of this is due to an increase in default risk, the rest is therefore due to an increase in systematic risk, and this in turn to an increase in the MRP because debt betas are unlikely to have risen. The resulting estimates of the MRP range from 9% to 15%. VAA's belief that the MRP has risen since the GFC is entirely plausible but the details of VAA's argument are not, as follows. Firstly, the wide range in VAA's estimate of the MRP using this methodology reveal that it is highly imprecise. Secondly, VAA's estimate of the increase in default risk is based on average default rates for BBB bonds over time (ibid, para 110) rather than the default rates that investors have expected since the GFC, and therefore is likely to significantly understate the allowance for default risk within the DRP since the GFC. Thirdly, at least part of the increase in the DRP will be due to an increase in the allowance for the illiquidity of BBB bonds, and Dick-Nielsen et al (2012, Table 5) estimates that the illiquidity premium on BBB bonds in the US rose from 8% of the DRP to 29% from 2005-2007 to 2007-2009. Applying these percentages to VAA's (2013, para 104) claim that the DRP rose from about 1.2% to 3.2%, the increase in the illiquidity premium would account for 0.82% of the 2.0% increment in the DRP, i.e., almost half of it.

Fourthly, VAA's belief that debt betas did not rise during this period is implausible because positive debt betas arise at least partly from default risk, default risk was higher, and even VAA seem to acknowledge this at one point (ibid, para 136). To illustrate the significance of this point, if the MRP did not rise from 6.0%, but debt betas rose from .17 to .25 during this period (these debt beta figures are presented by VAA themselves), the impact of this increase in debt betas on the DRP would be 0.5%, i.e., one quarter of the alleged 2.0% increment to the DRP.

Fifthly, the alleged increase in the DRP is based upon Bloomberg data, and there are grounds to believe that this data has overstated the DRP increment since the GFC. For example, from the commencement of the GFC in September 2008 until CBASpectrum ceased publishing its DRP estimates, the DRP estimates of Bloomberg and CBASpectrum for ten-year BBB bonds diverged by as much as 3.3% (AER, 2011a, Figure A.6). Coupled with the lack of transparency of the processes underlying these estimates, such variation damages the credibility of all such estimates. In addition, Credit Suisse (2011, pp. 1-3, Figure 12) has recently expressed the view that the AER's DRP allowances are currently excessive (by about 1.0%), implicitly attributes this error to the AER's reliance upon the Bloomberg Fair Value Curve (BFVC), and advises its clients to expect a reduction in the allowed DRP upon the AER abandoning the use of the BFVC. In addition, the ITRAXX CDS index (which equally weights the five-year CDS contracts on the 25 most liquid investment grade Australian bonds) exhibited a considerable rise during 2008 and 2009 followed by significant subsequent subsidence whilst the BBB five-year BFVC shows no such subsequent subsidence (AER, 2011b, Figure 9.6). Naturally, the problem (if there is one) could lie with the ITRAXX index rather than the BFVC. However the ITRAXX index has the dual advantages of both liquidity and transparency. Furthermore, in commenting on this discrepancy in behaviour, CEG (2012b, pp. 74-75) observes that the cause might lie in the BFVC under reacting in the 2008-2009 period rather than being too high subsequently. This is entirely possible. However, any acknowledgement of deficiency in the BFVC during 2008-2009 must also damage its credibility in the post 2009 period, particularly from such a staunch defender of the BFVC as CEG and absent any explanation for why the problem would have been confined to only 2008-2009.

To illustrate the difficulty in generating a reliable estimate of the increment to the MRP using VAA's approach, suppose VAA are right to believe that the DRP rose by 2.0%, that virtually all of this was an increase in systematic risk, that the debt beta did not change, and that the debt beta was 0.1. If so, then the MRP would have to have risen by 20%, i.e., from (say) 6% to 26%! Alternatively, suppose that the DRP only rose by 1.70% (the other 0.30% being Bloomberg error), the incremental default risk explains 0.50%, the incremental illiquidity allowance explains 0.50%, the MRP immediately prior to the GFC was 6.0%, and the debt beta rose from 0.10 to 0.20. In this event the MRP would have risen to only 6.5%, i.e.,

$$2.0\% - 0.30\% = 0.50\% + 0.50\% + [.2(6.50\%) - .1(6.0\%)]$$

In summary, whilst the MRP is likely to have risen since the GFC, VAA's line of argument neither concludes with a definite estimate of the increment nor would it be capable of producing a definite estimate, and the range of results from this methodology is unacceptably wide.

VAA (2013, paras 126-133) also recommends consideration of MRP estimates of the Merton (1980) type, but this has been dealt with in reviewing the submission of EMCS (section 2.14), which has the same set of authors.

VAA (2013, paras 182-189) appears to suggest that the liquidity of CGS has increased since the GFC, thereby lowering yields, and therefore CGS are no longer suitable as a proxy for the risk free rate. However the Officer (1994) version of the CAPM that is invoked by the QCA and other Australian regulators assumes, as does the standard version of the CAPM (Sharpe, 1964; Lintner, 1965; Mossin, 1966), that all assets are highly liquid, because illiquidity is (inter alia) a manifestation of high transaction costs and the CAPM assumes that there are no transactions costs. Thus, if the liquidity of CGS improves, it improves the match between the real world and that assumed by the model and therefore makes CGS even *more* suitable as a proxy for the risk free rate.

VAA (2013, paras 190-204) raises concerns about combining a long-term estimate of the MRP with the prevailing risk free rate. These comments are premised upon the belief that the QCA's estimate of the MRP is an estimate of the long-term MRP. However this is not the case. The QCA bases its estimate of the MRP upon the results from four different methodologies, two of which involve long-run historical data with the other two being forward-looking methods. The presence of the latter two estimates reveals that the QCA is not estimating the long-run MRP but is instead seeking to estimate the prevailing MRP, i.e., the MRP applicable to some future period commencing now. Furthermore the presence of two methods that use long-run historical data, and therefore will not be particularly sensitive to short-term changes in the MRP, is not inconsistent with the QCA seeking to estimate the prevailing MRP for the following reason. In seeking to estimate the prevailing MRP, a sensible approach would be to minimize the MSE of the estimate and this leads to averaging over the results from a wide range of methodologies, some of which might not be sensitive to short-term changes in the MRP (as discussed further in Lally, 2012a, section 4.4).

4. Review of Submissions under Task 2C

4.1 Unitywater

Unitywater (2013, page 49) favours use of the ten-year risk free rate on the grounds that its assets have long lives and its investors have long-term horizons. However, in order to satisfy the NPV = 0 principle, the term of the risk free rate must match that of the regulatory cycle (see Schmalensee, 1989; Lally, 2004b). Unitywater do not present any contrary arguments.

Unitywater (2013, page 51) favours use of a ten-year historical average of the ten-year risk free rate. The problems with such historical averaging have been discussed earlier in section 2.6.

Unitywater (2013, page 51) favours an estimate of the MRP based upon historical averaging, claims that such results are within the range 6-7%, and therefore favours 6.5%. However no evidence is presented in support of the empirical claim.

4.2 Synergies

Synergies (2013, section 2) favours use of the ten-year risk free rate on the grounds that its assets have long lives. However, in order to satisfy the NPV = 0 principle, the term of the risk free rate must match that of the regulatory cycle (see Schmalensee, 1989; Lally, 2004b). Synergies do not present any contrary arguments, although they do refer to arguments presented in SFG (2012a) and these are addressed separately.

Synergies (2013, section 3.2.1) favours use of a ten-year historical average of the ten-year risk free rate. The problems with such historical averaging have been discussed earlier in section 2.6.

Synergies (2013, page 17) favours an estimate of the MRP of 6.5% because it is the middle of the long-run band of 6-7%, and the latter belief is drawn from VAA (2013, para 81).[11] However, as noted in section 3.3, whilst it not clear how far back in time one should draw historical data from, the data series should terminate at the most recent point in time. Accordingly, as per VAA's Figure 1 and Figure 2, the estimate should be 6.0%.

4.3 SFG: Techniques for Estimating the Cost of Equity

SFG (2013c, Table 6) estimates the MRP at the end of 2012 at 7.9% using a variant of the DDM. This analysis has two principal shortcomings. Firstly, it does not embody the restriction that the long-run expected growth rate in dividends cannot exceed the long-run expected growth rate in GDP, let alone any deduction from the latter to recognize that an increasing share of GDP takes the form of dividends to new firms. In respect of the long-run expected GDP growth rate, Lally (2013b, page 17) estimates the real rate at 3%. Coupled with expected inflation of 2.5% (the middle of the RBA's target band), this implies a nominal rate of about 5.5% and this upper bound is violated by SFG's estimate of 5.8% (SFG, 2-13c, Table 6). Remarkably, SFG's failure to impose this upper bound restriction conflicts with them drawing upon similar work that does impose this restriction (SFG, 2013a, paras 94-98). Secondly, SFG's methodology assumes that, at any point in time, the expected return on equities is the same for all future years; this assumption is also made by CEG (2012) in the course of estimating the MRP through a similar methodology and (as discussed in Lally, 2012a) is both unreasonable and is likely to overestimate the MRP when the risk free rate is low (as at present).

