REVIEW OF ARGUMENTS ON THE EQUITY RISK PREMIUM AND THE RISK-FREE RATE

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EXECUTIVE SUMMARY

This paper reviews recent arguments by SFG and Frontier on behalf of the DBP relating to estimating the allowed cost of capital for the DBNGP. In respect of the equity risk premium for the DBNGP, SFG and Frontier employ a method for estimating it that suggests that the ERAWA's estimate is too low. However, after correcting errors in their analyses, the resulting ranges for the equity risk premium of the DBNGP do not conflict with any estimate by the ERAWA and are also very wide. Furthermore, these results arise from estimated ranges for the elasticity coefficient in SFG's model and the illiquidity allowance in the DBNGP's cost of debt that are likely to be too narrow, and estimated ranges for the default probability and the expected recovery rate in this debt that are highly speculative. These bands of uncertainty are not an esoteric issue. If any of these four parameters are incorrectly estimated, the equity risk premium for the DBNGP will also be incorrectly estimated using SFG's approach. In view of all this, I do not consider that this methodology contributes much to the existing approaches to estimating the equity risk premium.

In respect of the risk-free rate, none of the further three arguments raised by Frontier support regulatory use of the ten-year rather than the (usually lower) five-year risk-free rate under a five-year regulatory cycle. Firstly, Frontier's belief that regulatory resetting of prices more frequently couldn't lower the cost of capital is not supported by any evidence, it would be impossible to obtain empirical evidence on this matter, and consideration of two hypothetical and extreme cases demonstrates that the reset frequency does affect risk and therefore must affect the cost of capital. Secondly, Frontier's belief that risks associated with the value of the assets at the end of the regulatory cycle can't be reflected in the beta estimate, and therefore must be addressed by using the ten-year risk-free rate, is never explained nor is it demonstrated that use of the ten-year rate would provide the appropriate compensation for this unrelated issue even if compensation were warranted. Thirdly, Frontier's belief that the imposition of a five-year regulatory cycle raises the firm's refinancing risk, and hence its equity beta, and that this is not reflected in the ERAWA's estimate, and therefore must be addressed by using the ten-year risk-free rate, suffers from the same problems. In addition, it wrongly presumes that firms subject to such regulation would align their borrowing with the regulatory cycle and thereby incur material refinancing risk when the evidence is that firms instead adopt interest rate swap contracts so as to avoid this refinancing risk.

1. Introduction

The ERAWA is currently assessing a regulatory proposal for a five-year access arrangement from Dampier Bunbury Pipeline (DBP), relating to the Dampier Bunbury Natural Gas Pipeline (DBNGP) for the period 2016-2020. As a cross-check on its estimate of the cost of equity, DBP (2014, section 6) invokes a relationship between the costs of debt and equity based on the work of SFG (2014a), and argues that the 'current' DRP of 1.8% implies that the equity risk premium for the DBNGP (the product of beta and the MRP) must exceed 6.0%, which exceeds the ERAWA's estimate. In addition the DBP (2016, section 7) raises further arguments in support of a ten-year risk-free rate, arising from Frontier (2016c). This paper reviews both of these sets of arguments.

2. The Lower Bound on the Equity Risk Premium for the DBNGP

2.1 SFG's Arguments

SFG (2014a, para 86) invokes the following formula for the relationship between the expected returns on equity and debt:

$$E(R_e) - R_f = \Omega\left[E(R_d) - R_f\right] \tag{1}$$

where Ω is the elasticity of equity returns relative to debt returns (from Campello et al, 2008, equation 1).[1] SFG (2014a, paras 76-77) also invoke a formula for the elasticity from Schaefer and Strebulaev (2008):

$$\Omega = \frac{1}{\left(\frac{1}{\Lambda} - 1\right)\left(\frac{1}{L} - 1\right)} \tag{2}$$

where Δ is the derivative of equity value with respect to the value of the firm and L is the market leverage ratio. Using this formula, SFG (2014a, para 88) estimates this elasticity to be at least 6.0. In addition, with a DRP of 1.8% (the promised yield on debt net of the risk-free rate), SFG must deduct the allowance for expected default losses to obtain the expected

[1] SFG (2014a, para 68) appears to attribute the formula to Merton (1974), but the formula does not arise there or even derive directly from Merton's analysis. The most that can be said is that Merton (1974) is the seminal paper in this area.

rate of return on debt net of the risk-free rate. SFG (2014a, para 91) cites S&P in support of a default rate of 0.15% per year on BBB+ corporate bonds over the past 30 years, which implies a default rate of 1.5% at any point during the life of a ten-year bond. SFG (2014a, para 92) also cites S&P in support of an average recovery rate of 50% on BBB+ bonds that default. With a promised interest rate of 5.2%, SFG (2014a, para 93) argues that the expected rate of return on the bond is then 4.38% per year as follows:

$$E(R_d) = 0.985(0.052) + 0.015(0.50 - 1) = 0.0438 \tag{3}$$

Substitution of this figure of 4.38% into equation (1), along with the risk-free rate of 3.4% and the lower bound estimate for the elasticity of 6.0 yields a lower bound on the equity risk premium (ERP) for the DBNGP of 6.0% as follows:

$$E(R_e) - R_f \geq 6[.0438 - .034] = .06 \tag{4}$$

This contrasts with the estimate of 4.2% in the ERAWA's Guidelines (the product of an MRP of 6% and a beta of 0.7), which implies that the figure of 4.2% is too low.[2]

Frontier (2016a, section 4) updates these calculations as follows, using a ten-year swap rate of 2.98%, a ten-year DRP relative to swap of at least 2.50%, a recovery rate in the event of default of 50%, and a default rate per year of 0.24% for generic BBB rated debt. The latter figure implies a default rate of 2.37% over the life of a ten-year bond, whilst the first two figures imply a promised yield of at least 5.48%. Substitution into equation (3) yields

$$E(R_d) = 0.976(0.0548) + 0.024(0.50 - 1) = 0.0415 \tag{5}$$

Substitution of this into equation (4) along with a ten-year government bond yield of 2.87% then produces an ERP of at least 7.76%:

$$E(R_e) - R_f \geq 6[.0415 - .0287] = .0776 \tag{6}$$

[2] The ERAWA's current estimate is 5.32%, comprising a beta of 0.7 and an MRP of 7.6% (ERAWA, 2015, Appendix 4, page 89). However this is still less than SFG's lower bound.

