REVIEW OF SUBMISSIONS ON THE MRP AND THE RISK-FREE RATE

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EXECUTIVE SUMMARY

In its recent draft decision concerning the Maximum Allowable Revenue for Aurizon Network, the QCA estimated the four-year risk-free rate at 3.21% and the MRP at 6.5%. In response, it has received submissions on these matters from SFG, Aurizon, The Brattle Group, AngloAmerican, and the QRC. This paper has reviewed these submissions and the points of agreement are as follows.

Firstly, as claimed by SFG, the Officer formula for converting between the costs of equity inclusive and exclusive of imputation credits will hold under conditions other than the cost of equity comprising only the expected dividend yield. However, these additional conditions are much more extensive than claimed by SFG and collectively are extremely unrealistic. A superior approach to this matter is to utilise a conversion formula between costs of equity with and without imputation credits that follows from the definitions of these two costs of equity, without recourse to any assumptions, and this is the formula used by the QCA.

Secondly, SFG favours formally considering results from the "Wright" method for estimating the MRP and this exerts an upward effect upon the MRP estimate. As noted by SFG, I agree. However, SFG fails to note that I also support consideration of results from other markets, doing so exerts a downward effect upon the MRP estimate, and the net effect would be downward.

Thirdly, The Brattle Group claim that the QCA's DDM fails to take share buybacks into account and this leads to downward bias in the estimate of the MRP. I agree with this point, but correction for it (by adding buybacks to current dividends) should be accompanied by a deduction from the historical average growth rate in EPS that is used for forecasting purposes (so as to remove the upward effect of buybacks) and the net effect would be to raise the MRP estimate by up to 0.50%. The inability to be more precise is not a significant issue because this estimate of the MRP is the QCA's highest and therefore any increment to it would not change the QCA's median MRP estimate.

Fourthly, I acknowledge the usefulness of the historical Australian EPS data invoked by SFG and the desirability of fitting a curve to the data. However, the results from 1990 that are favoured by SFG are not indefinitely sustainable, this points to using the full data set for estimating the expected long-run growth rate in EPS, and the effect of doing so suggests that the QCA's estimate for the expected long-run growth rate in DPS is too high, in which case the resulting DDM estimate of the MRP is too high. As with the previous point, this is not a significant issue because this estimate of the MRP is the QCA's highest and therefore any deduction from it is unlikely to change the QCA's median MRP estimate.

1. Introduction

In its recent draft decision concerning the Maximum Allowable Revenue for Aurizon Network, the QCA (2014a, Table 4) estimated the four-year risk-free rate at 3.21% and the MRP at 6.5%. In response, it has received submissions on these matters from SFG, Aurizon, The Brattle Group, AngloAmerican, and the QRC.[1] This paper seeks to review these submissions.

2. SFG

2.1 The Term of the Risk-Free Rate

SFG (2014a, section 2) argues that commercial practice is to use the ten-year risk-free rate in valuing equities. However, the QCA is not engaged in valuing equities but in periodically setting the allowed rate of return in order to cover a business's efficient costs, and this is equivalent to satisfying the NPV = 0 principle. Since the exercises are different, what is appropriate in one case need not be appropriate in the other. As shown in Schmalensee (1989), Lally (2004) and Lally (2007a, 2007b), this regulatory situation implies that the appropriate term of the risk-free rate is that matching the regulatory cycle. This analysis cannot be rebutted by citing commercial practice in an unrelated exercise.

SFG (2014a, section 2, section 5) also refers to a report by Incenta (2013), which is a survey of the valuation practices of 14 investment analysts focusing upon the valuation of regulated businesses subject to a five-year regulatory cycle. Accordingly, it has potentially more relevance to the QCA's situation than valuation practice in general. This report is examined in Lally (2014a, pp. 26-28), and the conclusion reached there is that the Incenta survey results do not suggest that the QCA should adopt the ten-year risk-free rate. SFG (2014a, section 2) has not responded to any of the points raised in Lally (2014, pp. 26-28).

SFG (2014a, section 3, section 5) argues that setting the risk-free rate to match the regulatory period (typically five years), in order to satisfy the NPV = 0 principle, presumes that the market value of the regulatory business at the end of the current regulatory cycle is known now, that this is not the case, and therefore the appropriate risk-free rate is one matching the life of the regulated assets, which implies use of the longest available term for the risk-free

[1] A submission was also received from Vale but it contains no specific comments on the risk-free rate or the market risk premium.

rate (ten years). SFG (2014a, section 3) notes the QCA's (2014b, page 47) argument that, even if the business's value at the end of the cycle is not certain (which is the case), such risk will be compensated through beta (if systematic) and therefore using a longer-term risk-free rate will involve duplicate compensation. In response, SFG argues that the NPV = 0 principle will still be violated and therefore the QCA's point is irrelevant. However, SFG's argument is not simply that uncertainty about the business value at cycle end undercuts the claim that NPV = 0 implies use of the five-year risk free rate but that use of the ten-year rate is appropriate. Thus, the QCA's point is relevant and SFG do not address it.

Furthermore, moving from the five to the ten-year risk-free rate in the presence of risk implies that risk gives rise to a discontinuity in the choice of the risk-free rate, i.e., in the absence of risk, the five-year risk free rate is appropriate whereas the presence of risk at any level warrants use of the ten-year risk-free rate. However, this is not correct. Whatever the level of risk is that is associated with the business value at period end, one could hypothesise it shrinking to zero. As it shrinks to zero, the compensation would also have to shrink to zero, and this could *not* be achieved through switching from the ten to the five-year risk-free rate at some point. Furthermore, there are times at which the ten-year risk-free rate is below the five-year rate. At such times, using the ten-year rate ceases to compensate businesses for the risk associated with uncertainty about the cycle end business value and instead imposes a penalty. Furthermore, one could hypothesise increasing the level of risk associated with the business value at cycle end. If the use of the ten rather than the five-year risk-free rate is intended to compensate investors for this risk, the margin in the ten-year rate over the five-year rate would need to grow. However, it would not because this risk-free rate margin is determined by considerations relating to risk-free rates (principally expected future rates, and compensation for holding long-term bonds) that have no relevance to the risks associated with the cycle end value of regulated businesses.

All of these points are intuitive, and suggest that SFG's argument is incorrect. However, the ultimate test is whether the NPV = 0 principle still leads to the conclusion that the appropriate risk free rate must match the regulatory cycle even in the presence of risks associated with the business value at cycle end. SFG claims that it does not and cites many papers by me that imply that this is not the case. However, all of these citations involve proofs in which the risks in question were assumed away by me in order to simplify the proof. For example, SFG

(2014a, para 57) refers to Lally (2013a, page 47). The quotation presented by Lally is preceded by the words

"*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*."

Thus, SFG's citations of reports by Lally do not settle the matter. The matter is instead settled in Lally (2004), which is concerned with precisely this question and demonstrates that the NPV = 0 principle implies that the appropriate risk-free rate is that matching the regulatory cycle "..even in the presence of cost and volume risks, and risks arising from asset valuation methodologies." (ibid, page 18). These risks are allowed for by adding a risk premium to the discount rate used to value cash flows, and therefore also to the cost of equity allowed by the regulator, not by altering the term for the risk-free rate. Thus, regardless of whether the value of the business at the end of the cycle is uncertain, the appropriate risk-free rate is always that matching the regulatory cycle. SFG's contrary claim is therefore incorrect.

SFG (2014a, section 4) argues that the QCA's use of the five-year risk-free rate as the first term of the CAPM along with use of the ten-year rate to estimate the MRP is inconsistent with the CAPM, which requires use of the same rate throughout the model. This claim concerning the CAPM is true; the CAPM provides a cost of capital over a period corresponding to the interval between successive portfolio reassessments by investors, and this interval is assumed to be common to all investors. If (say) this common interval is five years, then the relevant risk-free rate within the model is the five-year rate. However, the model does not specify this common period and it clearly varies across investors. A pragmatic response would be to define this period as the across-investor average period between successive portfolio reassessments. As discussed in Lally (2012, section 6), empirical analysis suggests that it is likely to exceed one year and even a figure of ten years is entirely plausible. Since this range is unhelpfully wide, 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. Neither option assists in dealing with the

Aurizon regulatory situation, in which the regulatory period is four years and therefore we require a cost of equity over four years rather than five or ten years.

Even if this logical conflict is simply ignored, and the CAPM defined over (say) ten years were interpreted as providing an annual cost of equity that is then applied to a four year period, the annual cost of equity for asset *j* would be as follows:

$$E(R_j) = R_{f10} + MRP_{10}\beta_j \tag{1}$$

So, as the risk (and therefore the beta) of the asset goes to zero, the estimated cost of equity on this asset goes to the ten-year risk-free rate. However, an asset delivering a riskless payoff in four years must be valued using the four-year risk-free rate, not the ten-year rate. So, equation (1) would be invalid for assets with payoffs in four years. So, consistency with the CAPM requires not only the same risk-free rate throughout the model but limiting it to situations in which payoffs arise only at the future point that underlies the model. Consideration of the NPV = 0 principle yields the same result: the appropriate discount rate for a four-year regulatory cycle is the four-year risk-free rate plus a risk premium. So, if the CAPM supplies this discount rate, the first term in the CAPM would have to be the four-year risk-free rate, not the ten-year rate.

A possible solution to this conundrum is to define the MRP relative to the risk-free rate matching the regulatory problem. Thus, when faced with a four-year regulatory problem, invoke the CAPM with a four-year risk-free rate throughout the CAPM. However, this approach faces the conceptual difficulty that a regulator might be simultaneously regulating assets with a variety of regulatory cycles, such as one and four years. If the MRP is defined using the four-year risk-free rate in the present case, it would have to be defined using the one-year rate in these other cases, and this would be inconsistent with the CAPM because there is only one MRP in the model.