In addition to these shortcomings in the methodology, it is interesting to note that, apart from the last three of SFG's estimates shown in their Table 6 (which are undertaken every six months

[11] Synergies refer to Officer and Bishop but they are the authors of the VAA paper.

since 2002), all but one of the previous estimates are below 6%. In fact, most of the estimates since the GFC commenced in late 2008 are also below 6%. This raises the possibility that SFG has been motivated to recommend the methodology now only because it now produces estimates above 6%.

SFG (2013c, section 2.5) also estimates the MRP at the end of 2012 at 7.5% from a regression of realized market excess returns on various predictors, with a prediction period of one month. The methodology follows that in Petkova and Zhang (2005). However, more recently, such regression models have been closely scrutinized. Goyal and Welch (2008) examine models of this type, with prediction periods of up to five years, and conclude that "most models seem unstable or even spurious" (ibid, page 1504). Campbell and Thompson (2008) reach more favourable conclusions about these predictive regressions relative to using the historical mean excess return, using prediction periods of up to one year, providing sensible restrictions are placed on the signs of coefficients and excess return forecasts: "the out-of-sample explanatory power is small, but nonetheless is economically meaningful for mean-variance investors" (ibid, page 1509). So, providing there are appropriate restrictions on signs, such models provide small gains in the prediction of excess returns for prediction periods of up to one year.

SFG's methodology therefore suffers from four shortcomings. Firstly, the prediction period is only one month whereas regulators are typically interested in MRP estimates over the next five years. Secondly, SFG do not impose any such restrictions on signs and therefore their analysis would not offer these prediction gains. Thirdly, even with such restrictions and unlike other methods of estimating the MRP, this approach is justified on a purely empirical basis (its predictive power) and the predictive power relative to the historical average excess return is minimal, with an R^2 of only 1% (ibid, Figure 2). Finally, even with such restrictions, the predictive power over excess market returns does not necessarily imply anything about the MRP because the predictive power may simply arise from market informational inefficiency. Even Campbell and Thompson (ibid, page 1511) imply that these prediction gains are a manifestation of market inefficiency rather than changes in the MRP: "We show that…investors could have profited by using market timing strategies." Clearly one cannot *profit* from investing in equities if the MRP is expected to be higher, because the higher risk premium would simply be compensation for greater risk. So the reference to "profit" implies market informational inefficiency.

4.4 Queensland Urban Utilities

QUU (2013b, page 47) argues that use of the prevailing risk free rate rather than a longer term average increases volatility in both the WACC estimate and prices to consumers, and that this is undesirable. However, if the WACC is volatile, the estimate should reflect it where possible. If this leads to more volatile prices to consumers, this is a second order consideration; the first requirement is to set the allowed WACC as accurately as possible in order to satisfy the NPV = 0 principle. Furthermore, price volatility can be dampened by 'transitioning' mechanisms and this has been done on some occasions. Effectively this involves variations from straight line depreciation during the asset life in order to dampen volatility in prices.

5. Review of SFG Submissions on the Term of the Risk Free Rate

SFG (2012a, section 2.2) correctly notes that the term structure is usually upward sloping. Thus, if the NPV = 0 principle is satisfied by matching the term of the risk free rate to the regulatory term, it follows that a shorter regulatory term would typically lower the WACC of the regulated business and therefore typically lower prices to consumers. SFG observes that this apparent gain to consumers from a shorter regulatory term, without any loss to regulated businesses, is not being implemented by regulators and therefore there must be some error in the reasoning, which they consider to be the belief concerning matching the term of the risk free rate to the regulatory term. However there are numerous reasons why regulatory terms are not set at very low levels. One is that the regulatory term determines the period for which regulated businesses retain the benefits from efficiency gains, and therefore determines the sharing of efficiency gains between producers and consumers. Another is that very short regulatory terms, coupled with output prices being set in accordance with prevailing short-term risk free rates, leads to greater volatility in output prices. Thus there is a trade-off between lower expected prices and higher volatility from reducing the regulatory term. The same trade-off is faced by borrowers in choosing interest rates that are reset frequently (floating rates) and rates fixed for some longer term; floating rates are on average lower (because the term structure is typically upward sloping) but involve greater volatility; some borrowers favour the floating rates and others the longer-term rates.

SFG (2012a, section 2.3) argues that use of the five year risk free rate within the first term of the CAPM requires that it also be used in estimating the MRP, that the QCA instead uses the ten-year risk free rate in estimating the MRP, that the QCA (in part) justify this on the grounds that MRP estimates from these two risk free rates are not statistically significantly different, and SFG considers that this argument is wrong. SFG do not provide a specific reference to a QCA document other than it being a determination relating to Queensland Rail, and this suggests that the relevant material is in QCA (2010, pp. 40-42). Consistent with SFG's claim, the QCA do cite the issue of statistical imprecision in support of not modifying the MRP estimate by using five rather than ten-year bond yields. As with SFG, I do not agree with this rationale for using the ten rather than the five year risk free rate for estimating the MRP. However, the QCA also note that using five rather than ten year bond yields does not change the rounded estimate, in accordance with their practice of rounding. I concur with the QCA's latter reasoning, and I also favour rounding to the nearest 1% (as discussed in Lally, 2012a, section 5). So I concur with the QCA's decision and its principal argument but not with a secondary argument that it invokes.

SFG (2012a, section 2.4) also argues that an unregulated firm with long-life assets and operating in a competitive market would use ten-year debt, its debt cost would then be that of ten-year debt, output prices in this market would reflect such costs, regulation should seek to replicate competitive market outcomes, and therefore the appropriate risk free rate for setting the prices of regulated businesses is the ten year rate. I have two reservations about this argument. Firstly, merely because a firm borrows for ten years, it does not follow that it is subject to the ten-year cost of debt; the firm might borrow for ten years, but use interest rate swap contracts to convert the risk free rate component into a different term. Secondly, the belief that regulation should seek to replicate competitive market outcomes is only true in the sense that unregulated firms in competitive markets charge prices that just cover costs, including the cost of capital, and regulation should seek to do likewise. Merely because both types of firms are subject to prices that just cover their costs, it does not follow that every detail about them is or should be identical. Nor is it possible for every detail to be identical because regulated firms are by definition regulated, in recognition of circumstances that differ from those of unregulated firms in competitive markets, and there are a variety of regulatory models. For example, one might regulate prices or revenues, and one might reset these at high or low frequency, and one might allow some costs to be passed-through. All of these regulatory choices affect the cost of capital of a regulated firm. So, having made the choice and therefore determined the cost of capital of the regulated firm, the cost of capital allowed by the regulator must compensate for it rather than match the cost of capital as an otherwise identical unregulated firm in a competitive market. Expressly alternatively, the cost of capital reflects risk, regulation affects the risk of regulated firms, and therefore the cost of capital for a regulated business may differ from the that of an otherwise identical unregulated firm in a competitive market.

SFG (2012a, section 3) disputes the proposition presented (inter alia) in Lally (2007a) that, in order to satisfy the NPV = 0 principle, the term of the risk free rate used to set the allowed rate of return for a regulated return should match the regulatory term. In particular, SFG argue that this result holds only if the expectations hypothesis for the term structure of interest rates holds. In support of this claim, they produce a series of equations, apparently intended to match those in Lally (2007a). The most significant equation is the penultimate equation on page 7, in which the present value now of a cash flow arising in two years is the expected cash flow discounted using the current one-year (presumably risk free) interest rate (R_{01}) and the expectation now of the (presumably risk free) one-year rate in one year (R_{12}):[12]

$$PV = \frac{E(X)}{(1+R_{01})[1+E(R_{12})]}$$

This equation is presumably meant to match one in Lally (2007a), but it does not. Furthermore, there are two problems with this equation. Firstly, one can only use risk free rates to discount an expected cash flow in two years if the cash flow is currently certain, which it clearly isn't because it depends on the interest rate chosen by the regulator in one year to set the allowed cost of capital for the following year. Secondly, even if this cash flow were certain, the appropriate

[12] SFG write their equation using R_{12} rather than $E(R_{12})$, but they define R_{12} as an expectation. Thus, for clarity, I define R_{12} as the actual one-year risk free rate and therefore $E(R_{12})$ is the expectation now of it.

discount rate would be the current two-year spot risk free rate. However, SFG use the current one-year risk free rate coupled with the expectation now of the one-year rate in one year, and this will only equal the current two-year spot rate if the expectations hypothesis concerning the term structure prevails, which even SFG does not believe to be true.

Subsequently SFG claim that the equations presented by them implicitly embody the assumption that the expectations hypothesis about the term structure of interest rates holds. This is true, but only because SFG implicitly invoke this assumption in the penultimate equation on their page 7, which does not correspond to anything in Lally (2007a). If one seeks to identify an implicit assumption in a proposition, and to do by presenting a set of equations, these equations should match those of the author whose work is critiqued. If they do not, as is the case here, they cannot serve their intended purpose. Thus, not only do SFG wrongly attribute an assumption to Lally (2007a), and note (correctly) that the assumption does not hold (SFG, 2013d, footnote 2), they actually invoke the assumption themselves. SFG's analysis here is a summary of that in Hall (2007), and the critique presented here follows that in Lally (2007b).[13]

SFG (2012a, section 3) goes on to claim that, if the term structure of interest rates is upward sloping, then using a term for the risk free rate that matches the regulatory term will under-compensate the regulated firm in the NPV sense. However this analysis follows from the penultimate equation on their page 7. Since that equation is flawed, as described in the previous paragraph, the conclusions arising from it will be likewise.