Again, this is well above the ERAWA's (2015, Appendix 4, page 89) current figure of 5.32%.

2.2 ERAWA's Analysis and Frontier's Response

The ERAWA (2015, Appendix 4C) rejects SFG's analysis on five grounds. Firstly, the ERAWA claims that the Merton (1974), Campello et al (2008), and Schaefer and Strebulaev (2008) papers do not provide relevant results for assessing the link between the costs of debt and equity. In response, Frontier (2016a, section 3.2) argues that they are relevant. I am perplexed by the ERAWA's claim. Equation (1) does link the costs of debt and equity, and equation (2) permits estimation of one of the parameters in equation (1). The ERAWA may have meant that these papers do not focus upon the issue here, and they also state this, but the usefulness of equations (1) and (2) is not lessened by the attention given to other matters in the papers from which they are derived.

Secondly, the ERAWA argues that equation (1) above rests on specific assumptions and therefore is not generally valid, as acknowledged by Campello et al (2008). Frontier (2016a) does not comment on this claim. The claim is true and the most important assumption is one that is not even acknowledged by either SFG (2014a) or Campello et al (2008): that corporate bond prices are not affected by the inferior liquidity of corporate bonds relative to the risk-free rate.

Thirdly, the ERAWA cites Schaefer and Strebulaev (2008, page 1) in stating that structural models providing poor explanations of bond prices, because they are poor predictors of default and do not incorporate factors other than credit risk, which implies that equation (2) is not useful. In response, Frontier (2016a, section 3.2) cites Schaefer and Strebulaev (2008, page 1) in stating that, despite such limitations, these models provide good estimates of the elasticity coefficient in equation (1). Frontier's claim may be true and, if so, would be sufficient to justify using equation (2) to estimate the elasticity coefficient in equation (1). However, the ERAWA's point is true and it is relevant not to equation (2) but to the credibility of SFG's methodology, which ignores the impact of the illiquidity of corporate bonds (relative to the risk-free rate) on the DRP of corporate bonds.

Fourthly, the ERAWA argues that SFG's analysis assumes that debt and equity prices are determined in the same (integrated) market rather than being determined in segmented markets. In response, Frontier (2016a, section 3.3) argues that it is implausible that debt and equity in the same firm would be priced independently and inconsistently in segmented markets. I agree, but plausibility is secondary to the evidence. In particular, I am not aware of any evidence for inconsistent pricing and considerable evidence for consistent pricing. For example, Schaefer and Strebulaev (2008, section 5) find that bond returns are sensitive to returns on an equity index, a measure of volatility in equity returns, the return differential between large and small stocks, and the return differential between high and low book-to-market stocks, all of which have been found to be significant factors in equity returns.

Fifthly, the ERAWA argues that, as shown in SFG (2014a, Figures 1-3), the lower bound on SFG's elasticity coefficient for a ten-year bond is 7 rather than 6. In response, Frontier (2016a, section 3.4) accepts the point. I agree.

Lastly, the ERAWA argues that the MRP estimates implied by SFG's analysis are implausibly high as shown in ERAWA (2015, Table 43). For example, SFG (2014a, para 104) notes that the total cost of debt proposed by the DBP is at least 5.66% with a risk-free rate of 3.54%, which implies a DRP of at least 2.13%. Deducting SFG's estimate of the allowance for expected default costs of 0.82% (see section 2.1) yields an expected DRP of at least 1.31%, multiplication by the lower bound on the elasticity coefficient (7) produces an ERP for the DBNGP of at least 9.17%, and division by the equity beta estimate of 0.70 produces an MRP estimate of at least 13.1%, which is implausible. In response, Frontier (2016a, section 3.4) notes that their estimate of the equity beta is greater than 0.70 and therefore an estimate of the MRP that was consistent with it would be lower than the ERAWA's estimate. However, even using Frontier's (2016a, section 3.4) contemporaneous equity beta estimate of 0.91, the implied estimate for the MRP would be at least 10.1% and this contrasts with Frontier's contemporaneous MRP estimate of 7.61%. So, using a set of numbers that Frontier subscribes to, in the form of a DRP of at least 2.13%, an allowance for expected default losses of 0.82%, an elasticity coefficient of at least 7, and an equity beta of 0.91, the result is an estimate of the MRP of at least 10.1%, and this conflicts with Frontier's estimate of 7.61%.[3] Furthermore, these calculations inherent all of the deficiencies in SFG's analysis described above, most particularly the failure to allow for illiquidity in corporate bonds.

[3] Frontier also claims that some of the figures in ERAWA (2015, Table 43) are not at the same points in time. This claim does not relate to the numbers above.

