REVIEW OF WACC SUBMISSIONS ON AURIZON'S REGULATORY REVIEW

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EXECUTIVE SUMMARY

Aurizon Network has recently submitted a DAU for the regulatory period from 1 July 2017 to 30 June 2021 (UT5 period), for the QCA's consideration. Inter alia, Aurizon has proposed an indicative WACC of 6.78% including a risk-free rate of 2.13% (based upon the yields on ten-year government bonds over the 20 days finishing on 30 June 2016), an MRP of 7%, and a gamma value of 0.25. With the following three exceptions, which do not affect the resulting estimates, I do not agree with the arguments raised by Aurizon or their consultants in support of a gamma of 0.25, an MRP of 7.0%, or the use of yields on ten-year government bonds for determining the risk-free rate within the first term of the CAPM.

Firstly, I concur with The Brattle Group that share repurchases should be allowed for in a DDM and that the QCA has not done so. However, there are data availability problems in doing so and the effect of allowing for this would be to raise the MRP estimate by less than 0.50%. The Brattle Group claims that the effect is 0.50% but does not demonstrate how it estimates the effect at 0.50%. The point is not significant because it would not change the median result amongst the QCA's estimates for the five methodologies.

Secondly, I concur with many of the criticisms raised by both Frontier and The Brattle Group concerning the Fernandez surveys. However, the surveys have the advantage of including results from a wide range of countries. Furthermore, desisting from using them would have no practical effect because the other type of survey evidence used by the QCA (valuation reports) yields almost identical estimates.

Thirdly, I acknowledge the conceptual argument raised by The Brattle Group in favour of matching the risk-free rate within the MRP to that used in the first term of the CAPM. However, this approach also has conceptual drawbacks and the best course of action is not clear-cut. Furthermore, even if the best course of action matched that favoured by The Brattle Group, the required correction to the MRP would be much smaller than claimed by The Brattle Group, and it would not change the median result amongst the QCA's estimates for the five methodologies.

My own views on these parameters are as follows. In respect of the risk-free rate used within the first term in the CAPM, and as with the QCA, I favour that rate whose term matches that

of the regulatory cycle so as to satisfy the NPV = 0 principle. In respect of the MRP, and again as with the QCA, I favour consideration of results from five methods: Ibbotson, Siegel, Wright, the DDM used by the QCA, and the average of the MRP estimates in valuation reports and the Fernandez survey. I also favour consideration of results from both Australia and a range of other markets due to the statistical imprecision in these estimates. In respect of the Australian results, the QCA's most recent estimates are 6.4%, 5.5%, 9.2%, 7.0%, and 6.0% - 6.8% respectively. In respect of these surveys results, I favour an estimate from the bottom half of the QCA's distribution, because many survey participants may have already included imputation credits in their estimates and many of those who have not rely primarily upon historical data to form their estimate. I also favour use of an equally-weighted median. Applying these principles to the Australian results, the median is 6.4%. I also favour rounding to the nearest 1.0%.

In respect of gamma, since the CAPM that is being used (the Officer version) assumes complete segmentation of national equity markets and this implies that all investors could use the credits, the natural choice for the utilization rate is 1 despite the empirical fact that many investors in Australian equities are foreigners who cannot use the credits. Furthermore, given that national equity markets are partly integrated, estimating the utilization rate at 1 seems to be the only approach that leads to estimates of the cost of equity that will typically lie within the range arising under complete segmentation and complete integration of national equity markets. If this approach to estimating the utilization rate is not adopted and foreign investors are recognized when estimating it, they ought to be also recognized in defining the utilization rate and therefore the natural estimate is the proportion of Australian equities held by local investors. With this approach, I favour the use of all equity rather than only listed equity and therefore an estimate for the utilization rate of at least 60%. I consider the redemption rate for imputation credits to be a very unsatisfactory estimator, and the use of market prices to be an even less satisfactory estimator. In respect of the distribution rate, I favour estimating it using financial statements for a subset of high value firms and an estimate of this type is at least 0.83 for the top 20 such firms. So, with a utilization rate of 1 and a distribution rate of at least 0.83, the resulting estimate of gamma is at least 0.83. Alternatively, with a utilization rate of at least 0.60 and a distribution rate of at least 0.83, the resulting estimate of gamma is at least 0.50.

1. Introduction

Aurizon Network has recently submitted a DAU for the regulatory period from 1 July 2017 to 30 June 2021 (UT5 period), for the QCA's consideration. Inter alia, Aurizon (2016, Table 3) has proposed an indicative WACC of 6.78% including a risk-free rate of 2.13% (based upon the yields on ten-year government bonds over the 20 days finishing on 30 June 2016), an MRP of 7%, and a gamma of 0.25. This paper assesses these last two parameter estimates and the use of the yields on ten-year government bonds averaged over a period close to the commencement date of the regulatory cycle.

2. Gamma

Aurizon (2016, section 11.4.9) favours a gamma value of 0.25, involving the product of a utilization rate (theta) of 0.35 (based upon SFG's dividend drop-off study) and a distribution rate of 0.70. These estimates and the supporting reasoning are drawn from Frontier (2016a). By contrast, the QCA (2016b) favours a gamma value of 0.47, involving the product of a utilization rate of 0.56 (based upon results from a range of methodologies) and a distribution rate of 0.84 (based upon results from the 20 largest ASX companies). The QRC (2017, section 4.8) concurs with this. I therefore review the work of Frontier (2016a).

Frontier (2016a, section 2) argues that gamma is the market value of the credits. Frontier commences by noting that the equity value is the present value of the pre-tax cash flows (Y), net of company taxes (TAX), plus the effect of the imputation credits (IC), discounted at some rate k:[1]

$$S = \frac{E(Y) - E(TAX) + E(IC)\theta}{k} \qquad (1)$$

Frontier then decomposes this into the value component not associated with the credits (the first part) and the value component associated with the credits (the second part):

$$S = \frac{E(Y) - E(TAX)}{k} + \frac{E(IC)\theta}{k}$$

[1] This formula reflects the discussion and calculations in Frontier (2016a, paras 18-33). Frontier is assuming a level perpetuity framework, but this is innocuous for the present purposes.

Frontier then argues that the second part is the market value of the credits. Finally, Frontier argues that θ must then be the market value per dollar of imputation credits (due imminently). However, the last step is wrong, and consists of attempting to deduce the definition of a parameter within an equation from mere inspection of the equation in which it appears, as if the equation had merely 'dropped from the sky'. This equation (like any other in a model that has been theoretically developed) arises from a set of assumptions and definitions coupled with the laws of algebra, and the definition of θ within that process is a weighted average over the utilisation rates of investors for imputation credits. This settles the matter and one cannot then substitute a different definition for this parameter θ.

It is useful to note that the first of the two terms on the RHS of the last equation is the market value of the cash flows excluding the imputation credits. However, it does not follow that either of the terms in its numerator, being $E(Y)$ and $E(TAX)$, is defined as a market value and neither of them is so defined. It is the application of the discount rate k (which is a market rate) that converts these numerator terms, which are not market values, into market values. So, if the LHS of an equation is a market value, it does not follow that every parameter on the RHS of that equation is also a market value or rate. The same applies to θ in the numerator of the second term on the RHS of the last equation.

Notwithstanding these comments, θ will be equal to (as opposed to defined as) the market value of a \$1 credit due imminently under certain conditions. Since the credits are not separately traded, an appropriate definition of their market value would be "the increment to the value of a share arising from an additional \$1 of credits due imminently". Using equation (1), the increment in value would be θ. So, if equation (1) is valid, then θ would be equal to the market value of a credit due imminently. Accordingly, an unbiased estimate of the market value of a \$1 credit due imminently would be an unbiased estimate of θ. However, this conclusion does not change the definition of θ, being the weighted average over investors' utilization rates, and such an estimate does not displace an estimate arising from the definition of θ but instead is simply a complement to it. Furthermore, the condition that equation (1) is valid is crucial, and anything that undercuts the validity of equation (1) will drive a wedge between θ and the market value of a credit due imminently. For example, it is uncontroversial that dividends are taxed more onerously than capital gains in Australia, equation (1) does not reflect this, and therefore is wrong, but regulators continue to use this

model presumably because they judge that the error from doing so is outweighed by the complexity of a better model. The result is that θ within equation (1) is still the weighted average utilization rate but the market value of a credit due imminently will be less than θ to reflect the higher tax rate on dividends. So, an estimate of the market value of a $1 credit due imminently would underestimate θ. Similarly, the actions of tax arbitrageurs may cause equity values to depart from equation (1) and therefore the market value of a credit due imminently will diverge from θ.[2] In summary, θ is defined as the weighted-average over investors' utilization rates, and it will also be equal to the market value of a $1 credit due imminently under certain conditions but these conditions are unrealistic and drive a wedge between the two phenomena.

Frontier's argument is similar to that in SFG (2014a, pp. 97-100), and much of the response provided here to Frontier's argument can be found in Lally's (2015a, pp. 9-10) rebuttal of SFG. However, despite citing Lally (2015a), Frontier offers no response to these arguments in Lally (2015a, pp. 9-10).

Frontier (2016a, para 38) also argues that the QCA assumes that there is "a one-for-one correspondence between redemption and market value". However, the QCA makes no such assumption. Instead the QCA simply adopts the Officer model, and therefore the definition of θ that arises within a rigorous derivation of that model. This is the standard and correct practice in using any model that has been derived from underlying assumptions. If the model is valid, it follows that there will be a one-to-one correspondence between θ (a weighted average utilization rate) and the market value of the credits, but this is not an assumption, let alone one made by the QCA.

