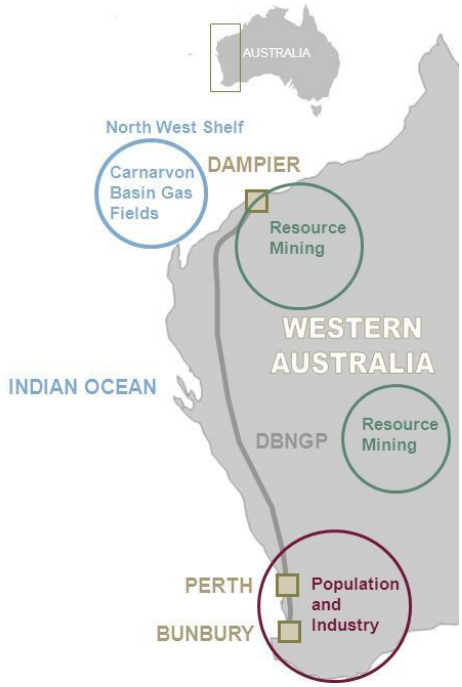
Proposed Revisions
DBNGP Access Arrangement

2016 – 2020 Access Arrangement Period
Supporting Submission: 56

Date Submitted: 24 February 2016

DBP Transmission (DBP) is the owner and operator of the Dampier to Bunbury Natural Gas Pipeline (DBNGP), Western Australia's most important piece of energy infrastructure.

The DBNGP is WA's key gas transmission pipeline stretching almost 1600 kilometres and linking the gas fields located in the Carnarvon Basin off the Pilbara coast with population centres and industry in the south-west of the State



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Executive Summary

This submission responds to the Draft Decision made by the Economic Regulation Authority in respect of DBP for its AA4 period (which was intended to cover the period from 1 January 2016 to 1 January 2020); specifically in reference to arguments pertaining to rate of return. While the majority of this submission focusses on the differences between DBP and the ERA in respect of the return on equity, the submission also covers the following areas:

- Cost of debt.
- Gamma – the value of imputation credits.
- Inflation.
- The term of the risk-free rate.
- Gearing.

The results for the overall rate of return which have been included in DBP's Amended Proposal are shown in the table below.

Element	Value
Cost of debt	5.59%
Cost of Equity	10.84%
Gearing	0.6
WACC	7.69%

For inflation, we adopt a forecast of 1.91 percent, and for gamma, we adopt a value of 0.25. The former reflects an acceptance of the ERA's amendment to DBP's original approach to inflation (we are now exactly in-line with the ERA's approach) and the latter reflects our original position from our Original AA Proposal. In respect of the term of the risk-free rate, DBP agrees with the ERA's use of the five-year BBSW in respect of debt, finding it is the most appropriate rate given the hybrid approach the ERA proposes to use, but still believes that the ten-year risk-free rate is the most appropriate rate to use for the return on equity, as it best reflects the totality of long-run risks faced by equity holders.

The major point of difference between DBP and the ERA is in respect of the method for determining a return on equity that will contribute to the allowed rate of return objective as required by Rule 87(5) of the NGR. There are two central issues of difference between DBP and the ERA in respect of the return on equity. The first of these relates to the problem of bias which is inherent in certain models, with consequential impacts upon the outputs produced by such models, including the ERA's chosen model for estimating the return on equity, the Sharpe-Lintner CAPM. DBP considers that the ERA has not made a proper assessment of its approach to that issue and has based its conclusions on superficial reasoning and irrelevant evidence, while ignoring relevant evidence. Further in at least one respect, the ERA has failed to make a proper application of the evidence which it has itself produced in relation to the identification or quantification of bias within its chosen model. Had it given proper regard to the evidence available to it, we believe the ERA would have reached a different conclusion.

The second issue relates to the need to test outputs. Nowhere does the ERA test whether the outcome of its approach to estimating the return on equity meets Rule 87(5). DBP does this through the use of its model adequacy test. That there is a need to test outcomes as well as inputs is a fundamental aspect of the regulatory framework in the NGL and NGR. This is explained in Chapter Four of this submission.

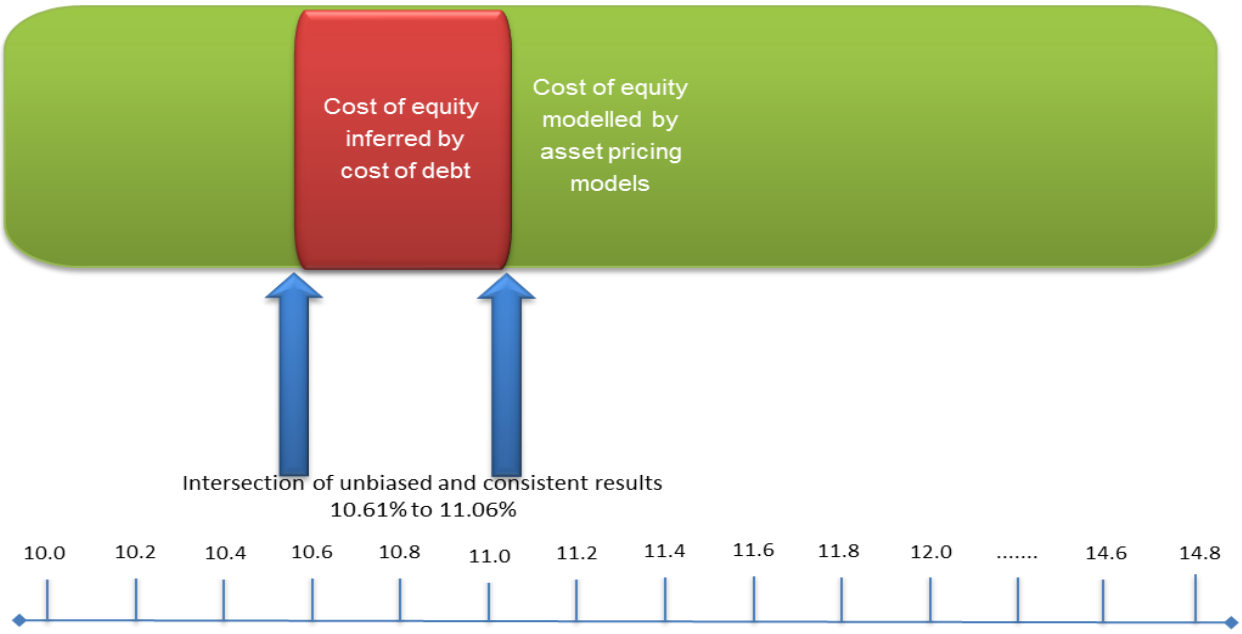
Since DBP does not accept the ERA's rejection of our approach, DBP has maintained substantially the same approach to determining the return on equity from its AA Proposal, that is, the approach of using its "model adequacy test" to consider the outputs of models giving rise to a range of unbiased outcomes; model results that neither systematically overstate or systematically understate actual returns. The data used for that testing has been updated. Further, DBP has followed the ERA's suggestion that it may implement an alternative way of testing outputs from models (the use of cross validation). That cross validation testing supports DBP's previous findings in relation to the testing of bias for models used to estimate the return on equity.

The updated range of unbiased outcomes from DBP's model adequacy test is shown in the table below.

	beta	Risk free rate	Market risk premium	Return on equity
25th percentile estimate of betastar	1.00	2.87	7.03*	9.9
99th percentile estimate of betastar	1.70	2.87	7.03	14.82

*Source: DBP analysis * note that this is equivalent to the ERA's use of a 7.6 percent MRP given that it measures the MRP from the five-year risk-free rate and we use the ten-year rate. The difference between the two rates during our observation period was 57 bps.*

As in the AA Proposal, DBP then considers information from the cost of debt via a consistency test, which serves to narrow the range of unbiased outcomes to a set which is unbiased and consistent. This gives rise to the range shown in the figure below.



The mid-point of the range of unbiased and consistent results is 10.84 percent, and DBP believes this is the best estimate of the return on equity.

In its Draft Decision the ERA proposes a return on equity of 7.28 percent. This is not a direct "apples with apples" comparison, as the ERA's illustrative results in the Draft Decision were drawn directly from the ATCO Final Decision and reflect market conditions in March 2015, whereas DBP's illustrative results are drawn from November 2015.

However, there are further reasons why the ERA's estimate is not consistent with the best estimate it could make given the evidence upon which it has chosen to rely. Specifically:

- The ERA originally supported its choice for the range of beta in the Guidelines (Guidelines Explanatory Statement, p. 190.) of 0.5 to 0.7 by noting that the 95 percent confidence interval around its estimates of beta was between 0.3 and 0.72, and then, using regulatory judgment, chose the upper end of that range in order to account for the downward bias of the SL-CAPM. However, according to the ERA's own calculations for the period until October 2015, the 95 percent confidence interval shifted from 0.3 to 0.72, to 0.41 to 0.81. Notwithstanding the change in the limits of the range, the ERA still has chosen a beta of 0.7 when applying the methodology from the Guidelines to the DBNGP Draft Decision. While the ERA continues to use regulatory judgment to choose the value of beta and its reason for exercising such judgement is to adjust for the potential downwards bias of the SL-CAPM, the ERA has shifted, therefore, from choosing a point which is two basis points below the top of the 95th confidence interval, to one which is 11 basis points below this upper limit. If a value for beta were to be set at two basis points below the upper limit of the new range, it would be 0.79.
- Evidence collected by CEG suggests that the underlying data informing beta has undergone a "structural break" (ie – the older data do not reflect the new reality) and thus that estimating beta on three years, rather than five years of data is likely to be more reliable. The most recent

estimate of beta (from a value-weighted portfolio) using three years of data and not adjusting for the downward bias of low beta stocks is 0.95.

- The ERA adjusts beta for the downward bias using the "theoretical implications" of the Black CAPM, but does not apply actual empirical information from the Black CAPM because estimates of the zero-beta premium (the element of the Black CAPM which captures the downward bias) are varied. However, even if one takes the smallest value of the zero-beta premium that the ERA itself calculates and thus adopts the most conservative view of downward bias in the SL-CAPM informed by the Black CAPM, joining this with the ERA's current median estimate of beta results in a bias-adjusted beta of 0.88, not 0.7.

The consequences of the ERA making appropriate use of its own information, without changing its overall methodology, and without accepting either the model adequacy or consistency tests (or indeed any testing of model outputs at all) that DBP has proposed are shown in the table below.

Beta evidence	Beta estimate	Return on equity estimate
ERA current approach	0.7	7.62%
2bps below top of new range of confidence interval	0.79	8.3%
ERA betastar	0.88	8.99%
Shorter estimation period	0.95	9.52%

Source: DBP analysis. Note that all estimates assume an MRP of 7.6 percent and a risk-free rate of 2.3 percent. That is, the five-year risk-free rate and the market risk premium relative to the five-year risk-free rate.

In respect of the cost of debt, DBP and the ERA are much more closely aligned with the exception of:

- The cost of debt raising and hedging, which we believe the ERA has under-estimated, by around nine basis points.
- The new issue premium, which we believe the ERA has ignored.
- DBP's use of capex weighting for the different tranches of debt (forward-looking only), which results in a difference of principle but, since DBP plans no capital investment above the threshold proposed for the implementation of capex weight during the AA4 period, no difference in practical outcomes.

DBP has accepted the substantive elements of the ERA's proposed approach to the cost of debt, being its hybrid approach, its approach to estimating the debt risk premium (though we use R, not Excel) and its choice of the relevant risk-free rate. Bringing all this together gives a cost of debt estimate of 5.592 percent, being:

- The five year BBSW of 2.46 percent.
- The ten-year debt risk premium of 253.57 bps
- Hedging costs of 14.8 bps.
- Debt raising costs of 17.84 bps.
- A new issue premium of 27 bps.

Table of Contents

1. INTRODUCTION....1
2. OVERVIEW OF DBP'S POSITION IN THE AA PROPOSAL....4
3. THE ERA'S DRAFT DECISION....11
4. THE LAW AND ECONOMICS OF THE NGL AND NGR IN DETERMINING THE ALLOWED RATE OF RETURN....16
5. OVERVIEW OF DBP'S RESPONSE TO THE DRAFT DECISION AND AMENDED AA PROPOSAL....24
6. RETURN ON EQUITY – DETAILED DISCUSSION....31
7. TENOR OF THE RISK-FREE RATE - DETAILED DISCUSSION....67
8. INFLATION AND GEARING – DETAILED DISCUSSION....69
9. GAMMA – DETAILED DISCUSSION....71
10. RETURN ON DEBT – DETAILED DISCUSSION....73
11. CALCULATING DBP'S WEIGHTED AVERAGE COST OF CAPITAL....85
12. BIBLIOGRAPHY....103

APPENDIX A: DEPARTURES FROM AND ADDITIONS TO THE GUIDELINES....106
APPENDIX B: FRONTIER - RESPONSE TO THE ECONOMIC REGULATION AUTHORITY ON ESTIMATION OF THE RISK FREE RATE....107
APPENDIX C: FRONTIER - CONSISTENCY BETWEEN THE RETURN ON EQUITY AND THE RETURN ON DEBT: RESPONSE TO THE DBP DRAFT DECISION....108
APPENDIX D: AN APPROPRIATE REGULATORY ESTIMATE OF GAMMA: RESPONSE TO THE DBP DRAFT DECISION....109
APPENDIX E: DBP CAPEX WEIGHTING MODEL....110
APPENDIX F: CEG - ESTIMATING BETA TO BE USED IN THE SHARPE-LINTNER CAPM....111
APPENDIX G: HOUSTONKEMP - EVALUATING FORECASTS: RESPONSE TO THE ERA'S DRAFT DECISION ON PROPOSED REVISIONS TO THE ACCESS ARRANGEMENT FOR THE DAMPIER TO BUNBURY NATURAL GAS PIPELINE 2016 – 2020....112
APPENDIX H: HOUSTONKEMP - THE BLACK CAPM: RESPONSE TO THE ERA'S DRAFT DECISION ON PROPOSED REVISIONS TO THE ACCESS ARRANGEMENT FOR THE DAMPIER TO BUNBURY NATURAL GAS PIPELINE 2016 – 2020....113
APPENDIX I: ESQUANT - REVIEW OF ERA CROSS-VALIDATION APPROACH: A REPORT PREPARED FOR DBP....114
APPENDIX J: ESQUANT – DRP PACKAGE....115
APPENDIX K: DAA – REVIEW OF STATISTICAL ASPECTS OF CAPITAL ASSET PRICING MODEL 116
APPENDIX L: CONFIDENTIAL LIST OF BONDS USED AND THEIR YIELDS....117

List of Tables

TABLE 1: SUMMARY OF DBP WACC POSITION IN ORIGINAL AA PROPOSAL 4
TABLE 2: ERA DRAFT DECISION RATE OF RETURN PARAMETERS 11
TABLE 3: DBP PROPOSED ACTUAL INFLATION – 2011 TO 2015 29
TABLE 4: DBP PROPOSED FORECAST INFLATION – 2016 TO 2020 29
TABLE 5: SL-CAPM NO INTERCEPT IN MODEL AND PREDICTIONS 52
TABLE 6: SL-CAPM WITH INTERCEPT IN MODEL AND PREDICTIONS 53
TABLE 7: GAINS FROM GAMING THE CAPEX WEIGHTS WITH ANNUAL REVIEW OF FORECAST CAPITAL SPEND 78
TABLE 8: GAINS FROM GAMING THE CAPEX WEIGHTS – WITH FIVE-YEARLY REVIEW 79
TABLE 9: HEDGING AND DEBT-RAISING COSTS FROM DBP'S ISSUES PAPER SUBMISSION 80
TABLE 10: MODEL ADEQUACY TEST RESULTS – ERA SLCAPM 86
TABLE 11: MODEL ADEQUACY TEST RESULTS – 99TH PERCENTILE BETA SL-CAPM 86
TABLE 12: MODEL ADEQUACY TEST RESULTS – BLACK CAPM 87
TABLE 13: MODEL ADEQUACY TEST RESULTS – FAMA FRENCH MODEL 87
TABLE 14: MINCER-ZARNOWITZ TEST RESULTS 88
TABLE 15: MODEL ADEQUACY TEST RESULTS – 99TH AND 25TH PERCENTILE BETASTAR RESULTS 90
TABLE 16: MEAN SQUARED ERROR OF FORECAST ERRORS – ALL MODELS 90
TABLE 17: MONTH AHEAD 10-FOLD, LOOCV AND TIME SERIES CROSS VALIDATION – DETAIL FOR PORTFOLIO ONE (METHOD B) 95
TABLE 18: YEAR AHEAD 10-FOLD, LOOCV AND TIME SERIES CROSS VALIDATION – DETAIL FOR PORTFOLIO ONE (METHOD B) 95
TABLE 19: UPDATED BETA ESTIMATES FOR THE BEE – ORIGINAL SAMPLE SET 97
TABLE 20: UPDATED BETA ESTIMATES – ERA DRAFT DECISION APPENDIX 4A(II) SAMPLE SET 98
TABLE 21: UPDATED BETASTAR ESTIMATES FOR THE BEE 98
TABLE 22: UPDATED UNBIASED ESTIMATES OF THE RETURN ON EQUITY 99
TABLE 23: TEN YEAR YIELDS FOR THE BEE 100
TABLE 24: ALTERNATE BETA ESTIMATES AND THEIR EFFECT ON RETURN ON EQUITY 102

List of Figures

FIGURE 1: ERA RETURN ON EQUITY PROCESS 7
FIGURE 2: UNBIASED AND CONSISTENT ESTIMATES OF THE COST OF EQUITY 10
FIGURE 3: BETA ESTIMATES FOR US FIRMS 44
FIGURE 4: DEBT AND EQUITY RETURNS THROUGH TIME 46
FIGURE 5: ROLLING 3 AND FIVE-YEAR BETAS 65
FIGURE 6: MONTH AHEAD 10-FOLD, LOOCV AND TIME SERIES CROSS VALIDATION – ALL PORTFOLIOS (METHOD B) 93
FIGURE 7: YEAR AHEAD 10-FOLD, LOOCV AND TIME SERIES CROSS VALIDATION – ALL PORTFOLIOS (METHOD B) 94
FIGURE 8: UNBIASED AND CONSISTENT RESULTS FOR THE COST OF EQUITY 101

List of Boxes

BOX 1: THE ERA'S JUDGEMENT AND THE ATCO FINAL DECISION 62
BOX 2: DBP'S PROPOSED APPROACH TO THE COST OF DEBT 75
BOX 3: FIVE YEAR RISK-FREE RATES IN DEBT AND TEN YEAR RISK-FREE RATES IN EQUITY 83

1. INTRODUCTION

1.1 On 22 December 2015, the Economic Regulation Authority (**ERA**) made its draft decision (**Draft Decision**) in relation to the full access arrangement proposal filed by DBNGP (WA) Transmission Pty Ltd (**DBP**) on 31 December 2014 (**Original AA Proposal**).

1.2 The Draft Decision indicates that the ERA:

(a) is not prepared to approve the Original AA Proposal; and

(b) requires 74 amendments to the Original AA Proposal in order to make the access arrangement proposal acceptable to the ERA.

1.3 The Draft Decision also fixes a period for amendment of and/or addition to the Original AA Proposal (**revision period)**, which revision period expires on 22 February 2016.

1.4 On 22 February 2016, pursuant to Rule 60 of the NGR, DBP submitted the following documents which make up the amended access arrangement proposal (**Amended AA Proposal**):

(a) Amended Proposed Revised Access Arrangement; and

(b) Amended Proposed Revised Access Arrangement Information.

1.5 Rule 59(5)(c)(iii) of the NGR requires the ERA to allow at least 20 business days from the end of the revision period for submissions to be made (in relation to both the Draft Decision and the Amended AA Proposal). The ERA has advised that interested parties are able to make submissions on the ERA's Draft Decision up until 4:00pm (WST) 22 March 2016.

1.6 While DBP has submitted to the ERA that the Amended AA Proposal contains the information that the NGA (which includes the WA National Gas Access Law text (**NGL**) and the National Gas Rules (**NGR**) requires to be included in order to enable it to be approved by the ERA, DBP also advised that it will be filing the following supporting submissions that explain and substantiate the amendments and additions in the Amended AA Proposal that have been made to address various matters raised in the Draft Decision:

(a) Submission 50 – Amended AA Proposal

(b) Submission 51 – Response to Pipeline Services Amendments

(c) Submission 52 – Response to Terms and Conditions Amendments

(d) Submission 53 – Response to Opening Capital Base Amendments

(e) Submission 54 – Response to Forecast Capital Expenditure Amendments

(f) Submission 55 – Response to Forecast Operating Expenditure Amendments

(g) Submission 56 – Response to Rate of Return Amendments

(h) Submission 57 – Response to Other Tariff Related Amendments

(i) Submission 58 – Response to Other Non-Tariff Related Amendments

1.7 In this Submission 56, DBP makes submissions in respect of three amendments required by the Economic Regulation Authority (ERA) in respect of rate of return issues, in Appendix 4 of its Draft Decision (**DDA4** – with all of its appendices and sub-appendices) on rate of return and Appendix 5 (DDA5) on gamma. The amendments are below.

Required Amendment 6

DBP must amend the inflation assumptions in its proposed revised access arrangement to reflect the values in Table 7(Authority Actual Inflation for AA3) and Table 8 (Authority Forecast Inflation for AA4) of this Draft Decision.

Required Amendment 14

The Authority requires that the rate of return be estimated consistent with the method used to develop the estimates set out in Table 42 (Rate of return for the Draft Decision) of this Draft Decision. The *indicative* nominal post tax rate of return for 2016 is 6.02 per cent. This estimate needs to be updated for the Final Decision. The Authority requires that DBP nominate, as soon as practicable, the averaging period for 2016 to be used in estimating the rate of return for the Final Decision.

The Authority requires an annual adjustment to be applied to the debt risk premium to be incorporated in each subsequent tariff update during the fourth access arrangement period. The first annual update will apply for the tariff variation for the 2017 calendar year, and should be determined based on the automatic formula set out in Appendix 4G of this Draft Decision. The resulting annual adjustment to the rate of return should be incorporated in the Annual Tariff Variation.

The Authority requires that DBP nominate, as soon as practicable, the averaging periods for each annual update applying for 2017, 2018, 2019 and 2020. The averaging periods for each year must be a nominated 40 trading days in the window 1 June to 31 October in the year prior to the relevant tariff variation, which will allow estimation of the updated DRP for inclusion in the relevant annual tariff variation. The nominated 40 trading day averaging period for each of the four years do not need to be identical periods, only that they occur in the period 1 June to 31 October in each relevant year, and are nominated prior. The nominated averaging periods for the annual updates will remain confidential.

For each annual update for 2017, 2018, 2019 and 2020, the Authority will estimate the updated rate of return following the relevant annual averaging period and then notify DBP of the outcomes as soon as practicable. Following that notice, DBP is required to respond on any issues as soon as practicable, in order to allow the updated estimate to be finalised prior to submission by DBP of its proposed annual tariff variation within the required timeframe.

Required Amendment 15

DBP is required to adopt a gamma of 0.4.

1.8 The topics from these amendments that are covered by this submission are:

(a) Return on equity

(b) The risk free rate – in particular its tenor.

(c) Gearing

(d) Inflation

(e) Gamma

(f) Return on debt

1.9 The structure of this submission is therefore as follows. Chapter Two of this report provides a high-level overview of DBP's position in relation to each of these rate of return matters in the Original AA Proposal, and Chapter Three then provides a similarly high-level overview of the response by the ERA in the Draft Decision in respect of each of these issues. Chapter Four provides the legal and economic basis for the position DBP has taken in response to the ERA's Draft Decision, and Chapter Five provides the summary of our response on each of the issues above. Chapters Six through Ten then provide the detail of our response on each point, with:

(a) Chapter Six addressing our detailed response in respect of the return on equity; this is the most substantial chapter in this report, as it is where we and the ERA have the greatest differences in our viewpoint.

(b) Chapter Seven addresses our detailed response on the tenor of the risk-free rate.

(c) Chapter Eight addresses our response to gearing and inflation; the two topics are relatively minor and are thus treated together.

(d) Chapter Nine addresses our detailed response in respect of gamma.

(e) Chapter Ten addresses our detailed response in respect of the return on debt.

1.10 Some 12 months have passed since DBP submitted its Access Arrangement Proposal (AA Proposal). In the interim, new data have emerged which warrant an update to the rate of return DBP has proposed. Thus, Chapter 11 applies the approaches to debt and equity summarised in Chapters Six and Ten, to produce an updated estimate of the overall WACC. This includes an empirical application of the version of the model adequacy test for equity suggested (but not implemented) by the ERA in its Draft Decision.

1.11 Amendment Six is uncertainly worded, but if the ERA means that it requests DBP to adopt its approach to the estimation of inflation, then DBP has accepted this amendment. Amendment 14 covers almost all matters relating to rate of return in a single amendment. DBP's response to that amendment is as follows:

(a) In relation to return on debt - DBP has largely accepted the ERA's required amendments, with only minor amendments or additions

(b) In relation to return on equity - DBP rejects the ERA's approach in favour of an update (for new data) to its approach from the Original AA Proposal.

(c) In relation to gamma - DBP rejects the major departure from the ERA's own *Rate of Return Guidelines* (ERA, 2013 – the Guidelines) that has led the ERA to an estimate of 0.4 for gamma. In so doing, DBP has maintained its own minor departure from the Guidelines, which leads to a gamma of 0.25.

1.12 As a final point, the paragraph numbering in DDA4 appears to have experience problems, with inconsistent and repeated paragraph numbers. For this reason, we have provided paragraph and page references throughout, though only for DDA4. These reflect the version of DDA4 made public on the ERA's website on December 22nd 2015; if the ERA issues a revision of its Draft Decision which corrects the problem with paragraph numbers, our paragraph references will no longer match the revised version, but the page numbers should still match.

2. OVERVIEW OF DBP'S POSITION IN THE AA PROPOSAL

2.1 In this section, we provide a brief overview of DBP's position as presented in the Original AA Proposal for the period 2016-2020 (**AA4**). Table 1 shows DBP's proposed weighted average cost of capital (**WACC**) in the Original AA Proposal, noting that the actual numbers are strongly driven by the risk-free rate prevailing at the time of the submission (3.54 percent for equity and 3.85 percent for debt).

Table 1: Summary of DBP WACC position in Original AA Proposal

Element	Value
Return on Equity (nominal post-tax)	11.71%
Return on Debt (nominal pre-tax)	6.13%
Gearing Ratio (Debt:Equity)	60:40
Nominal Vanilla WACC	8.36%

Source: DBP Original AA Proposal

2.2 In respect of gamma, the valuation of imputation credits, DBP proposed a value of 0.25, and for inflation, DBP proposed to use a different value each year based on a forecast of inflation for that year with values ranging from 2.04 to 2.30 percent.

2.3 The approach DBP took to derive the above figures for the indicative allowed rate of return were based on four guiding principles:

(a) Following the ERA's *Rate of Return* Guidelines (ERA 2013 – the **Guidelines**) wherever possible.

(b) Keeping information "live" through the process for as long as possible so that the final results are informed by all relevant information.

(c) Empirical assessment and cross checking of all modelled parameters and model outputs and a generally data driven process of analysis.

(d) Minimal use of judgment, restricted to the end-points of the analysis when no more can be learned considering relevant data.[1]

Approach to Gearing

2.4 In respect of gearing, DBP followed the ERA's Guidelines, and used the same level of gearing as the ERA itself uses, namely 60 percent debt to 40 percent equity.[2]

Approach to Risk-free rate

2.5 There are three issues in respect of the risk-free rate: the tenor of the risk-free rate to use, the instrument to use to calculate the risk-free rate and the averaging period.

2.6 As to the term, DBP submitted that the 5 year term proposed by the ERA for the calculation of the risk free rate in its Guidelines was inappropriate, the appropriate term being 10 years. In doing so, DBP submitted that the material relied on by the ERA did not contain assumptions reflective of the real world and were otherwise inconsistent with the rule 74 NGR in relation to the requirements for forecasts of estimates.[3]

1 Page ii of DBP's AA Proposal Submission 12
2 Para 3.2 on page 13 of DBP's AA Proposal Submission 12
3 See chapter 3, pages 13 to 18 of DBP's AA Proposal Submission 12.

2.7 In relation to the instrument to be used to calculate the risk free rate, in the Guidelines (paragraphs 92 to 95) the ERA had proposed to use the non-indexed five-year Commonwealth Government Security (CGS) for calculating the risk-free rate for both debt and equity, and to estimate this using the two bonds which straddle the end of the AA period and linear interpolation (essentially a weighted average, where the weight depends on the difference between the expiry date of the bond and the date of the end of the access period). DBP's proposal as to the instrument adopted the ERA's approach of using linear interpolation but instead of using just two bonds straddling the terminal date, DBP used all bonds, with decreasing rates the further the bond is from the target date.[4]

2.8 For the averaging period, DBP adopted the proposal advocated by the ERA in its Guidelines by basing its risk free rate on a 40 day averaging period.[5]

Approach to return on debt

2.9 The return on debt for each year of AA4 consists of two parts: the estimation of a return on debt at the outset of AA4, and (if relevant) the updating, each year of that return on debt through the course of AA4, as contemplated by Rules 87(9)(b) and 87(12) NGR.

2.10 DBP's approach to the return on debt, leading to an estimate of 6.13%, was outlined in Chapter Four (commencing page 13) of Submission 12 of the Original AA Proposal AA Proposal.

Approach to Return on debt at the outset of AA4

2.11 The approach followed by DBP to calculate the return on debt at the outset of AA4 is the sum of:

(a) the relevant risk-free rate,

(b) the debt risk premium and

(c) the cost of raising debt and hedging.[6]

2.12 In respect of the risk-free rate, rejecting the ERA's approach of using a five-year instrument, DBP proposed to use the ten-year Commonwealth Government Security (**CGS**)[7].

2.13 In respect of the debt risk- premium, the ERA's own approach changed considerably from the Guidelines to the ATCO Draft Decision which came out shortly before DBP filed its Original AA Proposal. DBP accepted the ERA's "revised bond yield approach as outlined in the ATCO Draft Decision (and in our own Draft Decision, pp 105 -15) which differed from the position the ERA had taken in its Guidelines[8].

2.14 DBP also used the same debt-raising and hedging costs the ERA used in its Guidelines.[9] Finally, DBP proposed to include a premium covering the actual difference between the yields required on bonds in the primary issuance market (where the benchmark efficient entity or "BEE" would actually issue debt) and the secondary markets which provide the data for estimating yield curves; the new issue premium.[10]

Approach to annual updating of return on debt

2.15 The return on debt annual updating approach proposed by the ERA was clearly in a state of flux between the Guidelines and the ATCO Draft Decision, with considerable opposition from

4 Page 80 of DBP's AA Proposal Submission 12
5 Page 81 of DBP's AA Proposal Submission 12.
6 Page 19 - 21 of DBP's 2014 AA Proposal Submission 12; then detailed discussion at pages 21- 23.
7 Page 20 - 24 of DBP's 2014 AA Proposal Submission 12, read with Chapter Three of that Submission in relation to the 10 year risk free rate.
8 Page 20 - 24 of DBP's AA Proposal Submission 12.
9 Page 21 of DBP's 2014 AA Proposal, Submission 12.
10 See Appendix H to Submission 12; see also page 21 of Submission 12.

stakeholders. The ATCO Draft Decision proposed an annual updating mechanism involving book-entry adjustments (rather than changes in price) during an AA period with a "wash-up" of unders and overs in the following period which was in DBP's view unworkable.

2.16 For this reason, DBP proposed to simply adopt the AER's approach to annual updating[11], even though DBP did not believe that it was optimal either. The AER's approach involves, broadly, a trailing average (over ten years) of the total cost of debt, with a transition period of ten years from the status quo to this trailing average.

Approach to the return on equity

2.17 DBP's approach to estimating the return on equity was outlined, primarily, in Chapter Five (commencing page 42) of DBP's Original AA Proposal Submission 12. The relevant cross-check for the return on equity, and then the overall allowed rate of return, were outlined in Chapter Six commencing page 82 of Submission 12. Following that process, DBP estimated an indicative return on equity of 11.71%.[12]

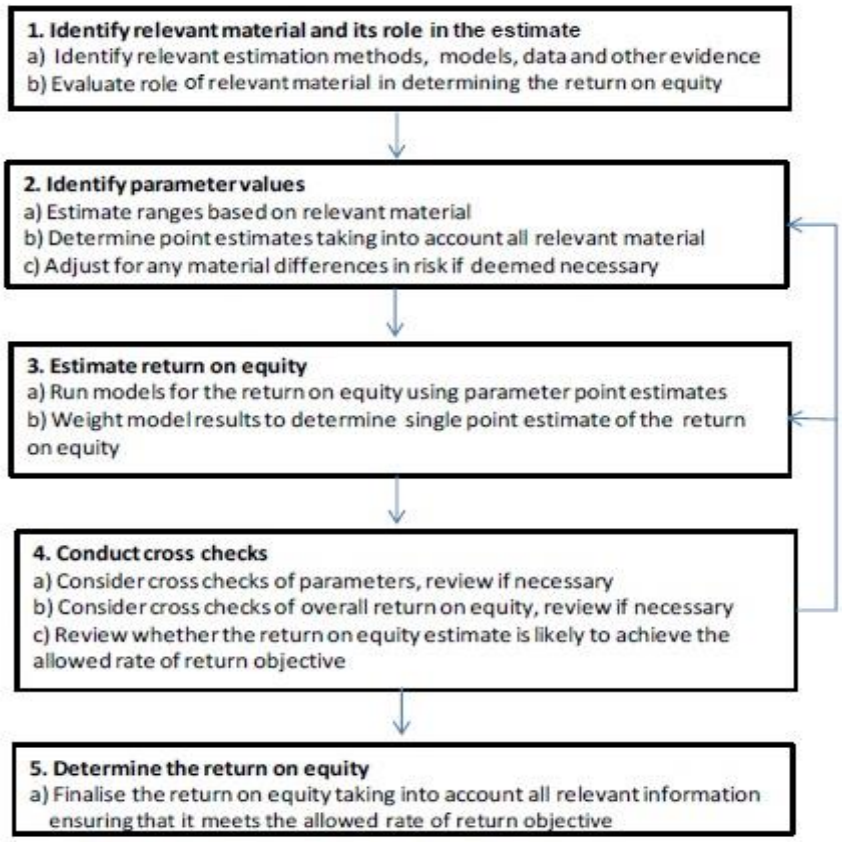
2.18 The core aspect of DBP's approach to the cost of equity which differentiates it from the approach in the Guidelines and subsequent applications of the Guidelines approach by the ERA was DBP's use of empirical analysis and testing to seek to determine and as necessary estimate the bias present in the outcomes generated from the application of relevant models (including the ERA's application of the preferred model from the Guidelines of the SL -CAPM). That empirical testing was performed using DBP's "model adequacy test[13].

The ERA's five stage process

2.19 DBP's general approach in relation to the steps to be adopted in determining the return on equity[14] followed the 5 stage process formulated by the ERA in the Guidelines, and shown in Figure 1.

11 See in particular pages 39 to 41 of DBP's 2014 AA Proposal Submission and the preceding discussion of the various approaches.
12 Page 89 of DBP's 2014 AA Proposal Submission 12.
13 See in particular the discussion of the model adequacy test commencing page 49 of Submission 12.
14 See in particular page 42 of the 2014 AA Proposal Submission 12 and more generally the approach adopted throughout Chapters Five and Six of that Submission.

Figure 1: ERA return on equity process



Source: ERA Guidelines, Figure 1

Stage 1: Identifying relevant material and the role of the material

2.20 In the Guidelines, the ERA, at Stage One of its five-stage process, asks whether asset-pricing models are, in principle, robust.

2.21 In its Original AA Proposal Submission 12, at Stage One DBP asks two questions in determining the relevance of a given asset pricing model and the role (if any) to be performed by that model in estimating the return on equity, namely[15]:

(a) Whether he model can be shown to have a firm grounding in the relevant economic theory. That is, models that are proposed must have a solid theoretical underpinning in the literature, and/or have a sufficiently robust history of estimation in the literature. If they do not, then the models might be formed purely through some data-mining exercise and be unlikely to lead to robust, reliable results.

(b) That the application of the model is demonstrably capable of contributing to the achievement of the Allowed Rate of Return Objective (**ARORO** of Rule 87(2)) and is consistent with the key principles and objectives which govern the process - the Revenue and Pricing Principles (**RPP**s) and the National Gas Objective (**NGO**). That is, the empirical outcomes produced by a model can be shown to have sound predictive abilities in respect of the return on equity, by reference to observable data over a lengthy period of time.

2.22 It was the introduction of this substantive second sub-step - the model adequacy test - which reflects the significant point of departure from the approach adopted by the ERA. While such

15 Pages 45/46 of DBP's 2014 AA Proposal Submission 12.

empirical testing was not contemplated by the ERA's Guidelines, step 5 of the Guidelines does envisage the performance of cross-checks of the return on equity and assessing whether the return on equity is likely to achieve the ARORO.[16]

2.23 In the Guidelines the ERA indicated an intention to use only the Sharpe-Lintner Capital Asset Pricing Model **(SL-CAPM)** after Stage One with other models being given a role in estimating the value for various parameters used in the SL-CAPM such as the market risk premium (**MRP**) (using the dividend growth model or **DGM**) and beta (the Black CAPM; in "theory" only). Given the evidence that the SL-CAPM, as implemented by the ERA, is statistically downward biased (a problem which the ERA acknowledged at paragraph 141 of its Guidelines), DBP submitted that it was necessary to take steps to correct the bias. Such steps require more than just the use of regulatory judgment, particularly where the ERA has conducted no adequate analysis to determine whether applying an outcome at the higher end of its preferred model would be sufficient to deal with the acknowledged downward bias of the ERA's preferred model.[17] It is, particularly, in that context that DBP advanced the proposal for the testing forecast returns against actual returns and the consistency of cost of debt and equity estimates – as manifested in the model adequacy test and the consistency tests (respectively) - in estimating the return on equity.

2.24 If only the first of the theoretical/principled criteria is met, then a given asset pricing model may still be relevant but its role should be confined to cross-checking the outcomes of models that pass both of the theoretical and the empirical criteria applied by DBP.[18] It is only models which meet both criteria that are used in stages 2 and 3 of the ERA's five stage process, as adopted by DBP.

2.25 DBP's substantive analysis as to whether the various asset pricing models are relevant in theory and principle, is contained at pages 47 to 49 of its Original AA Proposal Submission 12. DBP concluded[19] that each of the Black CAPM, Fama-French Model (**FFM**) and the SL-CAPM are relevant from a theoretical or principled perspective.

2.26 Next, DBP tested all models which it considers relevant in theory or principle (the SL-CAPM, the Black CAPM and the FFM – noting that the ERA disagree in respect of the robustness of this last model) using its empirical model adequacy test that involves the use of over 40 years of market data. DBP's analysis and the process by which it tested whether a given model is empirically sound or relevant, so as to determine the role which should be played by that model (if any) in determining the allowed rate of return, is outlined at pages 49 to 51, then 55- 73 of DBP's Original AA Proposal Submission 12. The SL-CAPM (both the variant of it as applied by the ERA and the traditional version of the model) and the FFM did not pass the test, but the Black CAPM did.[20]

2.27 The practical upshot of applying the model adequacy test is that DBP deviated from the Guidelines in estimating the return on equity; we did not use the variant of the SL-CAPM which the ERA proposed, and which is biased downwards.

2.28 DBP could have simply implemented the model which passes the model adequacy test, the Black CAPM. Instead, and due solely to its stated desire to adhere to the Guidelines as closely as possible[21], DBP made use of another variant of the SL-CAPM which uses empirical information from the Black CAPM to correct for the bias of the SL-CAPM. This is called the "betastar" model, which is described and then applied at pages 67 to 73 of DBP's Original AA Proposal Submission 12.

Stage 2: Identify parameter values

16 Page 46 of DBP's 2014 AA Proposal Submission 12.
17 Page 44 of DBP's 2014 AA Proposal Submission 12.
18 Page 46 of DBP's 2014 AA Proposal Submission 12.
19 See pages 49 and 60 of DBP's 2014 AA Proposal Submission 12.
20 Page 60 and 66/67 of DBP's 2014 AA Proposal Submission 12.
21 Page 67 of DBP's Submission 12. See also pages 60 and 82 in which it is acknowledged that DBP could have implemented Black CAPM directly, but for the desire to adhere to the Guidelines to the extent possible.

2.29 Having identified the versions of the betastar model (formed by choosing different points on the confidence interval of betastar) which can be shown to pass the model adequacy test, DBP proceeds to estimate the value of each of the parameters of the model. Whilst the model adequacy test is conducted using 40 years of monthly data from SPPR, the estimation of the appropriate return on equity for the next five years is undertaken using more recent data, with higher frequency, over a shorter time period.

2.30 In estimating the different parameters of the model, we maintain the approach of working in ranges, in particular, using different values for betastar based upon those which can be shown to pass the model adequacy test. This means that a range of model outcomes is estimates at Stage 3. Point estimates are used for the risk-free rate because it is a direct market estimate not subject to modelling uncertainty for the MRP because this is a point estimate provided by the ERA; we do not estimate the MRP ourselves.[22]

2.31 DBP estimates beta using five years of weekly data from Bloomberg in the same way that the ERA does, and indeed obtains very similar results. DBP then adjusts beta to form betastar using a simple algebraic manipulation of the Black CAPM equation.

2.32 In relation to the estimation of values for the other parameters:

(a) The market risk premium is estimated as the long-run historical average.

(b) The risk-free rate is estimated as the current 40-day average of the ten-year CGS in a process which is the same as that used by the ERA except that the ERA applies it to the five-year CGS.

Stage 3: Estimate return on equity

2.33 This is formed by applying the unbiased betastar estimates in the SL-CAPM framework (adding the product of betastar and the market risk premium to the risk-free rate). Doing so, DBP derived an initial range (but not yet a point estimate) for the return on equity of between 9.67% and 13.72%, based on the confidence interval for estimating betastar.[23]

Stage 4: Cross Checks

2.34 Rather than use judgement to choose a point in the range described above, DBP used information from the return on debt to narrow the range first, following its consideration of other cross-checks, as specified in Chapter Six of Submission 12.

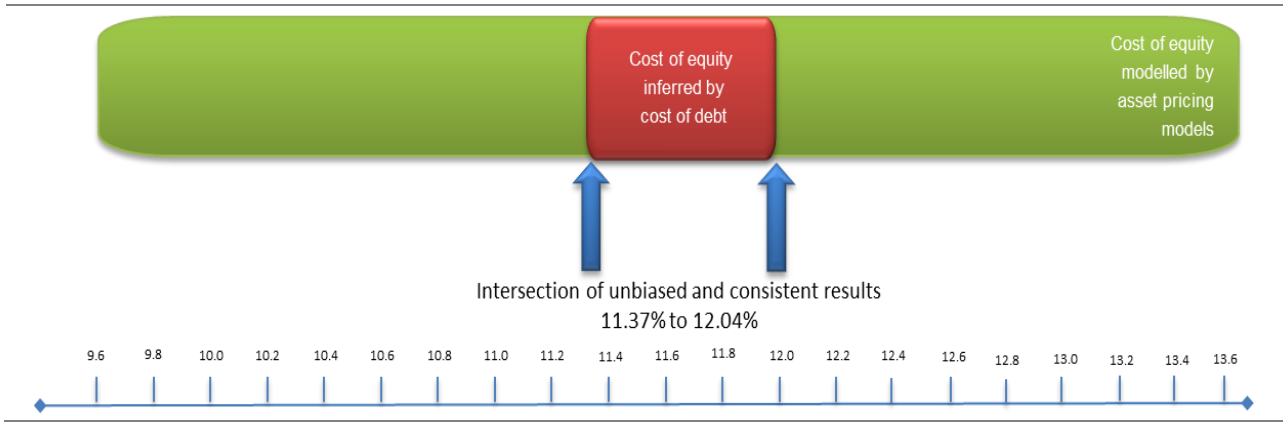
2.35 DBP contended that adopting this approach on cross checking was a necessary and appropriate consideration having regard to the requirements in Rule 87(5)(b) and (c) and Rule 87(11) which establish a regime, as emphasised by the Australian Energy Market Commission (**AEMC**) in the Rule Change Determination, which requires a consideration of the relationship between the return on debt and the return on equity.[24] The ERA also foreshadowed some sort of approach considering the relevant interrelationship in Explanatory Statement Appendix 29 to the Guidelines, but it never operationalised it. DBP did so.