2.3 Further Analysis

The errors in SFG's analysis shown in section 2.1 above are as follows. Firstly, the premiums shown in equation (1) relate solely to risk, and therefore only data that relates to risk can be inserted. However, even after deducting expected default losses from the DRP, part of the remainder is compensation for the inferior liquidity of corporate bonds relative to government bonds. This has to be deducted, but it hasn't, and doing it would reduce the lower bound on the equity risk premium for the DBNGP. Furthermore, there is a considerable body of literature on the DRP impact arising from the inferior liquidity of corporate bonds relative to the risk-free asset (government bonds), with Amihud et al (2005, section 3.3.2) providing a comprehensive survey. More recently, Almeida and Philippon (2007, Table II) summarise results from a number of papers, in which the proportion of the DRP due to the possibility of default ranges from 34% to 71% for BBB bonds (and the rest due to illiquidity). Furthermore, like SFG (2014a), Almeida and Philippon sought to estimate the probability of default from the DRP but (unlike SFG) they deducted out an estimate of the illiquidity premium. The same failure to account for illiquidity occurred in SFG (2014b) as discussed in Lally (2015a). In response to the latter, Frontier (2016b, para 85) claimed that "..if there are no defaults and the debt is held till maturity the debt holders are likely to earn the yield over the life of the asset." However, nothing in this (uncontroversial) claim contradicts anything in the analysis in Lally (2015a, section 2.2). The reasonable conclusion to draw is that Frontier does not dispute the point that the cost of debt contains an illiquidity allowance, and that it constitutes a significant proportion.

Secondly, SFG (2014a, para 89) alleges that the DRP here is for a BBB+ bond. By contrast, Frontier (2016a, section 4) treats the bonds as BBB (as opposed to wider BBB), by using default rate data for BBB bonds from S&P (2015, Table 9) for the period 1980-2014. Neither is correct; as discussed in ERAWA (2014, para 827), the relevant bonds are in the wider BBB range. This is important because credit rating affects the default probability.

Thirdly, SFG's (2014a) calculation shown in equation (3) involves combining a default probability over a ten-year period (1.5%) with other parameter values that relate to a one-year period. Frontier (2016a, section 4) makes the same error. The correct calculation should have used the default probability for a one-year period.

Fourthly, since the bond in question is a ten-year one, the relevant default probability is that over the next ten years (converted to an annual equivalent) rather than the default probability over the next year, and the former figure will be larger than the latter because it reflects the fact that a BBB bond with a residual life of ten years is highly likely to be re-rated over the next ten years ("ratings migration") and, whilst rating changes are approximately as likely to be up or down, the increase in the default probability from a downgrade is much higher than the reduction in the default probability from an upgrade. S&P (2015, Table 21) shows that, after a one-year period, a (wider) BBB bond has an 85% chance of remaining there, a 4% chance of an upgrade to A, a 4% chance of a downgrade to BB, a 1% chance of a downgrade to B, and a 6% chance of being unrated. So, ignoring the unrated bonds, the upgrade probability approximates the downgrade probability. However, as shown in S&P (2015, Table 24), the default probabilities over a one-year period for these wider rating categories are 0.07% for A, 0.20% for BBB, 0.76% for BB, and 3.88% for B. So, the adverse impact on default from a downgrade dwarfs the favourable impact on default from an upgrade. So, unsurprisingly, S&P (2015, Table 24) shows that the default rate for a bond rated BBB is 0.20% over the subsequent one-year period whilst the average over the subsequent ten years is 0.41% per year, with the latter figure derived from the default rate of 4.06% over the subsequent ten-year period (S&P, 2015, Table 24) converted to an annual rate as follows:

$$(1-.0041)^{10}=1-.0406$$

Fifthly, SFG claim that an ERP for DBNGP of 6.0% as shown in equation (4) is a lower bound. However, this calculation requires lower bounds for both the expected return on debt and the elasticity, and only the latter parameter estimate is a lower bound.

Sixthly, as argued by the ERAWA (2015, Appendix 4C) and accepted by Frontier (2016a, section 3.4), the lower bound on the elasticity coefficient for a ten-year bond is 7 rather than 6.

I now consider the effect of correcting these six errors in SFG's analysis. This will require upper and lower bounds on relevant parameter values, and midpoints. In respect of the elasticity parameter for a ten-year bond, SFG (2014a, Figures 1-3) suggest a range of 7-9 with a midpoint of 8. This band is too narrow because it assumes that the model used to generate the parameter estimate is correct, and this may not be the case. So, more plausible bounds would be wider but I have no basis for quantifying this. In respect of the illiquidity issue, Almeida and Philippon (2007, Table II) summarise results from a number of papers, in which the proportion of the DRP due to the possibility of default ranges from 34% to 71% for BBB bonds (and the rest due to illiquidity). So, the proportion due to illiquidity ranges from 29% to 66%. The important feature of any estimate for the illiquidity allowance is that it matches that embodied in the current observed cost of debt for the DBNGP. So, any of these estimates from 29% to 66% are plausible. Furthermore, these estimates presume that the allowance proportion does not change over time, and this is unlikely. Thus, the band of uncertainty is even wider than 29% to 66%. So, a conservative estimate for the illiquidity allowance embodied in the current cost of debt for the DBNGP is 29% to 66% of the DRP.