In summary, there are four imperfect options. Firstly, define the CAPM to apply to a fixed period (such as ten years), invoke the risk-free rate for that term throughout the model, and apply the model only to problems involving this fixed term. This is consistent with the CAPM but without practical value because some regulatory situations will lie outside this scenario. Secondly, define the CAPM to apply to a fixed period such as ten years, invoke the risk-free rate for that term throughout the model, and apply the model to all regulatory problems (even those with a five-year cycle). This is inconsistent with the CAPM, because the CAPM would only be applicable to regulatory situations with cycles matching the fixed period to which the CAPM applied, and will also violate the NPV = 0 principle whenever the regulatory cycle differs from this fixed period. Thirdly, define the fixed period to which the CAPM applies to match the particular regulatory situation. Thus, faced with different regulatory problems, the regulator would be simultaneously invoking different CAPMs (one version for a four year regulatory cycle, another version for a five-year regulatory cycle, etc), which is contrary to the model but at least the NPV = 0 principle would not be violated. Fourthly, define and estimate the MRP for a fixed period (such as ten years) but match the first term of the CAPM to each particular regulatory problem. This is also contrary to the CAPM, and would also avoid violations of the NPV = 0 principle. Furthermore, if the MRP is estimated to some degree of rounding and pre-rounded estimates defined relative to various risk-free rates do not differ sufficiently to alter the rounded estimate, then the third option coincides with the fourth (and this will be discussed further in section 3.2). The QCA has chosen the fourth option. SFG favours the second option with a ten-year risk-free rate. So, SFG's claim that the approach favoured by the QCA (option 4) is inconsistent with the CAPM is true, but so too is SFG's favoured approach (option 2) and the only approach that is entirely free of this inconsistency problem (option 1) is devoid of practical value. Thus, inconsistency with the CAPM is unavoidable. Given this, it would be sensible to at least avoid violating the NPV = 0 principle, and this favours either the third or fourth options. I therefore favour the QCA's course of action (option 3) over SFG's (option 2). In respect of choosing between the third and fourth options, these are equivalent in the present circumstances because the rounded MRP estimates for four and ten-year terms are equal (as discussed in section 3.2) and therefore the relative merits of these two approaches need not be considered here. If one were required to choose between them, the fourth option minimises the adjustments to the CAPM (by modifying only the risk-free rate) whilst the third option avoids the surface appearance of inconsistency with the CAPM.

SFG (2014a, para 94) also argues that the QCA's approach of using the four-year risk-free rate within the first term of the regulatory cycle and the ten-year rate in estimating the MRP would lead to an underestimate of the expected market return and therefore an underestimate of Aurizon's cost of equity. In particular, SFG note that the four and ten year risk free rates prevailing at the time of the UT4 Draft Decision were 3.21% and 4.06% respectively, and that the QCA estimated the MRP at 6.5% defined relative to the ten year risk-free rate. This implies an expected return on the market of 10.56% as follows:

$$E(R_m) = R_{f10} + [E(R_m) - R_{f10}] = .0406 + .065 = .1056$$

By contrast, the QCA's estimate for Aurizon's cost of equity involving use of the four-year risk-free rate and the MRP defined relative to the ten-year risk-free rate implies an estimate of the expected return on the market of 9.71% as follows:

$$E(R_m) = R_{f4} + [E(R_m) - R_{f10}] = .0321 + .065 = .0971$$

Since the latter estimate of $E(R_m)$ is too low, SFG concludes that the QCA's estimate of Aurizon's cost of equity would also be too low. However there are two assumptions underlying this line of argument. Firstly, it assumes that $E(R_m)$ is invariant to the future period over which it is defined. This is not plausible; if the ten-year risk free rate exceeds the four year rate, it may be because the four-year rate is expected to rise and it is plausible that $E(R_m)$ would also be expected to rise. Accordingly, $E(R_m)$ would be higher defined over the next ten years than the next four, consistent with these results. Thus it is not clear that any estimation error would arise. Secondly, even if $E(R_m)$ were invariant to the future period over which it is defined and therefore the true MRP varied with the future period over which it was defined, this would only matter to the extent that the term structure in the MRP was not buried by any rounding that was undertaken in the estimation process. This issue is addressed in section 3.2, and it is shown there that the difference between unrounded four and ten-year MRP estimates does not affect the rounded estimate.

SFG (2014a, section 5) claims that the current regulatory practice in Australia is to use the ten-year risk-free rate and, in support of this, it refers to the practice of the AER and IPART. However, SFG (2014a, para 23) also acknowledges that the ERA uses the five-year rate and of course the QCA does likewise. This contrary evidence contradicts SFG's claim. Furthermore, even if SFG's claim were true, any proposed procedure must rest upon its inherent merits rather than mere observation of existing practice. Without such an approach, no progress in any area is possible. Moreover, this is an approach that SFG is entirely sympathetic to. For example, SFG (2012a) supported the use of a trailing average for the cost of debt despite the fact that this practice was not used by any Australian regulator at the time. Naturally, SFG supported the use of this approach because of its perceived inherent merits. The same principle applies to the QCA's approach to determining the term of the risk-free rate. The methodology must stand or fall on its own merits.

2.2 Converting Between Ex-Imputation and With-Imputation Returns

SFG (2014b, sections 2-4) argues that the QCA uses one kind of conversion formula (between returns with and without allowance for imputation credits) in dealing with the MRP but a different conversion formula within the cash flows, and that this difference is inappropriate. To explore this matter and to simplify the presentation, I focus upon an all-equity firm. Under the Officer (1994) framework used by the QCA, imputation is treated as a process in which at least some of the corporate taxes paid are treated as personal tax. This has two implications. The first is that dividends (pre personal tax) must now include the imputation credits (to the extent they can be used by investors). Consequently, within the CAPM, the rates of return on equity must be inclusive of these imputation credits (to the extent they can be used). So, the equilibrium expected rate of return on the equity of a firm inclusive of the effect of imputation credits is

$$E(R_e^I) = R_f + [E(R_m^I) - R_f]\beta_e$$

where R_f is the risk free rate, β_e the equity beta defined against the Australian market index, and $E(R_m^I)$ the expected rate of return on the Australian market portfolio inclusive of imputation credits to the extent they can be used. Letting S_m denote the current value of the market portfolio, IC_m the imputation credits on the assets included in the market portfolio, U the utilisation rate on the credits, DIV_m the dividends on the market portfolio, Z_m the proportion of these dividends that are fully franked, R_m^I the actual rate of return on the market portfolio including the imputation credits, and R_m^X the actual rate of return on the market portfolio excluding the imputation credits, then

$$R_m^I = R_m^X + \frac{IC_m}{S_m}U$$

$$= R_m^X + \frac{DIV_m}{S_m}\frac{IC_m}{DIV_m}U$$

$$= R_m^X + \frac{DIV_m}{S_m}Z_m\frac{T_c}{(1-T_c)}U \qquad (2)$$

Thus, when estimating the MRP using past returns data (as in the Ibbotson method), it is necessary to measure returns using this equation. The same correction applies to the expected return on the market portfolio inclusive and exclusive of the effect of imputation credits (and might be used to adjust MRP estimates from surveys):

$$k_m^I = k_m^X + \frac{E(DIV_m)}{S_m}Z_m\frac{T_c}{(1-T_c)}U \qquad (3)$$

Letting Q_m denote the ratio of the expected (cash) dividend yield of the market to its cost of equity exclusive of the effect of imputation credits (k_m^X), it follows that

$$k_m^I = k_m^X\left[1 + Q_m Z_m\frac{T_c}{(1-T_c)}U\right]$$

$$= k_m^X\left[\frac{1-T_c(1-UQ_m Z_m)}{1-T_c}\right] \qquad (4)$$

The same relationship would hold for the cost of equity of a specific firm inclusive and exclusive of the effects of imputation credits, with the parameters *Q* and *Z* now specific to that firm:

$$k_e^I = k_e^X\left[\frac{1-T_c(1-UQZ)}{1-T_c}\right] \qquad (5)$$

The second implication of the Officer framework is that the corporate taxes paid by the business are reduced by the amount of company tax treated as personal tax on dividends, being the distributed imputation credits to the extent that they can be utilised by investors. Letting S_0 denote the current value of equity for the company, S_1 the expected value in one year, REV_1 the revenues over the first year, OC_1 the cash costs except company taxes over the first year, TAX_1 the company taxes over the first year, *F* the proportion of these company taxes that are distributed as imputation credits, and IC_1 the distributed imputation credits over the first year, then S_0 is the present value of S_1, REV_1, OC_1, and TAX_1 (net of that part distributed as imputation credits and utilised by investors), discounted using the Officer CAPM with the MRP denoted ϕ:

$$S_0 = \frac{E(REV_1) - E(OC_1) - E(TAX_1) + E(IC_1)U + E(S_1)}{1 + R_f + \phi\beta_e} \tag{6}$$

$$= \frac{E(REV_1) - E(OC_1) - E(TAX_1) + E(TAX_1)FU + E(S_1)}{1 + R_f + \phi\beta_e}$$

$$= \frac{E(REV_1) - E(OC_1) - E(TAX_1)(1 - UF) + E(S_1)}{1 + R_f + \phi\beta_e}$$

In a regulatory situation, output prices and therefore expected revenues are periodically set to ensure that the present value of the net cash flows is equal to the initial investment in fixed assets. Assuming resetting every year, and doing so correctly, then both S_0 and S_1 would be equal to the concurrent regulatory asset book values (A_0 and A_1 respectively). So, the last equation implies that the expected revenues for the first year would be

$$E(REV_1) = A_0 - A_1 + A_0(R_f + \phi\beta_e) + E(OC_1) + E(TAX_1)(1 - UF)$$

The difference $A_0 - A_1$ is the regulatory depreciation for year 1 (RD_1). So

$$E(REV_1) = RD_1 + A_0(R_f + \phi\beta_e) + E(OC_1) + E(TAX_1)(1 - UF) \tag{7}$$

This equation says that regulatory revenues are the sum of regulatory depreciation, return on capital, operating costs, and corporate taxes (except the part treated as personal taxation). In addition, letting TD_1 denote tax depreciation, the corporate tax obligation is

$$TAX_1 = (REV_1 - OC_1 - TD_1)T_c$$

Taking expectations in the last equation and substituting into equation (7) yields

$$E(TAX_1) = \frac{\lfloor RD_1 + A_0(R_f + \phi\beta_e) - TD_1 \rfloor T_c}{1 - T_c(1-UF)} \tag{8}$$

Substitution of the last equation into equation (7) yields

$$E(REV_1) = RD_1 + A_0(R_f + \phi\beta_e) + E(OC_1) + [RD_1 + A_0(R_f + \phi\beta_e) - TD_1]\frac{T_c(1-UF)}{1 - T_c(1-UF)} \tag{9}$$

Returning to equation (6), the numerator term involving the imputation credits at the firm level can be transferred to the denominator as follows:

$$S_0 = \frac{E(REV_1) - E(OC_1) - E(TAX_1) + E(S_1)}{1 + R_f + \phi\beta_e - U\dfrac{E(IC_1)}{S_0}}$$

Using equation (3), this is as follows:

$$S_0 = \frac{E(REV_1) - E(OC_1) - E(TAX_1) + E(S_1)}{1 + R_f + \left[k_m^X - R_f + U\dfrac{E(IC_m)}{S_m}\right]\beta_e - U\dfrac{IC_1}{S_0}} \tag{10}$$

Furthermore, Officer (1994) also develops a formula for converting from the cost of equity exclusive of the credits to the cost inclusive of them, as follows:

$$k_e^I = k_e^X\left[\frac{1 - T_c(1-UF)}{1 - T_c}\right] \tag{11}$$

This equation requires additional assumptions to those underlying the Officer framework described above, and these additional assumptions are described below. Thus, use of the Officer framework does not require use of equation (11).