Frontier (2016a, para 39) argues that, in estimating other WACC parameters, the QCA relied upon market prices, it did not do so for θ, and Frontier implies that this is inconsistent. However, the QCA has adopted the definitions of parameters that arise within a rigorous derivation of the model used by them, and the estimation methods it uses are consistent with

[2] Equation (1) is the Officer (1994) model, and the discount rate here is a single-period version of the CAPM, i.e., investors choose portfolios now so as to maximize their expected utility from the payoff at some future point but without revising their portfolios. By contrast, tax arbitrage involves a sequence of buy and sell decisions, such as the decision to sell an asset and to repurchase it within a few days. Such activity by investors is incompatible with a single-period version of the CAPM, and therefore may give rise to the market value of a credit due imminently that diverges from the definition of θ within the Officer model (as a weighted average over the utilization rates of individual investors).

those definitions. Merely because it is appropriate to use market prices in estimating some parameters within the Officer model, it does not follow that they should be used in estimating all parameters.

Frontier (2016a, section 3) also argues that the ACT in its recent SAPN decision (ACT, 2016b) does not assist the QCA in determining how to estimate gamma because the ACT did not address that question. This is semantics. The ACT concluded that "the AER did nor err, nor was unreasonable, in giving most weight to the 'utilisation' approach." (ACT, 2016b, para 159). This is clearly supportive of the QCA adopting the same approach.

Frontier (2016a, section 3) also notes that the QCA (2016a, page 108) considered the ACT (2016a) decision, judged that the ACT's reasoning was based upon a 'market value' definition of theta, and judged that this was not relevant to its approach, and therefore was not in conflict with the QCA's approach. Frontier disagrees with the QCA's reasoning, and I concur. The ACT (2016a) favoured a market value approach to theta over a utilisation rate approach, which clearly conflicts with the QCA's approach. However, in a subsequent decision with a different panel, the ACT (2016b) supported the AER's approach, which matches the QCA's approach. So, the latest ACT decision supports the QCA's approach.

Frontier (2016a, para 80) also argues that use of the "actual value of the credits" rather than "some theoretical construct" would be consistent with the QCA's approach to every other WACC parameter. However, the claim that WACC parameters are actual values rather than theoretical constructs is not true. The cost of equity is a market rate, but not an observed market rate because it cannot be observed and therefore must be estimated using some theoretical construct, and the theoretical construct used here is the CAPM. Furthermore, even if all WACC components were actual market values, all parameters in equation (1) arise from the set of assumptions underlying the Officer (1994) model. So, necessarily, there is no inconsistency within the model. To redefine any parameter in the numerator of equation (1) to achieve some sort of consistency with the definition of parameters in the denominator of (1) would produce an equation that no longer arose from a set of assumptions, and such an equation would have no meaning. One either uses a model or one doesn't and, if a model is used, it must be used in total.

Frontier (2016a, para 84) argues that estimating theta directly in accordance with its definition as a weighted average utilisation rate is impossible without additional assumptions and three such assumptions are allegedly made by the QCA and the AER. The first of these is claimed to be that every credit that is redeemed has a "value to the investor who redeems it equal to the full face value". This is presumably a reference to the fact that the Officer model assumes that there are no transactions costs associated with the redemption of credits. However, recognition of these costs would not change the definition of theta but require replacement of the Officer model by a more complex variant (Lally, 2016, page 13). So, this issue arises regardless of how theta is estimated. Furthermore, this assumption is particularly innocuous because the transactions costs are so small (Lally, 2016, page 13). Frontier's second alleged assumption is that all investors are equally risk averse. Lally (2016, pp. 16-17) analyses this issue and concludes that the effect of this assumption is to induce an overestimate of theta of 0.06. This is not a trivial issue but it must be compared to the difficulties in estimating theta using other methods and, in the case of dividend drop-off studies, the problems are much more severe. Frontier's third alleged assumption is that all investors (domestic and foreign) have no wealth other than that which they invest in Australia. This is presumably a reference to the fact that the Officer model assumes that there are no foreign investors, that the QCA and the AER recognize them in estimating theta, and this implies that investors have no wealth other than that which they invest in Australia. Clearly, this assumption is wrong (both local and foreign investors invest elsewhere) but it is a consequence of using a model that embodies an empirically false assumption and the problem is not avoided merely by estimating theta from dividend drop-off studies. In particular, the resulting estimate of theta is likely to be reduced by the presence of foreign investors, and therefore a parameter estimate reflecting the presence of foreign investors is inserted into a model that assumes that there are no such investors.

Frontier (2016a, para 85) claims that relaxing these three assumptions would result in a lower estimate of theta. This is true only of the second of Frontier's points, as discussed in the previous paragraph. Relaxing the first assumption leads to a new model rather than a lower estimate of theta. Relaxing the third assumption, by ignoring foreign investors in estimating theta, would lead to the much higher estimate of 1 (Lally, 2016, page 18).

Frontier (2016a, para 86) implies that the real world complexity is beyond the capability of models to embody, market prices do reflect this complexity, and theta should be estimated

from market prices. However, despite denigrating models, Frontier still uses the Officer model. The point of contention is not then the use of models but whether a parameter within the model that has been chosen (theta) should be estimated in accordance with its definition in the model or not. Frontier is in effect cherry picking, by using models when it suits them whilst disregarding parameter definitions in favour of other approaches when it suits them. If dividend drop-off studies yielded estimates of theta of 1, it is rather unlikely that Frontier would be advocating for them.

Frontier (2016a, paras 87-91) argues that the estimate of theta from dividend drop-off studies is entirely compatible with the Officer model as presented in Lally (2015a). Frontier starts by expressing the current value for equity (S_0) as a function of the gross dividend in the first year (cash plus imputation credits), the expected equity value just after that dividend, and the discount rate:

$$S = \frac{E(DIV_1) + E(IC)\theta + E(S_1)}{1+k} \qquad (2)$$

Frontier rearranges this to produce the following:

$$\frac{S_0(1+k) - E(S_1)}{S_0} = \frac{E(DIV_1)}{S_0} + \frac{E(IC_1)\theta}{S_0}$$

Replacing expectations by their realized counterparts then requires appending a residual term:

$$\frac{S_0(1+k) - S_1}{S_0} = \frac{DIV_1}{S_0} + \theta\frac{IC_1}{S_0} + \varepsilon$$

Further recognizing that the coefficient on the cash dividend term may not be 1, the result is

$$\frac{S_0(1+k) - S_1}{S_0} = \delta\frac{DIV_1}{S_0} + \theta\frac{IC_1}{S_0} + \varepsilon$$

This corresponds to the model used in the dividend drop-off analysis, which appears to prove Frontier's claim. However, there are two errors here. Firstly, the act of appending the coefficient δ to the cash dividend term is recognition that cash dividends are not valued at

'face value', and the most likely explanation for this is that dividends are taxed differently to capital gains. Accordingly, it should also be attached to the imputation credit term:

$$\frac{S_0(1+k)-S_1}{S_0} = \delta\frac{DIV_1}{S_0} + \delta\theta\frac{IC_1}{S_0} + \varepsilon \qquad (3)$$

Thus, the estimated coefficient on the imputation credit term is not θ but $\delta\theta$, and therefore one should estimate θ by dividing the estimated coefficient on the credits by that on the cash dividends. This point has been made before repeatedly (Lally, 2004a, page 37; Lally, 2016, pp. 22-23). Secondly, equation (2) arises from a set of assumptions about markets and investor behavior, and these assumptions preclude the tax arbitrage activity that is likely to affect estimates of θ derived from dividend drop-off studies. Thus, on both grounds, Frontier's claim that the estimate of theta from the coefficient on the credits in dividend drop-off studies is entirely compatible with equation (2) is not correct. Furthermore, θ in equation (2) is defined as the weighted average utilization rate, equation (3) derives from it, and therefore θ in equation (3) is also defined as the weighted average utilization rate. Thus, even in the dividend drop-off studies, the parameter being estimated is the weighted average utilization rate.

Frontier (2016a, paras 92-95) notes that Lally (2016) examines a range of methods for estimating theta other than the use of market prices, and argues that these approaches are irrelevant because regulators are interested in the market value of the credits and such approaches fail to address this question. However, regulators are instead interested in the market value of the business so as to ensure that their regulatory decisions align this with the regulatory asset value, they need a model of firm value to do so, the model chosen is the Officer model, and this model contains a parameter θ defined as a weighted average utilization rate for credits. All of the methods considered in Lally (2016) are methods for estimating this parameter.

Frontier (2016a, para 96-107) notes the wide variation in results from various market-based approaches to estimating theta, and argues that the correct response to this is to identify the best method here rather than to conclude that such approaches are unreliable. However, it is not apparent to me which of these methods is the best, and Frontier offers no recommendation. Furthermore, even if it were possible to identify the best such method, it

would still be markedly inferior to other methods of estimating theta for reasons discussed in Lally (2016, pp. 22-32). Frontier's response to this point would presumably be that one of these market-based methods must be used because only these methods estimate the market value of the credits (Frontier, 2016a, para 106). However, as discussed earlier in this section, the goal is to estimate theta (defined as a weighted-average utilization rate) and market-based methods are only one of several possibilities for doing so.

Frontier (2016a, section 4) claims that the standard approach to estimating the distribution rate, using ATO tax data and yielding an estimate of 0.70, is appropriate, widely considered to be reliable, and "has never been questioned" (ibid, para 136). However, these claims are false. As noted in Lally (2015a, page 22), and in respect of Hathaway (2013) who is the first source of these estimates, Hathaway considered that estimates of the distribution rate using ATO tax data (about 70%) are more reliable than those using dividend data (about 50%) but he is clearly not highly confident about the former figure. For example, he describes the discrepancy between these two approaches as "unresolved" (ibid, para 67) and acknowledges his imperfect understanding of the data with the words "or else I am missing something significant in these data" (ibid, para 74). Frontier (2016a, section 4) does not respond to these points but is clearly aware of them because they cite Lally (2015a). The failure to respond suggests that the point cannot be rebutted. Until that matter is resolved, the credibility of any ATO figures is weak.