In respect of the default probability on a ten-year bond with a wider BBB rating, using data from 1981-2014, S&P (2015, Table 24) estimates the default rate at 4.06% over ten years (by averaging over the lifetime default rates on ten year bonds identified in 1981, the lifetime default rates on ten-year bonds identified in 1982, etc), and 4.06% over ten years is equivalent to 0.41% per year as shown earlier. Using data for the slightly longer period 1970-2010 and in respect of Baa bonds (equivalent to S&P's BBB), Moody's (2011, Exhibit 34) gives a higher default rate over ten years of 4.90%, which averages 0.50% per year. In addition, using data for the much longer period 1920-2010, Moody's (2011, Exhibit 33) gives an even higher default rate over ten years of 6.90%, which averages 0.71% per year. As with the illiquidity allowance, the crucial feature of any estimate of the default probability is that it matches that embodied in the current cost of debt for the DBNGP. Clearly, the historical data set preferred by investors when setting the current cost of debt for the DBNGP is indeterminable. Furthermore, it is unlikely that any of these sample means would be used by investors without some correction for present economic conditions because the default probability over the next ten years is likely to depend upon current economic conditions. This is apparent from Moody's (2011, Exhibit 42), which provides the default rates on ten-year Baa bonds over the following ten years for each cohort year from 1970 to 2000. In particular, the extreme cohort cases are not randomly distributed but clustered in time in accordance with economic conditions, with the worst four cohorts (with default rates of over 7.5%) concentrated in the 1981-86 period and three of the four best ones (under 3.0%) concentrated in the early 1990s. Further evidence comes from Xiang et al (2013, Figure 2), who present average prices for five-year CDS contracts (which are forecasts of the default rate over the next five years) on a set of US investment grade bonds (mostly A and BBB in approximately equal numbers) over the 2005-2009 period, and these cross-company average CDS prices range from 0.3% to 3.6% over that period.[4] Taking account of all this, a plausible estimate of the default probability over the next ten years that is embodied in the current ten-year BBB cost of debt for the DBNGP would lie within a fairly wide range. A (speculative) estimate of the band is from 3% to 8% over a ten-year period, with a midpoint of 5% (equivalent to 0.3% per year to 0.8% per year, with a midpoint of 0.5%).

Finally, in respect of the expected recovery rate, the estimate of 50% used by SFG (2014a, para 92) and drawn from S&P is merely one amongst competing sample means. For example, SFG (2014b, footnote 47) estimates the average recovery rate at 43% based upon Moody's data for 1982-2013, whilst Mora (2012, Table 1) estimates it at 39% using Moody's data from 1970-2008. As with the illiquidity allowance and the default probability, the crucial feature of any estimate of the expected recovery rate is that it matches that embodied in the current cost of debt for the DBNGP. So, any of these estimates from 39% to 50% are plausible. Furthermore, all of these estimates presume that the expected recovery rate is fixed over time, and this is unlikely to be the case. The annual recovery rates shown in Mora (2012, Chart 2) show significant clustering of extreme results during good and bad economic conditions, implying that the expected future recovery rate depends upon current economic conditions. This widens the band of uncertainty beyond the figures from 39% to 50%. Furthermore, the appropriate estimate for a particular firm will also depend upon the country (due to variation in legal systems), the industry within the country, and the firm within the industry. In respect of industry variation, Mora (2012, Table 1) presents results that vary from 25% for Finance to 57% for Utilities (although the sample sizes are too small in some cases to place much reliance on industry variations).[5] In respect of firm level variation, Jankowitsch et al (2012, Table 4) finds that numerous firm-level factors are statistically significant in explaining recovery rates even in conjunction with industry dummy variables. All of this suggests that the band of uncertainty for the expected recovery rate embodied in

[4] By way of comparison, S&P (2015, Table 24) estimates the average default rate on A and BBB bonds over a five-year period at 0.57% and 1.95% respectively, for an average of about 1.3%. The corresponding averages for Moody's (2011, Exhibit 33 and 34) are 1.4% using 1970-2010 data and 2.1% using 1920-2010 data respectively. So, the range in the CDS prices is wider than the average default rate figures of 1.3% to 2.1%, which is unsurprising because each of the cross-company average CDS prices is at a point in time rather than averaged over time. Thus the two types of data are compatible.

[5] With only 22 observations for Utilities, and a standard deviation of 32%, the 95% confidence interval for the estimated recovery rate for this industry is from 44% to 72%.

the current cost of debt for the DBNGP would be very large. A (speculative) estimate of the band is from 25% to 75% with a midpoint of 50%.

I now reassess the calculations in SFG (2014a), involving a promised yield of 5.2% comprising a risk-free rate of 3.4% and a DRP of 1.8%. Modifying equation (3) to reflect a midpoint estimate for the default probability of 0.5% per year yields an expected rate of return on the debt of 4.92% as follows:

$$E(R_d) = 0.995(0.052) + 0.005(0.50 - 1) = 0.0492$$

Deducting the illiquidity allowance of 0.86% (the midpoint DRP proportion of 48% applied to the DRP of 1.8%) leaves an expected rate of return on debt sans illiquidity of 4.06%. Substitution of this into equation (1) with a midpoint elasticity estimate of 8 yields a midpoint estimate for the ERP of the DBNGP of 5.3% as follows:

$$E(R_e) - R_f = 8[.0406 - .034] = .053$$

In respect of the lower bound, I use an upper bound default probability of 0.8%, a lower bound recovery rate of 25%, an upper bound illiquidity allowance of 1.2% (66% of 1.8%), and a lower bound elasticity coefficient of 7. The result is a lower bound on the ERP of 0. Finally, in respect of the upper bound, I use a default probability of 0.3%, a recovery rate of 75%, an illiquidity allowance of 0.52%% (29% of 1.8%), and an elasticity coefficient of 9. The result is an upper bound on the ERP of 10.7%. This range from 0 to 10.7% does not conflict with any estimate by the ERAWA referred to earlier.

Repeating the process for Frontier's (2016a) analysis, shown in section 2.1, and differing only in using a promised yield of 5.48% comprising a risk-free rate of 2.87% and a DRP of 2.61%, the bounds on the ERP are 1.7% to 15.8% with a midpoint estimate of 8.7%. Again, this range does not conflict with any estimate by the ERAWA referred to earlier. Furthermore, since the DRP in Frontier's (2016a) analysis (2.61%) differs significantly from that in SFG's (2014a) analysis (1.8%), at least one of the illiquidity allowance, default probability or expected recovery rate must have changed and therefore using the same estimates for all three parameters in both cases would be wrong. This further illustrates the need for wide bands of uncertainty on these three parameter estimates.