The fact that the analysis in Lally (2007a), as well as in Lally (2004b) and Schmalensee (1989), does not assume anything about the term structure of interest rates is clear from those papers. However, it might be useful to provide a very simple example of this. Suppose a regulated firm is set up now, with assets costing \$100m and having a life of two years, no debt, no opex, and no corporate taxes. In addition the regulatory cycle is annual, regulatory depreciation is 50% per year, and the only source of risk is interest rate risk. The regulator therefore sets the output price, and hence the revenues, to cover regulatory depreciation plus the cost of capital (which equals the risk free rate). These revenues are assumed to be received at the end of the first year

[13] Presumably Hall (who is an employee of SFG) is the author of the SFG report.

and also at the end of the second year. In addition, suppose that the one year risk free rate is currently 5%.

Now suppose the regulator uses the one year risk-free rate in each of its annual regulatory determinations. It will therefore use 5% for the first year. In one year, it will use whatever the actual one year risk-free rate is at that point (R_{12}). Consequently, one year later, the actual cash flows received by the business will be regulatory depreciation of $50m and cost of capital of $50m$R_{12}$. This sum is known at the beginning of the second year, and therefore can be valued at that point using the prevailing one-year risk-free rate, which is R_{12}. So the value in one year of the revenues received one year later is $50m as follows:

$$V_1 = \frac{\$50m + \$50mR_{12}}{1 + R_{12}} = \$50m \tag{1}$$

At the end of the first year, the regulated business will therefore receive V_1 = $50m plus revenues to cover regulatory depreciation of $50m and the cost of capital for the first year of $100m(.05). Since this sum is known at the beginning of the first year it can be valued using the prevailing risk-free rate, which is 5%. So the value now of V_1, plus the revenues received at the end of the first year, is $100m as follows:

$$V_0 = \frac{\$50m + \$100m(.05) + \$50m}{1.05} = \$100m$$

This present value of $100m matches the initial cost of the assets and therefore the regulator's choice of interest rates satisfies the NPV = 0 principle. Furthermore, this result holds regardless of the term structure of interest rates because no interest rates other than the current one-year rate of 5% have been numerically specified.

We now turn to the alternative approach favoured by SFG, which involves the regulator using the two year rate now, and the one year rate in one year because the remaining asset life then would only be one year.[14] To explore the consequences of this, suppose that the current one-year spot rate is 5%, the expectation now of the one-year spot rate in one year is 20%, and the current two-year spot rate is 15%. The latter rate is above that implied by the expectations hypothesis, consistent with the empirical evidence and SFG's (2013d, footnote 2) belief. If SFG favours use of the one-year risk free rate in one year, as conjectured above, they would presumably agree with the calculation shown in equation (1) above, i.e., regardless of what the actual one-year risk free rate in one year is, the value in one year of the remaining revenues would be V_1 = \$50m. So, at the end of the first year, the regulated business will receive V_1 = \$50m plus revenues to cover regulatory depreciation of \$50m and the cost of capital of \$100m(.15). Since this sum is known at the beginning of the first year it can be valued using the risk-free rate at the beginning of that year, which is .05. So the value now of the revenues received one year later, and the residual value of the business, is \$110m as follows:

$$V_0 = \frac{\$50m + \$100m(.15) + \$50m}{1.05} = \$110m$$

This value of \$110m is \$10m larger than the initial cost of the assets, and therefore the NPV = 0 principle is violated. This occurs because the term structure is upward sloping and the regulator has (wrongly) used a risk free rate whose term exceeds that of the regulatory term. Furthermore, as the margin by which the current two-year risk free rate exceeds the current one-year rate, the margin by which the value of the business's revenues exceeds \$100m would grow. For example, if the current two-year interest rate were 30%, the present value of the business's revenues would be \$124m. At a current two-year rate of 50%, the present value would be \$143m. Clearly, these hypothetical two-year interest rates are extreme but they dramatize the error in SFG's thinking.

The scenario examined here is conceptually identical to that of a floating rate bond, and the same recursive valuation process applies. For such bonds, the interest rate used at each reset point must be for a term matching the reset frequency (Jarrow and Turnbull, section 13.2.4). So, if the

[14] It is clear from SFG's numerical example in their section 3.5 that they set the regulatory cost of capital for the second year equal to the one year risk free rate at the beginning of that year. The regulatory rate they use for the first year in their example (5.94%) is slightly different to the two-year rate prevailing at the beginning of the first year in their example (6%) but the two are sufficiently close for the present purposes.

interest rate is reset annually, the rate used must be a one-year rate. For example, suppose one borrows \$1m for two years, with the interest rate reset annually, and there is no default risk. Letting R_{12} denote the one-year risk free rate observed in one year, the bond then pays \$1m(1+R_{12}) one year later, at the maturity of the bond. Since the payoff is certain at the beginning of that year, it should be discounted using the one-year risk free rate at that point, which is R_{12}. So the value of the bond at that point is \$1m as follows:

$$V_1 = \frac{\$1m(1+R_{12})}{1+R_{12}} = \$1m$$

Letting R_{01} denote the one-year risk free rate observed now, the bond therefore pays interest of \$1mR_{01} in one year. Coupled with the bond value of \$1m in one year, the total payoff in one year is \$1m(1+R_{01}). Since this payoff is certain at the beginning of the year, it should be discounted using the one-year risk free rate at the beginning of that year, which is R_{01}. So the value of the bond at that point is \$1m as follows:

$$V_0 = \frac{\$1m(1+R_{01})}{1+R_{01}} = \$1m$$

This matches the amount borrowed and therefore satisfies the fundamental principle of interest rate setting (that the promised rate(s) must be such as to generate a value on the bond at issue date equal to the amount borrowed). If a two-year rate were used for setting the interest payment for the first year, and the two-year rate at that point exceeded the one year rate, the value now of the bond would exceed the amount initially borrowed and therefore violate this fundamental principle. Unsurprisingly, the analysis in SFG does not invoke a recursive valuation process; had they done so, they would have reached the same conclusions presented here.

In summary, SFG's belief that matching the risk free rate term to the regulatory term ('term matching') is not necessary to satisfy the NPV = 0 principle is false; their error arises from invoking a valuation equation that applies a risk free rate to an uncertain future cash flow and by assuming that the expectations hypothesis concerning the term structure of interest rates prevails, which is both empirically false and even recognized as such by SFG. In addition, SFG's belief that the expectations hypothesis is a necessary condition for term matching to satisfy the NPV = 0 principle is incorrect; term matching is required to satisfy the NPV = 0 principle regardless of how the term structure of interest rates is determined. In addition, SFG's belief that if term matching satisfies the NPV = 0 principle there is a free lunch available to consumers (in the form of lower output prices by reducing the regulatory cycle) is not correct; output prices would be lower (on average) with a shorter regulatory cycle but there are disadvantages to this including shortening the period for which regulated businesses retain the benefits from efficiency gains, and greater volatility in output prices. In addition, SFG's belief that using the five rather than the ten year risk free rate to estimate the MRP must reduce the MRP estimate is not correct; the impact of this change is lost in the rounding of the MRP estimate to the nearest 1%. Finally, SFG's belief that a regulator should use the ten year risk free rate in order to produce output prices that match those of an otherwise identical unregulated business operating in a competitive market is not correct; even if the output prices of the latter firms did reflect the ten year risk free rate, due to the use of ten-year debt that was not swapped into another term, regulation should instead seek output prices that cover costs including the cost of capital, and the latter depends upon the particular form of regulation.

SFG (2013d) contains the same material as that just reviewed, with only minor wording changes.

6. Review of the QCA's Approach

6.1 Consistency with the NPV = 0 Principle

The first question posed by the QCA is whether combining a 'spot' five-year risk free rate with an MRP estimated using a variety of methods, and data from a variety of periods, is consistent with the NPV = 0 principle. I interpret the reference to a five year risk-free rate to be a reference to a risk-free rate whose term matches the regulatory cycle. The question of the appropriate term of the risk free rate has been dealt with in the previous section, and reveals that that the term of the risk free rate should match that of the regulatory cycle.

The NPV = 0 principle is fundamental to regulation; lower revenues than those that satisfy this principle will fail to entice producers to invest and higher revenues constitute the very excess profit that regulation seeks to prevent (Marshal et al, 1981). To explore the implications of this principle for the question of whether the 'spot' risk free rate should be used, I start with the simplest possible regulatory scenario, in which fixed assets are purchased now, all financing is equity, a revenue or price cap is set now that yields revenues only in one year, all operating costs are incurred at the same point, the regulatory assets purchased now have a life of one year, there is no risk relating to revenues or operating costs, and there is no differential personal tax treatment across different sources of investment income. In this case the value now of the revenues received in one year (*REV*) net of operating costs received in one year (*OPEX*) is determined by discounting at the *current* one year risk free rate (R_{f1}), and the NPV = 0 principle implies that this value should equal the purchase price of the fixed assets (*B*):

$$B = \frac{REV - OPEX}{1 + R_{f1}} \tag{2}$$

It follows from this that the revenues must be as follows:[15]

$$REV = OPEX + B + BR_{f1} \tag{3}$$

So, the revenues must equal the sum of *OPEX*, the cost of the fixed assets (*B*), and the return on the investment of *B* at the current one year risk free rate R_{f1}. This analysis is a simplified version of that in Schmalensee (1989) and Lally (2004).