2.36 DBP's approach for assessing the relative returns on debt and equity used options pricing theory and the fact that debt and equity are both options on the same underlying asset and will; thus have a relationship between their values.[25] Since data on the return on debt is more directly observable market data, this information provides an important cross check on the return on. The net result of

22 This is a pragmatic response. We could have considered the joint distribution of betastar, the MRP and the risk-free rate and found points on this confidence interval, but this would have been significantly more difficult, with little gain in terms of the robustness of results.
23 Page 80. of DBP's Submission 12.
24 Page 84/85 of DBP's Submission 12. See also the various statements of the AEMC from the Rule Change Determination, quoted on page 85.
25 Page 80 of DBP's Submission 12. See also Appendix L to Submission 12.

applying the consistency test was shown on page 89 of the Original AA Proposal, Submission 12 as follows:

Figure 2: Unbiased and consistent estimates of the cost of equity



Source: DBP Original AA Proposal, Figure 10

Stage 5: The return on equity

2.37 The final value for the return on equity, 11.71 percent, is simply the mid-point of the red range in Figure 2 above.[26]

Approach to Inflation

2.38 DBP's approach to inflation was also outlined in Chapter Seven.[27]

2.39 In summary, DBP used the same approach as the ERA, involving straddling indexed and non-indexed bonds and the Fisher equation, except that DBP:

(a) used multiple straddling bonds rather than just the two nearest the end of the AA4 period; and

(b) calculated inflation for each year during the AA4 period rather than just for the period as a whole.

Approach to Gamma

2.40 DBP's approach to gamma was set out in Chapter Seven of Submission 12.[28] That approach involved a relatively minor deviation from the Guidelines.

2.41 DBP used the same dividend drop-off methodology the ERA proposes in its Guidelines but, mindful of the econometric errors in the estimation processes the ERA uses to obtain the range of theta estimates in its own dividend drop-off study, we instead use best-practice work undertaken by SFG and commissioned by the Australian Competition Tribunal, which determines a value of theta, and thus gamma, towards the bottom end of the ERA's range, at 0.25, for gamma.

26 Page 89 of DBP's 2014 AA Proposal Submission 12.
27 Pages 96/97 of DBP's 2014 AA Proposal Submission 12.
28 Pages 90-96 of DBP's 2014 AA Proposal Submission 12.

3. THE ERA'S DRAFT DECISION

3.1 In the Draft Decision, the ERA did not accept the approach of DBP in the Original AA Proposal for estimating the rate of return and instead required its own numbers.[29] The ERA also concluded that DBP's approach and the resultant rate of return did not meet the NGL or the NGR.

3.2 For the most part, the ERA followed its own Guidelines, but it did introduce some changes in:

(a) The set of bonds used, the source of the risk-free rate, the cost of hedging and the means of calculating the debt risk-premium;

(b) the MRP in the return on equity; and

(c) The approach to updating the cost of debt each year.

3.3 These new approaches were consistent with the approach the ERA applied in the ATCO Final Decision of September ERA, 2015). So, the ERA's approaches now differ in certain respects from those outlined in its Guidelines.

3.4 This section briefly describes the ERA's position in respect of the following topics relevant to the estimation of the rate of return – gearing, inflation, the return on equity, the return on debt and gamma. The results the ERA obtains for the WACC in the Draft Decision compared with those proposed by DBP in its Original Proposal (to the extent DBP proposed a value for a particular parameter in its Original AA Proposal) are shown in Table 2 below.

Table 2: ERA Draft Decision rate of return parameters

Rate of Return parameter	Original AA Proposal	Draft Decision (as at 02 Apr 2015)
Nominal Risk Free Rate		1.96%
Real Risk Free Rate		0.06%
Inflation Rate		1.90%
Debt Proportion	60%	60%
Equity Proportion	40%	40%
Debt Risk Premium (10 year trailing average)		2.502%
5 year IRS (effective yield)		2.431%
Return on Debt; 5 year Interest Rate Swap Spread		0.47%
Return on Debt; Debt Issue Cost (0.125%) + Hedging (0.114%)		0.24%
Return on debt	6.13%	5.18%
Australian Market Risk Premium		7.60%
Equity Beta		0.7
Corporate Tax Rate	30%	30%
Franking Credit	25%	40%
Nominal After Tax Return on Equity	11.71%	7.28%
Nominal After Tax WACC	8.36%	6.02%
Real After Tax WACC	6.20%	4.04%

Source: Draft Decision, Table 42, p114

3.5 Note that part of the difference is driven by the roughly 150 bps difference in risk-free rates which is partly a function of the movement in the market value of that parameter over time (risk free rates were at record lows in March 2015) and partly a function of the fact that the ERA uses the five year, and DBP the ten-year CGS. Had the ERA made its Draft Decision using a risk-free rate from the same time period DBP used, it would have obtained a result of roughly seven percent, rather than 6.02 percent, meaning the real difference between DBP and the ERA is in the order of 136 bps.

29 Draft Decision pages 109 to 112; and Appendix 4 to the Draft Decision.

3.6 Although each of the matters going to make up overall WACC in the Draft Decision are addressed below, most substantial divergence - both in approach and in relation to the results derived from that approach - as between DBP's Original AA Proposal and the ERA's Draft Decision arose in relation to the return on equity.

ERA's Approach to Gearing

3.7 The ERA maintains a 60/40 gearing ratio, consistent with that of DBP (DDA4 para 114, p27) and of the Guidelines.

ERA's approach to the tenor and risk free rate

3.8 In respect of the tenor of the risk-free rate, the ERA maintained a term of five years for both debt and equity (DDA4, paras116-46, pp27-34). In doing so, the ERA justified its position by three reasons:

(a) The market value of the regulated asset at the end of the AA period may not be known with certainty, but that this is irrelevant, because it is certainty of the regulated asset base which matters, as the regulator sets allowed revenues based upon a return to the regulated asset base. Since the regulated asset base is relatively certain, then Lally's theoretical model which sets the risk-free rate allowance equal to the tenor of the regulatory period applies. This also explains why commercial practice is irrelevant; analysts are seeking to establish value for an asset in perpetuity whilst the regulator is seeking to set a price for short period of time.

(b) Although the regulatory asset base (**RAB**) is not completely certain, the equity and credit risk premia provide sufficient compensation for any risk that might exist in respect of RAB certainty, and thus the regulated asset is like a vanilla coupon bond, with the relevant WACC similar to the yield to maturity on that bond. Just as one would use the three month bill rates as the basis for setting the quarterly coupon payment for a one year floating rate note, it is appropriate to use the five year risk-free rate to set the "coupon" or regulatory revenue, for an asset with much longer tenor.

(c) Contrary to the contention raised by DBP in its submission as to the approach adopted by the ERA in its Rail Guidelines[30], gas and rail are different because the rail Code requires the regulator to set the effective term of for its estimates at the economic life of the assets, and the NGL/NGR does not.

ERA's approach on debt and its annual update

3.9 This section provides a very brief overview of the ERA's response to DBP's position in respect of debt and equity. Further details, including DBP's assessment of this response, and our final position heading into the ERA's Final Decision, are contained in the relevant Chapters below.

3.10 The ERA's approach to determining the return on debt, including its response to DBP's submission, is outlined at DDA4 pages 89 to 142. Although each of DBP's submissions on debt and the ERA's outline of its position are lengthy (and covered off in later sections of this submission), in respect of estimating the actual number for the return on debt, the approaches were largely aligned, except for the following:

(a) **Term and use of CGS -** In its Original AA Proposal, DBP indicated it would use the ten-year CGS, whilst the ERA, in its ATCO Final Decision, has moved to the five-year bank-bill swap rate (BBSW).[31]

(b) **Debt raising / hedging costs -** The ERA rejected DBP's debt-raising and hedging costs, as it has now recalculated these subsequent to the Guidelines, and the costs DBP had used from the Guidelines were used partly in error by DBP (DDA4, para648, p136).

30 See page 16 of DBP's Submission 12.
31 The ERA always used a five-year rate, but it switched from the CGS to the BBSW in the ATCO Final Decision.

(c) **New issue premium -** The ERA has rejected DBP's inclusion of a new issue premium, to cover the fact that issuing debt in a primary market is more costly than is represented by secondary market yields (DDA4 para 651-68, pp136-41).

(d) **Debt risk premium -** DBP used the programming language R to estimate the debt risk premium, but the ERA switched from using R to using Excel in its ATCO Final Decision (DDA4, para 553, p115).

3.11 In respect of the annual updating process, the ERA rejected DBP's use of the AER approach, but it did not require DBP to adopt the approach in the ATCO Draft Decision to which DBP was responding in its Original AA Proposal. Instead the ERA requires that DBP adopt its "hybrid approach" as described in the ATCO Final Decision (see also pp 97-102 of DDA4).

ERA's approach on return on equity

3.12 With the exception of how it calculates the MRP, in the Draft Decision the ERA has not substantively deviated from its approach on estimating the return on equity that is outlined in its Guidelines. In particular, the ERA:

(a) maintained its 5 stage process as set out in the Guidelines; and

(b) more materially, concluded that SL CAPM is a relevant model for informing the ERA's estimate of the prevailing return on equity and proceeded to use that model to formulate its estimate for the return on equity, this includes using the same value for beta, 0.7 (DDA4, para 173-86, pp 36-48).[32]

3.13 To the extent that the ERA concluded other models to be relevant, they were only used to inform the parameter values within the SL CAPM, as follows:

(a) the Dividend Growth Model in relation to the market risk premium; and

(b) the Empirical or Black CAPM in relation to the equity beta (but not any actual estimates from this model) (DDA4 para176, p39).

3.14 Otherwise, the ERA concluded that all other models and approaches were irrelevant, at the current time, without some new developments in terms of the theoretical foundations or the empirical evidence (DDA4, para 177, p39).

3.15 In reaching its conclusion as to the approach to the return on equity, the ERA rejected the following aspects of DBP's approach to the calculation of the rate of return on equity:

(a) DBP's use of its model adequacy test used to estimate the appropriate range for the return on equity (DDA4, para166-98, pp41-7 and Appendix 4B).

(b) the betastar model which passes DBP's model adequacy test (ibid);

(c) the consistency test (between debt and equity) used to estimate a point within a range for the return on equity(DDA4 para 418-23, p 88 and Appendix 4C);

3.16 The ERA's reasons outlined in the Draft Decision for rejecting the model adequacy test and resultant betastar model are stated to be both theoretical and empirical. Those reasons may be summarised as follows:

(a) **DBP didn't test the ERA's version of the SL-CAPM -** The form of the SL-CAPM tested by DBP, in particular the form of the market risk premium used, is not the same as the form the ERA settled upon in its ATCO final decision. In particular, the ERA concludes that DBP has used historical and "backward looking" versions of the MRP and has therefore not tested the version of the SL-CAPM the ERA actually uses(DDA4 para 170-1, p 42 and Appendix 4B).

32 See also Appendix 4A in relation to the ERA's treatment of asset pricing models.

(b) **Models (conceptual objections) -** One should not compare the SL-CAPM with the Black CAPM and FFM in any kind of empirical test because the ERA has determined the latter two models are not robust in the Australian context (DDA4 para 165, p41).

(c) **Black CAPM -** The ERA accepts the theoretical relevance of the Black CAPM, and indeed asserts that it uses the theory of the Black CAPM to adjust its estimate of beta in the SL-CAPM (DDA4, para 256, p58). However, it concludes that the Black CAPM, when estimated in the Australian context, is insufficiently robust (DDA4, para 745-7, p157). Further, the ERA concludes that the Black CAPM is also not used by practitioners (DDA4, paras739-40, p156). This criticism is expanded upon in Appendix 4B (paragraphs 994-1004 and 974), where the ERA says the predictive power DBP finds for the Black CAPM is unique and not supported in the literature (DDA4, para 975, p214).

(d) **The zero-beta premium -** Key to the ERA's criticism of the robustness of the Black CAPM is the conclusion that the estimates of the zero-beta premium are too varied to be reliable(DDA4, paras 176-85, pp43-5 and paras 994-1004, pp218-21). Further, the particular version of the zero beta return used by DBP (based on a study by NERA from 2013) is not within the range it is supposed to be, namely between the risk-free rate and the market returns (DDA4,paras 994-6, pp218-9).

(e) **Betastar violates the integrity of the models** - The ERA contends that the betastar model, which DBP uses to estimate a range for the return on equity, is a violation of the integrity of both the Black and SL-CAPM models, and one should only ever estimate each model in its own right (DDA4 paras 959-71, pp212-14).

(f) **Betastar and risk** - The betastar parameter contains a mix of bias correction and systematic risk, which the ERA says is not appropriate and the amount of bias correction is too large, potentially pointing to abnormal returns and not a bias correction (DDA4 paras 980-85, pp216-17). At the same time, despite the fact that betastar contains a bias correction and systematic risk, because it is greater than one, the ERA concludes that DBP must be saying that energy firms have more systematic risk than the market.

(g) **Nonsensical results of the model adequacy test** - The ERA concludes that the model adequacy test produces nonsensical results primarily because it shows that low beta firms actually earn higher returns than the market as a whole and high beta firms actually earn less for equity holders than their promised return to debt holders (DDA4, para 193, p46 and paras1016-17, pp224-5). The ERA says that this conflicts with the theory of the SL-CAPM and the principled analysis of experts like McKenzie and Partington (ibid).

(h) **Other statistical flaws -** The ERA also suggests that there are a range of potential statistical problems which it believes might be associated with DBP's model adequacy test, but which it has not explored by seeking to replicate any of DBP's empirical work (DDA4, para 195, p46 and paras 1019-42, pp 225-31).

(i) **DBP's data selection -** The ERA queries DBP's selection of data has selected its data from various different sources (DDA4, paras 991-3, p218).

3.17 The reasons for rejecting the consistency test are that:

(a) the link between debt and equity is not well established;

(b) the test does not follow what the ERA believes is standard finance theory;

(c) the test uses an approach which is not well established; and

(d) the test is sensitive to changes in its assumptions.

3.18 Having rejected DBP's proposed deviations from the Guidelines, the ERA proceeds to derive the estimates for the following parameters as part of step 2 of its approach to calculating the return on equity:

(a) beta (0.7) (DDA4, paras 253-7, pp57-8).

(b) MRP (7.6 percent above the five-year rate) (DDA4, paras 258-355, pp58-77). Apart from avoiding cross checks of the return on equity as a whole, the major deviation from its

Guidelines is the ERA's approach to the estimation of the market risk premium. In its Draft Decision, the ERA took into account a much wider range of information than was proposed in the Guidelines.

3.19 To explain its estimation process (Stage 3 of the ERA's process, see DDA4, paras356-8, pp77-8) and to cross check each element of the SL-CAPM (Stage 4 of the ERA's process – see paras 359-60, p78), despite the ERA suggesting in its Guidelines that it would do so, it undertakes no meaningful assessment of the overall return on equity as part of its cross checks, and rejects each of the cross checks of equity that DBP proposed, most notably its test of consistency between debt and equity (DDA4, paras 418-22, p88).

ERA's approach on gamma

3.20 In respect of gamma, the ERA has deviated substantially from its own Guidelines, and now favours an approach based upon the share of domestic equity held by eligible domestic shareholders. Its amendment for gamma requires DBP to adopt this approach rather than using DBP's own approach which is closer to the ERA's Guidelines.

3.21 Use of this new approach gives a gamma of 0.4 compared to DB's proposed gamma of 0.25.[33]

ERA's approach on inflation

3.22 In respect of inflation, the ERA rejected DBP's:

(a) use of multiple, rather than two spanning bonds; and

(b) calculation of inflation for each year during AA4 rather than providing a single estimate for the period as a whole (DDA4, paras 162-72, pp34-6).

3.23 In so doing, the ERA implemented the approach to the estimation of inflation that it had proposed in its Guidelines originally.

33 See page 113 of the Draft Decision then the detailed discussion at Appendix 5 to the ERA's Draft Decision.

4. THE LAW AND ECONOMICS OF THE NGL AND NGR IN DETERMINING THE ALLOWED RATE OF RETURN

Aspects of the statutory scheme

4.1 DBP addressed issues relating to the statutory framework at Section 2 of its submission dated 31 December 2014. Four inter-related aspects of that scheme remain central to a decision that promotes the scheme's objectives: the NGO, the RPPs, the ARORO and the need to derive the best possible estimate for the allowed rate of return.

The NGO

4.2 The Law is primary legislation. The NGO prescribed by s 23 states its objective. It directs attention to promoting efficient investment in, and efficient operation and use of, natural gas services for the long term interests of consumers of natural gas with respect to price, quality, safety, reliability and security of supply of natural gas. Four aspects of it can be noted.

4.3 *First*, the objective is forward-looking. In seeking to "promote" efficiency in the ways identified in section 23, the NGO is directed to creating an environment more conducive to improving efficiency in those ways than the environment that would otherwise exist.[34] *Secondly*, it is multi-faceted. It refers to the promotion of efficiency in a range of possible ways. Some balancing or weighing of competing aspects of efficiency may be necessary. *Thirdly*, it contemplates that various methodologies may achieve that end. *Fourthly*, by stating the objective of the entire regime, it provides greater certainty to service providers and access seekers about possible regulatory intervention, and promote national consistency (both across jurisdictions and between access regimes).[35]

The RPPs

4.4 Sections 24(2)-(7) set out the RPPs. The principles are stated normatively by reference to what is intended to be achieved. The principles complement the NGO in the circumstances to which they apply. Section 28 of the NGL articulates the manner and context in which regard must be had to the RPP.

4.5 As observed by the Tribunal in *Re Application by ElectraNet Pty Limited (No 3)* [2008] ACompT 3, at [15], construing the RPPs with the NGO:

> *requires prices to reflect the long run cost of supply and to support efficient investment, providing investors with a return which covers the opportunity cost of capital required to deliver the services.*[36]

4.6 Section 24(2) of the NGL deploys a floor as opposed to a ceiling when speaking of efficient costs - a service provider should be provided with a reasonable opportunity to recover *at least* the efficient costs that the service provider incurs in the specified respects. The ERA recognises this in describing its NPV=0 criteria as a "limit from below" (Explanatory Statement Appendix 2, paragraph 3).

4.7 The statutory language recognises the role of opportunity in promoting economic efficiency. It reflects a regulatory approach of setting prices for services that allow for the recovery of efficient costs. So much was observed by the Tribunal in respect of the analogous language of s 7A of the

[34] *Re Sydney Airports Corporation Ltd (2000) 156 FLR 10; Re Duke Eastern Gas Pipeline Pty Ltd (2001) 162 FLR 1*
[35] *Ministerial Council on Energy's Review of the National Gas Pipelines Access Regime, May 2006 page 7. See further, Second Reading Speech for the National Gas (South Australia) Bill 2008, Parliament of South Australia, Hansard, 12 June 2008 at page 2697.*
[36] Reaffirmed by the Tribunal in *Application by Energy Australia and Others* (*includes corrigendum dated 1 December 2009*) [2009] ACompT 8 (12 November 2009) at [18].

National Electricity Law in A*pplication by Energy Australia and Others (includes corrigendum dated 1 December 2009)* [2009] ACompT 8 (12 November 2009) at [81]:

> *It might be asked why the NEL principles require that the regulated NSP be provided with the opportunity to recover at least its efficient costs. Why 'at least'? The issue of opportunity is critical to the answer. The regulatory framework does not guarantee recovery of costs, efficient or otherwise. Many events and circumstances, all characterised by various uncertainties, intervene between the ex-ante regulatory setting of prices and the ex post assessment of whether costs were recovered. But if, as it were, the dice are loaded against the NSP at the outset by the regulator not providing the opportunity for it to recover its efficient costs (e.g., by making insufficient provision for its operating costs or its cost of capital), then the NSP will not have the incentives to achieve the efficiency objectives, the achievement of which is the purpose of the regulatory regime.*

4.8 Thus, given that the regulatory setting of prices is determined prior to ascertaining the actual operating environment that will prevail during the regulatory control period, the regulatory framework may be said to err on the side of allowing at least the recovery of efficient costs. This arises in a context in which no is adjustment generally made after the event for changed circumstances.[37]

4.9 In short, ensuring that a service provider has the opportunity to recover at least its reasonable costs is fundamental to the character of the rules as incentive regulation, and to the overarching objective of efficiency, under the various ways identified in the NGO.

The Rules and the ARORO

4.10 The Rules are delegated legislation. Such legislation is to be construed according to its context, which includes the Act under which the delegated instrument is made.[38] For a correct understanding of an item of delegated legislation, it may be necessary not only to consider the wording of the enabling Act, but also its legislative history.[39] Finally, it must be construed in a manner consistent with the primary legislation by which it is authorised.[40]

4.11 Rule 87 of the NGR fits within the statutory structure of the NGO and the RPPS. It is a form of incentive regulation. Sub-rules 87(1)-(5) make general provision in respect of the ARORO. Rule 87(2) provides that the allowed rate of return is to be determined such that it achieves the ARORO. Rule 87(3) defines that objective. Rule 87(4) identifies the components of the allowed rate of return. Rule 87(5) states the matters to which regard must be had in determining the rate of return.

4.12 In stating that regard must be had to certain matters, the NGR directs that the ERA must give weight to the matters as a fundamental element in making its decision, without excluding proper consideration of other matters.[41] The ERA may have regard to other matters in so far as these are germane to the subject matter, scope and purpose of the enquiry mandated by the NGR.[42] It may determine the weight to be ascribed to the various matters.[43] However, the enumerated matters must factor in its decision.

4.13 Rules 87(6) – (12) provide for the constituent aspects of the rate of return. Rule 87(13)-(19) make provision for the rate of return guidelines.

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[37] *Application by Energy Australia and Others (includes corrigendum dated 1 December 2009) [2009] ACompT 8 (12 November 2009) at [79]-[82]*
[38] *One.Tel Ltd v Australian Communications Authority (2001) 110 FCR 125 at 141; Hallgath v Australian Community Pharmacy Authority (No 2) (2011) 197 FCR 15 at 19*
[39] *Crompton v General Medical Council [1981] 1 WLR 1435, 1437*
[40] *See further Schedule 2, clauses 7(1) and 52(1) of the NGL.*
[41] *Rathbone v Abel (1964) 38 ALJR 293 at 295 (Barwick CJ) and 301 (Kitto J); R v Hunt; Ex parte Sean Investment Pty Ltd (1979) 180 CLR 322 at 329*
[42] *R v Australian Broadcasting Tribunal; Ex p 2HD Pty Ltd (1979) 144 CLR 45 at 49-50; 27 ALR 321 (Stephen, Mason, Murphy, Aickin and Wilson JJ)*
[43] *Turner v Minister for Immigration and Ethnic Affairs (1981) 35 ALR 388 at 392 (Toohey J).*

4.14 Rule 74(1) is relevant to certain inputs into the analysis Rule 87 directs. It provides that information in the nature of a forecast or estimate must be supported by a statement of the basis of the forecast or estimate. Rule 74(2) states that a forecast or estimate: (a) must be arrived at on a reasonable basis; and (b) must represent the best forecast or estimate possible in the circumstances.

4.15 Rule 87 emerged from the AEMC's National Electricity Amendment (Economic Regulation of Network Service Providers) Rule 2012 and the National Gas Amendment (Price and Revenue Regulation of Gas Services) Rule 2012 of 29 November 2012 (the **Rule Change** and **Rule Change Determination**).[44] Each of the Rule Change and the underlying Rule Change Determination is a "Rule extrinsic material" for the purposes of construing the respective Laws and Rules.[45]

4.16 The Rule Change altered the manner in which the ERA determines the rate of return that service providers can earn on their assets and the process for the setting of guidelines for rate of return.

4.17 It made three principal amendments. *First*, prior to November 2012 rule 87 of the NGR required the return on equity to be determined using "a well-accepted financial model, such as the Capital Asset Pricing Model". The Rule Change amended rule 87 such that regard must now be had to relevant estimation methods, financial models, market data and other evidence. *Secondly*, it introduced the ARORO within rule 87(3). That objective is focussed upon the rate of return required by a benchmark, efficient service provider with similar risk characteristics as to the service provider, in respect of the provision of reference services.[46] *Thirdly*, the Rule Change introduced a requirement that the AER periodically publish and regularly update rate of return guidelines.

4.18 In adopting harmonised return on capital rules for all regulated electricity and gas networks the AEMC declined to use the term "well accepted financial model", which was a term historically included in the NGR. Previous regulatory determinations and merits appeals concerning former rule 87 of the NGR demonstrated that the "well accepted" standard tended to prevent the regulator and appeal body from scrutinising whether the SL-CAPM really was producing estimates that are commensurate with prevailing market conditions. The corollary of the protection afforded to the SL-CAPM was that the standard constituted a significant hurdle to considering alternative, potentially superior, approaches. The "well accepted standard" led the AER to reject a proposal by AGN in relation to its Queensland and South Australian gas access arrangement in 2011 (when it was named Envestra) to base its returns on both the SL-CAPM and a range of newer models (Grundy, 2010). The Tribunal similarly confirmed that the standard worked in that way in the following cases: *Application by WA Gas Network Pty Ltd (No 3)* [2012] ACompT 12 and *Application by DBNGP (WA) Transmission Pty Ltd (No 3)* [2012] ACompT 14 (the **DB Proceedings**).[47]

4.19 In the DB Proceedings, the Tribunal observed, at [82]-[89], that it "is almost inherently contradictory then to say that the approach or the model is not likely to produce a reliable output – assuming the inputs are appropriate – if that approach and that model are well accepted" (at [84]). This observation was made in the particular context of consideration of the SL- CAPM.

4.20 The Rule Change Determination reveals the AEMC's disagreement with that observation. At section 6.2.4 (pages 48-49), the AEMC says this:

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[44] *AEMC; Rule Determination, National Electricity Amendment (Economic Regulation of Network Service Providers) Rule 2012, National Gas Amendment (Price and Revenue Regulation of Gas Services) Rule 2012; 29 November 2012.*

[45] *Schedule 2, clause 8(1) defines "Rule extrinsic material". It includes both a draft and a final Rule Determination, such as the Rule Change Determination. Clause 8(3) provides that such material can be used to assist in the construction of a Rule: (a) if the provision is ambiguous or obscure, to provide an interpretation of it; (b) if the ordinary meaning of the provision leads to a result that is manifestly absurd or is unreasonable, to provide an interpretation that avoids such a result; or (c) in any other case, to confirm the interpretation conveyed by the ordinary meaning of the provision.*

[46] *The AEMC emphasises the centrality of the ARORO to the new regime: see throughout the Rule Change Determination, for example, pages 18, 38-39, 48, 68 and 90.*

[47] *Application by DBNGP (WA) Transmission Pty Ltd (No 3) [2012] ACompT 14.*

> *In both the ATCO Gas and DBP cases, the Tribunal rejected the contention of the applicants that giving primary emphasis to rule 87(1) would reflect the NGO and the RPP. Such a conclusion does not reflect the approach of the Commission to determining an appropriate rate of return. The Commission considers that the primary consideration should be whether or not the overall allowed rate of return reflects benchmark efficient financing costs. A focus on the overall estimate of the rate of return is the key objective of the new framework.*

4.21 It is apparent from the Rule Change Determination that the AEMC prefers an approach under which multiple models are deployed and cross checked by reference to each other. At section 6.5 (page 67), the AEMC observes:

> *To determine the rate of return, the regulator is also required to have regard use [sic] relevant estimation methods, financial models, market data and other evidence. The intention of this clause of the final rule is that the regulator must consider a range of sources of evidence and analysis to estimate the rate of return.*

4.22 In similar terms, at section 6.5 (pages 56-57), the AEMC states that a framework relying on a relatively mechanistic approach to estimating the rate of return will not best achieve the NGO. At section 6.2.4, in the final paragraph on page 48, the AEMC says this:

> *The Commission is of the view that any relevant evidence on estimation methods, including that from a range of financial models, should be considered to determine whether the overall rate of return objective is satisfied.*[48]

4.23 In referring to the Tribunal's conclusion that the use of a well-accepted financial model secured an estimate of the required return on equity was reasonable and commensurate with the prevailing conditions in the market, the AEMC notes, at page 48:

> *The Commission considered that this conclusion presupposes the ability of a single model, by itself, to achieve all that is required by the objective. The Commission is of the view that any relevant evidence on estimation methods, including that from a range of financial models, should be considered to determine whether the overall rate of return objective is satisfied.*

4.24 Finally, the AEMC links, at pages 43-44, the consideration of a range of models to the production of the best possible estimate of the efficient financing costs as required by the NGO, NEO and RPP:

> *Achieving the NEO, the NGO, and the RPP requires the best possible estimate of the benchmark efficient financing costs. The Commission stated that this can only be achieved when the estimation process is of the highest possible quality. The draft rule determination stated that this meant that a range of estimation methods, financial models, market data and other evidence must be considered.*

4.25 As emerges from these materials, the ARORO sits at the heart of the statutory scheme in so far as it concerns the rate of return. It prescribes an *outcome*. The scheme comprised by ss 23, 27 and 28 of the NGL and rules 74 and 87 of the NGR requires the overall rate of return to be estimated in a manner that will result in the best possible estimate to achieve the ARORO and NGO and to meet the RPPs and that this is arrived at on a reasonable basis. It further prescribes certain matters that must be achieved to achieve that outcome. For example, the NGO and the RPPs cannot be achieved if the estimated rate of return does not reflect the efficient financing costs of the hypothetical benchmark efficient entity contemplated by NGR 87(3). What must be considered or tested against these objectives is the quality of the estimate of the overall rate of return; not just its constituent parts. Put differently, subject to the constraints of relevancy and the like, what matters most is not the various models used as inputs to assessment nor the values of the elements used in each of the models, but the results or "outputs" derived from the application of such model/s.

[48] Related statements are made at section 6.2.4 (page 48) second paragraph, third sentence; in the particular context of the rate of return requirement see section 6.5 at page 69, under the heading "Estimating return on equity"; and within section 6.4.1 generally.

4.26 The ERA must seek to achieve this outcome by selecting the apparently best outcome from the set of reasonable, possible outcomes. In doing so, the ERA ought not exclude any apparently relevant data. Rule 87(5)(a) uses the broad language of estimation methods, financial models, market data and other evidence. It is only by proper consideration of all relevant data as well as estimation methods, financial models and other evidence that the ERA is likely to arrive at the best estimate and that it has arrived at that best estimate on a reasonable basis (as required by NGR 74(2)) to meet the ARORO, NGO and RPP.

4.27 The determination of a "best estimate" outcome that is arrived at on a reasonable basis cannot be said to be achieved by the exclusion of apparently relevant data and other evidence and the use of non-transparent judgment at varying stages throughout the estimation process. The use of all relevant data and the assessment of that data by reference to empirical analysis in that estimation process such that the use of judgment is kept to a minimum will ensure that the outcome has been arrived at on a reasonable basis.

4.28 The Draft Decision departs from the correct approach.

4.29 In the Draft Decision, for the purposes of estimating the return on equity, the ERA focuses upon the selection of the best model and thereafter appears to assume that, once such a model is chosen, and once its inputs are determined, it will produce an outcome that contributes towards the achievement of the ARORO. The ERA also uses its own judgment at many steps in the estimation process to determine not only the outcome but also the value of certain parameters in the model

4.30 This results in insufficient attention to the result of the analysis. The construction and approach that DBP adopts requires the outcome produced by particular methods or models to be tested, in particular for their cogency in estimating the return on equity, and whether that outcome could lead to a return on equity that contributes to the achievement of the ARORO. DBP seeks to achieve this, inter alia, by empirical testing (both of the performance of such models in estimating the return on equity, historically, and in the relationship between the return on debt and the return on equity).

4.31 This principle of testing outcomes for their ability to contribute to the ARORO similarly underpins the model adequacy test. Coupled with the RPP (encapsulated in the ERA's notion of an NPV=0 lower boundary) this gives rise to a consideration of how well models forecast actual outcomes and, more particularly, whether model forecasts are statistically unbiased (i.e., the forecast errors are not statistically significantly different from zero) or biased (the forecast errors are statistically significantly different from zero). Models that are biased in a statistically significant sense will, on the basis of the empirical data available, be unable to deliver an outcome that meets the RPPs. In particular, if a model produces rates of return that are biased downwards, use of the model will load the dice against the service provider. That is precisely what section 24(2) of the NGL seeks to avoid.

4.32 When proper regard is had to the terms of the NGR and NGL, and the objective intention of the rule maker, it is clear that*:*

4.33 For the allowed return on equity, one must use methods, models and approaches that, in combination, are capable of arriving at a result that contributes to the achievement of the ARORO, and is consistent with the NGO and the RPP;

(a) the estimation processes, for both the allowed return on equity and allowed rate of return, must give one confidence that the outcome of that process is capable of delivering an allowed rate of return that achieves (or, in the case of the allowed return on equity, contributes to the achievement of) the ARORO; and

(b) where there is a sound basis for concluding that a relevant model, approach or estimation process is not capable of achieving (or, in the case of the ROE, contributes to the achievement of) the ARORO, either or both:

(i) the application of the method, model, approach or estimation process must be adjusted to overcome these concerns; and

(ii) the method, model or approach must be given less weight in the process of determining the allowed rate of return.

4.34 The ERA acknowledges that its chosen model is not perfect and to address this says that it will have regard to the theoretical insights from the Black CAPM when estimating the equity beta from within the estimated range in determining a return on equity with the SL CAPM (DDA4 paras 247-52, pp56-7 and 747 p157.

4.35 However, the ERA has not been transparent in the way in which it has had regard to the insights from the Black CAPM. An analysis of the figures which the ERA has used in its determination of the return on equity shows they are not consistent with it having any regard to the insights from the Black CAPM. If the regulatory regime were such that only one model were to be used to estimate the return on equity (which DBP does not agree is the case), then in order for the ERA to set a value for β* having regard to the theoretical findings of the Black CAPM, it must estimate value for β and ZBP/MRP and it must use DBP's betastar formula to determine the appropriate increment to β*. As outlined in paragraphs 6.30 to 6.33 and Appendix F, when that is done for all plausible values of β and ZBP/MRP, even the lowest estimate the ERA itself produces, this would result in a significantly higher estimate of β* than 0.70 - in DBP's submission

Convergence and divergence between DBP's and the ERA's approach on return on equity

4.36 As noted by the ERA (DDA4, para 242, p56), the Rate of Return Guidelines indicated that the relevant empirical evidence supports a view that, when applying the SL-CAPM, there is some downward bias in equity beta estimates that are less than one, and upward bias in equity beta estimates that are greater than one (Guidelines, Explanatory Statement para 74). In the Guidelines, the ERA foreshadowed that it intended to undertake more work to quantify the extent of the potential bias. That task, which was a rational one, was taken up by DBP. It was an impetus that gave rise to the model adequacy test.

4.37 The ERA, on the other hand, and for no stated reason, seems to have abandoned the exercise of seeking to quantify the extent of the potential bias. In Appendix 4 to the Draft Decision it states that it "is of the view that it is difficult to quantify the extent of any downward bias" (DDA4, para 247, p56). Even if that is correct, it does not excuse the failure to try.

4.38 The ERA records that "following an extensive literature review, the Authority's view is that this bias is not well established in either the theoretical and empirical studies" (DDA4 para 245, p56). Unfortunately, the ERA provides no particulars of the "extensive literature review". The ERA cites two papers (DDA4 para 707, p149), but neither paper justifies the conclusion that the bias is not well-established and neither excuses the ERA from an obligation to explore the issue in a rigorous way, including through quantitative analysis.

4.39 It is important for the ERA to identify the literature upon which it relies, including because there is a number of different and distinct forms of bias that may be associated with the estimation of beta and it is necessary to be sure that the literature is addressing low beta bias rather than a different form of bias. The phenomenon known as low beta bias was described by Handley in a report for the AER as follows (Handley, 2014, p5):

> *An apparent weakness of the Sharpe-CAPM is the empirical finding, for example by Black, Jensen and Scholes (1972) and Fama and French (2004), that the relation between beta and average stock returns is too flat compared to what would otherwise be predicted by the Sharpe-CAPM – a result often referred to as the low beta bias.*

4.40 The low beta bias so described is not a bias in deriving estimates of beta. Rather, it is a bias in the stock returns generated by the SL- CAPM, and, particularly for present purposes, a downward bias when beta is below one. This is distinct, for example, from a question as to whether there is a statistical bias in deriving beta caused by estimation error.

4.41 It is apparent that the ERA is not questioning that there is at least the potential for low beta bias associated with the SL- CAPM. That is because it concluded in the Draft Decision that it "will continue to account for the theoretical implications from the Black CAPM, and the potential for the use of the SL- CAPM to underestimate returns" (DDA4, para 256, p58). In the Draft Decision, the ERA concludes that: "the Black CAPM is relevant for the purpose of estimating a return on equity for regulatory decisions in Australia" (DDA4 para 745, p 157). DBP agrees with that conclusion.

4.42 It follows that Rule 87(5) requires that, in determining the allowed rate of return, regard must be had to the Black CAPM. In order to have regard to the Black CAPM, it is necessary to have rational and reasonable regard to it. To have irrational or unreasonable regard to something is not truly to have regard to it at all. For the reasons presented below, the way that the ERA has proposed to have regard to the Black CAPM is neither rational nor reasonable.

4.43 The ERA concluded that "it is impractical to utilise the Black CAPM to determine the return on equity directly" (DDA4, para 746, p157). Those reasons are:

(a) the concept of zero beta portfolio is not well established;

(b) estimates of the zero beta portfolio are both unstable and unreliable, particularly in the Australian context – they are not sufficiently robust; and

(c) the Black CAPM has not been widely adopted by academics or practitioners in Australia or overseas for estimating a return on equity directly.

(d) For the reasons identified at paragraph 5.14, each of the reasons advanced by the ERA is wrong

4.44 The ERA indicated that it will "recognise the theoretical insight from the Black CAPM when estimating a return on equity with the Sharp Lintner CAPM" (DDA4 para 745, p 157). It says that it will "have regard to these outcomes when estimating the equity beta from within the estimated range" (DDA4 para 745, p 157). It determined to adopt the estimate of equity beta of 0.7, being toward the upper end of the estimated range of 0.3 to 0.8 (DDA4, paras 247-57, pp56-8). The so-called "theoretical implications from the Black CAPM", as identified by the ERA, seem to be no more than that "it suggests a downward bias in the return on equity generated by the SL- CAPM for firms with an equity beta less than 1" (DDA4, para 247, p56). Presumably, the ERA believes that adopting an estimate of beta from the upper end of the range this will constitute an indirect utilisation of the Black CAPM. However, as will be shown, the approach that has been foreshadowed by the ERA is so lacking in rationality and rigour that the result will be that the ERA will fail to have regard to the Black CAPM, and thus will fail to satisfy the requirements of Rule 87.

4.45 Without having embarked on any empirical work, the ERA has no way of knowing whether adoption of a number towards the upper end of a range will sufficiently accommodate the low beta bias. There is no logical reason to suppose that the top end of the range provides a reasonable cap that will accommodate the bias or that the "limit from below" (ie NPV≥0) has at least been exceeded. That is particularly so once it is appreciated that the bias that is under consideration is not a bias in estimating beta but rather a bias in the returns on equity that are generated by the SL- CAPM. There is no logic in merely picking a number from a range, being a range that may generate returns that are too low. A number towards the high end of the range can never fully accommodate for the bias. An analogy may demonstrate the logical flaw. If 10 stopwatches are suspected to be biased by running too slowly, the bias is not sensibly addressed by using the watches to time an event and selecting as the correct time the fastest time from the 10 watches.

4.46 The approaches of DBP and ERA converge in a significant way. Both approaches recognise that the orthodox application of the SL-CAPM is likely produce a return on equity that is too low to contribute to the achievement of the ARORO. The learning behind the Black CAPM reveals that to be true. Both DBP and the ERA accommodate the low beta bias by an adjustment to the value of beta that is derived from the orthodox application of the SL-CAPM. Thus, neither the ERA nor DBP apply the SL-CAPM in its orthodox form. Both turn to the Black CAPM in deriving a return on equity. From there the two approaches diverge.

4.47 The ERA's approach is to simply choose a beta that is higher than the best statistical estimate but within a range of estimates of beta. That is a rudimentary reaction that suffers from the logical flaws that have been identified: there is no attempt to ascertain the existence and magnitude of the bias exhibited by the SL-CAPM, nor is there is any attempt to determine what is required to compensate for that bias and, finally, the method adopted by the ERA is entirely arbitrary because it cannot know whether its chosen range or the value from within that range is capable of solving the bias problem. An analysis of the use of its chosen value (see paragraphs 6.30 to 6.33 and Appendix F) suggests that its chosen solution is, in fact, in capable of achieving the result the ERA has set out to achieve.

4.48 The approach adopted by the ERA and that adopted by DBP both result in an increase in the cost of equity above the level that would otherwise be adopted if the Sharpe-Lintner CAPM were employed without regard to the Black CAPM. Moreover, in both cases this is achieved by adjusting the same parameter – raising the value of beta above the level that would be used without having regard to the black CAPM ('β') to a higher value ('β*'). That is, in economic substance both DBP and the ERA have a 'betastar' estimate. DBP's value for β* was however, informed by the results of its model adequacy test. The ERA's adjustment was achieved by the exercise of regulatory judgment.

4.49 Moreover, the way in which it exercised its judgement ignored the ERA's own evidence (from the application of the Black CAPM) which would result in a conclusion that the ERA's estimate of β*=0.70 is unreasonable.

4.50 DBP, on the other hand, takes a much more transparent and empirically robust approach. It demonstrates, first, whether there are models which exhibit no bias, secondly the quantum of the bias range found within models which do exhibit bias and, finally, the range of values to be used to compensate for that bias. Then DBP applies some simple algebra which demonstrates that the results of the implementation of the Black CAPM can be reflected in an adjustment to beta in the SL- CAPM. When that same simple algebra is applied to the ERA's approach (as it is above), the problem becomes manifest.

4.51 There is good reason to suppose that the allowance by the ERA is insufficient.

5. OVERVIEW OF DBP'S RESPONSE TO THE DRAFT DECISION AND AMENDED AA PROPOSAL

5.1 This section contains an overview of DBP's response to the Draft Decision in respect of the rate of return matters referenced in Chapters Two and Three, and the reasons for the response that underpins the rate of return included in DBP's Amended AA Proposal.

Return on Equity

5.2 The estimation of the return on equity for AA4 is the issue where DBP and the ERA have greatest disagreement between the Original AA Proposal and the Draft Decision. In response to the ERA's Draft Decision, DBP's Amended AA Proposal proposes a return on equity that is determined by:

(a) Continuing to focus on ensuring that the outcomes from applying the ERA's 5 step process outlined in the Guidelines – being the outcomes from each relevant model and from the proposed return on equity, rather than just the value of each of the parameters used in a single model - delivers a rate that meets the requirements of Rule 87(5) of the NGR, which is that it contributes to the achievement of the allowed rate of return objective (ARORO).