With these preliminaries, I now turn to SFG's (2014b, sections 2-4) argument. This is that the QCA uses the conversion formula (4) in estimating the MRP inclusive of the effect of imputation but uses formula (11) in its cash flows. The claim that the QCA uses equation (4) when estimating the MRP, or the equivalent equations (2) and (3), is correct (for example, see the QCA, 2014a, page 232). However the claim that it uses equation (11) in its cash flows is not correct and SFG never provide any evidence to that effect. The only QCA cash flow equations that SFG (2014b, paras 88-89) cites are those in the QCA (2014a, Table 95) and these are equations (7) and (8) above (subject to the firm being unlevered). Clearly, equations (7) and (8) are not (11). SFG (2014b, para 62) attributes to the QCA (2014b, page 84) the belief that equation (11) is embedded into the regulatory PTRM, but the QCA makes no such claim and is in fact critical of the formula.

What SFG may be arguing is that the regulatory revenues shown in equation (9) are boosted by the imputation adjustment within the MRP (with the details as shown in equation (3)), and regulatory revenues are reduced by the imputation adjustment to taxes in the last term of equation (9), and that these two effects should match.[2] However the MRP adjustment is the market wide impact of imputation whilst the tax adjustment is the business specific impact. As is apparent from equation (10), these two adjustments will only match if the business is typical of the market in the relevant respects, i.e., it has a beta of 1 and the same ratio of expected imputation credits to equity value. To take an extreme example, if a business has an equity beta of zero, there is no MRP adjustment to its regulatory revenues and therefore the only imputation adjustment to its regulatory revenues would be the reduction arising from the imputation credits reducing its effective corporate tax payments. Given that the QCA's (2014a, Table 4) decision includes an estimated equity beta of 0.8 for Aurizon, the conditions for matching are not satisfied for Aurizon.

SFG (2014b, paras 36-37) also argues that the QCA should determine the allowed revenues without adjustments for imputation credits in either the MRP or the cash flows. Such an argument is consistent with SFG's apparent belief that the MRP and tax consequences of imputation should offset, as discussed in the previous paragraph. This is equivalent to dispensing with the Officer model in favour of the standard version of the CAPM (Sharpe, 1964; Lintner, 1965; Mossin, 1966). In the face of this suggestion, one could reasonably wonder why regulators (or anybody) else would ever have used the Officer model if it produces the same results as the standard CAPM when properly implemented. Of course, it

[2] There is a third effect from imputation, being the reduction in the expected market return exclusive of credits because the value of equity will rise whilst the cash dividends are unchanged. However, this is not an adjustment that the regulator must make. Furthermore, this third effect nets off against the imputation adjustment to the MRP shown in equation (3). So, the only impact from imputation is the reduction in the effective corporate taxes paid, shown at the end of equation (9), and therefore a reduction in regulatory revenues.

doesn't produce the same results unless the firm matches the market in the two respects described above. The consequences of switching to the standard CAPM would be to remove the MRP uplift to the regulatory revenues in equation (9) and also remove the downward adjustment to taxes. As discussed, these two effects match only for a firm with a beta of 1 and a ratio of imputation credits to equity value that matches the market portfolio. Thus, for a firm with a beta less than 1, as is the case with Aurizon, the MRP uplift would be unusually low and therefore the switch to the standard CAPM is likely to raise the regulatory revenues. Since the Officer CAPM is more compatible with the Australian tax environment than the standard version, such an increase in revenues would not be warranted.

SFG (2014b, Appendix 2) also argues that the Officer (1994) conversion formula between the costs of equity with and without imputation credits, as shown in equation (11) above, does not require that the cost of equity comprises only the expected dividend yield, and instead requires only that retained funds (which give rise to expected capital gains) are invested in NPV = 0 projects. SFG's proof starts as follows. Defining F to be the distribution rate for credits that are created, then per \$1 of after-tax profit, there will be \$$F$ of dividends and retention of \$1(1-F). Assuming that retained funds are invested in NPV = 0 projects, the value of the retained funds will be \$1(1-F) per \$1 of after-tax profit. However, even the first sentence in this proof embodies two other assumptions. Firstly, since "profit" is merely an accounting concept involving numerous non-cash items whilst retention of funds for investment is a cash flow concept, SFG are assuming that profit after tax is equal to operating cash flow net of taxes and interest. Secondly, SFG are assuming that the distribution rate for credits is equal to the dividend payout rate, and this implies that pre-tax profit is equal to taxable income and that all taxes are paid to the ATO (in order to generate distributable credits). For example, if pre-tax profit and taxable income equal \$10m and the corporate tax rate is 30%, the firm will pay taxes of \$3m to the ATO and therefore after-tax profit will be \$7m. With a dividend payout rate of 60%, dividends will be \$4.2m and the attached credits (at the maximum rate of 43%) will be \$1.8m, which implies a distribution rate of 60%.

Neither of these assumptions generally holds. In respect of the first assumption, since profit is net of accounting depreciation (based upon the purchase cost of assets many years ago) and operating cash flow is net of replacement investment at current prices, profit and operating cash flow will generally diverge and typically profit will be higher because the replacement cost of assets grows over time. In respect of the second assumption, pre-tax profit and taxable income generally differ because they are based upon different rules. Furthermore, some corporate taxes may be paid to foreign tax authorities and therefore do not give rise to imputation credits. For example, suppose that pre-tax profit is $10m but taxable income is $8m because the firm has engaged in tax avoidance. The corporate tax will then be $2.4m and therefore after-tax profit will be $7.6m. With a dividend payout rate of 60%, dividends will be $4.6m and the attached credits (at the maximum rate of 43%) will be $2.0m, which implies a distribution rate of 83% even if all taxes are paid to the ATO. If only half of the taxes are paid to the ATO, of $1.2m, all will be attached to the dividends and the distribution rate will be 100%. So, the distribution rate for credits exceeds the dividend payout rate.

In addition, even the one assumption recognised by SFG (that retained funds are invested in NPV = 0 projects) is not generally true and even SFG (2014b, para 107) acknowledge this. Thus, whilst the Officer (1994) conversion formula will hold under conditions other than the cost of equity comprising only the expected dividend yield, these additional conditions are much more extensive than claimed by SFG and collectively are extremely unrealistic. A superior approach to this matter is to develop the conversion formula between costs of equity with and without imputation credits from the definitions of these two costs of equity, without recourse to any assumptions. This appears in Lally (2014b), as shown in equation (5) above, and the Officer conversion formula is simply a special case of it when the (highly unrealistic) assumptions referred to above prevail. Consequently, even if the QCA had used the Officer conversion formula, this would not have been appropriate.

2.3 Application of the Dividend Discount Model

SFG (2014c, section 2) argues that the QCA’s (2014a, pp. 233-234) DDM for estimating the MRP, involving mean reversion towards some assumed value for the cost of equity from the tenth year into the future, leads to very pronounced variation over time in the MRP estimate for the first ten years and that this is undesirable. In particular, applying the QCA’s methodology to every month from July 2002 to December 2013 yields variations in the MRP estimate from -7% to 17% with a convergence period of 20 years and a deduction from the expected GDP growth rate of 1.5%, through to a range from -2% to 11% with a convergence period of 10 years and a deduction from the expected GDP growth rate of 1.5% (SFG, 2014c, Figure 1). However, variation over time per se is not an undesirable feature of an estimator. The important point is whether this variation reflects the underlying situation. On this issue, SFG could have reasonably observed that some of the MRP estimates that arise from application of the QCA's methodology are very low or even negative and this is clearly implausible. However, SFG's preferred approach to estimating the MRP, involving the assumption that, at any point in time, the cost of equity is the same for all future years still produces implausible results. In particular, and as shown in SFG (2014c, Figure 2, Panel B), the MRP estimate rises only slightly in late 2008 (from 6% to 7%) and then plummets to 2% in mid 2009. This period corresponds to the height of the GFC, in which one would have expected the MRP to significantly rise rather than fall. So, the conclusion to be drawn here is not that the QCA's use of two discount rates is problematic but that there is a more general problem with the data or methodology at the height of the GFC.

The nature of this deficiency is apparent by considering the most extreme of these MRP estimates, which occur in July 2009 (lowest) and July 2010 (highest). These correspond to points at which the short-run expected growth rates in EPS are the most extreme, being -9.2% in July 2009 and 18.5% in July 2010.[3] I will focus upon SFG's analysis at these points in time, in which the long-run expected growth rate on DPS is 5.1% (denoted the H scenario by SFG). For July 2009, the prevailing dividend yield was 6.4%, to which the short-run expected growth rate in EPS of -9.2% was applied for two years, followed by convergence over either 10 or 20 years to the long-run expected growth rate in DPS of 5.1%. To simplify the presentation, I adopt SFG's preferred position of a constant discount rate (*k*). With convergence to the expected growth rate of 5.1% in 20 years, the expected growth rates in years 3, 4, …. 20 are -8.4%, -7.6%, ... 5.1%, and therefore the discount rate *k* solves the following equation:

$$1 = \frac{.064(1-.092)}{1+k} + \frac{.064(1-.092)^2}{(1+k)^2} + \frac{.064(1-.09)^2(1-.084)}{(1+k)^3} + ... \qquad (12)$$

The solution is $k = .074$ and therefore the MRP is .019. This is implausibly low (especially for a period of such great uncertainty as mid 2009) and the explanation is clear. Investors may have expected EPS to decline at the rate of 9.2% for the following two years but it is unlikely that they expected the growth rate to linearly converge on 5.1% over the next 18 years, implying a negative growth rate for the majority of the 20 year period. It is far more

[3] The QCA's DDM utilises analysts' short-run forecasts of EPS coupled with a convergence period towards the long-run expected growth rate. This short-run EPS data is not disclosed in SFG (2014c) but was provided upon request.

likely that they expected this extremely low growth rate of -9.2% to quickly improve. For example, if the long-run rate of 5.1% was attained from the end of the second year, the resulting value of k by suitably modifying equation (12) would be 10.2%, yielding a much more plausible MRP of 4.6%. Furthermore, given that the average short-run forecast growth rate in EPS (over the 2002-2013 period examined by SFG) is 9.6%, it is plausible that investors expected the growth rate of -9.2% to quickly revert to 9.6% and then fade away to 5.1%. In this case, the MRP prevailing in July 2009 would have been even higher than 4.6%. By contrast, the QCA's methodology only allows shortening in the convergence period to ten years coupled with linear convergence. Under the conditions prevailing in mid 2009, this is likely to be a poor approximation to the expectations of investors. The reverse issue arises in July 2010, i.e., it is likely that investors would have expected the high short-run growth rate in EPS to fade away to the long-run rate much more quickly than the linear rate over 10-20 years that is allowed for in the QCA's methodology, leading to a lower MRP estimate. The conclusion to be drawn from this is that, whilst a DDM may provide a reasonable estimate of the MRP under most conditions, it will not do so when short-run forecasts of EPS are extreme, regardless of whether it has one or two discount rates. The problem lies in the convergence pattern between the short and long run expected growth rates in DPS.

