Proposed Revisions
DBNGP Access Arrangement

2016 – 2020 Regulatory Period

Rate of Return

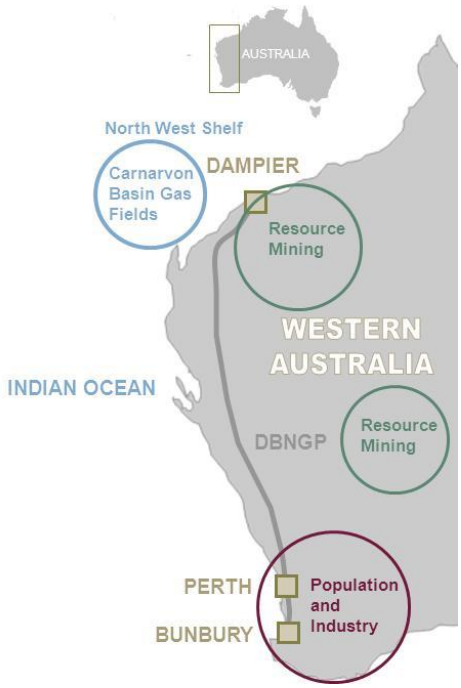
Supporting Submission: 12

PUBLIC VERSION

Date Submitted: 31/12/2014

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

DBP's Proposed Revised AAI includes a rate of return, estimated in accordance with NGR 87, of 8.36% (Post Tax Nominal) (**Rate of Return**). The key elements associated with the Rate of Return are as follows:

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 / Post Tax Nominal WACC	8.36%

This submission contains a detailed description of how we have estimated the proposed Rate of Return, and the justification for that Rate of Return. Our submission has been developed using the following four guiding principles:

- Following the ERA's Rate of Return Guidelines wherever possible.
- Keeping information "live" through the process for as long as possible so that final results are informed by all relevant information.
- Empirical assessment and cross checking of all modelled parameters and model outputs and a generally data-driven process of analysis.
- Minimal use of judgment, restricted to the end-points of the analysis when no more can be learned by considering relevant data.

We believe this has led to a materially preferable outcome compared to the outcome which we would have obtained through rigid application of the ERA's Guidelines, and to a rate of return which can be demonstrated to have met the Allowed Rate of Return Objective in the NGR.

Return on Debt

In respect of the return on debt, a departure is made from the Guidelines in respect of the methodology used in the estimation of the return on debt at the outset of the AA Period, but this departure is done in a way that is almost identical to the approach the ERA itself follows in the ATCO Draft Decision. The only differences between our approach and that of the ERA in the ATCO Draft Decision are that:

- A ten-year risk free rate is used instead of the five-year rate used in the Guidelines. We consider the ERA is incorrect in the use of the five-year risk-free rate (something that affects equity as well) because the more standard regulatory and commercial practice is to use the ten-year rate; and
- a new issue premium of 27 basis points has been added to the return on debt. This reflects the requirements of NGR 87(10) that the Operator receive a return associated with raising debt that implies a new issuance of debt and reflects the fact that, empirically, new debt issuances require higher yields than secondary debt to induce the market to take on large amounts of debt over short periods of time.

In respect of the ERA's annual updating approach outlined in the Guidelines, we note that the ERA has itself departed from the methodology in the Guidelines in the ATCO Draft Decision. We too have departed from the methodology in the Guidelines but in a different manner to the ERA's departure in the ATCO Draft Decision. DBP's reason for the departure is that the methodologies proposed by the ERA in both the Guidelines and the ATCO Draft Decision are likely to have significant practical implementation issues that will prevent the ERA's return on debt contributing towards the achievement of the ARORO in practice.

Instead, we have adopted an annual updating approach based on the methodology outlined by the AER in its rate of return guidelines. We have modified the AER's methodology slightly such that, not only is there a ten-year transition period at the outset of the switch to this new approach, but every block of capital expenditure made in an access arrangement period in excess of a certain threshold (being a tenth of the capital base) itself has a ten-year transition period. This is so that stale information is not reflected in new assets, potentially creating perverse investment incentives and inefficiencies.

Return on Equity

In respect of the return on equity, we have followed the ERA's five-stage process outlined in the Guidelines, with three key departures.

At Stage One, we consider that, if models are to have a role in empirical estimation of the return on equity (as required by NGR 87(5)(a)), they must not only have a theoretical grounding, they must also be capable of being shown to be empirically relevant. The ERA has undertaken only a theoretical assessment of models at this Stage, but has not undertaken an empirical assessment of model outcomes to assess their relevance.

We have developed such an empirical assessment - the "model adequacy test" - based upon the notion that, when model predictions are compared with actual subsequent outcomes, the predictions should not exhibit any statistically significant upward or downward bias. Assessing models against a benchmark such as this is consistent with, and is indeed a mathematical representation of, the ERA's own NPV=0 condition outlined in the Guidelines. Only models that pass both tests are used by us in applying Stages Two and Three of the ERA's process outlined in the Guidelines.

At Stages Two and Three, two key departures from the Guidelines have been made:

- Firstly, ranges, rather than point estimates (as is done in the Guidelines), have been used in the application of each relevant model. The key reasons are that these ranges from an input into the cross checks to be undertaken at Stage Four and the use of point estimates causes relevant information to be discarded. Consistent with the reasoning of the AEMC, it is crucial that all relevant information be carried forward as far as is practicable in the estimation process, and that the exercise of judgement should not solely be used to discard information along the way.
- Secondly, in estimating the risk free rate used in all models, a ten-year term is used rather than the five-year term used by the ERA in the Guidelines.

At Stage Four, we examine the results from models used to calculate the return on equity at Stages Two and Three of the ERA's five-stage process with a series of cross checks. Cross checks play a greater role in our approach than is the case in the Guidelines - the ERA appears to have reservations in its Guidelines concerning the cross checks it proposes and even in the ATCO Draft Decision, it used them sparingly, with a focus only on elements of the SL-CAPM, rather than the overall return on equity.

Furthermore, we operationalise a cross-check the ERA noted as one potential cross-check in its Guidelines (but did not explain the methodology for how it might be implemented); the consistency between calculated debt and equity premia. We have therefore added to the Guidelines by outlining a methodology for operationalising this cross check. This is done using the notion first suggested by Merton (1974) that debt and equity are options on the same underlying asset, and can thus be priced as options. The reason for using this approach as an additional methodology at Stage Four is that, consistent with the reasoning of the AEMC, it first makes use of as much information as is available on the return on equity from examining equity data. These estimates are then refined using information from the return on debt.

Other Matters

Consistent with the Guidelines, we have used a 60 percent gearing level. The two non-rate of return issues in the Guidelines where there has been a departure relate to the methodologies for estimating inflation and gamma.

- In respect of inflation, while the same approach is followed as the ERA follows, we have used more than two bonds to undertake the linear interpolation that derives the inflation rate (the same is true for the risk-free rate).
- In respect of gamma, while the methodology outlined in the Guidelines (and not the ATCO Draft Decision) of using dividend drop-off analysis is followed, there is a departure in that we have based our results on the peer-reviewed academic literature and not on the non-reviewed approach taken by the ERA itself. The reason for this departure is that it gives greater confidence that it will be a better estimate and is one that is arrived at on a transparent and reasonable basis.

Implementation of Approach to estimating Rate of Return

DBP's estimates of the return on debt are summarised as follows:

	Yield	Spread to swap	Swap rate	Yield implied by spread to swap
Gaussian Normal	5.67	1.80	3.85	5.65
DBP Nelson Siegel	5.76	1.85	3.85	5.70
ERA Nelson Siegel	5.77	1.86	3.85	5.71
Nelson Siegel Svensson	5.75	1.81	3.85	5.66

Using the information from this table, and a return on debt placement and hedging (consistent with the Guidelines) of 0.15 per cent and a new issue premium of 0.27 per cent (a departure from the Guidelines) provides a range from 6.08 to 6.19 per cent, and an average estimate of 6.13 per cent. This average estimate is our proposed return on debt used to estimate the Rate of Return.

In respect of the return on equity, we re-examined the principled analysis the ERA undertook in the Guidelines and came to different conclusions than the ERA in its Guidelines; accepting that the Black CAPM and the Fama-French model may be relevant models. However, the model adequacy test suggests that only the Black CAPM is statistically unbiased, and is thus considered a relevant model for the purposes of Stages Two and Three of the ERA's process where the rate of return is calculated.

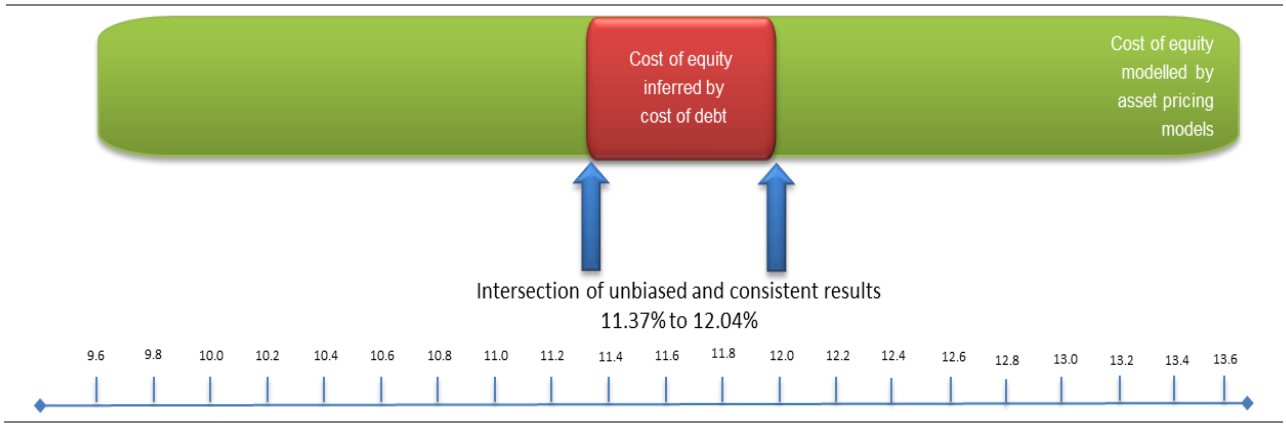
However, mindful of the regulatory history in using the SL-CAPM formula, the Black CAPM is adapted such that the information in the zero-beta premium is reflected in the beta of the SL-CAPM rather than a distinct parameter in its own right, and accordingly DBP implements a SL-CAPM formula with this new beta, that is termed "betastar".

The mean of this betastar model provides the best estimate of the return on equity but, in keeping with the notion of model adequacy and statistical bias, as well as our approach to keep as much information "live" through as much of the process as we can (to avoid final results being influenced by judgement in a non-transparent way), we examine values for betastar drawn from points on its confidence interval (rather than just the mean) to ascertain what level of betastar gives a biased downwards and unbiased outcome. The results of following this approach are shown below. For convenience, we also show the results from two recent draft decisions concerning access arrangement revisions proposed under the NGR (the ERA's ATCO Draft Decision and the AER's Jemena Draft Decision; though we note that these are significantly lower than the values for return on equity used by most brokers and market analysts.

	Beta	RFR	MRP	Re
20th per centile estimate of betastar	0.94	3.54	6.5	9.67
99th per centile estimate of betastar	1.57	3.54	6.5	13.72
ERA ATCO Draft Decision	0.7	2.95	5.5	6.80
AER Jemena Draft Decision	0.7	3.55	6.5	8.10

The values for betastar are much higher than the range of values for beta that the ERA used in the Guidelines in its application of the SL-CAPM, and indeed the upper limit is higher than one. DBP does not suggest that the benchmark efficient entity is riskier than the market as a whole. Instead, betastar reflects both systematic risk and the zero beta premium; it is a consequence of the manipulation of the Black CAPM into an SL-CAPM formula and not a reflection of systematic risk per se. In fact, the Black CAPM model that underpins the formation of betastar calculates a level of systematic risk identical to the mean beta in the empirical SL-CAPM.

In respect of consistency between the return on equity and the return on debt using the Merton(1974) options-pricing framework, the return on equity implied by the range of debt estimates above (converted to expected, rather than promised return on debt, and with the return on debt placement and hedging and the new issue premium removed) using the most conservative assessment of the elasticity between debt and equity that the data will permit is mapped against the range of outcomes for the return on equity that is derived from the unbiased asset pricing models below. The intersection between the two ranges provides the cross check of the return on equity, as per Stage Four of the ERA's five stage process.



The range of return on equity estimates that are both unbiased and consistent with the return on debt estimates is 11.37% to 12.04%. From this range, we have chosen the mid-point of that range, giving a return on equity of 11.71%.

When coupled with a return on debt of 6.13% and a gearing of 60%, this gives a Nominal Vanilla (or Post Tax Nominal) WACC of 8.36%.

We submit that this Rate of Return:

1. is the best estimate, arrived at on a reasonable basis, of a rate of return that 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 (the allowed rate of return objective);
2. is most consistent with and will most likely contribute to the National Gas Objective; and
3. has the best regard to the Revenue and Pricing Principles.

Table of Contents

List of Tables

List of Figures

List of Boxes

1. INTRODUCTION

1.1 On 31 December 2014, DBNGP (WA) Transmission Pty Ltd (**DBP**) filed the following documents with the Economic Regulation Authority (**ERA**):

(a) proposed revised Access Arrangement (**Proposed Revised AA**); and

(b) proposed revised Access Arrangement Information (**Proposed Revised AAI**).

1.2 These documents cover the access arrangement period commencing on 1 January 2016 and ending on 31 December 2020 (**AA Period**). They contain the information that the National Gas Access (WA) Act 2009 (**NGA**) (which includes the Western Australian National Gas Access Law text (**NGL**) and the National Gas Rules (**NGR**)) requires to be included in order to enable the ERA to approve them.

1.3 In addition to the Proposed Revised AA and Proposed Revised AAI, a number of additional supporting submissions were filed to assist the ERA in assessing the Proposed Revised AA. These include the following:

(a) Submission 1: Proposal

(b) Submission 2: Cost Controls and Governance

(c) Submission 3: Proposed Reference Service

(d) Submission 4: Terms and Conditions

(e) Submission 5: Non-Tariff Related Issues

(f) Submission 6: Cost Verification and Allocation

(g) Submission 7: Actual Capital Expenditure (Expansion)

(h) Submission 8 Actual Capital Expenditure (Stay-in-Business) (Part 1 & 2)

(i) Submission 9: Forecast Capital Expenditure

(j) Submission 10:Forecast Operating Expenditure

(k) Submission 11: Capacity and Throughput Forecast

(l) Submission 12: Rate of Return

(m) Submission 13: Total Revenue

(n) Submission 14: Tariff Model and Tariff Calculation

1.4 As required by NGR 72(1), the Proposed Revised AAI contains:

(a) The return on the projected capital base for each year of the AA Period (by applying the allowed rate of return for each such year to the projected capital base for the year);

(b) the proposed return on equity, return on debt and the allowed rate of return, for each regulatory year of the AA Period, in accordance with NGR 87[1], including departures from the methodologies set out in the Rate of Return Guidelines[2] and the reasons for that departure;[3]

(c) the proposed formula that is to be applied in accordance with NGR 87(12);[4]

(d) the estimated cost of corporate income tax calculated in accordance with NGR 87A, including the proposed value of imputation credits referred to in that rule.[5]

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1 *Proposed Revised AAI, Table 20.*
2 *In this regard, the relevant guidelines are the ERA Rate of Return Guidelines, 16 December 2013*
3 *Proposed Revised AAI, section 13*
4 *Proposed Revised AAI, section 13 and Proposed Revised AA, clause 11.6*
5 *Proposed Revised AAI, section 14.*

1.5 This submission provides further information in relation to DBP's approach to the determination of the proposed return on equity, return on debt and the allowed rate of return, including in relation to any departure from the methodologies set out in the ERA's Rate of Return Guidelines (the **Guidelines)**[6] and the reasons for that departure.

1.6 We have been guided in developing our approach by the NGL, the NGR and the Guidelines; along with their Appendices and Explanatory Statement). These submissions also address, where appropriate, matters raised by the ERA in its "Draft Decision on Proposed Revisions to the Access Arrangement for the Mid- West and South-West Gas Distribution System", dated 14 October 2014 (**ATCO Draft Decision**), as representative of the ERA's latest views on a range of topics.

1.7 The NGL and the NGR govern the approach that is to be taken to the determination of an access arrangement. The Guidelines do not act as a substitute for the proper interpretation of the NGL or the NGR. Whilst the NGR requires Guidelines to be published[7], those Guidelines are not mandatory.[8]

1.8 Wherever possible, we have sought to follow the Guidelines (or the ERA's revised approaches on certain issues in the ATCO Draft Decision). Indeed, on only a few occasions do we depart from them. Each departure is made on the basis that we consider that applying the Guidelines to the determination of the allowed rate of return for the DBNGP Access Arrangement may result in outcomes that do not meet the requirements of the NGR or NGL.

1.9 In proposing our allowed rate of return, we have also dealt with matters in respect of which the Guidelines are silent or where the Guidelines discuss an approach (or several approaches) but do not endorse any of them clearly or do not explain the approach in detail. We consider these cases to be additions to, rather than departures from, the Guidelines.

1.10 We make three key departures from, or additions to, the Guidelines:[9]

(a) **Risk Free Rate** - The ERA proposes a 5-year term for the risk free rate, whereas DBP proposes a 10 year term. DBP considers that a key assumption upon which the ERA has based its conclusion does not hold in reality. That assumption ignores long-term risks associated with infrastructure service provision, for which the service provider should be compensated. It is therefore appropriate to use the longer-term (10 year) risk-free rate, as is the case for the AER and IPART who do so for similar reasons to those we discuss in this submission.

(b) **Relevance and the role of asset pricing models, ranges and cross-checks for equity** - The ERA's five-stage process for assessing the return on equity is affected by three difficulties which require a departure from the Guidelines:

(i) first, the assessment of relevance at Stage One involves an assessment only on a theoretical basis. Instead, there should be an assessment based on both theory and empirical evidence. Models that pass only a theory test should perform a different role to those that pass both tests; with the latter performing the primary role of calculating the rate of return and the former playing a more limited role in conducting cross checks;

(ii) secondly, in Stages Two and Three, the ERA proposes to make use only of point estimates. However, we consider that this causes relevant information to be discarded too early in the process. Accordingly, we report ranges throughout Stages Two and Three and into Stage Four; and

(iii) thirdly, the ERA appears to have reservations in its Guidelines concerning the cross checks it proposes. In the ATCO Draft Decision, it used them sparingly, with a focus only on elements of the SL-CAPM, rather than the overall return on equity. We consider that proper and meaningful cross checks on the overall return on equity

[6] *The ERA Rate of Return Guidelines, 16 December 2013*
[7] *NGR 87(13)*
[8] *NGR 87(18)*
[9] *For a complete list of departures and additions, see Appendix A:*

should be conducted. Most notably, we operationalise a cross-check the ERA noted as one potential cross-check in its Guidelines (but did not explain how it might be implemented); the consistency between calculated debt and equity premia.

(c) **Annual updates of the return on debt** - In respect of the ERA's approach to its annual update for the return on debt, we believe it is likely to suffer from significant implementation problems that, unless corrected, could result in a failure to meet the allowed rate of return objective (**ARORO**).[10] These problems appear very difficult to solve. Accordingly, we have adopted the AER's annual updating approach from its Guidelines, that we consider better contributes to the achievement of the ARORO and does not suffer from the flaws of the ERA's model.

1.11 In the ATCO Draft Decision, the ERA itself has departed from its own Guidelines in two key respects.

(a) **Approach to estimation of gamma** – Aside from some technical errors in respect of the movement of prices on non-dividend days, that is out of step with the academic literature, the approach to the estimation of gamma in the Guidelines will better achieve the ARORO than the approach adopted by the ERA in the ATCO Draft Decision;

(b) **Approach to the estimation of the return on debt at the outset of the Access arrangement (AA) period** - We believe that the ERA's departure in the ATCO Draft Decision better contributes to the achievement of the ARORO than the approach adopted by the ERA in the Guidelines. In the Guidelines, the ERA made use of its joint-weighted approach. However, in the ATCO Draft Decision, the ERA now makes use of a wider range of models, and a ten-year term for the debt risk premium. We believe the ERA has been correct in making this departure from its Guidelines in the ATCO Draft Decision and we have thus followed a similar approach, with a different assumption for the risk-free rate, in our estimation of the return on debt.

1.12 This submission is structured as follows:

(a) Chapter 2 contains a discussion of the key relevant statutory framework and issues, that provide the foundation for our subsequent economic analysis, particularly departures from the Guidelines;

(b) Chapter 3 covers three over-arching issues that impact upon both the return on debt and equity. These are: (1) gearing; (2) the definition of the Benchmark Efficient Entity (both topics where we adopt the ERA's position) and (3) the term of the risk-free rate for the purposes of estimating the return on debt and on equity, where we disagree with, and depart from, the ERA's position as outlined in the Guidelines;

(c) Chapters 4 to 6 form the substantive portion of the submission. They cover the estimation of the proposed return on debt and on equity, and the test of consistency in the treatment of debt and equity. Each chapter covers the theoretical basis of our work, as well as the results of our empirical assessments. Specifically:

(i) the return on debt is estimated in Chapter 4;

(ii) Chapter 5 addresses the return on equity. We do not conclude that chapter with a final point estimate for the return on equity (Stage Five of the ERA's five-stage process from the Guidelines). Reaching this point of the analysis requires us to consider information relevant to the formation of the return on equity, that comes from the estimation of the return on debt (Chapter 4) via the test of consistency between the two estimates (Chapter 6); and

(iii) the cross check and consistency tests are explained and implemented in Chapter 6. The final estimate of the return on equity is presented at the end of Chapter 6.

(d) Chapter 7 covers three important issues not directly related to the calculation of the return on debt and equity but addressed in the Guidelines: (1) the derivation of an estimate of gamma; (2) the calculation of inflation, and (3) the implementation of the post-tax revenue model.

[10] *As required by NGR 87(8)*

(e) Chapter 8 concludes with an assessment and brief discussion of the overall weighted average cost of capital.

2. STATUTORY FRAMEWORK AND ISSUES

2.1 This chapter sets out the key elements of the applicable statutory framework that governs the determination of a service provider's allowed rate of return, being the national gas objective (**NGO**)[11], the revenue and pricing principles (**RPP**)[12] and NGR, including the significant recent amendments to NGR 87.

The key elements of the statutory scheme as it applies to rate of return

2.2 The NGL and NGR contain four key, related, principles to which a service provider and regulator must adhere when (inter alia) proposing or determining the service provider's allowed rate of return. They are the NGO, the RPPs, the ARORO and the need to derive the best possible estimate for the allowed rate of return, as discussed immediately below.

2.3 Section 23 of the NGL sets out the NGO, as follows:

> *The objective of this Law is to promote 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.*

2.4 Sections 24(2)-(7) set out the RPPs. They are as follows:

> *(2) A service provider should be provided with a reasonable opportunity to recover at least the efficient costs the service provider incurs in—*
>
> *(a) providing reference services; and*
> *(b) complying with a regulatory obligation or requirement or making a regulatory payment.*
>
> *(3) A service provider should be provided with effective incentives in order to promote economic efficiency with respect to reference services the service provider provides. The economic efficiency that should be promoted includes—*
>
> *(a) efficient investment in, or in connection with, a pipeline with which the service provider provides reference services; and*
> *(b) the efficient provision of pipeline services; and*
> *(c) the efficient use of the pipeline.*
>
> *(4) Regard should be had to the capital base with respect to a pipeline adopted —*
>
> *(a) in any previous-*
> *(I) full access arrangement decision; or*
> *(ii) decision of a relevant Regulator under section 2 of the Gas Code;*
> *(b) in the Rules.*
>
> *(5) A reference tariff should allow for a return commensurate with the regulatory and commercial risks involved in providing the reference service to which that tariff relates.*
>
> *(6) Regard should be had to the economic costs and risks of the potential for under and over investment by a service provider in a pipeline with which the service provider provides pipeline services.*
>
> *(7) Regard should be had to the economic costs and risks of the potential for under and over utilisation of a pipeline with which a service provider provides pipeline services.*

2.5 Critically, among the RPPs, section 24(2) deploys a floor, as opposed to a ceiling, when speaking of efficient costs. In stating that 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 has recognised this fact by describing its Net Present Value (**NPV**) = 0 criteria as a "limit from below" (Explanatory Statement Appendix 2, paragraph 3).

[11] *Section 23, NGL*
[12] *Section 24, NGL*

2.6 The NGO and the RPPs are related concepts directed towards the common goal of efficiency. The NGO sits at the heart of the statutory scheme. It is complemented by the RPP (set out above) in the circumstances in which those principles are engaged. Section 28 of the NGL articulates the manner and context in which regard must be had to the RPP, as follows:

> *Section 28(1)(a) of the NGL provides that the ERA must,[13] in performing or exercising an ERA economic regulatory function or power,[14] perform or exercise that function or power in a manner that will or is likely to contribute to the achievement of the national gas objective.*

2.7 Section 28(2)(a) provides that the ERA must take into account the revenue and pricing principles:

- *when exercising a discretion in approving or making those parts of an access arrangement relating to a reference tariff; or*
- *when making an access determination relating to a rate or charge for a pipeline service.*

2.8 On 29 November 2012, the Australian Energy Market Commission (**AEMC**) made the National Gas Amendment (Price and Revenue Regulation of Gas Services) Rule 2012 (the **Rule Change** and **Rule Change Determination**). Among other things, the Rule Change effected significant changes to the way in which a rate of return for inclusion in the calculation of the Total Revenue for an Access Arrangement is to be determined under the NGL and the NGR. Central to the Rule Change was the introduction of an allowed rate of return objective, within NGR 87(3) (the **ARORO**) as follows:

> *The allowed rate of return objective is that the rate of return for a service provider is to be 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 (the allowed rate of return objective).*

2.9 The AEMC also made other important changes to the process for determining a service provider's allowed rate of return under NGR 87 (which is set out in full at paragraph 2.33 below). However, no change was as significant as the introduction of the ARORO, the primacy and centrality of which was repeatedly emphasised by the AEMC in the Rule Change Determination.[15]

2.10 Finally, since the determination of the allowed rate of return inevitably involves the process of estimation, NGR 74 assumes importance, since it is this rule that dictates the nature and quality of the estimate required. NGR 74(1) of the NGR 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. Importantly, NGR 74(2), then provides that a forecast or estimate must be arrived at on a reasonable basis and must represent the best forecast or estimate possible in the circumstances.

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[13] *Schedule 2, clause 12(2) of the NGL provides that, in the NGL, the word "must", or a similar word or expression, used in relation to a power indicates that the power is required to be exercised. By contrast, section 28(2)(b) provides that the ERA may take into account the revenue and pricing principles when performing or exercising any other ERA economic regulatory function or power, if it considers it appropriate to do so. Schedule 2, clause 12(1) of the NGL provides that, in the NGL, the word "may', or a similar word or expression, used in relation to a power indicates that the power may be exercised or not exercised, at discretion.*

[14] *Section 2 of the NGL defines this notion as meaning a function or power performed or exercised by the ERA under this Law or the NGR that relates to the economic regulation of pipeline services provided by a service provider (a) by means of; or (b) in connection with, a scheme pipeline and includes a function or power performed or exercised by the ERA under this Law or the NGR that relates to (c) the preparation of a service provider performance report; (d) a ring fencing decision; (e) an applicable access arrangement decision; (f) an access determination (if the ERA is the dispute resolution body).*

[15] *See, for example, pages 18, 38-39, 48, 68 and 90.*

The allowed rate of return is about the overall result, not solely the parameter values of one model

The appropriate interpretation of the NGL and the NGR

2.11 In the context of determining the allowed rate of return, what emerges from the above rules and provisions is a scheme that 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.