(b) Continuing to make use of its model adequacy test in order to have greater confidence that the return on equity is of a rate that contributes to the achievement of the ARORO. DBP has also implemented a version of the model adequacy test suggested by the ERA. The results support our original findings.

(c) If the updated implementation of this test with new data (see Chapter 11) continues to show the Black CAPM passing the test and the SL-CAPM and FFM failing it, continuing to make use of DBP's betastar model, which transparently adjusts beta in a SL-CAPM framework using information from the Black CAPM.

(d) Continuing to make use of the consistency test to ensure the return on equity and return on debt are consistent with each other.

5.3 This is substantially the same approach adopted by DBP in its Original AA Proposal (with the addition of extra model adequacy test work noted above) and it means that the amendments required by Amendment 10 of the Draft Decision that relate to return on equity have not been made in the Amended AA Proposal.

5.4 There are a number of reasons why DBP:

(a) does not accept the ERA's reasoning for its decision on the return on equity;

(b) is of the view that the ERA's amendment relating to return on equity would be inconsistent with the requirements of the NGR and NGL and in particular would not result in a decision which contributes to the achievement of the ARORO; and

(c) considers that, on a proper application of the NGR and NGL, an access arrangement that estimates the return on equity (and the resultant value for that return) as DBP does in its Amended AA Proposal would lead to a return on equity being a materially preferable outcome and which contributes to the achievement of the ARORO.

5.5 Those reasons are explained below. Before addressing a number of detailed issues that arise, we consider two fundamental issues.

Fundamental issues

5.6 There are two fundamental issues that infect the ERA's Draft Decision. These reflect aspects of DBP's approach that the ERA appears to have missed. The first is that our finding that the SL-CAPM is biased downwards is not something which is unique, but is rather something that is well-established in the literature. Moreover, the ERA's own results for the Black CAPM should have signalled to it that the bias-adjustment it proposes to make to beta is manifestly inadequate. The

second is that testing model outputs ought to be a fundamental requirement of the estimation of the return on equity, meaning some kind of empirically based test is required to assess the ability of any model to deliver and outcome that contributes to the achievement of the ARORO (such as the model adequacy test).

5.7 In relation to the first fundamental issue:

(a) The findings of bias in the SL-CAPM from the model adequacy test are not a surprise, nor are they demonstrating anything that has not been found elsewhere in existing and well accepted literature. Although the ERA suggests that it has undertaken an "extensive literature review" (DDA4 para 245, p56), it provides no indication of having considered many of the papers put to it by DBP, and others, which suggest a downward bias to the SL-CAPM.

(b) The ERA's own estimates of the zero-beta premium in the Black CAPM (which would be zero if the SL-CAPM were true) ought to have led it to suspect its own bias adjustments (which were motivated by consideration of the "theoretical insights" of the Black CAPM) because the smallest value of the zero beta premium the ERA finds is not zero and in fact implies a much larger adjustment of beta than the ERA actually makes. This should have led the ERA to focus on testing the relevant models more thoroughly in order to discover the "right" answer, or an answer which represents a best estimate possible in the circumstances and is most likely to contribute to the achievement of the ARORO.

(c) The ERA's opaque process of filtering general insights from the Black CAPM through to a judgement-based beta adjustment in the SL-CAPM, but explicitly excluding consideration of any actual empirical results from the Black CAPM, when it forms its judgement has caused the ERA to overlook a fundamental inconsistency between its own empirical work and its exercise of judgment, and has meant that it has not, in any serious way, endeavoured to meet the goal expressed in the Guidelines (paragraph 141) of discovering more about the extent of bias in the SL-CAPM and responding accordingly.

5.8 The second fundamental issue is that the need to test model outputs and to give meaningful consideration to the results of those tests is, or should be, a key component of regulatory practice. This demands, in practice, a robust empirical test; an output-based assessment of what models actually produce, rather than a focus solely on the estimation of model inputs and a faith that this will lead to the correct answer. The need for a legitimate analysis of the appropriateness of the overall outcomes produced by models is apparent from the AEMC's guidance when it introduced the notion of the ARORO in the rule change (AEMC, 2012, pp46, 67 and 89-90).

5.9 DBP is not wedded to its own model adequacy test as the sole means of considering or testing the quality of outputs derived from use of particular models. Although DBP considers that the model adequacy test suffers none of the faults the ERA ascribes to it in the Draft Decision (which are explained in later sections of this submission), we do not consider it to be the "last word" in testing model outputs. In its Draft Decision, the ERA proposed that "*a more appropriate framework for assessing prediction accuracy, and hence model adequacy is to utilise the cross validation measure of prediction accuracy*" (DDA4 para 196 p46; discussed in detail at Appendix 4B(i), commencing page 232). DBP agrees that it is appropriate for the ERA to consider, and where suitable propound, other robust empirical tests which assist with assessing the quality of the overall estimate. However,

(a) the results from implementing the cross validation method of prediction accuracy support the results of bias of certain models (including the SL-CAPM) derived from applying DBP's proposed model adequacy test (see paragraphs 11.13 to 11.15); and

(b) the ERA falls into error because it does not apply the cross-validation method (or any other testing) to its own model outputs.

5.10 It is important that there is some real consideration of the reasonableness of the overall estimate for the return on equity (and not just parameters within a model) including some robust, empirical, test of the overall results derived. If there is no such test of model outputs one is left with only regulatory judgement about "reasonableness" of outputs and the hope that regulators who exercise such judgement have taken into account all relevant information.

5.11 Whilst, some degree of regulatory judgment is inevitable in the process (empirical data can take one only so far), the use of judgement by the ERA in its Draft Decision would not appear to be giving confidence that the ERA's return on equity derived from its approach in the Draft Decision is the best estimate arrived at on a reasonable basis in circumstances, or one which could contribute to the ARORO or meet the RPPs) where there is evidence of bias inherent in the ERA's chosen model - even on the ERA's own estimation.

5.12 These fundamental issues underpin both DBP's response to the ERA's Draft Decision and its approach in the Amended AA Proposal. Nonetheless, a response needs to be made to each of the particular shortcomings in a Draft Decision. We now turn to the elements of this response.

Detailed issues

5.13 In this section, we respond to the detailed issues raised by the ERA in respect of DBP's model adequacy test and consistency test, which are the two most important innovations introduced by DBP in its Original AA Proposal.

5.14 In respect of the model adequacy test, raised at paragraph 3.16:

(a) **DBP did not test the ERA's version of the SL-CAPM** (DDA4 para 170-1, p 42 and Appendix 4B) – First, DBP could not have done so because the ERA did not settle upon its final version of the MRP until the ATCO Final Decision, six months after DBP submitted its AA Proposal. Secondly, the ERA has misunderstood the nature of DBP's Method B, which shows that, no matter how well the ERA might be able to forecast the MRP, the SL-CAPM would give biased results. It follows that the difficulties which beset the model are not overcome by the selection of a more accurate MRP. Finally, having now seen the ERA's latest approach to the MRP, DBP implements a Method C, which tests the SL-CAPM composed in the manner the ERA has done in the Draft Decision (including the selection of MRP), and this shows the same downward-biased results for the SL-CAPM as shown in the AA Proposal. This is detailed in paragraphs 6.47 to 6.53.

(b) **Models (conceptual objections)** (DDA4 para 165, p41) – The ERA's various conceptual criticisms of DBP's model adequacy test are all made based on a misunderstanding of the nature of the model adequacy test, which simply examines vectors of errors, to establish whether they are, on average, zero. The nature of the model producing the errors is completely irrelevant. This is discussed in paragraph 6.55.

(c) **Black CAPM –** The issue of the Black CAPM not being robust in the Australian context (DDA4, para 745-7, p157) is rendered largely irrelevant by the use of the model adequacy test, which allows one to check the outputs of any implementation of the Black CAPM and reject those which are clearly biased (see paragraphs 6.60 to 6.62). In any event, the allegation that it is not widely used (DDA4, paras739-40, p156 and paras 994-1004, pp218-21 and para 974 p214) is not supported by the evidence (see paragraphs 6.15 to 6.23). Finally, the suggestion that DBP's findings in respect to the empirical veracity are somehow unique ignores 40 years of empirical evidence (see the report of CEG at Appendix F).

(d) **The zero-beta premium –** The ERA's findings as to the variation in the zero-beta premium (DDA4, paras 176-85, pp43-5, paras 994-1004, pp218-21 and Appendix 4A(i)) are cast into some doubt by problems in the ERA's empirical estimation (see paragraphs 6.59 to 6.68 and Appendix H), but in any case, the ERA misses a key point: all of its own estimates of the zero-beta premium are above zero, and in fact much higher than would be the case if its own adjustment for bias using the "theoretical implications" (DDA4, para 256, p58) of the Black CAPM were true. This inconsistency should, at the very least, have caused the ERA to question the quantum of its own bias adjustment, and thence to employ a robust empirical test of outputs to determine which of these two inconsistent results is likely to be correct. This could include DBP's model adequacy test, or the ERA's own cross validation tests, either of which would, in DBP's view, have shown emphatically the inadequacy of the ERA's method for addressing the bias problem and the value used in that method. This is discussed further in paragraphs 6.30 to 6.35 and the report of CEG at Appendix F. Finally, the position of the empirical zero beta premium within the range suggested by theory

(DDA4,paras 994-6, pp218-9) is wrong because the relevant theory relates to the portfolio of all risky assets, and says nothing at all about the market portfolio (see paragraph 6.63).

(e) **Betastar violates the integrity of the models** (DDA4 paras 959-71, pp212-14) – In one sense, DBP and the ERA do the same thing in respect of the Black CAPM. Both bring information from the Black CAPM into the SL-CAPM in order to address the perceived problem of bias in the SL-CAPM. The only difference between them (apart from the fact that DBP tests its resultant model and the ERA does not) is that DBP's approach is transparent about what it does, and correctly follows the required algebraic manipulation required to create a betastar which incorporates information from the Black CAPM. While the ERA's approach is not transparent. Since DBP and the ERA do the same thing, if DBP is guilty of "violation", so is the ERA; it is not absolved from this by filtering information through a process of regulatory judgement. This is discussed in paragraphs 6.130 to 6.142 and the report of CEG at Appendix F.

(f) **Betastar and risk** (DDA4 paras 980-85, pp216-17) – DBP agrees that its betastar contains a mixture of systematic risk and bias adjustment. So too does the ERA's adjusted beta, which is 5/7ths systematic risk and 2/7ths bias adjustment. DBP and the ERA differ only in the proportion of bias and systematic risk in their adjusted betas, and the ERA provides no evidence beyond an assertion of regulatory judgement that its proportion is correct, whereas DBP puts its betastar model to a formal test (being the model adequacy test) and finds it is unbiased. Additionally, the ERA's assertion that DBP's betastar is picking up "abnormal returns" misunderstands the nature of the test. The test would only pick up such returns if they were systematic, and if they were systematic (to a statistically significant degree) then this would suggest that the model being tested is biased, which is precisely what the model adequacy test is attempting to uncover. This is discussed in paragraphs 6.140 and 6.141 and the report of CEG (Appendix F).

(g) **Nonsensical results of the model adequacy test** (DDA4, para 193, p46 and paras1016-17, pp224-5) – The ERA contends that the model adequacy test produces nonsensical results. This assertion reflects an empirical fact: low beta firms tend to earn relatively high returns. This is well documented in empirical evidence put before the ERA, which it appears to have ignored. The empirical facts of stock returns only appears nonsensical if one is wedded to the view that the SL-CAPM is correct, and thus interprets any empirical evidence which contradicts the theoretical predictions of the SL-CAPM as evidence that the empirical evidence, and not the SL-CAPM, is incorrect. This is discussed in paragraphs 6.69 to 6.86.

(h) **Other statistical flaws** (DDA4, para 195, p46 and paras 1019-42, pp 225-31) - The ERA raises the possibility of a series of potential statistical flaws which it considers might exist in relation to DBP's model adequacy test, but does not investigate DBP's empirical work in order to understand if there is any basis to consider that the flaws do in fact adversely impact our results. DBP has obtained independent expert advice which suggests that the ERA's accusations of statistical flaws are unfounded, and suggests in many cases a misunderstanding of the statistics involved. This is discussed in paragraphs 6.87 to 6.95 and in the report of Data Analysts Australia at Appendix K.

(i) **DBP's Data Selection** (DDA4, paras 991-3, p218) – All of the data used by DBP for its model adequacy test, except the HML factor in the FFM come from the same source, and we only source that piece of data from the website of Ken French (rather than the SPPR data we otherwise use) because the SPPR data does not contain accounting data. Most particularly, all of the data for all of the models which pass the model adequacy test come from the same source. Although we can see no reason why different data sources would pose a problem in principle (and the ERA provides none), the issue does not arise here. This is discussed further in paragraphs 6.96 to 6.104

5.15 In respect of the consistency test raised at paragraph 3.17 (see DDA4 paras 418-23, p88 and Appendix 4C for details on all issues:

(a) **The link between debt and equity is not well established –** The ERA appears to have reached this conclusion without a proper analysis of the papers upon which the test which uses the link is based, and has misquoted extensively from the papers themselves (see 6.152 to 6.160 and see the report of Frontier Economics Appendix C).

(b) **The test does not follow what the ERA believes is standard finance theory –** DBP does not accept that the test is inconsistent with standard finance theory. The paper upon which the literature is based is the 9th most cited in the history of the *Journal of Finance* and is part of the work that earned its author a Nobel Prize in economics. The papers upon which the test is directly based are all published in highly-rated finance journals (see paragraphs 6.152 to 6.160 and the report of Frontier Economics at Appendix C).

(c) **The test uses an approach which is not well established** – the approach is well established, because it is derived directly from the options-pricing theory noted above.

(d) **The test is sensitive to changes in its assumptions** – The ERA has used inconsistent data and has applied the test incorrectly in deriving its results. Additionally, its findings lack logic because the use of the lowest elasticity number feasible (the aspect of the test which leads to sensitivity – according to the ERA) shows that the ERA's allowance for the cost of equity is too low, and this finding would be reinforced, not contradicted, if one used, as the ERA proposes, a higher elasticity number (see paragraphs 6.152 to 6.160 and Appendix C).

Return on Debt

5.16 In respect of the return on debt, DBP has, in its Amended AA Proposal, generally accepted the ERA's required amendments in Amendment 10, both for the calculation of the return on debt, and for its annual updating. This includes the use of the five-year BBSW, as noted above.

5.17 The only aspects of Amendment 10 which DBP has not included in its Amended AA Proposal are relatively minor, being:

(a) DBP continues to believe that capex-weighting (see DDA4, paras 565-76, pp117-19) is an appropriate way in which to reflect the marginal cost of debt for large capital projects (greater than ten percent of the capital base). DBP accepts the ERA's proposal that this not be backwards looking due to a lack of incentive effects, but it has proposed that a forward-looking capex-weighting approach be maintained.

(b) DBP believes the ERA has under-estimated the costs of hedging and debt-raising, and has not had sufficient regard to the evidence provided in these respects (see DDA4 paras 638-50, pp133-6). This has led to the Amended AA Proposal including a value for hedging costs of 14.8 bps (not 11.4 bps) and for debt raising costs, of 17.84 bps (not 12.5 bps).

(c) DBP maintains that the new issue premium does reflect a valid cost faced by the benchmark efficient entity, and should be included (see DDA4 paras 651-68, pp136-41)

(d) DBP believes that the process of updating the cost of debt should not be on an "as soon-as-practicable" basis (see Amendment 14), but rather that more formalised timeframes should be placed upon both the ERA and DBP in order that the process not be subject to delays.

(e) DBP does not accept the ERA's use of an Excel-based approach (see DDA4, para 553, p115) for estimating the debt risk premium, because it contains too many steps and is too subject to user error. Instead we have developed a package in R which replicates the ERA's results, and allows the calculation of the debt risk premium in a single step. This model will be made publicly-available.

5.18 DBP has also proposed an additional element to the estimation of the return on debt by way of the inclusion of a fixed principle which fixes the ERA's hybrid approach post 2020 when DBP is highly likely to find itself regulated by the AER. Given the AER currently applies a trailing average to the risk-free rate and has started a transition process already for the East Coast service providers, it is unlikely the AER will make a special case for WA firms. Absent of a fixed principle protecting the ERA's approach, DBP is likely to face costs unwinding its hedges in 2020, and will face additional risks from today due to the uncertainty amongst our financiers about just what the AER might do in respect of applying its trailing average approach to WA firms. The fixed principle is a simple way to avoid this aspect of regulatory risk which is a consequence only of a change of regulator.

Inflation and gearing

5.19 In respect of gearing, DBP proposed the same level of gearing as the Guidelines, and the ERA has accepted this level. DBP's Amended AA therefore continues to use a gearing level of 60 percent.

5.20 In respect of inflation (see DDA4, para 162-7, pp34-6), the wording of the suggested amendment by the ERA (Amendment #6) is unclear (see discussion in Chapter Eight) but DBP has adopted the approach the ERA has used to determine inflation, namely a single estimate, based upon two straddling bonds either side of the end of the AA4 period. There is a slight difference in the following inflation numbers between what is required by the ERA in the Draft Decision (as a result of Amendments 6 and 10) and what has been proposed by DBP in the Amended AA Proposal:

(a) actual inflation for 2015; and

(b) forecast inflation for each year from 2016-2020.

5.21 These differences are due primarily to timing issues associated with the timing of the release of the Draft Decision and the uncertainty in timing of the Final Decision (see Chapter Eight for further submissions). A summary of DBP's position on inflation used in the Amended AA Proposal is provided in Table 3 and Table 4.

Table 3: DBP proposed actual inflation – 2011 to 2015

	2011	2012	2013	2014	2015
DBP Original AA Proposal	3.10%	2.20%	2.75%	2.05%	2.02%
ERA Draft Decision	3.10%	2.20%	2.75%	1.72%	2.75%
DBP Amended AA Proposal	3.10%	2.20%	2.75%	1.72%	1.69%

Source: DBP Original AA Proposal Submission 1 Tables 2 & 3, ERA Draft Decision Tables 7 & 8, ABS Consumer Price Index (ABS ref 6401.0) and DBP Amended AAI Proposal, Table 3, submitted to ERA on 22 February 2016

Table 4: DBP proposed forecast inflation – 2016 to 2020

	2016	2017	2018	2019	2020
DBP Original Proposal	2.04%	2.09%	2.16%	2.22%	2.30%
ERA Draft Decision	1.90%	1.90%	1.90%	1.90%	1.90%
DBP Amended AA Proposal*	1.91%	1.91%	1.91%	1.91%	1.91%

Source: DBP Original AA Proposal Submission 1 Tables 2 & 3, ERA Draft Decision Tables 7 & 8, RBA Indicative Mid-Rates of Selected Australian Government Securities (RBA data series F16) and DBP Amended AAI Proposal, Table 3, submitted to ERA on 22 February 2016.

**Please note that these figures are provisional and are determined using the same methodology as required by the ERA in its Draft Decision except that the 40 trading days prior to 30 November 2015 have been used instead of the 20 trading days DBP proposes to use the estimate inflation and other market data prior to the Final Decision. Note also that the calculation is based upon the bonds that are above and below the target date at the end of the period (ie – November 30th 2020). One relevant non-indexed bond expires on November 20th 2020, midway through the 40-day averaging period. Splitting the analysis to consider the average to November 20th and the average from November 20th, and then averaging the result, gives a result of 1.96 percent for a simple and 1.97 percent for a weighted average rather than the 1.91 percent shown in Table 4.*

Tenor of the risk-free rate

5.22 DBP's Amended AA Proposal does not adopt the ERA's approach (see DDA4, para 115-50, pp27-33) in the Draft Decision of using a five-year CGS as the proxy for the risk-free rate used in the calculation of the return on equity, but agrees with the ERA's use of the five-year BBSW for the calculation of the return on debt.

5.23 In respect of the return on equity, the ERA has relied upon a theoretical construct based upon numerous papers by Lally which assumes, at its core, that the only risk facing regulated firms in respect of pricing is interest rate risk. Whilst it might be appropriate to set the tenor to five years (or whatever the regulatory period is) in this imaginary scenario, it is not appropriate in the real-world environment where regulated firms face a host of risks from a wide variety of sources. A far more

suitable approach is to recognise the long-run nature of this risk and to use the long run risk-free rate that is widely used by other regulators.

5.24 To do so is consistent with the revenue and pricing principles as it gives the service provider a greater opportunity of recovering at least its efficient costs.

5.25 In respect of the return on debt, the hybrid approach the ERA proposes (see DDA4 para 466-627, pp97-132) to use means that the rational response of an efficient regulated firm issuing debt with a tenor longer than five years is to swap that part of the debt which can be swapped and to fix it for five years. This means that it is appropriate for the ERA to recognise the five-year tenor for the risk-free rate in respect of debt, provided it accounts for the cost of the swap; which it does. DBP therefore agrees with this aspect of the ERA's position on tenor.

5.26 The fact that firms face a variety of risks is something that is recognised by both the ERA and Lally, but the ERA dismisses this concern by saying that these risks are reflected in equity and debt risk premia. The ERA provides no evidence that this is the case, and indeed we believe it would be almost impossible to calculate an adequate compensation for these risks in debt and equity. For this reason, recognising the long run risk taken by equity holders in infrastructure, we continue to believe that the ten-year tenor for the risk free rate is appropriate. We do so despite noting that one effect of our approach to the return on equity in general will be to provide DBP with a lower cost of equity using a ten versus a five-year tenor for the risk-free rate. This is discussed further in Chapter Seven, and supported by expert opinion from Frontier in Appendix B.

5.27 Two additional points remain in respect of tenor-related issues:

(a) DBP accepts the ERA's use of a Commonwealth Government Security for the cost of equity and a bank bill swap rate for the cost of debt.

(b) In respect of the averaging periods, for illustrative purposes in this response, DBP has used a 40-day average to the 30th of November 2015, but proposes to use 20-day averaging periods for the risk-free rates through the course of the AA4 period.

Gamma

5.28 The ERA has deviated from its Guidelines in respect of the two elements which comprise gamma; the distribution rate and the value of an imputation credit (theta). In respect of the distribution rate (see DDA5, paras 117-29, pp29-30), the ERA has not correctly accounted for the presence of large multinationals in the set of listed firms and, once this is done, the figure for both listed equity and all equity (the two categories the ERA considers) is 0.7, which is the same figure it uses in its Guidelines and the same figure DBP uses. The ERA has also erred in its attempt to "match" the distribution rate for listed equity with the theta calculated on the basis of listed equity (and likewise for all equity). This misunderstands that the former is a firm specific parameter (like beta in the SL-CAPM) whilst the latter is a market-wide statistic, like the MRP.

5.29 In respect of theta (see DDA5, paras 25-116, pp4-29), rather than calculate the market value of imputation credits as it did in it Guidelines, the ERA has shifted to the approach developed by the AER, which one of the AER's own consultants describes as being in "stark contrast to the approach elsewhere" (Ainsworth, Partington and Warren, 2015, p27). The AER's (and now ERA's) approach is based on an assumption that all those who can make use of imputation credits value them at their face value whilst those who cannot utilise them value them at zero. This has the practical effect of meaning that the market value of the credits is simply the proportion of credits held by those who can utilise them. In order to justify this assumption of "full value", the ERA relies upon convoluted and untested theoretical arguments. Moreover, the two experts for the AER who have developed said arguments (Lally and Handley) have developed different arguments and each believes that the other is wrong. In light of this, DBP considers it more appropriate for the ERA to make a market estimate and has used the best practice SFG study commission by the Competition Tribunal (SFG, 2011) which produces an estimate of theta of 0.35, and thus a gamma of 0.25.

6. RETURN ON EQUITY – DETAILED DISCUSSION

6.1 In this Chapter, we provide our detailed response to the ERA's decision in respect of the return on equity. As stated previously, our fundamental points are that:

(a) our findings in respect of the bias are firmly grounded in the literature, but that the ERA has not adequately dealt with this in its application of the SL-CAPM, and;

(b) that the use of a robust empirical test of outputs, even if it not ours, is a crucial component of the regulatory process.

6.2 Although these two fundamental points underpin all of the discussion below, and although we elaborate upon them further when we discuss the model adequacy test in paragraphs 6.27 to 6.37 below, this Chapter is not primarily about these two points, but rather is a detailed discussion of each of the arguments that the ERA has raised in respect of the return on equity in its Draft Decision which has led it into error.

6.3 Before commencing with this detailed discussion, it is important to make a comment on the ERA's required amendment 14. Even if (contrary to DBP's submission) the ERA's reasoning does not lead to error, and we sought to implement the ERA's proposed amendment, DBP could not do so. The amendment requires us to implement the SL-CAPM using the five-year risk-free rate and a beta of 0.7, along with the ERA's estimate of the MRP. The first two can be done, but not the third. This is because the ERA's estimate of the MRP changes at each regulatory decision based upon how it interprets a number of "forward looking" indicator variables, but the Draft Decision fails to outline the ERA's methodology for quantifying the correlation between changes in these variables and the change in the MRP. Nor can one gage how to estimate the change by comparing changes between regulatory decisions. This is because in its Draft Decision for both the DBNGP and Goldfields Gas Pipeline, the ERA has not re-estimated the MRP, at the time of each Draft Decision, rather, it has maintained the same estimate developed in the ATCO Final Decision and has presented the numbers from the ATCO Final Decision as "illustrative". Moreover, the actual estimate of the MRP in the Final Decision, 7.6 percent, is identical to that proposed by ATCO some six months prior to the Final Decision in ATCO's response to its own Draft Decision, when each of the indicator variables had very different values compared to their values at the time of the Final Decision. DBP thus has no way of estimating what the ERA might judge to be a reasonable MRP for DBP based upon the evidence which the ERA says it considers when making this decision. The suggested amendment, then, in addition to being based on unsound reasoning, is impossible to effectively implement without further explanation from the ERA.

6.4 We turn now to the substantive reasons for rejecting the ERA's assessment of our Original AA Proposal in respect of the return on equity, in the following four sections of this Chapter below. We then examine the ERA's position in respect of parameters in the SL-CAPM in the last section of this chapter. Re-estimation of our model adequacy test, consistency test and return on equity using new data not available when we submitted our Original AA Proposal more than a year ago is undertaken as a separate exercise in Chapter 11.

Reasons for rejecting the ERA's views on relevant asset valuation models

6.5 Stage One of both DBP and the ERA's process involve a consideration of the merits of different asset-pricing models from a principled perspective. For the ERA, this is the only component in Stage One, but for DBP, the in-principle assessment is matched with an empirical assessment via its model adequacy test. This means that, for DBP, a model might be considered relevant in principle, but not pass the empirical test; the SL-CAPM is affected in this way.

6.6 The outcomes of DBP and the ERA's in-principle assessments are not vastly different in respect of the models that are accepted in principle as being relevant. Both DBP and the ERA accept that the Black CAPM, dividend growth model (DGM) and SL-CAPM are relevant in principle. The ERA notes (DDA4, para 701, p148) that DBP has concluded, based on the views of CEG, that using the SL-CAPM is inappropriate, but this is incorrect. While CEG expressed reservations about aspects

of the SL-CAPM, DBP, like the ERA, considered it a theoretically relevant model as the ERA records at para 181 on page 40 DDA4). DBP and the ERA differ in our opinions in respect to the Fama-French model (FFM), which DBP consider (on the advice of CEG) to be relevant in-principle but the ERA does not. This is an important distinction, but it has limited practical implications for present purposes, because we do not actually use the FFM to estimate the return on equity as it fails, albeit marginally, the model adequacy test, like the SL-CAPM (although it does comprise one of the models which are used in DBP's cross-check). For this reason, we do not provide a detailed response to the ERA's conclusions in respect of the FFM, but this should not be taken as agreement with the ERA's stance; DBP considers that the model has relevance in principle.

6.7 Likewise, we only use the DGM in the same way the ERA does (in the estimate of the MRP) and have not sought to comment on the ERA's assessment of, particularly, the form of the DGM used by Frontier. While DBP has some reservations about the approach of the ERA in this regard, the issue is not material in the present context.

6.8 The substantive issues between DBP and the ERA lie in the SL-CAPM and the Black CAPM, in particular the degree to which the ERA believes the former is robust and the latter is not and the degree to which DBP believes the opposite.

Is the SL-CVAPM relevant?

6.9 Turning to the SL-CAPM, the ERA somewhat overstates the case in respect of the empirical robustness of the SL-CAPM, noting that (DDA4, paras 244-245, p56):

> *'Various studies have argued that the Black CAPM may predict a higher return on equity than the Sharpe Lintner CAPM, implying a low asset beta bias.*
>
> *However, following an extensive literature review, the Authority's view is that this bias is not well established in either the theoretical and empirical studies.'*

6.10 The ERA's assessment of the literature differs from the AER's assessment and, in particular, the assessment of the literature of the AER's advisers. The AER, for example, acknowledges that (AER, 2015, p290):

> *'the SLCAPM has weaknesses,'*

6.11 the AER's advisers, Partington and Satchell (2015, p9), point out that:

> *'it would be fair to say that a substantial weight of academic opinion takes the evidence to be against the CAPM'*

6.12 As a final point, Fama and French (2004, p25), in a review article on the SL-CAPM note:

> *"The CAPM's empirical problems may reflect theoretical failings, the result of many simplifying assumptions. But they may also be caused by difficulties in implementing valid tests of the model. For example, the CAPM says that the risk of a stock should be measured relative to a comprehensive "market portfolio" that in principle can include not just traded financial assets, but also consumer durables, real estate and human capital. Even if we take a narrow view of the model and limit its purview to traded financial assets, is it legitimate to limit further the market portfolio to U.S. common stocks (a typical choice), or should the market be expanded to include bonds, and other financial assets, perhaps around the world? In the end, we argue that whether the model's problems reflect weaknesses in the theory or in its empirical implementation, the failure of the CAPM in empirical tests implies that most applications of the model are invalid".*

6.13 None of this, moreover, is new information, It has been known for over 40 years that there is empirical evidence against the SL CAPM. Mehrling (2005, p104-5), for example, reports that:

> *"The very first [Wells Fargo] conference was held in August 1969 at the University of Rochester in New York State ... The focus of the first Wells Fargo conference was on empirical tests of the CAPM ... the most significant output of the first conference was the paper of Fischer Black, Michael Jensen, and Myron Scholes (BJS), titled "The Capital Asset Pricing Model: Some Empirical Tests," eventually published in 1972. ... One important consequence of the BJS tests was to confirm earlier suggestions that low-beta stocks tend to have higher returns and high-beta stocks tend to have lower returns than the theory predicts."*

Is the Black CAPM relevant?

6.14 In respect of the Black CAPM, there is the issue of the variability and robustness of the zero-beta premium estimates, which we deal with in paragraphs 6.59 to 6.68 (because the ERA has also used this as a reason to reject our model adequacy test). This leaves as a substantive issue, the acceptance of the model.

6.15 Here, the ERA appears to have missed considerable relevant information in deciding that the Black CAPM is not relevant. As CEG points out (Appendix F), this is incorrect, and appears to be based upon an assertion, which is untested, made by Handley, based upon reference to a NERA report which says the opposite. CEG finds, by contrast, that the model has widespread use and the central finding of a flatter security market line is still taught, because it is still true, in mainstream finance textbooks. Moreover, many adjustments that practitioners make to beta (such as the Blume adjustment) are reflecting the same intuition that drove the creation of the Black CAPM.

6.16 Additionally, the ERA appears to have missed a great deal of US evidence as to its use. The single reference cited by the ERA (Sudarsanam, Kaltenbronn & Park, 2011, p27) actually refers to only one US regulator. Moreover, an additional footnote (ibid) indicates that:

> *"In the literature, a zero beta CAPM is a variant of the traditional CAPM but with the zero beta portfolio taking the place of the risk-free asset. The zero beta CAPM was proposed as it fitted empirical data on risk and return better than the traditional CAPM. In the US case, however, this term seems to be used to describe the adjustment made to estimated beta for mean reversion or reversion to the market beta of one as proposed by Blume and Vasicek. See Lally (1998) on the use of Blume and Vasicek betas."*

6.17 Malko (2015) provides evidence of more widespread use. He refers to the Black CAPM and the "empirical" or "E-CAPM", but notes that they are the same in practice; the latter being an empirical response to the theory of the former. He notes that the E-CAPM has seen widespread application in recent years in the US, being presented by experts in regulatory cases in California, Colorado, Delaware, Kentucky, Maryland, Michigan, Minnesota, Michigan, New York, South Dakota, Virginia Washington and West Virginia. He notes that the common response of regulators, when presented with evidence from the E-CAPM is considered along with evidence from the SL-CAPM and DGM in a multiple models approach.

6.18 In the US, energy network regulation for interstate transmission businesses is undertaken by the Federal Energy Regulatory Commission (FERC) and in-state distribution businesses are regulated by the Public Utilities Commission in each State. At both levels, the divided growth model is used and (in different ways) significant weight is also given to the SL-CAPM, Empirical CAPM (that is, the Black CAPM) and FFM and this provides more stable investor returns.

6.19 FERC's approach is to primarily use the dividend growth model but regard is had to the estimates produced by capital asset pricing models and the final return on equity point estimate is significantly influenced by the results of these other models.

6.20 At the State level, the range of models is often given an explicitly equal role. All models identified in the Guidelines as 'relevant models' are generally considered by these state regulators as useful in the determination of allowed return on equity.

6.21 The US regulators who have been presented with Empirical CAPM evidence have considered it along with evidence from the DGM or DCF and SL-CAPM (that is referred in the US to as the Sharpe CAPM). The results from all these approaches have been recorded in the decisions and the selection of a particular figure has been made following that consideration.

6.22 Use by regulators of the Zero-Beta and Empirical CAPM includes:

(a) New York Public Service Commission, 2009 applied 50/50 weighting to the "Traditional" CAPM/zero-beta CAPM at paragraph 56.[49]

(b) New York Public Service Commission, 2007 applied 50/50 weighting of traditional CAPM results and zero beta CAPM results at paragraph 20.[50]

(c) New York Public Service Commission in 2006 applied a 50/50 weighting traditional CAPM result and zero beta CAPM result at paragraph 19.[51]

(d) Oregon Public Utility Commission, 2001 used the zero-beta in preference to the SL CAPM noting that "as beta decreases, the cost of equity decreases by less than the SL-CAPM model suggests" meaning "that the cost of equity for utilities with betas of less than 1 are closer to the cost of equity for an average risk stock than is shown by the SL-CAPM model. Under this model, the required return for the risk-free asset is expected to be higher than the return on Treasury bills".[52]

6.23 Aside from examining what interpretation a ruling puts on an adjustment, it is difficult to see how one would distinguish between the hypothesis that a regulator is using the Black CAPM and the hypothesis that a regulator is making a Blume or Vasicek adjustment; the same issue that CEG notes above.

6.24 Part of the issue is that the ERA does not appear to have taken account of relevant information presented to it. For example, it appears to have disregarded the information DBP provided in its response to the ERA's issues paper to DBP's AA proposal on empirical findings that low beta stocks tend to earn high returns. That information is material, in DBP's view, in that it contradicts the finding that results of the model adequacy test are "nonsensical" (see paragraphs 6.69 to 6.86 below).

6.25 As a final point, the ERA notes that DBP (DDA4para 180, p40):

> *"presents only limited new information in its proposal – in relation to relevant estimation methods, financial models, market data and other evidence – that was not considered as part of the development of the Rate of Return Guidelines"*

6.26 This is incorrect in respect of the model adequacy test and consistency test, which were never considered as part of the Guidelines process except to the extent that DBP made submissions at that time about the need to test outcomes against the ARORO.

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[49] *Proceeding on Motion of the Commission as to the Rates, Charges, Rules and Regulations of Consolidated Edison Company of New York, Inc. for Electric Service; Petition for Approval, Pursuant to Public Service Law, Section 113(2), of a Proposed Allocation of Certain Tax Refunds between Consolidated Edison Company of New York, Inc. and Ratepayers 2009 N.Y. PUC LEXIS 507.*

[50] *Proceeding on Motion of the Commission as to the Rates, Charges, Rules and Regulations of National Fuel Gas Distribution Corporation for Gas Service 2007 N.Y. PUC LEXIS 449; 262 P.U.R. 4th 233.*

[51] *Proceeding on Motion of the Commission as to the Rates, Charges, Rules and Regulations of Central Hudson Gas & Electric Corporation for Electric Service; Proceeding on Motion of the Commission as to the Rates, Charges, Rules and Regulations of Central Hudson Gas & Electric Corporation for Gas Service 2006 N.Y. PUC LEXIS 227; 251 P.U.R. 4th 20.*

[52] *In the matter of PacifiCorp's Proposal to Restructure and Re-price its Services in Accordance with the provisions of SB 1149. 2001 Ore. PUC LEXIS 418; 212 P.U.R. 4th 379.*

Reasons for maintaining a model adequacy test

6.27 As we discuss above, we have two fundamental issues in respect of the model adequacy test; its congruence with other available evidence that appears to have been ignored by the ERA, even when the evidence is its own, and the fact that a model adequacy test or robust empirical test of outputs of some kind is necessary for effective, robust and transparent regulation, meaning the ERA's rejection of any test of its outputs is a fundamental error in the Draft Decision.

The model adequacy test's conclusions are confirmed by the established literature

6.28 The ERA's response, where it deals with the outcomes of the test (rejection of the SL-CAPM and acceptance of the Black CAPM) appears to assume that DBP's model adequacy test is somehow unique and new, and produces results found by nobody else. For example, the ERA says (DDA4 para 975, p214):

> *"Second, DBP concludes that the Black CAPM performs bets on the test as compared to the Sharpe Lintner CAPM and Fama French models. The Authority notes that its finding is not confirmed by any other study in Australia or overseas."*

6.29 However, this is contrary to more than 40 years of empirical finance;[53] the notion that the SL-CAPM is biased downwards is hardly a new finding, and indeed the ERA accepts that this downward bias exists when it chooses 0.7 for beta, specifically acknowledging that it is doing so in order to address the issue of bias.

6.30 The results of DBP's model adequacy test, particularly in respect of the SL-CAPM are not new, in light of the wider empirical literature. However, they also ought not be surprising in light of the ERA's own empirical research using the Black CAPM. The ERA makes it quite clear that it will only adjust beta by considering the "theoretical implications" of the Black CAPM (DDA4 para 256, p58) and that a lack of reliability of estimates of the zero-beta premium preclude it from making any use whatsoever of empirical information from the Black CAPM (DDA4, para 746, p571).

The ERA ignores its own evidence about bias

6.31 It would appear from the ERA's discussion of the issue that its main concern is forming the "best" point estimate of the zero-beta premium, in line with its approach to estimating the SL-CAPM, where point estimates of parameters are of primary importance. However, in adopting this stance of using no empirical information from the zero-beta premium, the ERA misses an important implication of its own research; although its estimates of the zero-beta premium are indeed varied, they are all more than zero. More to the point, the smallest estimate of the zero-beta premium the ERA makes implies an adjustment to beta to account for bias, if the Black CAPM is to be used to inform the extent of the downward bias of the SL-CAPM (as appears to be the ERA's intent when it proposes to use the "theoretical implications" of the Black CAPM for precisely this purpose), that is much larger than the adjustment the ERA actually makes to account for bias.

6.32 The smallest estimate of the ratio of the zero-beta premium to the market risk premium made by the ERA is 0.61 (see DDA4 Table 25, 0185), whilst the best estimate the ERA has for beta (unadjusted for bias) for the average of equal and value-weighted portfolio appears to be 0.685 (see DDA4 Table 28, p 193). Applying the algebra DBP uses to create betastar from its empirical Black CAPM findings, which CEG notes is the correct way in which to create a bias-adjusted beta in an SL-CAPM framework, implies a bias-adjusted beta of 0.88, not the value of 0.7 the ERA proposes to use.

[53] *See Fama & French (2004, p35) who note "The success of the Black version of the CAPM in early tests produced a consensus that the model is a good description of expected returns." This consensus was, they note, subsequently overturned; not by the original SL-CAPM but rather by models like the FFM which introduce other factors that better explain stock returns than beta alone.*

6.33 There is thus a clear inconsistency between the "theoretical implications" the ERA uses to inform its judgement about the bias adjustment implied by the Black CAPM and the smallest adjustment it would have made for bias using its own empirical calculations of the same model. The ERA fails to address this inconsistency because it fails to make any use of its own information on the basis that the variety of zero-beta estimates it obtains makes it difficult to know how to make best use of the information from an empirical Black CAPM estimation.

Need for an empirical test of outputs

6.34 Neither the SL-CAPM nor the Black CAPM represent "the truth"; they are both models. The inconsistency between the "theoretical implications" of the Black CAPM the ERA purports to be considering and the smallest empirical result that it fails to consider can be considered as a necessary condition to move away from no consideration of any empirical evidence from the Black CAPM whatsoever, but cannot be considered as a necessary condition for being able to claim that the "right" bias adjustment has now been found.

6.35 Instead, the next step should have been to examine other objective information, and this brings us to the second fundamental issue noted above; the concept of testing model outcomes. The ERA appears to be in two minds about this. On the one hand, it is believes it has come up with an appropriate estimate of the return on equity, despite none of its cross checks containing any kind of meaningful examination of outputs and despite the evidence of its own estimation of the Black CAPM. On the other, however, it notes (DDA4, para196, p46) that if one were to do some kind of model adequacy test, one would not do what DBP did, but would rather use cross-validation. This is clearly an important issue for the ERA, and one it has not ignored, because it has devoted a whole sub-appendix (Appendix 4B(i)) to describing in detail how such a test might be undertaken, although it has not applied its cross validation testing to any model.

6.36 For its part, DBP is not irrevocably wedded to its model adequacy test as the only way in which tests of model outputs can be assessed; provided an alternative test is suitably robust we would be happy to use it in place of our own model adequacy test, and indeed we implement the cross validation test the ERA has proposed (see paragraphs 6.124 to 6.129 and Chapter 11). However, in DBP's view it is erroneous to conclude that the output of a model meets the necessary objectives prescribed by the rules, without applying some rigorous form of cross check. In that regard, the AEMC specifically required regulators not to follow the simplistic approach of assuming that well-estimated inputs to a model regulators consider theoretically robust must produce a reasonable outcome, noting (AEMC, 2012, p48):

> *"In both the ATCO Gas and DBP cases, the Tribunal rejected the contention of the applicants that giving primary emphasis to rule 87(1) would reflect the NGO and the RPP. Such a conclusion does not reflect the approach of the Commission to determining an appropriate rate of return. The Commission considers that the primary consideration should be whether or not the overall allowed rate of return reflects benchmark efficient financing costs. A focus on the overall estimate of the rate of return is the key objective of the new framework."*

6.37 And further (ibid, pp89-90):

> *"The Commission does not consider that the regulator could be satisfied it had met that overall objective if it made estimates about components or parameters that form part of the rate of return estimate in isolation and without considering the overall estimate against the overall objective."*

Unfounded basis for the ERA's rejection of the model adequacy test

6.38 Our over-arching concern in relation to the assessment of our model adequacy test is the superficial nature of the assessment. The superficiality of the ERA's assessment of the model adequacy test is apparent from DDA4, where the ERA dismisses, in around six pages (around half of which is concerned with a discussion of the zero-beta premium; see discussion in paragraphs 6.59 to 6.68), the test in its entirety, before embarking upon the main focus of its discussion on the

return on equity, its own estimation of parameters in the SL-CAPM. There is an appendix which supports the main assessment (Appendix 4B, pp197-231) in which the ERA makes essentially five main points, namely:

(a) That the model adequacy test is inappropriate because the betastar model which emerges is inappropriate (DDA4 paras 959-71, pp212-14), and contains too much bias adjustment and not enough systematic risk (DDA4 paras 977-85, pp215-17)

(b) That DBP did not actually test the model which the ERA uses when it applies the SL-CAPM, because of the way we estimated the MRP (DDA4 paras 951-5, p211).