SFG (2014c, section 2.3) also argues that the QCA *assumes* that the cost of equity within the first ten years differs from that beyond that point, and there is "no reliable basis" for this assumption. However, the QCA makes no such assumption. Instead, it merely allows for that possibility and allows the data to 'speak'. Naturally, doing so requires an assumption about the long-term value for the cost of equity and the time taken for reversion to it from any higher or lower level. However, SFG does not object to the QCA's choices here. By contrast with the QCA, it is SFG who makes a strong assumption: at any point in time, the future cost of equity within the first ten years is always equal to that beyond the first ten years. The onus of responsibility to provide evidence in support of this assumption lies with SFG and they have not done so.

SFG (2014c, section 3.2) argues that the QCA's (2014a, pp. 233-234) DDM for estimating the MRP, involving limiting the expected growth rate in DPS to the expected growth rate in GDP (at most), is unwarranted because substitution of share repurchases for cash dividends will violate the restriction even if the restriction were valid in the absence of repurchases. To illustrate this point, SFG consider a firm with 100m shares, EPS that have just been generated of \$1, a retention rate of 35%, an expected growth rate in earnings and therefore dividends of 4.6% (corresponding to expected GDP growth less 1% for dilution), and a cost of equity of 10%. The value per share is then \$13.24 as follows

$$P = \$0.65 + \frac{\$0.65(1.046)}{1.1} + ... = \$13.24 \tag{13}$$

and therefore the value of the equity in the business is \$1,324m. Now suppose 27% of earnings are used to repurchase shares (\$27m), retention remains at \$35m, and therefore dividends fall to \$38m. At a repurchase price of \$13.24, 2.04m shares will be repurchased, leaving 97.96m shares amongst which the dividend of \$38m is split, which yields a DPS of \$0.388 and a share price of (\$1324m - \$65m)/97.96m = \$12.85. The following year, earnings are expected to be 4.6% larger at \$104.6m, of which 35% is retained for investment, 27% is used for repurchases (\$28.24m), and the remaining 38% is paid in dividends (\$39.75m). The expected equity value in one year will be 4.6% larger than before (\$1,384.9m), implying an expected share price in one year of \$138.49m/97.96 = \$14.14, which will be the repurchase price. Since \$28.24m is used for repurchases, the number of shares repurchased will be 2.00m, leaving 95.96m shares amongst which the dividends of \$39.75m are split yielding a DPS of \$0.414. So, the expected dividend yield is \$0.414/\$12.85 = .0322 and the expected rate of growth in DPS is .0678, which matches the expected capital gain percentage. So, the expected growth rate in DPS (6.68%) exceeds that of GDP less dilution (4.6%), and even that of GDP (5.6%).

Implicitly, SFG have valued a share in the company that is never repurchased.[4] This is harmless if repurchases do not shift wealth between those who do and don't sell, and SFG's analysis satisfies that condition. As shown by SFG, this share has an initial dividend of \$0.388 and an expected growth rate in its dividends of 6.78%, which implies a share price (*P*) of \$13.24 as follows:

$$P = \$0.388 + \frac{\$0.388(1.0678)}{1.1} + ... = \$13.24 \tag{14}$$

[4] No such share actually exists, as application of a fixed repurchase rate indefinitely will eventually lead to all but an infinitesimally small fraction of one share being repurchased. However, to an acceptable degree of approximation, there is a single share that is never repurchased.

Scaling up by 100m shares yields the current equity value of $1324m. Clearly, one could deduce the discount rate of 10% on this share by the DDM approach, and this would require an expected growth rate in its dividends of 6.78%, contrary to the QCA's restriction. Furthermore, this discount rate would apply to all equity in the company. An alternative approach would be to aggregate over all shares to directly value the equity. This aggregation does *not* involve equation (14) with substitution of aggregate dividends in the company for the dividends of the one share that is never repurchased. In aggregating over all shares in this one company, only an infinitesimally small proportion of shares in the company have a dividend stream out to infinity. The rest have a dividend stream that terminates at some point with a payout under a repurchase. Table 1 shows the pattern of payouts across different shares.[5]

Table 1: Time Series of Payouts for Shares in a Company

Repurchase Date	No. Shares	0	1	2	3
Now	2.04m	$13.24	0	0	0
One Year	2.00m	$0.388	$14.14	0	0
Two Years	1.96m	$0.388	$0.414	$15.10	0
Three Years	1.92m	$0.388	$0.414	$0.442	$16.12
……	…	…	…	…	…
Total	100m	$65m	$67.99m	$71.12m	$74.39m

For example, 2.04m shares are repurchased now and therefore have one payout of $13.24 each now. An additional 2m shares are repurchased in one year and therefore have a payout now of $0.388 per share and an expected payout per share of $14.14 in one year. Aggregating over all these shares, the payout now is $65m, the expected payout in one year is $67.99m, and this involves an expected growth rate of 4.6%, not 6.78%. So the equity value of the company (*S*) is as follows:

$$S = \$65m + \frac{\$65m(1.046)}{1.1} + ... = \$1324m \tag{15}$$

[5] All of the figures in Table 1 above can be found in SFG (2014c, Table 1, Panel B).

Alternatively, one could have obtained equation (15) directly by recognising that S is the present value of all future payouts to all existing shares (dividends and repurchases), these payouts start with $65m, and are expected to grow at 4.6% forever. This expected growth rate of 4.6% is that for GDP less an allowance for dilution.

In summary, for a company that devotes a fixed proportion of earnings to repurchases, there is an infinitesimally small proportion of the shares for which the expected growth rate in dividends could exceed the expected growth rate in GDP, and this expected growth rate could be used in estimating the discount rate on this company as per equation (14). Alternatively, one could aggregate over all shares in the company, as shown in equation (15), in which the payouts to shareholders include buybacks and the expected growth rate in payouts to shareholders is constrained by the expected growth rate in GDP, and estimate the discount rate here. However, the present issue involves estimating the MRP, and therefore the discount rate on the market portfolio. This requires aggregating over all companies, to produce a valuation equation identical in principle to (15), in which dividends are augmented by repurchases and the expected growth rate in payouts to shareholders is constrained by the expected growth rate in GDP. Thus, SFG's line of argument is relevant to the discount rate on a company but cannot be applied to the market portfolio and therefore is not relevant to estimating the MRP.

Nevertheless, SFG's example does highlight an interesting point. The growth rate in the EPS of a company is elevated by share repurchases (from 4.6% to 6.78% in SFG's example), and the same elevation will occur in the market-average growth rate in EPS. Thus, in so far as EPS data is used to form a conclusion about the appropriate expected growth rate for payouts to shares, the observed EPS growth rate should be reduced to account for the repurchases effect. Thus, if all companies were similar to the one in SFG's example and therefore the observed EPS growth rate for the market were 6.78%, one should deduct 2.18% to account for the repurchases effect to yield an EPS growth rate of 4.6% without repurchases, and this figure could then be used in equation (15) to estimate the discount rate on the market portfolio. An alternative approach would be to ignore repurchases in measuring current dividends, in which case one should use the observed growth rate in EPS without any deduction for repurchases, i.e., the two errors offset. However, the offset only occurs if firms in general have adopted a constant repurchase rate over the historical period used to observe the average growth rate in EPS. By contrast, if (for example) repurchases are now at the level invoked in the above example (27%) but they only recently commenced, the historical average growth rate in EPS would be below 6.78% and therefore the MRP would be underestimated. So, this alternative approach is not recommended. Furthermore, even in using an equation like (15), the appropriate deduction from the historical average growth rate in EPS would not in general be clear and therefore the most that might feasibly be done is to use the historical average and recognise that it will be too high and therefore that the MRP will be overestimated.

SFG (2014c, section 3.2) also discusses the role of dividend reinvestment plans, and points out that a 100% payout policy coupled with a dividend reinvestment plan raises the dividend yield and depresses the expected growth rate in EPS relative to retention of some earnings. This point is correct but it does not contribute to SFG's argument that the expected growth rate in EPS could exceed that of GDP. Nevertheless, the existence of such schemes raises the question of how they should be dealt with. A dividend reinvestment plan is equivalent to a company paying the dividends in question and then undertaking a new share issue in which the subscribers to the new shares are the existing shareholders. In the latter case, the dividends are included in an equation like (15) whilst the new share issue boosts the GDP growth rate but this benefit does not flow to existing shares (and hence to the EPS or DPS) because the number of shares in the firm has increased. Consequently, the growth rate in both EPS and DPS is below that of GDP and therefore so too will the expected growth rate in DPS. A dividend reinvestment plan should be treated in the same way, and it is. Dividends that are part of the reinvestment plan are still included in dividends (despite not being paid out), the new equity investment boosts the GDP growth rate but this benefit does not flow to existing shares (and hence to the EPS or DPS) because the number of shares in the firm has increased. Consequently, the growth rate in both EPS and DPS is below that of GDP and therefore so too will the expected growth rate in DPS.

SFG (2014c, section 3.3) argues that constraining the expected growth in DPS to that of expected GDP growth is only necessary in the very long-run, which is beyond the point at which there is any material effect on equity value. SFG provide the following example. Currently, profits are 11.6% of GDP. If GDP is expected to grow at 5.6% per year for 100 years and profits are expected to grow at 6.1%, then profits rise to 18.6% of GDP after 100 years. From this point, the expected growth rate has little effect upon the value of equities.