In conclusion, after correcting for the errors in the analysis by SFG (2014a) and Frontier (2016a), the resulting ranges for the ERP of the DBNGP do not conflict with any estimate by the ERAWA and are also very wide. Furthermore, these results arise from estimated ranges for the elasticity coefficient and the illiquidity allowance that are likely to be too narrow, and estimated ranges for the default probability and the expected recovery rate that are highly speculative. These bands of uncertainty are not an esoteric issue. If any of these four parameters are incorrectly estimated, the ERP for the DBNGP will also be incorrectly estimated using SFG's approach. In view of all this, I do not consider that this methodology contributes much to the existing approaches to estimating the ERP.

3. Further Arguments on the Risk-Free Rate

SFG (2014c) raised a number of arguments in support of regulatory use of a ten-year risk-free rate when prices are reset five yearly, on behalf of DBP. These arguments were critiqued by Lally (2015b, section 2). In response, Frontier Economics (2016c) has presented three further arguments on this point, on behalf of DBP. Before considering these points, I reiterate my views on this matter. The appropriate choice of risk-free rate term could differ for the costs of debt and equity. In respect of the cost of equity, the appropriate choice can be determined by considering a firm without debt. In assessing the appropriate action by the regulator, the fundamental principle to be satisfied is that the present value of the net cash flows to equity holders should equal their initial investment (Marshal et al, 1981). If this principle is not satisfied then equity holders are either over or under compensated by the regulator. Following this principle Schmalensee (1989) shows that the risk-free rate term must match the regulatory cycle. In doing so, he assumes that the only source of uncertainty is over future interest rates. Lally (2004) obtains the same result even after allowing for additional sources of uncertainty, in the form of cost and demand shocks, and risks arising from depreciation methods in which the aggregate depreciation allowed by the regulator may diverge from the cost of the assets. These additional sources of uncertainty impart uncertainty to the value of the regulatory assets at the end of the regulatory cycle and should be dealt with through an appropriate risk premium (which is consistent with the CAPM).

In the presence of debt, Lally (2007) shows that satisfaction of the NPV = 0 principle requires that the regulator continue to match the risk-free rate term to the regulatory cycle (for both the allowed cost of equity and debt) and also that the firm chooses borrowing arrangements whose effective risk-free rate has the same term. Firms can do so by engaging in staggered borrowing of any desired term (to deal with refinancing risk) and entering interest rate swap contracts to align the risk-free rate component of their cost of debt to the regulatory cycle. For example, if firms choose to borrow (staggered) for ten years, they swap each borrowing arrangement into floating rate debt at the time of borrowing and then (at the beginning of each regulatory cycle) swap these floating rates into the five-year fixed rate to match the regulatory cycle. Furthermore, firms would have strong incentives to act in this way so as to match the risk-free rate component of their borrowing costs to the rate allowed by the regulator (hedging). In addition, assuming they borrow for a longer term so as to minimise refinancing risk, undertaking these swaps reduces their expected borrowing costs because the expected five-year rates over the next ten years are less than the current ten-year rate.

I now turn to Frontier's three arguments.[6] Firstly, Frontier (2016c, paras 26, 54, 60-61, 84c) argues that regulation should seek to replicate the prices that would prevail in a comparable competitive market, that comparable businesses are capital intensive with long lived assets, that their cost of capital reflects this, and therefore embodies the long-term (ten-year) risk-free rate, and the same should apply to the regulated situation. Mindful that Lally (2015b, section 2) argues that regulation affects risk and hence the cost of capital of a business according to the frequency of price setting and other decisions, in which case the cost of capital prior to regulation is not relevant to the situation once regulation is introduced, Frontier (2016c, paras 11, 46, 61-64) argues instead that the price resetting frequency does not affect risk, and in support of this claims that there is considerable variation in the price setting frequency in unregulated markets without consequent changes in the cost of capital. This argument has multiple shortcomings. In particular, nothing in it contests the importance of the NPV = 0 principle and the analysis in Lally (2004) showing that this requires a regulatory risk-free rate term to match the regulatory cycle. Furthermore, despite claiming that there is considerable variation in the price setting frequency in unregulated markets without consequent changes in the cost of capital, no empirical evidence is presented by

[6] These three arguments are summarized in the Conclusions section of their paper but the treatment of them is intertwined and dispersed across their paper.

Frontier in support of this claim. Furthermore, such evidence would be unattainable; it would require a laboratory experiment in which the analyst objectively measured the cost of capital in a particular market characterised by a particular price resetting frequency, changed the reset frequency and then objectively measured the cost of capital again. However the allowance for risk in the cost of capital cannot be measured, only estimated almost certainly with error, and even Frontier (2016c, para 52) recognises this.

Furthermore, consideration of two extreme and hypothetical cases is sufficient to demonstrate that the price setting frequency affects risk, and therefore must affect the cost of capital, as follows. Suppose the output prices of a monopolist supplying an essential service were set once and never reset, demand subsequently changed dramatically and remained at that level indefinitely, and all costs were fixed with respect to output and time. The result would be that the cash flows of the firm would dramatically change and then remain at the new level. By contrast, with frequent resetting of the price to reflect prevailing demand, such uncertainty about future cash flows would be eliminated. Thus, the firm faces vastly more risk in the first scenario, due to the regulatory choice of the price resetting frequency. So long as the demand shock was systematic, the cost of capital in the first scenario would be higher than in the second. By contrast, customers would be protected from price shocks in the first scenario but not in the second. Of course, these cases are extreme and hypothetical but if risk differs significantly across these two cases it is plausible that it does so in less extreme cases where empirical assessment would be inconclusive.