(c) That the Black CAPM is not "robust" in Australia (DDA4, paras 994-1004, pp 218-21).

(d) That the results are nonsensical because low beta firms have a higher return than the market and high beta firms a lower return than their cost of debt ((DDA4, paras 1005-18, pp222-25).

(e) That a range of statistical issues might affect the test (DDA4, paras 1019-38, pp225-31).

6.39 The first and third points are irrelevant, when proper regard is had to what the model adequacy test seeks to achieve. One cannot dismiss a test on the basis of the models which pass, unless one can show that the test itself is somehow biased towards those models. The ERA has not done this. Instead, it is the fact that these models pass the test, and that the ERA has concerns about these models (with which DBP disagrees) that is used to dismiss the model. We discuss the Black CAPM issues in paragraphs 6.59 to 6.68, and betastar in the following section (paragraphs 6.130 to 6.140) as a separate issue to the model adequacy test itself.

6.40 The second point misunderstands what DBP did, particularly in respect of its "Method B", and the ERA's position on MRP changed more than six months after we submitted our Original AA Proposal. We discuss this further in paragraphs 6.47 to 6.51.

6.41 The fourth point misunderstands the test. It does not "produce" outcomes in respect of return on equity estimates - that remains the role of models. Rather, the test compares predicted outcomes with actual outcomes. It is an empirical fact that low beta stocks actually have relatively high returns, and the model adequacy test reflects this empirical fact. This is discussed further in paragraphs 6.69 to 6.86.

6.42 The fifth point is untested by the ERA- it suggests a range of statistical issues which might exist, but undertakes the most basic assessment to ascertain whether they do or not. Indeed, the ERA has not checked model adequacy test and its workings at all, even to check whether our calculations are correct or not; it did not even obtain the dataset which it would have needed to replicate the portfolio formation we used. As it transpires, the statistical issues the ERA raises are incorrect (see discussion in paragraphs 6.87 to 6.95).

6.43 DBP went to significant lengths to engage with the ERA, having regard to the necessarily rigorous empirical nature of the testing required, and in the knowledge that an assessment of that empirical testing would be required. In particular:

(a) Prior to submitting our Original AA Proposal, and prior to even completing our work using the model adequacy test, DBP met with the ERA (in November 2014) to outline our work and what our early results showed. It was at this meeting that the ERA suggested the use of Mincer Zarnowitz tests in addition to the t and Wald tests we were then using.

(b) Providing the ERA with not only a detailed description of what we did, in our Original AA Proposal, but all of the actual regression code we used, and all of the non-confidential input data. This included translating some code from SAS to R so the ERA could use it. DBP has engaged Data Analysis Australia (**DAA**) to undertake an independent assessment of our work from a statistical and coding perspective.

(c) When the ERA sought to obtain the SPPR data which we use as the input to our model adequacy test, at the end of October 2015, we sought to assist the ERA in obtaining the data at the lowest cost.

(d) In the time between our Original AA Proposal and the ERA seeking to obtain the input data, SIRCA issued an updated dataset, containing one more year of data. The ERA indicated it may examine the model adequacy test in light of this updated dataset. DBP thus provided updated regression code and results.

(e) At DBP's initiative, six meetings (at bi-weekly intervals) were proposed in order to discuss aspects of the quantitative analysis DBP had undertaken. Before each of these meetings, DBP sought to understand what issues the ERA might like to discuss in relation to DBP's WACC work and each time we were told the ERA had nothing to discuss.

6.44 Notwithstanding that engagement, the ERA's Draft Decision is not made on grounds which are statistically or empirically based. In those circumstances, if the ERA conducts its own testing and empirical analysis, whether in response to this submission or others raised following the Draft Decision, DBP considers that it ought to be afforded a proper opportunity to consider and respond to any such testing before the ERA hands down a Final Decision.

6.45 The discussion below focussing on the detail of the ERA's Draft Decision follows the particular conclusions the ERA has made in respect of the model adequacy test (see discussion above at paragraph 6.38). In particular:

(a) We explore the so-called "conceptual issues" which the ERA believes affect the test.

(b) We explore the information the ERA presents in respect of the degree of variance in zero beta premium estimates in the Black CAPM.

(c) We respond to the ERA's allegation of "nonsensical" results.

(d) We respond to the list of statistical issues which the ERA considers might affect our test.

(e) We respond to the ERA's claims about data issues.

(f) We respond to arguments the ERA has made about bias in the SL-CAPM. We note that this is not in response to our model adequacy test per se, but is contained in the section where it discusses its own approach.

(g) We present the results of an audit of our approach undertaken by independent experts DAA as evidence that the approach has independent support

The ERA's "conceptual" issues and DBP's new Method C

6.46 The ERA first rejects DBP's model adequacy test on conceptual grounds. The main argument appears to be that DBP is not testing the model that the ERA uses, and is setting up a "straw man" (DDA4para 171, p42) using historical data on the MRP. There are two key errors here.

6.47 The first is conceptual. The SL-CAPM is not a model of the MRP. The MRP relates to the movement of the market, and the SL-CAPM is not a model of the movement of the market, but is rather a model of the movement of a stock (or portfolio) with the market; its covariance.

6.48 It is true that, in order to make an estimate of the rate of return, the regulator must make use of an MRP estimate; the return on equity is the risk-free rate plus beta times the MRP (however the latter is formed). However Method B, when properly understood, renders concerns about how the regulator might estimate the MRP irrelevant.[54] Method B uses the actual MRP each period, rather than an estimate of it. This was done because much of the variation in the return of a stock is due to variation in the return to the market, which the SL-CAPM does not seek to explain, and this noise reduces the power of the tests (see Original AA Proposal, Submission 12, para 5.120). As noted in the Original AA Proposal (ibid), this is not implying that the ERA could perfectly predict the MRP, but rather only that it made unbiased predictions, and therefore any variation in its predictions of

[54] *As CEG points out, Method B is essentially a version of the classical tests of the SL-CAPM first undertaken by Black & Scholes (1972) and Fama & McBeth (1973). It has also been used by CEG itself (2008). In other words, it is not new, and is not somehow a major deviation from the literature.*

the MRP would not influence its return on equity estimates in the long run.[55] Thus Method B does not require that DBP replicate the approach that the ERA uses in assessing the MRP.

6.49 While our Method B tests do not presume that the ERA has perfect foresight, one way of interpreting our Method B results is that they show that, even if the ERA could use regulatory judgement to perfectly predict the excess return to the market, its use of the SL-CAPM would still lead to biased estimates of the return on equity, and using the Black CAPM would not.

6.50 The second issue arises as a matter of timing. DBP made its Original AA Proposal in December 2014, shortly after the ATCO Draft Decision. Our formulation of the MRP in the model adequacy test was based upon the ATCO Draft Decision as being the most recent example of the ERA's approach. There, the ERA chose a fixed band of five to 7.5 percent, and then several conditioning variables within that band. Since the fixing of the band was based on the ERA's assessment of information roughly contemporaneous with the present, DBP could not know whether the same band would have been used through more than 40 years had the regulator been regulating gas pipelines for all that time, let alone where in that band it would have chosen based on conditioning variables with only one observation of how it proposed to do so, because its decision involved regulatory judgement. This was the reason for the choice of the historical average at that time.

6.51 The ERA subsequently changed its approach to the estimation of the MRP, six months after DBP submitted its Original AA Proposal, a matter which DBP could not have been expected to predict in formulating its testing. Having regard to the ERA's new approach for the estimation of MRP, it is possible for DBP to create a "Method C" which better reflects this new model for determining MRP. Given that the new model maintains a large measure of regulatory judgement it is impossible to reflect exactly what the ERA would do under any situation over the past 50 years. However, it is possible to establish an upper and lower bound. The lower bound remains at the Ibbotson historical average DBP used last time; Method A. The upper bound as described in the ATCO Final Decision (repeated in DBP's Draft Decision, DDA4 para 306, p67) appears to be, in an absolute sense, the result for the DGM at any point in time. However, when the ERA sets to an estimates an MRP, obtaining the figure of 7.6 percent, it starts with the range between the Ibbotson and Wright estimates of the MRP, then considers information from the DGM and its so-called "forward indicators" to eventually choose a point a little above the mid-point of the range between the Ibbotson and Wright versions of the MRP, because some of these indicators appear to be above their historical average (DDA4, para 348, p76).

6.52 The risk-free rate in Australia, as measured by the CGS, is roughly 30 bps higher than the lowest point is has been at (roughly the same time as the ATCO Final Decision data were sourced) since 1969, and still the ERA has not used an MRP higher than that provided by the Wright method. Nor is it clear under what conditions the ERA would move towards what appears to be currently its highest bound, the DGM results. Thus, Method C assumes in the first instance that the upper bound for the MRP is that determined by the Wright method.[56] However, since the DGM result is currently around ten percent higher than that for the Wright method and since the Wright method result might not always be particularly high (we have no way of knowing what the ERA would do under these, or indeed any circumstances other than those at the ATCO Final Decision), we also allow variants of Method C whereby the MRP is five, ten, 15 and 20 percent higher than the estimate formed by the Wright CAPM. This gives rise to five variants of Method C.

6.53 DBP has implemented several versions of Method C, using the 95th and 99th percentile of beta, and the mean beta, and all fail to provide unbiased results. These results are shown in Table 10 and Table 11 in Chapter 11, along with the rest of our empirical work. In all cases, the version of the SL-CAPM using an MRP formed via Method C fails to pass the model adequacy test. That is, even adopting the ERA's new approach to MRP and testing that approach using the most reasonable assumptions available, the conclusions from our Original AA Proposal remain. To the extent that the ERA chooses an MRP lower than the upper bound(s) specified in Method C, and to the extent

[55] *CEG makes precisely this point in its expert report, (see Appendix F).*
[56] *This is an upper bound, unlike the somewhat arbitrary seven percent of the ATCO Draft Decision, that DBP can calculate through time. We follow the same approach as the ERA outlines (including using the ERA's gamma) in Table 6 (from DDA4, p63).*

that it would have done so for each past observation, since the result in Table 10 above is that Method C is biased downwards, the only reasonable conclusion is that the ERA's actual approach would have delivered a result which is more biased downwards. This ought not be particularly surprising; if the ERA could not get an unbiased answer with its version of the SL-CAPM using a perfect forecast of the MRP (Method B) it seems unlikely that it could do so when the forecast is imperfect (Method C).

6.54 The change of approach to the MRP is the main "conceptual" issue the ERA raises in DDA4, but it also raises three smaller issues, as follows:

(a) DBP cannot compare the Black CAPM and FFM with the SL-CAPM because the former two are not robust within the Australian context (para 167, p41 and para 173, p42).

(b) DBP invokes the ERA's use of Diebold-Mariano tests as motivation for its model adequacy test, but this is not comparing apples with apples (para 945-6, p209).

(c) The ERA is unconvinced that the ten portfolios DBP uses are relevant for testing the different models (para 959, p212)

6.55 The first of the three points above suggests a misunderstanding of the nature of the model adequacy test. The only input to the test is the vector of errors in forecasts (forecast return minus predicted return), which the t and Wald tests then compare to ascertain whether the errors (which are nothing more than a series of numbers) have a mean of zero. The models that create the forecasts are irrelevant in respect of considering their errors. Indeed, if the Black CAPM and FFM were not robust in the Australian context, this is precisely the kind of thing one would expect to be highlighted when the results of these models are tested via a model adequacy test.

6.56 As to the second point, DBP's reference to the ERA's work with Diebold Mariano tests was that the notion of testing predicted with actual outcomes was not entirely novel within the regulatory context. In a different context, with a different test, and with a different criterion (accuracy, not bias) the ERA has tested predictions against actual outcomes. We would in fact support the more widespread use of empirical testing by regulators in place of regulatory judgement.

6.57 The final point above is ambiguous because the ERA provides no reasoning behind its statement that it is not convinced that the portfolios used by DBP are relevant for both the SL-CAPM and Black CAPM. However, in circumstances here the ERA has not reviewed the necessary data to arrive at that conclusion, there can be no basis for such conclusion.

6.58 DBP reiterates the point we made in the Original AA Proposal (para 5.89). That is, although one could form portfolios in many different ways, if the model being tested posits that returns are associated with a particular factor, then it seems entirely logical to construct portfolios on the basis of that factor. Moreover, stratification based on beta has the useful property in the Australian regulatory context that the ARORO requires us to consider the efficient financing costs of a firm facing a similar level of systematic risk as the benchmark efficient entity. Stratifying the sample by beta, and obtaining at least one portfolio with a similar beta to energy firms allows us to examine this issue directly, because it shows the market price of facing a particular level of systematic risk.

Variance in estimates of the zero-beta premium and robustness of the Black CAPM in Australia

6.59 The ERA expresses concern about variation in estimates of the zero-beta premium, a parameter of the Black CAPM. This is discussed as one of the three "empirical" problems associated with the test.[57] (see Appendix 4 (pp43-5) and (Appendix 4A(i)) to producing its own estimates of the zero-beta premium. Variation across these estimates is used to further the argument made by the ERA that estimation of the zero-beta premium is fraught with difficulty.

6.60 As discussed above, this focus on variation in estimates of the zero beta premium has caused the ERA to ignore important evidence about the minimum value of the variable, which assists to

[57] The ERA's description of the objections as being "empirical" in nature is something of a misnomer, as the ERA has not undertaken an empirical assessment of DBP's work. nor obtained the data necessary to do so.

quantify the bias associated with the SL-CAPM and overcome the difficulty in assessing that bias (see DDA4 para 247 p56). However, there is second point; variation in the estimation of a particular parameter, like the zero-beta premium is not a problem associated with the model adequacy test. Quite the opposite; it is a problem which the model adequacy test seeks to overcome.

6.61 DBP has estimated the zero-beta premium a certain way, and found that this way of estimating the zero-beta premium leads to a version of the Black CAPM that passes its model adequacy test. However, we could have equally estimated the zero-beta premium in a plethora of different ways and subjected each of the resulting versions of the Black CAPM to a model adequacy test. This is in fact exactly what we did with the SL-CAPM, testing a version with the mean estimate of beta, with the 95th percentile estimate of beta and the 99th percentile estimate of beta (and similarly for betastar). Some versions of the Black CAPM with different estimation methods for the zero beta premium may have passed (as our implementation does) and some may have failed.

6.62 The point is that whatever goes into a model, the model's outputs must meet some required benchmark (here the model adequacy test). For this reason, the ERA misses a key benefit of using an output-based test. Using a model adequacy test allows a regulator to consider different models in an objective fashion against an objective benchmark in such a way that concerns about variability in how an input to a particular model is estimated (or indeed other concerns about the internal workings of that model) become a second-order concern. This is in fact a key benefit of having a robust output-based test; it is much more difficult to "game" a transparent output-based test than if the debate about acceptable models centres around the views of experts and the exercising of regulatory judgement.

6.63 Thirdly, the ERA notes that the zero-beta premium should lie between the risk-free rate and the market return on equity (DDA4 para 995, p219) and the ERA points to Figure 8 in Submission 12 of the AA Proposal to indicate that this is not the case. There are two points to make in response to this. Firstly, there is an error in the ERA's statement; Brennan (1971) shows that the zero beta rate (not premium) should lie between the risk-free borrowing and lending rates, and the borrowing rate should be below the return to the market portfolio of all risky assets. The zero beta premium should thus lie between zero and the market risk premium. Secondly, the return to the market portfolio of all risky assets is not observable and so we and the regulator use the return to the market portfolio of stocks as a proxy. Brennan (1971) says nothing about where the zero-beta premium relative to the market portfolio of stocks should lie.

6.64 A final point relates to the amount of variation found in estimates of the zero-beta premium and the degree to which these estimates are or are not robust enough to use. It would appear that the ERA has rather overstated its case in respect to the amount of variation found in estimates of the zero-beta premium. DBP does not dispute that there is some variation, but HoustonKemp argues that the problem is not nearly as large as the ERA suggests; it is not that much larger than the variation in estimates of the market risk premium.

6.65 There are two pieces of evidence the ERA presents to support its point. The first is its own work in respect of the zero-beta premium. HoustonKemp (see Appendix H) has assessed this work in detail, and suggests that it may be subject to a number of important flaws:

(a) The ERA incorrectly computes the returns to stocks on the days following ex-dividend days. The ERA incorrectly presumes that a purchaser of a share of stock on the ex-dividend day will pay the sum of the price at the close of business and the dividend distributed.

(b) There is no sign in the ERA's code that it takes steps to ensure that dividends and prices are denominated in the same currency. When dividends and prices are denominated in different currencies returns can be very badly mismeasured.

(c) The ERA selects stocks based on whether they are currently members of the All Ordinaries and so, because membership of the All Ordinaries is determined by market capitalisation, on their current market capitalisations. The ERA has selected a set of stocks that are known to have performed well on average. Stocks that over the last five years or 20 years have performed well will be more likely, all else constant, than stocks that have performed badly

over the last five years or 20 years to be current members of the All Ordinaries. It is likely, therefore, that the ERA's results suffer from survivorship bias.

(d) Rather than setting the return to a stock on a day when it does not trade – or over a week or a month when it does not trade – to missing, the ERA sets the return to zero if a price has previously been recorded. Treating missing returns as zero returns can lead to estimates of the beta of a stock that are biased towards zero. This may affect the ERA's estimation of beta in the SL-CAPM as well, but HoustonKemp was not asked to assess this.

(e) In computing an estimate of the zero-beta premium, the only restriction that the ERA places on the number of observations required to compute a past estimate of beta is that there be at least two observations. Some of the estimates on which the ERA relies will be constructed using very few observations and will thus be imprecise.

6.66 These empirical issues may have a significant effect on the ERA's empirical estimates, and suggest that at the very least that the ERA's empirical work be subject to the same kinds of independent audit as DBP submitted its own work to (see paragraphs 6.115 to 6.123).

6.67 The second piece of evidence the ERA presents is the opinions of various experts. These have, in most cases, been engaged by the AER and not the ERA, but the ERA appears to be endorsing the views of experts as being supportive of its own view that estimates of the zero-beta premium are likely to be highly variable and potentially not very robust. HoustonKemp (Appendix H), has addressed the various pieces of expert evidence in some detail, and concludes:

(a) Partington & Satchell (2015) are incorrect to conclude that zero-beta estimates are "virtually worthless" due to their sensitivity to extreme values, when in fact there are no extreme values in the estimates that NERA, and subsequently HoustonKemp, provide. Additionally, the stability of NERA and subsequently HoustonKemp estimates of the zero-beta premium through time suggests that they are clearly not "worthless" – the fact that they are stable and lie significantly above zero illustrates that the SL-CAPM is not consistent with the data.

(b) Partington & Satchell (2015) are incorrect to conclude that an estimate of the zero-beta cannot be current because it requires almost 20-years of data to estimate robustly.[58] The argument ignores the fact that DBP, and HoustonKemp, estimate a zero-beta premium which is added to the current risk-free rate to produce a current zero-beta rate.

(c) The discussion on the technical issues in respect of the zero-beta premium, raised in the paper by Beaulieu, Dufour and Khalaf (2012), pertain primarily to situations where the beta of a stock is very close to one or the betas of a group of stocks are close to one, and this is not the case for the large set of ASX stocks used by NERA and HoustonKemp in estimating the zero-beta premium. Moreover, the evidence of instability through time that Beaulieu, Dufour and Khalaf provide pertains to the zero beta rate (risk-free rate plus premium) and not the zero-beta premium. It is thus of limited relevance.

(d) The findings of the work of Ray, Savin and Tiwari (2009) have been addressed in NERA (2015), provided to the ERA; the issue of asymptotic distributions is not an issue for DBP because we used simulations to correct for issues with the asymptotic distribution which might influence critical values.

(e) The work of Da, Guo and Jagannathan (2012) about the use of the SL-CAPM in respect of projects does conclude that it is still valid, but only if one adjusts all betas for the growth options that some firms hold, which neither the ERA nor the AER do; it is not a finding in respect of the SL-CAPM as actually used by regulators.

(f) The paper by Kan, Robotti and Shanken (2013) suggests that, when portfolios are formed a certain way, the superiority of the FFM over the SL-CAPM vanishes, but the authors do not say that the SL-CAPM is superior, and overall they find that the inter-temporal CAPM performs best, followed by the FFM. Like others, they find a negative, rather than a positive relation between the returns on portfolios of stocks and estimates of their betas.

[58] *Note that the ERA uses much less data than this to estimate its zero-beta premia. In fact 20 years is the longest time series used. It is not clear how the ERA's approach in this respect would align with Partington and Satchell's views*

6.68 The conclusion we draw from this brief summary, and the more detailed work in Appendix H, NERA (2015) and HoustonKemp (2016), is that much of the evidence regulators collect in respect of the Black CAPM, leading to the conclusion it is not robust, has been misinterpreted. Variation in estimates of the zero-beta premium is an issue whose importance is overstated, the ERA overlooks key information by ignoring other aspects of the zero-beta premium estimates it produces (like them all being greater than zero) and there are, in any case, serious doubts about the reliability of the regulator's estimates. In conclusion, from examining the ERA's empirical evidence and the views of the AER's experts, the case against the Black CAPM is, in DBP's submission, weak.

Nonsensical results from applying the model adequacy test

6.69 The second empirical objection the ERA makes to the model adequacy test is that its results are "nonsensical". This is not based upon any assessment of the empirical work we have undertaken, or the uncovering of any flaws in our calculations; as discussed previously, the ERA has undertaken none of the detailed assessment needed to support such a finding. Instead the finding is based upon, essentially, the fact that actual returns differ from those predicted by the SL-CAPM; an issue DBP addressed in its response to the ERA issues paper for our Original AA Proposal, where it made a similar error (see paras 3.27 to 3.42).

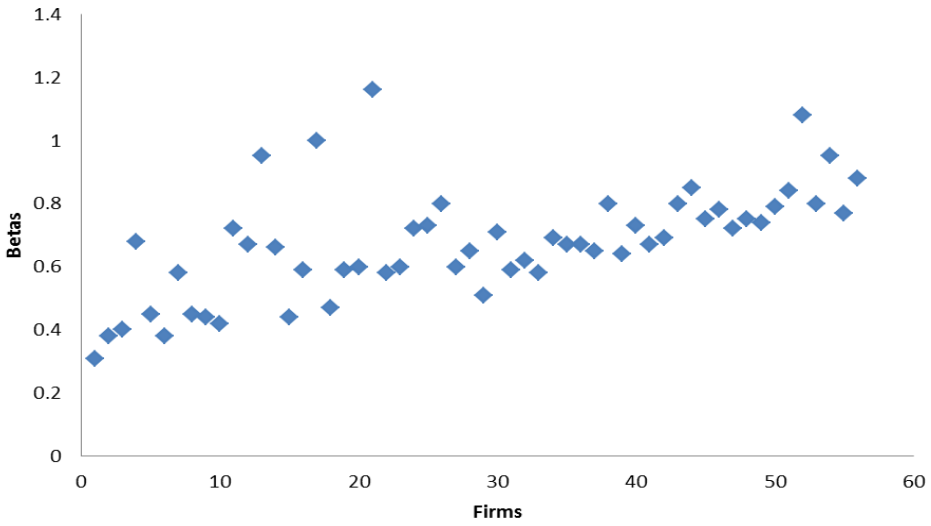
6.70 The heading of the relevant section (see DDA4 p45) suggests the model adequacy test is "producing" results which are nonsensical. However, as has been earlier explained, all the test does is compared predicted outcomes with actual outcomes. What it is really showing is that, when one models the return on equity in the way that the ERA does (note the results of Method C above in relation to the ERA's new approach to the MRP), the results the ERA's approach give are both statistically and economically significantly lower than the actual returns made by firms with similar levels of systematic risk. In other words, empirical fact is substantially different from model prediction, and the model adequacy test simply reflects an empirical reality. This is not a nonsensical result.

6.71 The ERA motivates its "nonsensical" conclusions with two examples. Firstly, (DDA4 para 187-92, p45 and paras 1005-18, pp222-5) it shows that adding the mean forecast error (of Portfolio One; which has a similar beta to energy firms) to predictions made by the SL-CAPM for an energy firm would produce a return higher than the market.[59] This the ERA deems nonsensical, because it has good conceptual reasons for believing that the systematic risk of an energy firm is less than one. It backs this up by opinions from McKenzie and Partington that energy firms, which they believe are insulated from business risk and face inelastic demand ought to have low systematic risk.

6.72 There are three points to make in response to this. Firstly, whatever McKenzie and Partington (2012) might believe about energy firms, it is not clear that their beliefs are entirely borne out by reality, as this plot of betas for US energy firms from SFG (2013) shows.

[59] *DBP notes that this is not how the model adequacy test operates, nor what we have suggested regulators ought to do.*

Figure 3: Beta estimates for US firms



Source: SFG 2013 Table 6

6.73 DBP is not suggesting that the ERA should start considering US energy firm betas directly, but merely point out that, if McKenzie and Partington (2012) were correct, one ought to see evidence supporting their claims in US markets as well, and the evidence more mixed than would be the case if these authors were correct.

6.74 Far more importantly, however, is the way the ERA has missed a key point DBP has consistently made. We agree that if systematic risk is determined by covariance, one can easily calculate beta using five years of data and find that it is low. The point made in our Original AA Proposal (see Submission 12 para 5.92 and 5.124) is that firms with a similar level of systematic risk to energy firms, with betas of around 0.5, actually earn significantly more in the marketplace than regulators believe is appropriate for regulated energy firms. Thus, if the basis of the SL-CAPM is true, an investor seeking the same level of systematic risk exposure as she would obtain from energy stocks will actually earn far more by seeking that systematic risk exposure elsewhere in the economy.

6.75 This point is not new to DBP or unique to the dataset we used. In response to the ERA's issues paper on our Original AA Proposal (see paras 3.27-42) we presented numerous papers which have found the same pattern as we observe in markets all round the world and further evidence can be found in Lewellen, Nagel and Shanken (2010), Kan, Robotti and Shanken (2013) , CEG (2008) and SFG(2014). Indeed, one of the experts used by the AER on return on equity matters, and cited by the ERA, agrees with us, noting (Fishwick, Muijsson & Satchell, 2014, p 2):

> *"One of the observations over the cross section of stocks is that the historical risk-return trade-off is flat or inverted: within the CAPM one would expect that stocks with high systemic risk would outperform their low risk counterparts, but results have shown otherwise."*

6.76 The ERA has also ignored its own evidence. Vo (2015), the published version of the ERA's work on the FFM, finds that the coefficient on the beta associated with the market portfolio is zero. Fama and French (1992, p432) note that:

> *"We show next that when common stock portfolios are formed on size alone, there seems to be evidence for the model's central prediction: average return is positively related to β. The β of size portfolios are, however, almost perfectly correlated with size, so tests on size portfolios are unable to disentangle fi and size effects in average returns. Allowing for variation in β that is unrelated to size breaks the logjam, but at*

> *the expense of β. Thus, when we subdivide size portfolios on the basis of pre-ranking βs, we find a strong relation between average return and size, but no relation between average return and β.*

6.77 By contrast, Vo (2015) makes no comment on what his finding of only very weak evidence that beta is in fact positive as the SL-CAPM (and Black CAPM) suggest it must be.

6.78 This is not to say, of course, that the resounding conclusion of the empirical literature is that the SML has zero or negative slope and although some have presented evidence that the SL-CAPM is "dead" (Lai & Stohs, 2015) there is a range of empirical evidence which also supports a positively sloped SML, albeit with a shallower slope than the SL-CAPM.[60] However, a finding of low beta stocks having high returns is neither nonsensical nor unprecedented in the literature and the ERA has ignored evidence in drawing this conclusion.

6.79 Ignoring this evidence has an important impact. To the extent that investors take into account actual returns when forming expectations, the effect of the ERA's reliance on the SL-CAPM would be to mute investment in regulated energy stocks, because investors would realise they can earn higher returns for the same level of risk elsewhere. Since the ARORO requires the ERA to set the rate of return such that it is "commensurate with the efficient financing costs of a benchmark efficient entity with a similar degree of risk as that which applies to the service provider in respect of the provision of reference services" (Rule 87(2)), the approach is contrary to the Rules.

6.80 The final point is one made by CEG (see Appendix F) who note that the ERA is not making an "apples with apples" comparison because of gearing. The average firm on the ASX has a gearing of roughly 37 percent, which is about half what the ERA allows for the BEE (see Appendix F) which would mean that a regulated entity could have low fundamental risk and yet still have relatively high risk compared to the average firm in the market owing to its being geared nearly twice as high.

6.81 The second "illustration" the ERA provides reflects Portfolio 9, a high beta portfolio for which the bias inherent in the SL-CAPM is positive, not negative. Here, after applying the same simple adjustment of model predictions by the mean forecast error, the ERA concludes that the test must be nonsensical because it suggests a return on equity lower than the return on debt.

6.82 There are three issues here. Firstly, the ERA has ignored standard errors, focussing only on mean forecast errors. Attached to the point estimate, 6.37 per cent per annum if one uses method B, is a standard error of 6.37/2.709 = 2.35 per cent per annum. Thus a 95 per cent confidence interval for the true mean forecast error will be 6.37 – 1.96 * 2.35 to 6.37 + 1.96 * 2.35 per cent per annum, that is, 1.76 to 10.98 per cent per annum. It would be difficult to describe as 'nonsensical' many of the adjustments that lie within this confidence interval.

6.83 Secondly, and perhaps more importantly, the ERA creates a comparison which is not between apples and apples. The forecast error is the difference between model predictions and actual outcomes for equity holders in high risk firms. However, the cost of debt to which the ERA refers (it provides no estimate of the cost of debt for Portfolio 9) appears to be the promised cost of debt. The actual return on debt may in fact be significantly different from the return promised by high-risk firms in Portfolio 9.

6.84 Finally, the ERA suggests that it is somehow impossible for the return on equity to be less than the return on debt. However, this is not true. Firstly, as the *Economist*, points out, equity returns can be negative for long periods of time:[61]

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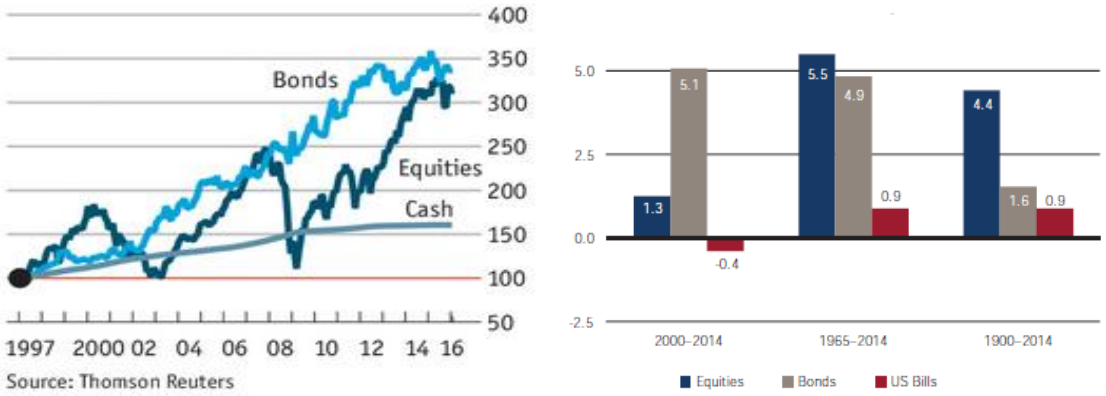
[60] *See Fama & French, 2004, for a review of the early literature in this regard. Note in the same paper the authors present evidence of a negative relationship between return and beta for portfolios sorted on book to market rations.*

[61] *See http://www.economist.com/blogs/buttonwood/2016/01/investing. See http://www.economist.com/news/finance-and-economics/21690104-low-bond-yields-dont-always-help-equity-returns-false-comfort for more recent evidence, from Japan, that the total return from bonds can be substantially above equity returns for extended periods of time.*

"Elroy Dimson, Paul Marsh and Mike Staunton of the London Business School are the acknowledged experts on global investment returns, having compiled data covering 22 countries over more than a century. As of February 2013, the longest period of negative real returns from US equities was 16 years. But it was 19 years for global equities (and 37 for world ex-US), 22 for Britain, 51 for Japan, 55 for Germany and 66 for France. Such periods are much longer than most small investors would have the patience to wait."

6.85 The same article points to the work shown in the left hand side of Figure 4, suggesting that bonds have actually out-performed equities over recent periods of time, and Dimson, Marsh & Staunton (2015) show similar evidence in the figure on the right hand side of Figure 4. Finally, Bloomberg, tracking returns on debt and equities over successive 30-year windows note that, in the 30 years to 2011, debt in fact did better than equities in the US.[62]

Figure 4: Debt and equity returns through time



Source: LHS http://www.economist.com/blogs/buttonwood/2016/01/investing, RHS, Dimson, Marsh & Staunton (2015) p60. Note that the left hand side is global bonds and equities, and the right hand side is for the world exclusive of the US

6.86 This is not to say that debt is somehow a better investment than equity, and that one ought to expect that debt will out-perform equity in any particular period. Rather, it is to point out that the ERA's "impossibility" finding in relation to the relative returns of debt and equity is incorrect; if periods can be found where debt out-performed equity, then it is not automatically nonsense that Portfolio Nine has lower actual returns for equity than what the ERA believes are promised debt returns, particularly when Portfolio Nine is one of the riskiest portfolios we examine.

Alleged other statistical issues

6.87 The ERA presents a list of supposed statistical issues which it asserts may affect the model adequacy test in paragraph 195 (p46), with further details in paragraphs 1026 to 1038 (pp 227 to 31). These are as follows:

(a) The test DBP uses is not one of bias but prediction accuracy.

(b) The test does not include the uncertainty of prediction estimates within the test.

(c) The testing of each portfolio via the t-test gives rise to a multiple comparison problem, which will increase with the number of portfolios.

(d) The method of generating predictions potentially suffers from pseudo-replication.

(e) The t-test is not specified.

(f) The model adequacy test is not state of the art in the statistical literature, and there are no references in the literature in defence of the method cited by DBP.

[62] *See http://www.bloomberg.com/news/articles/2011-10-31/bonds-beating-u-s-stocks-over-30-years-for-first-time-since-19th-century*

6.88 The first five of these points are general points about the statistical robustness of what DBP actually did, whilst the last is a suggestion about what DBP ought to have done, and should be read in conjunction with paragraph 196 (p46) where the ERA suggests that the "state of the art" it refers to is cross validation. We examine the cross validation approach in the final subsection of this section (see paragraphs 6.124 to 6.129) and take the ERA's suggestion of applying this test empirically in Chapter 11.

6.89 Taking the last point first, DBP makes no pretence that its version of a model adequacy test is the best or the only way in which one could test for prediction bias; of course there are many methods. However given that the idea of any kind of testing of model outputs is, in one sense new in regulation in Australia, we chose prediction bias tests which have been around for a long time, and are familiar in the literature.

6.90 While we did not provide literature defending the use of a t-test, the t-test has been around since the early 20th Century, and is the standard approach employed to test the difference between two means, which is all that the prediction bias test is.

6.91 However, in response to the Draft Decision, DBP engaged Houston Kemp to undertake such a review, focussing on the use of t-tests in finance to examine issues similar to those which we address in the model adequacy test. Moreover, since the ERA has suggested that cross-validation tests are in fact the "state of the art", we also asked HoustonKemp to examine the use of this technique in finance (see Appendix G).

6.92 In respect of t and Wald tests, HoustonKemp conduct a review of high-quality finance journals, finding more than 400 instances, including 70 specific to forecasting, where Wald tests have been used. The t-test is, as DAA (Appendix K, para 71) puts it "highly generic" and "very standard" and is so widely used in empirical papers that it is rarely included in the kind of key words which are easily searched in literature reviews. We note, however, that DAA (ibid) conclude that its use is "totally appropriate" in the context of a model adequacy test such as that which DBP uses.

6.93 HoustonKemp find that the generic term "cross-validation" comes up in 56 finance papers and some 168 forecasting papers, whilst the more specific "k-fold cross-validation" is much rarer. However, we note that "k" is often replaced by a number; ESQUANT, for example, refer to "10-fold cross validation" when implementing the ERA's proposed cross-validation tests. Thus, although cross-validation is not as widely used as t-tests and Wald tests, it is hardly unknown in finance.

6.94 More usefully than a mere citation count, however, HoustonKemp point out that the results of Bergmeir & Benitez (2012) and Bergmeir, Hyndman & Koo (2015) cannot simply be translated to the context of testing the outputs of asset pricing models without careful consideration of whether the nature of the models being assessed match the properties of the papers being cited. More prosaically, DAA (Appendix K) note that, whilst cross validation is indeed an accepted part of statistical practice and has enabled statisticians to handle some problems far better than traditional methods, for linear regression models, far simpler methods, such as the Akaike Information Criteria are just as good as cross validation. It is unclear whether the added complexity of the ERA's cross validation results will indeed improve the inferences about model adequacy DBP's proposed test is attempting to make.

6.95 In relation to the first five potential statistical robustness concerns surrounding the model adequacy test, raised by the ERA, DBP presents evidence from HoustonKemp of the Wald and t-tests (Appendix G) and evidence from DAA (Appendix K) who were engaged specifically to examine statistical issues. Overall, DAA finds the ERA's concerns to be groundless. Briefly:

(a) DBP does test bias and in fact only tests bias; this is precisely what the t-tests and Wald tests used by DBP are designed to test, and for which both tests have been widely used for decades. The longer discussion (DDA4, paras 0122-25, pp225-7) raises criticisms which DAA finds to be simply not relevant in the context of the models being examine.

(b) In respect of the uncertainty around prediction errors, although this may, in principle, be an issue, as we make clear in our December 2014 submission (Sub 12 App D), we conduct bootstrap simulations to examine the behaviour of the *t* statistics and Wald statistics that we

use both under the null that the SL CAPM is true and under the alternative that it is false. The close correspondence between the simulated distribution of the *t* statistics and Wald statistics with the theoretical distributions for the statistics that we use in our model adequacy tests indicates that any concern on the part of the ERA that we have incorrectly assessed the standard errors of the mean forecast errors that we construct is misplaced. In addition, both the simulations and the results of our tests indicate that the *t* and Wald tests that we use have the power to reject the null hypothesis that the SL CAPM is true in favour of an alternative hypothesis

(c) In respect of the multiple comparison issue, HoustonKemp show that, whilst it is potentially an issue for a series of t-tests, particularly if they are not independent of one another, the Wald test is a joint test of the null hypothesis is simultaneously true across all portfolios, and thus does not suffer the issue that the ERA raises. It is by no means clear that the t-tests undertaken by DBP suffer from the issue in reality either (the ERA provides no evidence of this), but the addition of the Wald test ensures that, even if they do the inferences made by the test remain robust.

(d) The potential for pseudo-replication is acknowledged, but DAA (unlike the ERA) tested for autocorrelation and, finding none, note that it is no0t an actual concern given the dataset DBP has used. Moreover, as HoustonKemp show (Appendix G) the ERA's concern about an artificial inflation of power in going from less frequent (five years) to more frequent (one month) data is misplaced; HoustonKemp shows that even moving to daily data has only a minimal effect on the power of the tests.

(e) DAA finds the t-test is correctly, and clearly specified, and implemented in accordance with best practice. Where the ERA expands upon this point (DDA4 para 1035, p230) and discusses two-sample and paired t-tests, DAA notes that comparing model predictions and actual values could be termed a paired t-test, and that the ERA has raised no issues of substance, but that its "curious" discussion on the use of the Diebold Mariano test might be based on the ERA attempting to clarify what was done by DBP. DBP admits to be somewhat confused at what the ERA actually means in paragraph 1035. If by "paired t-tests on the difference between corresponding predictions" it means that we should compare, say the SL-CAPM prediction with the Black CAPM prediction, then this would simply tell us how different the forecasts are, which is already clear from the mean forecast errors, and appears to add little to our understanding of model adequacy (see Appendix G). Additionally, when DBP did examine some paired comparisons of errors (subtracting, the errors of the Black CAPM from the errors of the SL-CAPM, say) and examining if the result was, on average, zero the vector of the differences in forecasts was auto-correlated, even though each error vector was not, and the resultant "paired" t-tests tell us little of substance.

Alleged data issues

6.96 The ERA makes two comments in respect of the data which DBP use for the model adequacy test. Firstly, in a footnote on p47, the ERA states

> *"This need for a long time series was considered one of the weaknesses of the model adequacy test (Appendix 4B), one which can be circumnavigated (sic) by various approaches to cross-validation (Appendix 4B(i))"*

6.97 There is nothing inherent in the model adequacy test which requires us to use the SPPR dataset. We could have equally used Bloomberg, Thomson Reuters, Morgan Stanley or any other source of data to undertake our model adequacy test. We use the SPPR data because it is the longest database of stock returns available in Australia and it is highly regarded in Australia.

6.98 Just as it is possible to undertake DBP's model adequacy test with other datasets, it is possible to undertake cross-validation with the SPPR data, or with data from other datasets; the two approaches are identical in respect of what data can be used. The key question is which dataset ought to be used. The longer is the dataset, the greater is the likelihood that it will not be dominated by single events (the GFC, say) that might not be particularly reflective of how the future might eventuate. In finance, because the data are noisy, analysts generally use the longest time

series they can (structural breaks permitting) and Campbell, Low & MacKinlay (1997, p204-7) show the significant losses in power which come from using shorter datasets with finance data. We would argue that, consistent with best practice, any test ought to be undertaken using long datasets.[63] Indeed, failure to use long dataset when working with noisy finance data in particular leads to results with very low power that make it very difficult to make any robust conclusions at all.

6.99 This is particularly an issue for the cross validation the ERA proposes to use. As pointed out in paragraphs 11.1411.15 (see also Appendix I), the error structure induced by overlapping time series means that cross validation cannot be used for these series and instead monthly results must be aggregated to annual results, or some other less frequent set of data. Unless the ERA uses a long time series, this means that it cannot implement cross validation robustly; if anything the ERA will need more data to do cross validation robustly.

6.100 The second comment is in paragraphs 991-3, where the ERA suggests that DBP's choice of data sources are "ungrounded", because the zero-beta premium estimates come from NERA, the HML factors come from Ken French's website and the remainder of the data come from the SPPR database. The ERA notes that DBP has also provided no evidence to support its decision to use the data on the HML factor from Ken French's website, but to calculate the SMB factor ourselves.

6.101 Although DBP is unclear what an "ungrounded" data-source is, the ERA's concerns are misplaced. In the first instance, although we used NERA estimates of the zero-beta premium, NERA actually calculated those estimates using SPPR data. There is thus no issue at all in respect of different underlying assumptions in the data.

6.102 Secondly, in respect to the HML and SMB factors, the ERA is correct, that DBP did not provide an explanation for the use of different sources in our Original AA Proposal. The explanation is:

(a) That Ken French provides only the HML factor for Australia on his website; we could not have used this source for both factors.

(b) That the SPPR database contains only data from the stock market; not the accounting data needed to calculate the HML factor. Thus, we could not have calculated the HML factor using the SPPR database.

6.103 DBP could, of course, used a single database such as Bloomberg to estimate both FFM factors, and indeed as an input to every aspect of the model adequacy test. In an ideal world, we would have done exactly this. However, this would have meant that we would only have been able to capture a very short time series; Ken French himself uses data from Morgan Stanley International and Bloomberg to calculate his HML factors because relevant Bloomberg data go back only to 2007. A very short time series, particularly one which begins in 2007, would have meant that the results of any kind of model adequacy test would have results with very low power indeed. This would mean that any statistical inferences made would be highly suspect. Although, in an ideal world, we would have used a single source of data for everything, that was not possible in light of data availability problems.