Consequently, an expected growth rate equal to that of GDP (5.6%) could be adopted.[6] However, it is inconceivable that any analyst or investor would expect the growth rate in EPS to differ for years beyond 100 compared to year 100. Beyond some future point, informational limitations would require the same expected growth rate in EPS (or GDP) for all subsequent years and that point would have to be much less than 100 years into the future. If this point is 20 years hence, then one must adopt a constant expected growth rate from that point. Since this expected growth rate applies to *all* subsequent years, it cannot exceed the long-run expected growth rate in GDP. Furthermore, SFG's claim that the GDP growth rate constraint only operates in the very long-run is inconsistent with its earlier claim (discussed in the previous two paragraphs) that the expected GDP growth rate is irrelevant to a DDM.

SFG (2014c, section 3.3) argues that the QCA's (2014a, pp. 233-234) DDM for estimating the MRP, involving setting the long-run expected growth rate in DPS to the expected GDP growth rate less a deduction for dilution (due to new share issues by existing companies and the formation of new companies), is unwarranted because the deduction for dilution is based upon DPS and EPS results from a historical period (from 1900) that is not suitable for extrapolation into the future. SFG also argues that one should fit a curve to the growth rate data rather than use the geometric mean growth rate per year, because the latter is quite sensitive to the first and last observations. Instead, using EPS data from MSCI Barra, SFG argues that the appropriate historical period to use for estimating dilution is that from 1990 (because inflation-targeting commenced at that point), "trend" EPS grew faster than "trend" GDP from this point (compared to slower before), and the PE ratio is higher from this point. Accordingly, SFG favours an expected long-run growth rate in EPS equal to that of GDP, and therefore no deduction for dilution. I agree with SFG's use of curve fitting. However, some dilution is essential because the long-run expected growth rate in earnings for all shares in all companies (both currently existing and arising at some future point) must match that for GDP (or else the earnings share of GDP either goes to zero or exceeds 100%), and therefore the long-run expected growth rate for the earnings flowing to existing shares in existing companies (which is the expected growth rate in the EPS of these companies) must be less than that of GDP. This is a matter of logic rather than empirical analysis. Empirical analysis is required merely to estimate the size of the deduction to account for new companies and new shares in existing companies, not whether it is warranted.

[6] SFG do not add this final point but it is implicit in everything that they do argue.

Furthermore, since the real growth rate for the EPS of listed Australian companies from 1990-2013 exceeded that for GDP (5.0% versus 3.4%), this period is necessarily an aberration and therefore is not a useful historical period from which to estimate the future expected growth rate. Thus, SFG need to use a longer period and the longest period for which they have EPS growth rate data for Australia is 1969-2013, during which the real GDP growth rate exceeded that for EPS (3.2% v 1.5%). The last two figures point to a deduction for dilution of 1.7%, which is even larger than the mid-point of 1% used by the QCA (2014a, page 233). So, the QCA's deduction of 1% for dilution is conservative relative to the Australian EPS evidence, and therefore its MRP estimate will be too high. Similarly, if one sought to estimate the MRP using the Ibbotson methodology and felt that the last 25 years were the most suitable (because inflation targeting had altered the cost of equity) but the estimated MRP over this period were negative, this would rule out use of such a period for estimating the MRP.

Furthermore, SFG (ibid, page 22) argues that the higher PE ratio observed since 1990 is due to both higher expected growth and a lower cost of equity, consistent with its view that historical evidence on the EPS growth rate prior to 1990 is irrelevant to the current and future situation. Accordingly, one would have expected SFG to argue that MRP estimates based upon historical averaging over periods before 1990 (the Ibbotson, Siegel, and Wright methods) would be biased up and therefore might warrant some deduction to reflect that bias. However, SFG fails to mention this.

Furthermore, as discussed earlier, the Australian EPS growth rate data cited by SFG is inflated by share repurchases, and therefore a deduction is required to obtain the EPS growth rate in the absence of repurchases, and only this latter figure should be used to estimate the MRP. Thus, the QCA's deduction of 1% from the expected GDP growth rate is too little for two reasons: the historical Australian data (EPS v GDP growth rate) points to a dilution deduction of 1.7% rather than 1%, and the EPS data used here have not been stripped of the repurchases effect. The effect of both points is that the QCA's estimate of the MRP using the DDM approach is too high. However, since this estimate is significantly in excess of the QCA's other estimates, the median estimate is not affected.

2.4 The Market Risk Premium

SFG (2014d, section 2) notes that the QCA (2014a) raised the MRP estimates from two of the four approaches considered by it relative to its earlier Market Parameters Decision (QCA, 2014b), thereby raising both the mean and median estimate, but its decision was 6.5% in both cases. SFG attributes this to the QCA rounding to the nearest 0.5% but argues that the QCA ought to have revealed the weight applied to each piece of evidence and its rationale for that choice of weights. However, in both of the QCA reports just referred to (QCA, 2014b, pp. 22-23; 2014a, page 237), the QCA clearly states that it now prefers to exercise judgement over the decision on the MRP rather than (as previously) mechanically adopt the mean result over the four methods (subject to rounding). Given this new approach, there are no weights to reveal; if there were, then this would be the very mechanical approach that the QCA has elected to move away from. Thus, the QCA's behaviour in not providing weights is consistent with its change in approach.

SFG (2014d, page 9) also argues that the QCA claims to have moved away from a rounding procedure but must still be doing so because its decision of 6.5% did not change between the two reports whilst both the mean and median result increased. In support of the first claim, SFG cites the following statement by the QCA (2014b, page 15), and made in relation to consideration of additional evidence: "The broader range of evidence does not readily lend itself to an averaging and rounding procedure." I think SFG's argument is very pedantic. Clearly the QCA has engaged in some degree of rounding, for the reasons given by SFG. Nor could it be otherwise; once judgement is applied, rounding is unavoidable because judgement in this area cannot be extended to several decimal points. Since rounding has and must be undertaken, the QCA quotation should then be interpreted as claiming (reasonably) that the additional evidence considered by it does not lend itself to averaging, with the words "and rounding" added merely because this was part of the QCA's earlier approach. So, there is no inconsistency between the QCA's statement and its current behaviour.

SFG (2014d, section 2) also raises questions about the QCA's ranges for the MRP arising from each of its approaches. These are matters for the QCA to elaborate upon. They do not raise any concerns in my mind about the reasonableness of the QCA's conclusion, because its conclusion lies near the centre of the point estimates for the four methods that it clearly places most weight upon.

SFG (2014d, section 3) notes that the QCA's (2014a) UT4 Decision embodies a lower cost of equity than its earlier UT3 Decision, and argues that this is implausible. Since the lower cost of equity is caused by the lower risk-free rate, and the reduction in this parameter is not in dispute, SFG are implicitly arguing that the MRP must have risen by at least as much as the risk-free rate fell. My view is that such a claim is plausible but cannot be conclusively proven and SFG offer no proof whatsoever. Furthermore, the QCA's practice of placing significant weight on the Ibbotson and Siegel estimators implies that their MRP estimate will not react quickly to changes in the true MRP. However, this is sensible for two reasons. Firstly, even if one sought the 'best' estimate of the MRP at the current time, 'best' is usually understood to mean minimal mean squared error (MSE) and MSE is likely to be minimised by placing significant weight on the Ibbotson and Siegel estimators (as discussed in Lally, 2012, section 4.4). Furthermore, it is more important for a regulator to seek accurate compensation over the life of regulated assets rather than over each regulatory cycle, and therefore it is more important to seek a good estimate of the long-run average MRP than that prevailing at the current time. Consequently, even if use of the Ibbotson and Siegel approaches did underestimate the MRP at the present time, they may produce good estimates of the long-run average MRP and therefore be highly desirable. So, the use of the Ibbotson and Siegel estimators is likely to improve both the estimate for the prevailing MRP and the estimate of the long-run average.

SFG (2014d, section 4) does not favour the use of the Siegel method for a number of reasons. Firstly, SFG (ibid, para 70) attributes to the QCA (2014a, page 230) the claim that the Siegel method "is not used by other regulators". However, the QCA make no such claim; instead, they merely report that this view was presented in some submissions. Furthermore, even in reporting this, the QCA adds that the New Zealand Commerce Commission does use the methodology, and SFG fail to report this. Furthermore, a variant of the Siegel methodology is favoured by SFG (2014d, section 6) and is widely used by UK regulators (Wright, 2012).

Secondly, SFG (2014d, para 70) also attributes to the QCA (2014a, page 230) the claim that over 99% of survey respondents have said that they do not use it in estimating the MRP. Again, the QCA makes no such claim and instead merely reports that this view was presented to it in some submissions. The relevant submission(s) is not disclosed by the QCA but it may be from the QTC (2013, page 12), who claim 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, as noted in Lally (2013a, page 23), 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). Thus the extent to which these survey respondents are influenced by Siegel is not clear, and therefore the claim in question is unwarranted. Furthermore, every regulator must use their own judgement in estimating the MRP and therefore selecting amongst various methods for doing so. Selecting a method merely because it is widely used, or not selecting a method because it is not widely used, is not an exercise in judgement; the choice must rest on its own merits.

Thirdly, SFG (ibid, paras 77-79) notes that implementation of the Siegel method requires an estimate of the expected real risk-free rate over the period for which historical data are used, the QCA prefers the period from 1958, the QCA's estimate of the expected real risk-free rate is the average yield over the period from 1987 on inflation-indexed bonds issued by the Australian federal government (3.7%), this involves extrapolating this average yield back over the previous 30 years, and SFG argues that this extrapolation is unreasonable and therefore that the data to implement the Siegel approach is not available. However, SFG fail to note that the QCA (2014b, page 65) offers an additional justification for the estimate of 3.7%: it is similar to the average realised real return of 3.5% over a long period (1883-1939) during which inflation was low (averaging 0.9%). These two pieces of information support the QCA's conclusion that the expected real risk-free rate over the period from 1958 (or any earlier period) was about 3.7%, and rebut SFG's claim that sufficient data is not available to implement the Siegel approach.

Fourthly, SFG (ibid, paras 80-83) argues that the "basis" of the Siegel methodology was that the future expected real yields on government bonds would remain at about the 4% level observed at the time the Siegel (1992, 1999) papers were written and this is inconsistent with them having fallen below 3% in Australia for the last ten years and below 2% for the past three years. However, this characterisation of Siegel (1992, 1999) is not correct. Siegel does not predict 4% in all future years. His prediction, quoted by SFG, is that real yields are "likely to be significantly higher than that estimated on earlier data", and this can only reasonably be interpreted as an average over a reasonably long future period. Over the reasonably long period since inflation-indexed government bonds have been available in Australia (from 1987), the average real yield has been 3.7% as noted in the previous paragraph. By contrast, the average realised yield on conventional ten-year government bonds over the period 1940-1990 was 0.7% (see Lally, 2014a, page 11). This seems like a very strong vindication of Siegel's prediction.