2.12 The ARORO, 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.

2.13 If the chosen approach for determining a service provider's allowed rate of return is the application of one or more financial models, one cannot say with any degree of confidence whether the ARORO, NGO and RPPs have been achieved if the analysis is confined to consideration of the appropriateness or accuracy of inputs or parameters in the models. It is necessary to consider the results or "outputs" derived from the application of such model/s.

2.14 This principle underpins the model adequacy test set out in paragraphs 5.50 to 5.63. 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.

Objective of the Rule Change Determination

2.15 The applicable provisions of the NGL and NGR support the proposition that the ERA should focus upon the output of the proposed rates of return on equity and debt, as opposed to solely the inputs into each of these rates. Various statements in the AEMC's Rule Change and Rule Change Determination buttress this approach. To the extent necessary, recourse to this "Rule extrinsic material" is permissible as part of the interpretive process pursuant to Schedule 2, clause 8(1) of the NGL.

2.16 Amongst other things, the Rule Change identified the proposed amendments as an attempt to permit a departure from the approach adopted by the Australian Competition Tribunal to the construction and application of former NGR 87 in two related decisions, [2012] ACompT 12 and [2012] ACompT 14 (the **DBP Proceedings**).

2.17 NGR 87 of the NGR previously provided:

> *(1) The rate of return on capital is to be commensurate with prevailing conditions in the market for funds and the risks involved in providing reference services.*
>
> *(2) In determining a rate of return on capital:*
>
> *(a) it will be assumed that the service provider:*
> *(i) meets benchmark levels of efficiency; and*
> *(ii) uses a financing structure that meets benchmark standards as to gearing and other financial parameters for a going concern and reflects in other respects best practice; and*
>
> *(b) a well accepted approach that incorporates the cost of equity and debt, such as the Weighted Average Cost of Capital, is to be used; and a well accepted financial model, such as the Capital Asset Pricing Model, is to be used.*

2.18 Central to the Rule Change was the introduction of the ARORO. 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.

2.19 In the DBP Proceedings, the Tribunal (at [82]-[89]) adopted an approach under which, once it is acknowledged that a model is "well accepted", 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 consideration of the Sharpe-Lintner CAPM.

2.20 The Rule Change Determination reflects the AEMC's disagreement with the analysis of the Tribunal in the DBP Proceedings. At section 6.2.4 (pages 48-49), the AEMC says this:

> *"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."*

2.21 It is also 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."*[16]

2.22 At section 6.2.4, in the final paragraph on page 48, the AEMC also cautioned against presupposing the ability of a single model, by itself to achieve all that is required by the objective and said 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."*[17]

2.23 In its discussion of the return on debt (at section 7.5, pages 89-90 of the Rule Change Determination) the AECM said this:

> *"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. Therefore, those aspects of the final rule that relate to the return on debt estimate should be seen as part of the analysis to inform the estimate of an overall rate of return"*

2.24 Further, at page 43 of the Rule Change Determination, the AEMC observed that the quality of the estimation process is intrinsically linked with the achievement of the NGO and the RPP. The AEMC (referring to its earlier draft determination published as part of the Rule Change process) observed as follows:

> *"Achieving the NEO, 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."*

2.25 The AEMC states at section 6.5 of the Rule Change Determination (pages 56-57) that a framework relying on a relatively mechanistic approach to estimating the rate of return will not best achieve the NGO.[18]

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[16] *See further the statement at the beginning of paragraph 2 at page xi in this respect.*

[17] *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.*

2.26 Accordingly, 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:

(a) one must use models and approaches that, in combination, are capable of arriving at a result that achieves the ARORO, and is consistent with the NGO and the RPP;

(b) the estimation process must give one confidence that the outcome of that process is capable of delivering an allowed rate of return that achieves (or contributes to the achievement of) the ARORO; and

(c) where there is a sound basis for concluding that a favoured model, approach or estimation process is not capable of achieving the ARORO, either or both:

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

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

2.27 It is unlikely that an approach that in effect relies on the application of a single model will result in the best forecast or estimate for achieving the ARORO. That prospect becomes less likely still, if a particular deficiency with a favoured model (or with the way in which that favoured model is applied) is identified; that is, some identifiable deficiency which goes beyond the limitations inherent in all models as recognised by the AEMC. Such is the case with the model favoured by the ERA, the Sharpe-Lintner CAPM, a model that is widely acknowledged, including by the ERA,[19] to exhibit a downward bias for stocks or portfolios with a beta of less than one.

The role of regulatory judgment/discretion

2.28 The AER has pointed out (e.g. AER Jemena draft decision of November 2014 (**Jemena Draft Decision**), page 3-16) that no one correct answer achieves the ARORO, and that there is a need to make use of discretionary judgment. The ERA likewise recognises this matter. That exercise of discretionary judgment, of course, is not unconfined. It is constrained by the subject-matter, scope and purpose of the legislation by which the discretion is conferred.

2.29 So much was made clear by the AEMC throughout the Rule Change Determination. The discretionary exercise was described by the AEMC (at pages 66/67) in the following terms:

> *"Whether or not the estimated rate of return meets the allowed rate of return objective will invariably require some level of per cent, but this per cent should be based with reference to all relevant estimation methods, financial models market data and other evidence that could reasonably be expected to inform a regulator's decision."*

2.30 At section 5.5, page 37, of the Rule Determination, the AEMC states:

> *"The regulator must actively turn its mind to the factors listed, but it is up to the regulator to determine how the factors should influence its decision. It may, indeed, consider all of them and decide none should influence its decision. It is not intended that the regulator's decision is solely dependent on how it applies any or all of those factors. The intention is that where the rules require the regulator to consider certain factors in conjunction with an overall objective, it should explain its decision including how it has had regard to those factors in making a decision that meets the objective"*

2.31 Sound regulatory judgment must proceed on a reasoned basis, having regard to applicable theories and relevant, available data. Such judgment should result in the selection of the apparently best outcome from the set of reasonable, possible outcomes. Sound regulatory judgment would not result in the exclusion of relevant data: NGR 87(5). 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 (as required by NGR 74(2)) to meet the ARORO, NGO and RPP.

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[18] *See also section 6.5, page 69, fourth paragraph.*
[19] *See, for example the Guidelines, paragraph 141.*

2.32 So much is also true of the ultimate exercise of decision-making. In the Rule Change Determination the AEMC said this (at pp 55-56):

> *"In discharging their economic regulatory functions the AER and ERA are required to consider their decisions in terms of achieving the NEO, the NGO and the RPP. The regulator should be expected to follow good administrative decision-making practice. In this context, such practice requires a full and considered explanation for decisions and adherence to due process, rigour and objectivity required under administrative law principles. That the regulator would strive for the highest quality estimates to best achieve the NGO and the RPP can be necessarily expected. If a service provider considers that the regulator has fallen short in this regard, then it can consider appealing the regulator's decision. The Commission is of the view that the NER and the NGR cannot, and should not, be an exercise in rigidly specifying actions for the regulator that are already incumbent upon it."*

NGR 87(1) - (12): Calculating the Rate of Return

2.33 Having described what we see as the key elements that underpin the rationale behind, and proper interpretation of, the scheme relevant to the determination of rate of return, it is convenient to set out the text of NGR 87(1)-(12) in full:

> *(1) Subject to rule 82(3), the return on the projected capital base for each regulatory year of the access arrangement period is to be calculated by applying a rate of return that is determined in accordance with this rule 87 (the allowed rate of return).*
>
> *(2) The allowed rate of return is to be determined such that it achieves the allowed rate of return objective.*
>
> *(3) The allowed rate of return objective is that the rate of return for a service provider is to be 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 (the allowed rate of return objective).*
>
> *(4) to subrule (2), the allowed rate of return for a regulatory year is to be:*
>
> *(a) a weighted average of the return on equity for the access arrangement period in which that regulatory year occurs (as estimated under subrule (6)) and the return on debt for that regulatory year (as estimated under subrule (8)); and*
> *(b) determined on a nominal vanilla basis that is consistent with the estimate of the value of imputation credits referred to in rule 87A.*
>
> *(5) In determining the allowed rate of return, regard must be had to:*
>
> *(a) relevant estimation methods, financial models, market data and other evidence;*
> *(b) the desirability of using an approach that leads to the consistent application of any estimates of financial parameters that are relevant to the estimates of, and that are common to, the return on equity and the return on debt; and*
> *(c) any interrelationships between estimates of financial parameters that are relevant to the estimates of the return on equity and the return on debt.*
>
> *Return on equity*
>
> *(6) The return on equity for an access arrangement period is to be estimated such that it contributes to the achievement of the allowed rate of return objective.*
>
> *(7) In estimating the return on equity under subrule (6), regard must be had to the prevailing conditions in the market for equity funds.*
>
> *Return on debt*
>
> *(8) The return on debt for a regulatory year is to be estimated such that it contributes to the achievement of the allowed rate of return objective.*
>
> *(9) The return on debt may be estimated using a methodology which results in either:*
>
> *(a) the return on debt for each regulatory year in the access arrangement period being the same; or*
> *(b) the return on debt (and consequently the allowed rate of return) being, or potentially being, different for different regulatory years in the access arrangement period.*
>
> *(10) Subject to subrule (8), the methodology adopted to estimate the return on debt may, without limitation, be designed to result in the return on debt reflecting:*

(a) the return that would be required by debt investors in a benchmark efficient entity if it raised debt at the time or shortly before the time when the AER's decision on the access arrangement for that access arrangement period is made;
(b) the average return that would have been required by debt investors in a benchmark efficient entity if it raised debt over an historical period prior to the commencement of a regulatory year in the access arrangement period; or
(c) some combination of the returns referred to in subrules (a) and (b).

(11) In estimating the return on debt under subrule (8), regard must be had to the following factors:

(a) the desirability of minimising any difference between the return on debt and the return on debt of a benchmark efficient entity referred to in the allowed rate of return objective;
(b) the interrelationship between the return on equity and the return on debt;
(c) the incentives that the return on debt may provide in relation to capital expenditure over the access arrangement period, including as to the timing of any capital expenditure; and
(d) any impacts (including in relation to the costs of servicing debt across access arrangement periods) on a benchmark efficient entity referred to in the allowed rate of return objective that could arise as a result of changing the methodology that is used to estimate the return on debt from one access arrangement period to the next.

(12) If the return on debt is to be estimated using a methodology of the type referred to in subrule (9)(b) then a resulting change to the service provider's total revenue must be effected through the automatic application of a formula that is specified in the decision on the access arrangement for that access arrangement period.

2.34 NGR 87(13)-(19) make provision for the rate of return guidelines, and are described from paragraph 2.36 below.

NGR 87(13) - (19): Calculating the Rate of Return

The Relevant Rules

2.35 NGR 87(13) to (19) set out the rules and procedure governing the rate of return guidelines to be made by the regulator at least every 3 years. One set of Guidelines will apply in guiding the approach to the allowed rate of return that ERA is to adopt in each of the three access arrangements approvals processes regulated by it (including the DBNGP).

2.36 In summary, NGR 87(14) provides that the Guidelines must contain:

> *the methodologies that the ERA proposes to use in estimating the allowed rate of return, and how the application of those methodologies are proposed to result in a return on equity and debt in a way which is consistent with the ARORO;*
>
> *the estimation methods, financial models market data and other evidence it proposes to take into account the return on equity and debt and the value of imputation credits (i.e. gamma, which is dealt with in Rule 87A).*

2.37 NGR 87(18) makes it clear that the Rate of Return Guidelines are not mandatory, but stipulate that if the regulator makes a decision that departs from a position set out in the Guidelines, it must state the reasons for that departure. A similar requirement is placed on the service provider pursuant to NGR 72(1)(g).

The ERA's Rate of Return Guidelines

2.38 On 16 December 2013, the ERA published Rate of Return Guidelines intended to meet the requirements of the NGR, in particular NGR 87(13) (the **Guidelines**).

2.39 Consistent with the Rule Change, the Guidelines indicated, in a non-binding way, the manner in which the ERA intended to go about the task of determining the allowed rate of return in each of the three access arrangement approval processes it regulates.

The ERA's departure from its own Guidelines in the ATCO Draft Decision

2.40 As mentioned above, on 14 October 2014 the ATCO Draft Decision was made by the ERA.

2.41 In the ATCO Draft Decision the ERA departed, in several material respects, from the approach it had proposed in the Guidelines (as it is, of course, entitled to do under NGR 87(18)). For example, the ERA departed from its previously proposed position as to how the Debt Risk Premium should be measured and changed its approach to adjusting revenue pursuant to its annual updating approach (see paragraph 553 of the ATCO Draft Decision).

2.42 In those instances there is, in DBP's view, the potential for uncertainty to arise. On the one hand, pragmatism suggests that DBP should justify its own position by reference to the ERA's most recently stated position - that is, its position as espoused in the ATCO Draft Decision. However, because it seems that the NGR (particularly NGR 72(1)(g) of the NGR) may suggest that DBP is required to justify its departure from the Guidelines, in any instance where the ERA has departed from its own Guidelines in the ATCO Draft Decision, DBP has deemed it necessary in this submission to set out its own position by reference to both the ATCO Draft Decision and the Guidelines.

3. OVERARCHING ISSUES

3.1 In this chapter, we present our conclusions about three over-arching issues that affect both the return on equity and the return on debt. These are:

(a) gearing;

(b) the benchmark efficient entity; and

(c) the term of the risk-free rate.

Gearing

3.2 For gearing, we propose to make use of 60 per cent debt, 40 per cent equity, as per the ERA's Guidelines.

The benchmark efficient entity (BEE)

3.3 In the Guidelines, the ERA identifies the benchmark firm as (paragraphs 58 and 59) : "An efficient 'pure-play' regulated gas network business operating within Australia without parental ownership, with a similar degree of risk as that which applies to the service provider in respect of the provision of reference services".

3.4 We have followed the ERA's position in the Guidelines in respect of the definition of the BEE, and have used the set of energy firms to determine the return on equity, and the set of BBB-rated debt (exclusive of finance firms, but including foreign bonds issued by Australian firms) to determine the return on debt. As such, there is no departure from the Guidelines in this respect.

3.5 For the purposes of calculating the return on equity, we use the following set of energy firms:

(a) Envestra;

(b) APA;

(c) DUET;

(d) Hastings Diversified Utility Fund;

(e) AusNet Services (previously, SP AusNet); and

(f) Spark Infrastructure.

3.6 For the purposes of calculating the return on debt, we have followed the ERA's approach of including all BBB-band firms outside the finance sector. A list of the relevant bonds and their issuers, based on Appendix 5 from the ATCO Draft Decision, is provided in Appendix K.

The term of the risk-free rate

3.7 In contrast to the AER, the ERA has determined that the appropriate term for the risk-free rate, used in both the estimation of the return on debt and equity, is five years, rather than the more common long-term rate of ten years. Its approach is also in contrast to prevailing practice in commercial markets that, like most other regulators (see Appendix B) use the long-term risk-free rate in cost of capital decisions.

3.8 The ERA, in the recent ATCO Draft Decision, acknowledges that its approach is quite different from practice elsewhere in regulatory and commercial fields, but justifies its approach with reference to a theoretical model developed by Lally (2007).[20] This theoretical model suggests that the NPV=0 outcome (that is, the discount rate that makes the stream of revenues equal to the initial asset value) is only achieved when the term of the risk free rate used to underpin (in Lally's simple model, it is the entire discount rate) the overall rate of return is set to the term of the regulatory determination. In the first subsection below, we point out that Lally's (2007) assumptions are not reflective of the real-world nature of the regulatory framework, that therefore makes it inappropriate for the ERA to use the model as a basis for determining the appropriate tenor for the risk-free rate.

3.9 A second issue affecting the ERA's approach to estimating a risk free rate is that it will not meet the requirements of NGR 74(2). If the requirement in the NGR to reflect relevant market information is to be adhered to, it seems difficult to understand how the ERA could note, and then discard, such information, in favour of a theoretical model. We explore this issue in a second sub-section below. We conclude with DBP's preferred approach to the tenor of the risk-free rate, that matches that which has become the norm in other regulatory jurisdictions. Further detail on all the points raised in this chapter is provided in a report prepared by SFG, a copy of which is contained in Appendix B.

Term and Lally's theoretical assumptions

3.10 Lally's (2007) model is centred on an NPV=0 condition. This, as Incenta (2013) point out, means nothing more than choosing a discount rate that yields a present value of cash flows that is the same as the allowed costs for the regulated entity. We agree with this notion, but disagree that the NPV=0 condition is satisfied by using five-year risk-free rates in the regulatory context, which is the result contended for by Lally (2007) and the ERA.

3.11 Like any theoretical model, Lally (2007) abstracts from reality to develop an analytically tractable model. That approach is orthodox at the level of theory. However, when theory is used to guide policy, simplifying assumptions take centre-stage, because if they do not adequately take into account the real world issues the policy is seeking to address, they can lead to inappropriate outcomes and outcomes that are inconsistent with the legislative objectives.

3.12 The most important assumption in this respect is that which Lally makes about the terminal value of the asset. Like a government bond, he assumes that the value of the asset at the end of the AA period (two AA periods in his model) is known with certainty at the outset.[21] If this were true, Lally's model would hold, and this would justify the use of a tenor for determining the interest rate that matches the five-year AA period as the service provider would earn a "certain" (except for demand risk) revenue through the AA period and would then receive a certain terminal payment at the end of the access period, just as occurs with government bonds. However, if this assumption does not hold, then the NPV=0 condition is not met by using interest rates reflective of the five-year regulatory term, but requires the use of a longer-term rate that reflects the uncertainty of cashflows

[20] *Lally has written many papers, along very similar themes and mostly as paid consulting work for regulators, but this paper contains the core of his work on this topic. Davis (2003) in another report for regulators, is also cited by the ERA in respect to its NPV=0 argument in Appendix Two of the Guidelines, but Davis also makes assumptions about the certainty of the terminal asset value (Davis 2003, p7). In later work Davis (2014, p17), whilst maintaining his position in respect of debt, notes in respect of equity "Because the historical market risk premium used in CAPM cost of equity determination is calculated as a premium over the 10 year bond rate, it is appropriate to use that rate in that specific context".*

[21] *See Appendix B: for details of the numerous papers in which Lally confirms that this assumption is being made, including his original paper.*

occurring after the conclusion of the current access period which affect the terminal value of the asset at the conclusion of this access period. This is discussed in detail in the report in Appendix B.

3.13 The key question therefore concerns the certainty of the asset value at the conclusion of the current access period. The value of an asset reflects the NPV of expected future cashflows. As the ERA notes in the ATCO Draft Decision (see footnote 255, p146), in the regulatory sphere, this could be broken into a short term of the next access period, followed by the cashflows to perpetuity that the ERA suggests would be discounted at a different long-term rate. Clearly, if the asset is worth the NPV of a stream of discounted cashflows to perpetuity at the conclusion of the current access period, and these cashflows are discounted using a rate that is currently unknown (either because the parameters of a known model are unknown or because the future models used by regulators are currently unknown), then Lally's assumption of certain asset values at the termination of the AA period fails to hold.

3.14 Other regulators have acknowledged this fact, as Appendix B makes clear. This has motivated their choice of the long-run risk-free rate as the relevant rate. For example, the AER recognises that aligning the term of the risk-free rate to the term of the AA period is only justified in the case where the end-of-period market value of the asset is known with certainty from the outset (AER Guidelines Explanatory Statement p183)

> *In Lally (2012), the argument for a five year term relies on the 'present value principle'—the principle that the net present value (NPV) of cashflows should equal the purchase price of the investment.*
>
> *Lally stated that the present value principle is approximately satisfied only if the term of equity matches the regulatory control period. Lally illustrated this point using a numerical example in which there is no risk, so the return on equity equals the risk free rate. The example sets allowed revenues at the beginning of the regulatory control period using the yield to maturity on a five year risk free bond. Lally showed that in this example, the 'present value principle' is approximately satisfied: the NPV of the cashflows is approximately equal to the book value of the assets.*
>
> *The reason why the principle is satisfied is that the structure of the bond payments and the structure of the regulatory payments are similar…The core intuition behind the argument for a five year term is that the cashflows from the building block model have a similar structure to the cashflows from a five year bond. Put simply, the argument is that an equity investment in a regulated business is—at least in respect of its term—like an investment in a five year bond.*
>
> *The central issue in the debate about the term of equity, therefore, is the extent to which the cashflows from an equity investment in a regulated business are like the cashflows from a five year bond.*

3.15 However, the AER goes on to note that the cashflows from an equity investment in a regulated business are not like the cashflows from a five year bond in a very important respect – whereas a bondholder receives a known payment at maturity, the infrastructure equity owner does not. Rather, infrastructure equity (like all equity) is risky and the value of shares five years into the future cannot possibly be known with certainty. Using the same Lally derivation on which the ERA now relies, the AER notes that this necessary precondition does not hold in practice, but only under certain theoretical assumptions (AER, ibid):

> *In Lally's calculation above, the cash flow in each year is the allowed revenue net of opex and capex, except in the final year, where the closing value of the regulatory asset base (RAB) is included in the cash flow. That is, the assumption is that the investor receives a cash payment equal to the RAB in the final year of the regulatory control period. While under certain assumptions, the market value of equity is equal to the residual value of the RAB, these assumptions may not hold in reality.*

3.16 The AER then cites Incenta (2013) which explains that:

> *The argument that the term of the risk-free rate should be set equal to the length of the regulatory period relies on the end-of-period market value of the asset being known with certainty from the outset; and*

3.17 Since this necessary precondition does not hold, the term of the risk-free rate should not be set to the length of the AA period (AER, ibid):

> *…investors are unlikely to evaluate regulated assets with reference to a 5 year bond because – unlike the case of the bond – the residual value at the end of each 5 year period is inherently risky. This is because the residual value is not returned in cash, but rather comprises a 'value' whose recovery remains at risk from future regulatory decisions and changes in the market (both technological changes and changes to customer preferences).*

3.18 The AER (ibid) also notes that the same point has been made by Officer and Bishop (2008):

> *Officer and Bishop said that the argument for a five year term would be correct only if after five years, in the event that 'they [the owners of the regulated business] choose to walk away from the asset, they would be fully compensated'. Officer and Bishop propose, however, that the owners are not, in reality, guaranteed of such compensation—the problem is that there is no guarantee that the secondary market will deliver a price equal to the value of the equity component of the RAB.*

3.19 The AER concludes that the term of the risk-free rate should be set to 10 years and not to the length of the AA period.

3.20 The ERA has reached similar conclusions to the AER in respect of railways (ERA 2014, paragraphs 50 and 51) (**Rail Guidelines**):

> *The WACC must remunerate the efficient financing costs of the rail service provider over the (long term) economic life of the assets. This contributes to maintaining the financial value of an investment in present value terms over its life. With this financial capital maintenance, investors can expect to recover the opportunity cost of employing their capital, given the associated risks, as well as the real value of their initial investment, over time.*
>
> *This accords with the 'NPV=0', or present value principle. The present value principle requires that the present value of a service provider's revenue stream match the present value of the expenditure stream*

3.21 And further (ibid, paragraph 53 and 54):

> *In addition, the Authority considers that the long economic life of rail assets means that the long term average real return on equity may be used to inform the market risk premium.*
>
> *For the cost of debt, the Authority considers that the long term should also account for the longest practical term of available data. Again, use of the 10 year term CGS provides reliable data, and would also be consistent with the term for the risk free rate used for the return on equity.*

3.22 It is not clear why railways and gas pipelines, both long-term infrastructure assets, should be considered so different as to warrant such different treatment. The ERA provides no clear reason in either the Guidelines or the Rail Guidelines, noting only in a footnote in the Rail Guidelines that the energy Guidelines reach different conclusions, and referring the reader to those Guidelines for the reasons why. However, upon reading the relevant sections of the energy Guidelines, one finds arguments about the regulatory asset base (**RAB**) and revenue certainty such as those outlined below which appear to contradict the ERA's conclusions in respect of rail. We can perceive no real difference between the degree of RAB and revenue certainty in rail versus gas that would result in this major difference in respect of the relevant methodologies for determining the risk-free rate. The RAB in rail is based on the ERA's GRV approach, which can result in a different value each year, but we do not see how this differs significantly from the various powers the ERA has to change the RAB in energy and, moreover, as we note below, certainty in the RAB is not the same as certainty in the market value of the asset, which is the requirement of Lally's model.

3.23 It would appear that the only reason for such different treatment between the two industries is the fact that the governing legislation in rail requires the ERA to make use of a long-run rate, whilst NGR 87 is less prescriptive.

3.24 As distinct from rail, in gas pipelines, the ERA bases its adherence to a five-year risk-free rate on two key arguments; intra-period certainty in revenues (advanced as a reason in the ATCO Draft

Decision, paragraph 631) and certainty over the RAB (advanced as a reason in the Guidelines, Appendix 2, paragraph 70).

3.25 There are several problems with arguments based on revenue certainty within a given AA period. In the first instance, revenues have never been certain in the past as, with price caps, regulated firms face demand risk.[22] Moreover, both the ERA and AER propose annual update mechanisms which mean that revenues will be less certain in future than they have been in the past, because they will be based upon a return on debt which is updated during the access period using information which is currently unavailable. Indeed, the ERA motivates it annual update mechanism precisely on the basis that it aligns more closely with the pressures faced in a competitive industry (see Chapter 4) where certainty of revenue is not present.

3.26 More importantly, the ERA's argument skirts the core issue that intra-period certainty of revenues is not the same thing as Lally's assumption of certainty of the market value of the firm at the conclusion of the AA period. Since gas pipelines are not bonds, the value of the asset at the conclusion of a given access period is, as the ERA itself notes (see paragraph 3.10), the present value of future cashflows. These are based on the next (and subsequent) access determinations and are not certain given currently available information. In short, intra-period certainty of revenues is entirely irrelevant in the context of the terminal value of the asset in Lally's model, and is not a reason to adopt the five-year risk-free rate.

3.27 In its Guidelines (Explanatory Statement, Appendix 2, paragraph 70) the ERA focuses on the certainty of the RAB, not intra-period revenue streams:

> *Furthermore, the Authority considers that as the value of the regulatory asset base is assured at the end of the regulatory period, then investments in regulated assets may be considered to be a sequence of investments with a horizon of five years*

3.28 The RAB or capital base is not the same thing as the market value of the asset (the present value of future expected cashflows). In fact, regulators use it as a proxy for the economic value; since regulators determine the cashflows and the discount rate (the WACC) for an asset, using them to determine the asset value introduces a circularity. Just because an asset has a RAB of $1 billion today, does not mean that an investor will earn $1 billion plus the current return on capital. Instead, as the ERA's extracted statement indicates, the investor will receive a sequence of payments, every five years, and every one of these but the first will be based on uncertain information when viewed from the perspective of the present. In this, as noted above, the investor is no different from an investor in any other asset, and thus requires the same kind of discount rate; one which reflects long-run uncertainty. This is one based on the ten-year risk-free rate and not the five.

3.29 However, even if the current RAB exactly reflected the market's expectation of future revenue streams discounted at the relevant rate (which it could only do entirely by chance, or if risk-free rates never changed) the RAB value is not certain through time. Regulators have the power to declare assets redundant, change depreciation schedules or disallow forecast capital expenditure from being rolled into the asset base. Over the longer-term, the entire regulatory system can change, as can the economy at large.[23] Actually creating RAB certainty, which is not the same thing as certainty of market value, would require that regulators give up all flexibility over the RAB; it seems much more prudent to simply recognise the relevant risk by using the long-term risk-free rate, as other regulators have realised.