To illustrate the application of equation (2), suppose *OPEX* = \$10m, *B* = \$100m and R_{f1} = .06. It follows from equation (3) that *REV* must be \$116m. The intuition for this is clear. Investors with \$100m to invest could invest in the risk free asset at 6% to yield \$106m in one year. Undertaking the regulatory activities and therefore purchasing the regulatory assets is an alternative investment with the same (nil) risk. Thus, undertaking the regulatory activities and therefore purchasing the regulatory assets should also yield a return of 6% on the investment of \$100m, which implies net cash flow of \$106m in one year, and hence revenues of \$116m.

[15] In this equation, regulatory depreciation equals the cost of the asset (*B*) because the asset life is only one year. When the asset life exceeds one year depreciation each year is less than the purchase price of the assets.

This demonstrates that the risk free rate that should be used is that prevailing at the beginning of the regulatory period. Suppose that some historic average of the one year rates had instead been used and this historic average was 7%. In that event, following equation (3), the price or revenue cap would have been set to allow revenues of $117m and therefore a rate of return of 7% on a risk free investment with a one year life. This rate of return would be too high because the one year risk free rate at the beginning of the regulatory period was 6%. Alternatively, if the historical average risk free rate had been 5%, then the price or revenue cap would have been set to allow revenues of $115m and therefore a rate of return of 5% on a risk free investment with a one year life; this rate would be too low.

The analysis above assumes away any risk relating to operating costs or revenues. Once these are recognized then a risk premium must be added to the discount rate, and therefore also the rate of return allowed by the regulator, to reflect conditions prevailing at the commencement of the regulatory period and applicable to the regulatory period. Thus, if the regulatory period were five years, the appropriate risk premium would be the five year premium prevailing at the commencement of the regulatory period. However, unlike the risk free rate, the prevailing risk premium cannot be observed and therefore must be estimated (inevitably with some error). So, one should seek the 'best' estimate of the prevailing risk premium. Since the QCA invokes the Officer (1994) version of the CAPM, in which the risk premium is the product of beta and the MRP, and the MRP is the concern here, the issue then is how to obtain the 'best' estimate of the prevailing MRP.

This is a fundamental issue in statistics and the usual criterion is to minimize the Mean Squared Error (MSE) of the estimate (Ferguson, 1967, page 11).[16] Furthermore, if more than one estimation method is available, one should choose the combination of estimation methods that minimizes the MSE. This is facilitated by choosing individual estimators that are less than perfectly correlated. Furthermore, even if one or more of these estimators are biased at the present time, such as the historical average excess return, inclusion of that estimator might still

[16] The MSE is the average over the squared differences between the estimated value and the true value.

be warranted. To demonstrate these points let $\hat{T}$ denote an estimator and T the true value of the parameter being estimated, in which case the MSE of the estimator is as follows:

$$
\begin{aligned}
MSE &= E\left[\hat{T} - T\right]^2 \\
&= E\left[\hat{T} - E(\hat{T}) + E(\hat{T}) - T\right]^2 \\
&= E\left[\hat{T} - E(\hat{T})\right]^2 + \left[E(\hat{T}) - T\right]^2 \qquad (4)
\end{aligned}
$$

where the first term in the last equation is the variance of the estimator and the second term is the square of the bias. Now, suppose that there are two estimators. Letting w denote the weight on the first estimator, this weight should be chosen to minimise the MSE of the weighted-average estimator:

$$
\begin{aligned}
MSE &= E\left[w\hat{T}_1 + (1-w)\hat{T}_2 - T\right]^2 \\
&= E\left[w(\hat{T}_1 - T) + (1-w)(\hat{T}_2 - T)\right]^2 \\
&= w^2 E\left[\hat{T}_1 - T\right]^2 + (1-w)^2 E\left[\hat{T}_2 - T\right]^2 + 2w(1-w)Cov(\hat{T}_1, \hat{T}_2) \\
&= w^2 MSE_1 + (1-w)^2 MSE_2 + 2w(1-w)Cov(\hat{T}_1, \hat{T}_2) \qquad (5)
\end{aligned}
$$

where $Cov(\hat{T}_1, \hat{T}_2)$ is the covariance between the two estimators. Now suppose that two uncorrelated estimators are available: the historical average excess return, which has a standard deviation of 2% and is currently biased down by 1% as an estimator of the MRP over the next regulatory cycle, and a forward-looking estimator, which is unbiased and also has a standard deviation of 2%. Using equation (4), the MSE of the historical average excess return is $.022^2$ whilst that of the forward-looking estimator is $.02^2$. Thus, despite the significant bias, the historical average excess return is only marginally inferior to the forward-looking estimator in MSE terms. Furthermore, with the MSEs of these two estimators as just determined and following equation (5), the MSE of the combined estimator is minimised at $.015^2$ with w = .44, i.e., a 44% weight on the historical average excess returns and therefore a 56% weight on the forward-looking estimator. So, even with significant bias in the historical average excess return at the present time, it still warrants significant weight in a weighted-average estimator and the combined estimator has a MSE that is significantly less than the better of the two individual estimators.

An even better goal than choosing an estimator with minimal MSE for the MRP over the next regulatory cycle would be to choose an estimator with minimal MSE for the MRP over the *life* of the regulated assets, i.e., under or over estimation within a single regulatory cycle would be of no great consequence relative to aggregate errors over the entire life of the regulated asset. With such a long period, short-term biases in the historic average excess return methodology are likely to wash out, and therefore the merits of historical averaging will be even greater than previously concluded.

In summary, satisfying the NPV = 0 principle requires use of the 'spot' risk free rate rather than a historical average and the prevailing MRP. Since the latter is unobservable, one should therefore employ the 'best' method for estimating it. The usual formalization of this is minimal MSE of the estimator, and this is likely to be achieved by averaging over a number of individual estimators some of which may involve the use of long-run historical data. So, in respect of the question posed by the QCA as to whether combining a 'spot' risk free rate with an MRP estimated using a variety of methods and data from a variety of periods is consistent with the NPV = 0 principle, the answer is unequivocally yes.

6.2 Consistency with the CAPM

The second question posed by the QCA is whether combining a 'spot' five-year risk free rate with an MRP estimated using a variety of methods, and data from a variety of periods, is consistent with the CAPM. As in the previous section, I interpret the reference to a five year risk-free rate to be a reference to a risk-free rate whose term matches the regulatory cycle, and this matter has been dealt with in section 5, i.e., the term of the risk free rate should match that of the regulatory cycle.

The CAPM version that is used by the QCA (Officer, 1994) is a model that specifies the equilibrium expected rate of return on a risky asset (i.e., the expected rate of return that just compensates for risk), as follows:

$$E(R_j) = R_f + [E(R_m) - R_f]\beta_j \tag{6}$$

where R_f is the risk free rate, $E(R_m)$ is the equilibrium expected rate of return on the 'market' portfolio, and β_j is the beta of asset j defined as

$$\beta_j \equiv \frac{Cov(R_j, R_m)}{Var(R_m)}$$

One of the assumptions underlying this model is that investors select portfolios based on the Markowitz (1952, 1959) model, in which an investor chooses (at some point in time, T) that portfolio of assets that has the 'best' probability distribution of returns over a future period from time T. Consequently, R_f, $E(R_m)$ and β_j must be defined as applying to the same future period commencing with time T. This model can be used to estimate the cost of equity capital for a regulated entity. Doing so requires that the Officer and regulatory models be aligned to the maximum extent possible. So, if the regulatory period were five years and the future time period implicit in the CAPM were also five years, the appropriate values for R_f and $E(R_m)$ would be the five year rates prevailing at the commencement of the regulatory period and β_j should be defined with respect to the probability distributions for R_j and R_m over the five year period corresponding to the regulatory period. The more difficult conceptual issue arises if the regulatory period differs from the future period implicit in the CAPM. However, as discussed in Lally (2012a, section 6), the most that one can empirically say about the latter period is that it is likely to exceed one year. This favours treating the future period implicit in the CAPM as matching the regulatory period. However data availability issues may affect the period for which the MRP is defined, and these are discussed further in section 6.3.

In any event, averaging the risk free rate over a historical period would never be compatible with the Markowitz model (because an investor makes a portfolio decision at a point in time) and therefore would never be compatible with the Officer model. Furthermore, in respect of $E(R_m)$ or equivalently the MRP, the fact that this is defined as the value prevailing at the commencement of the regulatory period and for that period does not rule out the possibility that historical data might be used to estimate it because it cannot be observed, as discussed in the previous section. In addition, and again because the parameter cannot be observed, estimating it in a variety of ways and forming some average of the individual estimates would not be inconsistent with the definition of the parameter.