Furthermore, for the present purposes of estimating the MRP, Siegel's prediction about real bond yields is secondary. His more important point concerns the MRP, consistent with the titles of both of his papers. In particular, he argues that the average realised return on conventional government bonds was unusually low for a substantial part of the 20^{th} century, due in large part to unexpected inflation, that this raised the Ibbotson MRP estimate, that it is unlikely to recur, and therefore the future MRP is likely to be below the Ibbotson estimate. The performance of Australian government inflation-indexed bonds over the last three years neither vindicates nor contradicts this argument. Instead, the evidence lies in the realised real yields on conventional bonds and the yields on inflation-protected bonds over sufficiently long periods to negate any irrelevant short-term effects. As noted by Lally (2014a, page 11), Australia's experience from 1883-2013 can be divided into a low inflation era (1883-1939), a high inflation era (1940-1990), and a second low inflation era (1991-2013) with average inflation rates of 0.9%, 6.4% and 2.5% respectively. The corresponding average real yields on ten-year government bonds were 3.5%, 0.7% and 3.5%. So, in the high inflation era, real yields on government bonds were markedly below that from the earlier period (highly suggestive of ten-year inflation forecasts having been too low in this high inflation era) and with little 'compensation' in the subsequent low inflation era (due to ten-year inflation forecasts being too high). The effect of this would have been to inflate the Ibbotson MRP estimate by almost 3% over the period 1940-1990. If the Ibbotson estimate is based upon data from 1883, the high inflation period represents 38% of it and would therefore inflate the Ibbotson estimate by about 1%. If the Ibbotson estimate is based upon data from 1958, the high inflation period represents 58% of it and would therefore inflate the Ibbotson estimate by almost 2%. Consideration of the yields on inflation-indexed bonds is consistent with this; the average yield since their introduction in 1987 is 3.7% as noted in the previous paragraph, and therefore supports the conclusion that the average realised real yield of 0.7% on ten-year conventional bonds during the high-inflation period was depressed by about 3% due to unexpected inflation. The fact that these inflation-indexed yields have recently dropped (presumably because of the GFC and the European debt crisis) subtracts nothing from Siegel's arguments about the effect of unexpected inflation during the late 20th century.

SFG (2014d, section 5) notes that the QCA (2014a, page 232) draws upon a median MRP estimate of 6% from 'independent expert' reports but challenges this on two grounds. Firstly, SFG notes that the risk-free rates used in these reports (being ten-year rates or rates in excess of this) exceed the five-year rates used by the QCA, and therefore the QCA ought to do likewise. This 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, as argued in Lally (2013a, pp. 23-26), the two exercises are fundamentally different, and this readily explains the difference in rates. The QCA resets the risk-free rate every 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. 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. SFG offers no response to this argument.

Secondly, SFG argues that whilst the median is 6% it is also the lowest value in these reports, and the remaining figures (41%) are in excess of 6%, leading to a mean of 6.4% and this should be favoured over the median. SFG notes the QCA's (2014a, page 232) rationale for using a median (to eliminate the influence of outliers) but argues that this concern is not present here. However, there have been other situations in which means have been significantly affected by one outlier, leading to the QCA preferring the median. For example, and as discussed in Lally (2014a, pp. 6-7), the MRP survey by Fernandez et al (2013, Table 2) yields a median result for Australia of 5.8% and a mean of 6.8%. The large difference is clearly attributable to a single response at 25% (ibid, Table 2), whose deletion from a sample size of 17 would reduce the mean from 6.8% to 5.7%. This Australian outlier is also the largest response across the 20 markets for which data is used here (Australia plus the 19 foreign markets) and it gives rise to a standard deviation amongst the Australian responses that is larger than for any of these other 19 markets (ibid, Table 2). One could reasonably suspect that this outlier came from a respondent who sought to manipulate the average result. In view of this, I am entirely sympathetic to the QCA favouring the median response over the mean response. In the interests of consistency, it would be bound to adopt the same approach to the reports from the independent experts.

SFG (2014d, section 6) argues in favour of formally considering results from the "Wright" method. As noted in Lally (2013a, page 3), and referred to by SFG, I agree. However, SFG fails to note that I also support consideration of results from other markets (Lally, 2013a, pp. 61-63) and, as shown in Lally (2013a, Table 1), doing so exerts a downward effect upon the MRP estimate, and the net effect would be downward. Furthermore, in respect of the "Wright" method, since I consider this method to be addressing the same problem as the Siegel method but in a different way (see Lally, 2014a, page 12), I also support the QCA considering results from the Siegel method. Presumably in response to this point, SFG (2014d, section 6) argues that the Wright method in fundamentally different to the Siegel method in the sense that the Wright method is designed to deal with the possibility that currently expected inflation differs from past inflation whilst the Siegel method is designed to deal with the possibility that past inflation exceeded the expectation of it. However, I do not agree with this characterisation of the Wright method. To focus upon the crucial point, I assume that the average realised real return on the market portfolio matches its expectation. Since the Wright method assumes that the expected real return on the market portfolio is constant over time, I will initially assume that this is the case (and purely for illustrative purposes nominate 7% as this parameter value. So, letting i_F denote future inflation, R_{f0} the current nominal risk-free rate, R_{fr0} its real counterpart, the Wright estimate of the future MRP (in nominal terms) is

$$M\hat{R}P_W = [(1.07)(1+E(i_F)-1] - R_{f0} = [.07 - R_{fr0}][1+E(i_F)] \quad (16)$$

This estimate is invariant to past inflation, providing that the historical average realised real return on the market portfolio is invariant to past inflation, and this condition is implicit in the assumption underlying this method that the expected real return on the market portfolio is constant over time. So, since SFG's characterisation of the Wright method (as a method designed to deal with the possibility that currently expected inflation differs from past inflation) is wrong, its explanation of the difference between the Wright and Siegel methods is incorrect.

To appreciate the similarities and differences in the two methods, let $\overline{R}_m$ denote the historical average nominal return on the market portfolio, $\overline{R}_{mr}$ its real counterpart, $\overline{R}_f$ the historical average nominal risk-free rate, $\overline{R}_{fr}$ its real counterpart, $E(R_f)$ the ex-ante expectation of the nominal rate over the historical period, $E(R_{fr})$ its real counterpart, and i_H the historical average inflation rate. The Ibbotson estimate of the MRP is then

$$M\hat{R}P_I = \overline{R}_m - \overline{R}_f \cong \overline{R}_{mr} - \overline{R}_{fr} = .07 - \left[\frac{1+\overline{R}_f}{1+i_H} - 1\right] \tag{17}$$

By contrast, the Siegel estimate of the MRP is

$$M\hat{R}P_S = M\hat{R}P_I + \overline{R}_{fr} - E(R_{fr}) = .07 - E(R_{fr}) \tag{18}$$

Thus, if past inflation i_H exceeded its expectation and therefore was not fully reflected in the past average nominal risk-free rate $\overline{R}_f$**,** the Ibbotson estimate of the MRP in equation (16) is inflated above its expected value whilst the Wright and Siegel estimates are invariant to this. So, the latter two methods are motivated by the same problem and both provide solutions to it. The point of difference is that low current values for the real risk free rate R_{fr0} will raise the MRP estimate from the Wright method but not the Siegel method.

To illustrate all this, suppose that the historical average inflation rate was expected to be 3% (ex-ante) and the expected real risk-free rate was 3.7%, implying a nominal risk-free rate of 6.8%. If these expectations had been realised, the Ibbotson estimate of the MRP would have been 3.3% in accordance with equation (17). However, suppose the average inflation rate was actually 8% and the average nominal risk-free rate rose from 6.8% to only 8.8% due to underestimation of the inflation shock. Following equation (17), the Ibbotson estimate of the MRP would have been 6.3%, which involves an increase of 3.0% due to the unexpected inflation. In addition, suppose that the current real risk-free rate is 3.7%, consistent with earlier expectations in relation to the historical period examined, and expected inflation is currently 2%. Following equations (16) and (18), both the Wright and Siegel estimators of the MRP would yield an MRP estimate of 3.3%, which is the true value. However, if the current real risk-free rate were only 2%, the Wright estimate of the MRP would rise to 5.1% (being the correct value) whilst the Siegel estimate would remain at 3.3% (and therefore be too low). Finally, and contrary to the assumption underlying the Wright method, suppose now that the expected real rate of return on the market portfolio is not constant over time but instead moves with the real risk-free rate. Thus, if the real risk-free rate has recently dropped from its earlier value of 3.7% to 2%, the expected real return on the market portfolio would fall from its earlier value of 7% to 5.3%. In this case, the true MRP is now 3.3%, the Wright method overestimates it at 5.1%, and the Siegel method correctly estimates it at 3.3%.

In summary, in the presence of an unanticipated inflation shock in the past, the Ibbotson estimate of the MRP will tend to be too high, the Wright and Siegel estimates will be unaffected by this shock (and therefore tend to be better), the latter two estimates may differ, and each will be superior under certain conditions.

SFG (2014d, section 7) raises some concerns about the QCA's DDM. These issues have been addressed in section 2.3 above.

SFG (2014d, section 8) summarises its MRP estimates from various approaches. The only incremental point here is that SFG favours adjusting ex-imputation MRP estimates from surveys and independent expert reports to with-imputation estimates using the Officer (1994) formula shown in equation (11) above, on the grounds that this equation is used by the QCA to determine cash flows. As discussed in section 2.2, this claim concerning the QCA is not correct and therefore equation (11) must be assessed on its own merits. As further discussed in section 2.2, equation (11) holds under only very restrictive conditions, equation (5) requires no such conditions, and therefore (5) is superior.

SFG (2014d, section 9) raises concerns about internal consistency in the QCA's approach to allowing for the effect of imputation credits. The fundamental point here is that two approaches to dealing with imputation credits should lead to the same result but do not because the QCA uses inconsistent adjustment formulas in different parts of its analysis. This issue has been addressed in section 2.2 above and SFG's claim is not correct.