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[22] *For example, the difference between revenues forecast at the start of the last access arrangement, and actually earned by ATCO of roughly $50 million in each of the last two access arrangement periods (ATCO, 2014, p46, Figure17).*

[23] *By way of an example, the regulatory asset life of a gas pipeline is 70 years. In 1910, the Interstate Commerce Commission (now the Surface Transportation Board) was just on the cusp of gaining real power over US railroads. Over the coming decades, it expanded its regulatory reach considerably until it controlled almost every aspect of railway investment and operation, before the inflexibility this created caused the bankruptcy of several railways in the 1970s, and the deregulation of the industry in 1980 with the* Staggers Act *(see Hoogenboom & Hoogenboom, 1976 for details). The US economy also changed markedly over the same period. Closer to home, a mere 15 years ago, DORC was the chosen method of valuing the RAB, and the PTRM was unknown. The notion that the current RAB will depreciate from its current value to zero over 70 years in a smooth fashion which might be perfectly predicted by examining current depreciation policies is fanciful.*

3.30 In short, precisely because Lally's assumption of terminal asset value certainty does not hold, whether one uses the correct measure of market value or the incorrect proxy of the RAB, meeting the NPV=0 condition requires that the long-term risk-free rate is used. Otherwise, relevant risks relating to long-term cashflows will not be captured by regulators,[24] which would be counter to the requirement of the ARORO that the risks associated with efficient provision of reference services are compensated.

Five-year risk-free rate is not a best estimate arrived at on a reasonable basis

3.31 The NGR require that firms be allowed to earn their efficient cost of capital. NGR 87(7) in particular requires the regulator to have regard to prevailing conditions in the market for funds in estimating the return on equity. As Appendix B indicates, one prevailing condition in the market for funds is that commercial players make use of long-term discount rates when considering long term assets like pipelines. Indeed they do so even when regulators make use of short-term risk-free rates in their regulatory determinations. The ERA recognises this prevailing condition in the market, but proposes to ignore it, arguing (Explanatory Statement paragraph 465):

> *Second, the Authority considers that equity analysts are generally trying to estimate the value of the company, which involves estimating the present value of the stream of future cashflows, to perpetuity. In that case it would be reasonable to utilise the longest possible term risk free rate to contribute to the discount rate to be applied to those cashflows. However, that is not the regulatory task, which involves determining a rate of return for a five-year period, based on an understanding that the full value of regulatory asset base will be returned over its effective life.*

3.32 Investors do not have an "understanding that the full value of the RAB will be returned over its effective life". If investors believe that depreciation policies will remain unchanged for 70 years, and that the ERA will never declare an asset to be redundant, then they will understand that they will obtain a return *of* capital equal to the RAB through depreciation. However, they will also understand that their return *on* capital will be determined by future regulatory determinations (the "series of investments" above) and that the WACC in each future regulatory determination is not entirely predictable when viewed from the present. This is no different from any other long-run investment they make, and this is why market players, even when they are assessing regulated entities subject to five-year access periods (see Appendix B), use the long-run risk-free rate. By avoiding standard commercial practice, the ERA fails to compensate long run risk that would be compensated for any other similar asset in commercial marketplaces, and thus does not meet the ARORO.

[24] *We note the ERA's construction of a short-term and long-term in respect of cashflows, and point out that, if it only ever uses the short-term rate, the risks it acknowledges about long-term cashflows will never be compensated. This is covered in more detail in Appendix B.*

4. RETURN ON DEBT

4.1 As set out in Chapter 2, NGR 87(8) to (11) set out the principles relevant to the return on debt, including the manner in which the return on debt is to be estimated. Fundamentally, the return on debt must be determined in a manner that contributes to achievement of the ARORO: NGR 87(8).

4.2 This Chapter of the submission focuses on the two key elements relating to the return on debt:

(a) an assessment of what the return on debt ought to be at the outset of the AA period; and

(b) the way in which that return on debt is to be updated (if at all) during the access period. This latter issue arises because of the introduction of NGR 87(9), which permits an estimate of the return on debt that results either in the return for each regulatory year in the access arrangement period being the same (NGR 87(9)(a)) or the return on debt and hence the overall rate of return, differing as between regulatory years (NGR 87(9)(b)). Further, NGR 87(10) permits that the methodology adopted to estimate the return on debt may — without limitation — be designed to result in the return on debt reflecting the matters at sub-paragraphs (a) and (b), or some combination thereof (NGR 87(10(c)).

4.3 DBP is in broad agreement with the ERA's approach to the calculation of the return on debt at the outset of the AA period, as articulated in the ATCO Draft Decision (the sum of the risk free rate, debt risk premium and debt-raising and hedging costs; see ATCO Draft Decision paragraph 819) save for the following two key departures from the methodologies outlined in the Guidelines:

(a) As outlined in Chapter 3, we believe that the appropriate risk-free rate ought to be the ten-year risk-free rate and not the five-year rate.

(b) We have added a premium to cover the fact that raising debt in primary markets is more costly than the rate that debt subsequently earns in secondary markets.

4.4 However, in respect of the proposed updating of the return on debt over the course of the AA Period, a more substantive departure by DBP is proposed from the relevant methodology outlined in the Guidelines (and also from that outlined by the ERA in the ATCO Draft Decision). Central to the ERA's approach is the notion that the full cost of at least the "unhedgeable" part of the return on debt (i.e. the DRP) be updated each year. In the Guidelines, this updating is to be reflected in actual prices over each year of the access arrangement,[25] whilst in the ATCO Draft Decision, there is to be constant prices during an access period, with a “true-up” to reflect the net change in revenue which would have eventuated at the end of five years, at the commencement of the next access arrangement period.[26]

4.5 DBP does not believe either the ERA’s initial approach as set out in the Guidelines or its revised approach in the recent ATCO Draft Decision will result in a return on debt during each year of the AA Period that contributes to the achievement of the ARORO. The approach, originally proposed by the ERA in the Guidelines, had some merits in terms of very simple, abstract economic theory, but suffered from some deficiencies in terms of practical implementation that could mean it would lead to a return on debt that is not consistent with the RPPs. The ERA's subsequent amendments to the methodology in the ATCO Draft Decision have not addressed all of the practical implementation problems, but have in our view, lost whatever theoretical merits that once existed.

4.6 We propose a different annual updating approach, which is based upon that proposed by the AER (2013) in its Rate of Return Guideline. That approach involves updating one tenth of the return on debt each year, to reflect the staggered debt portfolio that efficient firms implement to minimise their return on debt.

[25] *See paragraphs 71 to 82 of the Guidelines.*
[26] *See paragraphs 553 and then 897-911 of the ATCO Draft Decision.*

Calculation of the return on debt at the outset of the access arrangement period - principles

4.7 In the ATCO Draft Decision, the ERA changed its approach to estimating the return on debt at the outset of the AA Period from that outlined in the Guidelines. The current methodology, as set out the ATCO Draft Decision (paragraph 874), is as follows:

(a) ascertain the ten year debt risk premium over the swap rate for relevant BBB-rated corporate bonds using a combination of the three models shown in Table 1, using the last 40-days of trading data;

(b) add the premium between the ten year CGS and the ten-year swap rate;

(c) add the cost of swapping from the ten to the five year CGS;[27]

(d) add an allowance for debt-raising and hedging costs (currently 15bps in total); and

4.8 add the five-year risk-free rate.

4.9 The differences are shown in Table 1 below.

Table 1: Key return on debt changes - Guidelines to ATCO Draft Decision

Guidelines	ATCO Draft Decision
Use the ERA's joint weighted model to ascertain the debt risk premium	Use the Reserve Bank's Gaussian Normal approach, the Nelson-Siegel model and the Nelson-Siegel-Svensson model to ascertain the debt risk premium
Tenor of the debt risk premium should reflect the term to maturity of existing bonds	Tenor of the debt should reflect the term at issuance of bonds - currently ten years
No allowance for swapping from the ten year CGS to the five year CGS	Allowance for swapping from the ten-year CGS to the five-year CGS.
Only Australian bonds issued by Australian companies allowed; finance companies included	Any bonds issued by Australian firms allowed, but bonds from financial firms excluded

Source: Guidelines paragraph 102-5 and ATCO Draft Decision paragraphs 833-872

4.10 We consider that the ERA's approach of using Gaussian Normal and Nelson-Siegel models is a substantial improvement on the methodology in the Guidelines centred around the ERA's joint-weighted model. The Guidelines methodology could not produce an effective tenor for the debt risk premium that was equal to the target tenor, except by chance, and this made it susceptible to under or over-estimation of the relevant premium. By contrast, the three models now favoured by the ERA in the ATCO Draft Decision to estimate the debt risk premium can match effectively with target tenor, avoiding this problem.

4.11 In respect of the other three departures shown in Table 1, these all reflect what efficient firms actually do (they issue overseas, they aim to issue ten-year debt and they swap from ten to five year risk-free rates to match the AA period). Since the requirement of the ARORO is that the ERA reflect efficient financing costs, all of these changes mean that the current methodology better reflects the ARORO than the methodology in the Guidelines did.

4.12 As outlined in paragraph 4.3, we propose two substantive departures from the ERA's approach in the Guidelines to estimating the rate of return on debt. Firstly, we propose to replace the five year risk-free rate with the ten-year risk-free rate, based on our findings about the appropriate risk-free rate in Chapter 3. This would, of course, remove from the methodology for estimating the return on debt the need to add the cost of swapping from ten to five-year debt. Secondly, we propose to add a premium for the cost of new debt, described in paragraph 4.17.

[27] *We note from Appendix 6 of the ATCO Draft Decision that the ERA is still developing its methodology in this respect.*

4.13 This means that the return on debt is estimated via:

(a) ascertaining the ten year debt risk premium over the swap rate for relevant BBB-rated corporate bonds using a combination of the three models shown in Table 1, using the last 40-days of trading data;

(b) adding the premium between the ten year CGS and the ten-year swap rate;

(c) adding an allowance for debt-raising and hedging costs (currently 15bps in total);

(d) adding a new issue premium to account for the fact that the primary issuance of debt is more costly than its subsequent value in secondary markets would suggest is the case (27 bps); and

(e) add the ten-year risk-free rate.

4.14 The formula for estimating a return on debt in a way which meets the requirements of the NGO, the RPPs and the NGR is as follows:

Return on Debt = Risk Free Rate + Debt Risk Premium + Debt Raising Costs + Hedging Costs + New Issue Premium

4.15 This return on debt, as discussed at the conclusion of this chapter in paragraph 4.98, is then updated each year in accordance with the methodology outlined in paragraphs 4.29 to 4.97the same fashion.

Allowances for debt-raising costs

4.16 We believe that there are two components associated with the cost of raising debt. The first of these are the administrative costs associated with raising the debt and implementing relevant hedges. These are covered in paragraphs 144 to 148 of the Guidelines and total 15bps. We have adopted this value in our methodology for estimating the return on debt.

4.17 The second component is a new issue premium. The data on debt yields used by the ERA (and ourselves) come from secondary markets. However, NGR 87(10) discusses the cost of raising debt; either just before the start of the AA period (NGR 87(10a)) or over a historical period prior to the access period (87(10b)). Debt cannot be raised in secondary markets but must instead be raised in primary markets. Secondary markets are used for the trading of debt.

4.18 If however, regard is to be had to the data from the secondary markets, the cost of raising debt in the primary markets is more costly than in the secondary markets. This is due, in part, because the tranches of debt issued in primary markets are larger and involve more risk than is the case after they have been divided into smaller parcels in secondary markets. CEG (see Appendix H) has traced the value of debt over a period of several months after issuance for a large number of firms and has calculated that the new issue premium is 27bps. Failure to include this premium would mean that the service provider will not be compensated for the full cost of raising debt and thus NGR 87(10) has not been met. Accordingly, we include this premium in our methodology for estimating the rate of return on debt.

Calculation of the return on debt at the outset of the access arrangement period - empirical estimation

4.19 In this section, we discuss the results of our estimation of the models discussed above for the estimation of the debt risk premium at the outset of the AA period. Apart from the fact that DBP uses the ten-year risk-free rate, DBP agrees with the ERA's approach.

4.20 The first step in the analysis is to choose the set of bonds for inclusion in the analysis. We note the ERA's criteria (Guidelines paragraph 103) and suggest that, now that it is using curve-fitting techniques, the two-year minimum is perhaps less relevant than it was in the past. However, following the ERA's methodology, DBP is prepared to adopt this criterion. DBP bases its selection

of bonds on Appendix Five of the ATCO Draft Decision. The ERA did not identify which bonds it used for each named corporate, and since its analysis was only over a short time period (one week) it seems likely that some bonds that would otherwise have met its criteria (from these firms or others) may not have been used due to missing data. We therefore:

(a) collect all relevant bonds (meeting the criteria) for the named corporate entities from Appendix Five of the ATCO Draft Decision;

(b) examine remaining bonds from Bloomberg to ascertain whether there are other relevant corporates issuing debt in our sample period (the 40 trading days to September 30 2014) that, for reasons of missing data, were not picked up in the ERA's shorter sample period; and

(c) eliminate bonds that did not meet the ERA's criteria of sufficient data (at least 50 per cent of observations available during the period).

4.21 The results of this selection process are shown in Appendix K which records both the issuer and the unique bond identifier, making replication of DBP's results easier for third parties. Having selected our bonds, we applied four different estimation methods to the return on debt:

(a) the Reserve Bank's Gaussian Normal model;

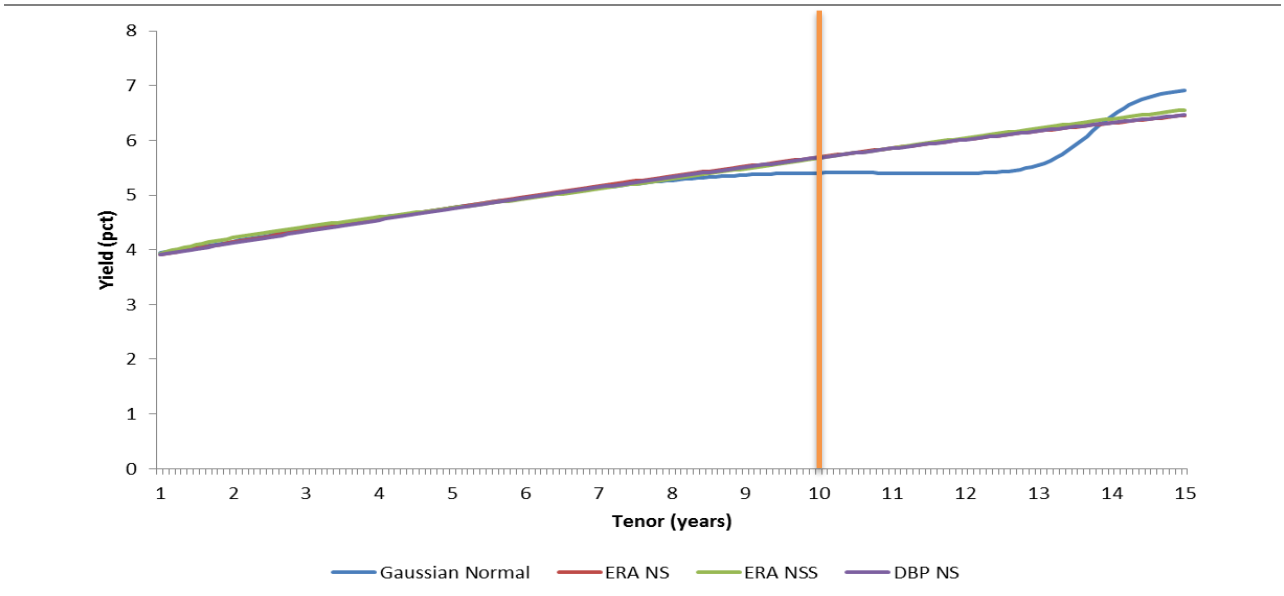
(b) the two R-packages the ERA uses in the ATCO Draft Decision to estimate the Nelson-Siegel and Nelson-Siegel-Svensson models; and

(c) a Nelson-Siegel model written in R, but not using these two packages.

4.22 The fourth model is an addition to the ERA's approach, and we add it because the standard R packages are less transparent when it comes to how they are estimating each model. In particular, they do not indicate how the lambda parameter in the Nelson-Siegel model is estimated. Calculating the Nelson-Siegel model from scratch allows us to perform a check on the two R-packages used by the ERA in the ATCO Draft Decision. As can be seen below, there is very little difference between the outcomes from applying the different models.

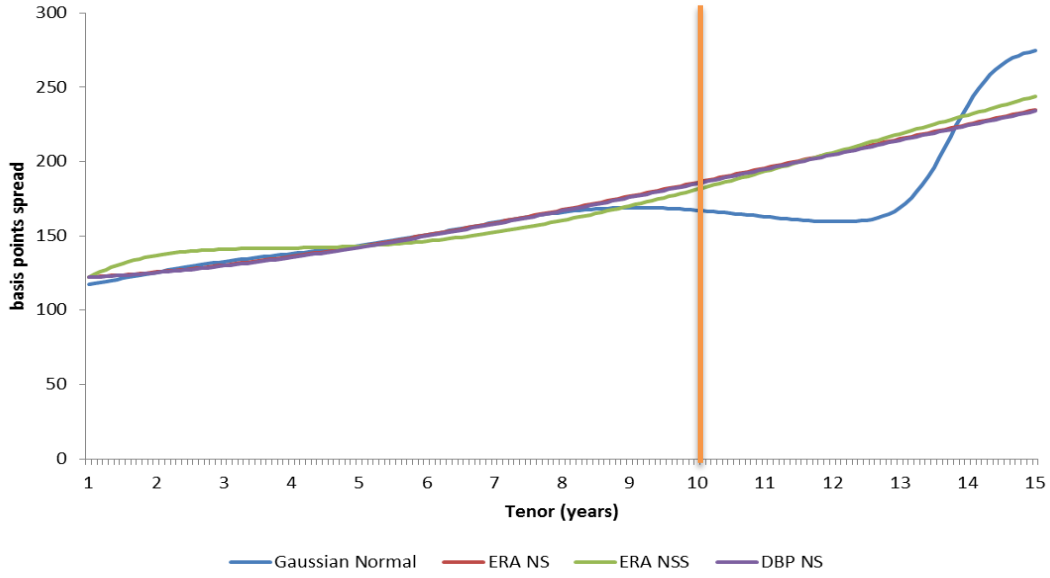
4.23 The yield curves estimated for each model are shown in Figure 1 and Figure 2. We show the results for yields and for the spread to swap.

Figure 1: Yield curves for return on debt estimations - Yields



Source: DBP analysis. Note that these yields are semi-annual like the raw Bloomberg data upon which they are based.

Figure 2: Yield curves for return on debt estimations - Spreads



Source: DBP analysis. Note that these yields are semi-annual like the raw Bloomberg data upon which they are based.

4.24 The Gaussian normal approach tracks the answers for the other three methods very closely out to between eight and nine years, and then does increasingly poorly. This is because of small numbers of bonds from which to extrapolate at longer tenors. At a maturity of ten years, the effective tenor of the RBA's Gaussian Normal approach is no longer ten years. This has been noted elsewhere, most recently by Lally (2014a) in work for the AER and also by the ERA in its ATCO Draft Decision (paragraph 848). Lally also indicates how this ought to be corrected (ibid, p39, equation 4), and we employ Lally's correction. The only difference being that, unlike the RBA, when we estimate the yield under the Gaussian Normal approach, we do so directly, rather than by adding an estimated spread to a known swap rate (see Lally's footnote 21, p38, ibid). Thus, unlike Lally (ibid, p39, unnumbered equations) we do not need to subtract the difference between the swap rates at the target and effective tenor from our estimate of the ten-year yield formed under a Gaussian Normal approach. Our estimate of the yield at ten years is 5.404 (un-annualised), which is 3 bps higher than Lally's (ibid) figure of 5.37 after he has made his adjustment, and our estimate of the yield at seven years is 5.13 (un-annualised) per cent, which is 2 bps higher than that of Lally. The small differences appear to be based on a different sampling period, not a different methodology.

4.25 Our estimates of the effective tenor under the RBA approach of ten and seven year bonds (10e and 7e respectively in Lally, ibid) are slightly different from Lally's, at 8.58 and 6.75 years respectively. The relevant CGS yields at these tenors (found through linear extrapolation) are 3.41 and 3.21 per cent respectively (annualised). Our annualised estimate of the ten-year CGS formed via linear interpolation (see paragraphs 5.188 and 5.189) is 3.54 per cent. Our figures differ slightly from Lally, but again this appears to be due to differences in sampling periods, not methodology.

4.26 The net result of applying Lally's (2014) correction is a Gaussian Normal yield of 5.67 per cent. All of the yields, and spreads to our calculated ten-year swap rate of 3.85 per cent (Bloomberg ADSWAP10 averaged over the 40 trading days to September 30 2014) are shown in Table 2 below. For the models other than the Gaussian Normal, the results for the models calculated using yields and swaps are shown in the first two columns, and the yields implied by the spreads to swap (ie - spread plus ADSWAP10) are shown in the fourth column. We present the results in this way to check that we obtain similar results whether yields are estimated directly, or created by adding spreads to swaps to swap rates and risk-free rates as per the ERA's approach. For the Gaussian Normal model, we calculate the yield via Lally's correction above in the first column, and then infer the spread to swap in the second column, so the fourth column is irrelevant. We do this because

Lally does not present a way of correcting directly in spreads the way he has done for correcting in yields.

Table 2: Return on debt results at a tenor of ten years

	Yield	Spread to swap	Swap rate	Yield implied by spread to swap
Gaussian Normal	5.67	1.82	3.85	5.67
DBP Nelson Siegel	5.76	1.85	3.85	5.70
ERA Nelson Siegel	5.77	1.86	3.85	5.71
Nelson Siegel Svensson	5.75	1.81	3.85	5.66

Source: DBP analysis

4.27 Once the new issue premium and debt-raising and hedging costs are added, the range of yields from Table 2 above is from 6.08 to 6.19 per cent. Following our steps described at paragraph 4.12 above, we estimate the return on debt at 6.13 per cent, which is comprised of:

(a) ten year DRP over swap rate = 1.86 percent;

(b) premium between the ten year CGS and the ten-year swap rate = 0.31per cent;

(c) allowance for debt-raising and hedging costs = 0.15 per cent;

(d) new issue premium = 0.27per cent; and

(e) ten-year risk-free rate = 3.54 per cent.

4.28 This figure will be updated by us in the revisions we make to our proposal in response to the ERA's draft decision, to reflect new information in respect of points a, b and e.

Updating the return on debt during the access period

4.29 The ERA's approach to the methodology of annual updating has changed significantly over the past 12 months, and differs significantly from that proposed by the AER. Under the original proposal being considered by the ERA in November 2013, the entire return on debt would have been updated every year. Two customers (Alinta and Wesfarmers) lodged strong objections to this methodology on the basis of the volatility in prices that would result, and thus the Guidelines had the risk-free rate remaining constant but the debt risk premium changing every year. On the surface, this methodology appears to reduce volatility in pricing, but in reality makes no net difference to the position of customers. If the risk-free rate is held constant, the service provider must buy a hedge for five years, and if it is allowed to vary, customers must buy a hedge against the same volatility that is induced (in pricing, rather than in debt costs). Since there is likely to be no difference in the hedge costs of DBP and major customers such as BHPB or Wesfarmers, both approaches are functionally equivalent in terms of the overall position of shippers.

4.30 In the ATCO Draft Decision, after more opposition from shippers (see ATCO Draft Decision paragraph 900), the ERA suggested that it will keep the return on debt constant over the five-year access arrangement period, but keep track of the changes in revenue that would have eventuated if it had changed the return on debt annually using the methodology in the Guidelines, and then apply a "true-up", of the net revenue position at the start of the next access period. It is not yet clear, from the ATCO Draft Decision, how this process would be implemented in practice, and we believe it will face substantial implementation issues (see paragraphs 4.66 to 4.75).

4.31 The AER, by contrast, proposes (after a ten year transition period; see paragraphs 4.77 to 4.86 below) to roll over one-tenth of the return on debt each year during an access arrangement period, to mimic what its investigations have shown efficient firms actually do in taking out staggered debt portfolios to minimise refinancing risk and thereby minimise, overall, their return on debt.

4.32 We understand the underlying logic of the differing approaches each regulator has taken; at least before the ERA's departure from its Guidelines in the ATCO Draft Decision. The AER has looked at what efficient firms actually do and, since the overwhelming evidence is that they stagger debt (see paragraphs 4.62 to 4.65 below), it has decided to replicate this outcome in pricing. The ERA, by contrast, has looked at the pressures which competitive firms face - the pressure of rival entry at any time, where the rival is able to issue debt at the then current market rate. It has therefore sought to replicate this external pressure, on the assumption that this will induce an efficient response from regulated firms. The ERA recognises that the response is likely to be a staggering of debt but, unlike the AER, it does not seek to impose this outcome; only the pressure which is likely to lead to that outcome.

4.33 Although consideration of more nuanced, realistic assumptions about the characteristics of the economic situation being assessed complicate matters (see paragraphs 4.40 to 4.49 below), when viewed from the perspective of perfect competition economics, there is potential merit in the approaches of both the AER and ERA (prior to its departure from the Guidelines). Moreover, it seems likely that, when one looks from a long-term, general equilibrium perspective (within the context of those same textbook economics), the outcomes are likely to be the same. The major difference is who bears the risks.

4.34 Under the approach proposed by the AER, if a firm always issues ten-year debt and rolls over its debt exactly ten per cent per annum,[28] it is almost certain of having its debt repaid (with the exception of demand risk), and thus it can obtain very low lending rates. It gets no advantage from this, of course, because its return on debt is set with reference to the actual return on debt of its peers, all subject to the same regime (at least on the East Coast) and thus facing the same low costs. Instead, this advantage gets passed on to consumers in the form of lower prices. However, the lower prices for consumers right now come with a cost; consumers bear the risks formerly borne by regulated firms of future interest rate changes. Thus, if interest rates are high now and subsequently decline, consumer prices will decline more slowly, because they will still reflect some of the old debt. Consumers have taken a lower up-front cost now in exchange for bearing interest rate risk that would otherwise be borne by the service provider.

4.35 By contrast, under the ERA's approach, consumers do not bear the risk of future interest rate changes, as there is no legacy of debt cost overhang; at least under the original ERA plan, the true-up mechanism re-introduces this risk.[29] However, since the service provider bears interest rate risk, its return on debt must rise because credit risk has increased and lenders will demand higher compensation in return. This was the central message of the paper by Valta (2012), which noted that firms in more competitive industries face higher interest rate costs;[30] they do so because they bear interest rate risk. Moreover, the ERA recognises this fact in its discussion of "subsidies" for regulated firms (Explanatory Statement, paragraph 367-9). These are not subsidies to regulated firms, because they are passed on to consumers, but rather reflections of credit risk. Thus, under the ERA's (original) proposed approach, consumers are being asked to pay more now through a higher debt cost than would apply to firms under the AER's proposed regime, in exchange for not having to face interest-rate risk in the future. Again, there is a shift of risk, back to service providers.