6.104 We note finally that any data issues which might arise from using two different sources make no difference to our results; although two data sources are used for the FFM, meaning our rejection of the FFM in the model adequacy test may be incorrect based upon the ERA's concerns about different assumptions underpinning different data sources, only one is used for the SL-CAPM and Black CAPM. Thus, any differences in data-sources are irrelevant in respect of the findings which bear directly upon the choice of model we eventually use.

[63] *We note the ERA has made very similar arguments itself in the past in support of long time series; indeed chiding DBP for using time series which it believes may be too short in the context of Diebold Mariano test work on the prediction power of different averaging periods for the risk-free rate (see ERA Explanatory Statement for the Draft Rate of Return Guidelines, p248, available from https://www.erawa.com.au/gas/gas-access/guidelines/rate-of-return-guidelines)*

Bias in the SL-CAPM and the "theory" of the Black CAPM

6.105 The ERA deals with DBP's model adequacy test on pages 41 to 48, as part of its discussion on Stage One of its five-stage process. Having dismissed the test, the ERA then focuses on its own approach (pp48-89) in relation to parameters in its favoured model, the SL-CAPM, and the cross checks it makes of those parameters.

6.106 Within this discussion, however, on pages 56 and 57, the ERA does make some comments in respect of bias in respect of the SL-CAPM, within the context of a discussion on beta. Although not directly related to the model adequacy test, it is useful to explore these comments, in light of the information from the model adequacy test and other information provided by DBP, as well as statements made by the ERA elsewhere in the Draft Decision.

6.107 The ERA begins this section by noting that it had considered in the Guidelines, the evidence suggesting that (para 242, p56):

> *"there is some downward bias in equity beta estimates that are less than one and upward bias in equity beta estimates that are greater than one"*

6.108 This is technically incorrect, as it is not bias in the estimates of beta per se that is the issue, but rather it is the case that the SL-CAPM as a model produces results which are biased downwards for low beta stocks and biased upwards for high beta stocks. It is bias in the model, not bias in the estimation of beta per se which is the issue (see paragraphs 4.39 to 4.41). However, this may simply be an error of drafting. The ERA then goes on to say that, despite this empirical finding, which it acknowledges, it rejects a suggestion by SFG (not in support of DBP) that this implies a beta of one for two reasons:

(a) It has rejected the use of the Black CAPM as its implementation in Australia is unreliable.

(b) Even though the Black CAPM predicts higher returns than the SL-CAPM, which may imply that the SL-CAPM has a low beta bias but the Black CAPM does not, the ERA's view is that this bias is not well established in either the theoretical or empirical studies.[64] In any event, the SL-CAPM and Black CAPM are two different models, which need to be estimated separately in their own right.

6.109 The practical upshot of this conclusion is that the ERA believes that the Black CAPM has a use only insofar as it suggests a downward bias for the SL-CAPM where beta is less than one, but that it should not be used directly due to concerns about the reliability of estimates of the zero-beta premium, and that any downward bias for stocks with low betas is difficult to quantify (para 247, p56). Thus, the most appropriate response is to choose a value of beta towards the top end of its estimated range of 0.3 to 0.8.

6.110 As discussed above (see paragraph 6.30 to 6.35 and Table 24), this leads the ERA into error, and its bias adjustment based on the "theoretical implications" of the Black CAPM is much lower than even the smallest adjustment it would have made if it had considered its own empirical evidence. It may have, as proposed, adopted a method of cross validation to quantify bias, but it has relied upon untested regulatory judgement.

6.111 The importance of the arguments above for DBP's Draft Decision comes when the ERA begins to talk about using the "theoretical insights" of the Black CAPM to motivate its choice of beta (see DDA4 para 747, p157) and, in the context of the DBP Draft Decision, where it says that such indirect use of the Black CAPM is acceptable, but use of empirical information using betastar is incorrect, an issue we address in detail in paragraphs 6.130 to 6.140.

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[64] *The ERA notes that this conclusion is based upon an "extensive literature survey" (para 245, p56) but has not provided any evidence of this survey. By contrast, CEG's expert report (AA Proposal, Submission 12 Appendix C) contains an appendix detailing a literature review by Bruce Grundy of papers seeking empirical support for the SL-CAPM which show its bias. This evidence has also been ignored by the ERA.*

6.112 The Black CAPM was originally developed (see, McKenzie & Partington, 2014, for a brief overview of the different papers and their differing positions) in response to empirical findings which began to emerge in different finance conferences late in the 1960s (see Mehrling, 2005) which appeared to show that the actual return for low beta stocks was higher than the SL-CAPM predicted, whilst the actual return for high beta stocks was lower. As the ERA points out elsewhere (see DDA4 para 722, p152), the only theoretical difference between the SL-CAPM and the Black CAPM lies not in beta, but on the intercept; the Black CAPM assumes the lending and borrowing rates differ and do not equal the risk free rate, but unlimited long and short positions are possible, whilst the SL-CAPM assumes unlimited borrowing and lending is possible at the risk free rate. The practical effect of this theoretical change is to shift the intercept of the security market line upwards, and thus lessen its slope. This, in turn, makes the expected returns of low beta stocks higher and of high beta stocks lower than predicted by the SL-CAPM.

6.113 This is important when considering the bias adjustments made by the ERA and DBP (through its betastar model). The ERA, motivating the "theory" of the Black CAPM, changes beta, using a higher level of beta than the mean value it obtains from its own regressions. However, the theoretical change from the SL-CAPM to the Black CAPM has nothing whatsoever with beta, it is a shift of the intercept. Moreover, there is no way to generalise from the particular adjustment the ERA makes to any other stock, or indeed to a situation where energy stocks have a different beta. The ERA believes that energy stocks with a beta of 0.5 ought to use their 95th percentile to remove bias in the SL-CAPM, and thus a beta of 0.7. However, what would the ERA recommend for stocks with a beta of 0.8, or 0.9, or 1.2? Would different points, above and below the mean of the beta estimate suffice, and what rule would it employ? The choice of the 95th percentile for beta appears precise, and the ERA has argued that it is not arbitrary (see below). However in DBP's submission it is both arbitrary and unrelated to the theory of the Black CAPM, and further is instead a much less elegant response than Black, Brennan and others to the empirical observation that low beta stocks tend to have actual returns higher than predicted.

6.114 By contrast, betastar is an algebraic manipulation of the Black CAPM such that the effect of the higher intercept (the sole change in theory between the SL-CAPM and Black CAPM) is loaded into beta(star). It thus reflects the "theoretical insights" of the Black CAPM directly, through this algebraic manipulation; essentially doing exactly the same thing as the Black CAPM model does. This means, in turn, that there is no ambiguity about what to do for stocks with different betas; the adjustment is exactly the same as for the Black CAPM itself, where low beta stocks have higher returns predicted by the betastar model compared to the SL-CAPM, except that the change comes through an adjustment to beta (compare Original AA Proposal Submission 12 Tables 6 and 10, with Table 11) which is exactly consistent with the "theory" of the Black CAPM.

The results of the DAA audit

6.115 The ERA, as noted above, has not made a proper assessment of DBP's empirical work. DBP has, however, sought an independent viewpoint as to the statistical validity of the work it has undertaken to ascertain whether or not it represents "best practice" in some way. This assessment was undertaken by Data Analysis Australia (DAA) and their report is provided in Appendix K.

6.116 Overall, DAA endorse DBP's approach, and agree with our conclusions in respect of which models are biased and which are not, suggesting that DBP's work provides reasonable estimates of the appropriate risk premia, performing substantially better than the ERA's approach.

6.117 The assessment, however, does recommend improvements:

(a) DBP's econometric coding is uses poor programming style and was clearly developed for internal purposes. However, this did not prevent DAA from being able to replicate almost all results, and ensuring that the results presented by DBP are largely free from error.

(b) The t-tests for the FFM use data up to time t, rather than up to time t-1, but when this is corrected, it does not change the substantive conclusions DBP draws in respect of the FFM.

(c) There is an error in the calculation of the Wald statistics for the two ends of the unbiased range for betastar, and DBP should in fact have found a slightly higher lower bound than it did. In Chapter 11, the lower bound for betastar is found to have increased.

(d) It is not good statistical practice to choose points on a confidence interval to overcome bias. The issue is particularly acute for the ERA's approach, where a point estimate is used, but in the upper and lower bounds for betastar, what DBP is actually uncovering is a reasonable range for betastar. Other approaches could also have been used to uncover such a range.

(e) The delta method used to determine the standard errors of betastar may not have included some of the skewness in the distribution, which is why the unbiased estimates of betastar are not symmetric around its mean.

(f) DBP did not present results of tests for autocorrelation, but DAA were able to confirm for themselves that this was not an issue in the data, and thus does not affect DBP's results.

6.118 There is one additional issue which DAA consider to be more important than those above. DBP undertook its estimates of different asset pricing models with an intercept (that is, excess portfolio return = intercept + beta* excess market return for the SL-CAPM). However, it undertook its forecasting without an intercept (that is excess portfolio return = beta*excess market return). This is common practice in finance (see, for example, Fama & French, 1997), and indeed the ERA itself estimates beta with an intercept (DDA4 p190), but then sets that intercept to zero when providing a rate of return (see DDA4 p78).[65] This is done in finance because including an intercept in the model allows one to reduce the bias of the estimate of beta (not the bias of the SL-CAPM as a whole) without, usually, creating a significant issue in respect of reduced precision.

6.119 However, the approach DBP and the ERA have taken appears non-standard when viewed from the perspective of statistical experts; standard statistical practice would mean one would ordinarily forecast with the same model used to estimate parameters. Thus, if the model used to estimate parameters has an intercept, so should the forecast, and likewise if the forecast has no intercept, then neither should the model fit to the data.

6.120 To explore this further, DAA went beyond its initial brief to examine the consequences of DBP's (and the ERA's) inconsistency between the model form used to estimate parameters and the model form used to make forecasts. Firstly, they considered what the consequences would be of estimating the SL-CAPM with no intercept, and then forecasting with no intercept. The results are shown in Table 5.

Table 5: SL-CAPM no intercept in model and predictions

		Method A		Method B	
Wald test		26.340		29.829	
Portfolio	Betas	MFE	t statistic	MFE	t statistic
1	0.543	-4.66%	-2.000	-5.32%	-2.903
2	0.614	-4.57%	-1.863	-5.30%	-2.937
3	0.581	-4.11%	-1.638	-4.83%	-2.768
4	0.774	-4.51%	-1.707	-5.31%	-3.195
5	0.866	-2.36%	-0.779	-3.24%	-1.880
6	0.886	-0.85%	-0.284	-1.89%	-1.257
7	0.966	1.80%	0.538	0.75%	0.438
8	1.179	2.44%	0.633	1.05%	0.558
9	1.354	7.54%	1.702	5.86%	2.510
10	1.377	6.32%	1.157	4.64%	1.217

Source: DAA Appendix K, Table 3 MFE stands for "mean forecast error"

[65] *The allowed return is the risk-free rate plus beta times the market risk premium (or excess return to the market). The excess return to the stock, in terms of paragraph 6.118 above, is the return minus the risk-free rate, so there is no intercept in this allowance (the risk-free rate is not an intercept in respect of returns excess to the risk-free rate).*

6.121 The results shown in Table 5 are essentially the same as for the vanilla SL-CAPM in DBP's original work (see AA Proposal, Submission 12, Table 10) and both are very poor models when it comes to forecasting.

6.122 DAA estimated a version of the SL-CAPM with an intercept, and then used that intercept in their forecasts, and the results of doing so are shown in Table 6 below.

Table 6: SL-CAPM with intercept in model and predictions

		Method A		Method B	
Wald test		5.971		6.187	
Portfolio	Betas	Mean forecast error	t statistic	Mean forecast error	t statistic
1	0.536	-0.11%	-0.047	-0.78%	-0.413
2	0.608	-0.27%	-0.108	-1.01%	-0.542
3	0.576	-0.25%	-0.097	-0.97%	-0.544
4	0.766	1.13%	0.415	0.31%	0.180
5	0.857	4.14%	1.328	3.22%	1.815
6	0.882	2.32%	0.765	1.28%	0.836
7	0.966	1.42%	0.424	0.38%	0.221
8	1.182	-0.19%	-0.049	-1.54%	-0.826
9	1.362	1.40%	0.324	-0.22%	-0.097
10	1.384	1.20%	0.225	-0.44%	-0.118

Source: DAA Appendix K Table 4

6.123 If the intercept is added to the model forecasts, then the problem of bias essentially vanishes. Moreover, DAA undertakes further analysis, which suggests that the intercept is roughly the same for all ten portfolios, and thus that imposing a single intercept across all portfolios is a valid restriction to make in the modelling. This is exactly what the Black CAPM does and, although DAA has come at the problem in a different manner, they provide further confirmation that the Black CAPM is a model which can be held to be unbiased in the Australian context.

The ERA's proposed model adequacy test

6.124 Although the ERA rejects DBP's model adequacy test, it appears to believe that, were one to undertake some form of test of model adequacy, one ought to do so using cross validation (see para 196, p46, and then Appendix 4B(i) for more detail). The ERA kindly provided DBP with some code for undertaking cross validation as part of a package of regression code provided upon request,[66] which suggests that the ERA has started to look at an alternative model adequacy test, but did not provide any results in its Draft Decision.

6.125 To the extent that the ERA goes further in its cross-validation work by actually implementing a test or tests (which would constitute something of a change in approach from that adopted by it in the Draft Decision), DBP would appreciate the opportunity to examine and comment upon the results of this work at some point in time prior to the final decision, to avoid the potential for procedural fairness issues to arise and to ensure that the ERA has the benefit of the views of all stakeholders on this issue going into the Final Decision.

6.126 DBP reiterates the point made above that we have no intrinsic opposition to the use of cross-validation or indeed any potentially robust form of testing model outputs. However, one needs to be very careful about what one is actually doing. Quite apart from the statistical issues raised by HoustonKemp in Appendix G, there is an issue of logic. K-fold and LOOCV cross validation operate by removing one or more elements from a data-set, and creating a "test" dataset upon which the model, formed using the remaining data, is tested for predictive accuracy. If one has a

[66] *Although the code describes a more general cross validation exercise, and not the specific example in Appendix 4B(i).*

cross-sectional model, this need not be a problem, because one could develop a model on all sectors of the economy but one, then test it on the sector that was "left out", before doing the same thing with a new sector of the economy, and thus form a model which is robust overall.

6.127 However, the situation is different when it comes to time series data, because one could be using data from the 1970s and 1990s, say, to "predict" the 1980s. This is illogical, because an investor in 1979 would not have access to the information from the 1990s in order to make predictions about the 1980s. The more common approach (as DAA point out in Appendix K), used by DBP and by Henry (2009, 2014) is to make use of an expanding window or (as ESQUANT point out in Appendix I) to make use of the process set out by Hyndman & Athanasopoulos (2014) which is essentially the same as DBP did, except that we included only bias in the loss function, and not variance. In fact examined cross validation during the early stages of the development of the model adequacy test, but did not pursue it, for precisely this reason.

6.128 That is not to say cross validation can have no place, but its results need to be interpreted with care. Since it is impossible to predict using information from the future, the use of cross-validation is not really a "predictive" test at all, but is rather a more complicated way of doing in-sample testing of how well the different models fit the data. This is a valid thing to do, and its use is widespread in finance. Indeed, NERA (2015a) do both out-of-sample and in-sample tests in a version of the model adequacy test prepared for several East Coast service providers and presented to the AER. However, if one is seeking to ask the question "how well will these models predict future returns?", which is what the model adequacy test is seeking to do, it is not clear whether cross validation is the correct approach.

6.129 These concerns aside, because the ERA suggests we make use of a cross-validation model, we provide a summary of expert work undertaken by ESQAUNT (see Appendix I) in Chapter 11. Just as NERA (2015a) find similar results in respect of model bias from in-sample and out-of-sample tests, our findings in respect of k-fold and LOOCV cross validation match our findings from our model adequacy test very well, and cause no change to our overall conclusions

Reasons for maintaining betastar

6.130 The ERA has criticised DBP for the creation of its betastar, forming a further basis for rejecting the model adequacy test as an approach. In respect of the betastar model itself, the ERA makes the following points:

(a) Combining the Black and SL-CAPM in the way that DBP has is a violation of both models (para 959-69, pp212-13).

(b) The ERA is not aware of any literature or empirical studies which use a betastar approach, and DBP fails to provide a single reference to support its view that betastar is well established or at least follows any standard economic or statistical theories (para 970, pp214).

(c) It is inappropriate to consolidate the effects of bias and systematic risk into betastar (para 971, p214).

(d) Betastar actually contains only a small amount of systematic risk, and is mostly comprised of a bias adjustment (para 980-83, pp216-17).

(e) The ERA is not convinced that the bias in beta is as large as the betastar adjustments would suggest (para 980, p216).

(f) Because betastar is more than one, DBP is claiming that it faces more systematic risk than the market as a whole (para 985, p217).

6.131 In respect of the first of these points, DBP makes two submissions. Firstly, as outlined in paragraph 2.28 chose to use the betastar model to minimise deviations from the Guidelines. Secondly, DBP commissioned an expert report from CEG (see Appendix F), which finds no support for the ERA's position. DBP and the ERA are in fact both doing the same thing; each have perceived that the SL-CAPM produces downwardly-biased results and each has sought to glean

information from the Black CAPM in order to do so. The only way in which it can be seen as a "violation" is to define any departure from the strict requirements of a model as a violation. Moreover, if this definition is held to be true, then the ERA also violates the integrity of both models in its adjustment of beta - that issue is not overcome by the use of regulatory judgment. .

6.132 By contrast, the ERA's approach in response to a finding of downward bias for low beta stocks in the SL-CAPM appears to reflect a belief that:

(a) if it adds an increment to its best estimate of β; but

(b) does not base that estimate on explicit analysis of the empirical evidence that justifies an increment; then

(c) it can implicitly depart from the strict application of the SL CAPM without explicitly doing so.

6.133 CEG concludes that this approach is completely irrational; the ERA is acknowledging that bias exists, acknowledging that different models can supply information which might help overcome the bias, but then explicitly rejecting any information from those models in order to solve the bias problem in order to satisfy itself that it is not deviating from the SL-CAPM in any material way.

6.134 CEG also considers that the notion that the Black CAPM and SL-CAPM are so different that one cannot be the source of information for the other to be false. The SL-CAPM is a special case of the Black CAPM, wherein the zero-beta premium is assumed to be zero. If it transpires empirically that the zero-beta premium is not zero then, far from being irrelevant information, the Black CAPM is precisely the source of information to inform the analyst about how much bias might actually exist. The formula for doing so, as CEG points out, is precisely DBP's betastar formula.

6.135 As CEG point out, quite apart from being mathematically correct, DBP's betastar adjustment is transparent and can be easily followed by any observer. By contrast, there is no way of understanding what the ERA has done, save for understanding that it used the 95th percentile of beta (which is the wrong response to bias in a model, as DAA point out, see Appendix K) without any understanding of why the 95th percentile was the correct one to use.[67]

6.136 The reason the ERA gives for not using empirical information from the Black CAPM is the wide variety of estimates of the zero-beta premium, but this is no reason to use none of the information. As CEG points out, the variation might be large, but the minimum zero-beta premium is always above zero, and by failing to use even this information, the ERA has simply failed in its requirements as a regulator to make the best use of available information. Moreover, in doing so, the ERA departs from its practice in respect of parameters in the SL-CAPM. For example, the MRP is formed with reference to the DGM (which is far less closely related to the SL-CAPM than the Black CAPM is) and the direct empirical information that comes from that model. The DGM gives even more variation than the Black CAPM, and is even more sensitive to input assumptions, so it is not clear why it is appropriate to use this model to inform the MRP, but it is not appropriate to use the Black CAPM to inform beta; provided of course that the resultant model is subject to a robust output-based test.

6.137 In respect of the second point in paragraph 6.130 above, the ERA is largely correct, the only reference we can find in the literature to something like a betastar transformation is Black Jensen & Scholes (1972 – the formulation is implicit in Equation 2 from this paper and is an algebraic manipulation of it). This, however, is not surprising; in the ordinary course of events, if the Black CAPM passed a test like the model adequacy test but the SL-CAPM did not, one would simply have used the Black CAPM. However, betastar was adopted so as to minimise departure from the Guidelines.

6.138 DBP did not explain the "standard economic and statistical theories" underpinning betastar because, as is apparent in Submission 12 of our Original AA Proposal, it is nothing more than an

[67] *In any case, the ERA has moved away from the 95th percentile, or rather the 95th percentile has moved away from it; see discussion in paragraphs 6.180 to 6.186. The choice of 0.7 appears now to be a completely arbitrary exercise in regulatory judgement.*

algebraic manipulation of the Black CAPM (see Submission 12 p68), and its "economic and statistical properties are well known, and not altered by a simple algebraic manipulation of its components".[68]

6.139 The third point is in paragraph 6.130 above puzzling. The whole basis for the ERA choosing a beta of 0.7, rather than using the mean estimate of beta from its own SL-CAPM estimations is that it is seeking to address the potential problem of the bias in the SL-CAPM; exactly the same thing that DBP is doing. The ERA itself notes (DDA4, para 247, p56):

> *"Nevertheless, to acknowledge the potential bias inherent in the theory of the Sharpe Lintner CAPM, the Authority considers it may be appropriate to adopt an equity beta in the Sharpe Lintner CAPM which is somewhat higher than the best estimate of 0.5, toward the upper end of the estimated range of 0.3 to 0.8"*

6.140 The fourth and fifth points in paragraph 6.130 above are closely related. Here, in contradiction to the third dot-point, the ERA seems to be saying that one ought to expect some bias adjustment in beta, but not too much; in simple terms, if the adjusted beta was 5/7th systematic risk and 2/7th bias adjustment (the rough proportions in the ERA's solution) then this would be appropriate, but the proportions of the two factors in DBP's betastar are not appropriate. If this is the contention, it is important for the ERA to articulate what proportion of bias and systematic risk it would consider to be an appropriate maximum and most importantly, why it believes that maximum proportion to be appropriate. At the very least, the ERA ought to undertake the step of endeavouring to demonstrate why its own 5/7th - 2/7th proportion is appropriate. In fact, its own evidence from the Black CAPM suggests that it is not.

6.141 The closest the ERA comes to proffering a potential reason as to why DBP's proportions are wrong is at paragraph 980 (p216) where it suggests that betastar is picking up "abnormal return elements". This statement is not explained and the basis for it is difficult to determine, the ERA having conducted no empirical testing of its own. . If any "abnormal returns" were random, periods of high returns would balance out periods of low returns and the net effect on the results of the model adequacy test would be zero, as the test is simply a test of whether the forecast errors are, on average zero. If the abnormal returns were systematic (more under-returns than over-returns, say), then the ERA is correct, and the model adequacy test would pick these up; indeed it has in the case of the SL-CAPM. However, systematic errors in an empirical model generally mean that the model has some missing explanatory variables or is not explaining the data well, because models which explain the data well have random errors; this is in fact a basic characteristic of statistical modelling. Thus, if the ERA is suggesting that the model adequacy test is picking up systematic "abnormal returns" when it finds that the SL-CAPM is biased downwards, then it in fact agrees with DBP when we claim that this is because the SL-CAPM is an model which performs poorly empirically, and thus ought to be replaces with something else.

6.142 The last point from paragraph 6.130 above is without foundation. After observing that betastar incorporates both bias and systematic risk (which is correct – see Original AA Proposal, Submission 12 para 5.151), it then argues that whenever beta is greater than one, DBP must be saying that energy firms have more systematic risk than the market, which we do not say. From this it concludes that betastar is a poor model, which is incorrect.

Reasons for maintaining the consistency test and rejecting the ERA's cross checks

6.143 Stage Four of the ERA's process (and DBP's) involves cross-checking the return on equity estimates. The AEMC was quite explicit that cross checks were to be of the overall return on equity (see paragraphs 6.36 and 6.37), and DBP notes in its own AA Proposal (Submission 12

[68] *Note that the standard errors of betastar, necessary for calculating its confidence interval, are complex, and we describe how this is done in Appendix D of Submission 12, as well as providing the ERA with the regression code used. This formulation of standard errors reflects best statistical practice, which the ERA can show for itself by following our approach.*

para 5.80) that it follows the AEMC's directive and checks parameters at Stage Two and only overall return on equity estimates at Stage Four.

6.144 The ERA, responding to a criticism by CEG (AA Proposal, Submission 12, Appendix C) that it rejects the Fama-French Model on the basis of its empirical results but does not expose the SL-CAPM to similar tests, concludes that it does cross check the overall return on equity derived from the SL-CAPM with other evidence to ensure it is robust and reasonable. However it provides no evidence of having undertaken such tests. Moreover, in the ten pages (DDA4 pp78-89) where it undertakes its cross checks, it notes that three of them, the views of valuation experts, the decisions of other regulators and the relationship between debt and equity, can be used both as a check of the overall return on equity and the MRP. That contention requires some analysis.

6.145 In respect of the views of valuation experts, the ERA considers a report by Grant Samuels on Envestra from 2014 and a survey by Enrst and Young from 2012. However, in respect to the former, the ERA is explicit (DDA4 para 391, p83 and 396, p84) that it is considering this evidence in respect of the market return on equity and not the return on equity it has calculated for DBP; in both of the cited paragraphs the ERA italicises the word "market" to make it clear that this is its focus. It then concludes in respect of this evidence (DDA4 para 400, p85) that the Grant Samuel estimates give it "no cause to revise its estimate of the return on equity, or its current estimates for the MRP". It is clear from the context, and the fact that no reference is made at all to the return on equity estimate made for DBP in the discussion preceding the conclusion (DDA4 paras 390-99, pp83-85) that the ERA is talking about the return on equity as a whole (ie – for the *"market"*), not the return on equity as calculated for DBP.

6.146 The ERA also considers, in a single paragraph (DDA4 para 401, p85), evidence from Ernst and Young, but only evidence pertaining to the market cost of equity, which it then compares with the market returns it has calculated using evidence from Grant Samuels, noting that the two market estimates are similar. There is a similar conclusion in respect to the return on equity and the MRP as noted in paragraph 6.145, but again it is clear from context that the ERA is not talking about the return on equity for DBP, but rather the overall return on equity for the market as a whole. To reinforce this conclusion, the ERA concludes the section (headed "Other evidence on the market risk premium and the implied market return on equity"[69] – DDA4 p79) by noting its belief that "the current estimate" is reasonable (DDA4, para 402, p85). It is clear, both from the discussion and the headings that the ERA refers to its estimate of the MRP when it talks about "the current estimate", and not its estimate of the return on equity for DBP, which is discussed nowhere in the relevant section.

6.147 In the discussion on evidence from other regulators (DDA4, para 404-14, p85-7) it is even more unambiguous that the ERA is talking about the MRP and not the return on equity for DBP, as it discusses the MRP estimates for the AER and IPART (albeit noting they use risk-free rates of a different tenor) and considers only the MRP estimates from other regulators in Table 11 (DDA4 p87). Its conclusion (DDA4 para 413-14, p87) also references only the risk-free rate and MRP.

6.148 The only aspect of the ERA's assessment of cross checks which considers anything other than individual parameters of the SL-CAPM is its consideration of evidence from the cost of debt, where it notes that (DDA4, para 425, p89):

> *"The Authority considers that the resulting differences in the premiums, of around 2.11 percentage points – being the difference between the return on equity of 7.28 percent and the cost of debt of 5.172 percent, is reasonable"*

6.149 There is no discussion as to how the ERA reached this conclusion of reasonableness, although it was not through the consistency test which DBP. This is because that test is rejected by the ERA rejects. DBP does not consider, given the importance of checking overall returns, that it is sufficient for a regulator to undertake only one check of the overall return on equity and in that check, provide no reasoning whatsoever as to how it obtained its conclusion of "reasonableness".

[69] *This is a sub-section heading, the overall section heading is "Cross checks of parameters in the Sharpe-Lintner CAPM" (DDA4, p79) which makes it even clearer that the ERA is checking parameter estimates.*

6.150 DBP discusses issues with beta (most particularly) and the MRP in paragraphs 6.165 to 6.195. The difficulty with the cross checks that the ERA has done is not what they say about individual parameters within the SL-CAPM, but what they do or do not say about the overall return on equity; as noted above, the single cross check the ERA has undertaken provides no reasoning whatsoever as to how the ERA reached its conclusion.

6.151 DBP makes use of three different cross checks of the overall return on equity:

(a) Submissions made by other service providers.

(b) Reports prepared by independent experts.

(c) DBP's consistency check based upon Merton (1974) and his insights as to the relationship between debt and equity, based upon options theory.

6.152 Of the three, the third is the most important cross-check, and is given most weight by DBP.[70] The ERA has rejected the cross check, and we discuss its reasoning, below. The ERA concludes (para 421, p88) that it:

(a) Does not follow any standard finance theory.

(b) Is not well established and is untested.

(c) Is sensitive, empirically, to changes in assumptions.

6.153 On these grounds, the ERA rejects SFG's approach and asserts its view that the link between the two markets is "not robustly established" (ibid, para 422). It then proceeds to mischaracterise SFG's work by suggesting that SFG "states that the return on equity can be directly derived from the cost of debt" (ibid para 423). This is incorrect, and highlights a superficial approach to this evidence. SFG notes that, based upon the work of Merton (1974), since debt and equity are options on the same underlying asset and driven by the same underlying forces, there will be a positive relationship between them. This is not the same as deriving a cost of equity directly from the cost of debt, as SFG points out that (Original AA Proposal, Submission 12 Appendix L, para 75):

> *"Before proceeding, we reiterate the very important point that we have made above. We do not suggest that this framework can be used to obtain a single point estimate of the required return on equity from the analysis of primary data. Estimating the required return on equity is a complex task that requires consideration of a whole range of models, estimation methods, data and other evidence. Rather, our point is that the Merton framework is very useful when considering the relationship between the required return on equity and the required return on debt for the same firm. The Merton framework provides valuable insights into the relativity between these two quantities. The Merton framework has been shown to perform well empirically in explaining the relative returns on equity on debt and it is for that purpose that we consider in this report. The relativity between the required return on equity and the required return on debt takes on new importance under NGR 87(5) which requires stakeholders to have regard to the consistency of parameter estimates and to the interrelationships between parameters."*

6.154 Further, it would appear from one of the ERA's conclusions in respect to the consistency test that it is yet to review the literature upon which it is based in sufficient detail. The ERA notes at DD Appendix 4C, para 1086, p1087:

> *"The Authority is not in the position to provide response (sic) to the three key studies…. Which SFG has relied upon to support its analysis."*

[70] *The ERA notes (DDA4, para 426, p89) that, because the results of the consistency test are used to narrow the range of the cost of equity estimates, the core of our return on equity estimate is the relationship between debt and equity. However, this is false; as we make clear in our AA Proposal, the core of our estimate is the model adequacy test and the unbiased results it provides. Although the consistency test is an important cross-check, it is only a cross check.*

6.155 The ERA concludes that the consistency test does not follow "standard finance theory". The approach is an application of options pricing, which is a well-established body of work within the finance field. The *Journal of Finance* has on its website a list of the top 50 articles (in terms of numbers of citations) it has published throughout its long history. The SL-CAPM, upon which the ERA places so much faith, sits at number two on that list, and Merton's (1974) paper, upon which SFG ultimately relies, sits at number 9.[71] As SFG point out (Original AA Proposal Submission 12 Appendix L, para 25) the paper also forms part of the portfolio of work which ultimately led to his Nobel Prize. It is unclear what basis the ERA has for asserting that SFG's approach "does not follow standard finance theory".

6.156 Appendix C provides further detail responding to the ERA's assessment of the consistency test. The ERA's more detailed assessment of the consistency test suggests that:

(a) The papers upon which it is based are not concerned with the relationship between the cost of debt and equity but are about the term structure of interest rates or bond prices.

(b) The validity of the test is contingent upon debt and equity being priced in the same market. Moreover, if they are priced in the same market, then the implication of a mismatch could be due to debt being priced too high, or equity being priced too low.

(c) As noted above, the test is sensitive to its inputs.

6.157 In respect of the first point, Frontier (see Appendix C) note that the ERA has been selective in quoting from the relevant papers and, when the detail of each paper is explored in more detail, it is clear that each of the papers is in fact about the relativity of the cost of debt and equity; indeed the authors of the papers themselves make it explicit that this is the case.

6.158 In respect of the second point, Frontier (see Appendix C) note that, for it not to be the case that debt and equity are priced in the same market, it would need to be the case that investors are inconsistent in respect of their assessment of debt and equity. That is, they consider wholly different risk factors for the same asset when considering debt compared with equity.[72] The key point of the large literature which has grown up from Merton's (1974) seminal contribution is that debt and equity are contingent claims on the same asset, and that investors are not inconsistent in this manner. If this is the case, Frontier point out that it is much more likely that an estimate of the cost of equity is the estimate which is incorrect, because the cost of debt is more readily observed in the marketplace, and does not require the intercession of asset-pricing models to estimate.

6.159 In respect of sensitivity, Frontier note (see Appendix C) that the ERA is entirely correct when it points out that a different number for elasticity would produce different estimates of the cost of equity; this is a matter of mathematical necessity. However, this is precisely why the authors chose conservative estimates, to provide a minimum cost of equity consistent with cost of debt estimates. The ERA's point in this regard is thus irrelevant.

6.160 Frontier also note that, in its numerical examples, the ERA has chosen data which are not contemporaneous with each other, and this leads it to erroneous conclusions about the outcomes of the consistency test. For example, the ERA uses a higher debt risk premium than was current when the original report was written, and uses its own lower beta estimate rather than the estimate that the authors of the report considered relevant; both of which lead to a higher estimate of the market risk premium than would otherwise be the case and each of which, if corrected, lead to far more reasonable results than those presented by the ERA.

6.161 Turning now to the first two points from paragraph 6.151, in respect to submissions by other service providers, the ERA has rejected this evidence because neither the ERA nor the AER have accepted the studies referenced in these submissions. DBP believes that the reasoning of the

[71] *See* http://onlinelibrary.wiley.com/journal/10.1111/%28ISSN%2915406261/homepage/top_cited_articles_of_all_time.htm. *Note that two papers from Fama and French describing their models are ranked and number 19 and number 45.*

[72] *This is not an issue of systematic risk vs idiosyncratic risk, and whether equity is exposed only to the former but debt is exposed to both. Rather it is as issue of the factors themselves; whether investors in the DBNGP are concerned about interest rate risk when they invest in debt, and GDP growth when they invest in equity.*

AER and ERA is flawed in rejecting different models and using only the SL-CAPM with minor modifications (see discussion in paragraphs 6.5 to 6.26). However, even if one accepts the reasoning of regulators in rejecting these models for forming actual estimates of the return on equity, this does not necessarily invalidate their use as cross checks. For example, the ERA rejects the Black CAPM because it believes that estimates of the zero-beta premium are not robust. However, even if that were true, looking at the minimum of the range does provide valuable evidence about the extent of inconsistency between the bias adjustment based on the "theoretical implications" of the Black CAPM and its actual empirical evidence, as we have discussed previously. Just because a model is considered not sufficiently robust to actually estimate the return on equity does not mean it is incapable of being used to check estimates.

6.162 In respect of independent analysts, the ERA says that it does not accept that its interpretation of the Grant Samuel report or other independent analysts is flawed.

6.163 In respect of the Grant Samuel evidence, DBP's contention (Original AA Proposal para 6.8) was that SFG had estimated that the ERA's estimate of the overall return to the market was some 53 percent lower than the Grant Samuel evidence. In the ATCO Final Decision (para 1357), the ERA proposed that it ought to compare its long run estimate of the return on equity to the market (11.48 percent) with a range of 9.4 to 16 percent derived from the Grant Samuel range of 11.47 to 15.97 percent (once the ERA's views on dividend yields and gamma are taken into account) by reversing Grant Samuel's replacement of the current 10-year government bond yield with a higher risk free rate considered more representative of long-term trends by Grant Samuel. This is an apples with oranges comparison, because the ERA's estimate of the long run return to the market incorporates a long run risk-free rate which is much higher than the current risk-free rate which it uses in place of the Grant Samuel estimate. The proper comparison is between the ERA's long run return on the market estimate of 11.48 percent and the original Grant Samuel range of 11.47 to 15.97 percent, which would mean that the ERA estimate is right at the very bottom of the Grant Samuel range. Alternatively, if the ERA's preferred version of the Grant Samuel range, using current risk-free rates is used, then one must use the ERA's estimate of the current return to the market of 9.56 percent (1.96+7.6*1), which is again right at the bottom of the relevant range of 9.4 to 16 percent, and now 33 percent below the mid-point, rather than 53 percent as outlined by SFG previously. The ERA has failed to address this point.

6.164 Perhaps more importantly than a single study which is, through the passage of time, becoming decreasingly relevant, the ERA ignores the wider point DBP makes concerning expert studies. That is (Original AA Proposal para 6.11), the ERA (and AER) made estimates of the return on equity in the past which sat within the range of estimates made by market analysts and professional investors, but it (and the AER) have deviated sharply downwards in the most recent round of decisions when analysts have not. The ERA has failed to engage with this evidence,[73] and explain why in the past it produced estimates in line with market analysts but more recently it appears to have come to the view (at least implicitly) that market analysts are wrong and that substantially lower estimates of the return on equity for energy firms are required.

Issues with estimation of parameters in the SL-CAPM

6.165 Most of DDA4 that deals with the return on equity deals with the estimation of parameters in the SL-CAPM. DBP's main focus is on the estimation of the return on equity and not on the estimation of parameters in a single model; particularly when that model is known to exhibit downward bias (and fails the model adequacy test). However, we do perceive some issues with the MRP and beta within the SL-CAPM, and the choices made for each. We discuss these issues below.

[73] *In paragraph 401 (p85) the ERA mentions the Ernst & Young study noted by DBP, but only to compare its average with the ERA's own long run average of 11.48 percent. This misses the point; the point is that regulators once agreed with other market analysts and have now departed sharply downwards, without explaining why they have chosen to do this.*

Market risk premium

6.166 Overall, DBP does not object to the way in which the ERA has gone about assessing a suitable market risk premium. Indeed we consider that the ERA has moved the standard of debate around this single parameter in one asset pricing model forward significantly.

6.167 Our two concerns in respect of the MRP are firstly procedural and secondly technical.

6.168 In respect of process, the ERA has not sought to re-estimate the MRP based upon updated data, but has replicated its analysis from the ATCO Final Decision. The discussion is useful from the context of understanding what the ERA did in the ATCO Final Decision and why it made the choices it made. However, the process the ERA chooses, as with other aspects of rate of return, involves a great deal of regulatory judgement. The results one would obtain from the Wright CAPM, the DGM (as implemented by the ERA) and the Ibbotson approach can be fairly easily replicated at any point in time, and the conditioning variables the ERA uses can likewise be obtained by any analyst for any point in time relevant to future regulatory decisions. Thus, we can replicate the analysis up to paragraph 348 (p76) fairly readily.

6.169 However, it is apparent what the ERA did when it used its judgement in paragraphs 349 to 54 (pp76-7) in the ATCO Final Decision, it is impossible to know how its judgement might change in a different situation. For example, if VIX, spread and dividend growth data were all well above or well below their mean values, how much of a movement towards the upper end of the range of historical range (between the Ibbotson and Wright values) would the ERA contemplate, and how might the results from the DGM influence this? Additionally, where would the various results need to be before the ERA believed that the DGM evidence was sufficiently strong to warrant moving above the top end of the range formed by what the ERA terms its two "historical" measures?

6.170 A sample of two (three if different values for GGP and DBP are included, though the decisions were very close together) does not provide a comprehensive picture of how regulatory judgement might operate in a wide range of settings,[74] but it would provide stakeholders with at least some indication as to how judgement is affected by changes in the underlying variables. As things stand, DBP has no indication of how these changing variables will affect the ERA's use of judgement. Moreover, since we will only know this at the Final Decision, and since we can only make a challenge using evidence before the regulator at the time of its decision, if the ERA's use of judgement is in error, there is nothing we can do about this.

6.171 This raises an issue of fairness. The ERA has developed a new way of estimating the MRP, and provided stakeholders with no opportunity to see how that method operates over changes to the underlying variables which inform the regulators use of judgement when following this method. The appropriate course, if the ERA is to consider a shift in the MRP would be to allow stakeholders an opportunity to comment on updated MRP estimates and their basis prior to the Final Decision.

[74] *Almost nothing can, which is why DBP advocates judgement be used only at the end of the process, when its consequences are clearer, rather than at each and every step.*

Box 1: The ERA's judgement and the ATCO Final Decision

DBP notes the 20 pages or so of discussion on the ERA's new approach to the MRP in our Draft Decision which contains a great deal of detail. However, there is a point which is unclear to DBP. The ERA purports to use the DGM and other "forward indicators" to actually determine a point estimate for the MRP. Additionally, the ERA uses a current estimate of the MRP formed by the Wright CAPM (historical average of market returns minus current risk-free rate). One should therefore expect to see differences between MRP estimates as these variables all change.

However, we note that the ERA's final estimate for the MRP is 7.6 percent, which is identical to the MRP proposed by ATCO some seven months prior to the ERA's Final Decision for ATCO, when the risk-free rate and all the various "forward indicators" used by the ERA were different to the time of the Final Decision.

DBP is unsure how variation in the very variables which underpin the ERA's use of judgement to determine an MRP lead to no change at all in the estimate of the MRP? DBP considers that this adds to the uncertainty associated with the estimation of the MRP, and makes it even harder for DBP to try and second-guess the regulator in respect of how it will exercise its judgement.

6.172 To this end, because DBP has no way of knowing what decision the ERA might make in respect of our own MRP when it exercises its regulatory judgement in a situation where the risk-free rate (and hence Wright CAPM estimate of the MRP) and the ERA's four "forward" indicators are different, we have not sought to second-guess the ERA, but have instead simply adopted the same MRP as the ERA uses in its ATCO Final Decision. When estimating the return on equity, since the 7.6 percent premium in the ATCO decision is premium above the five-year risk-free rate, we subtract the average difference between the five and ten year rates during our illustrative period (57 bps) from 7.6 percent and use an MRP of 7.03.

6.173 The second, technical issue relates to the ERA's assessment of ESQUANT's evidence pertaining to the ERA's MRP (DDA4 paras 337 to 44, pp74-6). Although it is a technical issue, it has some important consequences, particularly for the use of conditioning variables. There are in fact two issues:

(a) The ERA has mischaracterised what ESQUANT did, and what it was instructed to do.

(b) The ERA has ignored an important part of ESQUANT's analysis.

6.174 Turning to the first point, the ERA's suggestion that ESQUANT were instructed to use time-invariant weights when examining the index proposed in the ATCO Draft Decision, is incorrect. ESQUANT examined the weights proposed by the ERA in the ATCO Draft Decision. These weights are shown in Table 42 of the ATCO Draft Decision, and discussed in paragraphs 725 to 733. Nowhere in the discussion is there any indication by the ERA that these weights are intended to be time-varying or fixed. Indeed, the only information given about why the particular weights were chosen is provided at paragraph 730:

> *"A weighting to each of the four forward indicators is assigned, to account for the quality and relevance of each of the forward indictors. Least weight is assigned to the ASX 200 volatility index, reflecting the short period of the data and its short term forward outlook. The other three indicators are weighted equally, as they are all considered to provide equally relevant information for the 5 year forward term."*

6.175 DBP asked ESQUANT to assess whether one set of weights produced an index that could be characterised as forward-looking or not. ESQUANT's finding was that they could not. Whether the regulator might or might not change the weights in future decisions was irrelevant. ESQUANT's findings would not change at all if it had put t-subscript's on the weights (DD para 340, p75) or not; this is irrelevant. Indeed, had the ERA chosen a different set of weights in a future decision (as opposed to abandoning weights entirely and simply assessing the different indices, which is what it has done), we would have asked ESQUANT to assess the new weights.