3. The Brattle Group

3.1 The Term of the Risk-Free Rate

The Brattle Group (2014, section III) acknowledges that Lally (2004) shows that the appropriate risk-free rate in a regulatory situation is that matching the term of the regulatory cycle but argues that two (unrealistic) assumptions underlying this analysis undercut its practical value. Firstly, they argue that Lally's analysis assumes annual regulatory resetting and this may not prevail at all future points. However, as noted in Lally (2004, footnote 1), this assumption is adopted in the paper merely for "presentational convenience" and relaxing it does not alter the result. The Brattle Group may have failed to appreciate this point because they do not appear to have read the paper and instead relied upon a summary of it by the QCA (2014a, page 195).[7] Secondly, the Brattle Group argue that Lally's analysis assumes that risks of asset stranding and revaluation are addressed through a risk allowance and this may not be feasible. Again, this characterisation of Lally's paper is wrong; no such assumption is made. Instead, Lally (2004, page 21) merely states that any such risks that do exist are not relevant to the choice of the appropriate risk-free rate.

The Brattle Group (2014, section III) also argue that the QCA's approach of using the four-year risk-free rate within the first term of the CAPM and the ten-year rate in estimating the MRP is inconsistent with the CAPM and would lead to estimation error, most obviously in the case of an asset with a beta of 1. The issue of inconsistency with the CAPM has been addressed in section 2.1. This leaves the question of error. To explore this, I draw upon The Brattle Group's example with four and ten year risk free rates of 3.25% and 4.07% respectively, along with MRPs defined relative to four and ten year risk-free rates of 7.32% and 6.50%. The expected return on the market portfolio $E(R_m)$ is therefore 10.57% regardless of whether one considers a four or ten year term. Consequently, the expected return on an asset j with a beta of 1 determined using the four-year risk-free rate and the MRP defined relative to the ten-year risk-free rate is 9.75% as follows:

$$E(R_j) = .0325 + .065(1) = .0975$$

[7] The Brattle Group cite the QCA's (2014a, page 195) summary of Lally (2004) but not the paper itself.

Since this is below $E(R_m)$, and should be equal to it, the QCA's approach would appear to be in error and would underestimate the cost of equity. However there are two assumptions underlying this line of argument. Firstly, it assumes that $E(R_m)$ is invariant to the future period over which it is defined. This is not plausible; if the ten-year risk free rate exceeds the four year rate, it may be because the four-year rate is expected to rise and it is plausible that $E(R_m)$ would also be expected to rise. Accordingly, $E(R_m)$ would be higher defined over the next ten years than the next four. Thus it is not clear that any estimation error would arise. Secondly, even if $E(R_m)$ were invariant to the future period over which it is defined and therefore the true MRP varied with the future period over which it was defined, this would only matter to the extent that the term structure in the MRP was not buried by any rounding that was undertaken in the estimation process. This issue is addressed in the next section, and it is shown there that the difference between unrounded four and ten-year MRP estimates does not affect the rounded estimate.

The Brattle Group (2014, section III) favours use of the ten-year risk-free rate throughout the CAPM on the grounds that this is common practice and because ten-year rates are less susceptible to monetary policy. However, leaving aside the merits of consistency throughout the CAPM (which have already been addressed in section 2.1), these additional arguments for using the ten-year rate are not compelling. Deference to common practice precludes progress in any area of human activity; practices must stand or fall on their own merits. In respect of monetary policy, the irrelevance of this is evident by considering a regulated asset with a life of one year and no risk. The cost of capital for this asset would be the one-year risk-free rate (because this is the alternative investment with exactly the same risk) and this conclusion would remain true even if that risk-free rate were significantly influenced by monetary policy.

3.2 The Market Risk Premium

The Brattle Group (2014, section IV) considers the implications of the QCA consistently using the four-year risk-free rate throughout the CAPM, and therefore estimating the MRP using the four-year risk-free rate. They argue that this involves adding 0.82% to both the Cornell and survey-based estimates of the MRP, based upon the differential between the four and ten-year risk-free rates over the QCA's (2014a, Table 4) estimation period (the last 20 days of October 2013), and adding 0.32% to both the Ibbotson and Siegel-type estimates based upon the same differential over the longest available period (2000-2013). Averaging over the results from these four methods, The Brattle Group (ibid, Table 1) estimated the

MRP using the four-year risk-free rate at 7.05% rather than 6.50% from the ten-year rate. However, the increment of 0.55% is too large for the following reasons.

Firstly, the longest period for which the differential between the Australian four and ten-year risk-free rates can be estimated goes back well before 2000. Australian data on three, five, and ten-year risk-free rates is available back to 1992, Australian data on five and ten-year rates is available back to 1972, and US data on five and ten-year rates is available back to 1953. The Australian three, five, and ten year rates from June 1992 to May 2013 average 5.65%, 5.86%, and 6.14% respectively.[8] Interpolating between the first two numbers yields an average four-year rate of 5.75%, and the difference from the ten-year rate is therefore 0.39%. The Australian five and ten year rates from January 1972 to May 1992 average 11.30% and 11.41% respectively, the difference is therefore 0.11%, and extrapolating to obtain the differential between four and ten year rates yields 0.13%. Finally, the US five and ten year rates from 1953 to 1971 inclusive average 4.32% and 4.38% respectively, the difference is therefore 0.06%, and extrapolating to obtain the differential between four and ten year rates yields 0.07%.[9] Taking a time-weighted average over these three differentials, the average differential between four and ten-year Australian Government bonds over the period 1953-2013 was about 0.20%.

Secondly, the survey evidence used by the QCA (2014a, pp. 231-232) comprises results from independent expert reports and the Fernandez et al (2013) results. Presumably the independent expert reports define the MRP relative to the ten-year rate but there are no grounds for concluding (as The Brattle Group does) that participants in the Fernandez survey do likewise. Some may even have provided responses relative to very short-term risk-free rates. Thus, the risk-free rate differential for the surveys should be applied only to the independent expert reports. Thirdly, in respect of the independent expert reports, SFG (2014d, para 88) indicates that these reports were written at various times from January 2008 to April 2013). Even if these MRP estimates were of the Cornell type, this alone would suggest that the appropriate period in which to compare the four and ten-year risk-free rates

[8] The data are drawn from Table F2 on the Reserve Bank's website (www.rba.gov.au), which provides constant maturity series for various bond terms. The figures reflect simple rather than compound interest but correction for this would only raise the differential between the five and ten year rates by about one basis point.

[9] The data are drawn from Table GS5 and Table GS10 from the website of the Federal Reserve Bank of St Louis (www.research.stlouisfed.org/fred2/), and they provide constant maturity series for five and ten year bond yields.

was this period rather than October 2013 as The Brattle Group does. The Australian three, five, and ten year rates from January 2008 to April 2013 average 4.31%, 4.50%, and 4.80% respectively.[10] Interpolating between the first two numbers yields an average four-year rate of 4.40%, and the difference from the ten-year rate is therefore 0.40% rather than The Brattle Group's figure of 0.82% based upon the October 2013 differential. Furthermore, most of these MRP estimates are 6% (SFG, 2014d, Table 2) and they are spread over a period of several years. So, it is most unlikely that these MRP estimates were generally of the Cornell type. Instead, they are likely to be principally based upon the Ibbotson-type results. In this case, the appropriate MRP adjustment for the differential between the four and ten-year risk-free rates would be 0.20% as discussed in the previous paragraph. So, in respect of these two types of survey evidence, the average adjustment is 0.10%.

So, across the four methods primarily relied upon by the QCA, the MRP increment from using four rather than ten-year risk-free rates is 0.20% for the Ibbotson and Siegel methods, 0.10% for the survey approach, and 0.82% for the Cornell-type estimate. The average increment is therefore 0.33% rather than the figure of 0.55% claimed by The Brattle Group. Since the QCA's (2014a, pp. 230-234) point estimates over these four estimation methods (with a ten-year MRP) are 5.5% for Siegel, 6.4% for surveys, 6.5% for Ibbotson, and 7.1% for Cornell, the corresponding values with a four-year MRP would be 5.7% for Siegel, 6.5% for surveys, 6.7% for Ibbotson, and 7.92% for Cornell. The medians are therefore 6.45% with a ten-year MRP and 6.6% with a four-year MRP. If the QCA is rounding its MRP estimate to 0.5%, which appears to be the case, it's estimate would therefore be unaffected by whether a four or ten-year MRP was adopted.

The Brattle Group (2014, section IV) also favours an Ibbotson-type estimate of the MRP of 7.6%, using data from Dimson et al (2014, Table 10) for the period 1900-2013. This estimate differs from those used by the QCA (2014b, Table 2) both in the time span and in various conceptual ways as follows. Firstly, the QCA obtain their MRP estimates from Brailsford et al (2008, 2012), who estimate the MRP using the arithmetic mean of the annual return on equities net of the contemporaneous yield on ten-year government bonds, which is consistent with defining the MRP as the expected market return net of the yield on ten-year government

[10] The data is from Table F2 on the Reserve Bank's website (www.rba.gov.au), which provides constant maturity series for various bond terms.

bonds, and this in turn is consistent with the CAPM. By contrast, Dimson et al (2014, page 23) estimate their MRP by arithmetic averaging over the annual geometric difference between the return on equity and the return on ten-year government bonds, which is consistent with defining the MRP as the expected geometric difference between the return on equity and the return on ten-year government bonds. This implicit definition does not correspond to the CAPM, whereas the QCA's does.[11] Secondly, Dimson et al do not include imputation credits in their MRP estimate whereas the QCA do, and inclusion of these is consistent with the Officer (1994) model. Thirdly, the QCA use all available data for Australia (from 1883) and assess the quality of the data, leading to more weight being placed on the period since 1958. By contrast, Dimson et al use data only from 1900 (for comparison across countries) and equally weight it despite implicitly acknowledging the superiority of the post-1958 data (ibid, page 61). On all three bases, the QCA's estimates are superior.

The Brattle Group (2014, section IV) do not favour the QCA's Siegel estimates on the following grounds. Firstly, they argue that the QCA prefers data from 1958-2013, the QCA's estimate of the expected real risk-free rate is the average yield over the period from 1987 on inflation-indexed bonds issued by the Australian federal government (3.7%), this involves extrapolating this average yield back over the previous 30 years, this extrapolation is unreasonable, and therefore that the data to implement the Siegel approach is not available. However, the same argument has been raised by SFG (2014d, paras 77-79) and addressed in the previous section, i.e., the QCA (2014b, page 65) offer an additional justification for their estimate of 3.7% and collectively this information supports the QCA's conclusion that the expected real risk-free rate over the period from 1958 (or any earlier period) was about 3.7%, which rebuts the claim that sufficient data is not available to implement the Siegel approach.