4.36 Since the only real difference between the two approaches is a shift in who bears the risk, in a general-equilibrium, long-run sense, it seems likely that the two would produce identical outcomes

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[28] *No firm would ever do this in reality, which the AER recognises, as each would take advantage of low cost debt periods to issue more than a tenth of debt and, moreover, since debt positions are costly to unwind, the consequences of any shift from strict adherence to the regime could be felt for many, many years.*

[29] *Moreover, it is not clear whether the scheme proposed in the ATCO Draft Decision would reduce credit risk in the same way the AER scheme does, because the regulated firm still faces the risk of future interest rate changes through the true-up mechanism. It would appear that the ERA has discovered a scheme which increases the cost of debt now, and creates an overhang of past debt costs, bringing together the negative aspects of both schemes. We do not consider this to be a positive development.*

[30] *See DBP's submission to the ERA's November 2013 workshop, available from* http://www.erawa.com.au/cproot/11892/2/Public%20submission%20-%20development%20of%20the%20Rate%20of%20Return%20Guidelines%20-%20Dampier%20Bunbury%20Pipeline.pdf

for the economy as a whole, if each is implemented perfectly. On the West Coast, consumers would pay more for their gas at any point in time through a higher debt risk premium, but would be better off in times when interest rates are low, whilst on the East Coast, consumers would pay less for their gas through a lower debt risk premium, but would bear interest rate risk. Provided consumers can hedge risks at roughly the same cost as service providers, which does not seem an unreasonable expectation for larger consumers, then the two approaches may be very similar in outcomes in the long run.

4.37 However, there are several reasons why equivalence in this "perfect world" might not occur in reality. Consideration of these issues leads us to believe that the ERA's approach is much less likely to meet either the ARORO or the efficiency outcomes it suggests may occur. These are:

(a) the notions of efficiency being pursued miss some important conceptual issues that mean the asserted efficiency gains might not be realised in reality. Perhaps more pertinently, the subsequent amendments to the ERA's original proposal detract still further from the ERA's original claims of efficiency gains;

(b) it is not clear whether the approach is consistent with and conforms to the requirements of the RPPs, something which depends upon the interpretation of efficient financing costs;

(c) in order for the ERA's approach to work, the price of debt must be correct. That is, it must correctly identify the premium in debt costs (reflective of credit risks) between firms in competitive and monopolistic industries. If it does not, debt will be mispriced, and any efficiency effects muted;

(d) other things may change. Firms in competitive industries may have different gearing and different costs of equity compared to those that face regulated return on debt regimes like those proposed by the AER. These effects must also be considered;

(e) consumer preferences are unclear; although the AER has received consumer support for its approach, every iteration of the approach proposed by the ERA has been opposed; and

(f) the objections to trailing averages made by the ERA in its Guidelines do not apply to the AER's approach. Indeed, it seems likely to better achieve the desirable efficiency effects the ERA cites, than its own approach, particularly in its current manifestation.

4.38 We discuss each of these issues in turn below, and conclude that, whatever the merits of the ERA's approach in terms of simple, abstract economic theory, and whatever equivalence might exist between the two approaches in an hypothetical world, consideration of the findings of more advanced economic theory and its practical implementation, mean that the AER's approach is likely to be preferable.

Box 1: Do prices in competitive industries reflect interest rates?

A key reason given by the ERA for its support of updated interest rate information is that this results in allocative efficient outcomes preventing incentives for under or over-investment relative to the optimum at prevailing rates (see Explanatory Statement paragraphs 336-7).

There is nothing wrong with this notion in theory, and indeed it reflects standard economic thinking within the context of a model of perfect competition where information on input costs is fed regularly into output prices and the ERA notes (Explanatory Statement paragraph 134) that a necessary (though not sufficient) condition for efficient financing costs would be that they are consistent with financing costs in the wider economy. However, we would suggest that it is not sufficient just to rely upon what ought to happen in theory, but rather it is necessary to ask what happens empirically in practice; do firms in fact change their prices as interest rates change?

To examine this, we examined prices from roughly 100 different sectors of the economy, using ABS price indices (see Appendix M) and their correlation with changes in interest rates. We in fact found evidence of negative, not positive correlation. See Appendix M

Debt is obviously not the only input to production, and thus examining correlation between interest rates and output prices alone may produce a skewed view. We therefore used the ABS input-output tables to examine the ten most important inputs to each of the 100 sectors of the economy noted above, and then performed regression analysis of price changes in these ten sectors plus interest costs, on the output prices of each of the 100 sectors of the economy. In these regression analyses we used three different types of bank debt, and two different bond rates, making for 500 regressions in all. The results are shown in Appendix M.

Not all of the regressions were significant, but of those that were, the best results we obtain are that at least one class of debt cost is significant as an input cost in only a quarter of output prices. Moreover, in only five per cent of industries were all five different types of debt a significant explanatory factor in output prices. We do not pretend that this analysis is the most comprehensive examination of the influence of interest rates on product prices, nor that the approach of using changes in the price of key inputs for a particular industry is the only way to examine the issue (though it seems logical to us). However, the ERA has provided no empirical support at all for its theoretical notion that competitive firms ought to change output prices as input prices (including the return on debt) change, and we have likewise failed to find very much empirical support for this theoretical position. Absent of other evidence, it would appear that the ERA is imposing "competitive" pressures on regulated businesses which simply do not exist for firms in the Australian economy at large

Efficiency and feasibility

4.39 As with many discussions of the allowed rate of return, a discussion of the best approach to the updating of the return on debt requires an appreciation of the concept of efficiency. In this context, the ERA bases its approach largely on arguments of allocative efficiency; more rapid dissemination of timely information leads to better allocative efficiency in the economy, as per textbook models of perfect competition where information is always current costless and evenly distributed through the market. However, the world is not perfectly competitive, and when imperfections are taken into consideration, the simple conclusions of basic textbook economics vanish, and are replaced with more nuanced findings. We discuss two pertinent issues here; the theory of second best and the effect of sunk costs. We conclude this section by looking at how the changes in the ERA's position have had the effect of rendering even the simple, perfect competition arguments moot.

The theory of second best

4.40 The first issue is whether the ERA can in fact expect the efficiency gains which is believes are likely to occur based on its textbook theoretical analysis. This is the issue of second best, first raised by Lancaster & Lipsey (1956-7). The theory of second best states that, in a world where there are a large number of deviations from the perfect competition framework, alleviating one imperfection through mechanisms that the government can control (in this case, removing imperfections created by monopolists being able to pass on interest rate risk to their customers) will not necessarily lead to an overall improvement in economic welfare. DBP raised this issue in submissions to the Guidelines process, but the ERA dismissed these concerns, noting (Explanatory Statement paragraph 126):

> *"The theory of the second best provides a cautionary tale about the unknown economic welfare effects of policy changes. For example, removing monopoly constraints on gas networks might lead to net welfare losses if costs associated with resulting increases in air pollution outweighed the benefits of the increased consumption of gas."*

4.41 Unfortunately, the issue of second best is not just a "cautionary tale" for policymakers, but rather requires a very careful consideration of policy responses and their impacts. Appendix I provides considerable detail on this issue, indicating why it is important for policymakers, in particular to prevent them from making rash policy decisions without carefully considering the impacts of the decision. The ERA, by contrast, ignores this need for careful consideration of policy impacts,[31] relying upon a paper by Ng (1977) which suggests that, under certain conditions (which do not hold in the sphere of economic regulation; see below), one can essentially ignore the problems of second best and be guaranteed a welfare improvement through implementing first-best policy responses (that is, considering one sector of the economy in isolation and attempting to fix the imperfections in that sector without considering the wider impacts of doing so). However, there are several problems with the ERA's approach.

4.42 The first of these is that the ERA is not really clear what it means by efficiency, and one of its definitions would appear to be incompatible with both the RPP and its other definition. In paragraph 19 of the Guidelines, the ERA states:

> *"The Authority notes that it is clear that the NGL and the NGO is intended to promote economic efficiency:*
>
> *The national gas objective is an economic concept and should be interpreted as such.*
>
> *The long term interest of consumers of gas requires the economic welfare of consumers, over the long term, to be maximised. If gas markets and access to pipeline services are efficient in an economic sense, the long term economic interests of consumers in respect of price, quality, reliability, safety and security of natural gas services will be maximised. By the promotion of an economic efficiency objective in access to pipeline services, competition will be promoted in upstream and downstream markets."*

4.43 However, elsewhere, the ERA notes:

> *"Further, the Authority considers that economic efficiency cannot be considered in terms of a single firm or a single group of consumers. Such a partial approach may be efficient in isolation, but still leave net efficiency gains once the full general equilibrium considerations are considered" (Explanatory Statement paragraph 329)*

and

> *"The Authority considers that the longer term interests of consumers, as set out in the National Gas Objective, are clearly served by promoting economic efficiency, not just in terms of investment and supply of pipeline services, but also for upstream and downstream use of energy and efficiency in the economy more broadly." (Explanatory Statement paragraph 332)*

4.44 As Markowitz notes (see Appendix I), it is the latter definition that is the appropriate one, given both the underlying economic theory and the requirements of the rules. Indeed, by invoking such a definition of efficiency, the ERA is actually demanding of itself that it examine the wider impacts of its policy choices and not simply focus on a single imperfection and its "correction". Markowitz delineates the concerns that regulators ought to have as being related to:

(a) consumers of natural gas;

(b) owners of natural-gas pipelines;

(c) workers in the natural-gas-pipeline industry;

(d) consumers of other existing products from whose production resources change with changes in regulatory policy affecting gas producers;

(e) prospective (actual) consumers of the other products that were not created (were created) because the resources that could have been used (were used) to create them were (were not) allocated to the creation and use of natural-gas pipelines;

(f) consumers of the other products whose relevant variable and marginal costs of production and (derivatively) prices would have been reduced by the production-process discoveries

[31] *Indeed, it undertakes no investigation of the likely impacts of its policy at all, merely asserting that efficiency will be improved.*

that would have been made by the production-process-research projects that were not executed because the resources that would otherwise have been used to execute them were allocated instead to the construction and use of natural-gas pipelines or the consumers of the other products whose relevant variable and marginal costs and hence prices were reduced by the use of the production-process discoveries that were made by the production–process-research projects that were executed because a policy reduced the amount of resources allocated to the construction and use of natural-gas pipelines;

(g) investors who would have profited from the alternative resource-uses sacrificed by any policy-generated increase in the amount of resources allocated to natural-gas-pipeline construction and use and the investors who did profit from the resource-uses that resulted from any policy-induced reduction in the amount of resources allocated to the construction and use of natural-gas pipelines; and

(h) workers whose labour would have been employed to execute any resource-uses sacrificed to any policy-induced increases in the amount of resources devoted to the construction and use of natural-gas pipelines or the workers whose labour was employed to execute the resource-uses that resulted from policies that reduced the amount of resources allocated to natural-gas-pipeline construction and use.

4.45 This is an exacting list. However, it is worth quoting in full because it highlights what is entailed by the general equilibrium framework the ERA seeks to invoke. Most importantly, as Markowitz notes in Appendix I, it is not the case that an increase in the welfare of consumers of natural gas will be monotonically related to the change in welfare of society overall once these broader effects are taken into consideration. If the ERA is serious about its efficiency arguments, it needs to take these impacts into consideration.

4.46 Secondly, the paper by Ng (1977) upon which the ERA relies is wrong, and, as Markowitz points out in Appendix I, cannot be relied upon to simply ignore the issues raised by the theory of second best. In the first instance, as Lipsey (2012) points out, the mathematical argument made by Ng (1977) does not lead to the conclusion that one can ignore issues of second best and that first best policy responses (those that deal with the economic imperfection in isolation without considering wider impacts) will always lead to welfare improvements, but rather leads to a conclusion that the best response is to make no policy change away from whatever position the economy finds itself prior to the policy change being contemplated.[32]

4.47 Perhaps more importantly, as Markowitz (Appendix I) points out, Ng's(1977) framework assumes just one imperfection in the economy which policymakers can do nothing about, and one which they can do something about, whilst in reality, there is usually one (or maybe a few) imperfections that policymakers seek to address with a given policy and a large number of imperfections which policymakers cannot address. Moreover, Ng (1977) assumes that policymakers are, as Markowitz puts it in Appendix I, "radically and irreversibly ignorant" about the direction and divergence from the first-best rule of the relevant second-best outcome. Markowitz suggests, and we would agree, that policymakers and regulators generally have access to more information than the restrictive assumption Ng (1977) employs. When these assumptions made by Ng (1977) are relaxed, the third best policy response (that is consideration of impacts from a policy change on the economy at large to the extent that available information makes feasible at a reasonable cost) becomes more nuanced.

4.48 Markowitz, in Appendix I, sets out in detail the different considerations a policymaker, or a regulator, ought to consider, and suggests the following eight step process ought to be followed to implement third best solutions:

(a) divide up the economy's total product-space into non-overlapping sub-areas;

(b) define the various categories of resource allocation that can take place in an economy and the related categories of economic inefficiency an economy can contain;

[32] *Lipsey (2012) contains detail on the mathematical flaws in Ng's (1977) argument that leads Ng to the wrong conclusion.*

(c) develop (different) formulas for the aggregate per centage distortions in the profits yielded by the economy's economics-marginal allocations of resources in each of the above categories that is generated by the Pareto imperfections in the economy;

(d) estimate the pre-policy magnitudes of the parameters in these formulas and hence the pre-policy magnitudes of the aggregate per centage distortions in the profits yielded by the economics-marginal allocations of resources in each category;

(e) estimate the impact of the policy on the magnitudes of the parameters in the formulas in question and hence the policy's impact on the aggregate per centage distortions in the profits yielded by the economics-marginal allocations of resources in each category;

(f) derive initial estimates of the impacts of the policy on the above categories of resource misallocation from the preceding estimates—i.e., by deriving from these estimates of the pre-policy aggregate-per centage-distortion figures for the profits yielded by the economics-marginal resource allocations in the relevant categories and the impact of the policy on these per centage-profit-distortion figures and, derivatively, from estimates of (A) the pre-policy magnitudes of the means, mean deviations, and mean squared deviations of the distributions of positive aggregate per centage-profit distortions for an economically-efficiently-large random sample of the economy's allocations between distantly-competitive products, between distantly-competitive investments, and between distantly-competitive projects and (B) the impact of the policy on these distribution-attributes;

(g) analyse the allocative cost and benefits of doing further empirical research into the pre-policy magnitudes of the relevant parameters and the impact of the policy on these parameters and continue to do such research until further investigation would be economically inefficient; and

(h) derive conclusions about the impact of the policy in question on the above-specified categories of resource misallocation from the analysis' final estimates of the pre-policy and post-policy magnitudes of the relevant distributions' relevant attributes.

4.49 This is more complicated than simply ignoring all wider impacts of a policy change based on an assumption about economic welfare impacts from a theoretical paper with mathematical flaws, and simply focussing on the impacts of the policy change in isolation on the sector of the economy (or its consumers) most directly affected. However, the ERA has not even undertaken an assessment of the direct impacts, nor even undertaken the most basic examination of whether the problem it asserts actually exists in the first place. Instead, it has relied upon theoretical arguments without any empirical assessment of the problem or the consequences of the solution whatsoever, and has asserted that an efficiency gain will be the result. We would submit that this is insufficient; regulators should not simply impose theory-based "solutions" to problems that have not even been assessed, and rely upon vague, untested assertions about efficiency gains to justify their actions, but should rather hold themselves to a considerably higher standard. This is most particularly the case when their theoretical arguments have real consequences for regulated firms and their customers. Markowitz's eight steps above show the way such an analysis might proceed.

Sunk costs

4.50 Secondly, the ERA's analysis ignores the presence of sunk costs. The Dampier to Bunbury Natural Gas Pipeline operated by DBP, for example, is a sunk cost, which will continue to be used to provide services by DBP, so long as the price of those services covers our variable costs. What the asset cost us to acquire in the first instance is irrelevant in the decisions to provide or not provide services, and nor does it influence future investment decisions, which are a function only of the return from those investments. This is the basic nature of sunk-cost economics, which is well-understood in the literature.

4.51 Now consider what would occur if the original ERA plan had been implemented.[33] If interest rates increase, the price of pipeline services goes up. This decreases demand. The same pipeline is in

[33] *Under the proposed changes in the ATCO Draft Decision, since the adjustment occurs in the next access period, the increase or decrease in prices will cause under or over-utilisation then, rather than during the current access period. Indeed, the tendency will be enhanced because the transitory nature of the increase or decrease in rates*

the ground, and the same capacity is available as sunk costs have not changed. All that happens is a sunk asset becomes idle when it could have been used to provide economically efficient services. Similarly, if a transitory drop in interest rates occurs, demand will increase, but DBP will not be able to expand its sunk asset base to respond, because investment decisions are made on the basis of expected interest rates (and other costs, and revenues) through the life of the asset, not on the instantaneous interest rate which, if transitory, may not make expansion viable. Designing prices to render an asset in turn idle and congested seems unlikely to improve economic efficiency. Whilst the ERA's arguments might have some relevance in a world with no fixed or sunk costs, where supply could expand and contract instantaneously in response to a change in demand, they have limited relevance in a world where supply is essentially fixed in the short term.

Efficiency and the annual update in the ATCO Draft Decision

4.52 The final point is that, whatever the merits in terms of the ERA's original proposal for annual updating, these have been removed by the proposed true-up mechanism because the flow of information the original proposal had been designed to create has now been interrupted, and only stale information, which may in fact contradict more recent information, is transmitted to the marketplace.

4.53 By way of an example, assume that interest rates are five per cent at the moment, rise to ten per cent in the middle of the forthcoming AA Period, and drop to four per cent by the time the next access arrangement period starts. Under the ERA's proposed scheme, at the start of the next access period, prices would rise as the true-up process allows the service provider to collect the revenues associated with the period when interest rates were ten per cent. However, the interest rates then current (four per cent) indicate, according to the ERA's own logic about efficiency, that prices ought to come down to reflect current information. Thus, precisely the wrong signal is being sent to consumers of gas.

4.54 Quite what the ERA's proposed scheme will do to investors is unclear, as we are unaware of any jurisdiction that has imposed it. However, what the scheme does is create a risk at the outset of an access period that interest rates will move against the service provider, creating a negative true-up at the outset of the next access period. This would result in cashflow constraints if the service provider needed to pay off more debt next access period associated with new investment at the same time as needing to find funds to pay for the true-up. Partway through the access period, when interest rate information starts to become known, this uncertainty starts to fade, as the size (and nature) of the true-up becomes clear; by the end of the access period, the true-up's size is known and effects on investment made then are clear. There would appear to be an inbuilt mechanism associated with the true-up which incentivises investment towards the end of the access period when information about interest rates is known, rather than when demand dictates investment ought to occur. We do not believe this is efficient.

4.55 There are also two additional practical issues that do not seem to have been addressed. In the ATCO Draft Decision (Appendix 7), the ERA suggests the true-up could be implemented over a period of one year or five years. If it occurs during the first year of the next access period, then the impacts of stale information will be short-lived, but there will likely be a large increase or decrease in price for that period.[34] A large price will adversely impact upon customers, and a large decrease will adversely impact on the cashflows of the regulated service provider, potentially making it unable to earn its efficient cost of capital. If the true-up process is drawn out, the impacts are smaller, but stale information is preserved for longer; if it is drawn out over an entire five year period then by the end of the next access period, ten-year old debt cost information is influencing

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will be clearly known as it will be based on past information, and thus any investment response will be even less likely than discussed above.

[34] *The ERA suggests this could be equivalent to 104 basis points in the debt risk premium, based on the average variation in debt risk premia per annum. It is not clear how this takes into account the compounding effect of its discounting factor, and may be an under-estimate. However, 100 basis points in debt costs translates to 60 basis points in WACC which, on a $3.5 billion asset is around $21 million in additional charges for consumers in the event of increasing debt risk premia during an access arrangement. We would welcome the views of consumers as to whether they believe this additional charge is justified by the strength of the ERA's arguments.*

price, and it is difficult to see the difference between this and the AER's trailing average in terms of the impacts of stale information.[35]

4.56 Secondly, it is not clear whether the ERA has factored in demand elasticity. If prices truly were to rise or fall, demand for gas transport would adjust based upon the elasticity of demand. Failure to take this into account would mean that the true-up would be too large; in both directions.[36] This would result in price swings being wilder, during the next access period, than would need to be the case to meet even the ERA's criteria of efficiency. It is not clear how the ERA proposes to calculate the elasticity of demand (if indeed it intends to do so at all), and we suspect that doing so would be highly problematic in the context of a small number of large shippers who use gas for a wide variety of purposes.

Consistency with the RPPs

4.57 As discussed above, the ERA intends to construct a scenario that imposes upon service providers the pressures which competitive firms face, with the expectation that their response will reflect the responses which competitive firms have under similar circumstances. This contrasts with the AER's approach of recognising what efficient firms do and implementing that approach in the determination of pricing, but it is not clear whether this reflects what the law actually requires.

4.58 One of the RPPs, at s 24(2) of the NGL, provides that

> *"A service provider should be provided with a reasonable opportunity to recover at least the efficient costs the service provider incurs in—*
>
> *(a) providing reference services; and*
>
> *(b) complying with a regulatory obligation or requirement or making a regulatory payment".*

4.59 Elsewhere in its Guidelines, the ERA appears to give more credence to these legal issues, noting:

> *"the benchmark cannot be purely hypothetical. The benchmark should be based on the actual costs and risks faced by an efficient service provider."* (Explanatory Statement paragraph 32)

and

> *"It is desirable that the benchmark not be hypothetical. This means that the benchmark must, as far as possible, reflect achievable financing practices, which reflect the practices of efficient firms exposed to a similar degree of risk as the regulated firm. Importantly, by reflecting achievable efficient financing practices, the benchmark will allow the service provider 'reasonable opportunity' to achieve the efficient parameters determined for the benchmark entity."* (Explanatory Statement paragraph 188)

4.60 The latter quote footnotes the Revenue and Pricing Principle 24(2) of the NGL.

4.61 If the law requires that prices reflect what efficient firms actually do in respect of their return on debt, then it is apposite to ask what they do. This evidence is considered below. The ERA has nowhere claimed that efficient firms engineer their debt in the way outlined by its annual update approach. Indeed, its most recent iteration of five-yearly true-ups would be impossible without a regulator to impose them on customers. Instead, its arguments (see Explanatory Statement paragraphs 350-66 for the argument and 368 for the conclusion) are that firms are able to implement efficient debt management practices in spite of regulatory policy, and that such policy is not an impediment to efficient debt management.

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[35] *The AER's approach introduces new information each year during the access period, whilst the ERA's approach does not. Thus, it is likely information would be more stale by the end of the subsequent access period in this circumstance.*

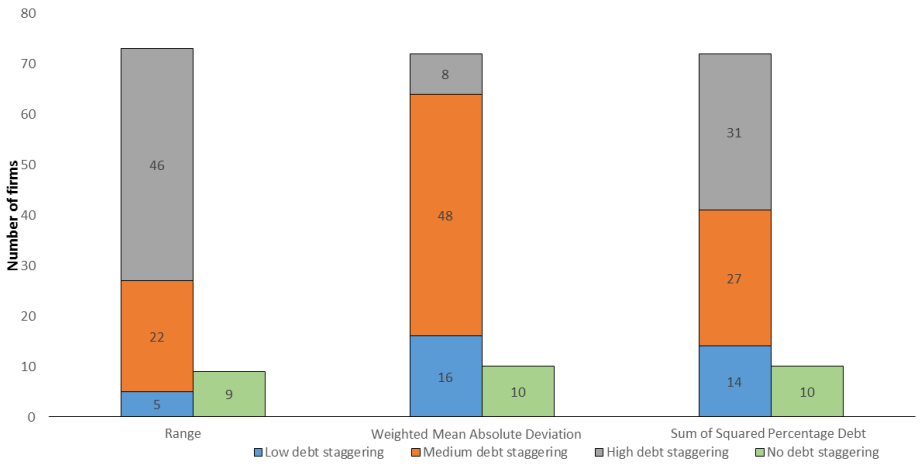
[36] *If elasticity is ignored, then the fact that demand will fall as prices rise, leading to less of a revenue increase is ignored, and the fact that demand will expand as prices fall leading to less of a revenue decrease will likewise be ignored. Thus, both adjustments will be too big.*

4.62 Appendix G provides extensive information on the range for each firm between its shortest and longest-maturing debt for some 619 parent firms of current debt issuers prepared by CEG. In addition to the range, CEG developed two more measures of debt staggering. The first of these is the weighted mean deviation, which records the average difference in time to maturity for a particular debt instrument and the sample as a whole (weighted by debt size). A larger value indicates more spread in debt for that company. The second is the sum of squared per centage of debt, which is the sum of the share of each debt instrument issued by a company in its total debt issuance. Like the Hirfindahl Hirschman Index in industrial economics which records market concentration, this records the degree to which a company has its debt concentrated in a few debt instruments; a high score is evidence of not very much staggering, and conversely for a low score.

4.63 Amongst the 619 companies including subsidiaries (see Appendix G for details), slightly fewer than half stagger their debt in some way, and of those, most have a range of less than five years with a relatively low weighted mean average deviation, and only a sixth have high staggering as measured by the sum of squared per centage of debt score. This suggests that, overall, staggering is rather limited; although the low core may partly reflect the fact that companies with subsidiaries stagger debt across several of these subsidiaries.

4.64 The question, however, is why. When CEG examine companies with credit ratings they find that, of the 82 parent companies in this sub-class, all but nine stagger their debt in some way. Of the nine who do not stagger their debt, four are sub-investment grade. Moreover, firms with credit ratings tend to engage in much more staggering than the sample as a whole. Among the credit-rated companies that did stagger their debt, 63 per cent have a range greater than 5 years (compared to 37 per cent in the whole sample), less than half (40 per cent) have a weighted mean absolute deviation score of less than 1.5 years (compared to 70 per cent in the sample as a whole) and 45 per cent of the credit rated firms were rated as high staggering under the sum of squared debt score compared to 18 per cent for the wider sample. These results are summarised in Figure 3 and explained in more detail in Appendix G.

Figure 3: Debt staggering amongst firms with credit ratings



Source: Appendix G.

4.65 The evidence suggests that firms who rely on a debt-financing strategy where credit ratings are important (such as public debt issues) have a strong tendency to stagger their debt. A lack of staggering in the wider sample might thus be interpreted as representing a lack of opportunity, associated with often smaller-scaled projects, rather than a lack of desire. Whatever the reason, for the purposes of regulators, who regulate firms that are not only credit rated but which have an investment grade, the message is clear; efficient firms stagger their debt, and this presumably

feeds through into their pricing decisions. This suggests that the AER was correct in imposing this structure on prices charged by regulated firms under its jurisdiction.

Right premium

4.66 The ERA notes a "subsidy" associated with the lower return on debt that monopolists pay by virtue of having a greater certainty of payback, because free from the entry of rivals, they can pass on interest rate changes to their consumers through prices (Explanatory Statement, paragraphs 367 and 369). Whilst it is wrong to call it a subsidy - at least a subsidy for service providers (the lower cost is passed through to consumers in a lower return on debt allowance) - it is true empirically that firms with greater market power pay less for their debt than firms in competitive industries (see Valta, 2012). This is due to their having lower credit risk for those who lend to them.

4.67 The ERA's proposed approach to the return on debt would remove the ability to pass on interest rate changes to customers, with the consequence that the firms regulated by the ERA will see their credit risks rise to similar levels that one would see in competitive markets, and thus that the cost of their credit would increase. Just as the ERA has recognised the existence of a "subsidy", it needs to recognise and calculate the scale of the premium required if it creates the credit risks present in a competitive industry but not in a monopolistic one. If it does not do so, then the return on debt it allows in its prices will not match the rates at which banks and bond markets are prepared to extend credit, and investment in the industry will necessarily suffer as credit is withdrawn by these institutions.

4.68 We are not concerned, at a principled level,[37] about a pricing scheme that creates the risks the ERA proposes to create, provided the risks are duly compensated. Our primary concern in respect of the proposed ERA scheme is that the premium be correctly calculated, because a failure to do so will have serious impacts on the ability of an efficient firm to finance the reference service DBP provides. Such a consequence is inconsistent with the ARORO, the NGO and the RPPs (including s 24(2) NGL).