Frontier (2016a, section 4) notes that Lally (2016, pp. 35-37) estimates the distribution rate from the financial statements of the 20 largest ASX companies, and that these estimates are biased downwards rather than upwards because such companies have foreign income. Frontier offers two responses to this analysis. Firstly, Frontier (2016a, para 124) argues that Lally's analysis involves a conceptual example involving a firm commencing foreign operations, and that this is irrelevant to the firms with established foreign operations in his sample. However, Frontier's claim is false. The example in Lally (2016, pp, 36-37) involves a firm that commences foreign operations and then tracks its distribution rate for many years, showing that it would take 17 years for the distribution rate to rise back to the level prevailing just before the foreign investment was undertaken. Furthermore, before this 17 year period had elapsed, the firm could engage in further foreign operations, so that its distribution rate could be permanently below the level prevailing just before the first foreign investment was

undertaken. So, the example in Lally is entirely relevant to firms with established foreign operations.

Secondly, Frontier (2016a, para 124) argues that the relevant comparison is between firms with foreign operations (with a distribution rate of 84%) and those without them (with a distribution rate of 70%), and that this demonstrates that foreign operations raise the distribution rate. However, the figure of 84% is the distribution rate for the top 20 firms, and Frontier is presuming that all of them have foreign operations (but provide no proof). Furthermore, the figure of 70% is presumably the distribution rate for publicly listed firms other than the top 20 using ATO data (as per Frontier, 2016a, Table 3), and Frontier is presuming that none of them have foreign operations (but provide no proof). Furthermore, the figure of 70% is based upon ATO data, which is unreliable for the reasons described above. So, Frontier's comparison is both faulty in principle and based upon unreliable ATO data. By contrast, Lally (2016, pp. 35-37) obtains reliable data on the foreign activities and the distribution rates of businesses, and then shows that the relationship is in the opposite direction to that claimed by Frontier.

Notwithstanding these points, it is an unsatisfactory feature of the firms examined by Lally (2016, pp. 35-37) that they have foreign operations because the benchmark efficient entity for regulatory purposes does not have foreign operations, and Frontier (2016a, para 137) alludes to this. However, the use of ATO data does not avoid this problem because the ATO data includes firms with foreign activities. The only means of completely avoiding this problem would be to select firms with no foreign operations, which would require the use of firms' financial statements rather than the ATO data. The drawback from doing so is that the aggregate market value of even a substantial sample of such firms (say, 20) is likely to be small and therefore raise concerns about the reliability of the resulting estimate of the distribution rate for the market sans foreign operations. The better approach is to at least initially examine the largest firms and assess whether the impact of foreign operations is to raise or lower the distribution rate. This is the approach in Lally (2016, pp. 35-37). Had this analysis shown that the distribution rate for the market sans foreign operations was no more than 0.83 (i.e., between 0 and 0.83), this range would have been too wide to be useful and therefore this approach would not have been viable. However, the analysis instead shows that the distribution rate for the market sans foreign operations is at least 0.83, i.e., between 0.83 and 1. This range is acceptably narrow and use of the lower bound of 0.83 (as the QCA

does) is advantageous to the regulated businesses. So, the regulated businesses have no grounds for complaint.

In conclusion, I do not agree with any of the arguments raised by Frontier. My own views on the appropriate estimates for the utilization and distribution rates are conveyed in Lally (2016). In respect of the utilization rate, since the CAPM that is being used (the Officer version) assumes complete segmentation of national equity markets and this implies that all investors could use the credits, the natural choice for the utilization rate is 1 despite the empirical fact that many investors in Australian equities are foreigners who cannot use the credits. Furthermore, given that national equity markets are partly integrated, estimating the utilization rate at 1 seems to be the only approach that leads to estimates of the cost of equity that will typically lie within the range arising under complete segmentation and complete integration of national equity markets. If this approach to estimating the utilization rate is not adopted and foreign investors are recognized when estimating it, they ought to be also recognized in defining the utilization rate and therefore the natural estimate is the proportion of Australian equities held by local investors. With this approach, I favour the use of all equity rather than only listed equity and therefore an estimate for the utilization rate of at least 60%. I consider the redemption rate for imputation credits to be a very unsatisfactory estimator, due to upward bias arising from local investors tilting towards stocks with high imputation credit yields and because of large unexplained discrepancies in the ATO data. I also consider the use of market prices to be an even less satisfactory estimator because it is highly likely that the estimates are biased (but of unknown direction), and they are highly variable according to the type of market data that is used (with dividend drop-off studies being merely one such type), the choice of statistical model, the criteria for selecting data, and the treatment of outliers in the data. In respect of the distribution rate, since it is a firm-specific parameter, it could be estimated using firm, industry, or market-wide data according to which was judged to provide the best estimate for this firm-specific parameter. Pragmatic considerations point to the use of market-wide data of some sort. Since the distribution rates for listed and unlisted businesses are significantly different and (private) regulated businesses are listed or owned by listed parents, the distribution rate for regulated businesses should be estimated from that of listed equity. Since the ATO data contains significant unresolved discrepancies, this favours the use of financial statements for a subset of high value firms and an estimate of this type is 0.83 for the top 20 such firms. Many of these firms have significant foreign operations, which are irrelevant to an estimate of the distribution rate for

regulated businesses. The effect of this feature of these firms is to underestimate rather than overestimate the distribution rate for the benchmark firm. Thus, the appropriate estimate for the distribution rate for the benchmark firm is at least 0.83. So, with a utilization rate of 1 and a distribution rate of at least 0.83, the resulting estimate of gamma is at least 0.83. Alternatively, with a utilization rate of at least 0.60 and a distribution rate of at least 0.83, the resulting estimate of gamma is at least 0.50. The QRC (2017, section 4.8) shares these views.

3. Risk-Free Rate

The QCA (2016b, section 4.4) favours the use of the yield on government bonds whose term matches the regulatory cycle for the first term in the CAPM (the risk-free rate), as observed at the beginning of the regulatory period. The QRC (2017, section 4.2) concurs with this. By contrast, Aurizon (2016, section 11.4.3) favours the use of the yield on ten-year government bonds, and cites The Brattle Group (2016)and EY (2016) in support of this. I therefore review these reports.

The Brattle Group (2016, section III) favours the yield on ten-year government bonds. In support of this, it claims that ten-year yields are less influenced by monetary policy, that regulated assets have long lives, and that equity investments are perpetual. The Brattle Group acknowledges that Lally (2004b) 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 (2004b) analysis assumes that risks of asset stranding and revaluation are addressed through a risk allowance and this may not be feasible. However, this characterisation of Lally's paper is wrong; no such assumption is made. Instead, Lally (2004b, page 21) merely states that any such risks that do exist are not relevant to the choice of the appropriate risk-free rate. The same claim was made by The Brattle Group (2014, section III), and addressed as above in Lally (2015b, section 3.1). The Brattle Group (2016) does not respond to this point. Secondly, The Brattle Group claim that Lally's analysis assumes that prices will be reset in the future and this may not occur. However, price regulation has been in force in Australia for almost 20 years and there are no reasonable grounds to believe it will be abandoned.

The Brattle Group (2016, section III) also argues that regulated businesses use long-term debt and this further supports the use of a ten-year government bond yield. However, this is an argument for the use of the ten-year government bond yield in setting the allowed cost of debt rather than the allowed cost of equity. Furthermore, there is no inconsistency between firms using long-term debt and a regulator resetting the risk-free rate component of the cost of debt every four years using the prevailing four-year rate because firms can (and many do) match their costs to the regulatory allowance via the use of interest rate swap contracts.

The Brattle Group (2016, section III) also favours using a forecasted risk-free rate rather than the rate prevailing at the beginning of the regulatory cycle. However, as shown in Lally (2004b), the risk-free rate that will satisfy the NPV = 0 principle must match the regulatory cycle and therefore must be the rate prevailing at the beginning of the cycle as well as for the same term as the cycle. Given the observed rate at the beginning of the cycle for the relevant term, the possibility that the rate does change or is expected to change is irrelevant. Naturally, forecasts of changes in rates will affect the prevailing term structure of rates, in accordance with the Expectations Hypothesis of the Term Structure.

EY (2016, Figure 3) reports that the risk-free rates used in valuation reports in 2015 (the latest year reported) exceed those used by the QCA by 1.4% on average. This is partly due to these valuation reports typically using the ten-year rate rather than shorter term rates used by the QCA, and also due to some of these reports using five or ten-year rolling averages of the risk-free rate rather than the prevailing rate used by the QCA. The rationale for the latter is the belief that five-year rates are unusually and temporarily low. However, as discussed in Lally (2013, pp. 24-26), these reports are concerned with valuing equities involving cash flows out to infinity, the term structure of risk free rates is upward sloping (at present), and it is therefore entirely appropriate to use a risk free rate in excess of even the prevailing ten year rate in doing so (if a single rate is to be used).[3] This has no implications for the QCA, who are and should be using the risk free rate whose term matches the relevant regulatory cycle, because the QCA (unlike the valuers) will periodically revise its rate. Thus, the valuers' use of rates that are in excess of even the prevailing ten-year risk-free rate has no relevance to the QCA. EY (2016) fails to respond to these arguments, and may not even be aware of them

[3] The conceptually proper approach would be to use the prevailing term structure of rates out to infinity, comprising the currently observed rates out to ten years coupled with estimates of the rates that would be observed if such bonds existed.

because they state that "It is not obvious why such a discrepancy should exist between the views of economic regulators and those of independent experts…" (ibid, page 2).

Aurizon (2016, section 11.5.1) also summarises arguments in SFG (2014e). These arguments have been addressed in Lally (2015b, section 2.1), and Aurizon offers no response to them.

Aurizon (2016, section 11.5.1) 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 (2014, 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. Aurizon has not responded to any of the points raised in Lally (2014, pp. 26-28).

Aurizon (2016, section 11.5.1) also presents an example purporting to show that the correct risk-free rate to use by the regulator is the ten-year rate. However, in doing so, Aurizon assumes that the appropriate discount rate to use embodies the ten-year rate, and its result follows from that. The crucial point here is to prove that the appropriate discount rate embodies the ten-year risk-free rate, and Aurizon defers to the papers reviewed above on that question. So, Aurizon's example adds nothing to the debate.