Secondly, Frontier (2016c, sections 3 and 4) addresses proofs (as in Lally, 2004) showing that satisfaction of the NPV = 0 principle implies that the appropriate risk-free rate to be used by a regulator in resetting prices every five years is the five-year rate, as with a floating rate bond in which the interest rate is reset every five years at the prevailing five-year rate. SFG (2014c, section 2) argued that such proofs are only valid if the value of the regulatory assets at the end of the regulatory cycle was known with certainty. In response, Lally (2015b, page 18) noted that this assumption does not underlie the proof in Lally (2004) and that any risks associated with the value of the regulatory assets at the end of the regulatory cycle should be addressed through an appropriate risk premium rather than by use of a longer-term risk-free rate. In response, Frontier (2016c, paras 57, 80) acknowledges the possibility that "..the equity risk premium increases to account for this risk.." but argues that there is "…no reason to think that the ERA (2015) does incorporate any such risks over the asset base into the allowed return to equity holders or that the ERA could incorporate this risk into an equity beta estimate in the future." Subsequently, Frontier (2016c, para 84) also states that "..there is no realistic prospect that this consideration has taken place in the ERA decision or that it could take place given the imprecision in estimation of risk to equity holders." So, the ten-year risk-free rate should be used. However, by acknowledging that an increased risk premium could address such risks, Frontier are clearly indicating that regulatory use of the five-year risk-free rate is conceptually correct but that one should instead use the ten-year risk-free rate because the beta estimate somehow doesn't reflect the risks associated with the regulatory asset value at the end of the regulatory cycle. This is a striking admission about the conceptual correctness of the five-year risk-free rate, contrary to all previous submissions by SFG on this question, and SFG is Frontier by an earlier name. For example, SFG (2012, section 3) argues that regulatory use of a five-year risk-free rate in a five-year regulatory scenario will only satisfy the NPV = 0 principle if the expectations hypothesis for the term structure of interest rates holds. Subsequently, SFG (2014c, section 2) argues that this result instead requires that the value of the regulatory assets at the end of the cycle is certain. Now, finally, Frontier accepts that the result will hold so long as any risks associated with the value of the regulatory assets at the end of the cycle are addressed through an appropriate risk premium. Furthermore, Frontier could not claim that the risk premium point is new, because it appears in Lally (2004).

The problems with Frontier's argument are twofold. In particular, Frontier fails to explain why the beta estimates considered by the ERAWA, and obtained in the usual way through time-series regression, would not reflect these risks associated with the value of regulatory assets so long as the comparators are appropriately chosen and, if they are not, the solution to the problem lies there rather than in use of the ten-year risk-free rate. Frontier's uncontroversial claim that beta estimates are imprecise doesn't address this problem; if the risks associated with the cycle end asset values raise the true beta, the expected value of the estimate will rise. The actual estimate might be less than this, but it is equally likely to be higher, and this risk does not warrant use of a different risk-free rate. Similarly, MRP estimates are imprecise, but Frontier does not argue that a higher risk-free rate should be used in compensation for this. Furthermore, even if the beta estimate used by the ERAWA somehow failed to reflect this increased risk associated with the value of the regulatory assets at the end of the regulatory cycle, Frontier fails to quantify the beta impact of these risks so as to justify using a risk-free rate that is 0.50% larger than the conceptually correct five-year rate of 1.96%. For example, if the beta impact of these risks is 0.04 and the MRP is 6%, the appropriate increase in the cost of capital would be 0.24% rather than the 0.50% arising by using the ten-year risk-free rate.

Thirdly, Frontier (2016c) argues that imposition of a five-year regulatory cycle raises the firm's refinancing risk, and hence its equity beta, this is not reflected in the ERAWA's estimate, and therefore the ten-year risk-free rate should be used in compensation. This is a particular type of risk associated with the value of the regulatory assets at the end of the cycle, and therefore a special case of Frontier's second argument described above. The details of this argument are as follows. Frontier (2016c, para 65) claims that the normal practice for a capital intensive business would be to issue debt with a long term to maturity, and subsequently identifies this as ten years (para 80). Frontier (2016c, para 81) adds that unregulated firms act in this way in order to deal with refinancing risk. Unstated, but uncontroversial, is that firms also stagger the borrowing. Thus, ten-year debt properly staggered would require refinancing only 10% of it per year. All of this is uncontroversial. In addition, Frontier (2016c, para 65) claims that regulatory resetting of prices at a particular frequency would prompt firms to borrow for that same period in order to hedge the interest rate risk. Since the regulatory cycle in question here is five years, Frontier is alleging that firms subject to a five-year regulatory cycle would switch from ten-year staggered debt to five-year debt, and this five-year debt could not be staggered if the purpose of switching to five year debt was to hedge the interest rate risk. Subsequently, Frontier (2015c, para 71) claims that firms would then be exposed to greater refinancing risk. Finally, Frontier (2016c, para 77) claims that the increased refinancing risk raises the equity beta but that this increase is not reflected in the ERAWA's beta estimate because estimates are imprecise.

Since this argument is a special case of Frontier's second argument described above, it inherits both deficiencies in Frontier's argument outlined above. Furthermore, and most importantly, the private sector firms (from whom the beta estimates are drawn) that have been subject to five-year regulatory cycles (and resetting of the allowed cost of capital in accordance with the prevailing rate) have *not* shortened their borrowing term to five years and aligned it with the regulatory cycle, because doing so would dramatically increase their refinancing risk. Instead, the evidence is clearly that they have adopted interest rate swap contracts in order to hedge the base rate component of the cost of debt. In particular, the AER (2009, pp. 152-154) in summarizing submissions from private-sector entities concludes that such hedging is standard practice amongst private-sector firms, Citipower et al (2013, page 7) states that they do hedge in this way, AGN (2015, page 45) do likewise, and SFG (2015, footnotes 2 and 32) refers to SA Power Networks, Citipower, Powercor, JGN, JEN, and United Energy as practitioners of this method. In addition, SFG (2012b, page 24) claim that it is standard practice amongst small to medium sized businesses to hedge in this way, NERA (2014, page 22) make the same claim, and Jemena (2013, page 19) claims that it is standard practice amongst Network Service Providers in general. Furthermore, amongst these papers, the only references to the hedging being done at any level less than 100% are 80 – 100% by Envestra (AER, 2009, pp. 152-154), 98 – 100% by SP Ausnet (AER, 2009, pp. 152-154), and 80 – 100% by AGN (2015, page 45). So, all of this evidence indicates that hedging at or close to 100% is and has been the general practice in the private sector when the allowed cost of debt is periodically reset in accordance with the prevailing rate. Frontier can hardly resist this evidence because much of it comes from SFG, which is Frontier by an earlier name.