Secondly, The Brattle Group argue that the QCA's conclusions concerning the Siegel estimate rely upon research into inflation in the period 1940-1990 (which seems to have been underestimated) but this may have been compensated for by overestimation since 1990. The Brattle Group do not cite the research in question (Lally, 2014a, page 11) and therefore may not have read it. Had they done so, they would have seen that the very concern they raise had been addressed there: the low inflation period from 1991-2013 was accompanied by an

[11] Dimson et al's use of geometric differencing (which is undertaken to make the results invariant to the currency in which they are expressed) can be overcome by taking the difference between the arithmetic mean return on equities and that on bonds, as these are disclosed in Dimson et al (2014, Table 13). However, the bond data are still returns rather than yields.

average real return on conventional government bonds of 3.5%, identical to that during the earlier low inflation period from 1883-1939, suggesting that there was no 'compensation' after 1990 for underestimation of inflation during the high inflation period. Furthermore, average real returns on Australian government inflation-indexed bonds over the period 1991-2013 averaged 3.4%, which is almost identical to that on the conventional government bonds, further suggesting that inflation was not materially overestimated in this period. All of this supports the conclusion that inflation was underestimated in the 1940-1990 period, this depressed the average real yield on conventional government bonds, there was no subsequent 'compensation' for this, and therefore the Ibbotson-type estimate of the MRP is too high.

Thirdly, The Brattle Group argues that the Siegel method is not widely used and therefore requires "additional explanation and empirical support". In my view, this has already been provided by the QCA (2014b, pp. 59-62) in the form of a summary of evidence, contrary views, and conclusions along with citations to relevant papers. If The Brattle Group thinks this inadequate, the appropriate course of action would be to cite additional relevant papers that the QCA does not seem to have considered. It has not done so.

The Brattle Group (2014, section IV) raise some concerns about the QCA's Cornell-type estimate of the MRP. Firstly, they claim that the QCA does not cite evidence in support of its deduction of 0.5%-1.5% from the expected real growth rate in GDP. This is not correct; the QCA (2014b, pp. 68-73) cites this evidence in the form of papers by Arnott and Ryan (2001), Bernstein and Arnott (2003), and Lally (2013b).

Secondly, they claim that the QCA's methodology fail to take share buybacks into account and this leads to downward bias in the estimate of the MRP. As discussed in section 2.3, buybacks must be added to dividends for purposes of estimating the MRP, and this has not been done by the QCA (because they make no reference to it). So, The Brattle Group's claim is correct and therefore buybacks must be added to the current dividends. Brown and Davis (2012, Table 1) provide aggregate off-market repurchases in each of the years 1999-2008 for Australian listed equities. In the last four years (2005-2008), they average $2.91b per year and addition of on-market transactions raises this by 54% (ibid, footnote 3), to $4.48b. In addition, the value of Australian listed equities at the beginning of each of these years 2005-

2008 is shown in Table 2 below.[12] The cash dividend yields for these years are also shown in Table 2, drawn from Brailsford et al (2012, Appendix). The products, being the dollar dividends for each year, are shown in the last column.

Table 2: Aggregate Dividends of Australian Listed Equity

Year	Equity Value	Div Yield	Dividends
1.1.2005	$938b	.049	$46b
1.1.2006	$1126b	.051	$57b
1.1.2007	$1413b	.044	$62b
1.1.2008	$1635b	.025	$41b

These dividends average $52b, and represent cash dividends. Both these dividends and repurchases are eligible for attaching imputation credits, so no adjustment is needed for this issue. Thus repurchases of $4.5b would add about 9% to these dividends. Adding this proportion to the imputation-adjusted dividend yield of 5.3% in a Cornell-type estimate of the MRP (QCA, 2014a, page 233), the dividend yield would rise by about 50 basis points (0.50%), and so too would the MRP estimate. However, it is implicit in this analysis that repurchases would represent about 9% of cash dividends in October 2013, when the QCA's MRP analysis was done. Instead, repurchases dropped significantly in 2008 (from $4.8b in 2007 to $600m in 2008: see Brown and Davis, 2012, Table 1), as a result of concerns that the right to attach imputation credits to off-market repurchases (which could be targeted at investors who could use the credits) would be withdrawn (The Board of Taxation, 2008). This did not occur but the possibility has been raised more recently.[13] I understand informally that, due to all this, these repurchases have not recovered to the pre 2008 level, in which case the increment of 0.50% to the MRP estimate would be too high. Furthermore, as discussed in section 2.3, repurchases (rather than dividends) would have raised the EPS growth rate, this increment should be deducted from the historical average EPS growth rate before using such a figure to estimate the expected growth rate in EPS, and not doing so (as is

[12] These figures are drawn from Table 32 on the website of the ABS (www.abs.gov.au).

[13] See http://www.afr.com/news/policy/tax/australian-taxation-office-targets-100m-in-possibly-illegal-franking-credits-20150507-ggw16u).

the case) would partially offset the error from not including repurchases in the current level of dividends. So, for both reasons, the MRP increment of 0.50% is too high. The inability to be more precise here is not a significant issue because the Cornell estimate of the MRP is the highest over the methodologies that are formally examined by the QCA, and therefore any increment to the Cornell MRP estimate would not change the median MRP estimate.

4. Aurizon

Aurizon (2014, section 10.2.4) notes the QCA's (2014a, page 206) claim that regulated entities typically match their exposure to the risk-free rate to the regulatory period, argues that an appropriate term for its debt is in excess of four years, and therefore that an allowed cost of debt that embodies a four-year risk-free (QCA, 2014a, Table 4) would therefore provide insufficient compensation. However, there is no conflict between the QCA's claim about matching and Aurizon's claim about the term of its debt. The QCA is referring to the general practice of regulated firms to borrow for longer than the regulatory cycle and to use interest rate swap contracts to convert the risk-free rate component of their cost of debt to a four-year term (so as to obtain protection against risk-free rate shocks). Consistent with this, the QCA (2014a, Table 4) compensates Aurizon for the transactions costs of these swap contracts. Aurizon seems to have misunderstood all of this.[14]

5. AngloAmerican

AngloAmerican (2014, section 3.4) argues that the MRP estimate should be lowered to reflect the low risk faced by Aurizon. However, AngloAmerican has misunderstood the nature of the MRP; it is a parameter that applies equally to all assets, and features of an asset that low its risk are instead reflected in its beta.

AngloAmerican (2014, section 3.4) also attributes to the QCA an earlier claim that three of the four methods it principally relies upon are biased up, and therefore its MRP estimate should be reduced. The claim is presumably drawn from the QCA (2012, page 11), at which time the QCA did not make a deduction from the long-run expected growth rate in GDP to account for dilution in the Cornell method, and it also equally weighted all data from 1883

[14] Other issues raised by Aurizon merely summarise submissions raised by their advisers and therefore are not discussed here.

onwards in its Ibbotson and Siegel estimates thereby exposing these estimates to upward bias due to data problems prior to 1958. However, the QCA now deducts 1% for dilution in the Cornell method (QCA, 2014a, page 233) and places primary weight on data from 1958 in the Ibbotson and Siegel methods (QCA, 2014a, pp. 229-230). In view of these changes in its methodology, the QCA's views in 2012 are now irrelevant.

6. QRC

QRC (2014, page 22) argues that the MRP is no more than 6%, and cites QRC (2013) in support of this. In turn the QRC (2013, section 2.3) refers to analysis by the QCA (2012, page 11), in which the estimates from four different approaches are 4.3% (Siegel), 5.8% (surveys), 6.2% (Ibbotson), and 8.7% (Cornell), with a median of 6.0%. In addition, the QCA (2012, page 11, page 23) argues that the Cornell estimator is biased upwards due to the lack of a deduction for dilution (new companies and new share issues by existing companies), and that the Ibbotson and Siegel estimators are biased upwards due to survivorship bias and factors reducing expected returns, such as the increased ease and lower costs of diversifying portfolios both domestically and internationally. However, the QCA (2014a) has since sought to address the bias issue in the Cornell estimate, recognised the possibility that the survey results do not allow for the effect of imputation credits, and updated all of these estimates, leading it to new point estimates of 5.5% (Siegel), 6.4% (surveys), 6.5% (Ibbotson), and 7.1% (Cornell), with an overall judgement (after consideration of other material) of 6.5%.[15] Since the QRC (2013, section 2.3) seems to defer to the QCA's judgement in 2012, consistency suggests doing likewise in 2014.

7. Conclusions

I have examined arguments raised by SFG, The Brattle Group, Aurizon, AngloAmerican, and the QRC, and I agree with the following points. Firstly, as claimed by SFG, the Officer formula for converting between the costs of equity inclusive and exclusive of imputation credits will hold under conditions other than the cost of equity comprising only the expected dividend yield. However, these additional conditions are much more extensive than claimed by SFG and collectively are extremely unrealistic. A superior approach to this matter is to

[15] The survey figure of 6.4% arises by averaging over the range of 6.0-6.8% considered by the QCA.

utilise a conversion formula between costs of equity with and without imputation credits that follows from the definitions of these two costs of equity, without recourse to any assumptions, and this is the formula used by the QCA.

Secondly, SFG favours formally considering results from the "Wright" method for estimating the MRP and this exerts an upward effect upon the MRP estimate. As noted by SFG, I agree. However, SFG fails to note that I also support consideration of results from other markets, doing so exerts a downward effect upon the MRP estimate, and the net effect would be downward.

Thirdly, The Brattle Group claim that the QCA's DDM fails to take share buybacks into account and this leads to downward bias in the estimate of the MRP. I agree with this point, but correction for it (by adding buybacks to current dividends) should be accompanied by a deduction from the historical average growth rate in EPS that is used for forecasting purposes (so as to remove the upward effect of buybacks) and the net effect would be to raise the MRP estimate by up to 0.50%. The inability to be more precise is not a significant issue because this estimate of the MRP is the QCA's highest and therefore any increment to it would not change the QCA's median MRP estimate.

Fourthly, I acknowledge the usefulness of the historical Australian EPS data invoked by SFG and the desirability of fitting a curve to the data. However, the results from 1990 that are favoured by SFG are not indefinitely sustainable, this points to using the full data set for estimating the expected long-run growth rate in EPS, and the effect of doing so suggests that the QCA's estimate for the expected long-run growth rate in DPS is too high, in which case the resulting DDM estimate of the MRP is too high. As with the previous point, this is not a significant issue because this estimate of the MRP is the QCA's highest and therefore any deduction from it is unlikely to change the QCA's median MRP estimate.

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