Castalia (2017, section 4.3) suggests that use of the ten-year risk-free rate rather than the rate whose term matches the regulatory cycle might be warranted if Aurizon was "struggling to recover its cost of debt or that it was facing financeability issues". However, whatever these difficulties to which Castalia alludes are, the appropriate compensation for them could not (except by chance) be provided by use of the ten-year rate rather than the rate whose term matches the regulatory cycle because the margin between the rates bears no connection to these difficulties. Furthermore, the margin is sometimes negative, and therefore Aurizon would face a penalty rather than compensation in that event.

In conclusion, I do not agree with any of these arguments in support of using the ten-year risk-free rate for the first term within the CAPM. My own views have been conveyed earlier in Lally (2015b, section 2.1), and support use of a risk-free rate whose term matches that of the regulatory cycle, so as to satisfy the NPV = 0 principle.

4. Market Risk Premium

The QCA (2016b, section 4.7) estimates the MRP at 6.5%, by applying a weighted median to the following estimates: 6.4% for Ibbotson, 5.5% for Siegel, 9.2% for Wright, 7.0% for Cornell, and 6.0-6.8%% for surveys. Castalia (2017, section 4.1) concurs with the QCA's estimate of 6.5%. By contrast, Aurizon (2016, section 11.4.6) estimates the MRP at 7.0% by invoking the MRP estimates of the QCA (2016a, section 4.7), of 6.4% for Ibbotson, 5.4% for Siegel, 8.9% for Wright, 8.2% for Cornell, and 6.0% for surveys, classifying them into two groups (those based on past returns, being the first three, and those based on contemporaneous information, being the last two), averaging over each set (to yield 6.9% and 7.1% respectively), and then averaging over these two means, to yield 7.0%. There are a number of problems with this process. Firstly, these QCA (2016a) estimates were based upon information up to 30 October 2015 (QCA, 2016a, page 68), the subsequent QCA (2016b) estimates were based upon information up to 31 May 2016 (QCA, 2016b, page 75), and Aurizon's regulatory cycle commences in mid 2017. Thus, the better QCA estimates to use are the later ones, with values of 6.4%, 5.5%, 9.2%, 7.0%, and 6.8% respectively. Secondly, the last figure (6.8% for surveys) is the upper bound on the QCA's estimate of 6.0-6.8% from surveys, arising if all of the survey results make no allowance for imputation credits and all such estimates are based upon the Cornell or similar approach. By contrast, if all of the survey results do allow for the credits, the appropriate figure is 6.0%. Alternatively, if none of them allow for the credits, but all of the estimates are based upon the Ibbotson, Siegel or Wright approaches, the appropriate figure would be closer to 6.0% than 6.8% in recognition of the fact that these methods use long-term historical data and only a minority of that data is drawn from the period in which imputation prevailed. Thus, if even a substantial minority of survey respondents do allow for credits in their estimates (say, at least 30%) and even a substantial minority of those who do not do so draw upon historical estimates rather than the Cornell approach (say, at least 30%), the appropriate MRP estimate will be closer to 6.0% than 6.8% (no more than 6.4%).[4] Thirdly, attempting to classify these estimates into the two categories that Aurizon does is problematic; the Wright method is a hybrid (because it uses both historical and contemporaneous data) and the survey approach is also a hybrid (because respondents are likely to consider both historical and current information). Thus,

[4] The same result would arise if a majority of survey respondents do allow for credits in their estimates, regardless of how the others estimate the MRP.

one should treat all of the estimates as belonging to a single set. Fourthly, when considering this entire set of estimates, the use of a median is preferable to a mean because it provides protection against outliers. The median of this set of five estimates is 6.4%. When rounded to the nearest 0.5%, this supports the QCA's choice of 6.5% rather than Aurizon's choice of 7.0%.

Aurizon (2016, section 11.4.6, section 11.5.2) also summarises the analysis from Frontier (2016b), The Brattle Group (2016), and EY (2016), and appears to concur with these reports even where they contradict its own reasoning. I therefore also examine these reports.

Frontier (2016b, Section 5, Table 4) argues that the market risk premium is 7.55%, based upon the results from two methods that are based upon past returns (Ibbotson and Wright) and two that are forward-looking (a DDM approach and the use of a set of market indicators). Two of these methods are both in common with the QCA's approach and involve common results (Ibbotson and Wright). This raises the following four fundamental issues.

The first fundamental issue is whether the set of market indicators used by Frontier (2016b, section 7.2.2) is appropriate. This process involves selecting four market indicators (the earnings yield, the BBB debt risk premium, the volatility of the ASX200, and the spread between ten and two-year government bond yields), determining the current value for each indicator, converting it to a percentile in its distribution of values over some historical period (presumably the maximum period for which data is available), averaging the four percentile values (to yield the 58th percentile), invoking the Ibbotson estimate of the MRP (6.40%) as an estimate of the MRP under normal market conditions, estimating the range of MRP values around the Ibbotson estimate (the range being 6%), and finally estimating the current MRP at 6.88% as follows:[5]

$$MRP = .064 + .06(.58 - .50) = .0688 \qquad (4)$$

The band of 6% (±3%) is estimated from the fact that the DDM estimates have a range of 7.2% over the last 10 years and the BBB debt risk premium has a range of 8.4% over the last 11 years. Frontier's process suffers from a number of problems. Firstly, whilst it is very plausible that these indicators are correlated with the true level of the MRP, Frontier offers no

[5] Frontier (2016b, para 172) reports the figure as 6.85% but it is 6.88% using their model.

evidence that they are sufficiently strongly correlated with it to be (collectively) given equal ranking with the other three methods used by Frontier. Secondly, there are numerous additional market indicators of this type and Frontier offers no rationale for selecting this particular subset of them. One is bound to suspect that they were selected in a self-interested fashion. To illustrate the problem here, suppose a different set of market indicators was used and the average percentile value was the 37th, corresponding to that for the government bond term spread (Frontier, 2016b, para 172). Invoking equation (4), the result would be 5.62% as follows:

$$MRP = .064 + .06(.37 - .50) = .0562$$

Alternatively, if a different set of market indicators was used and the average percentile value was the 91st, corresponding to that for the earnings yield (ibid, para 172), the result would be 8.86%. Thus, wide variations in results arise purely from the seemingly arbitrary choice of market indicators.

Thirdly, since the indicators are being used to draw conclusions about the extent to which the current level of the MRP departs from the 'normal', data on these indicators must be available for approximately as long as the period used to assess the normal level of the MRP (the last 116 years). However, data on one of them is only available for 8 years, data on another for only 11 years, and the longest of them is for only 29 years (ibid, para 172). To illustrate the resulting problem, suppose that only one market indicator is used, based upon evidence over the last 8 years, the indicator is perfectly correlated with the true (but unobservable) value of the MRP, and the current level of this indicator is high relative to that 8 year period but normal relative to the 116 year period used to estimate the MRP. Since the indicator is perfectly correlated with the true MRP, and current conditions are normal relative to the 116 years of MRP data, the application of equation (4) should produce an MRP estimate of 6.4% through an indicator percentile value of 50%. However, because the indicator percentile has been determined from only the last 8 years, and is high relative to that data, the percentile so determined will be above 50%, and therefore the application of equation (4) will yield an MRP estimate above 6.4%. This error occurs solely because the indicator data is available for only the last 8 years. Fourthly, the 6% band for the MRP is not obviously related to the two types of data used to set it. Lastly, Frontier offers no explanation for using only the band of DDM estimates and the band of DRP values for BBB bonds to set

the MRP band at 6%. There are a wide range of other data sets that could be used to do so. All of these points suggest that the market indicator approach used by Frontier is not appropriate.

The second fundamental issue is whether it is appropriate to use survey evidence. Frontier (ibid, paras 92-95) argues that the survey evidence from Fernandez et al (2015) should not be used. The points repeat those raised in SFG (2014c, paras 171-187), and many of the points raised here are reasonable. However, as argued in Lally (2013), some weight should be placed upon results from other markets and the Fernandez surveys are the only ones that allow this to be done. I therefore favour use of this survey as well as the valuation reports. Frontier (2016b) does not respond to these arguments. By contrast, Frontier (ibid, paras 96-105) is favourably inclined towards MRP estimates in valuation reports and also notes that they had earlier recommended use of such estimates, but Frontier fails to explain why they no longer apparently favour doing so. Finally, I note that, since the results from these two types of surveys are very similar, the question of whether one should use only the valuation reports or both types has no practical significance.

The third fundamental issue is whether it is appropriate to use the Siegel approach. Frontier (ibid, section 4.2.2) critiques this method as follows. Frontier's first argument is that the Siegel approach corrects for a perceived bias in the Ibbotson estimate but there are many other sources of bias that the QCA does not correct for. For example, Frontier states that average equity returns in the Australian market over the 2007-2013 period were zero, and this is clearly below what investors would have expected. However, the Siegel approach is adopted to address a bias in the entire Ibbotson estimate rather than a bias over some short period within the 116 years of data underlying the Ibbotson estimate. Biases of the latter type could be expected to wash out over the 116 years of data used in the Ibbotson estimate.

Frontier's second argument is that application of the Siegel approach requires an estimate of the expected real risk-free rate over the period for which historical data are used, and such estimates are problematic. The same argument has been raised earlier by SFG (2014b, paras 77-79) and rebutted in Lally (2015b, page 28). Frontier (2016b) is aware of the latter paper because they cite it, but does not respond to the arguments there.

Frontier's third argument is that the Siegel approach predicts that real government bond yields would rise after 1990, this prediction has proved to be inaccurate, and this undercuts the merits of the Siegel approach. Again, this argument has been raised earlier by SFG (2014b, paras 80-83) and rebutted in Lally (2015b, pp. 28-30). Frontier (2016b) is aware of the latter paper because they cite it, but does not respond to the arguments there.