In addition to issues relating to the definitions of parameters within the Officer model, there are also issues arising from the fact that this is a one-period model that is being applied successively in a multi-period regulatory situation, i.e., the model assumes that investors select portfolios at a point in time with the intention of liquidating them at some later point in time whilst the regulatory situations to which the model is applied do not have this terminal feature. Application of the CAPM to a succession of periods requires either a multi-period version of the CAPM (which recognize that investors are exposed to risks arising from future discount rates) or highly unrealistic assumptions about various parameters within one-period versions of the CAPM (such as the Officer model). However all models make simplifying assumptions and the usual consequence of invoking a model with more realistic assumptions is to aggravate difficulties in estimating parameters. Thus, regulators and others must exercise judgement in making the trade-off. So far as I am aware, all regulatory applications of the CAPM, the overwhelming majority of submissions to regulators, and most other applications of the CAPM involve a one-period version of the model presumably in recognition of this trade-off.

In summary, the QCA's practice of using the 'spot' risk free rate is entirely consistent with the CAPM. In fact, using a historical average would be inconsistent with the Markowitz model that underlies the CAPM and therefore also inconsistent with the CAPM. In respect of the MRP, the CAPM requires only that the MRP estimate reflect prevailing market conditions and apply to the future period corresponding to the average investment horizon of investors, and the latter cannot be reliably estimated. So the crucial CAPM requirement is that the MRP estimate reflects prevailing market conditions. The QCA's practice of estimating the MRP using a variety of methods, and data from a variety of periods, is entirely consistent with this. The only apparent conflict between the QCA's actions and the CAPM version that they adopt lies in the fact that they apply a one-period version of the CAPM to a regulatory problem that is multi-period in nature. However all models make simplifying assumptions and the usual consequence of invoking a model with more realistic assumptions is to aggravate difficulties in estimating parameters. Thus, regulators and others must exercise judgement in making the trade-off. So far as I am aware, all regulatory applications of the CAPM, the overwhelming majority of submissions to regulators, and most other applications of the CAPM involve a one-period version of the model presumably in recognition of this trade-off.

6.3 The Reasonableness of the QCA's Approach in Current Conditions

The preceding two sections have argued that the QCA's current practice of combining a 'spot' risk free rate with an estimate of the MRP arising from a range of methods and using data from different periods is consistent with both the NPV = 0 principle and the CAPM. However current market conditions are highly unusual in the sense that the spot risk free rate is unusually low and the MRP *may* be unusually high. Furthermore, the 50% weight that the QCA gives to MRP estimation methods that rely entirely upon historical data, coupled with its practice of rounding the MRP estimate to the nearest 1%, imply that its MRP estimate will not respond quickly to changes in the true value. Consequently, if the true MRP is currently high, it is likely that the QCA's estimate of 6% is too low. Thus, given that the QCA uses the 'spot' risk free rate, these points raise the possibility that the QCA's estimate of the MRP is unreasonable at the present time. My comments on this argument are as follows.

Firstly, the concern about the QCA's MRP estimate only arises because the QCA uses the 'spot' risk free rate, and it might then be argued (as Origin and QTC have) that the use of a historical average risk free rate would resolve the concern. However, I do not support the use of a historical average risk free rate for reasons given previously in section 2.6, i.e., this approach will overestimate the cost of equity for businesses with equity betas less than 1, wrongly assumes that the widely employed MRP estimate of 6% is an estimate of the long-term MRP, requires an entirely subjective judgement about the particular historical period chosen for averaging the risk free rate, and sacrifices an observable, significant, and relevant (in the NPV and CAPM senses) parameter in the form of the current risk free rate. So, if there is a problem, it must be resolved by changing the MRP estimate.

Secondly, it might be argued that the unit of rounding for the MRP estimate should be lower than the figure of 1%, and that this would raise the MRP estimate. However, the effect would be small (0.5% at most). Furthermore, as discussed in Lally (2012a, section 5), a lower unit of rounding increases the frequency of unwarranted changes in the rounded estimate, and prompts more lobbying for changes in parameter values within a methodology or changing the set of methodologies used to estimate the MRP. Since these disadvantages from a lower unit of rounding than 1% seem substantial, and the benefits so small, I recommend continued use of rounding to 1%.

Thirdly, it might be argued (as SFG have done) that the Ibbotson estimator yields an estimate of the average MRP over the historical period used in the estimation rather than one that is commensurate with prevailing conditions, and therefore should not be used. It is uncontroversial that the Ibbotson approach to estimating the MRP produces an estimate of the average MRP over the historical period used in the estimation rather than one that is commensurate with prevailing conditions, and clearly would not be suitable if it were the only means by which the MRP were estimated by the QCA. However the QCA averages over the results from a number of methods including the Ibbotson approach and the result from doing so is likely to be superior to relying only upon results from methodologies that reflect current market conditions. This involves a trade-off between bias and variance in the estimator.

Fourthly, it might be argued (as VAA, Unitywater and Synergies do) that the Ibbotson methodology yields 6.5% rather than the figure of 6.2% invoked by the QCA. However, the QCA’s estimate draws upon results from Brailsford et al (2012) for the 1883-2010 period, in conjunction with an estimated utilization rate on imputation credits of 0.625, and augmented with Reserve Bank data for 2011-2012. I concur with this.

Fifthly, it might be argued (as SFG and NERA do) that the Siegel estimate of 4.32% invoked by the QCA embodies a computational error or an improper choice of parameter value. I do not agree with the concerns raised by SFG and NERA. However, as discussed in section 2.12, the historical data used should be from the same source and time period, and correction for this point yields an estimate of 5.0% rather than the 4.32% obtained by the QCA.

Sixthly, it might be argued (as NERA do) that surveys of inflation expectations one year ahead reveal that there is no systematic tendency to underestimate or overestimate inflation, the premise that underlies the Siegel estimate of the MRP is then false, and therefore that the Siegel estimate should be dismissed. However, as discussed in section 2.12, this argument is not correct.

Seventhly, it might be argued (as SFG do) that the Fernandez survey invoked by the QCA is deficient in various ways. However, as discussed in section 2.2, I do not consider that the problems described by SFG are overly serious. Nevertheless, the survey referred to was undertaken in 2011 and the 2012 results are now available, which raises the MRP estimate to 5.9%.

Eighthly, it might be argued that the appropriate survey evidence to use is that from "independent valuation experts" during 2012, as QTC and NERA do, and this points to a much larger MRP estimate than the Fernandez survey. However, as discussed in section 2.9, the MRP estimates of these "independent valuation experts" average only 6.3%. This survey data has the advantage of coming from reports that are the product of considerable thought, whilst the Fernandez surveys have the advantages of providing responses from a wider group of informed observers as well as permitting international comparisons. Since both surveys have merit, I average over the results from both of them, yielding 6.1%.

Ninthly, a wide range of estimates of the MRP have been presented using versions of the DDM including SFG (2013a, paras 94-98), NERA (2013, section 6.2) and SFG (2013c, Table 6) with results of 8.5%, 8.03% and 7.9% respectively. In addition the QCA's (2012, Table 3.1) estimate is 8.7%. However only the first and last of these four estimates embodies the highly important restriction that the long-run expected real growth rate in DPS cannot exceed the long-run expected real growth rate in GDP. Furthermore, this is an upper bound and a reasonable deduction from it to reflect new share issues and the formation of new companies would be 0.5% - 1.5% (as discussed in Lally, 2013b, section 8). Furthermore, since the risk free rate is currently low and therefore the expected market return *may* also be currently low, the estimates should account for reversion in both parameters towards some long-run averages, as discussed in Lally (2013b, section 8). Taking account of all of these points, Lally (2013b, section 8) concludes that the range of estimates from this approach is 5.9% - 8.4% as at December 2012. However these estimates are premised upon a utilization rate on imputation credits of 35%. Using instead the QCA's utilization rate of 62.5%, the imputation-adjusted dividend yield rises from 5.34% to 5.74% and therefore the range in the MRP estimates is 7.0% to 9.5%.

Tenthly, it might be argued that the set of methodologies should be expanded to include various other approaches. Both SFG (2013a, para 92) and the QTC (2013, page 11) favour estimating the expected real market return from its historical average, converting this to its nominal counterpart using current expected inflation and then deducting the current nominal CGS rate. Like the Siegel approach adopted by the QCA, such an approach addresses the concern that unexpected inflation in the 20th century depressed the historical average real risk free rate below that expected and therefore induced an upward bias in the Ibbotson estimate of the MRP (and was proposed by Siegel, 1992). However, as discussed in section 2.2, I favour the approach adopted by the QCA as a response to the inflation shock issue. Nevertheless the approach proposed by SFG and the QTC has some merit independent of the inflation shock issue, i.e., regardless of the inflation shock issue, the approach would be superior to the Ibbotson approach if the expected real market cost of equity is more stable over time than the MRP and the evidence on this question, whilst favouring the Ibbotson approach, is not decisive. Thus, this approach might be added to the set of four methodologies currently used by the QCA. If so, the result would be 7.3% upon converting the historical average real market return of 8.3% to its nominal counterpart using current expected inflation of 2.5% (the midpoint of the RBA's target range), and then deducting the current (July 2013 average) nominal CGS rate of 3.7%. To this must be added the effect of imputation credits, which would match that in Brailsford et al (2012). Their MRP estimate increases by 0.3% when the estimate for U increases from 0 to 1 (ibid, Table 1, Table 3), which implies 0.2% at the QCA's preferred estimate for U of 0.625. Adding this adjustment of 0.2% to the above MRP estimate of 7.3%, the result is 7.5%. This approach could be viewed as the Ibbotson approach subject to substituting the current expected real risk free rate for the historical average. Thus, since the current expected real risk free rate (the nominal rate of 3.7% net of expected inflation of 2.5%, yielding 1.2%) is lower than the historical average real risk free rate (2.4%: see section 2.12), this approach yields an MRP estimate (7.5%) that is higher than that of the Ibbotson approach (6.2%).