6.176 The key finding of ESQUANT was that none of the individual forward-looking indicators is cointegrated with either market returns or the MRP, and hence any relationship between them would be entirely spurious (see Original AA Proposal para 5.185). This means, effectively that each individual indicator is actually revealing nothing meaningful at all about the MRP, and the

ERA's assessment from paragraph 321 to 336 (pp70-4) which relies upon considering each indicator in turn (the ERA appears to have abandoned its approach of forming an index as per the ATCO Draft Decision; time-varying weights or no) of the Draft Decision is meaningless.

6.177 Additionally, although it is possible to create a weighting of the four indicators that produces an index that is cointegrated with the return on the market (not the MRP), which the ERA reproduces in Table 9 of the DD (p75), quite apart from two of the weights being negative, this index neither Granger-causes, or is Granger-caused by market returns or the MRP. Thus, it is not a forward-looking index at all.

6.178 The net result of this analysis is clear; looking at each of the ERA's forward-looking indicators individually provides no meaningful information at all in respect of market returns or the MRP. It does appear possible to link an index comprised of the four indicators in the way the ERA did for the ATCO Draft Decision, but has abandoned subsequently, but the resultant index, apart from having some negative weights (which makes little sense for an index), neither Granger causes nor is Granger-caused by market returns or the MRP, so it is not forward-looking.

6.179 The ERA says in the DBP Draft Decision that it has adopted a "forward looking" approach to determining the MRP. However, the only forward-looking component of its new approach is the use of the DGM.

Beta

6.180 In respect of beta, DBP has no issue with the *estimation* of beta as undertaken by the ERA; when we use five years of weekly, end-of-the-week returns, we obtain roughly the same results the ERA does. We do, however, have two issues in respect to beta:

(a) The *estimate* of beta the ERA has used of 0.7 produces a result which is not consistent with the approach it has used in the past, because it has failed to take into consideration the changes in its beta *estimation*.

(b) The second relates to a potential issue concerning the efficiency of the market portfolio.

6.181 Turning to the first issue, in the *Rate of Return Guidelines*, the ERA produced a range for beta of 0.5 to 0.7. When challenged by ATCO's consultant SFG that this range was arbitrary, the ERA pointed to its *Guidelines*, where it had determined that the upper end of the 95 percent confidence interval around beta was 0.72, and responded that this showed that the upper bound was not arbitrary (ATCO DD para 744).[75] This upper bound has changed with new analysis and the ERA supports a range associated with the 95 percent confidence interval of 0.3 to 0.8 (DDA4, para 221, p51), noting that its 2015 study suggests the 95 percent confidence interval (ie –from the 2.5th to the 97.5th percentile) ranges from 0.41 to 0.81 (DDA4 para 223 p52).[76]

6.182 The ERA notes that, due to evidence for the potential for downward bias in the SL-CAPM, it determined, in its Guidelines to adopt a point estimate towards the upper end of its estimated range (DD para 214, p50). At the time of the Guidelines, and the ATCO Draft Decision, this translated to

[75] *Note that the 95th percentile might not be an arbitrary point, but choosing the 95th percentile to remove the problem of bias is itself an arbitrary decision, unconnected with the "theory" of the Black CAPM the ERA purports to be reflecting.*

[76] We are not criticising the shifting confidence interval; our own results point to the same shift. Indeed it is larger if ENV and HDF are kept in the sample, rather than removed, see

Table 19 and Table 20.

choosing a point almost at the 97.5th percentile of the distribution around beta. However, as the confidence interval around beta has shifted upwards, the ERA's choice of beta has not changed; it is now ten basis points below the same upper confidence interval limit that it used to justify its range for beta and ten basis points below the top end of the range (0.3 to 0.8) that it now considers reasonable (DD para 221, p51). It is also only just above the bootstrapped media estimates shown in Tables 28 and 29 of the Draft Decision (DDA4 p193-4), which would seem to suggest the ERA is now making almost no adjustment for bias at all.

6.183 The only justification in the Draft Decision for this shift is a single sentence (DD para 250, p57) in which the ERA notes that it:

> *"now considers that a value of 0.8, which is at the top of this estimated range, would be excessive for a gas distribution network (sic) such as the DBP (sic) with its highly diversified demand base"*

6.184 The fact that the both the ERA and the AER continue to use a beta of 0.7 (except for GGP) gives the appearance of continuity from their respective *Guidelines*, but this is illusory. Systematic risk is measured relative to the market and one would expect change as either the actual risks facing the firm changed or risks in the market changed. As the ERA points out, the relative sensitivity of firms to systematic risk can vary quite dramatically, even over relatively short time periods such as two years (DD para 230, p53). This means that one would not necessarily expect the same beta year after year, if regulators continued to use the same methodology.

6.185 Specifically, if it was necessary, based on the regulators judgement, to choose a value of beta two basis points lower than the top end of the 95 percent confidence interval formed around beta at the ATCO Draft Decision in order to address perceived problems associated with the downward bias of the SL-CAPM for low beta stocks, then a consistent regulator would also choose a point two basis points below the upper end of the same confidence interval to address the same bias issue in the DBP Draft Decision. This would necessitate the use of a beta of 0.79.[77]

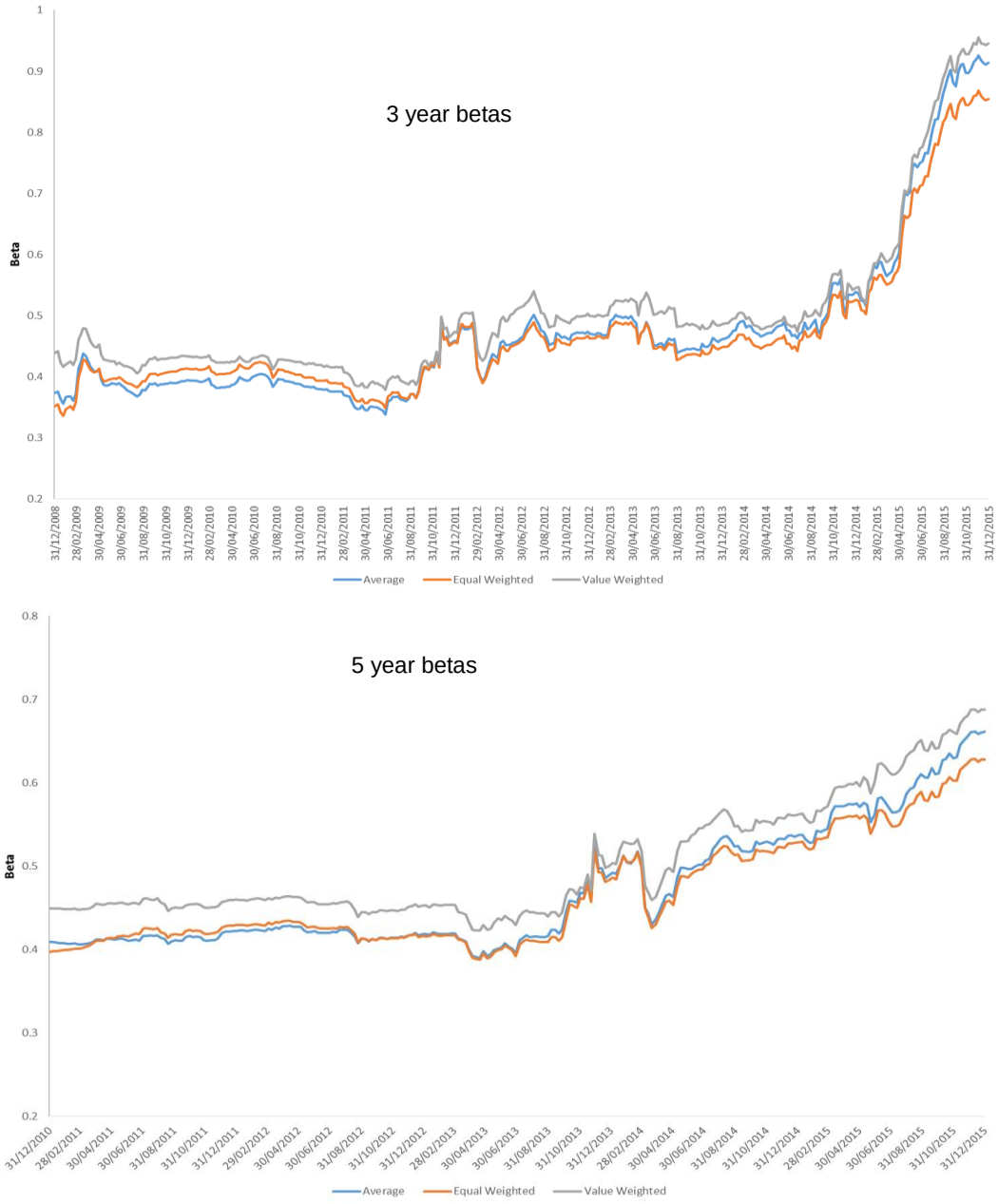
6.186 Although hidden by the fact that the ERA is using the same number for beta as it has done in the past, the ERA has actually changed its view in respect of correcting the bias associated with the SL-CAPM, and now believes that a smaller correction is needed; indeed, almost no correction at all to its median estimates. The original correction which gave rise to a beta of 0.7 was based purely on regulatory judgement and, despite the ERA undertaking to quantify the extent of this bias in its Guidelines (see Guidelines para 141), it has never tested whether this exercise of regulatory judgement has any merit, and rejects DBP's model adequacy test which does so. The ERA has now compounded this error by changing its mind about how much of a bias correction is needed, and providing no indication that it has done so, nor any indication why it has done so. If the ERA believes that the required correction for bias of the SL-CAPM has now changed, as its maintaining the same number for beta indicates that it does, then it needs to explain why it has changed its position in respect of this important issue.

6.187 The changing confidence interval in the ERA's own analysis points to a deeper issue in respect of beta. That is, beta appears to be changing, and changing substantially, over the past twelve months. Figure 5 provides a comparison of rolling three and five-year betas over the past several years.

6.188 Both beta calculations give roughly similar results until around the end of October 2014. From the end of that date, both begin to trend upwards (as do the ERA's results), but the three-year betas trend upwards much more sharply. For a value-weighted portfolio, the mean beta estimate, before an adjustment for bias (like the ERA's choice of 0.7 is around 0.95 and, as CEG points out, the lower bound of the 95 percent confidence interval for a three-year beta is, at present, above the bias-adjusted figure that the ERA uses for beta.

[77] *Actually a little higher if the ERA maintained the use of the same portfolio of firms it used in its previous studies; removing ENV and HDF has the effect of slightly reducing beta estimates.*

Figure 5: Rolling 3 and five-year betas



Source: CEG Appendix F, Figures 4 and 6

6.189 If taking two years of data out of a beta calculation significantly reduces its precision, then this would be a good reason not to do so, and to perhaps suspect the results in Figure 5 as being something like a statistical artefact. However, this does not appear to have happened. The 95 percent confidence interval the ERA calculates (DDA4, Table 28, p193) has a width of 0.274 for equal-weighted portfolios and 0.262 for value-weighted portfolios. By contrast, CEG find 95 percent confidence intervals for a three-year beta of 0.25, which, although not a direct apples-for-apples comparison, is not suggestive of a reduction in precision from losing the most stale two-years of data; quite the opposite.

6.190 To explore the matter further, CEG examined the data for structural breaks, finding compelling evidence for them in late 2014 for three-year betas, and in April 2012 (value-weighted portfolios) and September 2013 (equal weighted portfolios) for five-yearly betas. Examining the inputs to a

single beta estimate made today, CEG also finds evidence of a structural break in late 2012. Examining the relevant break points, CEG is of the view that the GFC (September 2008) and European sovereign debt crises (2011-12) are likely to be important factors, and notes that a five-yearly beta calculated today will include data from the time of the sovereign debt crises, but a three-year beta will not.

6.191 CEG's research is not definitive and, given the short timeframe from the ERA's Draft Decision to the current response, is not intended to be. However, it does provide strong evidence that the ERA's approach of using five-years of data, however robust it might be in a general sense, may be causing stale data to artificially decrease current beta estimates from where the market expects them to be over the next five years. For this reason, to the extent that the ERA proposes to continue to rely upon the SL-CAPM (beta adjusted or no) in the Final Decision, it would appear prudent to forsake the approach of re-estimating beta using different econometric techniques and the same dataset, and start examining whether more recent data are providing a more representative picture of the markets current perception of beta than its own favoured dataset is.

6.192 The second issue noted above is perhaps even more important that the first. In DDA4 (para 183, p44) the ERA notes that it has:

> *"also confirmed the inefficiency of the zero-beta portfolio utilising the NERA method of estimation (to the extent that it lies inside the return mean-variance efficient frontier)"*

6.193 This evidence is not in the Draft Decision. Through email correspondence, we confirmed with the ERA that this was a typographical error and the reference should have been to the "market portfolio". This points to a substantial issue.

6.194 Simply put, if the market portfolio is inefficient, then the SL-CAPM fails to hold, and the conclusions the ERA has drawn in respect of beta are wrong. The same is true of all other asset pricing models as well, but at the very least, DBP is able to show that the predictions made by an SL-CAPM predicated on an inefficient market portfolio are downward-biased estimators of the actual returns made firms with (imperfectly measured) systematic risk similar to (likewise imperfectly measured) systematic risk exposure to the benchmark efficient firm, whilst the Black CAPM does not produce downward-biased estimators.[78]

6.195 DBP trusts that the ERA will provide all stakeholders with the opportunity to view and comment upon this evidence before the final decision, so the ERA can take the comments of stakeholders into account when making its final decision, and all stakeholders are afforded the opportunity for procedural fairness.

[78] *Likewise, NERA (2015) has shown that a naïve model which assumes beta is one, and the BEE earns the same return as the market, is unbiased. If an inefficient market portfolio means no trust at all can be placed in the predictions of asset-pricing models, then this may be the best response for regulators, rather than engaging in pointless exercises of increasingly complex regression analysis to estimate a parameter (beta) which is meaningless.*

7. TENOR OF THE RISK-FREE RATE - DETAILED DISCUSSION

7.1 At the core of the ERA's arguments in respect of tenor is what Frontier (see Appendix B) refer to as "term matching" whereby the risk-free rate is set to match the tenor of the regulatory period to reflect the fact that the regulator, in so doing, removes interest rate risk for the regulated firm. The analogy the ERA uses is to bonds; just as the coupon on a one-year floating rate bond is reset every quarter based on the quarterly risk-free rate and not the prevailing annual rate, the regulatory equivalent of a "coupon" (the allowed revenues) should be set on the basis of the five-year rate and not the ten year rate.

7.2 The ERA concludes that this argument is not overcome by reference to RAB uncertainty, for the RAB is similar to the principal for a bond and, just as the RAB is uncertain, it is uncertain that the bond issuer will pay back the principal, which is why a premium is attached to bonds above the risk-free rate; a premium which the ERA holds is analogous to the debt and equity premia it provides regulated firms.

7.3 As far as it goes, the ERA's analogy between bonds and regulated infrastructure is one useful way of thinking about the relevant problem, and it would be correct if it were in fact the case that investors in regulated infrastructure, like bond-holders, faced only interest-rate risk. However this is not true; there is a diversity of risks faced by regulated infrastructure which are simply not present for bonds. For example (see Appendix B for a more detailed discussion):

(a) Pipelines have operating costs and bonds do not. Regulators set operating costs for a five-year period and the owners of the pipeline wear the risks associated with actual costs. Moreover, many operating costs have risk-profiles which do not line up neatly with the regulatory period; DBP does not, for example, renegotiate the contracts of all of its permanent employees once every five years to align with the regulatory period.

(b) Capital expenditure is subject to uncertainty, and there is no guarantee that actual cost overruns will be covered at the next regulatory review, if the regulator deems them inefficient. Instead, the regulated firm will earn no return on those overruns for the life of the relevant asset. In contrast, bonds have no capital expenditure, nor any requirement for maintenance capital spending during their life.

(c) In order to generate revenues, pipelines need to sell gas, and thus face demand risk. Indeed, financiers of pipelines generally require much more than five years of contracted demand before finance is forthcoming.

7.4 In theory, one could reflect all of these and other non-interest rate risk in the credit and equity risk premia, but the ERA does not do so; it simply calculates these premia based on market data from firms which may or may not be subject to them. Moreover, it is unclear whether it would be possible in practice to make the relevant adjustments to credit risk to reflect the fact that pipelines face more than just interest-rate risk and to do so robustly. This is in fact why other regulators follow the more standard practice of reflecting these longer term risks in the use of the long-run risk-free rate, just as occurs in the marketplace.

7.5 The ERA's approach also reflects a fundamental illogicality. Yield curves are generally upward-sloping, meaning the five year risk-free rate is lower than the ten-year rate, and thus that prices formed on this basis will be lower. In theory, the regulator could reset prices every day, and use the overnight rate, which would result in the lowest prices possible and essentially no interest rate risk. However, to match this, and enjoy the protection from interest rate risk the regulator provides, regulated firms would need to refinance their debt every day.

7.6 If it were possible to reduce prices by a such a mechanism, we would expect to see it happening in competitive markets; firms would lower their prices by more frequent refinancing of their debt, and thus take market shares from their rivals. The fact that firms do not do so is telling, and points to another underlying risk which the ERA misses; refinancing risk. A firm that refinanced its debt

every day would likely face very high refinancing risk, and thus a much higher debt cost, wiping out any pricing advantage from avoiding interest rate risk. Again, this is a risk ignored by the ERA, even though it accepts that firms do actually issue ten year debt as an optimal balance between interest rate and refinancing risk.

7.7 The basic message of Appendix B, where Frontier discusses these issues in more detail, is that the ERA's position is understandable, in theory, if and if only interest rate risk is considered to be the only risk which is relevant for investors in regulated assets. However, it fails to consider the actual range of risks (systematic risks for equity holders; interest rate risk is not the only systematic risk) faced by investors in the provision of the reference services and this, by Rule 87(3) is something that the ERA is not permitted to do, regardless of nice theory.

7.8 DBP notes, in making these points and seeking a ten-year tenor for the risk free rate, that it is actually doing itself a disservice. This can be easily seen in a simple example. Consider the case of a five-year risk-free rate of 2 percent and a ten year risk-free rate of 2.5 percent. Consider that the market risk premium is 7.5 percent above the five-year risk-free rate and thus 7 percent above the ten year rate. If the SL-CAPM framework is used:

(a) The cost of equity for a firm with a beta of 0.7 is 7.25 percent if the five year risk-free rate is used and 7.4 percent if the ten-year risk-free rate is used.

(b) If the firm's beta is one, both firms have a cost of equity of 9.5 percent; tenor does not matter.

(c) If the firm has a beta of 1.2, then it earns 11 percent if the regulator uses a five-year tenor and 10.9 percent if the regulator uses a ten-year tenor.

7.9 DBP's proposed betastar is higher than one. Arguments about whether this reflects the right balance of systematic risk and bias aside, the mathematical consequence of betastar, when the SL-CAPM framework is used, is that DBP earns a lower return on equity than if it simply accepted the ERA's proposed five-year tenor. DBP is making the point about the ten-year tenor as one of principle, not opportunism.

7.10 As a final point, DBP accepts the use of the five-year tenor for debt. This is due to the operation of the ERA's proposed hybrid model, for which this tenor is correct. This is something we discuss in more detail in Box Three in Chapter Ten.

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8. INFLATION AND GEARING – DETAILED DISCUSSION

8.1 Inflation and gearing are relatively minor points in the context both of the amendments suggested by the ERA and the overall Original AA Proposal. In respect of gearing, the ERA has suggested no change to DBP's approach, which itself follows the Guidelines. In respect of inflation, the ERA has objected to DBP's use of multiple straddling bonds and of forming inflation forecasts for each year during the AA period rather than a single inflation forecast.

8.2 DBP, in turn, has proposed new inflation figures, which are detailed in Table 3 and Table 4 in Chapter Five. This does not appear to be exactly what Amendment Six requires, but we are unsure of exactly what the ERA means in Amendment Six. The wording of the Amendment is:

> *"amend the inflation assumptions in its proposed revised access arrangement to reflect the values in Table 7 and Table 8 of this Draft Decision"*

8.3 We have assumed the ERA desires that we estimate inflation in the way that it does, and we have done so in this response, using a model which the ERA itself was kind enough to supply.

8.4 The methodology adopted by both DBP (in its Original AA Proposal) and the ERA (in the Draft Decision) for calculating actual inflation rates is the same – ie the actual inflation rate is determined by the changes in the CPI (all 8 cities) from one December quarter to the prior December quarter as published by the ABS (ABS ref 6401.0). Notwithstanding this, the values included in Table 7 of the Draft Decision for years 2014 and 2015 are not the same as those proposed by DBP in its Original AA Proposal for the same years, or those contained in Table 3 in Chapter Five. This is so for a number of reasons:

(a) At the time of submitting DBP's Original AA Proposal, the ABS had not published the CPI rates for December 2014 and 2015, and these were thus forecast by DBP. The ERA subsequently replaced the 2014 forecast made by DBP with an actual figure for 2014.

(b) At the time of the making of the Draft Decision, the actual inflation rate for 2014 had been published by the ABS but the inflation rate for 2015 had not been published, and the ERA thus published a forecast of inflation for 2015.

(c) DBP submitted its Amended AA Proposal on 22 February 2016. At that time, the actual CPI for the December 2015 quarter had been published by the ABS. That rate is 1.69%.

8.5 Given the ERA and DBP agree on the methodology for calculating actual inflation, it did not make sense to incorporate into DBP's Amended AA Proposal, the rate of inflation for 2015 set out by the ERA in Table 7 of the Draft Decision.

8.6 Accordingly, on 3 February 2016, DBP wrote to the ERA to confirm that, notwithstanding the wording of Amendment 6, if it responded in its Amended AA Proposal by using an inflation rate for 2015 that was the CPI (all 8 cities) for the December 2015 quarter rather than one that was calculated using the ERA's Treasury Bond Implied Inflation approach, the ERA would not decide, in the final decision, that DBP was not compliant with this aspect of Amendment Six.

8.7 The ERA confirmed in writing to DBP[79] that, to comply with Amendment 6 from the Draft Decision, DBP should use the inflation rate of 1.69% for the 2015 year, instead of the value of 2.75% included in Table 7 of the Draft Decision. DBP has therefore proposed, in its Amended AA Proposal, using the rates of inflation for each year of AA3 as shown in the final row of Table 3 in Chapter Five.

8.8 The small differences in Table 4 in Chapter Five for forecast inflation are a function only of timing; DBP has used the ERA's preferred approach for inflation. There appears to be a typographical error in the Draft Decision, as the source for Table 8, which contains the ERA's proposed forecast inflation is given as "Economic Regulation Authority, DBP Tariff Model, December 2015".

[79] *Email from Lincoln Flindell of the ERA to Anthony Cribb of DBP dated 3 February 2016*

Following the release of the Draft Decision, and at DBP's request, the ERA was kind enough to provide an Excel version of its inflation model. The data in this model show quite clearly that, as it has done elsewhere in the Draft Decision, the ERA has used the same numbers it used for the ATCO Final Decision (data drawn from the 20 trading days to the 20th of April 2015) as indicative numbers, and has not updated these; presumably with the intent of doing so once prior to the Final Decision when DBP and the ERA agree upon a date for the various time-dependent elements of the WACC such as the risk-free rates and debt risk premium. By contrast, DBP has used the 40 trading days to the 30th of November, consistent with the rest of the indicative numbers DBP provides in this response to the ERA's Draft Decision.[80] We note that these numbers will be updated prior to the Final Decision, consistent with the estimation of the cost of equity and debt.

[80] *The choice of the 40 trading days to the 30th of November does not imply that DBP disagrees with the ERA's suggestion that averaging periods for time-sensitive variables such as the risk-free rate be drawn from the 1st of June to the 30th of October (as per Amendment14). The choice of the averaging period is intended to be illustrative, showing the most recent full month of data prior to the ERA's Draft Decision. All of DBP's illustrative numbers are prepared based on this timeframe.*

9. GAMMA – DETAILED DISCUSSION

9.1 Gamma is the product of two distinct components; the distribution rate and the value of an imputation credit (theta). The ERA has deviated from its Guidelines in respect of the estimation of both, and has committed an error in doing so on both occasions. This is an issue because, whilst the Guidelines were by no means perfect, the ERA's deviation from them has been a retrograde step. In this Chapter, we summarise the ERA's error and our response. Further detail is provided in Appendix D in an expert report from Frontier. We note that gamma is currently one of the issues being considered by the Australian Competition Tribunal, and that the challenge mounted by various East-Cast service providers and ATCO has the same basis for gamma that DBP does, whilst the AER uses the same basis that the ERA does. There is thus little that is new in this Chapter.

The distribution rate

9.2 In the Guidelines, the ERA used a value for the distribution or payout ratio of 70 percent, based upon work by SFG (for DBP) and Hathaway and Officer (2004) (Guidelines Explanatory Statement para 927) but it noted that this was based on there not being any new evidence to support a different value. Subsequent to that time, several reports have been published (see Appendix D) which suggest that the figure for all equity is 70 percent, the figure for listed equity is 80 percent and the figure for the top 20 companies by market capitalisation is 84 percent. The ERA uses 80 percent for listed equity and 70 percent for all equity

9.3 The basic issue is that the top 20 firms are significantly different from the benchmark efficient entity, in that they have a high degree of foreign earnings, which provides them with an incentive to distribute more imputation credits because an imputation credit can be attached to any dividend, even a dividend paid for with foreign profits. The benchmark efficient entity, which is an Australian energy firm, without overseas operations cannot do this.

9.4 The ERA has recognised this point, and thus discards the 84 percent figure, using the 80 percent figure for listed and the 70 percent figure for all equity. However, this is incorrect, because the 80 percent figure is heavily influenced by the top 20 firms, because it is a weighted average formed using market capitalisation for the weights, and the top 20 firms are very large. If the top 20 firms are removed, then the average for the rest of listed equity becomes roughly 70 percent, the same as the figure for all equity.

9.5 The ERA makes a further error, which diminishes in practical importance once the above error is corrected. That is, it attempts to match the distribution rate for all equity with a theta calculated on the basis of all equity and likewise for listed equity. Doing so misunderstands the nature of the distribution rate and theta. The distribution rate is firm specific, like beta in the SL-CAPM; Coles and BHP may have very different corporate policies in respect of distributions of imputation credits and thus it would not be correct to use the one to proxy the other. For this reason, the ERA should choose a distribution rate for a set of firms which most closely reflects the characteristics of the BEE; in practical terms the set of listed equity with the top 20 firms removed.

9.6 By contrast, however, the value of an imputation credit is a characteristic of its holder, not its issuer; an investor will not value a dollar of imputation credits received from Coles any more or less than a dollar of imputation credits from BHP, as both have precisely the same effect on her tax burden. As Frontier explains, this makes theta like the market risk premium in the SL-CAPM. There is thus no distinction to be made between listed and all equity in respect of theta; the ERA made no such distinction when it was estimating theta based on market data in the Guidelines.

Theta – the value of an imputation credit

9.7 The ERA's value for theta is not based upon market data, but is instead based upon an assumption; the ERA assumes that any investor capable of using an imputation credit will value it

at its face value and any investor not so capable will value it at zero; the use of equity ownership shares is a direct consequence of making this assumption.

9.8 The problem is that, in order to support this assumption, the ERA and AER have had to construct a complex theoretical edifice, which one of the consultants regularly used by the AER has suggested (Ainsworth, Partington & Warren 2015 p27):

> *"The discussion in Section 3.2 around how market equilibrium is determined is directly relevant to this issue. It raises some questions over the philosophy underpinning the regulatory approach."*

9.9 More problematically, the AER, who initiated approach which the ERA subsequently followed, engaged two consultants to help develop this theoretical edifice, and each consultant came up with a different theoretical basis. Further, each consultant believes the other is wrong. It may well be that, at some stage in the future, some theoretical construct can be developed which results in a robust underpinning to the assumption of full value for imputation credits above. However, this stage has not been reached, and it thus appears more prudent at this stage to do what the Rules actually require, and measure the value of imputation credits in the way that Ainsworth et al (2015, ibid) favour; by their market value.

Determining the market value of an imputation credit

9.10 We now turn to the appropriate way in which one should estimate the market value of an imputation credit, and thus gamma. As the Guidelines suggest, we believe this should be through the dividend drop-off method.

9.11 The ERA has distanced itself from its own empirical assessments of value for gamma on two grounds; firstly that the coefficient it was attempting to estimate is incorrect, and needs to be adjusted to reflect the market value of dividends, and secondly that estimation is beset by econometric issues.

9.12 The first concern is contention is incorrect. As Frontier show in Appendix D (and have shown several times in the past), this purported adjustment gives rise to illogical outcomes, and is in fact mathematically incorrect; the latter point is also made by the AER's advisor Handley.[81] In relation to the second, Frontier (and formerly SFG) have addressed each potential econometric issue and shown it has no impact in practice.

9.13 DBP is in some agreement with the ERA, however, in that we believe the ERA's own dividend drop-off study should not be relied upon, but rather that one should rely upon other, more robust studies; principally the work undertaken by SFG on behalf of the Australian Competition Tribunal and subsequently updated by SFG in DBP's Original AA Proposal. This is covered in more detail in Appendix D. Doing so give a theta of 0.35 which, when combined with a distribution rate of 0.7, leads to a gamma of 0.25.

[81] *Handley does not accept the SFG approach, because he believes that value needs to be measured after corporate tax but before personal tax and all personal costs (which would give a value of one by taking out all the things which could change that value from one), but he does accept that it is the right proxy of the market value.*

10. RETURN ON DEBT – DETAILED DISCUSSION

10.1 In this Chapter, DBP provides a detailed overview in respect of our position on the cost of debt. We note that our position is, in broad terms, in alignment with that of the ERA, with only a few points of significant departure. However, our position is also different from our position in the Original AA Proposal, and it behoves us to trace through the path by which we have come to broad agreement with the ERA, as both our approaches have changed, so that the matter is made clear for stakeholders.

10.2 In general terms, DBP accepts the ERA's Draft Decision in respect of the cost of debt and proposes to adopt the ERA's approach with only small modifications. Our main objection to what was then the ERA's current approach when our Original AA Proposal was filed, the ERA's proposal for annual updating (found in the ATCO Draft Decision, paras 897 to 911), has now been changed, and DBP is satisfied with the changes the ERA has made. DBP and the ERA were already in broad agreement in respect of how the debt risk premium ought to be calculated at the time of the Original AA Proposal, and remain so. Remaining points of difference are relatively minor.

10.3 In respect of the calculation of the cost of debt at the outset of the regulatory period, and at each annual update:

(a) DBP agree with the use of the five-year BBSW.

(b) DBP disagree with the ERA's calculation of 12.5 bps for debt issuance costs (DD para 632-7, pp132-3) and consider 17.84 bps (in line with the latest evidence from Incenta) to be more appropriate. Likewise, following advice from UBS and considering the Draft Decision (paras 638-50, pp 133-6), DBP considers 14.8 bps to be appropriate for hedging costs, rather than the 11.4 bps the ERA considers appropriate. DBP also disagrees with the ERA's assessment of the New Issue Premium (DDA4, para 651-68, pp136-41) and considers that the ERA has erred in setting this to zero, based on available evidence.

(c) DBP agree with the ERA's "revised bond yield approach" using the Gaussian Normal, Nelson-Siegel and Nelson-Siegel-Svennson approach and including the extension of the Gaussian Normal model to take account of the difference between target and effective tenor (DD para 619-25, pp130-1). DBP also agrees with the ERA's criteria for selecting bonds. However, DBP makes the following comments:

(i) DBP has not used the ERA's Excel spreadsheet model for determining yield curves, but has rather developed a package in R which does exactly the same job, but does not require 17 pages of steps (described over pages 278 to 95 in DBP's Draft Decision) with the associated risk of operator error. We believe this R package meets the ERA's requirements and avoids the risks of operator error in the ERA's Excel-based approach but which the ERA does not appear to have considered. DBP will make its package and associated instructions available as a public document for use by all stakeholders.[82]

(ii) DBP has access to a Thomson-Reuters (TR), rather than a Bloomberg terminal, although we have used Bloomberg data in this response. Exactly the same functionality is available with TR as with Bloomberg, and we have, with the assistance of TR, developed a spreadsheet which replicates steps two and three (summarised in

[82] *Note that DBP's package starts at Stage 4 (p278 of the Draft Decision), estimating the yield curves using data downloaded into a csv file from Bloomberg or Thomson Reuters. However, there are also packages within R which allow a direct connection between R and Bloomberg (which the ERA has used) and R and Thomson Reuters, meaning that, conceptually, the whole process from Step 1 (p270 of the Draft Decision), including the download and conversion of data from Bloomberg/TR could be automated. This would avoid more potential operator error, and make the process much more automatic, as per the requirements of Rule 87(12). Whilst DBP accepts the ERA's revised bond yield approach, if implementing it requires following 25 pages of steps (pp 270-95 of the Draft Decision) each time an annual update is performed, this is arguably stretching the definition of the "automatic application of a formula" envisioned by Rule 87(12), leaving it open to challenge by other parties. By contrast, clicking one button on an R-package appears much more likely to meet the requirement of Rule 87(12). DBP would be happy to discuss this further with the ERA if required.*

DDA4 pp270-7) the bond data selection process.[83] We would suggest that restricting data to one commercial service provider of data would not really be in the interests of a regulatory process designed with the ethos of competition in mind, and that TR data should also be permitted.

10.4 In respect of the timing of the calculation of the initial cost of debt in 2016, DBP proposes the 20-day trading period shown in Clause 2.4 of the Access Arrangement Information. The updated inflation estimates and risk-free rate for the cost of equity will also be calculated during this period.

10.5 In respect of the annual updating approach, DBP will apply an annual adjustment to be applied to the debt risk premium to be incorporated in each subsequent tariff update during the fourth access arrangement period as required by the ERA's proposed Amendment 14. The first annual update will apply for the tariff variation for the 2017 calendar year. The resulting annual adjustment to the rate of return should be incorporated in the Annual Tariff Variation.

10.6 Further, in respect of annual updating:

(a) DBP agrees with the trailing average approach the ERA has utilised for the DRP, using data extending back to 2005, and with the use of annual averages using the RBA index for data pre 2015. DBP also agrees with the use of tranches equal to one-tenth the value of the RAB for all historical data. Finally, DBP agrees with the weighting process for past debt and current debt in the transition year of 2016, discussed in paras 609 to 18 (pp 126 to 30) in the Draft Decision.

(b) In respect of future tranches of debt, DBP proposes to use capex weights rather than equal-sized tranches, where forecast capex exceeds ten percent of the value of the RAB. Since the annual update sets the cost of debt for a new tranche over the course of the coming year, we propose our approach be based upon forecast capex rather than actual capex over the previous year. Further, since DBP does not propose any capex during the AA4 period which exceeds ten percent of the RAB, in practical terms, our approach matches that of the ERA.

(c) DBP nominates the 20 trading days detailed in Clause 11.7 of the Access Arrangement. Each of these dates is a 20-trading day window between 1 June to 31 October in the year prior to the relevant tariff variation as required, but are not identical, as permitted. DBP notes that the nominated averaging periods for the annual updates will remain confidential.

(d) The final paragraph of Amendment 14 suggests that the ERA will make the relevant calculation for the updated cost of debt and inform DBP "as soon as practicable", allowing DBP to respond "as soon as is practicable" to enable the relevant numbers to be finalised before the publication of the annual tariff variation. DBP agrees with the process of an estimate, a response and a finalisation, but believes there is a need to insert more rigour into the process to ensure all parties provide information in a timely manner to each other, in order to ensure that the tariff variation process can proceed in a timely manner.

10.7 To ensure the approach DBP proposes for debt is clear, the results of the discussion above are summarised in Box Two below.

[83] *The only thing we cannot replicate is the "country at risk" criteria for choosing bonds, as TR does not have the same filter as Bloomberg in this respect. However, given that the ERA publishes the list of actual bonds used (see Draft Decision, Appendix 4E, provided it publishes the ISIN and Bloomberg codes, we can obtain data on the relevant bonds from TR.*

Box 2: DBP's proposed approach to the cost of debt

In respect of the calculation of the cost of debt at the outset of the AA4 period and for each subsequent update will be:

- The risk-free rate will be the five-year BBSW, averaged over the relevant 20-day period shown in Clause 2.4 of the Access Arrangement Information.
- The hedging cost will be 14.8 bps/a and the debt-raising cost will be 17.84bps/a and the new issue premium will be 27 bps.
- The DRP will be the ten-year DRP for the set of bonds characterised by ERA's criteria in Table 13 (p108) of the Draft Decision, calculated using the ERA's revised bond-yield approach (as outlined in paragraphs 508 to 553, pp105-115 of DDA4), which DBP implements using a version of model coded in R, rather than Excel, and which has been provided to the ERA for public use.

In respect of the annual updating mechanism:

- Historical debt risk premia, prior to 2015, will be valued according to the process outlined in paragraph 469-70 (p98) of the Draft Decision. Future debt risk premia (and risk-free rate estimates) will be undertaken as outlined in paragraphs 471-77 (pp98-9) of the Draft Decision.
- Each future tranche of debt will be weighted by the capex weight method, based upon forecast capex for the forthcoming year, rather than having a weighting of 0.1, where capex in a given year is forecast to be greater than ten percent of the existing RAB, otherwise it will be 0.1. DBP proposes no such capex during the forthcoming AA period, and thus the use of capex weights has no practical effect during this time.
- DBP nominates the dates for each updating period to be the 20 trading days noted in Clause 11.7 of the Access Arrangement in each year of the AA4 period.
- The ERA will calculate the updated cost of debt (updating the risk-free rate and debt risk premium) for each new tranche of debt, providing the relevant number and supporting information within 5 working days of the end of DBP's nominated averaging period, providing 10 working days for DBP to respond formally, with both parties undertaking to work together thereafter to obtain a finalised tariff variation by the end of the first week of December each year.

10.8 We now turn to a discussion for the reasons behind each of the changes above.

Reasons for DBP's response in respect of debt

10.9 DBP proposes four changes to the approach the ERA has proposed in Amendment 14, and detailed in Appendix 4. These are:

(a) That each future tranche of debt (but not those in the average prior to 2015) be weighted according to capex weights rather than one-tenth per annum.

(b) That debt raising costs be 17.84 bps/a and hedging costs 14.8 bps/a, and that the new issue premium be 27 bps.

(c) That the process of finalising the updated cost of debt be more formal than the "as soon as practicable" approach relied upon by the ERA in its Draft Decision.

(d) That the ERA process be protected via a fixed principle

10.10 We discuss each of these proposed changes below, and the reasons behind them below. These changes are changes to the approach the ERA has developed in its ATCO Final Decision and subsequently applied to DBP (and GGP) in its Draft Decision. DBP's current position is also different from its 2014 AA Proposal, as noted above. In its Draft Decision, the ERA listed a series of objections to DBP's 2014 AA Proposal made in light of its ATCO Final Decision (para 434, p91), as follows:

(a) The ten-year term used for the estimation of the risk-free rate.

(b) The use of a ten-year trailing average for estimating the annual allowance for the risk-free rate.

(c) The requirement for a transition.

(d) The use of capex weights.

(e) The use of Commonwealth Government Securities as the proxy for estimating the risk-free rate.

(f) The allowance for hedging costs.

(g) The inclusion of a new issue premium.

10.11 Each of these objections is discussed through the remainder of the discussion on debt. DBP's current position in respect of each of these is as follows:

(a) DBP agrees to the use of a five-year risk-free rate for debt under the ERA's method.

(b) DBP accepts the use of the ERA's hybrid approach with a trailing average on the DRP and updates of the risk-free rate every five years.

(c) DBP agrees there is no need for a transition on the DRP, and accepts the ERA's approach of using historical debt risk premia.

(d) DBP maintains its support for the use of capex weights (see below).

(e) DBP agrees with the ERA that the BBSW is a suitable proxy for the risk-free rate.

(f) DBP disagrees with the quantum of hedging and debt-raising costs proposed by the ERA.

(g) DBP maintains its support for a new issue premium.

10.12 We discuss the reasons for DBP's position on each of these matters below.

The use of capex weights

10.13 DBP has proposed the use of capex weights, which mean that the weight of each tranche of debt is not one-tenth per annum but increases or falls with the changing value of the RAB. DBP's proposed means of implementing the model is by transitioning each new piece of capital expenditure (for simplicity, the annual capital expenditure each year; though a particular multi-year project could be inputted at completion if required) over ten years. This, as the ERA points out, is identical to the QCA's approach in its effect.

10.14 DBP provided a model of its capex weights with our Original AA Proposal, but this model was illustrative only, and did not contain any real data. Perhaps more importantly, although DBP proposes that a cut-off of ten percent of the RAB be used to determine the capex weights (ie, all additions to the RAB smaller than ten percent are effectively ignored), the model did not explicitly address this point. DBP has updated its model so that it now contains real data for debt risk premia from 2006 to 2015, real figures for capex and the RAB and implements the ten-percent cut-off properly. This new model is included as Appendix E to this submission.

10.15 Although the ERA recognises that capex weights are likely to be a better reflection of the marginal cost of capital (DDA4 para 565, p117), it expresses three concerns:

(a) If, as the ERA believes, it is difficult to distinguish between on-the-day and trailing average approaches in respect to prediction performance, then it is not clear that using capex weights will improve matters significantly (para 570, p118).

(b) The capex weights are to be based on forecast capital expenditure, and actual expenditure might change. Further, regulated firms might seek to game the system, by forecasting capital expenditure when the cost of capital is high, and then deferring that spending to a later year when it falls (paras 571-3, pp118-9).

(c) Use of capex weights creates complexity involved with developing a capex weights overlay within the PTRM, creating the need for a complex series of adjustments at each access arrangement revision, which increases the potential for error.

10.16 In respect of the first point, DBP agrees that, if there were no gain whatsoever, and the complexity of capex weights was substantial, then it would be difficult to motivate the move to more complexity. However, the ERA does appear to believe that there is a gain, noting in paragraph 441 (p92) of the Draft Decision:

> *"the on the day approach appears to deliver a DRP that is closer to the prevailing rate over the next 12 months much of the time, providing for superior signals for investment"*

10.17 And further (ibid):

> *"trailing average approaches can be weighted by new capex, overcoming this shortcoming, albeit at the cost of some complexity"*

10.18 It would appear that the ERA does believe there is a gain, most particularly in signalling for efficient investment over the coming 12 months; a sentiment with which DBP would agree. Moreover, DBP's spreadsheet model, is not complex and provides a ready-made solution for the next 30 years of regulatory determinations.

10.19 The concern about the potential for regulatory gaming is potentially a more serious objection. However, it does not appear to be the case that attempts to game the approach would be particularly successful. To explore this, DBP has created a simple model.

10.20 Assume a firm has an asset worth $1 billion in 2015, and it forecasts capital spending of $100 million in 2016, $200 million in 2017, nothing in 2018 and $150 million in 2019. Assume debt risk premia in 2016 are 250.2 bps (the figure used by the ERA in its Draft Decision as an illustration), and that they then either increase by ten percent per annum until 2025, or decrease by ten percent per annum over the same time period. If firms could game profitably, one would expect them to bring forward capex in the first scenario, compared to forecasts, and delay it in the second.