Frontier's fourth argument is that Siegel (1992) proposes several possible explanations for the low real government bond yields in the 20th century but the QCA focuses upon only one of them (unanticipated inflation), thereby overstating the importance of unanticipated inflation. Frontier is presumably referring to the following additional points offered by Siegel (1992, pp. 36-37): the legacy of fear from the Great Depression, interest rate controls from WWII till the 1980s, redistributive government policies after the Great Depression, and increased liquidity in the market for government bonds. However, none of these phenomena could explain the negative real returns that arose during the late 20th century, with Siegel (2011, Table 1) reporting an average of -3.9% on bonds for 1966-1981. So, at most, these additional factors could only have added to the outcome. Furthermore, amongst these additional explanations, the first two (like unanticipated inflation) were temporary and therefore *reinforce* the conclusion that low real yields on bonds in the late 20th century were temporary, leading to an upward but temporary effect on the estimated MRP, thereby justifying a downward adjustment to the Ibbotson estimate. It is not the particular grounds for the adjustment that matter but simply its merits.

Frontier's fifth argument is that the correction to the Ibbotson estimate to account for unanticipated inflation is overstated because the inflation-protected bonds used in this exercise (to estimate the expected real yield on the conventional bonds during the high inflation period) have lower liquidity than conventional government bonds, this raises their real yield, and therefore use of such data on inflation-protected bonds would overestimate the expected real yield on the conventional bonds. It is true that the inflation-protected bonds have a premium for inferior liquidity relative to conventional bonds. However, it is also true that the real yield on conventional bonds is uncertain (because inflation is uncertain), the same does not apply to inflation-protected bonds, and therefore use of the yield on the latter to estimate the expected real rate on conventional bonds may underestimate the expected real yield on conventional bonds. Since the net effect of these forces is unclear, one cannot conclude that the use of real yields on inflation-protected bonds would impart an upward bias

in the estimate of the average expected real-risk-free rate over the 1931-2014 period. Instead, one could say that the estimate is imperfect. However, as noted in Lally (2015b, page 28), the estimate using inflation-protected bonds is supplemented with data from the conventional bonds, and the estimates are similar: 3.7% from the inflation-protected bonds and the average realised real return of 3.5% on conventional bonds 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%.

Frontier's sixth argument is that the Siegel estimator is closely related to the Ibbotson estimator and therefore should not be included. It is true that there is significant commonality in the data used in both estimators (both use the historical average returns on equity), but the same is true of the Wright approach, which Frontier supports. Despite this significant commonality in data, all three approaches have produced significantly different estimates of the MRP. There are only two completely distinct estimators: Ibbotson and some version of the DDM. Thus, if one seeks a larger set of estimators, which is desirable in my view, the rest will have to be variants of one or both of the Ibbotson and DDM estimators.

In summary, I do not concur with any of Frontier's concerns about the Siegel approach. For reasons explained earlier (Lally, 2014, section 5.2; Lally, 2015b, pp. 29-30), I support the Siegel approach.

The fourth fundamental issue is that of whether Frontier's preferred version of the DDM is better than the QCA's. The points of distinction are as follows. Firstly, Frontier (2016b, section 7.2.1) assumes that the same market cost of equity applies to all future years whereas the QCA (2014, page 71) assumes mean reversion towards a long-run rate applicable from the tenth year, and therefore estimates the cost of equity applicable to the first ten years. Frontier (2016b, section 4.2.4) asserts that the QCA in doing so assumes that investors require a lower cost of equity for the first ten years. However, as noted in Lally (2015b, page 19), the QCA makes no such assumption; the result could be higher, lower or equal to the long-run estimate. Frontier (2016b) does not respond to this point. Furthermore, in respect of its use of market indicators, Frontier (2016b, section 7.2.2) itself assumes convergence towards a long-run average MRP. Secondly, Frontier (2016b, section 7.2.1) estimates the long-run expected real growth rate in dividends per share at 3% based upon a long-run

expected real growth rate in GDP of 3% (and the average growth rate in real earnings per share over the last 20 years) whereas the QCA (2016b, section 4.7; 2014, pp. 71-72) deducts 1% from the long-run expected real growth rate in GDP to recognize that part of the growth in aggregate dividends to all equity in all firms goes to new equity and new firms rather than existing equity in existing firms. Frontier's arguments essentially repeat those in SFG (2014d, section 3.3) and have been addressed in Lally (2015b, pp. 23-25). Frontier (2016b) does not respond to these arguments.[6] Thirdly, to convert its estimate of the long-run expected real growth rate in dividends per share into a nominal rate, Frontier (2016b, section 7.2.1) estimates long-run expected inflation from the yields on ten-year conventional and inflation-adjusted government bonds (at 1.4%) whereas the QCA (2014, page 72) uses the midpoint of the RBA's inflation target band (2.5%). Frontier's inflation estimator (break-even inflation) suffers from a number of difficulties, of which the most important are the liquidity premium on indexed bonds (which imparts a downward bias to this inflation estimate) and the inflation risk premium on nominal bonds (which could induce a bias in either direction). The net effect of these two phenomena could be positive or negative, leading to either upward or downward bias in estimating expected inflation by this method. Using Australian data over the period 1992-2010, Finlay and Wende (2012, Figure 3) estimate the net effect of these two phenomena at from 2.5% to -1.0% over both five and ten year periods. This suggests that the "break-even inflation rate" is a poor estimator of the expected inflation rate, even over the ten-year period to which the conventional and inflation-indexed bond yields relate. Extrapolating this estimate beyond that period, as Frontier does, is even more problematic. By contrast, the geometric average inflation rate in Australia from mid 1993 (shortly after inflation targeting commenced) till September 2016 was 2.53% per year.[7] So, the QCA's use of the RBA's 2.5% target inflation rate seems to be an unbiased estimate for the long-run expected inflation rate, and this is entirely plausible because it is the target to which monetary policy is directed. In summary, I do not concur with any of

[6] In respect of data on the past real growth rate in earnings per share, Frontier reports an average such rate of 3.4% over the past 20 years, and reduces its forecast to 3.0% in recognition of that fact that the earnings retention rate has fallen in recent years. This adjustment to reflect a decline in the retention rate fails to recognize that the reduction in the retention rate imparts a temporary boost to the real growth rate in earnings, which cannot be extrapolated into the future. So, Frontier's estimate here is too high and further supports the conclusion that the long-run expected real growth rate in dividends per share is less than 3%.

[7] Over this period, the CPI index grew from 60.8 to 109.4: data from Table G1 on the website of the Reserve Bank of Australia (http://www.rba.gov.au/statistics/tables/#inflation-expectations).

Frontier's concerns about the QCA's DDM approach and I favour the QCA's DDM approach.

In addition to these four fundamental points, Frontier (2016b) raises a number of additional issues as follows. Frontier (2016b, section 2.2, section 3) argues that three of the five estimation methods adopted by the QCA (Ibbotson, Siegel, and surveys) produce "essentially fixed estimates", and that this is an undesirable feature. However, in respect of the survey results, the stability in results over time is not inherent in the methodology but constitutes the judgement of the participants in the survey. Thus, Frontier is objecting to the outcomes from the surveys rather than the competence of the survey participants. This is not a reasonable basis on which to object to a survey. Furthermore, the surveys invoked by the QCA include valuation reports, Frontier (ibid, paras 96-105) is favourably inclined towards them, refers to the providers as "independent experts", and also notes that they had earlier recommended use of such estimates. Frontier fails to explain why they no longer favour the use of MRP estimates in these valuation reports.

Frontier (2016b, section 2.3) argues that the cost of equity estimated by the QCA has declined in the last three years from 10.8% to 8.6%, due to "the QCA's assumption that investors require a constant risk premium of 6.5% to be added to the contemporaneous government bond yield." The same claim is made in Frontier (ibid, para 66). However, the QCA makes no such assumption; the figure of 6.5% is the *result* of its methodology for estimating the MRP and this methodology does not guarantee a result of 6.5%.

Frontier (2016b, section 2.4 section 2.5) notes that the Cornell and Wright approaches invoked by the QCA and the AER yield estimates of the cost of equity that are essentially stable over the last three years, and therefore the MRP estimates from these two methods have risen over that period as a result of the risk-free rate declining. Presumably, the point of this is to contrast such results with the QCA's estimates of the MRP being stable over the same period. However, all this reveals is that three of the approaches invoked by the QCA have produced MRP estimates that have been stable over the past three years whilst two have produced MRP estimates that have risen. It does not demonstrate that the latter two methods are better.

Frontier (2016b, section 2.6, section 2.7) cites the views of a number of "respected market participants" to the effect that the cost of equity has remained stable whilst the risk-free rate has declined since the GFC, and therefore the MRP has risen. In substance, this is survey evidence in which the participants have been selected ex-post on the basis of their views. I consider that such an approach has minimal credibility relative to choosing types of survey evidence ex-ante, in accordance with the merits of the participants, and then accepting the results. Furthermore, these alleged market participants comprise the Governor of the Reserve Bank, three employees of a management consulting firm, three academics, and a selection of regulatory bodies. None of them would meet the normal definition of a "market participant". Furthermore, Frontier fails to include amongst this set of "respected market participants" those who undertake valuation reports but nevertheless Frontier (2016b, paras 96-105) is favourably inclined towards the MRP estimates in valuation reports, refers to the providers as "independent experts", and also notes that they had earlier recommended use of such estimates. Nor does Frontier invoke these estimates at any other point. One might suspect that the views of these "independent experts" are now excluded because their MRP estimates accord with the QCA's view.