In addition EMCS (2013, paras 35-48) favour a variant of the Merton (1980) approach, in which the one-year ahead MRP is estimated in accordance with an estimate of market volatility over that period coupled with reversion towards a long-run MRP estimate over the rest of the regulatory period. However, as discussed in section 2.14, this approach has too many shortcomings to be viable.

In addition VAA (2013, paras 96-122, paras 134-143) argue that the DRP on BBB bonds has risen by about 2.0% since the GFC, that less than 0.1% of this is due to an increase in default risk, the rest is therefore due to an increase in systematic risk, and this in turn to an increase in the MRP because debt betas are unlikely to have risen. The resulting estimates of the MRP range from 9% to 15%. However, as discussed in section 3.3, this approach has too many shortcomings to be viable.

In addition SFG (2013c, section 2.5) favours estimating the MRP from a regression of realized market excess returns on various predictors. The resulting estimate of the MRP is 7.5% at the end of 2012. However, as discussed in section 4.3, this approach has too many shortcomings to be viable.

Finally, results from other markets should also be considered. A possible objection to this is that such results from foreign markets reflect the true MRPs in those markets and therefore use of such results will introduce bias. However, as discussed earlier, the focus should be on MSE rather than bias and combining an estimate based upon only Australian data with estimates from various countries will yield a lower MSE than using only Australian data. Such estimators are well-established in the statistics literature (James and Stein, 1961; Efron and Morris, 1975; Efron, 2010) and they have also been applied in finance to estimating betas (Vasicek, 1973), variances (Karolyi, 1993), and expected returns (Jorion, 1986; Grauer and Hakansson, 1995). More recently, they have also been applied to estimating MRPs (Lally and Randal, 2012) and they generate considerable reductions in MSE because virtually all of the cross-country variation in MRP estimates appears to constitute estimation error rather than cross-country variation in true MRPs. A further possible objection to the use of foreign data is that it is inconsistent with use of a model (the Officer CAPM) that assumes that equity markets are fully segmented. However, the use of such a model implies only that the MRP is for Australia and therefore the best estimate for that MRP should be sought. If foreign data improve the estimate, this data should be used.

To illustrate the MSE gains from using data from multiple markets, suppose that an estimator using only Australian data is unbiased and has a standard deviation of 2% whilst an estimator using only US data has the same standard deviation, a bias of 1%, and the correlation between the estimators is 30%. Following equation (4), the MSE for the estimator using only Australian data is $.02^2$ whilst that using only US data is $.022^2$. Following equation (5), the MSE for a weighted-average of these estimators is minimised with a weight of 57% on the estimator using only Australian data and therefore 43% on the estimator based upon US data. Further, with this weighted average, the MSE of the combined estimator is $.017^2$, which is almost 30% less than for the estimator using only Australian data. With additional markets, the benefits from a combined estimator are even greater. In particular, Lally and Randal (2012) find that the reduction in MSE is more than 50%.

In respect of historical averaging of excess returns, Dimson et al (2013) provide results for 19 other markets (primarily in Western Europe) over the period 1900-2012. The average of these results is 5.9%.[17] This is almost identical to the result for Australia based on Brailsford et al (2012), but the latter is based upon the slightly longer time period 1883-2012. In respect of the estimate modified for the inflation shock in the 20th century, the average over the 19 countries will be the average of the conventional results (5.9% as just described), plus the cross-country average of the average real bond rates (2.1%, based upon the data from Dimson et al, 2013), less an improved estimate of the long-term expected real risk free rate. In respect of the latter, the estimate for Australia was 3.6% as noted above, and Lally and Marsden (2004, pp. 95-97)

[17] The results are the nominal arithmetic mean return on equities less that for bonds. So, for example, the figure for the UK is 11.25% less 6.14%, equalling 5.11%. Unfortunately the figures for bonds are returns rather than yields but the average difference over a long period is likely to be minimal.

estimate the figure at 3% - 4% for both New Zealand and the US. Applying this range of figures to the 19 countries in question, the cross-country average of these modified MRP estimates would be 4% - 5%, compared to the figure of 5.0% for Australia as described above. In respect of surveys, Fernandez et al (2012) provides responses across 82 countries. However many of these countries face significant political risks (especially confiscation) that may or may not be impounded into the MRP estimates and I therefore limit consideration of results to the same 19 foreign markets for which results from Dimson et al (2013) are used. Across these 19 countries, the average survey result is 5.8% (Fernandez et al, 2012, Table 2) and this is very similar to the survey-based figure for Australia. In respect of the Cornell estimator, and the Siegel variant favoured by SFG and the QTC, results for each of these 19 foreign markets would require considerable effort to generate and therefore this task is not undertaken.

All of these results are summarised in Table 1 below. Since some of these results are bands rather than point estimates, the mean cannot be determined and therefore the median is considered. The median result from the first four methodologies and using only Australian data, consistent with the QCA's current approach, is 6.1%. If the method proposed by SFG and QTC is added, the median rises slightly to 6.2%. Amongst results from other markets, substitution of these results for the Australian results would reduce the median to 5.9%. With rounding to the nearest 1%, both of these figures are 6%. All of this suggests that 6% is an appropriate MRP estimate for Australia.

Table 1: Estimates of the MRP

	Australia	19 Other Countries
Ibbotson estimate	6.2%	5.9%
Siegel estimate: version 1 (QCA)	5.0%	4.0% - 5.0%
Cornell estimate	7.0% - 9.5%	n/a
Survey	6.1%	5.8%
Siegel estimate: version 2 (SFG, QTC)	7.5%	n/a

It is also interesting to consider how much the estimates from these various approaches have changed since the commencement of the GFC in September 2008. In respect of the first two methods, these are based entirely upon historical averaging and therefore have moved very little. In respect of survey results, Fernandez conducted the same survey in 2009, enquired into the MRP that was being used in both 2008 and 2007 (Fernandez, 2009), and the result was 6.0% for Australia in 2007. Thus there has been no significant movement.[18] Averaging over the four individual markets for which 2007 responses are provided and comparing it with the average for the same countries in 2012, the result is an average increase of only 0.3%. Finally, in respect of the Siegel variant favoured by SFG and the QTC, this will move almost 1:1 with the risk free rate. So, since the risk free rate was 5.95% in August 2008 (just before the GFC) and was 3.79% in July 2013, the MRP estimate would have risen by about 2.2% over that period.[19] Such extreme sensitivity to movements in the risk free rate will be a strength if the expected real market cost of equity is more stable over time than the MRP, but not otherwise. However no persuasive evidence has been presented in support of the hypothesis that the expected real market cost of equity is more stable over time than the MRP, contrary evidence has been presented, and the respondents to the Fernandez survey clearly think that the MRP rather than the expected real market cost of equity has been much more stable over this period.

It is important that these Australian estimates use the same estimate of the utilization rate on imputation credits (U). The QCA adopts an estimate for U of 0.625 and therefore this estimate is impounded into the MRP estimate where possible. This occurs for all estimates except the survey results, for which the underlying estimate of U is unclear.

It is also important that all estimates of the MRP use the same risk free rate term. As discussed in Lally (2012a, section 6), the appropriate risk free rate term for estimating the MRP is that corresponding to the across-investor average period between successive portfolio reassessments.

[18] The 2009 survey targeted only at academics whilst the 2012 survey included a wider range of respondents. However, the 2012 survey provides the average response for academics as well as the overall average response and there is no material difference between the two averages in 2012.

[19] The figure of 5.95% is the average ten-year yield of 5.86% reported for August 2008 on the RBA's website, subject to correcting for the fact that the RBA converts a semi-annual rate to an annual rate using simple rather than compound interest. Similarly the figure of 3.79% is the July 2013 average of 3.75% reported by the Reserve Bank, corrected in the same way.

However, it is not possible to be any more precise about this than to say it is likely to be at least one year and could easily be ten years. The choice then rests upon more pragmatic considerations, with historical data availability for the risk free rate pointing to a ten year period whilst regulatory considerations (in the form of the typical regulatory period being five years) suggest a figure of five years. On balance, I think data availability is the more significant issue, and this favours treating the across-investor average period between successive portfolio reassessments as ten years. Accordingly, all of the above MRP estimates use the ten-year rate except the survey results, for which the underlying term is unclear.