4.69 There is nothing to suggest that the ERA has considered such a premium or how it might be calculated, despite recognising that it exists through discussing what it terms "subsidies" for monopolists in respect of credit costs. For example, the ATCO Draft Decision is silent on this issue, and the ERA calculates the return on debt for ATCO as though the set of risks ATCO faces are the same as they have always been.

4.70 In calculating the premium, it is not sufficient to assert that, because not all of the firms in the BBB-band credit range are regulated monopolists, that information about the size of a likely premium will somehow be filtered into the debt risk premium by considering the return on debt of firms from competitive industries that issue debt in the BBB-band. Quite apart from the fact that such a process does not recognise the risk explicitly and relies on there somehow being enough competitive firms that the weighted average will address the issue, the more fundamental problem is that nobody has established that an efficient provider of the reference service facing all the risks prevalent in other jurisdictions in Australia and the added risk of the ERA's annual update approach would still have debt priced in the BBB-band.

4.71 The ERA makes its choice of the BBB-band based upon an assessment of energy service providers using past information, wherein it finds that all of them have debt in this band and thus concludes that this reflects the similar risk level requirement in the NGRs. However, the ERA's proposed annual update mechanism did not apply in the past, and thus information from the past cannot be relied upon to judge whether the BBB-band still reflects the relevant level of risk. The ERA will need to rely upon something else to determine whether the BBB-band is still sufficient.

4.72 It is also not sufficient to assume away the premium by suggesting that it is not substantial. If it really were close to zero, then this would mean that there is essentially no difference in risk between firms on the East Coast regulated under the AER's scheme and those on the West Coast

[37] *We can see some important theoretical weaknesses, discussed above, but as a business, these are not our direct concerns.*

regulated under the ERA's proposed scheme. In other words, whatever transfer of risk to or from consumers created by each scheme is inconsequential. However, if this is true, then it also removes the key reason for the ERA's approach, as it would add nothing in terms of efficiency (because it changes nothing about risk allocation) compared with taking the AER's approach. In other words, an argument for an inconsequentially small premium is also an argument against the implementation of a separate regime by the ERA.

4.73 While we await some indication from the ERA as to how it proposes to calculate the relevant premium, without the recognition that such a premium needs to be calculated, it is prudent for us to adopt an approach that does not create the risk that gives rise to the need for a premium. That is, it is prudent to follow the AER's Guidelines in respect of an annual updating mechanism.

Changes in other parameters

4.74 The premium/subsidy issue discussed above need not manifest itself in the return on debt. If the return on debt is increased by a correct premium, then nothing else in the WACC will change. However, if it is not, then the return on equity demanded by the market will change, as will the level of gearing credit-rating agencies require service providers to hold. Thus, if the premium remains unrecognised in respect of debt, it must be captured in some other component of the WACC. Provided it is correct, DBP is not particularly concerned where it is recognised. However, again, it is not even clear the ERA has recognised the need for a premium, despite it being the logical outflowing of its own discussion about "subsidies" to monopolists, let alone how it might be calculated in debt or equity. For this reason, as above, we seek to avoid the issue by adopting the AER's approach to debt cost updating.

4.75 The ERA is cognisant of the fact that changes in debt cost policies could affect the return on equity, noting in Appendix 3 (paragraph 47):

> *"Mismatch timing risk has a cost, in that it leads to increased volatility for cashflows to equity. This volatility would result in a higher β, all other things being equal, so would still be compensated for the regulated firm. To the extent that this volatility was reduced, such as by moving to some kind of portfolio trailing average approach, then historic observations of the β would need to be adjusted down, to account for the reduction of this mismatch timing risk."*

4.76 We would point out that mismatch timing risk is not the only thing which can lead to a higher beta, and that, if a trailing average reduces beta estimates, the ERA's annual update mechanism, by virtue of having the opposite effect on risk, increases it.

Uncertainty about consumer preferences

4.77 Consumer groups have largely been favourable to the AER's approach (AER Guidelines Explanatory Statement p110-15). The same cannot be said about consumer comment on the ERA's approaches.[38] Whilst the ERA has sought to change its approach in light of consumer feedback, we believe it would be premature to conclude that consumers will judge the current proposal by the ERA to be favourable, given past criticisms. In the interim, it suffices to observe that the contrasting consumer responses to the respective approaches of the AER and the ERA to date provide further justification for the adoption of the AER's trailing average approach.

Objections and the trailing average

4.78 The ERA has two objections to trailing averages in its discussion on the issue in its Guidelines (See Explanatory Statement Appendix 3). The first of these is predictability, and the second is investment incentives. They are inter-related; investment incentives are improved if the regulatory return on debt better matches the prevailing return on debt (according to the ERA) and models with

[38] *See submissions to the ERA's debt proposal prior to the Guidelines in November 2013 (http://www.erawa.com.au/gas/gas-access/guidelines/rate-of-return-guidelines), and further submissions on the ATCO issues paper (http://www.erawa.com.au/gas/gas-access/mid-west-and-south-west-gas-distribution-systems/access-arrangements/proposed-access-arrangement-for-period-2014-2019).*

better predictive power increase the likelihood that this will happen. We too consider investment incentives to be of primary importance, and predictability to be a means to an end. However, it is apparent from reading the criticism that the "trailing averages" to which the ERA refers are not the same as the trailing average that the AER proposes.

4.79 The ERA is referring to averages of up to ten years length prior to an access period with no update during the access period itself,[39] whilst the AER's trailing average involves updating one-tenth of the ten-year return on debt every year during the access period. It is true that the AER's approach means that one-tenth of the return on debt now will reflect the return on debt ten years ago, but the fact that the approach is updated through the access period makes it fundamentally different to the "trailing averages" the ERA considers.

Box 2: Predictability

The ERA makes repeated reference to the superior predictability of an "on the day" approach to any form of trailing average in its Guidelines (Explanatory Statement paragraph 379). However, the ERA never tests the AER's trailing average approach. When it does test an annual update (See Explanatory Statement Appendix 6), what it does is test whether an n-day average prior to the access period is a better predictor of five n-day updates during the access period the access period than is the case for an m-day average prior to the access period compared to five m-day updates during the access period. It does not test whether an n-day average prior to the access period is a better or worse predictor of the actual average of interest rates during the access period than an n-day average which is subsequently updated five times during the access period. This is the test which actually matters from the perspective of comparing the ERA's approach to debt updating with the AER's.

DBP has performed such an analysis, and the results are provided at Appendix N. We find no support for either model; in both cases, neither model produces forecast errors which have the property of covariance stationarity which is necessary for the Diebold Mariano test the ERA uses to work. We find the same is true for the various "fixed" and "annual update" models the ERA tests in Appendix 6, which contradicts the ERA's findings, and have neither been able to replicate the ERA's results nor obtain from the ERA a sufficiently clear explanation of what it has done in terms of data manipulation which would explain why we are unable to replicate its results, despite using exactly the same input data and econometric models. For this reason, we would suggest that the ERA's findings in relation to predictability, even though they have only a tenuous connection to the actual annual update approach the ERA proposes to use, do not represent findings which can be relied upon to further the debate on the return on debt.

4.80 The ERA notes that a problem with the "trailing averages" it considers is that the information will be stale, and that the marginal investment will not face the marginal cost of investment (Explanatory Statement paragraph 345). However, this is clearly not the case with the AER's trailing average approach, whereby one tenth of the return on debt is rolled over every year. Thus, every marginal investment made during the access period will in fact face the marginal return on debt relevant at that time. Further to our discussion on sunk costs above, existing capital serviced by existing debt does not influence whether new investment is viable or not; what matters is the interest rate faced by that marginal investment, and the AER's approach delivers the signal which ensures that investment will occur at the right time.

4.81 The AER's approach does present problems where the "marginal" investment is not really marginal, but is greater than one-tenth of the asset base. However, we discuss a solution to this issue in our proposed annual update mechanism below (paragraphs 4.88 to 4.97). Overall, however, the AER's trailing average, as distinct from the trailing average the ERA discusses in its Guidelines is considered likely to deliver the correct signal to marginal investment precisely because it updates during the access period. The same cannot be said for the revised proposal from the ERA in the ATCO Draft Decision that delays the transmission of information.

4.82 Since the ERA makes the point about efficiency related to how well current interest rates are reflected in prices, it is worthwhile exploring this issue a little further. The ERA presents some evidence in its Explanatory Statement (see paragraphs 346-9 and Figures 2 and 3) which it suggests shows that a trailing average would lead to higher prices for consumers because of the overhang of stale information. However, it is clear from examining this evidence that the ERA is talking about the form of trailing average presented in the Western Power decision (ERA, 2012,

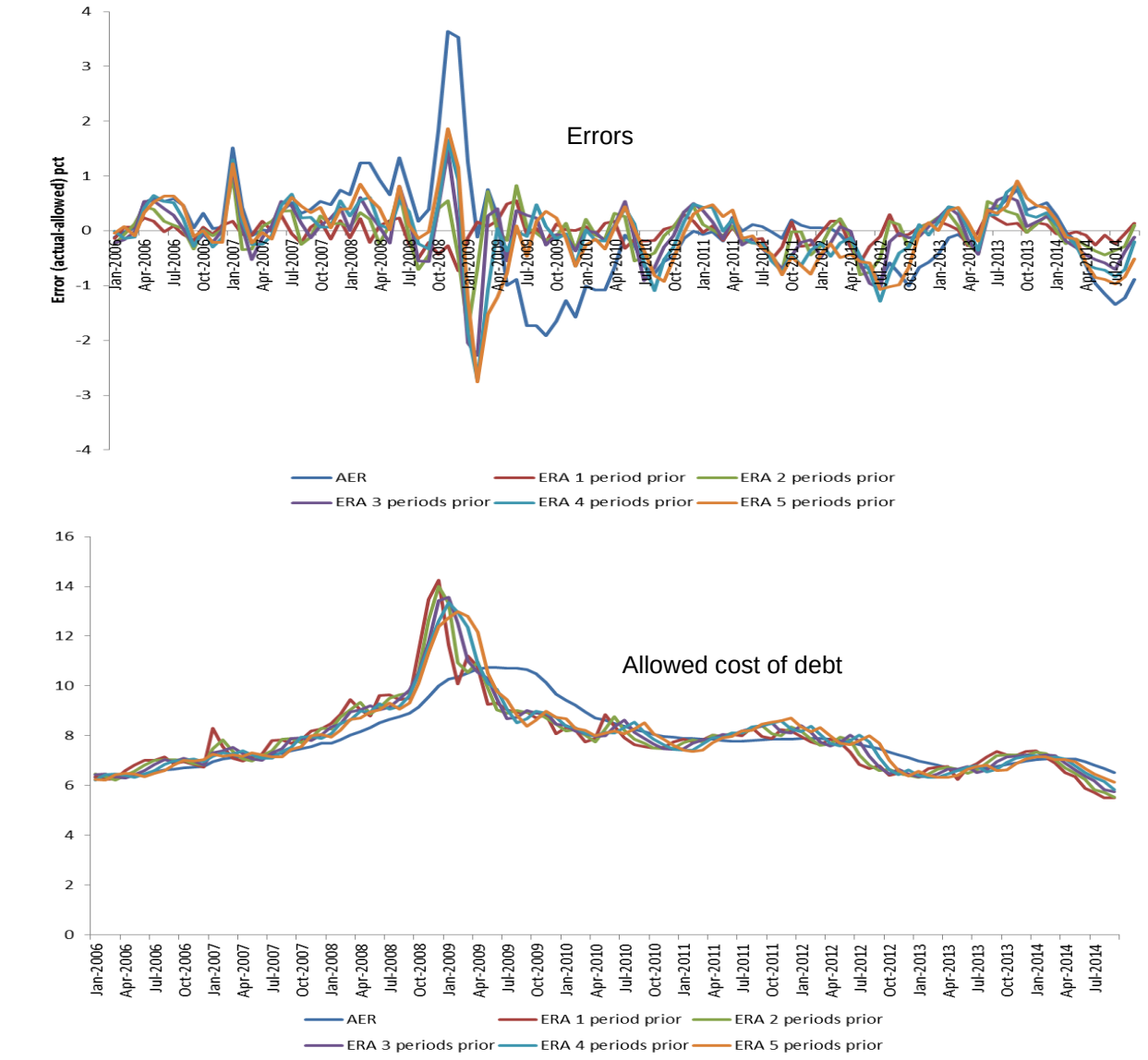
[39] *We understand that this form of a trailing average was proposed during the Western Power access decision several years ago, but to our knowledge, nobody proposed this during the more recent Guidelines process.*

Appendix 9), where no updating occurs through the access period, rather than the form of trailing average proposed by the AER where updating does occur. Again, it is useful to compare the two models that have actually been proposed. Our comparison is on the basis of the annual update proposed by the ERA in its Guidelines rather than the more recently proposed true-up mechanism from the ATCO Draft Decision, as it is unclear exactly how one would robustly model the effects of the true-up approach; certainly the ERA has not sought to do so.

4.83 To do this, we make use of monthly bond data from the RBA, and the RBA's monthly debt risk premium data. These data only go back to January 2005, giving us around ten years of data. Since there are no data on debt risk premia from before that time, we are not able to reflect a ten-year staggered debt portfolio approach. For this reason, for the purposes of analysis, we assume that the annual updates in both cases (for the ERA and AER) are in fact monthly updates, and that the AA period is five months, not five years. This means we can start the analysis in January 2006, after the ten-month transition has occurred, and when there are data on debt risk premia from ten months prior.

4.84 Figure 4 compares the allowed return on debt through time using the approaches of both the AER and ERA and the ten-year risk-free rate (the five-year risk-free rate pictures are very similar). There are five ERA curves and only one for the AER. This is because the ERA approach fixes the risk-free rate for five periods, and thus it matters when the last fix happens. The way to interpret the ERA curves is thus the interest rate that would have been received if the access period has started, at each point in time, t periods ago. Unlike the AER's scheme, the lines in Figure 4 do not trace out the interest rate a firm would receive through time, so what matters is the vertical distance between the lines at a point in time.

Figure 4: Comparing the return on debt under the ERA and AER schemes



Source: DBP analysis

4.85 What is clear is that most of the time, there is very little difference between the two schemes, certainly very little difference which is systematic across time. Differences only arise at times of crisis, provided the crisis affects the debt risk premium. In such times of crisis, the ERA scheme has a much greater reaction at a point in time, but recovers quickly, whilst the AER scheme has less of a reaction, and a longer recovery time. The real question for consumers, therefore, is the degree of variation they would like in their price paths; all the available evidence (See AER Explanatory Statement p110-15) suggests a preference for smoother price paths.

4.86 The discussion above covers the return on debt that will be received, but not whether this reflects the return on debt actually prevailing at a point in time in the market at large. To do this, we compared the return on debt allowed under each of the schemes (one for the AER, five for the ERA, as above) with the actual return on debt prevailing at a point in time, and then noted the errors (actual minus allowed). We then take an average, and test whether this is statistically significantly different from zero. The results are shown in Table 3 below; again we are using the same monthly, rather than yearly approach.

Table 3: Comparing how well current return on debt is reflected under the AER and ERA schemes

		AER	ERA - rfr set 1 period prior	ERA - rfr set 2 periods prior	ERA - rfr set 3 periods prior	ERA - rfr set 4 periods prior	ERA - rfr set 5 periods prior
From Jan 2006	correl allowed and actual	0.78	0.99	0.96	0.94	0.92	0.90
	Av error	-0.01	-0.02	-0.03	-0.05	-0.05	-0.06
	std error	0.89	0.21	0.39	0.51	0.58	0.64
From Jan 2010	correl allowed and actual	0.75	0.97	0.91	0.86	0.82	0.78
	Av error	-0.29	-0.03	-0.07	-0.12	-0.16	-0.20
	std error	0.51	0.20	0.32	0.40	0.45	0.50

Source: DBP analysis

4.87 Over the whole time period, there is no real difference between the two approaches, both give an allowed return on debt slightly greater than the actual return on debt in a given month, but the errors of each are not statistically significantly different from zero. In the period since the global financial crisis, the ERA's model shows no statistically significant difference between allowed and actual debt costs for the first two periods after a decision (when the information is freshest), but it over-rewards after that date; as does the AER's mechanism. The difference in degree of over-rewarding, however, is relatively small in both cases.

DBP's approach to updating the return on debt

4.88 Based on the discussion above, and particularly absent of any new evidence on how the ERA proposes to treat the premium issue, it is more practicable and prudent to adopt the AER's proposed annual updating approach.[40] That approach preserves marginal investment incentives at least as well as the ERA's proposal, is not subject to practical implementation issues and it is more likely to meet the requirements of the ARORO, NGO and RPP because it is closer to a replication of the debt financing practices that are actually implemented by efficient firms. In so doing, we propose to implement the same transition process that the AER proposes, over the next ten years.

4.89 DBP proposes one minor adjustment to the AER's proposed approach, to deal with new investment. This is not an issue which the AER addresses in the AER Guidelines, but it is an important one. Say, for example, an asset is worth $1 billion (in debt) now. This would mean ten tranches of $100 million debt, spread over the last ten years, and updating, one per year, over the next five years, and indeed, into perpetuity. Say new investment occurs in year three of this access arrangement period, and this is worth $500 million (in debt). The AER Guidelines are unclear when the adjustment to the trailing average will occur or exactly how it will occur, but at either the point in time of investment or at the next regulatory reset, one will have a $1.5 billion investment, with ten tranches of $150 million that will then roll forward.

4.90 Now assume that the interest rate now is seven per cent, and it has been thus for some time (for the sake of simplicity), but it changes to four per cent during the year when the new investment occurs. If this new asset is then treated as ten tranches of $150 million debt, projecting back ten

[40] *Several service providers have included in their recently revised pricing proposals submitted to the AER (under the NGR and the National Electricity Rules) a trailing average approach to varying the cost of debt during an AA period that varies from that version of the trailing average approach outlined by the AER in its Guidelines. At this stage, it is not apparent to DBP which of these variations of the trailing average approach best contributes to the achievement of the ARORO. To the extent that further guidance is given on which variation does best contribute towards the achievement of the ARORO during the ERA's assessment of DBP's proposed revised access arrangement, DBP would encourage the ERA to consider this guidance and, before the ERA issues its final decision:*

- *provide stakeholders with an opportunity to comment on this further guidance; and*
- *provide DBP with the opportunity to submit revisions on this aspect of the proposed revised access arrangement*.

years from either the point of investment or the start of the next access arrangement period, then clearly there will be several years where $50 million in debt which was incurred at four per cent is instead being rewarded at seven per cent. Such an outcome would send a perverse signal to investors, for what it does is incentivise investment at times when interest rates are low and high interest rates can be picked up through the trailing average, whilst dis-incentivising investment when interest rates are high, and the converse effect is seen.

4.91 To counter this effect, DBP proposes exactly the same transition period for new investment as is proposed by the AER for the existing asset base. That is the full current cost for the first year, one tenth of the new cost and nine tenths of the first year cost in the second year, one tenth, one tenth and eight tenths in the third year and so on. This removes the perverse incentives associated with an update which automatically changes the asset value and develops a new set of backwards-looking tranches of debt discussed above, and ensures that large investments, as well as those that are marginal, face the current cost of investing at all times.

4.92 Obviously such a transition period for every small addition to the capital base would quickly result in a very complex set of weights and prove unworkable. However, since the AER's approach updates the return on debt for one-tenth of the asset base every year, this forms a sensible cut-off for consideration, with additions smaller than this not treated as new stand-alone assets, and those above this level so treated. This is something that would be appropriate for discussion with the ERA, and indeed DBP would envisage that the investment plan, and how it would transition into the trailing average approach, would be discussed with the regulator at the start of each access arrangement period. As the system matures, it may be appropriate to simplify the weighting for some older assets and amalgamate them where doing so would not adversely affect efficient pricing.

4.93 DBP has developed a simple Excel spreadsheet model calculator (see Appendix J) which requires as inputs only the opening capital base (in 2016), the new capital spend each year after 2015 that exceeds the threshold noted above and the weighted average asset life for each new capital spend. It then sets out the trailing average for the opening capital base and each subsequent major capital spend, and weights the trailing average figure in each year by the value of relevant asset (opening capital base or new capital project *i*), as these assets depreciate through time.[41]

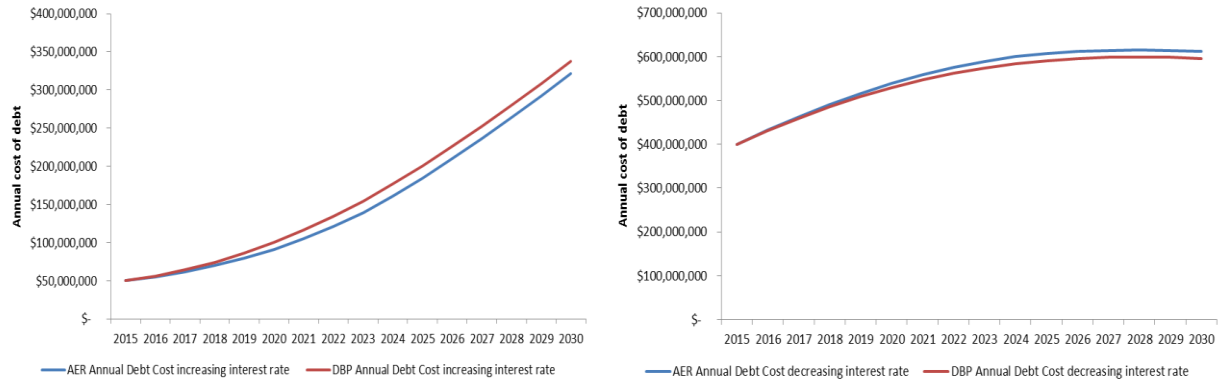
4.94 The model is very simple, and is only a slight departure from the AER approach, depending upon the size of the cut-off point for new capital spend to be entered as a discrete line item. The formula which underpins it is as shown in the AER's Guidelines (p20), and the same formula is applied to the opening capital and each new capital spend. The spreadsheet is set up to run from 2016 to 2050, but can easily be extended and adapted as needs be.

4.95 By way of an example of how the model works compared to the AER's approach, consider the case of an asset of $1 billion initially, which adds $100 million in new capital spend every year. Under the AER approach, if the asset value is updated every year, and the new asset value "cast backwards through time", one might have $100 million allocated to 2015 now, and $110 million allocated to it after a capital spend in 2016. This will obviously make a difference if the interest rate differs from year to year, as noted above.

4.96 In the example, the assets all depreciate over 60 years, and we assume two cases; where interest rates start at 5 per cent per annum in 2015 and increase by one per centage point per annum to 2050 when they reach 40 per cent, and a second case where they star at 40 per cent and decline to five per cent. These are clearly highly contrived examples. The results are shown in Figure 5.

[41] *The model works on real values, not nominal values, to avoid the complication of inflation. This should make no difference, because the relevant comparison being made is across all assets in a given year, and all assets are affected by inflation to the same degree.*

Figure 5: Example highlighting differences between DBP and AER updating approaches



Source: DBP analysis

4.97 There is clearly very little difference between the two approaches year on year, even with very large capital spend relative to the asset base each year and very large changes in interest rates. As expected, the DBP approach results in lower prices as interest rates are falling, and the AER approach results in lower prices when they are rising. However, the key point from an efficiency perspective is that each new investment only faces the interest rates current at the time of the investment and into the future, and does not have the potential to "reach back" into the past, which may lead to perverse investment incentives.

Conclusion

4.98 In respect to the return on debt, DBP draws the following conclusions:

(a) The ERA's process by which bonds are chosen for inclusion into the analysis is perhaps a little restrictive (in not allowing short-period bonds) but is otherwise sound, and we follow it.

(b) The ERA's approach to modelling the return on debt at the outset of the period using Gaussian Normal and Nelson-Seigel models (and their derivatives) is also sound (though there is a need to correct for effective tenor in the Gaussian normal approach) and we follow this approach.

(c) The ERA's approach to building up the return on debt is not sound for two reasons.

(i) Firstly, it uses a five-year risk-free rate, which we argue in Chapter Three is inappropriate, and requires the inclusion of the cost of swapping from ten to five-year risk-free debt which we do not require because we use the ten-year risk-free rate; and

(ii) Secondly the ERA does not include the full cost of raising debt as per NGR 87(10), and we thus include a new issue premium of 27 basis points.

(d) The ERA's approach to updating the return on debt through the regulatory period is fundamentally unsound, and likely to result in substantial practical implementation issues. We therefore follow the AER's trailing average approach, with a slight modification whereby a transition mechanism for major new capital spending is introduced to avoid the potential for perverse investment incentives.

5. RETURN ON EQUITY

5.1 This chapter describes our approach to the estimation of the return on equity, and describes the analysis undertaken to establish a return on equity. We have endeavoured to apply the ERA's five-stage process outlined in the Guidelines[42] to the extent that it is, in DBP's assessment, consistent with a proper application of the NGL and the NGR.

5.2 This chapter is divided into three components and a conclusion. These components are:

(a) a discussion of principles and how we propose to follow the five stages of the ERA's process for estimating the return on equity. In this section, there is a particular focus on our key departures from the Guidelines, including a "model adequacy test" which serves to highlight more clearly the different roles that different models of the return on equity ought to play;

(b) a discussion of the data used in the implementation of our model adequacy test, as applied to each of the relevant models we assess. This is part of the relevant data that we use in our assessment; and

(c) a discussion of our calculation of the return on equity, and tests of the parameters of the relevant models we use (Stages Two and Three of the ERA's five-stage process).

5.3 The chapter does not conclude with a final estimate of the return on equity. Rather, it ends at Stage Three of the ERA's five-stage process. This is because of the nature of the cross checks we have used in Stage Four of the ERA's five-stage process.

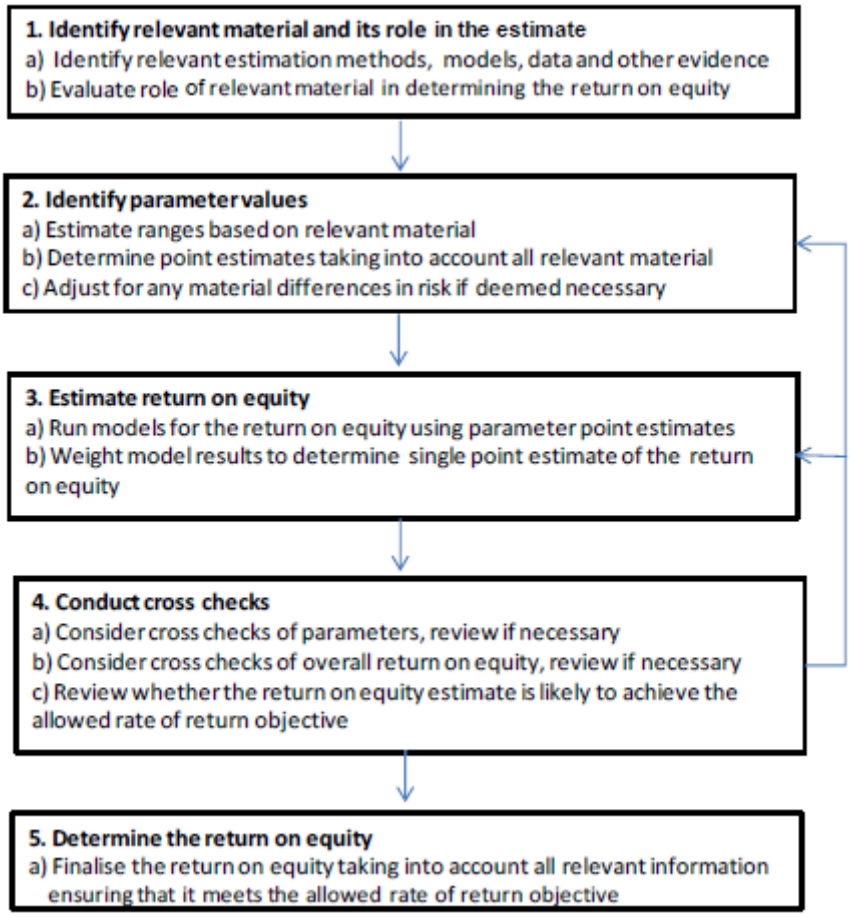
5.4 Cross checks play a greater role in our approach than is the case in the Guidelines; the ERA appears to have reservations in its Guidelines concerning the cross checks it proposes and even in the ATCO Draft Decision, it used them sparingly, with a focus only on elements of the SL-CAPM, rather than the overall return on equity. We give cross checks a more important role, and we flesh out a key cross-check which the ERA identified as a potential check in its Guidelines but did not explain how it might work. This is a cross check involving consideration of the premia for risky debt and risky equity, which also serves to address the requirement in the NGR for consistency between debt and equity.[43] Since this consistency test requires consideration of options pricing theory, which has not been widely used by Australian regulators in the past, we devote a separate chapter to cross checks and this consistency test, and thus undertake Stages Four and Five of the ERA's process in Chapter 6.