Frontier (2016b, section 2.6) claims that P/E ratios have not risen over the last three years, this implies that the inverse (the E/P yield) has not fallen, this implies that the market cost of equity has not fallen, and therefore that the MRP must have risen as the risk-free rate has fallen. However, E/P yields are also affected by growth forecasts for cash flows and short-term fluctuations in earnings. Thus, one cannot conclusively deduce anything about changes in the market cost of equity from changes in E/P yields. Furthermore, Frontier already includes the E/P yield amongst its set of market indicators and they are unrepresentative of the wider set of market indicators examined by Frontier because it generated the most extreme result across the four market indicators considered by them (Frontier, 2016b, para 172): a 91st percentile outcome compared to 52nd, 50th and 37th percentiles for the other three indicators.

Frontier (2016b, section 2.8) refers to two market indicators (E/P yield and the DRP on BBB bonds) whose movements in the last three years are inconsistent with that of the QCA's estimates of the MRP and the market cost of equity. However, Frontier (2016b, section 7.2.2) has included these market indicators amongst a wider set used to estimate the MRP in a more systematic fashion, and this market indicators approach has been assessed above.

Frontier (2016b, section 3) claims that the QCA fails to explain how it estimates the MRP from the five approaches considered, and that it is clear that the results from the Wright and Cornell methods must each have received negligible weight from the QCA. I do not agree with either point. The QCA uses judgement rather than applying specific weights to the methods that are considered, and I consider this to be a legitimate approach so long as its conclusion is compatible with the application of a plausible set of weights to the methods used. The methods used and the QCA's resulting estimates are 5.5% for the Siegel method, 6.4% for the Ibbotson method, 6.0% – 6.8% for surveys, 7.0% for the Cornell method, and 9.2% for the Wright method (QCA, 2016b, page 78).[8] Equal weighting is the natural choice and I also favour it. Using the midpoint of the range for surveys, the equally-weighted median over these five results is 6.4%, which is almost identical to the QCA's conclusion of 6.5%.[9] So, although the QCA does not specify a set of weights, its conclusion is reasonable and contrary to Frontier's claim it does not require negligible weights on the Cornell and Wright methods. Furthermore, reducing the weight on either or both of the Cornell or Wright methods and thereby raising the weights on the other three methods would not change the median (as noted by the QCA, 2016b, footnote 200). By contrast, raising the weight on either or both of the Cornell or Wright methods at the expense of the weights on the other three methods would raise the median, and raising these weights sufficiently would produce a weighted median above 6.5% (as noted by the QCA, 2016b, footnote 200). This would be consistent with Frontier's arguments discussed earlier, including zero weight on the Siegel method, but I disagree with such arguments for the reasons indicated above.

Frontier (2016b, section 3) claims that the QCA's MRP estimates are implausible because they move very little with substantial changes in market conditions, due to high weight on the Ibbotson and Siegel estimates. In statistical terms, Frontier are asserting that the QCA's estimates are biased (too high at some times and too low at others), and implying that this is a

[8] The QCA (2016b, page 78) also considers additional information that reflects current market conditions.

[9] The upper bound on the QCA's estimate from the surveys (6.8%) presumes that all survey participants do not allow for the credits and they all estimate the MRP using a forward-looking method of the DDM type. By contrast, if they all allow for the credits, the appropriate MRP estimate to use is the QCA's lower bound of 6.0%. Alternatively, if none of them allow for the credits but base their MRP estimates on results of the Ibbotson, Siegel, or Wright type using data from 1883, the upward adjustment for the credits would only be 0.20% (see Lally, 2014, pp. 14-15). Thus, recognizing that some participants do allow for the credits and that some of those who don't do so base their MRP estimates on historical data, the appropriate estimate of the MRP inclusive of the credits would be between 6.0% and 6.8%.

defect. However, as discussed in Lally (2015b, page 27), the QCA's approach 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. Furthermore, it is more important for a regulator to seek accurate compensation for businesses over the life of the 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 in the event that one faced this choice. Consequently, even if use of the Ibbotson and Siegel approaches did underestimate the MRP at some times and the reverse at others, 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. Frontier (2016b) does not respond to these arguments.

Frontier (2016b, paras 96-105) argues that the QCA does not appropriately use results from valuation reports to estimate the MRP. These points were raised earlier by SFG (2014b, section 5) and addressed in Lally (2015b, pp. 30-31), but Frontier (2016b) does not respond to these points.

Frontier (2016b, paras 102-104) notes that the QCA adopted survey-based MRP estimates of 6.0% excluding credits and 6.8% including credits in its UT4 Draft Decision, that the corresponding figures in its DBCT Draft Decision were 5.1% and 6.0% (QCA, 2016a, pp. 72-73), and that the QCA fails to explain this reduction. I understand that the reduction arose from the QCA (2016a) relying upon the Fernandez et al (2015, Table 2) survey results (median of 5.1%) because the Fernandez et al (2016, Table 2) survey results (median of 6.0%) were not yet available.[10] Furthermore, Frontier's query has been overtaken by events because the QCA has reverted to its earlier figures of 6.0% and 6.8% in its DBCT final decision (QCA, 2016b, page 78) consequent upon the Fernandez et al (2016, Table 2) results becoming available. Furthermore, as explained in Lally (2014, pp. 14-15), it is not clear whether survey respondents have included allowance for credits within their estimates. Thus, any decision to treat the survey results as being exclusive of credits (thereby warranting an

[10] The DBCT Draft Decision was published in April 2016 whilst the Fernandez et al (2016) survey was not available until May 2016.

increment for the credits) would be very generous to the DBCT, and any choice of estimate within the QCA's current range ought then to be below the upper limit.

Frontier (2016b, section 4.2.5) claims that the QCA has "effectively rejected" the Wright approach, that it has provided no cogent reason for doing so, and has done so against the advice of its consultant. However, Frontier's claim of "effective rejection" is an exaggeration because the QCA merely assigns a lower than equal weighting (less than 20%) to this method and in an example to illustrate its approach gives it a weight of 10% (QCA, 2016b, footnote 200). Furthermore, the practical effect of this weighting issue is nil, because assigning equal weight to each of the five methods considered by the QCA would produce a median result of 6.4% as discussed above, matching the result arising from the QCA's weighting scheme (QCA, 2016b, footnote 200).

Frontier (2016b, section 4.3.1) categorises MRP estimation methods into two types, averages over the estimates within each category, and then over the two categories. The two types are those based upon past returns and the current bond yield (Ibbotson and Wright), and those that use contemporary market information (DDM and the use of market indicators). However, this classification scheme is flawed; the two types are not mutually exclusive (because the current bond yield is also contemporary market information) and the description of the first type is incompatible with the Ibbotson method (because the Ibbotson method does not use the current bond yield). The source of the 'difficulty' is that the Wright method is a hybrid, which uses both past and current information. There is no practical significance to this here because the same MRP estimate would have occurred even if Frontier had simply averaged over the results from the four methods. A more significant issue would arise if a desirable estimation method could not be included in one of these categories, even with variation in the titles for the categories, and this may be the case for surveys, which cannot be clearly categorized in this way. However, if an estimation method is useful, it should not be excluded merely on account of classification difficulties. An equally significant issue would arise if one included an estimation method simply in order to equalize the numbers of methods in the two groups. This seems to have happened with Frontier's inclusion of market indicators, because neither Frontier nor SFG have previously used such a methodology and its inclusion equalizes the numbers of methods in the two categories.

The Brattle Group (2016, section IV) favours an MRP estimate of 7.7%, being the median of the results from the Ibbotson (6.8%), Wright (8.6%), and a DDM approach (8.6%). These estimates and the underlying methodologies differ from those adopted by the QCA. The Brattle Group also rejects estimates from two additional methodologies adopted by the QCA (Siegel and surveys). These points of distinction are examined as follows.

The Brattle Group's Ibbotson-type estimate of the MRP (6.8%) uses data without the imputation credits from Dimson et al (2016, Table 13) for the period 1900-2015 (6.6%) and adds 0.2% for the imputation credits. This estimate of 6.8% differs from the Ibbotson estimate of the QCA (2016b, section 4.7) of 6.4% in various ways as follows. Firstly, the formula used by The Brattle Group for correcting for imputation credits is equation (11) shown in Lally (2015b, section 2.2). That formula is critiqued by Lally (2015b, section 2.2), and The Brattle Group (2016) does not respond to these points of criticism. Secondly, this correction formula requires a gamma value and The Brattle Group uses 0.25. As discussed in section 2 above, this value is far too low. There is no practical significance to these two points, because the correct adjustment for the credits in accordance with equation (3) in Lally (2015b, section 2.2) would coincidentally be 0.20%.[11] Thirdly, the QCA obtain their MRP estimates from Brailsford et al (2008, 2012), subject to updating, and these authors estimate the MRP using the arithmetic mean of the annual return on equities net of the contemporaneous yield on ten-year government bonds. This is consistent with defining the MRP as the expected market return net of the yield on ten-year government bonds, and this in turn is consistent with the CAPM. By contrast, Dimson et al (2016, section 2.1) 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.[12] Fourthly, the QCA uses all available data for Australia (from 1883) and assesses the quality of the data, leading to more weight being placed on the data since 1958.

[11] The numerical calculation appears in Lally (2014, page 10).

[12] 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 (2016, Table 13). This reduces the MRP estimate (without allowance for the credits) from 6.6% to 6.1%. However, the bond data are still returns rather than yields.

By contrast, Dimson et al (2016) use Australian 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 both points, the QCA's estimates are superior. The same points were made in Lally (2015b, section 3.2) concerning an earlier report by The Brattle Group (2014) but they have not commented upon these matters in their latest report. There is no practical significance to the last two points, so long as the Dimson et al (2016, Table 13) data is used to estimate the MRP excluding the credits at 6.1% (see footnote 8) because the QCA's estimate without the credits is almost identical at 6.4% - 0.2% = 6.2%.