A natural question to ask is to what extent use of the five-year risk free rate would change the results in Table 1. In respect of the Ibbotson and Siegel (version 1) estimates, five-year risk free rates are only available back to January 1972 and, over the period since, ten-year rates have exceeded five-year rates by 0.20% on average.[20] Extrapolating this differential to the entire time series underlying the Ibbotson and Siegel (version 1) estimates, the result would be to raise them by 0.20% each. In respect of the Cornell and Siegel (version 2) estimates, these would also rise by the differential between the current five and ten year rates. In respect of survey results, there is no change because the risk free rate underlying these estimates are unknown. Thus, amongst the Australian estimates, the median estimate would continue to be that from the Ibbotson methodology and this would rise from 6.2% to 6.4%. Substituting foreign estimates for these Australian estimates, where available, and extrapolating the 0.20% differential discussed above to the foreign results for the first two methods, the median estimate would still be for the Ibbotson methodology and it would rise from 5.9% to 6.1%. So, with rounding to the nearest 1%, the choice of a five versus ten year risk free rate does not affect the rounded result for the MRP of 6%.

In summary, I concur with the QCA's use of a risk free rate prevailing at the commencement of the regulatory period, to ensure that the present value of the regulated entity's future cash flows matches its initial investment. In relation to the estimated MRP, I favour an approach that minimises the MSE and this leads to averaging over the results from a wide range of methodologies. These methodologies should include the historical averaging of excess returns

[20] See Table F2 on the Reserve Bank's website: http://www.rba.gov.au/statistics/tables/index.html.

(6.2%), the historical average of excess returns modified for the great inflation shock in the 20th century (5.0%), the result from the Cornell approach (7.0% - 9.5%), and the result from surveys (6.1%), with the latter averaging over those of Fernandez and those from independent valuations. The median of these four approaches is 6.1%. A wide range of other methodologies are available and some of them have been presented in submissions. These alternatives include estimating the expected real market cost of equity from the historical average real market return, converting this to nominal terms using prevailing expected inflation and then deducting the prevailing nominal risk free rate, yielding 7.5%. Relative to the Ibbotson methodology, this approach assumes that the expected real market cost of equity rather than the MRP is constant over time, and therefore will be superior to the Ibbotson approach if the expected real market cost of equity is more stable over time than the MRP. The evidence on this question, whilst favouring the Ibbotson approach, is not decisive, and therefore provides some support for use of this methodology as well as the Ibbotson methodology. Adding the 7.5% result from this methodology to the earlier four results, the median of these five approaches increases marginally to 6.2%. Evidence from foreign markets should also be considered. For the first, second and fourth of the five methods described above, the cross-country averages are 5.9%, 4.0% - 5.0%, and 5.8%. Substitution of these results for the Australian results would reduce the median to 5.9%. With rounding to the nearest 1%, all of these medians are 6% and therefore suggests that 6% is an appropriate MRP estimate for Australia. This matches the QCA's view.

7. Conclusions

This paper has reviewed a wide range of submissions to the QCA relating to the risk free rate and the MRP. The MRP submissions form two broad categories: those that allege error in the QCA's approach or calculations, and those that propose alternative methods for estimating the MRP that might complement the four approaches currently used by the QCA. In respect of alleged errors, I do not concur with any of these submissions. In respect of alternative methods for estimating the MRP, I consider that the survey-based MRP estimates should draw upon those from recent reports by independent valuation experts as well as from the Fernandez surveys, with averaging over the results from these two sources. In addition, I consider that the set of methodologies considered by the QCA should be augmented by one involving estimating the expected real market cost of equity from the historical average actual real return and then deducting the current real risk free rate (or converting the estimate of the expected real market cost of capital to its nominal counterpart and then deducting the current nominal risk free rate). The other methods proposed in the submissions have such serious shortcomings as to be unviable.

In respect of the risk free rate, the submissions primarily relate to the appropriate term to be used and whether the spot rate should be used. In respect of the use of the spot rate, a number of submissions favour historical averaging coupled with a long-term estimate for the MRP of 6%. However this approach will overestimate the cost of equity for businesses with equity betas less than 1, wrongly assumes that the QCA's MRP estimate of 6% is an estimate of the long-term MRP, embodies no rationale for using the particular historical period chosen for averaging the risk free rate, and sacrifices an observable, relevant and significant parameter in the form of the current risk free rate.

In respect of the term of the risk free rate, the QTC claims that matching this to the regulatory period so as to satisfy the NPV = 0 principle embodies a number of unrealistic assumptions. None of these claims are true. A number of other submissions also argue for the ten year risk free rate to reflect the life of the regulated assets or the investment horizon of investors, but do not assess whether the NPV = 0 principle would be violated (which it would be).

The principal submissions on the appropriate term of the risk free rate are from SFG, and my conclusions on these are as follows. Firstly, SFG's belief that matching the risk free rate term to the regulatory term ('term matching') is not necessary to satisfy the NPV = 0 principle is false; their error arises from invoking a valuation equation that applies a risk free rate to an uncertain future cash flow and by assuming that the expectations hypothesis concerning the term structure of interest rates prevails, which is both empirically false and even recognized as such by SFG. Secondly, SFG's belief that the expectations hypothesis is a necessary condition for term matching to satisfy the NPV = 0 principle is incorrect; term matching is required to satisfy the NPV = 0 principle regardless of how the term structure of interest rates is determined. Thirdly, SFG's belief that if term matching satisfies the NPV = 0 principle there is a 'free lunch' available to consumers (in the form of lower output prices by reducing the regulatory cycle) is not correct;

output prices would be lowered (on average) with a shorter regulatory cycle but there are disadvantages to this including shortening the period for which regulated businesses retain the benefits from efficiency gains, and greater volatility in output prices. Fourthly, SFG's belief that using the five rather than the ten year risk free rate to estimate the MRP must reduce the MRP estimate is not correct; the impact of this change is lost in the rounding of the MRP estimate to the nearest 1%. Finally, SFG's belief that a regulator should use the ten year risk free rate in order to produce output prices that match those of an otherwise identical unregulated business operating in a competitive market is not correct; even if the output prices of the latter firms did reflect the ten year risk free rate, due to the use of ten-year debt that was not swapped into another term, regulation should instead seek output prices that cover costs including the cost of capital, and the latter depends upon the particular form of regulation.

In respect of whether the QCA's practice of combining a 'spot' risk free rate with an MRP estimated using a variety of methods and data from a variety of periods is consistent with the NPV = 0 principle, satisfying the NPV = 0 principle requires use of the 'spot' risk free rate rather than a historical average and the prevailing MRP. Since the latter is unobservable, one should therefore employ the 'best' method for estimating it. The usual formalization of this is minimal MSE of the estimator, and this is likely to be achieved by averaging over a number of individual estimators some of which may involve the use of long-run historical data. So, combining a 'spot' risk free rate with an MRP estimated using a variety of methods and data from a variety of periods is consistent with the NPV = 0 principle.

In respect of whether the QCA's practice of combining a 'spot' risk free rate with an MRP estimated using a variety of methods, and data from a variety of periods, is consistent with the CAPM, the QCA's practice of using the 'spot' risk free rate is entirely consistent with the CAPM. In fact, using a historical average would be inconsistent with the Markowitz model that underlies the CAPM and therefore also inconsistent with the CAPM. In respect of the MRP, the CAPM requires only that the MRP estimate reflect prevailing market conditions and apply to the future period corresponding to the average investment horizon of investors, and the latter cannot be reliably estimated. So the crucial CAPM requirement is that the MRP estimate reflects prevailing market conditions. The QCA's practice of estimating the MRP using a variety of methods, and data from a variety of periods, is entirely consistent with this. The only apparent conflict between the QCA's actions and the CAPM version that they adopt lies in the fact that they apply a one-period version of the CAPM to a regulatory problem that is multi-period in nature. However all models make simplifying assumptions and the usual consequence of invoking a model with more realistic assumptions is to aggravate difficulties in estimating parameters. Thus, regulators and others must exercise judgement in making the trade-off. So far as I am aware, all regulatory applications of the CAPM, the overwhelming majority of submissions to regulators, and most other applications of the CAPM involve a one-period version of the model presumably in recognition of this trade-off.

Finally, in respect of the reasonableness of the QCA's approach under current market conditions, I concur with the QCA's use of a risk free rate prevailing at the commencement of the regulatory period, to ensure that the present value of the regulated entity's future cash flows matches its initial investment. In relation to the estimated MRP, I favour an approach that minimises the MSE and this leads to averaging over the results from a wide range of methodologies. These methodologies should include the historical averaging of excess returns (6.2%), the historical average of excess returns modified for the great inflation shock in the 20th century (5.0%), the Cornell approach (7.0% - 9.5%), and the use of surveys (6.1%), with the latter averaging over those of Fernandez and those from independent valuations. The median of these four approaches is 6.1%. A wide range of other methodologies are available and some of them have been presented in submissions. These alternatives include estimating the expected real market cost of equity from the historical average real market return, converting this to nominal terms using prevailing expected inflation and then deducting the prevailing nominal risk free rate, yielding 7.5%. Relative to the Ibbotson methodology, this approach assumes that the expected real market cost of equity rather than the MRP is constant over time, and therefore will be superior to the Ibbotson approach if the expected real market cost of equity is more stable over time than the MRP. The evidence on this question, whilst favouring the Ibbotson approach, is not decisive, and therefore provides some support for use of this methodology as well as the Ibbotson methodology. Adding the 7.5% result from this methodology to the earlier four results, the median of these five approaches increases marginally to 6.2%. Evidence from foreign markets should also be considered. For the first, second and fourth of the five methods described above, the cross-country averages are 5.9%, 4.0% - 5.0%, and 5.8%. Substitution of these results for the Australian results would reduce the median to 5.9%. With rounding to the nearest 1%, all three of these medians are 6% and therefore suggests that 6% is an appropriate MRP estimate for Australia. This matches the QCA's view. So I consider that the QCA's use of the spot risk free rate and an MRP estimate of 6% is reasonable under current conditions.