10.21 One approach the regulator might use to prevent gaming is to require the regulated firm to indicate whether or not capital expenditure forecast at the outset of the regulatory period actually went ahead during the previous year each time it does its annual update to see whether or not the firm was sticking with its forecast. It could then update the capex weights based on what was actually spent going forward. That is, it would check last years' forecast and change the forward-looking values for that tranche of capex from this year onwards, but would not attempt to claw-back any under or overspend.

10.22 Thus, for example, at the end of 2016 in the example above, the regulator could check and see whether the $100 million the firm said it would spend during 2016 was actually spent or not. If it was not spent, then the weighting for the year 2016 for the DRP estimate in 2017 would reflect a RAB of $1 billion, not $1.1 billion.[84] Thus, if the firm was seeking to game a declining DRP by putting off forecast capital expenditure, this strategy would provide limited returns because the relatively high DRP in 2016 would be applied to a lower RAB in the 2017 DRP allowance, wiping out the gains.

10.23 Table 7 provides an overview of just such a policy in action. In each case, the relevant change compared with the forecast made in 2015 (at the outset of the regulatory period) is known in 2016, for the purposes of simplicity, and thus affects the 2017 allowance for DRP. As can be seen in the differences from the base (ie – the firm spends exactly as forecast) are tiny; less than one percent of the DRP (roughly one basis point). It seems unlikely that a regulated firm would gamble with changing debt risk premia for such a small gain.

[84] *More specifically, the initial RAB line, depreciating from 2015 until 2075 would remain at $1 billion each time, and the capex line for 2016 (starting in 2016 and depreciating until 2076) would be zero from 2017 onwards, not $100 million (and subsequent depreciated values).*

Table 7: Gains from gaming the capex weights with annual review of forecast capital spend

	2016	2017	2018	2019	2020	avg	Diff (from base)
Base - increasing DRP	255.17	259.98	264.37	278.49	288.43	269.29	
Base - decreasing DRP	255.17	247.86	243.03	230.30	222.36	239.74	
Shift out 2017 capex in 2016 - increasing DRP	255.17	257.12	268.38	281.65	291.20	270.71	0.53%
Shift out 2017 capex in 2016 - decreasing DRP	255.17	252.12	239.73	227.69	220.08	238.96	-0.33%
Capex abandoned in 2016 - increasing DRP	255.17	260.59	264.92	279.40	289.22	269.86	0.21%
Capex abandoned in 2016 - decreasing DRP	255.17	247.87	243.04	229.86	221.98	239.58	-0.07%
capex doubled in 2016 - increasing DRP	255.17	259.45	263.91	277.69	287.75	268.80	-0.18%
capex doubled in 2016 - decreasing DRP	255.17	247.84	243.02	230.68	222.70	239.88	0.06%
divest $100 mil in 2016 - increasing DRP	255.17	261.32	265.56	280.46	290.14	270.53	0.46%
divest $100 mil in 2016 - decreasing DRP	255.17	247.89	243.05	229.35	221.53	239.40	-0.14%
$500 mil investment in 2016 not $100 mil - increasing DRP	255.17	258.25	262.85	275.83	286.13	267.65	-0.61%
$500 mil investment in 2016 not $100 mil - decreasing DRP	255.17	247.82	243.01	231.57	223.49	240.21	0.19%

10.24 Adjusting the weights every year in this manner is likely to be highly intrusive, and raises additional problems; if the firm actually did spend $500 million not $100 million, for example, would the regulator then need to assess the efficiency of that additional spending? Fortunately, the same principle as noted above in respect to the limited gains from gaming applies if the capital expenditure forecast for the last AA period is assessed prior to the next AA period commencing, which is what regulators already do.

10.25 This is shown in Table 8 overleaf. In this case, the base is capital expenditure happening exactly as forecast. Where it deviates, the firms pay the actual capital costs incurred during 2016 to 2019 (delaying investment is not free; the firm pays the DRP during the year when the investment happens, rather than when it was forecast), and then the allowed DRP in the years 2021 to 2025 (no new capital spending happens during this second AA period in our simple example) is based upon when the capital spending actually happened during 2016-20. This has the same effect as noted above; if the firm does obtain a gain from deferring expenditure from a high to a low DRP year, it loses later on because the RAB upon which the DRP is based going forward once the reconciliation is done is smaller during the high DRP year. The net effect, even without any kind of clawback mechanism, is almost no effect at all.

10.26 For this reason, there is no legitimate concern as to gaming, and capex weighting ought to be allowed.

Table 8: Gains from gaming the capex weights – with five-yearly review

	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	Average	Diff (from base)
Base - increasing DRP	256.29	255.17	259.98	264.37	278.49	288.43	302.04	319.67	341.74	368.67	293.49	
Base - decreasing DRP	256.29	255.17	247.86	243.03	230.30	222.36	212.79	201.75	189.37	175.80	223.47	
Shift out 2017 capex in 2016 - increasing DRP	256.29	255.17	257.12	268.38	281.65	291.20	304.41	321.65	343.32	369.86	294.91	0.484%
Shift out 2017 capex in 2016 - decreasing DRP	256.29	255.17	252.12	239.73	227.69	220.08	210.84	200.12	188.07	174.83	222.49	-0.438%
Capex abandoned in 2016 - increasing DRP	256.29	255.68	260.59	264.92	279.40	289.22	302.70	320.21	342.15	368.96	294.01	0.180%
Capex abandoned in 2016 - decreasing DRP	256.29	255.68	247.87	243.04	229.86	221.98	212.46	201.46	189.14	175.62	223.34	-0.060%
capex doubled in 2016 - increasing DRP	256.29	254.75	259.45	263.91	277.69	287.75	301.46	319.20	341.37	368.42	293.03	-0.155%
capex doubled in 2016 - decreasing DRP	256.29	254.75	247.84	243.02	230.68	222.70	213.09	202.00	189.58	175.96	223.59	0.053%
divest $100 mil in 2016 - increasing DRP	256.29	256.30	261.32	265.56	280.46	290.14	303.47	320.84	342.63	369.30	294.63	0.390%
divest $100 mil in 2016 - decreasing DRP	256.29	256.30	247.89	243.05	229.35	221.53	212.07	201.13	188.87	175.41	223.19	-0.127%
$500 mil investment in 2016 not $100 mil - increasing DRP	256.29	253.83	258.25	262.85	275.83	286.13	300.10	318.10	340.52	367.83	291.97	-0.515%
$500 mil investment in 2016 not $100 mil - decreasing DRP	256.29	253.83	247.82	243.01	231.57	223.49	213.77	202.58	190.06	176.34	223.88	0.180%

10.27 The ERA's final point refers to the complexity within the PTRM. It is not clear precisely what the ERA means, particularly in respect of the "overlay" within the PTRM. According to the AER's PTRM manual (p35) the annual update for the cost of debt is achieved by putting the relevant number for the cost of debt each year into a row in the PTRM inputs sheet (the reference is wrong in the manual, it is row 430, not row 412), up to and including the year entered in cell F21 in the X-factors sheet, so the model can recalculate the relevant smoothed revenues going forwards for the remainder of the access period. In other words, there is no need for any kind of "overlay" within the PTRM model itself, as the only required input is a cost of debt each year, which is just a number; how that number is calculated sits outside the PTRM model.

10.28 The ERA also refers to the need for a "complex series of revisions" at each Access Arrangement, but it is not clear that this is true either. In 2020, no revision will be required at all, because DBP has not actually proposed any capex during the AA4 period which exceeds ten percent of the existing RAB. In the event that such capex is proposed in the future, all the ERA would need to do is update the forecast capital expenditure for the previous five years with actual capital expenditure at each successive AA decision, and use these figures (along with forecasts for future capital spending) to form the weights for the next five years. This requires no extra work for the ERA, as it needs to assess previously forecast capital expenditure in any event, and can just translate its findings (amounts and timing) to the revised model DBP has provided. The new version of the model contains instructions on how this is intended to occur.

10.29 For these reasons, DBP proposes to use the capex weights going forwards, as we believe, like the ERA, that it provides better incentives for efficient marginal investment. However, we agree with the ERA (DDA4 para 1146, p255) that there are no incentive benefits associated with taking the capex weights back into the past, as we suggested in our Original AA Proposal. Instead, we propose to use the even one-tenth weighting the ERA uses to derive a DRP for 2015. This is calculated in Chapter 11.

Hedging and debt-raising costs

10.30 In DBP's Original AA Proposal, we proposed debt-raising and hedging costs of 15 bps. This was, as the ERA pointed out in its issues paper, incorrect, because it included 2.5 bps for hedging which we would not have needed to do because we proposed to use the ten-year risk free rate. However, following advice from UBS, it became apparent that the ERA's cost of debt calculations in the ATCO Draft Decision were not correct either, because the ERA has excluded a conversion factor used by the RBA (discussing this only in a footnote, and not explaining why it had made the exclusion) and had ignored the costs of cross currency swaps. This position was summarised in paragraphs 3.3 to 3.5 in DBP's response to the ERA's Issues Paper, and is summarised in Table 9 below drawn from the Issues Paper. In the Draft Decision, the ERA describes DBP's position as involving "apparent confusion" (DDA4 para 99, p21) because our position in the Original AA Proposal and response to the Issues Paper is different. There is no confusion; the relevant chapter in the Issues Paper response was called "New Information" and DBP was simply updating its original position with new information. We update our position further below, based on the new information from the Draft Decision and further work by Incenta (2015).

Table 9: Hedging and debt-raising costs from DBP's Issues Paper submission

Cost element	DBP Original AA Proposal	ERA position	Correct value
Conversion factors	13.5 to 17.4 bps*	0	13.5 to 17.4 bps
Cost of foreign hedges	0	0	18 bps
Cost of risk-free rate hedges	2.5 bps	10 bps	8.5 bps
Debt-raising costs	12.5 bps	12.5 bps	20 bps
TOTAL	28.5 to 32.4 bps	22.5 bps	60 to 63.9 bps

Source: UBS: Appendix B of DBP Issues paper submission

**Note – DBP did not explicitly include an allowance of 13.5 or 17.5 bps, but simply followed standard practice and included conversion factors*

10.31 In the ATCO Final Decision (para 1618), and subsequently in DBP's Draft Decision, the ERA has changed its stance on conversion factors, and now follows standard practice by including them. This means they are contained within the ERA's DRP estimates (as they have always been for DBP) and there is no need for any kind of premium. The first line in Table 9 above is therefore no longer relevant.

10.32 In respect of foreign hedges, the ERA has now acknowledged their existence, but believes the relevant cost is 14 bps, rather than 18 bps (DD, para 646, p135). Moreover, it notes that only 35 percent of debt for the benchmark efficient entity is raised overseas, meaning the relevant allowance is 4.9 bps, rather than 14. Applying the same logic to Table 9 above would result in an allowance of 6.3 bps, rather than 18. Finally, the ERA has revised its estimates of hedging costs for the risk free rate (to swap from ten to five years) which gives it total hedging costs (domestic and foreign) of 11.4 bps. By contrast, the relevant figures from the right-most column of Table 9, when the 18 bps is corrected for the proportion of foreign debt held is 14.8 bps, a difference of 3.4 bps. DBP believes that basing the allowance on 18 bps is more robust that basing it on 14 bps, because the 14 bps is based on discussions the ERA's consultant had with "the banks" (DD para 646, p135), whilst 18bps is a figure used by UBS, which is engaged on a daily basis with these transactions, and is thus considered more reliable.

10.33 In respect of debt-raising costs, the ERA has proposed a value of 12.5 bps. The main difference between this and the figure of 20 bps suggested in Table 9 above is that the latter includes Standard & Poors' liquidity requirement and Standard & Poors' requirement to finance three months ahead (DD, para 634 p133). The ERA rejects both on the basis of discussions it has had with finance providers who have suggested to the ERA that, under normal liquidity conditions, both would add only roughly one bps to costs (DD para 636, p133). No indication is provided as to who these finance providers are or what basis they provide for their conclusions, making it very difficult for these claims to be investigated further; we are left merely to accept that the ERA has looked into this matter and reached a conclusion.

10.34 Both of these costs are costs associated with Standard & Poors, and it is not clear why the ERA has not conferred with Standard & Poors to ascertain the veracity of the claimed amounts. Incenta (2015, p2-3) has done so and, moreover (ibid p14-19) has examined Standard & Poors' liquidity requirements and the costs of meeting them and has confirmed that Standard & Poors does require firms to refinance three months ahead of expiry (ibid p9) and estimated the costs of meeting this requirement (ibid pp20-1).[85] The ERA has nowhere shown any error in what Incenta has done, nor given any indication that the calculations are inaccurate, beyond reference to "discussions with finance providers".

10.35 For this reason, DBP does not accept the ERA's debt-raising cost figures. We note that the exact values for debt-raising costs are a function of the size of the debt, and the timing of the decision. Incenta (2015) report for Jemena, which is roughly the same size as DBP and is, like DBP, a private business, and do so using data from January 2015. This gives a total debt-raising cost of 17.84 bps per annum. DBP proposes that this figure be accepted as provisional for this Draft Decision, and the amount re-calculated at the same time as other time-dependent variables like the risk-free rate are estimated.

10.36 In respect of the New Issue Premium, the ERA makes theoretical (DDA4 paras 653-6, pp136-7) and empirical (DDA4, para657-65, pp137-41) arguments. The theoretical arguments respond to points made by CEG about transactions costs and imperfect information. DBP responds that any transactions are covered in debt-raising costs, and that imperfect information would be a product of inefficient markets, which should therefore not be rewarded.

10.37 In respect of transactions costs, we note (see paragraph 10.33) that 12.5 bps is too low, but that in any case that 12.5 bps is intended to account for a number of specific costs (see Guidelines para 144) and any new issue premium is not amongst them, so the ERA has not accounted for this cost.

[85] *As a prudent operator, DBP considers several factors in mitigating debt refinancing risk, one of which is to target the refinancing of debt facilities six months ahead of their maturity. This approach is consistent with the expectations of investors, auditors and ratings agencies.*

More importantly, the Rules require the ERA to reward efficient costs within the market, not within some theoretical paradigm. If a firm is inefficient, then this inefficiency should not be rewarded. However, if the market for debt is inefficient, and all efficient firms face this market inefficiency, then the ERA must reflect how the market operates, and not how a theoretical construct of the market might operate. The ERA therefore errs in respect to this theoretical argument.

10.38 In respect of empirical arguments, it is apparent that the ERA has not examined CEG's model in any great detail. It finds no actual errors that CEG have made, but rather points to a host of issues which might exist, and suggests that these issues, if they were germane, would cause the premium to potentially be zero. However, the ERA concludes that although the premium might exist at some points in time in some markets, it does not need to compensate for any such premium because, essentially, its compensation is more generous than other evidence suggests ought to be the case already (see DDA4, paras 666-7).

10.39 This is not how the ERA is supposed to address its task. If a cost is held to exist, as the ERA appears to concede in this instance (it does not conclude that the new issue premium is zero), then it is the ERA's task to determine the best estimate of that cost, and compensate service providers accordingly. It has not done so. Instead, the CEG study still remains the best estimate of the new issue premium in the Australian context and DBP, accordingly, maintains its support for it.

Formalising the process of updating the cost of debt

10.40 The ERA's process for updating the cost of debt each year requires it re-run its revised bond-yield approach, effectively going through the 33 pages of steps outlined in Appendix 4G of the Draft Decision. This stretches, somewhat the definition of "automatic" required under Rule 87(12), but DBP has accepted the approach. Sensibly, given the potential for operator error in such an update, the ERA has implemented a checking mechanism. DBP is indifferent between a checking mechanism whereby DBP calculates the relevant debt risk-premium and the ERA assesses it or the converse, and we note the ERA has chosen the converse.

10.41 The issue DBP has is that the checking mechanism is ill-defined in terms of timeframes; the ERA undertakes to do the relevant calculations and provide DBP with the outcomes "as soon as is practicable" after the end of the nominated period, and requires DBP to undertake to respond with issues "as soon as is practicable" after that. This is not particularly satisfactory for either party. For example, DBP could nominate a period ending on October 30 one year, and it could take the ERA three weeks to provide results, due to workload or other concerns that made it not "practicable" to provide the estimates earlier. This would leave DBP with very little time to check and respond in order that the tariff variation mechanism be deployed prior to the first of January in the following year. By contrast, the ERA could provide its output a few days after the end of the nomination period, but DBP could take several weeks to respond with a large number of issues, leaving the ERA with little time to respond.

10.42 For this reason, DBP proposes a small change which includes a timeframe by which actions need to be undertaken, thus:

(a) The ERA be required to provide its estimate of the cost of debt to be updated, along with relevant supporting information a maximum of five working days following the end of each averaging period.

(b) The supporting information should include the same information as at Appendix 4E of the Draft Decision, with the addition of the relevant ISIN codes for the bonds, rather than just their Bloomberg tickers.[86] DBP would then have 10 working days to respond with an acceptance or challenge to the proposed numbers, with reasons.

[86] *The ISIN code (http://www.isin.org/) is the International Securities Identification Number, and is a unique identifier for every security which can be used with any platform. Unlike, say a Bloomberg or TR ticker, which can only be used by other Bloomberg or TR users. Every bond has an ISIN. This facilitates checking Bloomberg results with TR data and vice versa.*

(c) The two parties would undertake to work together on any issues arising, such that the tariff variation mechanism (which DBP notes includes more than just the cost of debt update) is finalised by the end of the first week of December.

10.43 The delivery timeframes are not symmetric, but this is because of the tasks involved. The ERA needs only to run a set of spreadsheets which it already has, and indeed five days may be excessive for this task which, as per the requirements of Rule 87(12) is intended to be automatic. DBP would be happy to accept a shorter timeframe. By contrast, DBP needs to re-run the spreadsheets (in R) and then examine the output to ascertain whether any errors have occurred, or if there are any issues with the results. This naturally takes longer. If the ERA had proposed an approach whereby DBP undertook the initial estimation and the ERA the checks, the asymmetry between the parties would have been the other way, and, as noted above DBP would accept this order of analysis.

10.44 The requirement for supporting information is aimed at expediting the process. If, for example, the ERA provided simply the number which it had determined for the cost of debt, it would be almost impossible to ascertain where an error might have occurred, if DBP's own running of the model produces a different result. The result would be a needless process of reverse-engineering to find where the problem lies.

10.45 The final stage of the process is not timed (except for the end date), and is intended to provide both parties with time for discussion so that the root cause of whatever problem has been identified (by either party) can be uncovered and resolved.

Protecting the ERA approach via a fixed principle

10.46 The ERA proposes to use its hybrid model, which has a five-year risk-free rate (formed by the five-year BBSW) combined with a ten-year trailing average of the debt risk premium. Apart from issues in relation to capex weights and hedging costs (discussed below) DBP accepts this model.

Box 3: Five year risk-free rates in debt and ten year risk-free rates in equity

DBP accepts the use of a five-year BBSW for debt, but not the five-year risk-free rate in equity. This is not contradictory. In respect of debt, the ERA proposes to update the risk-free rate every five years. The rational response of an efficient firm to this regime (as both the ERA and AER have pointed out in respect to the existing on-the day approach) is to swap the risk-free component of newly-issued ten-year debt for a fixed five-year rate during the course of the regulatory period, and then re-swap at the prevailing rates at the commencement of the next AA period. As it should, the ERA includes the costs of these swaps.

A firm not subject to this method of estimating the cost of debt by a regulator would not undertake this kind of swapping arrangement but would issue staggered debt. The AER's trailing average approach reflects this competitive market outcome, and thus differs from the ERA's attempt to inject new information into prices via a periodic full-update of the risk-free rate.

Whether the ERA or AER is correct in their approach is immaterial for our purposes. What is important is that different risk-free rates are relevant in each scenario. If the ERA allowed the ten-year risk-free rate, it would over-compensate firms who swap to gain fixed five-year rates. Likewise, if the AER used the five-year rate, it would under-compensate those issuing ten-year staggered debt without swapping. The ERA recognises this when it discusses the appropriate way for large firms to split their debt (see DDA4 para 458, p96).

Equity is a different case. Whether regulatory prices are set every five years or not, equity holders are exposed to long-term risk (here we believe the ERA is mistaken; see discussion in paragraphs 7.1 to 7.10) and thus the relevant rate of return for equity needs to reflect this long-term risk, meaning that the ERA needs to use the ten-year risk-free rate for equity. Using the five-year risk-free rate means that part of the risk faced by equity goes unrewarded, and it would be incorrect to use a five year rate for equity just because a five-year rate is used for debt.

10.47 Were it the case that DBP was to be regulated into the foreseeable future, then there would be no need for this section of the discussion. However, this is not likely to be the case; current State Government policy is that WA energy providers will move to the AER before 2020, with details on timing and legislative arrangements to be finalised during 2016.

10.48 The practical upshot, for DBP, is that it will be subject to the AER's approach to the estimation of the cost of debt in 2020, and not the ERA's model. Although the exact model the AER will use is currently unclear, due to the challenges before the Competition Tribunal, all models being proposed by the AER and the other parties to the challenges involve trailing averages which include the risk-free component of debt; they differ only in the type of transition mechanism proposed from the status quo.

10.49 In 2020, when the AER makes its first determination for the cost of debt for DBP, and other WA regulated energy firms, we do not believe that it will make a special case for WA firms. That is, assuming it is the AER's approach to the cost of debt, with a transition on the risk-free rate and debt risk premium, which prevails before the Tribunal, the AER proposes that it will start the transition in 2015, and DBP does not believe it would be prepared to entertain a situation at the next round of regulatory determinations whereby all East Coast service providers have a cost of debt involving a trailing average which began in 2015, but DBP (and other WA energy providers) have a cost of debt which begins a transition in 2020. This would involve creating a "special case" based solely on geography which the AER seems unlikely to consider would be in the interests of efficiency in the Australian economy as a whole, particularly as it may create different prices on the East and West coasts.

10.50 This creates a dilemma for DBP's corporate Treasury. If it reacts efficiently to the ERA's hybrid model by hedging the risk-free component of its debt for five years then, come 2020, it will face a price which assumes tranches of debt priced according to the 2016, 2017, 2018 and 2019 risk-free rates, and it cannot go back and hedge the past. As the ERA notes (DDA4 para 583, p121), without some form of transition to a trailing average on the risk-free rate, DBP would need to go back and unwind a series of hedges, which will be very costly. Alternatively, if DBP's Treasury reacts now on the assumption that the AER will not allow a transition from 2020 and starts to replicate the pattern of tranches of debt, including the risk-free rate (as per the AER approach) from 2016, then DBP's cost of debt will not match the revenues being earned, which are based on the ERA's hybrid approach to debt and the 2016 risk free rate.

10.51 The problem is not solely associated with the fact that the AER will, with certainty, act a particular way, but the issue is rather that there is no way of knowing how it will act in 2020 until it starts the process of assessing WA energy firm access proposals, which will not happen for several years. This adds to risk right now, and is therefore priced in the debt that DBP is issuing in 2016; it is not an issue with no effect until 2020 that can therefore be ignored. Additionally, whilst DBP accepts that it must accept market risk associated with the fluctuation in rates (for example, if it cannot hedge exactly in the window associated with the annual update), this is not a market risk, but rather a regulatory risk due wholly and solely to a change in regulator before 2020.

10.52 The simple solution to this dilemma would be for the ERA to protect its own approach to estimating the cost of debt via a fixed principle.[87] This would provide certainty, at the Final Decision stage, that DBP will not face an uncertain approach and will obviate the risks outlined above. DBP therefore proposes a fixed principle which preserves the ERA's hybrid approach to the estimation of the cost of debt.

[87] *It could also be enshrined in the legislation by which energy firms are transferred from the care of the ERA to the AER, but this sits outside the purview of the ERA.*

11. CALCULATING DBP'S WEIGHTED AVERAGE COST OF CAPITAL

11.1 In our Original AA Proposal, DBP detailed how it had calculated its overall WACC, examining the determination of the cost of equity, the cost of debt and the application of the consistency test. DBP has not changed its approach significantly, but we do have access to an additional year of data between the timing of the Original AA Proposal and the Draft Decision. We therefore update all of our work to account for this new information in this Chapter. The Chapter, accordingly, contains three sections:

(a) An overview of the results of applying the model adequacy test and the models selected once new data are included. In this section, we include an application of the ERA's cross-validation approach, which delivers the same conclusions as DBP's model adequacy test.

(b) An overview of the process by which we determine the cost of debt, following the ERA's approach.

(c) An overview of the results of applying the consistency test, and obtaining consistent results for the cost of debt and equity, so that the resultant cost of equity is unbiased, and consistent with the cost of debt.

11.2 To presage the empirical findings of this Chapter, we find:

(a) The cost of debt is 5.592, based upon:

(i) A five-year BBSW for the 40 trading days to November 30th 2015 of 2.46 percent.

(ii) A debt risk premium of 253.57 bps.

(iii) A debt-raising cost of 14.8 bps.

(iv) Hedging costs of 17.84 bps.

(v) A new issue premium of 27 bps.

(b) A cost of equity formed using the betastar model which produces an unbiased range of cost of equity results ranging from 9.9 to 14.8 percent.

(c) A cost of equity range refined by considering the consistency test which provides an unbiased and consistent range for the cost of equity of 10.61 to 11.06 percent.

(d) A final cost of equity estimate of 10.84 percent.

Calculating the cost of equity

11.3 In this first sub-section we consider the estimation of the cost of equity. In our Original AA Proposal, this discussion consisted of two sections; an application of DBP's model adequacy test to find the unbiased models and then an estimation of those models using the recent relevant dataset. We follow the same process below, but we add an additional subsection between the application of DBP's model adequacy test and the estimation of the return on equity (range) for the BEE which summarises the results of an application of the ERA's proposed model adequacy test based upon the use of cross-validation techniques. Ultimately, we do not rely upon the ERA's proposed approach, because, as discussed in Chapter Six, the ERA's assessment of our own model adequacy test gives us no reason to divert from our position in the Original AA Proposal. However, we make no claim that our own test is the only test which might be conducted, and we thus present the results from following the ERA's suggestions.

Reapplying DBP's model adequacy test

11.4 The first stage in re-applying the model adequacy test is to test the various different versions of the SL-CAPM, the Black CAPM and the FFM using the new data. The results of doing so are summarised overleaf in Table 10 to Table 13.

Table 10: Model adequacy test results – ERA SLCAPM

		Method A		Method B		Method C Base		Method C 5%		Method C 10%		Method C 15%		Method C 20%	
Wald		25.60		26.96		26.19		26.06		25.93		25.82		25.72	
	betas	t-stat	MFE	t-stat	MFE	t-stat	MFE	t-stat	MFE	t-stat	MFE	t-stat	MFE	t-stat	MFE
Portfolio 1	0.584	-2.027	-4.62%	-2.993	-5.37%	-2.518	-5.70%	-2.459	-5.57%	-2.394	-5.43%	-2.323	-5.27%	-2.244	-5.10%
Portfolio 2	0.707	-1.649	-3.96%	-2.682	-4.75%	-2.212	-5.27%	-2.144	-5.11%	-2.070	-4.94%	-1.988	-4.75%	-1.897	-4.54%
Portfolio 3	0.655	-1.468	-3.60%	-2.597	-4.38%	-1.962	-4.78%	-1.900	-4.64%	-1.831	-4.47%	-1.756	-4.29%	-1.673	-4.09%
Portfolio 4	0.844	-1.451	-3.77%	-2.811	-4.64%	-2.063	-5.32%	-1.988	-5.13%	-1.906	-4.92%	-1.815	-4.69%	-1.714	-4.44%
Portfolio 5	0.921	-0.613	-1.82%	-1.661	-2.79%	-1.194	-3.52%	-1.121	-3.30%	-1.041	-3.07%	-0.953	-2.82%	-0.855	-2.53%
Portfolio 6	0.948	-0.131	-0.38%	-1.021	-1.49%	-0.742	-2.15%	-0.665	-1.93%	-0.582	-1.69%	-0.489	-1.43%	-0.387	-1.13%
Portfolio 7	1.034	0.723	2.37%	0.718	1.19%	0.124	0.40%	0.199	0.65%	0.282	0.92%	0.373	1.22%	0.474	1.55%
Portfolio 8	1.252	0.870	3.29%	0.946	1.74%	0.221	0.82%	0.300	1.12%	0.386	1.45%	0.482	1.81%	0.588	2.21%
Portfolio 9	1.440	1.779	7.68%	2.540	5.82%	1.106	4.71%	1.187	5.06%	1.276	5.45%	1.373	5.88%	1.481	6.35%
Portfolio 10	1.524	1.451	7.78%	1.545	5.79%	0.872	4.61%	0.940	4.98%	1.016	5.39%	1.099	5.84%	1.191	6.34%

Source: DBP analysis – note that MFE stands for "mean forecast error" and is, as in our Original AA Proposal Submission 12, the annualised mean forecast error.

Table 11: Model adequacy test results – 99th percentile beta SL-CAPM

		Method A		Method B		Method C Base		Method C 5%		Method C 10%		Method C 15%		Method C 20%	
Wald		25.03		25.63		25.73		25.59		25.44		25.31		25.20	
	betas	t-stat	MFE	t-stat	MFE	t-stat	MFE	t-stat	MFE	t-stat	MFE	t-stat	MFE	t-stat	MFE
Portfolio 1	0.611	-1.951	-4.45%	-2.897	-5.22%	-2.467	-5.59%	-2.405	-5.45%	-2.338	-5.30%	-2.263	-5.14%	-2.181	-4.96%
Portfolio 2	0.734	-1.578	-3.79%	-2.583	-4.61%	-2.164	-5.16%	-2.094	-5.00%	-2.017	-4.82%	-1.932	-4.62%	-1.838	-4.40%
Portfolio 3	0.680	-1.405	-3.44%	-2.514	-4.24%	-1.918	-4.68%	-1.854	-4.53%	-1.783	-4.36%	-1.705	-4.17%	-1.619	-3.96%
Portfolio 4	0.867	-1.394	-3.62%	-2.710	-4.50%	-2.025	-5.22%	-1.947	-5.03%	-1.863	-4.81%	-1.769	-4.58%	-1.666	-4.31%
Portfolio 5	0.943	-0.565	-1.68%	-1.583	-2.67%	-1.162	-3.42%	-1.087	-3.21%	-1.005	-2.97%	-0.915	-2.71%	-0.816	-2.42%
Portfolio 6	0.969	-0.086	-0.25%	-0.935	-1.37%	-0.711	-2.07%	-0.633	-1.84%	-0.547	-1.59%	-0.453	-1.32%	-0.348	-1.02%
Portfolio 7	1.054	0.764	2.51%	0.787	1.31%	0.152	0.49%	0.228	0.74%	0.313	1.02%	0.406	1.33%	0.509	1.66%
Portfolio 8	1.274	0.908	3.43%	1.010	1.87%	0.246	0.92%	0.327	1.22%	0.415	1.55%	0.512	1.92%	0.620	2.33%
Portfolio 9	1.465	1.818	7.86%	2.595	5.97%	1.133	4.83%	1.216	5.19%	1.306	5.58%	1.405	6.02%	1.515	6.50%
Portfolio 10	1.566	1.504	8.07%	1.600	6.03%	0.907	4.80%	0.978	5.18%	1.056	5.60%	1.141	6.07%	1.235	6.58%

Source: DBP analysis – note that MFE stands for "mean forecast error" and is, as in our Original AA Proposal Submission 12, the annualised mean forecast error.

Table 12: Model adequacy test results – Black CAPM

		Method A		Method B		Method C Base		Method C 5%		Method C 10%		Method C 15%		Method C 20%	
Wald		7.97		9.24		8.20		8.12		8.05		7.99		7.95	
	betas	t-stat	MFE	t-stat	MFE	t-stat	MFE	t-stat	MFE	t-stat	MFE	t-stat	MFE	t-stat	MFE
Portfolio 1	0.500	-0.689	-1.60%	-1.263	-2.31%	-1.103	-2.54%	-1.052	-2.42%	-0.997	-2.30%	-0.936	-2.16%	-0.868	-2.00%
Portfolio 2	0.624	-0.749	-1.82%	-1.440	-2.57%	-1.240	-2.99%	-1.180	-2.85%	-1.114	-2.69%	-1.042	-2.52%	-0.962	-2.33%
Portfolio 3	0.579	-0.444	-1.10%	-1.075	-1.86%	-0.875	-2.16%	-0.820	-2.03%	-0.760	-1.88%	-0.693	-1.72%	-0.620	-1.53%
Portfolio 4	0.772	-0.993	-2.59%	-2.091	-3.43%	-1.548	-4.02%	-1.479	-3.84%	-1.404	-3.65%	-1.320	-3.43%	-1.228	-3.20%
Portfolio 5	0.852	-0.402	-1.20%	-1.258	-2.13%	-0.935	-2.76%	-0.868	-2.57%	-0.793	-2.35%	-0.712	-2.11%	-0.621	-1.85%
Portfolio 6	0.884	0.006	0.02%	-0.722	-1.07%	-0.559	-1.63%	-0.488	-1.42%	-0.409	-1.19%	-0.323	-0.94%	-0.228	-0.67%
Portfolio 7	0.970	0.655	2.15%	0.616	1.03%	0.097	0.31%	0.168	0.55%	0.245	0.80%	0.331	1.08%	0.426	1.39%
Portfolio 8	1.184	0.382	1.43%	-0.011	-0.02%	-0.231	-0.86%	-0.156	-0.58%	-0.074	-0.27%	0.016	0.06%	0.117	0.43%
Portfolio 9	1.360	1.021	4.35%	1.158	2.60%	0.386	1.62%	0.463	1.94%	0.546	2.30%	0.639	2.69%	0.741	3.13%
Portfolio 10	1.393	0.729	3.84%	0.566	2.07%	0.202	1.05%	0.265	1.38%	0.334	1.74%	0.410	2.14%	0.494	2.59%

Source: DBP analysis – note that MFE stands for "mean forecast error" and is, as in our Original AA Proposal Submission 12, the annualised mean forecast error.

Table 13: Model adequacy test results – Fama French Model

				Method A		Method B		Method C Base		Method C 5%		Method C 10%		Method C 15%		Method C 20%	
Wald				16.70		16.93		17.17		17.10		17.04		17.00		16.97	
	Beta MRP	Beta HML	Beta SMB	t-stat	MFE	t-stat	MFE	t-stat	MFE	t-stat	MFE	t-stat	MFE	t-stat	MFE	t-stat	MFE
Portfolio 1	0.624	0.069	0.301	-1.573	-4.08%	-2.493	-4.72%	-2.192	-5.16%	-2.131	-5.02%	-2.065	-4.87%	-1.993	-4.70%	-1.912	-4.52%
Portfolio 2	0.715	0.255	0.076	-0.587	-1.54%	-1.473	-2.43%	-1.416	-3.61%	-1.352	-3.45%	-1.281	-3.27%	-1.204	-3.07%	-1.118	-2.86%
Portfolio 3	0.726	0.223	0.111	-1.157	-3.22%	-2.435	-4.02%	-1.237	-3.20%	-1.172	-3.04%	-1.101	-2.85%	-1.022	-2.65%	-0.935	-2.43%
Portfolio 4	0.828	0.250	0.072	-0.377	-1.21%	-1.246	-2.23%	-1.529	-4.26%	-1.461	-4.07%	-1.386	-3.87%	-1.304	-3.64%	-1.213	-3.39%
Portfolio 5	0.921	0.193	0.015	0.293	0.91%	-0.056	-0.08%	-0.668	-2.08%	-0.599	-1.86%	-0.523	-1.63%	-0.439	-1.37%	-0.346	-1.08%
Portfolio 6	0.957	0.189	-0.028	0.928	3.19%	1.180	1.98%	-0.276	-0.85%	-0.204	-0.63%	-0.124	-0.38%	-0.036	-0.11%	0.062	0.19%
Portfolio 7	1.035	0.229	0.035	0.835	3.33%	1.017	2.09%	0.551	1.88%	0.624	2.13%	0.704	2.40%	0.791	2.71%	0.889	3.04%
Portfolio 8	1.211	0.041	-0.055	1.538	6.63%	2.158	5.04%	0.299	1.12%	0.375	1.40%	0.459	1.72%	0.551	2.07%	0.653	2.45%
Portfolio 9	1.323	-0.159	0.003	0.968	5.01%	0.861	3.15%	0.692	2.82%	0.769	3.14%	0.853	3.49%	0.946	3.88%	1.049	4.31%
Portfolio 10	1.435	-0.105	0.332	0.748	0.66%	-0.258	-1.01%	0.558	2.81%	0.625	3.16%	0.698	3.53%	0.779	3.95%	0.869	4.41%

Source: DBP analysis – note that MFE stands for "mean forecast error" and is, as in our Original AA Proposal Submission 12, the annualised mean forecast error.

11.5 The results are broadly the same as they were for the Original AA Proposal. Indeed, our rejection of the SL-CAPM is marginally stronger, and is sustained through the various Method C estimates, which seek to replicate what the ERA now does in respect of MRP as close as we can. The FFM also performs slightly worse, and the Black CAPM slightly better than previously. For brevity, we have not included the results of the vanilla SL-CAPM, which is more biased than the version of the SL-CAPM the ERA employs.

11.6 We have again considered the results of the Mincer-Zarnowitz tests. DAA (see Appendix K) advise that these tests have very low power, and strongly advises against their use when examining the kind of structured bias DBP is seeking to uncover through its model adequacy test. DBP was aware of these concerns when it submitted its AA Proposal (see para 5.157 -59), where we noted that we only did so because the ERA had suggested these tests. Further, Holden and Peel (1989) show that a rejection of the null hypothesis of the Mincer-Zarnowitz test does not necessarily imply bias, and recommend instead the use of t-tests. In light of the expert advice from DAA, and the work of Holden & Peel (1089) we presume the ERA will no longer seek to employ an irrelevant test, but for the purposes of continuity from our AA proposal, we present un updated version of the Mincer Zarnowitz test results, that includes the various iterations of Method C, below.

Table 14: Mincer-Zarnowitz test results

	Intercept		Slope	
	estimate	standard error	estimate	standard error
Mean beta SL-CAPM				
Method A	0.985	0.215	-0.972	0.550
Method C - Base	0.855	0.205	-0.549	0.701
Method C - 5%	0.858	0.205	-0.534	0.670
Method C - 10%	0.861	0.206	-0.517	0.638
Method C - 15%	0.863	0.206	-0.498	0.607
Method C - 20%	0.866	0.206	-0.478	0.575
95th percentile beta SL-CAPM				
Method A	1.023	0.234	-0.824	0.568
Method C - Base	0.859	0.215	-0.512	0.696
Method C - 5%	0.683	0.014	-0.152	0.025
Method C - 10%	0.865	0.216	-0.483	0.634
Method C - 15%	0.867	0.216	-0.466	0.603
Method C - 20%	0.870	0.217	-0.447	0.571
Black CAPM and Betastar				
Method A	0.714	1.046	0.100	1.818
Method C - Base	-0.011	0.427	1.556	0.801
Method C - 5%	-0.031	0.438	1.571	0.809
Method C - 10%	-0.050	0.488	1.583	0.814
Method C - 15%	-0.069	0.457	1.590	0.815
Method C - 20%	-0.090	0.465	1.598	0.811
FFM	1.555	0.363	-1.741	0.773

Source: DBP analysis

11.7 The actual numbers, particularly for the Black CAPM and Betastar models, change quite substantially, but the overall conclusions from the model results do not. The reason for the results in Table 14 can be explained relatively easily. There is a reasonable amount of variation across the 10 portfolios in the estimates of their betas, their 95th percentile beta estimates and in their Fama-French beta estimates. So the standard errors of the intercept and slope coefficient in the Mincer-Zarnowitz regressions for these models are small enough that the tests are able to reject.

11.8 However, there is substantially less variation across the 10 portfolios in the returns forecast by the betastar approach and the Black CAPM. At each point in time, these models look back at past

data and, seeing little relation between returns and estimates of beta across stocks, they set the forecasts of the returns to the 10 portfolios to be similar to one another. As a result of this low dispersion in forecast returns, the standard errors associated with estimates of the parameters of the Mincer-Zarnowitz model are high, and the Mincer-Zarnowitz test has very little power. The reason for the big change in the gross numbers (compared to Table 13 in the AA Proposal, which also has high standard errors) is that, when standard errors are very high, a small number of additional observations can change results markedly.

11.9 It is worth noting that this is not indicative of a problem with the Black CAPM or betastar models per se, but rather, as DAA point out, with the test itself, which is ill-suited to the purpose for which it is being put. The test has low power across the board, but just enough power to point to a rejection of the SL-CAPM and FFM. For this reason, the results of Table 14 should be given little weight, and are presented only for continuity with the AA Proposal.

11.10 As was the case in our Original AA Proposal, rather than implement the Black CAPM directly, we make use of our betastar model (formulated in exactly the same way) and again look for points on the confidence interval of betastar which delineate the difference between biasedness and unbiasedness in forecast. This time around, the relevant range is from the 25th to the 99th percentile, marginally higher than last time.

11.11 The results for the betastar model are presented in the tables on the following pages, along with the MSE results. Note that in respect of the betastar results, we present only the 25th and 99th percentiles and only one version of Method C. In the former case, betastar is an algebraic manipulation of the Black CAPM, and thus has the same results as shown in Table 12, which we don't repeat. In the latter case, the calculation of standard errors for betastar needed to find points on its confidence interval is a non-trivial exercise, and the limits of time meant we could not do all versions of Method C.

11.12 In both cases, our results match the Original AA Proposal; importantly we do not lose precision (see MSEW results as we solve the bias issue. Note also in respect of betastar that the 25th percentile is where method C becomes biased downwards, implying that, even with the ERA's new approach to the MRP, it would need to use a markedly higher beta adjustment than it does in fact use.