Principles and theory

5.5 In formulating its approach to the return on equity, DBP has considered the ERA's five stage process, as set out in the Guidelines, and in Figure 6 below. This section provides an overview of these considerations, and a description of how DBP follows the five stages of the ERA's Guidelines. It is followed by a section discussing the data used in the assessment and model estimation process, and a section whereby we implement the first three stages of the ERA's five-stage process.

[42] *See Figure 6 for the ERA's five stage approach*
[43] *See NGR 87(5)(b) & 87(11)(b)*

Figure 6: ERA's five stage process for assessing the return on equity.



Source: ERA Guidelines, p23

5.6 Before we begin our assessment of each of the stages in the process, it is useful to point out a problem that we perceive in the logical flow of the process in Figure 6.

5.7 NGR 87(5)(a) of the NGR provides that, in determining the allowed rate of return, regard must be had, amongst other things, to relevant estimation methods, financial models, market data and other evidence.

5.8 It is accordingly mandatory for the ERA to have regard to financial models that are relevant to the exercise of determining the allowed rate of return.

5.9 A relevant consideration is one that sufficiently closely touches a matter that it is a proper thing to be taken into consideration.

5.10 It is important to determine, at the beginning of the analysis, what financial models are relevant to the exercise of determining the allowed rate of return. That is because it is well-established that a decision-maker's failure to take into account a relevant consideration that it is bound to take into account may constitute a reviewable error. [44]

[44] *See, in particular, the leading per cent of Mason J in Minister for Aboriginal Affairs v Peko-Wallsend Ltd (1986) 162 CLR 24 at 39–41*

5.11 It is apparent from the AEMC Rule Change Determination that the AEMC prefers an approach under which multiple methods and 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.*[45]

5.12 Similarly, at section 6.2.4, in the final paragraph on page 48, the AEMC says:

> *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.*[46]

5.13 The ERA's currently preferred position is to have regard only to the SL-CAPM after Stage One. The ERA has stated that it considers that only the SL-CAPM is relevant at the current time (Guidelines, paragraph113). That position sits uneasily with the AEMC's Rule Change Determination. That instrument constitutes Rule extrinsic materials within the meaning of Schedule 2, clause 8(1) of the NGL, and properly informs the construction of the NGL and the NGR in the circumstances identified in Schedule 2, clause 8(3) NGL (see s 20 NGL). Irrespective of what might be said about the SL-CAPM, we consider that the ERA has too readily identified other models as "not relevant". The difficulty of relying solely upon the SL-CAPM is aggravated in the current circumstances.

5.14 Evidence we have collected suggests that the Sharpe-Lintner CAPM, as implemented by the ERA, is statistically downward biased. This is a consequence of an acknowledged problem within the model that creates a downward statistical bias for stocks or portfolios with a beta of less than one. The ERA itself acknowledges this downward bias in the Guidelines[47].

5.15 In light of this downward statistical bias, it is necessary for the ERA to take steps to correct this bias. It is not sufficient for the ERA to exercise its judgment to apply an outcome at the higher end of its preferred model when it has conducted no adequate analysis to determine whether such an application would be sufficient to deal with the acknowledged downward bias of the preferred model, and particularly where analysis by DBP positively demonstrates that the ERA's approach does not correct for the bias. A proper means to address the bias appears, from the work undertaken by DBP, to require taking into consideration other relevant estimation methods and financial models.

5.16 The problems associated with the application of the SL-CAPM (whether as implemented by the ERA or as that model as traditionally been implemented) suggest that other models have been rejected too quickly by the ERA. If there were a single model that did not exhibit statistical downward bias or some other flaw, then perhaps other biased or otherwise flawed models could, arguably, be rendered irrelevant. But where all models have some flaws, then it is much more difficult to reject all but one of those models.

5.17 Accordingly, unless other financial models can be demonstrated as being plainly irrelevant to determining the allowed rate of return, it will be necessary (in any event and in particular in the current context) to include them in the staged analysis the Guidelines contemplate.

5.18 There are two means by which that might be done.

5.19 First, all potentially relevant financial models (that is, any model that cannot be relatively easily dismissed as being of no assistance whatsoever) could be included at Stage One, and worked

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[45] *See further the statement at the beginning of paragraph 2 at page xi in this respect.*

[46] *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.*

[47] *Guidelines, paragraph 141*

through a process of analysis contemplated by the AEMC which assesses their relevance against the ARORO.

5.20 Secondly, an alternative course would be to adopt the SL-CAPM as the foundation of the analysis and ascertain whether, as applied to a benchmark efficient entity with a similar degree of risk to that which applies to DBP in relation to the provision of the reference services, that achieves the allowed rate of return objective as required by NGR 87(2). In seeking then to apply that model, some adjustments would be required to seek to deal with the deficiencies that are shown to exist. Those adjustments may involve drawing upon other models.

5.21 The advantage of the first approach is that it most closely reflects the requirements of NGR 87. The advantage of the second approach is that (at least superficially) it involves least departure from the Guidelines. That may be superficial if the adjustments undertaken to the SL-CAPM are tantamount to replacing that model with another. As a matter of substance, the two approaches may really be doing the same thing.

5.22 We have adopted the first of these two approaches. That is, while we have maintained and adhered to the five stages in the ERA's process as set out in the Guidelines, we approach Stage One by applying a detailed consideration of the relevance and adequacy of the main models commonly considered for the purposes of estimating return on equity. This is a significant departure from the ERA's approach to Stage One of adopting a purely theoretical assessment of the relevance and adequacy of models and as a result, rejecting all models other than the SL-CAPM and to thereafter reduce the analysis to the inputs within that model.

5.23 DBP also proposes minor departures at Stages Two and Three, and at Stage Four, to use cross checks to a greater extent than is proposed in the Guidelines, including the operationalization of one of the cross checks identified by the ERA in the Guidelines (but for which no methodology was outlined).

Stage One - Identify relevant material and the role of that material

5.24 In this section, we discuss how we approach Stage One in the ERA's five-stage process. As set out above (see Figure 6), the first stage of the ERA's process is to identify the material relevant to the analysis, including the "relevant estimation methods [and] financial models" and so on referred to within NGR 87(5)(a); and the role of that material in each of the stages of analysis of the appropriate rate of return on equity. It also involves an assessment of relevant data. Paragraphs 5.87 to 5.110 below outline the data we propose to use as part of our model adequacy test. This constitutes new data not previously considered by the ERA. The remainder of this section discusses the relevance of models.

5.25 It is first necessary to give content to the notion of "relevance" within NGR 87(5). Something is relevant if it sufficiently closely touches a matter that it is a proper thing to be taken into consideration.[48] In the context of determining the allowed rate of return, the notion of relevance must be informed and guided by the statutory framework and the purposes it seeks to achieve.

5.26 A financial model will be of utility in the exercise of directly estimating the return on equity in Stages Two and Three, if the following criteria can be met:

(a) the 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 direct application of the model is demonstrably capable of contributing to the achievement of the ARORO and is consistent with the key principles and objectives which

[48] *See paragraph 5.9*

govern the process - the RPPs and the 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.

5.27 Where both of these conditions are met, the application of the model can lead to the outcomes being best estimates arrived at on a reasonable basis (and therefore compliant with NGR 74(2)). This means such a model should be used to estimate the rate of return in Stages Two and Three of the ERA's five-stage process.

5.28 If only the first of the two criteria are met, while the model may still be relevant, its role should be confined to performing a cross check of the outcome of models that pass both criteria above, which is done in Stage Four of the ERA's process.

5.29 This approach adopts a similar logic to that used by the ERA. In the Guidelines, the ERA concludes that "relevance" of a model is determined by the following criteria (Guidelines, paragraph 37):

(a) the model is driven by economic principles – based on a strong theoretical foundation, informed by empirical analysis;

(b) the model is fit for purpose;

(c) the model is supported by robust, transparent and replicable analysis that is derived from available, credible datasets;

(d) the model is capable of reflecting changes in market conditions and able to incorporate new information as it becomes available; and

(e) the model is supportive of specific regulatory aims.

5.30 Our main point of departure from the ERA in deciding the relevant models to be used in Stages Two and Three is not in respect of the logic of our approach, but rather in the rigour of the criteria adopted to assess "relevance" and the role of relevant models in the estimation process.

5.31 In relation to the first of our criteria, we note that the ERA has also identified it as one of its criteria of relevance – ie it is a model that has a strong theoretical foundation.

5.32 However, the second of our criteria – which involves an empirical assessment of models and their outputs is not expressly identified in any of the ERA's criteria outlined in paragraph 37 of the Guidelines; although it may be captured in some extent in points (b), (c) and (d). To the extent that these criteria involve an empirical assessment of the validity of the outcomes produced by a model being undertaken, we have not seen any evidence of the ERA undertaking this task in the Guidelines (or in the ATCO Draft Decision for that matter).

5.33 We believe that this criterion is critical for assessing the role that each relevant model will have in Stages Two and Three for a number of reasons.

5.34 Firstly, a model must not only be good in theory, but it must have sound predictive capability. This will give investors confidence that the outcomes are capable of being achieved in practice.

5.35 The best way of assessing whether a model has sound predictive capability is best done by using historical data statistically to test the predictive capacity of models. Investors seeking returns are concerned primarily with results, not theory. It is inconceivable that market players would continue to use models that they knew to be consistently incorrect. Service providers earn a real, not a theoretical, return and if this return is to accurately reflect the efficient cost of financing in the marketplace, then the models which are used to calculate that return must show that they are capable of meeting this benchmark in the real world.

5.36 In the development of the Guidelines, the ERA has undertaken a theoretical assessment of different asset pricing models in Stage One of its process (See Explanatory Statement, Appendix 8) and concluded that only the SL-CAPM meets its standards. That effectively puts an end to the possibility of any meaningful consideration, let alone application, of other models, methods, market

data or other evidence, other than to the very limited extent that a narrow selection of material may influence the inputs into SL-CAPM.

5.37 The second reason for why the second of our criteria is necessary in determining a model's relevance is because if it is not adopted and the ERA's approach followed, then the rejection of all other models at this Stage of the process is inconsistent with the requirements of the NGL and the NGR. In reaching this view, the ERA has not undertaken any empirical testing of the adequacy of each of the asset pricing models in light of the ARORO. Although it has examined the accuracy with which certain parameters in certain models have been estimated, it has not assessed whether the models themselves give acceptable results overall, despite acknowledging that the model which it uses exclusively, the SL-CAPM, exhibits a downward bias empirically (Guidelines, paragraph 141). We examine an empirical test of model relevance in paragraphs 5.50 to 5.63 below.

5.38 We now turn to a more detailed discussion of our two criteria for model relevance from paragraph 5.26.

A model's relevance - theory and principle – first criterion

5.39 The first component of a test of relevance in paragraph 5.26 is its theoretical support. The ERA undertakes an assessment of the various different asset pricing models in Appendix 8 of the Explanatory Statement. We have reservations with the degree of balance in the assessment process, whereby models other than the SL-CAPM are held to a higher standard than the SL-CAPM itself. Furthermore, the assessment process appears designed to assess whether the ERA should move away from its favoured position of using the SL-CAPM, rather than assessing which models meet the ARORO. SFG (2104a,c,d) outline these concerns in detail and we would reiterate the suggestion made in these reports that the ERA needs to adopt a more balanced assessment of different asset pricing models.

5.40 We have considered a number of financial models to assess whether they are relevant in theory and principle. The models considered are:

(a) Various forms of the SL-CAPM

(b) The Black CAPM

(c) The Fama-French model

(d) The Dividend Growth Model

5.41 The Dividend Growth Model would appear to be a sound theoretical model. In this regard, we note the conclusions of SFG (2014a,c,d) that the model does have sufficient principled basis to be used to establish the return on equity. Indeed, an argument might be made for its greater relevance compared to other models precisely because Australia is a small, open economy where investors regularly hold diverse portfolios of foreign assets, meaning that asset pricing models which rely upon measures of risk relative to a domestic stock market (such as the SL-CAPM, Black CAPM and Fama-French model) arguably do not reflect the reality of the market portfolio faced by domestic investors. This is an important issue for consideration in future Guidelines.

5.42 However, at this point in time, due to difficulties in obtaining a long enough time series of relevant variables, it is difficult to conclude that it meets the second of our criteria and therefore to subject it to our model adequacy test.

5.43 For the purposes of this submission, DBP has asked CEG to undertake a focussed review of the ERA's conclusions in respect of the Black CAPM and Fama-French Model, on the basis of principle and evidence in the literature, to understand whether the ERA was correct to reject both of these models at the first stage of its five stage process, and effectively ignore all relevant information they might provide about the return on equity. We did not ask CEG to examine whether the SL-CAPM is relevant from a principled perspective, as there is substantial evidence that it is, and we are not seeking to challenge this conclusion made by the ERA. This analysis is provided in Appendix C. In respect of the Black CAPM, CEG find that the ERA accept the notion of a downward bias in the

empirical estimates of beta made for low beta stocks using the SL-CAPM, and accept that the Black CAPM model may provide information about this bias. However, the ERA rejects any empirical estimation of the Black CAPM on the basis of the precision of estimates of the zero-beta premium. This rejection is not based on any assessment of the wider literature, but on an assessment of a handful of reports by NERA which, as CEG points out, the ERA appears to have misinterpreted.

5.44 Rejecting a model without consideration of the wide range of evidence available in the academic literature is, CEG concludes, incorrect, and that a proper consideration of almost 50 years of literature on this topic (including a series of papers which the ERA has cited as supporting the SL-CAPM, but which actually provide evidence for the Black-CAPM) would find that the ERA's concerns about the existence of a zero-beta premium has in fact been long settled.[49] For these reasons, CEG concludes that there is no valid reason not to include the Black CAPM amongst the set of models which are likely, in principle, to provide relevant information.

5.45 In respect of the Fama-French model, CEG examines the ERA's claim that the Fama-French model is based upon empirical and not theoretical grounds and finds that this a wholly unscientific approach to assessing models; the basic premise of science is that theories are made and then tested with evidence which, if they fail, results in their being refined or discarded. Rejecting models which have a solid empirical basis on the basis that their theory is not well-established (a point which is not, in fact, true in respect of the Fama-French model, see SFG 2014e) runs exactly opposite to the usual process of scientific endeavour.

5.46 The ERA also reject the Fama-French model on the basis of its own empirical test of the model. However, as CEG point out, this test is flawed as it is based on only five years of data; a data series so short as to be totally unprecedented in the academic literature on the subject. In so doing, the ERA ignores evidence, both from Australia and overseas, which finds much stronger support for the Fama-French model using a data-series of appropriate length.

5.47 The ERA's rejection of the Fama-French model as being a relevant model on the grounds that it does not explain returns on the Australian stock market based upon its own study, CEG points out, highlights a salient point; the ERA has conducted no similar study for the SL-CAPM or the Black CAPM. If it is to be assessing all models on an even basis, then it must conduct such a study. This is in fact precisely what we do in respect of our model adequacy test below. In an appendix to CEG's report, CEG note that Professor Bruce Grundy has examined a wide range of studies which examine the SL-CAPM in respect of its ability to explain stock market returns, and has found no study which, having examined the question empirically, has failed to reject the SL-CAPM. This is evidence which should have been considered by the ERA, but which appears to have been overlooked in the ERA's review of the relevant models.

5.48 The overall conclusion CEG draws is that the Black CAPM and Fama French model are both relevant models from at least a theoretical and principled basis , and should be considered to provide relevant information, but that existing empirical work suggests that empirical estimations of the SL-CAPM are unlikely to provide relevant information. This ought to be a key consideration for the ERA, and suggests that reliance on a model which has theoretical support, buttressed by an ad-hoc adjustment to beta to address known problems of bias without ever testing the efficacy of this adjustment is unlikely to provide estimates of the return on equity which can be shown to meet the ARORO. DBP has used this conclusion as the basis of its work below.

5.49 Having discussed our consideration of models which can be considered to meet the first criterion from paragraph 5.26, we now turn to a discussion of how we approach the second criterion. Note that we do not reach a conclusion about which models meet this criterion in this section; that discussion starts at paragraph 5.114.

[49] *This, as CEG points out, is the reason why the ERA has been unable to find Australian evidence published in a quality journal; academics are not rewarded for addressing questions that have already been settled, if their only contribution is to reconfirm something which is already well-known in the literature.*

A model's role - the model adequacy test – second criterion

5.50 The second of our criteria from paragraph 5.26 is one of empirical relevance associated with model outputs. The ERA has no overall test of whether the model it favours meets the ARORO. It has cross checks at Stage Four of its process, but it uses these only as tests of the values of certain parameters of models (see ATCO Draft Decision, paragraphs 762 to 816). For the most part, these cross-checks involve either:

(a) testing whether the ERA has estimated a particular parameter in a technically correct manner (such as its assessment of its beta estimates against the work of Henry (2014) - see ATCO Draft Decision, paragraph 807 to 816); or

(b) testing whether its views on a particular parameter match the opinions of other stakeholders, such as its assessment of the market risk premium and the consideration (see ATCO Draft Decision paragraphs 786 to 797) of the views of the stockbrokers Grant Samuel and other regulatory opinions.

5.51 However, it does not conduct any overall, empirically based, evaluation of models, to see how they actually perform compared to real data. This is a crucial component in determining the relevance and application of any model and is something that needs to be undertaken separately from any other cross-checking exercise.

5.52 Accordingly, we have developed a step in the process (the model adequacy test) which involves taking each of the models that are relevant as a matter of theory and principle (i.e., SL-CAPM, the Black CAPM, and the Fama-French model as outlined above), using them to forecast different points in time in the past, and comparing those forecasts to actual data. A model which, statistically, is shown not to be reliable in predicting actual outcomes (using historical data) seems unlikely to be appropriate as the sole relevant model going forward. This forms part of Stage One of the ERA's process, to assist in determining which models ought to be used in Stages Two and Three, and which ought to be limited to a cross-check role in Stage Four (or no role at all).

5.53 Our approach is not novel. Using historical data to test the predictions of models or hypotheses is standard practice in economics and other social sciences where experiments are generally not possible and such an approach is clearly contemplated by the ARORO test (see discussion in paragraphs 2.18 and 2.26). It is not novel in the context of regulation, but is rather based on precedent developed by the ERA itself. In the Western Power decision process (see ERA 2012, Appendix 9), an hypothesis was developed by the service provider that a longer averaging period would provide a better result. Rather than rely upon opinion about this hypothesis, the ERA tested it by using Diebold Mariano (1995) tests. Whilst we do not agree entirely with the way these tests were implemented in a technical sense, and the interpretation of their results for the return on debt (see Box 2), we believe the ERA's response to this hypothesis advanced by a service provider was entirely correct; treat a model as an hypothesis and test it. This is exactly what we propose to do here for the return on equity.

5.54 We now turn to a more detailed description of our model adequacy test, and how it works.

Model adequacy test

5.55 As outlined in Chapter 2 of this submission, section 24(2) of the NGL deploys a floor, as opposed to a ceiling, when speaking of efficient costs, in stating that 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. This concept of efficiency has been further enforced in the form of the ARORO with the requirement that the return "must be commensurate with the efficient financing costs of a benchmark efficient entity".

5.56 The ERA, and indeed the AER, has interpreted both of these requirements via an NPV=0 requirement. The ERA summarises this requirement as follows in Appendix 2 (paragraph 3) of the Explanatory Statement:

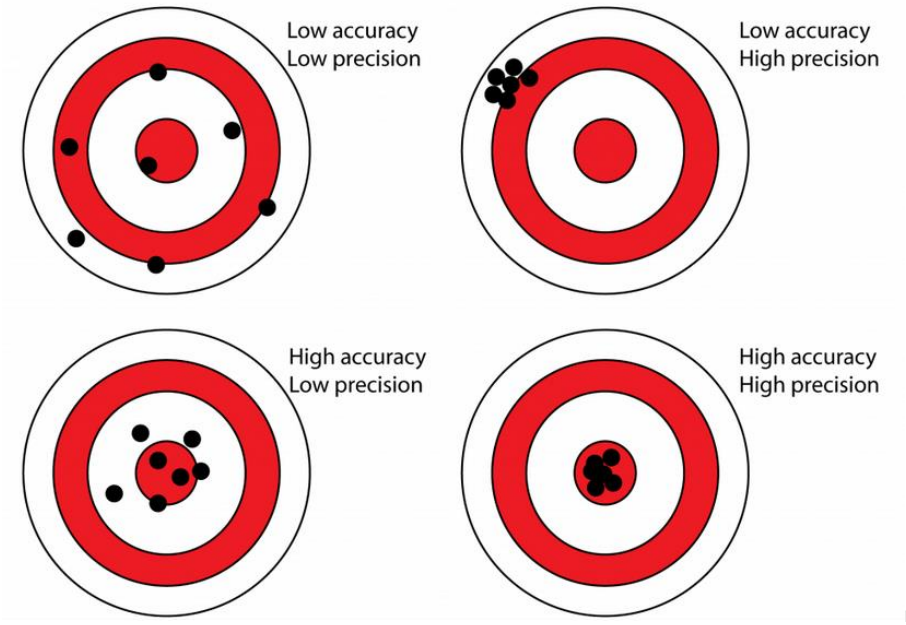
> *"However, the Authority considers NPV=0 as being the efficient condition, consistent with section 24(3) of the National Gas Law (NGL), which states that 'a service provider should be provided with effective incentives in order to promote economic efficiency'. The 'greater than or equal to' condition (which DBP had suggested in a submission to the Guidelines process) would then be consistent with NGL 24(2), which states that the service provider should be provided with 'a reasonable opportunity to recover at least the efficient costs' it incurs. In what follows, the Authority considers the efficient condition as the boundary, but accepts that it is a bound 'from below'."*

5.57 We agree with the ERA's notion of an NPV=0 criteria as expressed above, and how the ERA has linked it to the NGL and NGR.[50] Moreover, it also has a particular meaning in statistics which lends itself to a test which may be linked directly to the NPV=0 condition, and thence the ARORO and RPP.

5.58 The main purpose of using an asset pricing model, particularly in a regulatory context, lies in the ability of that model to predict the expected return on equity for the coming access period. An important question to ask, and indeed the question the ERA itself asked when using its Diebold Mariano tests is how well a model makes predictions about the required rate of return. The degree to which a prediction is "good" or "bad" could be a matter of precision; how close it gets to the "true" answer, and this is the basic premise behind the Diebold Mariano test.

5.59 However, a more appropriate focus is arguably statistical bias, or accuracy. The basic notion is highlighted in Figure 7.

Figure 7: Bias and precision



re

Source: Appendix C

5.60 A model result in the top-right corner which has high precision but low accuracy (that is, it is biased) may appear to be a good outcome if only the model inputs are examined, but it clearly is not when one looks at the outputs of the model (how far it is from the bullseye). From the perspective of the ARORO, a precise but biased answer means that a firm will be systematically over or under-compensated in respect of the efficient costs of finance relevant to the risks inherent in the reference service; it will not meet the ERA's NPV=0 criteria. Ideally, one would like to be in

[50] *Our model adequacy test goes further, and is in fact symmetric in that it punishes positive bias in exactly the same way as it does negative bias.*

the bottom-right corner,[51] but model results in the bottom left-corner are preferred to those in the top right because, even if each individual shot is imprecise, over the long-term, the unders and overs are evened out, and firm is compensated, on average, for the efficient costs of meeting the risks associated with the provision of reference services. For these reasons, our model adequacy test focuses primarily on bias.

5.61 The recent Jemena Draft Decision and the comments by McKenzie and Partington (2014, p14) on bias, arise in the context of the estimation of beta. Specifically, the paper cited by Henry (2008, p 12) examines whether the Vasicek and Blume adjustments are valid by assessing whether one estimate of beta in a series of rolling window estimates is followed by an estimate of beta that is closer to one. This is, of course, totally different to the notion of bias discussed here; here we are referring to whether or not a particular asset-pricing model systematically under or over-predicts relative to subsequent returns, and not whether a particular parameter in a particular asset pricing model moves in a particular way. Henry does not check the bias of the model predictions against subsequent actual returns; in either his 2008 paper or its 2014 update.

5.62 Our model adequacy test therefore proceeds as follows:

(a) first we take a financial model and parameterise it using data up to a point in time.

(b) then we use it to make a prediction on future returns.

(c) then we compare predicted with actual returns and record any error.

(d) having done that, we compare the errors over many periods and many different portfolios to understand whether they are, on average, zero.

5.63 In applying the models, we assume that the available data are an adequate reflection of the states of the world likely to prevail for investors. If we find that a model has an error – being a difference between predicted and actual outcomes - that is on average statistically different from zero, then that bias is sufficiently great that there is only a one or five per cent likelihood that the model could deliver an unbiased outcome. It is, in this respect, truly a model adequacy test; it does not show which models are best, but rather identifies those financial models which, without material adjustment, could **not** deliver an NPV=0 outcome.

5.64 The statistical tests we use to test for bias are the t-test (for individual portfolios) and the Mincer-Zarnowitz (1969) and Wald test (for a collection of portfolios). These tests are discussed further below.

5.65 "Models" tested in the above approach need not be simply "the SL-CAPM", or "the Black CAPM", but could be combinations of models (say a model which uses these two models with a 60/40 weighting) or particular ways of implementing a model. As an example, we test the SL-CAPM using the 95th per centile of an estimate of the distribution of an ordinary least squares (OLS) estimator for beta rather than an estimate of the mean of the distribution (the OLS point estimate). We use the 95th per centile because this is the way the ERA has implemented the SL-CAPM and it has done so purportedly to remove the downward bias associated with estimates of the return on equity that the SL CAPM produces for low-beta stocks. In what follows, for simplicity, we will label these estimates, “95th per centile estimates of beta”. All that is required is that models be formed in such a way that can be generalised. It is worthwhile noting that, at no point in time do we find a problem, propose a solution and then assert that this solution has solved the relevant problem; every solution becomes a new model, which is tested in exactly the same way.

5.66 Having discussed how we approach Stage One in the ERA’s five-stage process, we now turn to a description of how we approach Stages Two and Three. They are treated together because they are two parts of the one task; estimating the rate of return of particular models (in our approach, those which pass both criteria from paragraph 5.26 in Stage One).