Remarkably, Frontier (2016c, para 81) seems to recognise that use of these derivative contracts is an alternative to aligning borrowing with the regulatory cycle, but immediately repeats the claim that refinancing risk would be raised by the imposition of a five-year regulatory cycle. However, if interest rate swap contracts were used, they would augment rather than displace the firm's existing 'physical' borrowing arrangements. Since the refinancing risk arises from the 'physical' borrowing arrangements, it would be unaffected by the use of the swap contracts. Thus, Frontier's recognition that derivatives could be used contradicts their belief that refinancing risk would still rise. The mechanics of the process are thus. A firm that borrows for ten years and staggers it would require refinancing only 10% of the debt per year. If regulatory price resetting every five years prompted the firm to instead borrow for five years and align it with the regulatory cycle, this would involve rolling over 100% of the debt every five years, thereby dramatically increasing its refinancing risk as claimed by Frontier. However, if the firm instead used interest rate swap contracts, it would continue to borrow for ten years (at a ten-year fixed-rate) with staggering, swap each such fixed-rate borrowing into floating rate debt of the same term at the time of borrowing, and then swap all of the floating rate debt into five-year fixed-rate debt at the beginning of each regulatory cycle. These swaps would *not* change the firm's refinancing risk because the ten-year fixed-rate borrowing arrangements originally entered into by the firm would still be in force. So, given the adoption of swaps, there would be no increase in refinancing risk and therefore no increase in the equity beta arising from increased refinancing risk. Interestingly, SFG (2012b, pp. 23-25) recognises that material refinancing risk arises if the borrowing term is matched to the regulatory cycle but not when swaps are used. So, Frontier's current belief that refinancing risk arises regardless of whether the firm aligns the debt to the regulatory cycle or uses swaps contradicts SFG's (2012b) beliefs, and SFG is Frontier by an earlier name.

In summary, none of the further three arguments raised by Frontier support regulatory use of the ten-year rather than the (usually lower) five-year risk-free rate under a five-year regulatory cycle. Firstly, Frontier's belief that regulatory resetting of prices more frequently couldn't lower the cost of capital is not supported by any evidence, it would be impossible to obtain empirical evidence on this matter, and consideration of two hypothetical and extreme cases demonstrates that the reset frequency does affect risk and therefore must affect the cost of capital. Secondly, Frontier's belief that risks associated with the value of the assets at the end of the regulatory cycle can't be reflected in the beta estimate, and therefore must be addressed by using the ten-year risk-free rate, is never explained nor is it demonstrated that use of the ten-year rate would provide the appropriate compensation for an unrelated issue even if compensation were warranted. Thirdly, Frontier's belief that the imposition of a five-year regulatory cycle raises the firm's refinancing risk, and hence its equity beta, and that this is not reflected in the ERAWA's estimate, and therefore must be addressed by using the ten-year risk-free rate, suffers from the same problems. In addition, it wrongly presumes that firms subject to such regulation would align their borrowing with the regulatory cycle and thereby incur material refinancing risk when the evidence is that firms instead adopt interest rate swap contracts so as to avoid the refinancing risk.

4. Conclusions

This paper has sought to review recent arguments by SFG and Frontier on behalf of the DBP relating to estimating the allowed cost of capital for the DBNGP. In respect of the equity risk premium for the DBNGP, SFG and Frontier employ a method for estimating it that suggests that the ERAWA's estimate is too low. However, after correcting errors in their analyses, the resulting ranges for the equity risk premium of the DBNGP do not conflict with any estimate by the ERAWA and are also very wide. Furthermore, these results arise from estimated ranges for the elasticity coefficient in SFG's model and the illiquidity allowance in the

DBNGP’s cost of debt that are likely to be too narrow, and estimated ranges for the default probability and the expected recovery rate in this debt that are highly speculative. These bands of uncertainty are not an esoteric issue. If any of these four parameters are incorrectly estimated, the equity risk premium for the DBNGP will also be incorrectly estimated using SFG’s approach. In view of all this, I do not consider that this methodology contributes much to the existing approaches to estimating the equity risk premium.

In respect of the risk-free rate, none of the further three arguments raised by Frontier support regulatory use of the ten-year rather than the (usually lower) five-year risk-free rate under a five-year regulatory cycle. Firstly, Frontier’s belief that regulatory resetting of prices more frequently couldn’t lower the cost of capital is not supported by any evidence, it would be impossible to obtain empirical evidence on this matter, and consideration of two hypothetical and extreme cases demonstrates that the reset frequency does affect risk and therefore must affect the cost of capital. Secondly, Frontier’s belief that risks associated with the value of the assets at the end of the regulatory cycle can’t be reflected in the beta estimate, and therefore must be addressed by using the ten-year risk-free rate, is never explained nor is it demonstrated that use of the ten-year rate would provide the appropriate compensation for this unrelated issue even if compensation were warranted. Thirdly, Frontier’s belief that the imposition of a five-year regulatory cycle raises the firm’s refinancing risk, and hence its equity beta, and that this is not reflected in the ERAWA’s estimate, and therefore must be addressed by using the ten-year risk-free rate, suffers from the same problems. In addition, it wrongly presumes that firms subject to such regulation would align their borrowing with the regulatory cycle and thereby incur material refinancing risk when the evidence is that firms instead adopt interest rate swap contracts so as to avoid this refinancing risk.