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Table 15: Model adequacy test results – 99th and 25th percentile betastar results

	99pct betastar	Method A		Method B		Method C Base		25pct betastar	Method A		Method B		Method C - Base	
Wald		6.43		3.36		3.36			6.43		3.41		3.41	
	betas	t-stat	MFE	t-stat	MFE	t-stat	MFE	betas	t-stat	MFE	t-stat	MFE	t-stat	MFE
Portfolio 1	1.701	1.081	2.55%	0.266	0.97%	0.579	1.38%	0.880	-1.202	-2.77%	-2.068	-0.041	-2.012	-4.69%
Portfolio 2	1.528	0.529	1.30%	-0.094	-0.28%	0.032	0.08%	0.907	-1.118	-2.70%	-2.115	-0.039	-1.850	-4.53%
Portfolio 3	1.595	0.978	2.46%	0.286	0.89%	0.419	1.08%	0.891	-0.856	-2.11%	-2.009	-0.034	-1.638	-4.11%
Portfolio 4	1.322	-0.278	-0.73%	-1.028	-2.25%	-0.887	-2.35%	0.946	-1.200	-3.13%	-2.578	-0.043	-1.958	-5.13%
Portfolio 5	1.212	0.020	0.06%	-0.738	-1.41%	-0.513	-1.54%	0.962	-0.525	-1.56%	-1.639	-0.027	-1.135	-3.38%
Portfolio 6	1.168	0.357	1.05%	-0.156	-0.26%	-0.264	-0.78%	0.964	-0.095	-0.28%	-1.052	-0.015	-0.787	-2.30%
Portfolio 7	1.069	0.795	2.61%	0.740	1.26%	0.205	0.67%	0.979	0.615	2.01%	0.500	0.008	-0.009	-0.03%
Portfolio 8	1.200	0.780	2.94%	0.889	1.65%	0.270	1.02%	0.905	0.267	1.00%	-0.058	-0.001	-0.356	-1.33%
Portfolio 9	1.408	1.729	7.46%	2.597	5.98%	1.248	5.41%	0.819	0.816	3.46%	0.923	0.024	0.169	0.72%
Portfolio 10	1.447	1.354	7.24%	1.540	5.75%	1.006	5.42%	0.802	0.547	2.87%	0.464	0.018	0.067	0.35%

Source: DBP analysis – note that MFE stands for "mean forecast error" and is, as in our Original AA Proposal Submission 12, the annualised mean forecast error

Table 16: Mean squared error of forecast errors – all models

	Portfolio 1	Portfolio 2	Portfolio 3	Portfolio 4	Portfolio 5	Portfolio 6	Portfolio 7	Portfolio 8	Portfolio 9	Portfolio 10
Mean Beta										
Method A	0.0016	0.0018	0.0019	0.0021	0.0027	0.0026	0.0032	0.0042	0.0053	0.0081
Method B	0.0010	0.0010	0.0009	0.0009	0.0009	0.0007	0.0008	0.0010	0.0015	0.0040
Method C - Base	0.0016	0.0018	0.0019	0.0021	0.0027	0.0026	0.0032	0.0041	0.0052	0.0080
Method C - 5%	0.0016	0.0018	0.0019	0.0021	0.0027	0.0026	0.0032	0.0041	0.0052	0.0080
Method C - 10%	0.0016	0.0018	0.0019	0.0021	0.0027	0.0026	0.0032	0.0041	0.0052	0.0080
Method C - 15%	0.0016	0.0018	0.0019	0.0021	0.0027	0.0026	0.0032	0.0041	0.0052	0.0080
Method C - 20%	0.0016	0.0018	0.0019	0.0021	0.0027	0.0026	0.0032	0.0041	0.0052	0.0080
95th percentile beta										
Method A	0.0016	0.0018	0.0019	0.0021	0.0027	0.0026	0.0032	0.0042	0.0053	0.0081
Method B	0.0010	0.0010	0.0009	0.0009	0.0009	0.0006	0.0008	0.0010	0.0015	0.0040
Method C - Base	0.0016	0.0018	0.0019	0.0021	0.0027	0.0026	0.0032	0.0041	0.0052	0.0080
Method C - 5%	0.0016	0.0018	0.0019	0.0021	0.0027	0.0026	0.0032	0.0041	0.0052	0.0080
Method C - 10%	0.0016	0.0018	0.0019	0.0021	0.0027	0.0026	0.0032	0.0041	0.0052	0.0080
Method C - 15%	0.0016	0.0018	0.0019	0.0021	0.0027	0.0026	0.0032	0.0041	0.0052	0.0080
Method C - 20%	0.0016	0.0018	0.0019	0.0021	0.0027	0.0026	0.0032	0.0041	0.0052	0.0080

	Portfolio 1	Portfolio 2	Portfolio 3	Portfolio 4	Portfolio 5	Portfolio 6	Portfolio 7	Portfolio 8	Portfolio 9	Portfolio 10
99th percentile beta										
Method A	0.0016	0.0018	0.0019	0.0021	0.0027	0.0026	0.0032	0.0042	0.0053	0.0081
Method B	0.0010	0.0010	0.0009	0.0009	0.0009	0.0006	0.0008	0.0010	0.0015	0.0040
Method C - Base	0.0016	0.0018	0.0019	0.0021	0.0027	0.0026	0.0032	0.0041	0.0052	0.0080
Method C - 5%	0.0016	0.0018	0.0019	0.0021	0.0027	0.0026	0.0032	0.0041	0.0052	0.0080
Method C - 10%	0.0016	0.0018	0.0019	0.0021	0.0027	0.0026	0.0032	0.0041	0.0052	0.0080
Method C - 15%	0.0016	0.0018	0.0019	0.0021	0.0027	0.0026	0.0032	0.0041	0.0052	0.0080
Method C - 20%	0.0016	0.0018	0.0019	0.0021	0.0027	0.0026	0.0032	0.0041	0.0052	0.0080
Black CAPM and betastar										
Method A	0.0016	0.0018	0.0019	0.0021	0.0027	0.0026	0.0032	0.0041	0.0052	0.0080
Method B	0.0010	0.0010	0.0009	0.0008	0.0009	0.0007	0.0008	0.0010	0.0015	0.0039
Method C - Base	0.0016	0.0018	0.0019	0.0021	0.0027	0.0026	0.0032	0.0041	0.0052	0.0080
Method C - 5%	0.0016	0.0018	0.0019	0.0021	0.0027	0.0026	0.0032	0.0041	0.0052	0.0080
Method C - 10%	0.0016	0.0018	0.0019	0.0021	0.0027	0.0026	0.0032	0.0041	0.0052	0.0080
Method C - 15%	0.0016	0.0018	0.0019	0.0021	0.0027	0.0026	0.0032	0.0041	0.0052	0.0080
Method C - 20%	0.0016	0.0018	0.0019	0.0021	0.0027	0.0026	0.0032	0.0041	0.0052	0.0080
FFM										
Method A	0.0018	0.0020	0.0021	0.0024	0.0030	0.0029	0.0034	0.0042	0.0050	0.0076
Method B	0.0010	0.0010	0.0009	0.0008	0.0009	0.0007	0.0008	0.0010	0.0015	0.0036
Method C - Base	0.0018	0.0020	0.0021	0.0024	0.0030	0.0029	0.0034	0.0042	0.0049	0.0075
Method C - 5%	0.0018	0.0020	0.0021	0.0024	0.0030	0.0029	0.0034	0.0042	0.0049	0.0075
Method C - 10%	0.0018	0.0020	0.0021	0.0024	0.0030	0.0029	0.0034	0.0042	0.0049	0.0075
Method C - 15%	0.0018	0.0020	0.0021	0.0024	0.0030	0.0029	0.0034	0.0042	0.0049	0.0075
Method C - 20%	0.0018	0.0020	0.0021	0.0024	0.0030	0.0029	0.0034	0.0042	0.0049	0.0075

Source: DBP analysis

Applying the ERA's cross-validation version of the model adequacy test

11.13 In this section we present a summary of the results which obtain from implementing LOOCV and k-fold cross validation, as suggested by the ERA, noting the caveats about using the future in predictions associated with applying each of these methods, discussed in paragraphs 6.126 to 6.128. Further details are provided in Appendix I, and the expert report provided by ESQUANT.

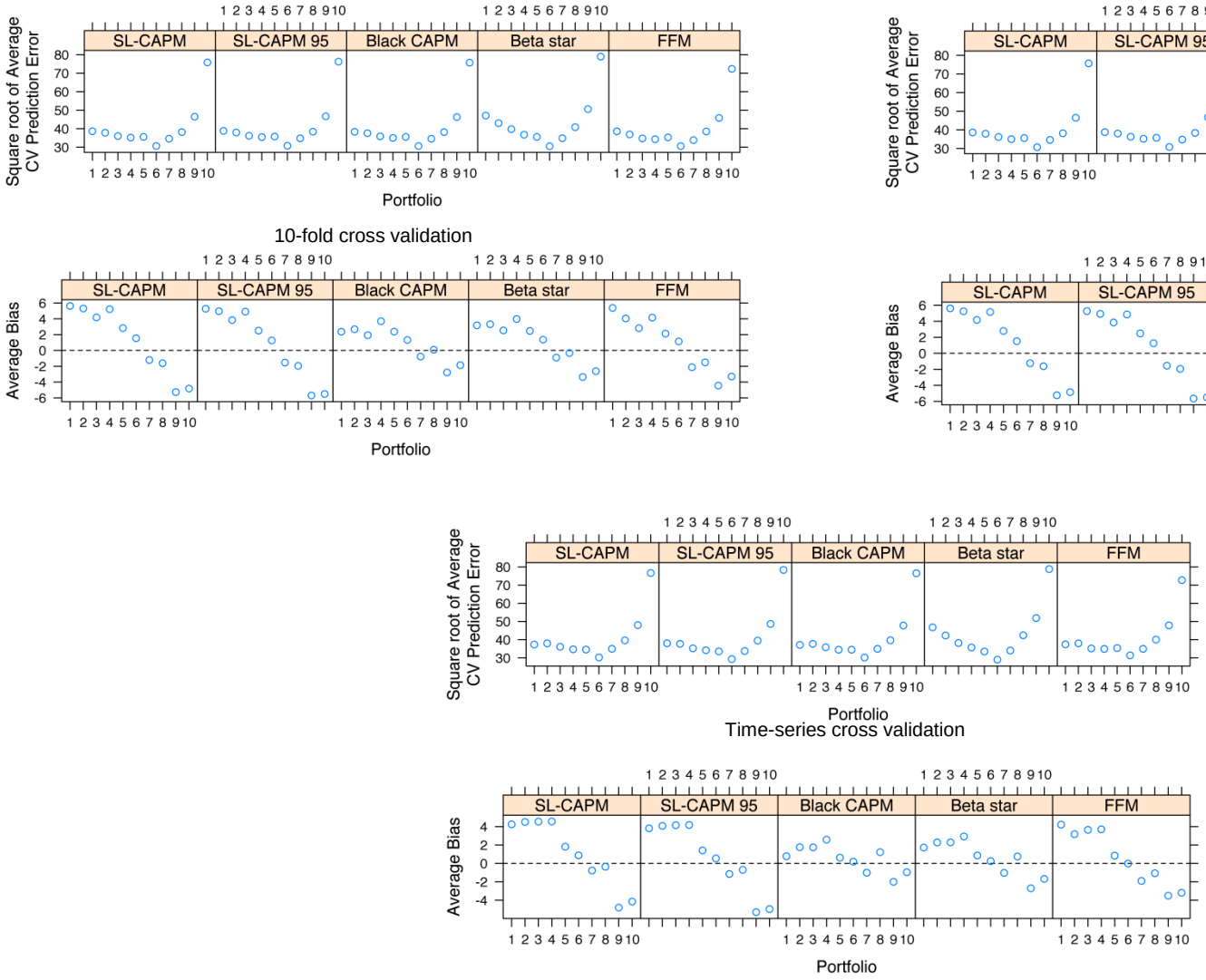
11.14 ESQUANT in fact undertook seven different crops validation tests; three for month-ahead and four for year-ahead forecasts. For both month ahead and year-ahead forecasts, ESQUANT applied 10-fold cross validation, LOOCV and time series cross validation (following Hyndman & Athanasopoulos, 2014). When undertaking forecasts, the month-ahead forecasts are not correlated, but an overlapping series of year-ahead forecasts (the forecast of March 2013 made in March 2012, followed by the forecast for April 2013 made in April 2012 etc) will have a correlation structure due to the fact that 59 of the data points used in a forecast at time t have also been used in time t+1. This correlation structure means that overlapping time periods cannot be used in cross validation. Thus, for year ahead forecasts, the data need to be aggregated to annual data. Time series cross validation is not affected by this issue, and thus for the year ahead models there is one time-series cross validation exercise which is annual data, and one which uses monthly data.

11.15 The issue of needing non-overlapping time series for cross validation means that much longer time series are needed to implement this approach than is the case for DBP's model adequacy test (or time-series cross validation). Even using the SPPR database, the annual results are formed with only 35 data-points, which is a very small dataset upon which to base conclusions. By comparison, the ERA code for cross validation contemplates using Bloomberg data, which generally only goes back to the mid-1990s, and means that cross validation at any data frequency lower than monthly would likely result in insufficient data to actually undertake the analysis. This would, in turn, mean that the ERA would likely be forced to use the same SPPR dataset that DBP has used, unless it can source one with an even longer history.

11.16 The results of ESQAUNT's analysis are shown in the figures and tables overleaf, with further results provided in Appendix I. Figure 6 shows the month-ahead results across all portfolios, whilst Figure 7 shows the year ahead results across all portfolios. Table 17 shows the detail for Portfolio One for month ahead, whilst Table 18 shows the same detail for year-ahead forecasts.

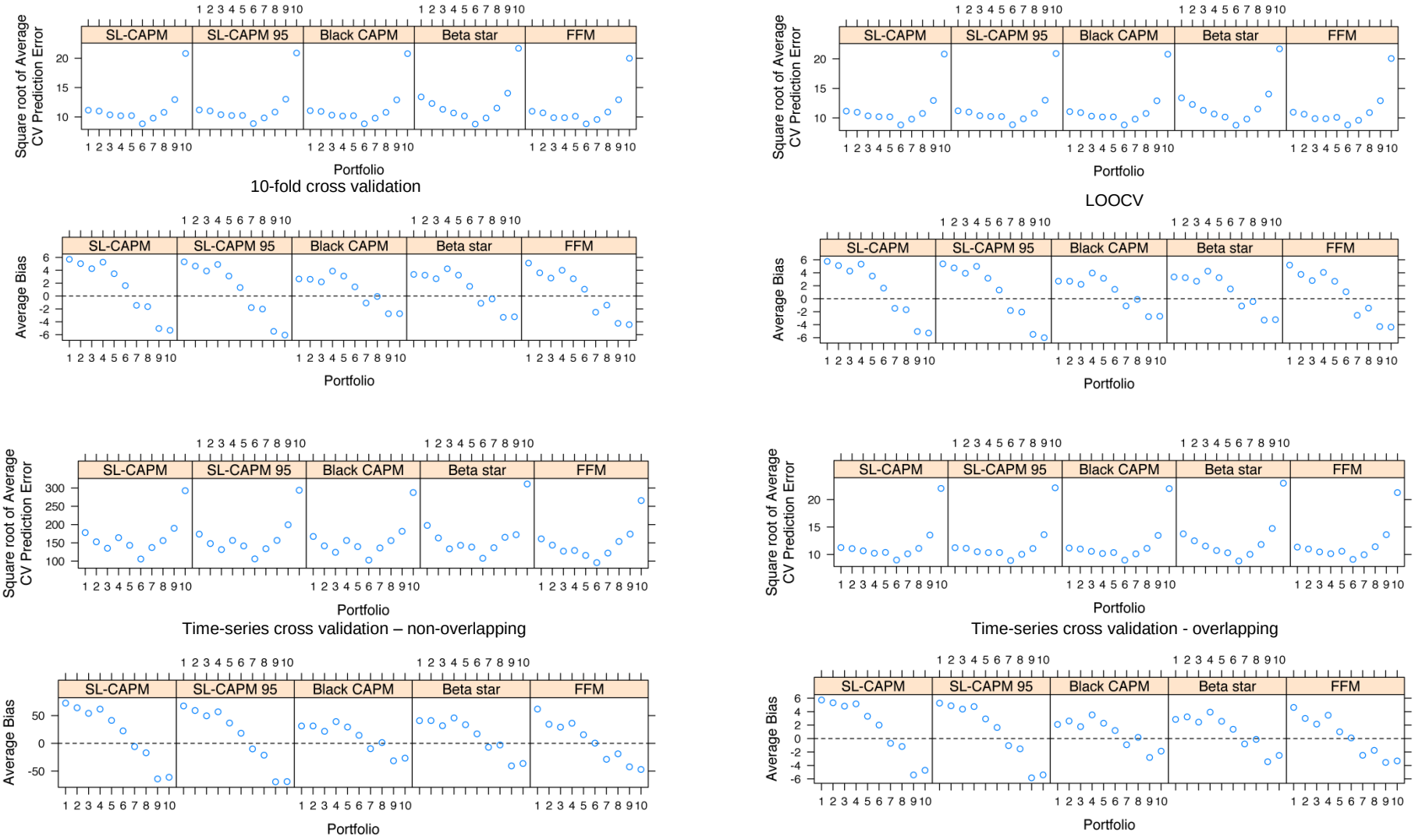
11.17 The results match fairly closely those from the AA Proposal, with Portfolio One being clearly biased under the SL-CAPM models, and that bias being significantly reduced when the Black CAPM and Betastar models are used. Indeed, the results match the literature in that the bias is negative for low-beta portfolios and positive for high beta portfolios. Note also that the square root of the prediction error varies across portfolios, but not across models; it is not the case that using the Black CAPM, say, leads to less precise results than using the SL-CAPM, and so there is no "trade-off" between a less precise and a less biased mode.

Figure 6: Month ahead 10-fold, LOOCV and time series cross validation – all portfolios (Method B)



Source: Appendix I, Figures 2, 5 and 8.

Figure 7: Year ahead 10-fold, LOOCV and time series cross validation – all portfolios (Method B)



Source: Appendix I, Figures 11, 14, 17 and 20

Table 17: Month ahead 10-fold, LOOCV and time series cross validation – detail for Portfolio One (Method B)

	10-Fold cross validation	LOOCV	Time-series cross validation
Square root of cross-validation error			
SL-CAPM	38.159	38.571	37.363
SL-CAPM95	36.357	38.736	38.028
Black CAPM	35.885	38.284	37.136
Betastar	44.115	47.148	46.769
FFM	36.119	38.289	37.439
Bias			
SL-CAPM	5.628	5.609	4.256
SL-CAPM95	5.278	5.276	3.814
Black CAPM	2.376	2.357	0.784
Betastar	2.381	3.113	1.725
FFM	5.382	5.431	4.219
t-tests for Bias			
SL-CAPM	2.482	3.044	2.202
SL-CAPM95	2.326	2.847	1.936
Black CAPM	1.057	1.278	0.406
Betastar	1.059	1.370	0.709
FFM	2.291	2.968	2.179

Source: Appendix I, Table 2.Note that betastar and the Black CAPM do differ slightly due to the use of the actual MRP in Method B

Table 18: Year ahead 10-fold, LOOCV and time series cross validation – detail for Portfolio One (Method B)

	10-Fold cross validation	LOOCV	Time series CV – non-overlap	Time series CV - overlap
Square root of cross-validation error				
SL-CAPM	11.149	11.156	11.324	11.263
SL-CAPM95	11.194	11.204	11.380	11.234
Black CAPM	11.067	11.072	11.230	11.173
Betastar	13.403	13.389	13.704	13.752
FFM	10.964	10.973	11.407	11.341
Bias				
SL-CAPM	5.704	5.750	6.035	5.732
SL-CAPM95	5.313	5.374	5.616	5.268
Black CAPM	2.656	2.707	2.600	2.102
Betastar	3.364	3.352	3.403	2.850
FFM	5.121	5.187	5.139	4.629
t-tests for Bias				
SL-CAPM	2.633	2.749	2.594	2.376
SL-CAPM95	2.436	2.568	2.451	2.238
Black CAPM	1.215	1.282	1.106	0.863
Betastar	1.396	1.344	1.231	1.076
FFM	2.411	2.545	2.418	2.236

Source: Appendix I Table 6. Note that betastar and the Black CAPM do differ slightly due to the use of the actual MRP in Method B

11.18 Turning to the detail in Table 17 and Table 18, the first block of the table is the mean-squared error, which can be compared with DBP's results in Table 16. Clearly, when considering results a month ahead compared to a year ahead, there is a great deal more variation in the former than the latter. However, two things are important to note; firstly, although variance swamps bias as a concern on a month-by-month basis, it reduces greatly a year ahead. More importantly, whilst variance reduces, bias does not. This suggests that using month-ahead forecasts as DBP does will give a good picture of the bias over a longer timeframe; though one could not say the same if one were attempting to infer anything about precision over a longer timeframe with monthly forecasts. Secondly, variance is again not very different across models; there is little cost, in respect of precision, from using the Black CAPM instead of the SL-CAPM.

11.19 The second block of information, the bias, is the same thing as the mean forecast error in DBP's results. Comparing Table 17 and Table 18 with Table 10 to Table 15 shows that the cross validation results, whether they be 10-fold or time series, match DBP's findings fairly closely. This gives us confidence that DBP's results are not some "nonsensical" artefact of the testing procedures we used but are in fact replicated when the ERA's own proposed cross validation tests are used.

11.20 The final block of information represents the t-tests on the bias. Here again, the results match fairly closely those of DBP, pointing to the fact that, even if k-fold cross validation were used, despite it not being a true "forecast" test, we would have obtained the same results. In other words, the ERA's proposed tests have confirmed, not contradicted DBP's test results.

Determining the unbiased range of cost of equity results for the BEE

11.21 The model adequacy test results suggest adopting a very similar approach to that which we adopted in the Original AA Proposal; we determine the return on equity for the BEE as being the relevant risk-free rate, which is the ten-year CGS, plus the market risk premium multiplied by the values of betastar which have been shown to be unbiased; the 25th and 99th percentiles respectively.

11.22 As noted in Chapter Six, since it is impossible for us to guess what the ERA will judge will be an appropriate value for the MRP under its new approach, we have simply used the ERA's MRP for ATCO, adjusted by the difference between five and ten-year risk-free rates for our sample period (57 bps). This gives rise to an MRP of 7.03 percent. The ten-year CGS, formed using the straddling bonds approach and using a target date of November 30th 2025 is 2.87 percent.

11.23 DBP has re-estimated beta using the five years of data to November 30th 2015. In our Original AA Proposal, we made use of Bloomberg data, and this time we have made use of data from Thomson Reuters, which is the same dataset that Henry (2009, 2014) uses. We note that TR does not have the ASA30 proxy for market returns so, like Henry (2009, 2014) we make use of the ASX 300 as our proxy. We examined betas using the ASX20, 50 and 100, and the value change very little. The results of our approach are summarised in Table 19. As with our Original AA Proposal, this is a portfolio beta, weighted by market cap, consisting of DUET, APA, Envestra, Spark Infrastructure Group, HDF and SP Ausnet.

Table 19: Updated beta estimates for the BEE – original sample set

	Raw beta	Re-levered betas	Re-levered beta lower CI	Re-levered beta upper CI	Beta t-stat	R-squared	F-stat
mongrosslog	0.620	0.688	0.577	0.799	12.207	0.352	149.014
tuegrosslog	0.633	0.702	0.587	0.818	11.992	0.344	143.802
wedgrosslog	0.500	0.556	0.432	0.679	8.857	0.222	78.448
thugrosslog	0.548	0.609	0.474	0.743	8.910	0.224	79.391
frigrosslog	0.561	0.623	0.497	0.750	9.710	0.255	94.286
mongrosspct	0.613	0.680	0.590	0.771	14.797	0.445	218.952
tuegrosspct	0.608	0.676	0.584	0.767	14.511	0.435	210.559
wedgrosspct	0.476	0.529	0.432	0.626	10.743	0.296	115.403
thugrosspct	0.527	0.585	0.478	0.693	10.709	0.295	114.681
frigrosspct	0.560	0.622	0.521	0.723	12.118	0.349	146.838
monxs5log	0.611	0.678	0.588	0.768	14.823	0.446	219.733
tuexs5log	0.610	0.678	0.586	0.769	14.589	0.438	212.840
wedxs5log	0.477	0.530	0.433	0.627	10.759	0.297	115.760
thuxs5log	0.527	0.585	0.478	0.693	10.708	0.295	114.667
frixs5log	0.558	0.620	0.519	0.721	12.114	0.349	146.746
monxs5pct	0.613	0.680	0.590	0.771	14.799	0.445	219.011
tuexs5pct	0.609	0.676	0.584	0.767	14.513	0.435	210.615
wedxs5pct	0.476	0.529	0.432	0.626	10.746	0.296	115.478
thuxs5pct	0.527	0.585	0.478	0.693	10.714	0.295	114.782
frixs5pct	0.560	0.622	0.521	0.723	12.124	0.349	146.983
monxs10log	0.620	0.688	0.577	0.799	12.208	0.352	149.040
tuexs10log	0.633	0.702	0.587	0.818	11.993	0.344	143.832
wedxs10log	0.501	0.556	0.432	0.679	8.859	0.222	78.484
thuxs10log	0.548	0.609	0.474	0.743	8.912	0.224	79.428
frixs10log	0.561	0.623	0.497	0.750	9.713	0.256	94.347
monxs10pct	0.613	0.681	0.590	0.771	14.800	0.445	219.043
tuexs10pct	0.609	0.676	0.584	0.767	14.514	0.435	210.659
wedxs10pct	0.476	0.529	0.432	0.626	10.747	0.296	115.505
thuxs10pct	0.527	0.585	0.478	0.693	10.714	0.295	114.796
frixs10pct	0.560	0.622	0.521	0.723	12.124	0.349	146.986

Source: DBP analysis

11.24 We note in Appendix 4A(ii) that the ERA has dropped Envestra and HDF from its original sample set as they are now dead stocks. We are unclear as to why it did not do this at its last estimation; Envestra was trading until September 2014, but HDF ceased trading in November 2012, a year before the ERA undertook the beta calculations in its Guidelines. The ERA has not explained this change in stance. Removing these firms from the dataset reduces the beta estimates slightly, as shown in Table 20, and, we note, also appears to reduce the explanatory power of the model.

Table 20: Updated beta estimates – ERA Draft Decision Appendix 4A(ii) sample set

	Raw beta	Re-levered betas	Re-levered beta lower CI	Re-levered beta upper CI	Beta t-stat	R-squared	F-stat
mongrosslog	0.510	0.567	0.451	0.682	9.686	0.254	93.820
tuegrosslog	0.415	0.461	0.344	0.577	7.773	0.179	60.422
wedgrosslog	0.360	0.399	0.282	0.517	6.688	0.138	44.726
thugrosslog	0.349	0.388	0.275	0.500	6.771	0.142	45.852
frigrosslog	0.421	0.468	0.368	0.567	9.255	0.237	85.661
mongrosspct	0.506	0.561	0.446	0.677	9.562	0.250	91.430
tuegrosspct	0.412	0.458	0.341	0.575	7.740	0.178	59.900
wedgrosspct	0.361	0.401	0.284	0.519	6.726	0.140	45.238
thugrosspct	0.352	0.391	0.278	0.504	6.812	0.143	46.404
frigrosspct	0.424	0.471	0.371	0.571	9.273	0.238	85.998
monxs5log	0.508	0.564	0.449	0.680	9.626	0.252	92.658
tuexs5log	0.414	0.460	0.343	0.576	7.762	0.179	60.252
wedxs5log	0.361	0.401	0.283	0.519	6.716	0.140	45.106
thuxs5log	0.350	0.389	0.276	0.502	6.787	0.142	46.064
frixs5log	0.423	0.470	0.370	0.569	9.276	0.238	86.050
monxs5pct	0.506	0.562	0.446	0.677	9.566	0.250	91.507
tuexs5pct	0.413	0.458	0.342	0.575	7.743	0.178	59.959
wedxs5pct	0.362	0.402	0.284	0.519	6.729	0.140	45.277
thuxs5pct	0.352	0.391	0.278	0.504	6.815	0.143	46.448
frixs5pct	0.425	0.472	0.372	0.572	9.278	0.238	86.074
monxs10log	0.511	0.567	0.452	0.682	9.692	0.255	93.926
tuexs10log	0.415	0.461	0.344	0.578	7.779	0.180	60.510
wedxs10log	0.360	0.400	0.282	0.517	6.692	0.139	44.781
thuxs10log	0.349	0.388	0.275	0.501	6.776	0.142	45.912
frixs10log	0.421	0.468	0.369	0.568	9.260	0.238	85.750
monxs10pct	0.506	0.562	0.446	0.677	9.567	0.250	91.537
tuexs10pct	0.413	0.458	0.342	0.575	7.745	0.178	59.986
wedxs10pct	0.362	0.402	0.284	0.519	6.730	0.140	45.296
thuxs10pct	0.353	0.391	0.278	0.505	6.817	0.143	46.466
frixs10pct	0.425	0.472	0.372	0.572	9.279	0.238	86.091

Source: DBP analysis

11.25 Given that the ERA has now changed the sample set for the BEE, we make use of the beta values in Table 20, rather than those from our original sample set in Table 19. Converting these figures into estimates of betastar provides the estimates shown below in Table 21.

Table 21: Updated betastar estimates for the BEE

Estimate Type	Estimate
beta	0.47
Mean betastar	1.15
25th percentile estimate of betastar	1.00
99th percentile estimate of betastar	1.70

Source: DBP analysis

11.26 Using these updated betastar estimates gives the range of unbiased estimates of the cost of equity as shown in Table 22.

Table 22: Updated unbiased estimates of the return on equity

	beta	Risk free rate	Market risk premium	Return on equity
25th percentile estimate of betastar	1.00	2.87	7.03*	9.9
99th percentile estimate of betastar	1.70	2.87	7.03	14.82

*Source: DBP analysis * note that this is equivalent to the ERA's use of a 7.6 percent MRP given that it measures the MRP from the five-year risk-free rate and we use the ten-year rate. The difference between the two rates during our observation period was 57 bps.*

Updating DBP's cost of debt estimate

11.27 DBP provided a cost of debt estimate with its Original AA Proposal, but this was based upon data current at September 2014. Moreover, the ERA approach has changed, particularly in respect of the annual updates, and thus we update our numbers and approach. For the purposes of this update, we use the illustrative period of the 40 trading days to November 30th 2015. We note that the first cost of debt estimate for the Final Decision will be during 2016, and the numbers will thus change for 2016.

11.28 The cost of debt is the sum of the risk-free rate (the five-year BBSW), the ten-year debt risk premium, the cost of hedging and the cost of raising the debt. The value of the five-year BBSW for the 40 trading days to November 30th 2015 is 246.22. The cost of hedging is 14.8 bps, the cost of debt raising is 17.84 bps and the new issue premium is 27 bps (see paragraphs 10.30 to 10.39).

11.29 The debt risk premium is more challenging. The value for 2015, at the illustrative time period of the 40 days to the end of November 2015 is:[88]

(a) One tenth of the RBA index for 2006 (72.4 bps).

(b) One tenth of the RBA index for 2007 (124.1 bps).

(c) One tenth of the RBA index for 2008 (348.9 bps).

(d) One tenth of the RBA index for 2009 (462.4 bps).

(e) One tenth of the RBA index for 2010 (212.7 bps).

(f) One tenth of the RBA index for 2011 (237.1 bps).

(g) One tenth of the RBA index for 2012 (317.2 bps).

(h) One tenth of the RBA index for 2013 (306.8 bps).

(i) One tenth of the RBA index for 2014 (225 bps).

(j) One tenth of (the RBA index for 2015 (227.33bps) times 11/12 plus the ERA revised bond yield approach (248.6 bps) times 1/12 (229.1 bps)

11.30 This gives a figure of 253.57 bps. In 2016, this would change with the value for 2006 falling off, and a new value for 2016 being calculated based on the same approach in the last dot point in the list above. We note that in the actual 2016 calculation, undertaken just prior to the Final Decision, the figure for 2015 will be one-tenth of 227.3 bps, rather than the weighted average above, which is intended just to illustrate how the ERA method works.

11.31 The key component of the ten dot-points above is the application of the ERA's revised bond yield approach which gives rise to the 248.6 bps in the tenth dot point. The revised bond yield approach requires us to select a set of bonds according to the ERA criteria set out in Table 13 (DDA4 p108), and this list of bonds is provided at Appendix 4E (for March 2015). We are then required to calculate the AUD equivalent yield of these bonds using the approach outlined in DDA4 pages 270

[88] *The actual numbers for the years 2006 to 2014 are taken from DDA4 p299 for the years 2006 to 2014, and we have calculated an annual figure for 2015 based on the same approach the ERA has used (see DDA4, para 1244-5, pp297-8). We thank the ERA for kindly providing us with the model they use to make this estimation.*

to 278. We have done this, and include the relevant yields of each bond, formed via this approach, in a confidential version of Appendix L, provided to the ERA to allow it to check our calculations but not made public to preserve the confidentiality of the Bloomberg data.

11.32 After averaging the yields via the techniques outlined in DDA4 Table 57 (p278) we apply the curve-fitting techniques detailed in DDA4 pp 278-95, with the exception that we use our R-package rather than the Excel-based approach the ERA favours (see discussion in paragraphs 10.3). Note that in so doing, we have adjusted the Gaussian Kernel approach such that the effective tenor equals the target tenor, as per the approach outlined in DDA4 para 619-25 (pp130-1). The results for each estimation technique, along with the resultant average, are shown in Table 23.

Table 23: Ten year yields for the BEE

Method	Yield
Gaussian Normal (target tenor)	5.47%
Nelson Siegel	5.55%
Nelson-Siegel-Svennson	5.39%
Average	5.47%

Source: DBP analysis

11.33 For the purposes of estimating the ten-year DRP, we subtract the average of the 10-year A$ swap rate for the 40 trading days to the 30th of November 2015 from the average shown in Table 23. The average for the ten year swap rate is 2.98%, which means the illustrative DRP estimate is 248.6 bps.

11.34 Bringing all of these figures together gives a cost of debt estimate of 5.592 percent, being:

(a) The five year BBSW of 2.46 percent.

(b) The ten-year debt risk premium of 253.57 bps

(c) Hedging costs of 14.8 bps.

(d) Debt raising costs of 17.84 bps.

(e) A new issue premium of 27 bps.

Applying the consistency test and obtaining a final result for the cost of equity

11.35 As a final stage, we examine the consistency of the cost of equity estimates above with other evidence as a cross check. In Submission 12, this had two elements; an examination of estimates using other models by service providers, regulators and practitioners and an examination of the consistency of the cost of equity estimates with the cost of debt estimates via a formal model based on options pricing theory.

11.36 In respect of the former, we have not updated our original work, contained in Sections 6.2-12 of Submission 12 of our Original AA proposal, but we note that our estimates of the unbiased range of cost of equity estimates is still congruent with the findings shown in Table 19 of Submission 12. The ERA's Draft Decision, by contrast, still sits below every estimate in Table 19.

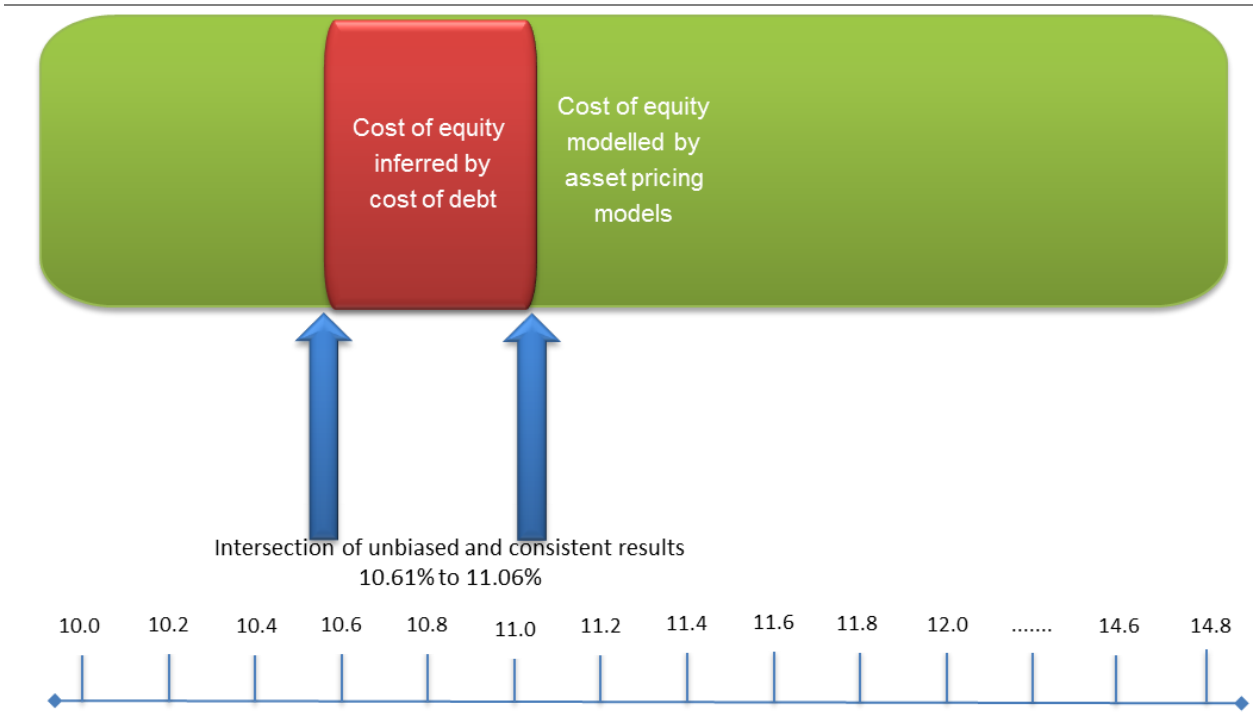
11.37 In respect of the latter, we take the information from the cost of debt calculations to infer a range for the cost of equity that is consistent with the cost of debt. In our Original AA Proposal, we formed a range for the cost of debt based upon the outcomes of the three models used to estimate the cost of debt (the Gaussian Normal, Nelson-Siegel and Nelson-Siegel-Svennson). The variation in the models is roughly the same as previously (compare Table 23 above with Original AA Proposal Submission 12, Table 2). However, in the Original AA Proposal, the estimate of the cost of debt is effectively an on-the day estimate, whilst it is now part of a trailing average. Thus, the variation in

the model estimates in Table 23 translates to a very narrow range for the trailing average debt risk premium; from 253 bps to 254.2 bps.

11.38 Mindful that this may present a false picture of precision, we also consider the (daily) standard deviation of the debt risk premium over the ten-year trailing average period (taken from the model the ERA kindly provided to us) and the standard deviation of the risk-free rate during the illustrative 40-day period to November 30th and use these to construct a confidence interval around the trailing average debt risk premium, which gives a range of 249.67 to 257.5 basis points.[89]

11.39 As in the Original AA Proposal, we translate the promised debt risk premium into an expected debt risk premium via the process described in Appendix C; the same approach we used in our Original AA Proposal. We then use Frontier's estimate of the minimum feasible elasticity to translate this expected debt premium into an expected equity risk premium. The results are shown in Figure 8.

Figure 8: Unbiased and consistent results for the cost of equity



Source: DBP analysis

11.40 As per Table 22, the 25th to the 99th percentile range of the betastar model gives unbiased estimates of the return on equity which range from 9.9 to 14.82 percent. The range of debt risk premia noted in paragraph 11.38 for the daily standard deviation on the trailing average give a consistent range from 10.61 to 11.06 percent (using the outputs of the three yield curve models produces a narrower range, from 10.80 to 10.87 percent, but the same mid-point). The mid-point of the intersection of the red and green ranges in Figure 8 above is 10.84 percent. This is DBP's best estimate of an unbiased return on equity which is consistent with the cost of debt proposed.

11.41 In contrast to our approach to the return on equity, the ERA uses a risk free rate (for our observation period) of 2.3 percent, a beta of 0.7 and an MRP of 7.6 percent. We present no new

[89] *We assume the 40-day risk-free rate and the ten-years of debt risk premium are uncorrelated, and we ignore the variance of the estimate of the DRP from the ERA's revised debt risk premium model, which only contributes one-twelfth of one tenth of the overall trailing average. We also considered annual standard deviations for the trailing average, which gave a wider range. The range is wide enough such that the lower end gives lower cost of equity estimates than the unbiased results shown in Table 22, so considering unbiased an consistent results gives a mid-point higher than our estimates here. Considering the mid-point just of the range implied by the annual confidence interval for the cost of debt gives the same answer we show here.*

evidence which would cause the ERA to change its MRP estimate, but we do present evidence which ought to cause it to consider its beta estimate.[90] In particular:

(a) The ERA's evidence that the top of the 95 percent confidence interval around beta is now 0.81, not 0.72 which would mean an adjustment for bias consistent with the way this adjustment was made in the Guidelines would be 0.79, not 0.7 (see paragraphs 6.1816.186).

(b) The evidence that a shorter time period increases beta without reducing its statistically desirable properties as the nature of the market portfolio appears to have changed, which produces a beta estimate of 0.95 (see paragraph 6.187 to 6.191 and Appendix F).

(c) The evidence from the ERA's own Black CAPM estimates which suggests that removing bias would require using a beta of at least 0.88 (see paragraphs 6.31 to 6.33).

11.42 Taking into account this wider range of evidence provides the following estimates for beta and the return on equity.

Table 24: Alternate beta estimates and their effect on return on equity

Beta evidence	Beta estimate	Return on equity estimate
ERA current approach	0.7	7.62%
2bps below top of new range of confidence interval	0.79	8.3%
ERA betastar	0.88	8.99%
Shorter estimation period	0.95	9.52%

Source: DBP analysis. Note that all estimates assume an MRP of 7.6 percent and a risk-free rate of 2.3 percent

11.43 If the ERA simply updates its beta estimates to reflect new information, and to reflect the moving confidence interval in its own estimations then this would result in a cost of equity estimate, using the SL-CAPM alone with no other information, or between 8.3 percent and 9.52 percent. If, by contrast, it used the information from its own empirical estimation of the Black CAPM model, it would conclude that a proper adjustment for bias must give a return on equity of 8.99 percent. In all instances, making better use of information it has already generated brings the ERA much closer to DBP's results, even before it tests any of its models for bias and consistency with the cost of debt.

[90] *And the tenor of the risk free rate. However, this has a small effect once beta moves close to one, because the MRP changes as well. We focus here just on beta to highlight the effects of changing this variable.*

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APPENDIX A: DEPARTURES FROM AND ADDITIONS TO THE GUIDELINES

This table shows the departures from and additions to the ERA's Rate of Return Guidelines which we make in our report.

Matter in Guideline	DBP position vis-à-vis Guidelines	Report Chapter reference
Nominal post tax model	Consistent	2
WACC Approach	Consistent	2
Definition of Benchmark efficient entity	Consistent	2
Approach to Gearing	Consistent	8
Methodology for setting term of risk-free rate of return	Consistent for debt, departure for equity	7
Methodology for estimating Inflation	Consistent	8
Methodology for estimating Gamma	Minor departure	9
Return on equity - Stage 1		
Methodology for determining the relevance of a model	Departure	6
Return on equity - Stage 2		
Use of ranges versus point estimates	Minor departure	6
Return on equity - Stage 3		
Use of ranges versus point estimates	Minor departure	6
Return on equity - Stage 4		
Methodology for assessing consistency between returns on debt and on equity	Addition	6
Return on equity - Stage 5	Consistent	6
Return on debt		10
Formula to be used for Return at commencement of Access Arrangement Period	Minor departure	10
Benchmark credit rating used in estimating Debt Risk Premium	Consistent	10
Cross Checking the debt risk premium	Minor departure	10
New issue premium	Addition	10
Methodology for annual update of Return on Debt	Consistent	10

APPENDIX B: FRONTIER - RESPONSE TO THE ECONOMIC REGULATION AUTHORITY ON ESTIMATION OF THE RISK FREE RATE

APPENDIX C: FRONTIER - CONSISTENCY BETWEEN THE RETURN ON EQUITY AND THE RETURN ON DEBT: RESPONSE TO THE DBP DRAFT DECISION

APPENDIX D: AN APPROPRIATE REGULATORY ESTIMATE OF GAMMA: RESPONSE TO THE DBP DRAFT DECISION

APPENDIX E: DBP CAPEX WEIGHTING MODEL

APPENDIX F: CEG - ESTIMATING BETA TO BE USED IN THE SHARPE-LINTNER CAPM

APPENDIX G: HOUSTONKEMP - EVALUATING FORECASTS: RESPONSE TO THE ERA'S DRAFT DECISION ON PROPOSED REVISIONS TO THE ACCESS ARRANGEMENT FOR THE DAMPIER TO BUNBURY NATURAL GAS PIPELINE 2016 – 2020

APPENDIX H: HOUSTONKEMP - THE BLACK CAPM: RESPONSE TO THE ERA'S DRAFT DECISION ON PROPOSED REVISIONS TO THE ACCESS ARRANGEMENT FOR THE DAMPIER TO BUNBURY NATURAL GAS PIPELINE 2016 – 2020

APPENDIX I: ESQUANT - REVIEW OF ERA CROSS-VALIDATION APPROACH: A REPORT PREPARED FOR DBP

APPENDIX J: ESQUANT – DRP PACKAGE

APPENDIX K: DAA – REVIEW OF STATISTICAL ASPECTS OF CAPITAL ASSET PRICING MODEL

APPENDIX L: CONFIDENTIAL LIST OF BONDS USED AND THEIR YIELDS