[51] *It may be that our final result is in fact in the bottom right corner, as tests of mean-squared forecast error show no drop in precision for models which pass the model adequacy test compared with the ERA’s favoured version of the SL-CAPM (see Table 14).*

Stages Two and Three - Identifying parameter values and estimating the return on equity

5.67 The five stage process outlined above by the ERA determines point estimate values for each of the parameters for whichever models are to be assessed at Stage Two, uses these to determine a value for the return on equity (or several rates of return) at Stage Three, and then assesses these results at Stage Four. At Stage Four, the parameters and the model results are to be assessed; though in practice, the ERA has only assessed model parameters, both in the Guidelines (see Appendix 29 of the Explanatory Statement to its Guidelines) and in the ATCO Draft Decision.[52] We depart from the Guidelines in Stages Two and Three on this point. In DBP's view it is not appropriate to carry forward only point estimates of parameters in models to the estimation of model results, nor point estimates of model results themselves to the cross checks at Stage Four.

5.68 The ERA motivates this carry-forward of point estimates of parameters on the basis of ease of comparison on the part of stakeholders (Explanatory Statement paragraph 100):

> *"The Authority considers that use of single point estimates for parameters is preferred. Point estimates allow stakeholders to readily compare outcomes with other reference points, for example from other sources."*

5.69 Additionally, both the ERA and AER have noted the AEMC's observation that there is no correct model, hence the need to make use of regulatory judgment making use of a broad range of outcomes, while subject to the need for certainty.

5.70 Although we acknowledge that stakeholders may well wish to compare model results and even model parameters with other information, we can see no reason why ranges would prevent them from doing so.

5.71 However, when point estimates have been adopted for inputs to a model that has been chosen in circumstances where:

(a) the model has known flaws in principle and theory;

(b) there is evidence to indicate that the model is not an accurate predictor of returns on equity in practice,

it is even more important to consider ranges for the value of each parameter to be used in that model.

5.72 In practice, our approach does not depart significantly from what the ERA actually does in its assessment process. The ERA does make use of more than point estimates in many cross checks (albeit, in the values for parameters used in the SL-CAPM), and we would support this approach.

5.73 The need for certainty does not mean locking out information from the process through the use of regulatory judgment, particularly where that exclusion is effected in the early stages of the process. Instead, it is important to keep information "live" through the process, and only exercise judgment at the end, when empirical data are no longer capable of rendering any more precision to the range of estimates that are likely to support the ARORO.

5.74 The process of only bringing point estimates forward to Stages Three and Four of the process is problematic for two key reasons - ignoring information that should not be ignored, and the use of judgment.

5.75 As to the first reason, if point estimates are the only things that are ever subject to scrutiny, then important information is lost, and stakeholders miss the opportunity to make their own judgments about the reasonableness of conclusions. For example, a beta estimate of 0.7 with a 95 per cent confidence interval of 20 basis points either side is very different from an estimate of beta of 0.7 with a 95 per cent confidence interval of 50 basis points either side. The former is quite precise

[52] `*It forms an opinion as to the reasonableness of the overall rate of return, but this is based on its assessment of the individual parameters. It does not assess the overall rate of return itself; in the ATCO Draft Decision, even a test of consistency between debt and equity is missing.*

and likely to be statistically robust whilst the latter is so imprecise that it is not statistically different from one. This is not only problematic from the perspective of whether the beta estimate is robust, but also from the perspective of whether the SL-CAPM should even have been used in the first instance. A beta of one effectively means that one is implementing a naïve model whereby the estimate of the cost of capital for a firm is just that for the market as a whole, and there is no need to add the complexity of the estimation of the SL-CAPM. As such, if the estimate of beta is not statistically significantly different from one, it calls into question the very validity of using the SL-CAPM to estimate the return on equity. This information should not be discarded from the estimation process at an early stage and, to be fair to the ERA, it does provide significant information on the precision of its parameter estimates.

5.76 The second reason why the process of only bringing point estimates forward to Stages 3 and 4 of the process is problematic concerns the use of judgment. For example, the ERA uses a point estimate of 0.7 for beta (the 95th percentile of the confidence interval around beta), even though the mean value for beta in its empirical estimation is roughly 0.5. It justifies this exercise of judgment on the basis of the fact that the SL-CAPM is known to bias downwards the beta of stocks and portfolios with a beta of less than one. While the process of adjusting the beta value, as a matter of principle, does have merit (see below), the exercise of judgment at Stage Two of the process to deliver an outcome which is checked at Stage Four means that the judgment itself is never checked; the ERA never checks whether adjusting the beta value to match the 95th percentile is sufficient to remove the problem of statistical bias in the SL-CAPM that the ERA itself identifies, and thus stakeholders can never know whether it was over or under-compensating.

5.77 In fact, in the Guidelines, the ERA acknowledges that further work is required in this regard.[53] The ERA noted in the Guidelines (at paragraph 141 and see also paragraphs 748 and 859 of the Explanatory Statement), that it intended to undertake more work following the publication of the Guidelines to quantify the extent of this potential bias so it could then inform the degree to which the ERA might adjust up the point estimate of the equity beta within the estimated range, so as to account for the potential beta bias. However, the results of such work are yet to be published by the ERA.

5.78 We acknowledge that finance data has a very low signal to noise ratio and that the data alone will never deliver a point estimate of the overall rate of return for equity. There will always be a need for a regulator to pick a point from a range, and this will always be an issue of regulatory judgment. However, this judgment should be exercised, as far as possible, at the end of the process of assessment. In simple terms, the regulator should allow the data to carry it as far as it is possible to go with the data alone, before a reasonable range is arrived at for the rate of return, and regulatory judgment is used to choose a point (the best estimate) on that range. Using judgment along the way – e.g., the choice of the 95th percentile for beta - means that relevant information is lost and that stakeholders find it difficult to understand how much of the outcome was driven by the actual empirical data, and how much by assumption and judgments made along the way. This makes the process less robust than it needs to be. By contrast, using judgment only at the end of the process makes it clear what the data alone are able to elucidate about the return on equity, and how regulatory judgment arrives at a precise final answer.

5.79 Accordingly, at Stages Two and Three, we form estimates that are ranges, and bring these ranges forward into our assessment at Stage Four. We now turn to a brief description of the cross checks we propose to employ, and note that the more detailed description, and application of these cross checks, occurs in Chapter 6.

Stage Four - cross checks

5.80 In respect of Stage Four in the ERA's five-stage process, we make one departure, and one addition to the Guidelines. The departure involves the assessment of parameter estimates within given models. We believe assessment of parameter estimates in their own right is important, but we consider this more logically fits into Stage Two of the ERA's process where parameter estimates are made in the first instance. This would be particularly important if, at some stage in the future,

[53] *Guidelines, paragraph 141.*

multiple models are estimated at Stage Three, and then weighted to form a final estimate of the return on equity which is tested at the ERA's Stage Four, because it may be difficult to ascertain at Stage Four whether it is parameter estimates or models which cause problems in the cross check stage if the models have been amalgamated into some kind of weighted average.

5.81 Thus, we consider checks of parameters as part of the process of Stage Two, and leave assessment of overall model results (and/or other data) to Stage Four. We consider this a minor change because the relevant checks still occur at some stage, and this is the most crucial element.

5.82 In respect of our addition, we begin by noting that the ERA appears less than impressed with most of the cross checks it considers in its Guidelines. The cross checks identified in the Guidelines and the ERA's views on each are summarised in Table 4.[54]

Table 4: Cross checks and the ERA's view on each

Cross Check	Summary of ERA view
Historical return on equity	Relevant for testing overall return on equity (ie -for the market as a whole)
Historical equity risk premium	Has statistical issues
Historical risk free rate	Only most recent rate is relevant (and informs CAPM directly - not a cross check)
Historical return on debt	Potentially useful as a lower bound for the return on equity
Historical beta estimates	Historical data are used to derive estimates of beta (parameter of the CAPM - not a cross check)
Current risk-free rate	See historical risk-free rate above
Current return on debt	See historical return on debt above
Survey evidence - broker reports	Can be used cautiously - subject to problems
Implied volatility	VIX measures may be useful, but only contain forward information for at most 12 months ahead.
Term structure variables	Can be used in some circumstances pertaining to overall economy risk
Credit metrics	Captured in the default spread within term structure variables
Other regulatory decisions	Should be made on merit, cognizant of underlying differences in assumptions
Relationship between the return on equity and debt	Information from these spreads is relevant, but the ERA has not found a way to be definitive about the difference between the two returns, except to note that they will not be constant.
Trading multiples and asset sales information	May provide information of a trend in access decisions, but only a rough guide.
Dividend yields	Could be relevant for selecting a point in a range if trends are appropriately taken into consideration.

Source: Explanatory Statement Appendix 29

5.83 Some of the checks listed in Table 4 are not cross checks per se, but rather are directly relevant only to inputs to the SL-CAPM. The ERA's main concern in Appendix 29 of the Explanatory Statement to the Guidelines appears to be the statistical properties of these variables; chiefly their stationarity (which does assist in understanding whether values from the past might be relevant for the future).

5.84 In respect of trading multiples, the ERA notes that it would be "remiss to attribute too much precision to the results" (Explanatory Statement Appendix 29 paragraph 75), and it believes that asset sales information provide only a "rough guide as to reasonableness" (ibid paragraph 77). We agree with both sentiments.

5.85 Most of the remainder pertain to parameters (several have subsequently been used to assess the MRP, for example - see below) or to the economy at large, not the overall return on equity for a

[54] *Where relevant, we have provided our own comments in parentheses.*

given firm. Only trading multiples, asset sales information and information from debt appear to pertain to the return on equity of a particular firm. It is interesting to note that the ERA has included the relationship between equity and debt, but has not reached any firm conclusions about how this might be adequately examined. We do reach firm conclusions about how this check should be implemented in practice, and have devoted part of Chapter 6 to describing our conclusions about how the premium on risky debt can be used to check model results for the premium on risky equity, and vice versa.

5.86 Having considered these issues associated with departures from the Guidelines, we now turn to implementation of our approach, starting with the additional data we use when performing our model adequacy test, and a discussion of the mechanics of applying the test. We then work through the ERA's five-stage process; or at least its first three stages, the final two stages being addressed in Chapter 6.

Data and portfolio formation

5.87 In order to implement our model adequacy test, we need data to use as our test case. The Guidelines do not specify which source of data the ERA has determined to be appropriate, beyond noting that it will use data from Australian corporate entities (Guidelines, paragraph 138), but it makes use primarily of data from Bloomberg when conducting its own empirical estimation of the various different components of the return on equity (and debt). We therefore infer that the ERA has concluded that Bloomberg data are relevant (a judgement with which we would concur) without necessarily proscribing other sources of data.

5.88 For our model adequacy test, we considered data from Bloomberg, but, while we can make use of weekly Bloomberg data to assess the rates of return appropriate going forward from the present time, Bloomberg data are not suitable for our model adequacy tests, because reliable time series go back only around 15 years or so. The issue is not the number of data-points, but rather the range of economic circumstances that are covered by the data. For example, it would not assist very much in understanding whether a model was appropriate or not if one had daily data, but all that data were only from 2008, as this does not represent a wide (or even typical) range of economic circumstances (this is also the same point we have noted about the basis relied on by the ERA to conclude, in the Guidelines, that the Fama French model is not a relevant model). Instead, we use the SPPR database produced by SIRCA. This database, which has monthly data on all stocks in the ASX going back to the early 1970s, and on some stocks several decades further back provides us with a useful, deep time series with which to test models. For this reason, we suggest that data from the SPPR database should also be considered relevant for the purposes of developing an estimate of the return on equity.

5.89 We do not implement our model adequacy test using stocks solely from the energy sector. It would be inappropriate to undertake our test using only such stocks. Quite apart from the massive changes that have affected this sector over 40 years, the more pressing issue is that stock returns (which asset pricing theories model) are driven, at least in part, by regulatory decisions about appropriate rates of returns and revenues.[55] Thus, it would not be appropriate to use only the returns to stocks so affected in order to ascertain what the right regulatory decisions are in terms of rates of returns and allowed revenue. Instead, we make use of a wide variety of sectors of the economy (indeed, the whole SPPR database) most of which are not affected by regulation. We are able to do this because asset pricing models are not sector specific. An asset pricing model used to predict the returns required on mining stocks should work in the same way as one used to predict the returns required on retail stocks, for example. Our approach is not predicated upon using the particular portfolios that we have used.

5.90 We initially examined industry portfolio returns, provided by SIRCA in its SPPR database,[56] but tests using these returns lacked power (see Box 3), and did not allow us to examine the link

[55] *Regulators take a similar approach in respect of asset values, which are similarly affected by regulatory decisions; rather than valuing assets based on the expected flow of revenues to that asset, since the expected flow of revenues is influenced by regulation, regulators use the cost of the assets in the regulatory asset base.*

[56] *The results of this analysis are summarised in Appendix D:*

between required return and levels of systematic risk adequately.[57] As an alternative, therefore, we formed 10 value-weighted portfolios based on past estimates of beta. This involved each year estimating the betas for the largest 500 firms listed on the ASX at the end of the previous year, grouping the stocks into deciles, and then recording the returns to portfolios formed from these deciles, and then record the returns for this portfolio over the coming year. So, for example, we compute beta estimates using data from January 1969 to December 1973 for stocks that are in the top 500 by market capitalisation at the end of December 1973. We allocate these stocks to 10 portfolios on the basis of these estimates and then record the returns to the portfolios for each month of 1974. Next, we compute beta estimates using data from January 1970 to December 1974 for stocks that are in the top 500 by market capitalisation at the end of December 1974, allocate these stocks to 10 portfolios on the basis of the estimates and then record the returns to the portfolios for each month of 1975. And so on. Thus we form portfolios in a way that is similar to the manner in which Black, Jensen and Scholes (1972) and Fama and MacBeth (1973) form portfolios. The approach, and its grounding in the literature, is discussed in Appendix D.

5.91 A brief summary of the beta portfolios is provided in Table 5.

Table 5: Portfolios formed on the basis of past estimates of beta - summary statistics

Portfolio	Average number of stocks per annum	Size in $ billions	Beta	Annualised mean excess return
1	27.5	5.287	0.536	8.278
2	28.0	5.984	0.608	8.641
3	28.5	6.634	0.576	7.947
4	28.3	11.714	0.766	9.617
5	28.3	15.832	0.857	7.982
6	28.7	10.319	0.882	6.583
7	28.3	11.618	0.966	4.461
8	28.3	14.396	1.182	5.213
9	28.4	7.591	1.362	1.474
10	27.9	3.577	1.384	2.765

Source: DBP analysis; see Appendix D for further details. Note that, because the portfolios are formed on past estimates of beta (as per Black, Jensen & Scholes (1972)) the ranking order changes slightly because betas are not stable. Thus, for example, whilst the stocks in Portfolio Three have higher betas than those in Portfolio Two when the portfolios are formed, by the time the betas of the portfolios are calculated, this ordering has on average changed.

5.92 Portfolio One is amongst the highest-earning portfolios, and the portfolios with higher betas have relatively low earnings. This finding is commonplace in the empirical literature, but is not in accordance with the theory of the SL-CAPM. We have examined the portfolios for errors or outliers, but find little evidence that these are driving returns. The basic message from Table 5, which ought to have profound importance for Australian regulatory practice, is that an investor looking for exposure to systematic risk at a level similar to that which affects the BEE (see Table 15 and note that the estimates, like those of the ERA, are around the same as Portfolio One above) who looks at empirical evidence of actual returns rather than a theoretical model, will expect a return much higher than that which the ERA believes is appropriate for energy firms. The outcomes in the ERA's Guidelines and recent ATCO Draft Decision are a clear signal to investors that energy is a poor investment prospect relative to other sectors of the Australian economy subject to similar levels of systematic risk exposure.

[57] *According to the theory of the SL-CAPM, any two stocks (or portfolios) with the same beta will have the same level of systematic risk. It does not matter whether they are from different sectors of the economy or have some other differentiating features; the theory states that their expected returns will be driven solely by covariance with the market portfolio, indexed by beta.*

5.93 Once portfolios are developed, a second point of importance is the forecast period; once a model has been estimated using data up to time t, how long is the period t+1 over which forecasts are made? Our model testing was undertaken using "month ahead" forecasts. That is, all of the data up to month t are used to form a parameter estimate(s) and make a prediction for month t+1, and this is then compared with the actual outcome for month t+1. We are well aware that the ERA does not set rates of return for one month, but for five years, looking to obtain a good estimate of the suitable rate of return for the next five years. One might therefore make a case for comparing the prediction of the model with the average of the subsequent five years of actual data.

5.94 However that is highly problematic. Firstly, even with roughly 40 years of data, by creating five-year averages, the dataset is effectively reduced to only eight unique data points (all the rest overlap, as a five year average formed from next month will have only one different entry than a five year average formed today). This reduces statistical robustness substantially and means that any conclusions from such tests would need to be treated with a great deal of caution. Secondly, from a technical perspective, creating five year averages induces a significant amount of serial correlation that is not present in the raw data. This considerably complicates the empirical analysis.[58] So, like most academic papers that test pricing models, we use monthly data (see, for example, Black, Jensen and Scholes (1972), Fama and MacBeth (1973) and Fama and French (1993)).

5.95 In Appendix D, we show that the pattern of statistical bias for each of the 10 portfolios in the month ahead matches very closely the pattern which exists in the five years ahead. We are thus confident that the monthly tests that we conduct are reflecting accurately what would occur over longer periods, but the tests involve fewer of the considerable complications that the longer-term tests would involve. This is our rationale for using them.

5.96 One final preliminary issue involves the tests we use for bias. We made use of the t-test and for individual portfolios, and the Mincer-Zarnowitz and Wald test for a collection of portfolios. The aggregate tests provide an overall picture of model fitness, whilst the individual portfolio results provide a picture at the level of the BEE, by considering portfolios with a similar level of systematic risk. This assists in understanding how bias might be addressed.

5.97 The t-test is a simple and standard test, widely used in statistics for more than a century to understand how far from a given number the mean of a set of data is. Here, the set of data is the forecast errors, and the null hypothesis is that the mean forecast error is zero. Thus, a statistically significant t-test result is evidence against the null, that is, the forecasts are biased. The formula for the t-test is:

$$\frac{1}{T}\sum_{t=1}^{T}(z_{jt}-\hat{z}_{jt}) \Big/ s\left(\frac{1}{T}\sum_{t=1}^{T}(z_{jt}-\hat{z}_{jt})\right) \qquad (1)$$

5.98 where z_{jt} is the return to portfolio j in excess of the return to a risk-free asset, $\hat{z}_{jt}$ is the forecast return to the portfolio in excess of the risk-free rate,

$\frac{1}{T}\sum_{t=1}^{T}(z_{jt}-\hat{z}_{jt})$ is the mean forecast error and

$s\left(\frac{1}{T}\sum_{t=1}^{T}(z_{jt}-\hat{z}_{jt})\right)$ is its standard error.

[58] *The common approach for serial correlation is to make use of the Newey-West (1987) approach, but examination of the results of doing so show that the extent of serial correlation here does not produce robust results, even after this correction.*

5.99 The Wald test, an extension of the t-test, tests whether each of a number of mean forecast errors for a collection of portfolios differs from zero. In so doing, the Wald test takes into consideration that the different series may covary with one another. The formula for the Wald test is:

$$\left(\frac{1}{T}\sum_{t=1}^{T}(z_t-\hat{z}_t)\right)\left(S\left(\frac{1}{T}\sum_{t=1}^{T}(z_t-\hat{z}_t)\right)\right)^{-1}\left(\frac{1}{T}\sum_{t=1}^{T}(z_t-\hat{z}_t)\right) \qquad (2)$$

5.100 where z_t is a vector of excess returns to the 10 portfolios, $\hat{z}_t$ is the forecast value of the vector,

$\frac{1}{T}\sum_{t=1}^{T}(z_t-\hat{z}_t)$ is the vector sample mean forecast errors and

$S\left(\frac{1}{T}\sum_{t=1}^{T}(z_t-\hat{z}_t)\right)$ is an estimate of the covariance matrix of the sample mean forecast errors.

5.101 The Mincer-Zarnowitz (1969) test has been widely used in international finance to test whether forward exchange rates are unbiased and efficient predictors of future spot exchange rates. It is less standard than the t-test and Wald-test, and so we provide a brief description of its use and meaning in Appendix D. We thank the ERA for pointing out in early discussions about our methodology that one can use this statistic to evaluate the performance of forecasts. The Mincer-Zarnowitz test regresses the realisations against the forecasts via the simple regression:

$$z_{jt} = \gamma_j + \delta_j \hat{z}_{jt} + \varepsilon_{jt} \qquad (3)$$

5.102 If $\gamma = 0$ and $\delta = 1$, then this means that the forecast is rational in the sense that the forecast will match the expectation of the outcome conditional on $\hat{z}_{jt}$.

5.103 If the slope coefficient were not equal to one, then there would be a better way of using the information contained in the forecast. If, for example, the slope coefficient were 0.5, then this would suggest that much of the variation in forecasts is not linked to shifts in expectations and so it would not be optimal to use the forecasts without first adjusting them. If the slope coefficient were equal to one, of course, then the intercept would be the mean forecast error and so this should be zero for the forecast to be unbiased. If, on the other hand, the slope coefficient were to differ from one, then the intercept would not be the mean forecast error and so the intercept would not have to be zero for the forecast to be unbiased.

5.104 The tests that Mincer and Zarnowitz suggest that one use are primarily designed for detecting whether a forecaster – perhaps a professional forecaster – can successfully track variation through time in expectations of outcomes. They are not primarily designed for detecting whether a forecaster can successfully track variation across a group of variables in expected outcomes – although they can be used for the purpose.

5.105 Since the ERA has suggested that we use these tests, we employ them to evaluate the forecasts that we produce. In particular, we use the Generalised Method of Moments (GMM) of Hansen (1982) to test whether the forecasts that we generate using a number of different pricing models are both efficient and unbiased. Since under the null hypothesis, the intercept and slope coefficient in (3) should be identical across portfolios, we impose this restriction and estimate the system:

$$z_{jt} = \gamma + \delta \hat{z}_{jt} + \varepsilon_{jt}, \qquad j = 1,2,...,N \qquad (4)$$

5.106 We test whether $\gamma = 0$ and $\delta = 1$ and provide the results later in the document. Before continuing, however, it will be helpful to make two observations about the use of Mincer-Zarnowitz tests.

5.107 First, Mincer-Zarnowitz tests use a regression of outcomes on forecasts. It follows that for the tests to deliver precise estimates of the parameters of the regression, there must be a reasonable amount of variation in the independent variable, that is, the forecasts. If there is only a small amount of variation in the independent variable, one will not be able to estimate either the regression's intercept or slope coefficient precisely. In other words, the Mincer-Zarnowitz tests will have low power.

5.108 So unless one deliberately models variation in the risk premium associated with a portfolio through time- by perhaps using variables known to track variation in the market risk premium and using high-frequency data to better estimate shifts in the risk of the portfolio through time – then Mincer-Zarnowitz tests conducted on each portfolio separately will provide little in the way of useful information.

5.109 Second, forecasts generated from short time series may be imprecise. Although imprecise forecasts may be unbiased, they may not be efficient. Much of the variation in an imprecise forecast generated from a short time series may represent random error and the Mincer-Zarnowitz test will penalise forecasts that have this kind of error associated with them.

5.110 A second concluding comment is made with reference to precision. The main focus in our analysis is bias, as this matches the NPV=0 condition the ERA uses to summarise the RPP. However, we agree, with the ERA's observation that it would not be much use solving the bias issue if doing so introduced a significant amount of imprecision into the model. We thus, as a final check, examine our favoured model to ensure that the mean squared forecast error is not significantly larger than in other models.

Estimating the return on equity

5.111 The discussion above covers a description of our approach through the five stages of the ERA's methodology for determining the return on equity, the data we propose to use, and the nature of the model adequacy test which forms the core of the empirical analysis in Stage One which establishes which models meet both of the criteria outlined in paragraph 5.26. The discussion in this section follows the three stages of our analysis:

(a) Implementing our model adequacy test as part of Stage One of the ERA's five-stage process to ensure that models which are carried through to Stages Two and Three of the process are capable of providing relevant outcomes as per the second criterion from paragraph 5.26.[59]

(b) Calculating the parameters for these relevant models as part of Stage Two of the ERA's five-stage process.

(c) Calculating a rate of return as part of Stage Three of the ERA's process.

5.112 The main focus of our discussion is our model adequacy test, which, as per paragraphs 5.55 to 5.63, is intended to ensure that only models that have a sound theoretical and empirical basis are used to calculate the rate of return on equity in Stages Two and Three. Our approach has been to start with the empirical SL-CAPM model, as applied by the ERA in its Guidelines (being the 95th percentile value of beta).[60] We estimate this model and test it using our model adequacy test above. We then test three other models that our in-principle analysis in paragraphs 5.39 to 5.48 suggest may be relevant (the empirical SL-CAPM using the mean estimate of beta, the Black CAPM and the Fama French model), before using this information to develop a final preferred model, which we also test. This model is then used to estimate parameters and rate of return results (using weekly Bloomberg data; as distinct from the monthly SPPR data used for the model adequacy test) in Stages Two and Three of the ERA's five-stage process.

[59] *The discussion on which models pass the first criteria is contained in paragraphs 5.39 to 5.49.*

[60] *By "empirical SL-CAPM", we mean that beta has been estimated using a regression which relates returns to a benchmark portfolio to the return to a market portfolio of stocks, which is distinct from modelling approaches which use the SL-CAPM formula, but form their estimate of beta by some other means. This distinction becomes important in subsequent discussions.*

5.113 To presage the results discussed below, the ERA's implementation of the empirical SL-CAPM fails the model adequacy test, and we present evidence that it provides results which are statistically biased downwards. This is not improved by further manipulation within the same model using the 99th percentile of beta. The only model which conclusively passes the model adequacy test is the Black CAPM, and it is thus this model which forms the basis of our assessment of the rate of return in Stages Two and Three of the ERA's process. However, we do not implement the Black CAPM directly, but rather use information from the model to modify beta in the SL-CAPM formula. We do this to minimise our departure from the ERA's Guidelines.

Stage One - examining the models

5.114 We have already established, in our discussion in paragraphs 5.39 to 5.48 above, that the SL-CAPM, the Black CAPM, and the Fama-French model are relevant from a principled or theoretical perspective, noting the ERA's different viewpoints on this topic. Our focus here, therefore, is empirical; examining whether each model passes our model adequacy test and therefore meeting the NPV=0 condition. As discussed above, failure to meet this fairly basic level of robustness is strong evidence that a given model is unlikely to contribute to the achievement of the ARORO.

The ERA-version of the SL-CAPM

5.115 We begin our empirical assessment of relevance with the model the ERA has used in its Guidelines, and in the ATCO Draft Decision and the way in which that model has been implemented in both. Given these documents reflect the latest thinking by the ERA for gas transmission pipelines, this is a logical place to start. The ERA implements the empirical SL-CAPM, but it does not implement a "vanilla" version of the model. The ERA recognises the central finding from the literature on the Black CAPM that the empirical SL-CAPM, as usually implemented, underestimates the returns required on low-beta stocks and overestimates the returns required on high-beta stocks. The mean beta for the benchmark efficient entity calculated by the ERA is 0.48 for an equal-weighted portfolio and 0.47 for a value-weighted portfolio (See the Explanatory Statement Tables 24 and 25, p 173). To address the fact that the ERA believes this estimate to be biased downwards (see paragraph 141 of the Guidelines or paragraph 755 of the ATCO Draft Decision), the ERA uses not the OLS point estimate of beta in the SL-CAPM, but the 95th per centile estimate which is approximately 0.7. Thus, our starting point is to assess a version of the empirical SL-CAPM which forms predictions using the 95th per centile estimate of beta.