The Brattle Group (2016, section IV) estimates the MRP using the Wright approach at 8.6% (including 0.3% for the imputation credits) whilst the QCA's (2016b, page 78) estimate is 9.2%. The Brattle Group's formula for adding the effect of the imputation credits is the same as for the Ibbotson method discussed in the previous paragraph, and therefore suffers from the same shortcomings discussed there, but The Brattle Group's adjustment of 0.3% is almost identical to the correct adjustment of 0.2% noted in the previous paragraph. This point aside, there seem to be two principal differences in the methodology. Firstly, The Brattle Group uses the Dimson et al (2016) data from 1900. By contrast, the QCA (2016b, section 4.7) uses longer term data from Brailsford et al (2008, 2012), subject to updating, and also assesses the quality of the data, leading to more weight being placed on the period since 1958. As discussed in the previous paragraph, the QCA's approach is superior. Secondly, in converting the estimate of the expected real return on equities to a nominal return, the QCA uses an inflation forecast of 2.5% corresponding to the midpoint of the RBA's target band whilst The Brattle Group (2016, footnote 70) use forecasts of 1.8% to 2.1% from two Australian banks, from one and two years ahead.[13] Since the purpose of the exercise is to estimate the MRP over the next regulatory cycle of four years, the appropriate inflation forecast is that for four years. So, the Brattle Group's forecasts are for too short a period. In respect of the QCA's use of the inflation target as a forecast, Tulip and Wallace (2012, Table 4) report that the RMSE of the RBA's forecasts are materially superior to use of the inflation target (and statistically significant) for one-year ahead (0.89% versus 1.41%), and marginally superior (but not statistically significant) for the second year ahead (1.27% versus 1.36%).

[13] The CBA forecasts for August 2016 are available at https://www.commbank.com.au/content/dam/commbank/corporate/research/publications/economics/forecasts-economic-financial/2016/120816-Forecasts.pdf whilst the Westpac forecasts for July 2016 are available at https://businessfocus.westpacgroup.com.au/blog/2016/july/25/weekly-economic-update-25-july-2016/

Tulip and Wallace (2012, Table 2) also report that the RMSE of the RBA's forecasts are marginally superior to those provided by other private sector forecasters (but the differences are not statistically significant). So, on the basis that one should use the inflation target in the absence of compelling contrary evidence, the best forecast over the next four years would be the RBA's forecast for the first year coupled with the inflation target for the remaining three years. So, the QCA's approach is close to optimal.

As discussed earlier in reviewing Frontier's Cornell-type estimate, the QCA's use of the RBA's 2.5% inflation target would appear to be an unbiased estimate over the long run, and this is entirely plausible because it is the target to which monetary policy is directed. By contrast, the forecasts used by The Brattle Group are only one year ahead for Westpac and two years ahead for the CBA. These are not long-term forecasts. In addition, the MRP estimate is obtained by deducting the nominal risk-free rate from the nominal expected return on equities, and The Brattle Group (2016, page 27) uses the current yield on a ten-year government bond for the risk-free rate here. This is inconsistent with using inflation forecasts over only one or two years. On all points, the QCA's approach is superior.

The Brattle Group (2016, section IV) estimates the MRP at 8.6% using a DDM favoured by Bloomberg (including 1.0% added for the imputation credits) whereas the QCA's DDM estimate (2016b, page 78) is 7.0%. In respect of the allowance of 1.0% for the credits, The Brattle Group's formula for adding the effect of the imputation credits is the same as for the Ibbotson method discussed in the previous paragraph, and therefore suffers from the same shortcomings discussed there, but The Brattle Group's adjustment of 1.0% is coincidentally almost correct.[14] So, there is no practical significance to this point. In respect of the Bloomberg approach, the full details are not disclosed by The Brattle Group but three points warrant comment. Firstly, in the Bloomberg approach, the long-run expected growth rate in cash flows is set equal to that of GDP. By contrast, the QCA (2016a, section 4.7; 2014, pp. 71-72) deducts 1% from the long-run expected growth rate in GDP to recognize that part of the growth in aggregate dividends to all equity in all firms goes to new equity and new firms rather than existing equity in existing firms. Clearly, The Brattle Group is aware of this 1% deduction but offers no contrary argument. Secondly, The Brattle Group argues that the

[14] Using equation (3) in Lally (2015b) along with a cash dividend yield of 5%, 75% of dividends being fully imputed, a corporate tax rate of 30% and $U = 0.56$, the adjustment for the credits is 0.90%. This exceeds the adjustment of 0.2% for the Ibbotson and Wright methods because they use historical data and imputation operated in only 20% of those years.

QCA's approach fails to allow for share repurchases and the effect of allowing for this is to raise the MRP estimate by 0.5%. As discussed in Lally (2015b, section 2.3), I agree that repurchases should be allowed for and the QCA has not done so but there are data availability problems and the effect of allowing for this would raise the MRP estimate by up to 0.50%. The Brattle Group does not demonstrate how it estimates the effect at 0.50%. Furthermore, in respect of the point in Lally (2015b, section 2.3) that not allowing for repurchases in the current 'dividends' is potentially offset by not correcting the EPS growth rate for repurchases, The Brattle Group argues that analysts would adjust the EPS growth rate for repurchases. However, this claim is irrelevant to their own analysis (i.e., Bloomberg's) because they use a long-run expected growth rate in EPS equal to GDP and this does *not* correct for repurchases. These points about repurchases are not significant because they would not change the median result amongst the QCA's estimates for the five methodologies. Thirdly, The Brattle Group claims that a DDM ignores option values inherent in stocks and therefore underestimates the MRP. It is true that a DDM ignores such option values but the effect is to instead *overestimate* the MRP. To illustrate this point, suppose that firms in a market currently generate dividends of \$9b per year, these are not expected to grow, the cost of equity is 10%, and the firms have growth options worth \$10b. Accordingly, the value of all equities in the market would be \$100b as follows:

$$S = \frac{\$9b}{.10} + \$10b = \$100b$$

The conventional application of a DDM would set the value of the equities (\$100b) equal to the present value of the expected dividends and solve for the discount rate k, as follows:

$$\$100b = \frac{\$9b}{k}$$

The resulting estimate of the discount rate k would be 11.1%, which overestimates the true value of 10% due to the presence of options. Accordingly, the MRP will also be overestimated. So, across these three points, only the second in principle favours the approach taken by The Brattle Group over that of the QCA, and even here they fail to demonstrate the alleged size of the effect whilst recognition of the point would not change the median estimate. The approach taken by the QCA is therefore favoured.

The Brattle Group (2016, section IV) does not favour the use of the Siegel method, for the following reasons. Firstly, The Brattle Group claims that the method is not widely used. I think this is true but neither was the wheel for some time after its discovery. Progress involves change, and requires assessment of methods on their merits. The Brattle Group's recourse to a DDM approach favoured by Bloomberg, and Frontier's (2016b) recourse to market indicators, could also be described as not being widely used, but I have assessed both of them on their merits rather than rejecting them on the basis of not being widely used. Secondly, The Brattle Group claims that the Siegel method "was derived for the period 1940-1990" and that it would be important to "repeat the study using data from the last 25 years". However, the Siegel methodology rests on the premise that the inflation shock in the late 20th century induced an overestimate of the MRP from the Ibbotson method, which warrants correction. If the premise is valid, and the correction addresses the problem, there is no cause for repeating the study beyond 1990 because the inflation shock has not persisted beyond 1990. Similarly, if Ibbotson estimates of the MRP contained transcription or computational errors over the 1940-1990 period, leading to an increase in the estimate, and these were corrected, there would be no cause to repeat that study.

The Brattle Group (2016, section IV) rejects surveys of the Fernandez et al (2015) type on various grounds. The points largely repeat those raised by SFG (2014c, paras 171-187), and many of the points raised here are reasonable. However, as argued in Lally (2013), some weight should be placed upon results from other markets and the Fernandez surveys are the only ones that allow this to be done. I therefore favour use of this survey as well as the MRP estimates from the valuation reports. The Brattle Group (2016) does not respond to these arguments. By contrast, The Brattle Group (2016, page 25) is favourably inclined towards MRP estimates in these valuation reports, but fails to explain why they do not draw upon them in estimating the MRP. Furthermore, desisting from using the Fernandez results would have no practical effect here because the other type of survey used by the QCA (valuation reports) yields almost identical estimates.

The Brattle Group (2016, section IV) notes that the DRPs on Australian corporate bonds with A ratings have been higher by about 0.80% in the period since 2007 than they were in the 2005-2007 period (as shown in their Figure 5), that a debt beta of 0.12 converts this into an MRP increase of about 6.5%, and therefore that the current MRP is significantly elevated

relative to its historical norm. This analysis suffers from two significant problems. Firstly, it treats the DRPs observed in the 2005-2007 period as the historical norm but supplies no evidence in support of such a claim. Secondly, it attributes all of the increase in the DRPs to systematic risk. The Brattle Group recognizes that there are other components to the DRP, but lists only default and tax premia. The outstanding omission here is an allowance for the inferior liquidity of corporate bonds relative to government bonds, and this allowance rose as a result of the GFC. For example, Dick-Nielsen et al (2012, Table 4) conclude that the illiquidity component of the DRP on US corporate bonds with A ratings rose from 0.02% in the 2005-2007 period (pre-GFC) to 0.50% in the 2007-2009 period (during the GFC). Using changes in the DRP to help estimate the MRP is not unreasonable but the process used by The Brattle Group is not reasonable.

The Brattle Group (2016, section III, section IV) argues that the risk-free rate used within the MRP must match that in the first term of the CAPM. So, if the QCA uses the four-year rate within the first term of the CAPM, it should use the same rate within the MRP. Since the MRP estimates above reflect use of the ten-year risk-free rate, these must be corrected for the differential between the four and ten-year risk-free rates, and the differential is about 0.45% averaged over the 1991-2016 period or 0.58% at the present time. These arguments are conceptually identical to those in The Brattle Group (2014, section III, section IV) and have been addressed in Lally (2015b, section 3.1, 3.2). In particular, the conceptual argument for a consistent risk-free rate is not clear-cut and, even if it were, the required correction to the MRP would be much smaller than claimed by The Brattle Group, and it would not affect the QCA's rounded estimate of 6.5%. The Brattle Group (2016) does not respond to these arguments.