APPENDIX: Terms of Reference

Terms of Reference: The Risk-free Rate and Market Risk Premium

1. Background

Queensland Competition Authority

The Queensland Competition Authority (the Authority) is an independent statutory body responsible for assisting with the implementation of competition policy for government-owned business entities in Queensland. In particular, the Authority is responsible for the economic regulation of key rail, port, and water monopoly infrastructure services.

Authority-wide Cost of Capital Review: Response to Submissions on Discussion Paper

The Authority is currently undertaking a general review of the methodology it applies for determining the weighted average cost of capital (WACC) for regulated businesses under its jurisdiction.

As part of this current WACC Review, the Authority published a discussion paper, *The Risk-free Rate and the Market Risk Premium* (November 2012), for public consultation. At the same time, the Authority also published an accompanying paper, *The Risk-free Rate and the Market Risk Premium* (August 2012), by Dr Martin Lally. Submissions were due on 29 March 2013, and the Authority received submissions from 14 stakeholders.

The majority of submissions were from regulated firms and Government departments and criticised the Authority's approach to estimating these parameters in current financial market conditions. In general, these stakeholders argue that, as Commonwealth government bond yields are currently very low, the Authority should change its approach to estimating the risk-free rate, the market risk premium, or both parameters.

Aurizon Network 2013 Draft Access Undertaking Submission

On 30 April 2013, Aurizon Network submitted its 2013 Draft Access Undertaking (DAU) for approval. The DAU includes Aurizon Network's cost of capital proposal, along with supporting consulting reports. Aurizon Network and its consultants make arguments relating to estimating the risk-free rate and market risk premium that are similar to arguments made in response to the discussion paper. They also criticise of some of the methods the Authority uses to estimate the market risk premium.

Unitywater and Queensland Urban Utilities (QUU) Price Monitoring 2013-15 Submissions

The Authority is monitoring the retail and distribution activities of five water providers in SEQ for 2013-15. On 30 June, Unitywater and QUU submitted their price monitoring information to the Authority. Unitywater's submission raises a number of concerns about WACC matters and includes a range of material which might not be included in its (separate) submission to the Authority-wide WACC review (see above). The QUU submission raises concerns with the WACC calculation approach currently adopted by the QCA, stating that these concerns will be addressed in the Authority-wide cost of capital review.

This Terms of Reference ('TOR') relates to providing advice to the Authority in response to these submissions and responding to a specific set of questions from the Authority, as detailed in section 2 below.

2. Consultancy Requirements

The TOR for this consultancy is to respond to:

(a) arguments in submissions on the Authority's discussion paper, *The Risk-free Rate and the Market Risk Premium* (November 2012);

(b) Aurizon Network's submission on the cost of capital with respect to the risk-free rate, market risk premium and the implied cost of equity;

(c) Unitywater's and QUU's submissions on the SEQ Price Monitoring 2013-15; and

(d) the specific set of questions set out by the Authority.

These tasks are described in more detail in the following sub-sections.

Task 2A

This task involves the consultant responding to arguments raised in response to the Authority's discussion paper by these stakeholders:

(a) Asciano;

(b) Aurizon Network, including supporting consulting documents:

  (i) SFG Consulting (19 March 2013) – *Response to the QCA Discussion Paper on Risk-free Rate and Market Risk Premium*; and

  (ii) SFG Consulting (25 March 2013) – *Response to the QCA Approach to Setting the Risk-free Rate*;

(c) Australian Rail Track Corporation;

(d) Dr Robert Bowman;

(e) DBCT Management;

(f) Origin Energy;

(g) Queensland Treasury and Trade;

(h) Queensland Resources Council;

(i) Queensland Treasury Corporation;

(j) Queensland Urban Utilities;

(k) Rio Tinto;

(l) United Energy / Multinet, including supporting consulting documents:

(i) NERA (March 2013) – *The Cost of Equity*;[21]

(ii) ESQUANT Statistical Consulting (9 April 2013) – *A Review of NERA's Analysis of McKenzie and Partington's EGARCH Analysis*.

(m) Unitywater, including supporting consulting documents:

(i) SFG Consulting (25 March 2013) – *Response to the QCA Discussion Paper on Risk-free Rate and Market Risk Premium;*[22]

(ii) SFG Consulting (25 March 2013) – *Response to the QCA Approach to Setting the Risk-free Rate*;[23] and

(iii) EMCS (March 2013) – Options for Estimating a Weighted Average Cost of Capital for Water Utilities: A Preliminary Discussion Paper;

(n) Vale Australia.

With respect to the submission by United / Multinet, the NERA report refers substantially to McKenzie and Partington (2012), and the consultant should review that paper for relevance as well.[24] Also, the NERA report includes a response to the AER in the context of using the arithmetic versus geometric mean when estimating the market risk premium. The Authority does not require the consultant to respond on that particular issue.

Task 2B

Task 2B requires the consultant to respond to arguments raised in Aurizon Network's 2013 Draft Access Undertaking submission related to the risk-free rate and market risk premium components of the cost of capital, including relevant supporting consulting reports:

(o) Aurizon Network (30 April 2013) – 2013 Draft Access Undertaking Volume 3: Maximum Allowable Revenue and Reference Tariffs, pp. 102-150;

(p) SFG Consulting (11 March 2013) – *Testing the Reasonableness of the Regulatory Allowance for the Return on Equity*;

(q) SFG Consulting (29 August 2012) – *Term to Maturity of the Risk Free Rate Estimate in the Regulated Return*;

(r) Value Advisor Associates (February 2013) – *Review of Debt Risk Premium and Market Risk Premium*, pp. 18-35.[25]

[21] The NERA report was commissioned by Multinet Gas to examine a number of issues arising from recent decisions of the Australian Energy Regulator (AER) and the Authority and to technical advice from their advisors.

[22] This appears to be the same report as document (b)(i) but with a different date.

[23] This appears to be the same report as document (b)(ii) but with a different date.

[24] McKenzie, M. and G. Partington (2012). *Review of Regime Switching Framework and Critique of Survey Evidence*, SIRCA Ltd, 7 September.

[25] The Authority does not require advice at this time on the first part of the paper, which addresses the cost of debt.

Task 2C

Task 2C requires the consultant to respond to arguments raised in Unitywater's and QUU's submissions related to the risk-free rate and market risk premium components of the cost of capital, including these relevant documents:

(s) Unitywater (28 June 2013) – *Price Monitoring Submission*, pp. 49-51;

(t) Unitywater (28 June 2013) – *Price Monitoring Submission Appendices*, including:

  (i) Synergies (June 2013) – *Review of the WACC to Apply to Unitywater for the 2013-15 Price Monitoring Period*;

  (ii) SFG Consulting (14 June 2013) – *Techniques for Estimating the Cost of Equity*.

(u) QUU (28 June 2013) – *QCA Interim Price Monitoring Information Return 2013-15*, pp. 44-47.

Task 2D

Task 2D requires the consultant to answer the following set of questions:

(a) Is the Authority's approach of determining the cost of equity – in particular, combining a 'spot', 5-year risk-free rate with a market risk premium estimate (which arises from a range of methods and different time frames) - :

  (i) consistent with the NPV=0 principle and if not consistent, still appropriate given information constraints;

  (ii) consistent with applying the CAPM for regulatory cost of capital purposes; and

  (iii) reasonable in current market conditions.

(b) Assess the claims in the three SFG reports regarding the Authority's approach to setting the term of the risk-free rate (documents (b)(ii), (m)(ii), (q)). In particular, assess the claims that the Authority's 'term matching' approach:

  (i) is not necessary to satisfy the NPV=0 principle and that using longer term debt does not violate that principle;

  (ii) only holds under the assumption that the forward curve represents an unbiased assessment of future interest rates; and

  (iii) implies that: 1) prices could be lowered without any cost to the firm by shortening the length of the regulatory cycle; 2) the estimate of the market risk premium must necessarily be changed; and 3) the regulator is estimating a price below that which would prevail in a competitive market.

(c) Assess the Authority's approach to estimating the market risk premium and whether it is reasonable in current market conditions. In answering this question:

  (i) assess, in particular, the criticisms of Authority's use of surveys and Siegel averaging to estimate the market risk; and

(ii) discuss whether the Authority should consider additional methods, including improvements to the survey method, and/or evidence for informing its estimate of the market risk premium.

In answering question (b), submissions related to this issue (i.e. the Authority's approach to setting the *term* of the risk-free rate) should be addressed in this response rather than as part of Tasks 2A, 2B, and 2C.

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