REFERENCES

AER, 2009. *Final Decision Electricity and Distribution Network Service Providers Review of the WACC Parameters* (www.aer.gov.au).

AGN, 2015. *Attachment 10.1 Rate of Return 2016/17 to 2020/21 Access Arrangement Information* (www.aer.gov.au).

Almeida, H., and Philippon, T., 2007, 'The Risk-Adjusted Cost of Financial Distress', *The Journal of Finance*, 62, pp. 2557-2586.

Amihud, Y., Mendelson, H., and Pedersen, L., 2005. 'Liquidity and Asset Prices', *Foundations and Trends in Finance*, 1, pp. 269-364.

Campello, M., Chen, L., and Zhang, L., 2008. 'Expected Returns, Yield Spreads, and Asset Pricing Tests', *Review of Financial Studies*, 21 (3), pp. 1297-1338.

Citipower, Powercor Australia, and SA Power Networks, 2013. *Response to the AER's Draft Rate of Return Guideline*, submission to the AER (www.aer.gov.au).

DBP, 2013. *ERA Draft Rate of Return Guidelines*: *DBP Response 23 September 2013* (www.erawa.com.au).

____ 2014. *Proposed Revisions*: *DBNGP Access Arrangement 2016-2020 Regulatory Period Rate of Return Supporting Submission 12* (www.erawa.com.au).

____ 2016. *Proposed Revisions DBNGP Access Arrangement*: *2016-2020 Access Arrangement Period Supporting Submission 56* (www.erawa.com.au).

ERAWA, 2014. *Draft Decision on Proposed Revisions to the Access Arrangement for the Mid-West and South-West Gas Distribution System* (www.erawa.com.au).

________ 2015. *Draft Decision on Proposed Revisions to the Access Arrangement for the Dampier to Bunbury Natural Gas Pipeline* (www.erawa.com.au).

Frontier Economics, 2016a. *Consistency Between the Return on Equity and the Return on* Debt: Response *to the DBP Draft Decision*, report prepared for DBP (www.erawa.com.au).

________________ 2016b. *Response to the Economic Regulation Authority on the Cost of Equity*, report prepared for DBNGP (www.erawa.com.au).

________________ 2016c. *Response to the Economic Regulation Authority on Estimation of the Risk Free Rate*, report prepared for Goldfields Gas Transmission (www.erawa.com.au).

Jankowitsch, R., Nagler, F., and Subrahmanyam, M., 2012. 'The Determinants of Recovery Rates in the US Corporate Bond market', working paper, New York University (http://people.stern.nyu.edu/msubrahm/papers/Recovery.pdf).

Jemena, 2013. *Submission from Jemena Limited to the AER*, submission to the AER (www.aer.gov.au).

Lally, M., 2004, 'Regulation and the Choice of the Risk Free Rate', *Accounting Research Journal*, vol. 17 (1), pp. 18-23.

________ 2015a. *Review of SFG's Approach to Estimating the Cost of Equity*, report prepared for the ERAWA (www.erawa.com.au).

________ 2015b. *Review of Arguments on the Term of the Risk-Free Rate*, report prepared for the ERAWA (www.erawa.com.au).

Merton, R., 1974. 'On the Pricing of Corporate Debt: The Risk Structure of Interest Rates', *Journal of Finance*, 29, pp. 449-470.

Marshal, W., Yawitz, J. and Greenberg, E., 1981. 'Optimal Regulation Under Uncertainty', *The Journal of Finance*, vol. 36, pp. 909-22.

Moody's, 2011. *Corporate Defaults and Recovery Rates 1920-2010* (http://efinance.org.cn/cn/FEben/Corporate%20Default%20and%20Recovery%20Rates,1920-2010.pdf).

Mora, N., 2012. 'What Determines Creditor Recovery Rates', (https://www.kansascityfed.org/publicat/econrev/pdf/12q2Mora.pdf).

NERA, 2014. *Return on Capital of a Regulated Electricity Network*, report prepared for TransGrid (www.aer.gov.au).

Schaefer, S., and Strebulaev, I., 2008. 'Structural Models of Credit Risk are Useful: Evidence from Hedge Ratios on Corporate Bonds', *Journal of Financial Economics*, 90, pp. 1-19.

SFG, 2012a. *Term to Maturity of the Risk Free Rate Estimate in the Regulated Return* (www.qca.org.au).

____ 2012b. *Rule Change Proposals Relating to the Debt Component of the Regulated Rate of Return*, report prepared for AEMC (www.aemc.gov.au).

____ 2014a. *The Relationship Between the Required Return on Debt and Equity*, report prepared for DBP NGP Ltd (www.erawa.com).

____ 2014b. *Cost of Equity for the Goldfields Gas Pipeline*, report prepared for Goldfields Gas Transmission.

____ 2014c. *The Term of the Allowed Return*, report prepared for DBP NGP Pty Ltd (www.erawa.com.au).

____ 2015. *Return on Debt Transition Arrangements under the NGR and NER*, report prepared for JGN, JEN and United Energy (www.aer.gov.au).

Schmalensee, R., 1989. 'An Expository Note on Depreciation and Profitability Under Rate-of-Return Regulation', *Journal of Regulatory Economics*, vol. 1, pp. 293-298.

S&P, 2015. *2014 Annual Global Corporate Default Study and Rating Transitions* (https://www.nact.org/resources/2014_SP_Global_Corporate_Default_Study.pdf).

Xiang, V., Fang, V., and Chng, M., 2013, 'Transmigration Across Price Discovery Categories: Evidence from the US CDS and Equity Markets', *Journal of Futures Markets*, 33, pp. 573-599.