It is also rather ironic that The Brattle Group favours this strict matching of terms within the CAPM but recommends or expresses favourable views about a whole range of other actions that would also depart from a strict application of the CAPM. The first of these is to recommend use of a forecasted risk-free rate rather than the rate prevailing at the beginning of the regulatory cycle (The Brattle Group, 2016, section III). Such an asset (if it exists) is not the risk-free asset, and therefore use of it is inconsistent with the CAPM. The second is to express a favorable view about augmenting the observed risk-free rate by a portion of the increase in the DRP (The Brattle Group, 2016, section III). Again, such an asset (if it exists) is not the risk-free asset, and therefore use of it is inconsistent with the CAPM. The third is

to express a favourable view of valuation reports (ibid, page 25) despite the fact that applications of the CAPM in these valuation reports almost always depart from a strict application of the model. In particular, EY (2016, pp. 21-23) report that, of the 24 reports produced in 2015 in which the CAPM is used, 23 made adjustments including applying company or project-specific risk premia, and using trailing average risk-free rates rather than the values prevailing at the valuation date. This third point also applies to Aurizon (2016), because it too recommends use of these valuation reports (ibid, page 290) whilst also recommending strict matching of the two risk-free rates within the CAPM (ibid, page 291). All of these departures from the CAPM are much more substantial than the issue of strict matching of risk-free rates.

EY (2016, Figure 3) reports that the average MRP used in valuation reports in 2015 (the latest year reported by them) exceeds that used by the QCA by 0.1%. Since the QCA has used 6.5% from 2014, this implies an average MRP value in the surveys of 6.6%. However, so as to gain protection from outliers, the median is preferable to the mean (see Lally, 2015b, pp. 30-31 for a dramatic example of the problem with using means). EY (2016) does not report the median or the full distribution for the 24 valuation reports that give rise to the mean of 6.6% but they note that 12 of these reports made direct adjustments to the risk-free rate (ibid, pp. 20-22), these are reported in their Appendix B along with the MRP estimates, and all but one of these MRP estimates is 6.0% (the other is 7.0%). So, it is reasonable to conclude that the median of the entire 24 estimates is also 6.0%. EY (2016, section 6.5.3) concludes that these estimates do not incorporate any allowance for the effect of imputation credits. If so, then this median of 6% constitutes an estimate of the MRP exclusive of the effect of the credits.

Aurizon (2016, pp. 290-291) argues that there are no MRP outliers in the EY (2016) report, and therefore no cause to use the median rather than the mean. However, EY (2016) does not disclose the full set of MRP estimates that underlies its average of 6.6% and therefore it is not apparent whether there are any outliers. Furthermore, it is not feasible to use a median in circumstances where there are outliers and a mean otherwise because this would lead to unresolvable debates over the definition of an outlier. Consistent use of the median is therefore the only viable course of action, as argued in Lally (2015b, pp. 30-31).

Aurizon (2016, page 291) also claims that certain points raised in SFG (2014d) have not been addressed by the QCA. However, these points were addressed in Lally (2015b, section 2.3), and Frontier (2016b) does not respond to these.

Aurizon (2016, page 292) also argues that the QCA fails to explain precisely how it deduces its MRP estimate of 6.5% from the set of estimates that it considers. The same issue has been raised by Frontier (2016b, section 3) and addressed above.

Aurizon (2016, pp. 292-293) also argues that, if the QCA matches the risk-free rate within the first term of the CAPM to the regulatory cycle, it should match the risk-free rate within the MRP to that cycle. Aurizon clearly recognizes that this might simultaneously lead to different MRP estimates for different regulatory problems, but does not consider this problematic. However, a strict application of the CAPM requires one estimate of a MRP at any one point in time. All of this highlights the issue discussed in Lally (2015b, section 2.1): any application of the CAPM to regulatory problems will lead to conceptual problems.

In conclusion, with three exceptions, I do not agree with these arguments concerning the MRP. Firstly, I concur with The Brattle Group that share repurchases should be allowed for in a DDM and that the QCA has not done so. However, there are data availability problems in doing so and the effect of allowing for this would be to raise the MRP estimate by less than 0.50%. The Brattle Group claims that the effect is 0.50% but does not demonstrate how it estimates the effect at 0.50%. The point is not significant because it would not change the median result amongst the QCA's estimates for the five methodologies. Secondly, I concur with many of the criticisms raised by both Frontier and The Brattle Group concerning the Fernandez surveys. However, the surveys have the advantage of including results from a wide range of countries. Furthermore, desisting from using them would have no practical effect because the other type of survey evidence used by the QCA (valuation reports) yields almost identical estimates. Thirdly, I acknowledge the conceptual argument raised by The Brattle Group in favour of matching the risk-free rate within the MRP to that used in the first term of the CAPM. However, this approach also has conceptual drawbacks and the best course of action is not clear-cut. Furthermore, even if the best course of action matched that favoured by The Brattle Group, the required correction to the MRP would be much smaller than claimed by The Brattle Group, and it would not change the median result amongst the QCA's estimates for the five methodologies.

The QRC (2017, section 4.4) favours an estimate of 6.0%, by consideration of the QCA's estimates for the Ibbotson, Siegel, DDM and survey methods. I also favour consideration of the Wright method, which produces the highest result amongst the QCA's estimates, and therefore raises the unrounded median estimate.

My own views on the MRP are reflected in Lally (2014, section 5.6), and involve consideration of results from five methods: Ibbotson, Siegel, Wright, the DDM used by the QCA, and the average of the MRP estimates in valuation reports and the Fernandez survey. I also favour consideration of results from both Australia and a range of other markets due to the statistical imprecision in these estimates. In respect of the Australian results, the QCA (2016b, section 4.7) reports these as 6.4%, 5.5%, 9.2%, 7.0%, and 6.0% - 6.8% respectively. In respect of these surveys results, I favour an estimate from the bottom half of the QCA's distribution, because many survey participants may have already included imputation credits in their estimates and many of those who have not rely primarily upon historical data to form their estimate. I also favour use of an equally-weighted median. Applying these principles to the Australian results, the median is 6.4%. Finally, I also favour rounding to the nearest 1.0%, yielding an MRP estimate of 6.0%.

5. Conclusions

With the following exceptions, which do not affect the resulting estimates, I do not agree with the arguments raised by Aurizon or their consultants in support of a gamma of 0.25, an MRP of 7.0%, or the use of yields on ten-year government bonds for determining the risk-free rate within the first term of the CAPM.

Firstly, I concur with The Brattle Group that share repurchases should be allowed for in a DDM and that the QCA has not done so. However, there are data availability problems in doing so and the effect of allowing for this would be to raise the MRP estimate by less than 0.50%. The Brattle Group claims that the effect is 0.50% but does not demonstrate how it estimates the effect at 0.50%. The point is not significant because it would not change the median result amongst the QCA's estimates for the five methodologies.

Secondly, I concur with many of the criticisms raised by both Frontier and The Brattle Group concerning the Fernandez surveys. However, the surveys have the advantage of including results from a wide range of countries. Furthermore, desisting from using them would have no practical effect because the other type of survey evidence used by the QCA (valuation reports) yields almost identical estimates.

Thirdly, I acknowledge the conceptual argument raised by The Brattle Group in favour of matching the risk-free rate within the MRP to that used in the first term of the CAPM. However, this approach also has conceptual drawbacks and the best course of action is not clear-cut. Furthermore, even if the best course of action matched that favoured by The Brattle Group, the required correction to the MRP would be much smaller than claimed by The Brattle Group, and it would not change the median result amongst the QCA's estimates for the five methodologies.

My own views on these parameters are as follows. In respect of the risk-free rate used within the first term in the CAPM, and as with QCA, I favour that rate whose term matches that of the regulatory cycle so as to satisfy the NPV = 0 principle. In respect of the MRP, and again as with the QCA, I favour consideration of results from five methods: Ibbotson, Siegel, Wright, the DDM used by the QCA, and the average of the MRP estimates in valuation reports and the Fernandez survey. I also favour consideration of results from both Australia and a range of other markets due to the statistical imprecision in these estimates. In respect of the Australian results, the QCA's most recent estimates are 6.4%, 5.5%, 9.2%, 7.0%, and 6.0% - 6.8% respectively. In respect of these surveys results, I favour an estimate from the bottom half of the QCA's distribution, because many survey participants may have already included imputation credits in their estimates and many of those who have not rely primarily upon historical data to form their estimate. I also favour use of an equally-weighted median. Applying these principles to the Australian results, the median is 6.4%. I also favour rounding to the nearest 1.0%.

In respect of gamma, since the CAPM that is being used (the Officer version) assumes complete segmentation of national equity markets and this implies that all investors could use the credits, the natural choice for the utilization rate is 1 despite the empirical fact that many investors in Australian equities are foreigners who cannot use the credits. Furthermore, given that national equity markets are partly integrated, estimating the utilization rate at 1 seems to

be the only approach that leads to estimates of the cost of equity that will typically lie within the range arising under complete segmentation and complete integration of national equity markets. If this approach to estimating the utilization rate is not adopted and foreign investors are recognized when estimating it, they ought to be also recognized in defining the utilization rate and therefore the natural estimate is the proportion of Australian equities held by local investors. With this approach, I favour the use of all equity rather than only listed equity and therefore an estimate for the utilization rate of at least 0.60. I consider the redemption rate for imputation credits to be a very unsatisfactory estimator, and the use of market prices to be an even less satisfactory estimator. In respect of the distribution rate, I favour estimating it using financial statements for a subset of high value firms and an estimate of this type is at least 0.83 for the top 20 such firms. So, with a utilization rate of 1 and a distribution rate of at least 0.83, the resulting estimate of gamma is at least 0.83. Alternatively, with a utilization rate of at least 0.60 and a distribution rate of at least 0.83, the resulting estimate of gamma is at least 0.50.

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