5.116 Before we begin, it is worthwhile pointing out that we do not replicate the ERA's most recent position exactly. In particular, the ERA has proposed to use the five-year CGS as the proxy for the risk-free rate but, as discussed in Chapter 3, we believe this is an error. As such, we have used the ten-year CGS. We also use the estimate of market risk premium from NERA (2013a,b) which is currently 100 basis points higher than the ERA's most recent estimate of the market risk premium (see paragraphs 5.172 to 5.187 for our assessment of the problems associated with this estimate). The net effect of these two departures is that, where we find evidence that the ERA version of the empirical SL-CAPM is biased downwards, or just borderline, this implies that the actual model being used by the ERA is likely to perform even worse. Our results, therefore, can be viewed as an optimistic assessment of the ERA's approach, if the abovementioned errors with the risk free rate and the market risk premium are removed.

5.117 To assess the ERA's approach, and indeed all the models, we use two different methods in assessing predictions. Method A evaluates the forecast:

$$\hat{z}_{jt} = \hat{\beta}_{jt}\hat{z}_{mt} \qquad (4)$$

5.118 The terms, from left to right in the above formula, are the forecast of the excess return, an estimate of beta computed using regression and monthly data from before month t and a forecast of the

market risk premium that is a long-run historical average.[61] This is almost exactly how regulators make predictions for rates of return through the next access period; by using an estimate of beta formed on past data, the current risk-free rate, and a forecast of the market risk premium. In the ATCO Draft Decision, the ERA changed the way it forms its estimate of the MRP, but as discussed below, this new approach does not appear to be very robust, and in any case cannot be implemented back into history for lack of data. Thus, we use the long-run historical average for the MRP that has been widely used by regulators in Australia in the past.

5.119 The estimate of MRP we use is relatively stable through time, but actual market returns are not. This means returns to the market are bringing a great deal of volatility into our valuation of forecasts. We intend to assess the ability of different pricing models to correctly predict the returns to portfolios and not to assess the extent to which the excess return to the market portfolio is predictable. Thus Method B evaluates the forecast:

$$\hat{z}_{jt} = \hat{\beta}_{jt} z_{mt} \qquad (5)$$

5.120 Here the forecast of the market risk premium is replaced by the realisation of the return to the market in excess of the risk-free rate for the period being forecast. The interpretation is not that the ERA is clairvoyant, but rather that, whatever forecast it makes is rational. In other words, we assume that the ERA does not systematically overestimate or underestimate the MRP. The practical effect of Method B is to remove noise created by market returns from the forecast errors that we construct, and so allow us to focus on whether the models that we consider have any tendency to systematically overestimate or underestimate the returns required on the 10 portfolios. In practice, however, whilst Method B can help in understanding whether a given model exhibits bias, it cannot be used for making predictions for the next five years, because we do not know the MRP for the next five years. Thus, it is Method A which forms the basis of our final return on equity estimation. Method B is rather used to improve the power of our model adequacy tests.

5.121 The results for the ERA's implementation of the empirical SL-CAPM are shown in Table 6.

Table 6: Wald and t-test results - ERA empirical SL-CAPM

		Method A		Method B	
Wald test		24.910		25.821	
Portfolio	*Betas*	*mean forecast error*	*t tests*	*mean forecast error*	*t tests*
1	0.623	-4.16%	-1.782	-4.85%	-2.621
2	0.692	-4.09%	-1.662	-4.85%	-2.676
3	0.653	-3.66%	-1.457	-4.40%	-2.546
4	0.839	-4.11%	-1.552	-4.93%	-2.925
5	0.927	-1.97%	-0.650	-2.87%	-1.663
6	0.947	-0.46%	-0.153	-1.50%	-1.005
7	1.031	2.23%	0.665	1.13%	0.661
8	1.250	2.91%	0.754	1.45%	0.771
9	1.443	8.15%	1.836	6.37%	2.709
10	1.516	7.28%	1.326	5.39%	1.403

Source: DBP analysis. Note – mean forecast errors are in percentage points per annum.

5.122 The "standard" five per cent critical value for a Wald test with 10 degrees of freedom is 18.3, whilst for the t-test it is 1.96 (1.645 and the ten per cent level). As noted in Appendix D, the simulated standard errors (based on the distribution of the data) are very similar to the standard critical

[61] *In our estimation work, we use, like Fama and French (1997), excess returns. In other words, we subtract the risk-free rate from the returns to the 10 portfolios and from the return to the market. Beta estimates are not sensitive to whether one subtracts the risk-free rate.*

values.[62] The errors are formed as predicted minus observed which means that negative t-statistics are indicative that the model has under-predicted actual returns and the firm is receiving an NPV-negative outcome.[63]

5.123 For the low-beta portfolios, the model has a statistically-significant negative bias at the five percent level under method B, and Portfolio One has a statistically significant negative bias at the ten percent level under Method A.[64] Method B is more reliable than Method A, because it produces more robust and statistically powerful results as it does not include variation in market returns.

5.124 This bias is not only statistically significant, but economically significant as well, with a mean forecast error of around four percentage points per annum. This means that a regulator using the ERA's approach setting prices which provide investors with returns that are four percentage points lower than they could be earning by facing similar levels of systematic risk elsewhere in the economy. This error is between half and two thirds of the overall allowed rate of return in recent Jemena (8.1 per cent – see AER 2014) an ATCO (6.8 per cent – see ERA 2014b) Draft Decisions. We would suggest that recognition of this error would lead to a materially preferable outcome (as per Section 259(4a) of the NGL) in respect of the regulators' estimates of the return on equity.

99th per centile of beta in the SL-CAPM

5.125 The evidence presented above suggests there are problems with the ERA's implementation of the empirical SL-CAPM. The extent of the bias in the empirical SL-CAPM for low-beta portfolios is so extensive that it is not removed by using the 95th per centile estimate of beta. An obvious extension is to use the 99th per centile estimate of beta in the implementation of the empirical SL-CAPM. This is the second model we assess. As the results in Table 7 below show, this does not appear sufficient of itself to solve the problem of bias either; most particularly when the focus is on the low-beta portfolios that are most similar to the BEE in respect of the level of the systematic risk they face. For these portfolios, the downward bias of the model is both statistically and economically significant.

Table 7: Wald and t-test results – empirical SL-CAPM and 99th per centile beta estimate

		Method A		Method B	
Wald test		24.355		24.557	
Portfolio	*Betas*	*mean forecast error*	*t tests*	*mean forecast error*	*t tests*
1	0.651	-3.99%	-1.707	-4.69%	-2.516
2	0.719	-3.92%	-1.592	-4.70%	-2.581
3	0.678	-3.51%	-1.394	-4.25%	-2.464
4	0.862	-3.97%	-1.496	-4.79%	-2.824
5	0.949	-1.83%	-0.603	-2.74%	-1.584
6	0.968	-0.32%	-0.108	-1.37%	-0.918
7	1.051	2.36%	0.705	1.24%	0.729
8	1.272	3.05%	0.791	1.58%	0.834
9	1.468	8.33%	1.875	6.53%	2.763
10	1.558	7.57%	1.378	5.63%	1.458

Source: DBP analysis. Note – mean forecast errors are in percentage points per annum.

[62] *McKenzie & Partington (2014) cite research by Ray, Savin & Tiwani (2009) which suggests that some papers reject the SL-CAPM too readily because they do not take into account the fact that the data do not always follow a "standard" distribution. This is not the case in our analysis.*

[63] *DBP is aware that standard statistical convention has errors as actual minus predicted, not predicted minus actual, but this form allows the non-statistician reader to easily interpret our results in light of the ARORO. Presenting our results in a more conventional statistical manner would make no difference whatsoever to our conclusions.*

[64] *Note the comment at paragraph 5.116; the actual model currently employed by the ERA is likely to perform worse than this, in respect of bias.*

5.126 The overall conclusion from the analysis above is that the version of the empirical SL-CAPM implemented by the ERA has significant limitations and should not be utilised, in Stages Two and Three of the ERA's five stage process; it is demonstrably downwardly biased and cannot contribute to the achievement of the ARORO.

5.127 However, we recognise that the SL-CAPM itself has a solid theoretical grounding. The problem is not necessarily with the SL-CAPM in theory, but with this particular empirical implementation of the SL-CAPM. As will be clear from the conclusion of the arguments presented below, we consider that a version of the SL-CAPM can still be considered relevant and utilised in Stages Two and Three of the ERA's five-stage process; albeit applied using only the formula of the SL-CAPM, rather than its empirical estimation of beta.

5.128 Before proceeding further to an examination of other models, we need to examine the power of the tests we have undertaken. The power of a test is the probability that it will reject the null (accept the alternative) if the null hypothesis is false (the alternative is true). In more simple terms, it is the likelihood of detecting that the sought after effect exists using the data, if indeed it exists in reality. In our case the "effect" is bias and our "null hypothesis" is that it does not exist. If the tests of bias we are using have low power given the data we are working with, then this means that the fact that the test detects a positive or negative result is not particularly meaningful and, given the nature of the data could merely reflect random variation. Formal testing of the power of statistical tests is something we have not seen done in the various empirical studies undertaken by or cited by the ERA. However, given the highly variable nature of finance data, we believe that the power of any tests conducted in the future should also be evaluated, and would suggest that tests with less statistical power than those we have used should be treated with some degree of scepticism.

Box 3: Are the tests powerful?

The results of our tests of statistical power are presented in Appendix D. We test power by examining the null hypothesis that the SL-CAPM is true against an alternative that the Black CAPM is true and the zero-beta premium is 0.5 per cent per month. This is a large zero-beta premium and so the predictions that the two models make differ in an economically significant way; if the tests of the SL-CAPM show little power when the null and alternative differ to this extent, then there is clearly limited power in our work in general.

Across all the beta-sorted portfolios, the simulations indicate that the Wald test statistic conforms relatively closely to its theoretical asymptotic distribution – a central chi-square with 10 degrees of freedom – although there is some evidence that the use of asymptotic theory would lead one to reject the null hypothesis that the SL-CAPM is true a little too frequently. Overall, the power results suggest that, at the five per cent significance level, the SL-CAPM will be rejected as false when in fact the alternative is true around 24 per cent of the time.

For portfolio 1, with the beta closest to the BEE, the null is rejected when false 20 per cent of the time using Method A and 29 per cent of the time using Method B. For portfolios 2 and 3 the figures are around 13 and 21 per cent. Beyond these portfolios, the probabilities of rejecting the null when false fall. However, most of these portfolios have betas that are closer to one, and what the power results appear to be indicating is that our test results are most powerful for the lower beta portfolios. Since the BEE is a low-beta portfolio, this suggests that our tests will have some power to detect any difficulty the SL-CAPM faces in delivering an unbiased estimate of the return required on the entity.

Other vanilla models

5.129 In this section, we examine three "vanilla" models, the SL-CAPM, the FFM and the Black CAPM. By "vanilla" models, we mean models where point estimates of parameters are used, as distinct from using the 95th per centile estimate of beta or something similar. The aim is to see not only whether these models are adequate on their own but also to understand whether they might be used to inform a model which is based in the framework of the SL-CAPM, to minimise departure from the Guidelines.

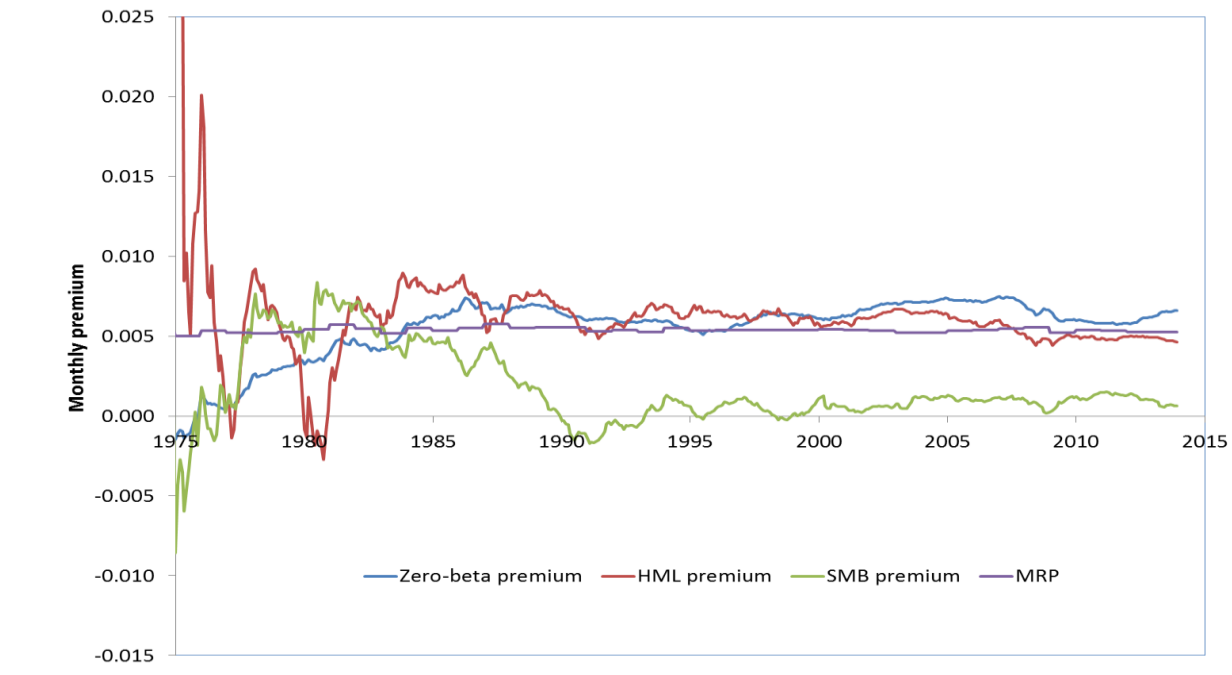
5.130 It seems highly likely that, if the 95th per centile estimate of beta does not pass our model adequacy test, the vanilla empirical SL-CAPM will do much worse. However, we include the assessment for completeness; if nothing else, it provides a check to make sure our test is working; if the vanilla empirical SL-CAPM passed our test but the ERA's version of the empirical SL-CAPM did not, then this would indicate a significant problem with the test.

5.131 We now turn to an examination of these models, using our test dataset. This analysis follows exactly the same structure as the assessment of the ERA's version of the empirical SL-CAPM above, and uses the data from the SPPR database. However, the Fama-French Model and Black CAPM introduce (between them) three new parameters which the SL-CAPM does not require. These are the zero-beta premium in the Black CAPM and the high-minus-low (HML) and small-minus-big (SMB) factors in the Fama-French model.

5.132 In our model adequacy tests, we make use of zero-beta premium estimates prepared by NERA (2013c), using data which stretch back to the 1960s (which comes from the SPPR database; which has coverage of larger firms prior to the early 1970s when it commences full coverage of the ASX) so that the zero-beta premium estimates are stable in the first decade of our test data-set from SPPR. The estimates are formed following the two-pass methodology of Fama & Macbeth (1973) and Litzenberger and Ramaswamy (1979), using the modified estimator from Shanken (1992); see NERA 2013c (Appendix A) for a discussion of the formation of the zero-beta premium.

5.133 The HML factor for the FFM we have sourced from the website of Ken French (see http://mba.tuck.dartmouth.edu/pages/faculty/ken.french/data_library.html), which contains data up to 2013, and the SMB we have estimated using SPPR data up to 2013 using the returns to the top and bottom 30 firms within the ASX 500 each month. The values for the HML, SMB and zero-beta premia from the start of our test dataset through to the present day, are shown in Figure 8, along with the market risk premium estimates for comparison.

Figure 8: HML SMB , MRP and zero-beta premia



Source: DBP analysis based on SPPR data (SMB), http://mba.tuck.dartmouth.edu/pages/faculty/ken.french/data_library.html NERA (2013a,b,c)

5.134 We now present the results. Table 8 summarises the results for the Black CAPM. The results of the Fama-French model are summarised in Table 9 and whilst the Vanilla SL-CAPM model is summarised in Table 10.

Table 8: Black CAPM - Wald and t-test results

		Method A		Method B	
Wald test		8.7331		9.8798	
Portfolio	*Betas*	*mean forecast error*	*t tests*	*mean forecast error*	*t tests*
1	0.536	-1.43%	-0.604	-2.09%	-1.120
2	0.608	-1.88%	-0.756	-2.60%	-1.421
3	0.576	-1.19%	-0.467	-1.91%	-1.074
4	0.766	-2.93%	-1.098	-3.71%	-2.213
5	0.857	-1.40%	-0.461	-2.27%	-1.306
6	0.882	-0.06%	-0.019	-1.08%	-0.716
7	0.966	2.02%	0.605	0.98%	0.570
8	1.182	1.09%	0.286	-0.28%	-0.148
9	1.362	4.81%	1.100	3.15%	1.364
10	1.384	3.45%	0.640	1.77%	0.472

Source: DBP analysis. Note – mean forecast errors are in percentage points per annum.

5.135 Here, the Black CAPM passes the aggregate Wald test for both Method A and Method B, and shows no evidence of bias under either method, even at the ten-per cent level of significance. The scale of the mean forecast errors has also substantially decreased; by around three-quarters. They are still relatively large (around 150 basis points per annum for low-beta portfolios) but they are not statistically-significantly different from zero.

5.136 We now turn to the Fama-French Model. The results are shown in Table 9. The asterisks indicate whether the relevant factors are significant in a regression for the given portfolio that uses the whole sample. Since the Fama-French model requires long data series to be estimated with robustness, the subsamples we use to generate predictions are less likely to have significant coefficients for these parameters. With the exception of Portfolio Nine, the sign of the significant coefficients match priors.

Table 9: Fama-French model - Wald and t-test results

				Method A		Method B	
Wald test				14.902		14.684	
Portfolio	*betaMRP*	*betaHML*	*betaSMB*	*mean forecast error*	*t tests*	*mean forecast error*	*t tests*
1	0.625*	0.064	0.156*	-2.93%	-1.178	-3.76%	-2.072
2	0.735*	0.249*	0.075	-1.91%	-0.714	-2.85%	-1.619
3	0.734*	0.220*	0.080	-1.52%	-0.562	-2.48%	-1.490
4	0.815*	0.250*	0.007	-3.11%	-1.090	-4.04%	-2.479
5	0.927*	0.195*	0.017	-0.92%	-0.286	-1.90%	-1.112
6	0.963*	0.186*	0.002	0.76%	0.239	-0.39%	-0.265
7	1.027*	0.237*	0.009*	3.77%	1.073	2.48%	1.493
8	1.209*	0.044	-0.034	3.01%	0.782	1.72%	0.921
9	1.299*	-0.152*	-0.053	5.92%	1.400	4.23%	1.849
10	1.466*	-0.117*	0.238*	8.15%	1.515	6.46%	1.775

Source: DBP analysis. Note – mean forecast errors are in percentage points per annum

5.137 The Fama-French model performs better than the SL-CAPM (see below) and the ERA's implementation of the empirical SL-CAPM, but not as well as the Black CAPM. Although it is unbiased overall (as evinced by the Wald statistics) it shows evidence of being biased downwards for Portfolios One and Four. Moreover, the estimates of individual parameters in the model are not always significant. This may be due in part to the nature of the portfolio formation process; a topic which we address in Box 4.

5.138 The final model we examine in this section is the vanilla form of the SL-CAPM. The results are shown in Table 10, along with the mean forecast errors.

Table 10: Vanilla empirical SL-CAPM - Wald and t-test results

		Method A		Method B	
Wald test		26.766		29.792	
Portfolio	*Betas*	*mean forecast error*	*t tests*	*mean forecast error*	*t tests*
1	0.536	-4.70%	-2.018	-5.34%	-2.915
2	0.608	-4.61%	-1.878	-5.32%	-2.938
3	0.576	-4.14%	-1.652	-4.84%	-2.765
4	0.766	-4.56%	-1.726	-5.34%	-3.207
5	0.857	-2.41%	-0.798	-3.27%	-1.891
6	0.882	-0.88%	-0.294	-1.89%	-1.259
7	0.966	1.80%	0.539	0.76%	0.443
8	1.182	2.46%	0.639	1.07%	0.569
9	1.362	7.59%	1.715	5.89%	2.522
10	1.384	6.37%	1.165	4.65%	1.220

Source: DBP analysis. Note – mean forecast errors are in percentage points per annum

5.139 It is worthwhile comparing Table 10 with the results for the Black CAPM in Table 8. The betas in each instance are identical. This is not an accident. The Black CAPM uses the same betas as the empirical SL-CAPM. The only differences between the two models are in their assumptions. Specifically, the SL-CAPM assumes that all investors can lend and borrow at the risk-free rate, whilst the Black CAPM relaxes this assumption. This has the practical effect of moving the intercept between the security market line and the vertical axis of a graph of risks and returns from a point determined by theory (the risk-free rate in the SL-CAPM) to a market-driven outcome (see SFG, 2014 for a succinct description of this distinction). In theory, the zero-beta premium in the Black CAPM should lie between the lending and borrowing rates if such rates exist. In practice it need not do so, though, because empirical implementations of the model do not use series of returns to the market portfolio of all risky assets but instead use series of returns to the market portfolio of stocks.

5.140 The assumption in the SL-CAPM that investors can borrow and lend at the risk-free rate is clearly false. We are not aware of any Australian corporates who are able to borrow on better terms than the Federal Government. The fact that this leads the results of empirical SL-CAPM estimations to be biased is well-known (see, for example, Friend & Bloom, 1970, Fama & MacBeth, 1973 and Brealey, Myers & Allen, 2011). If one accepts that investors cannot borrow and lend at the risk-free rate and uses an empirical, rather than a theoretical intercept for the security market line, then it is possible to predict, with a high degree of empirical validity (note the t-stats in Table 8 for the Black CAPM and the much lower mean forecast errors) what returns investors will demand in order to bear a certain level of systematic risk. If, however, one keeps the theoretical intercept, correcting the downwardly-biased predictions that result requires a very large adjustment to beta. This is a topic taken up in our discussion of our final model below.

5.141 Overall, our conclusions about the empirical vanilla SL-CAPM mirror those for the ERA's version of the empirical SL-CAPM above; it is not an adequate model to use in Stages Two and Three. We reach similar conclusions in respect of the FFM, but caveat these in Box 4 below. These models

might play a role as cross checks, but ought not play a role in the estimation of the return on equity in Stages Two and Three of the ERA's process.

5.142 However, the Black CAPM performs better, and meets our model adequacy test. The ERA (Explanatory Statement Appendix 8 paragraph 49) has suggested in respect of the Black CAPM that:

> *"…. the Authority considers that without some new development of the model in terms of its empirical performance, the Black CAPM cannot be relied on to achieve the rate of return objective, and hence is not relevant at the current time."*

5.143 Our results represent new empirical evidence about the validity of the Black CAPM in terms of its overall results. There is now a much stronger case for considering the use of this model than there may have been in the past, before tests such as our model adequacy test which aim to empirically test the degree to which different models are capable of meeting the NPV=0 condition were developed. Accordingly, it has an important role to play in the estimation of the return on equity in Stages Two and Three of the ERA's process, and we now turn to a more detailed description of that role.

Box 4: Did the FFM obtain a fair assessment

We obtain mixed results for the Fama-French model. In the aggregate tests, the Wald test suggests it is unbiased, whilst the MZ tests suggest that it is not. In the individual portfolio tests, Method B suggests it is still biased downwards for Portfolios One and Four, but the other evidence suggests that it is unbiased. There is a reduction in the mean forecast errors as well, though to a lesser extent than the Black CAPM. The evidence clearly shows that the model is better than the empirical SL-CAPM (whether at the mean or the 95th percentile of beta), but it does not provide definitive evidence of unbiasedness in the same way that the Black CAPM does. This has lead us not to use the Fama-French model in Stages Two or Three of the ERA's process. This conclusion is made with some caveats, and it should be made clear that the design of our tests in some ways militates against illustrating the benefits that using the Fama-French model may convey.

First, long series of data are required for our out-of-sample tests to deliver reliable results. Estimates of the returns required on portfolios will inevitably perform poorly in MZ tests if the estimates are based on short time series. In the US, where the Fama-French model was developed, data on the HML and SMB factors are available back to 1926, whilst in Australia, data on the factors go back only to 1975 (1974) for the HML (SMB) factor (see http://mba.tuck.dartmouth.edu/pages/faculty/ken.french/data_library.html). The absence of a long time series of returns makes out-of-sample testing more challenging. Thus one would expect Fama-French predictions of the returns required on the 10 portfolios that we employ to perform poorly not because of any defect in the model but because of the short time series employed.

Secondly, we have formed the portfolios on the basis of beta and not on the exposures of stocks to the HML and SMB factors or on the basis of book-to-market or size. This means that our tests will not reveal the advantages that the Fama-French model has been documented to have in pricing stocks that the SL-CAPM has difficulty in pricing correctly (see, for example, Fama and French (1993) and Brailsford, Gaunt and O'Brien (2012).

Final Model

5.144 For our final model, we make use of the information from the models that have performed well above. Two things guide us. We are looking for statistical robustness, first and foremost, and secondly, we are looking for a model that departs as little as possible from the ERA's Guidelines.

5.145 In principle, we could have implemented the Black CAPM directly. We might also have used adaptations of the FFM (like using different points on confidence intervals for its betas, or forming the portfolios in a way more favourable to the model). However, doing so would have involved a more significant departure from the Guidelines than is perhaps necessary. Instead, we have endeavoured to maintain the basic framework of the SL-CAPM, whilst using information from the results we obtain above for the Black CAPM. This involves adjusting the estimate of beta by more than choosing a different point on a confidence interval for the parameter. Instead, we replace beta by :

$$\beta_{jt}^{*} = \left(1 - \frac{\hat{z}_{0t}}{\hat{z}_{mt}}\right)\hat{\beta}_{jt} + \frac{\hat{z}_{0t}}{\hat{z}_{mt}} \quad (6)$$

here $\hat{z}_{0t}$ is an estimate of the zero-beta premium computed using data from before month t, $\hat{z}_{mt}$ is, again, an estimate of the market risk premium computed using data from before month t and $\hat{\beta}_{jt}$ an estimate of the beta of portfolio j computed using data from before month t. In what follows we refer to β_{jt}^{*} as a 'bias-adjusted' beta estimate.

A forecast of the return required on portfolio j in excess of the risk-free rate that uses a bias-adjusted beta estimate is:

$$\hat{z}_{jt} = \beta_{jt}^{*}\,\hat{z}_{mt} \quad (7)$$

Substituting in for β_{jt}^{*} gives:

$$\hat{z}_{jt} = \left(\left(1 - \frac{\hat{z}_{0t}}{\hat{z}_{mt}}\right)\hat{\beta}_{jt} + \frac{\hat{z}_{0t}}{\hat{z}_{mt}}\right)\hat{z}_{mt} \quad (8)$$

With some simple algebraic manipulation, this becomes:

$$\hat{z}_{jt} = \hat{z}_{0t} + \hat{\beta}_{jt}\left(\hat{z}_{mt} - \hat{z}_{0t}\right) \quad (9)$$

that is, a forecast of the return required on portfolio j in excess of the risk-free rate that uses an empirical version of the Black CAPM.

5.146 In making use of the framework or formula of the SL-CAPM in this way, whilst incorporating key information not gleaned from empirical estimation of parameters of the SL-CAPM (namely the empirical beta), we are not in fact making a significant departure from regulatory practice. Despite different regulators starting a process of empirical estimation of beta in 2009 (Henry, 2009), regulators have not historically used these empirically-estimated betas, but have instead used the formula of the SL-CAPM substituting in their own beta estimates formed by other means. For example, in DBP's last access arrangement, despite acknowledging the work of the AER in obtaining empirical estimates of beta that suggested a range of 0.4 to 0.7, the ERA chose to continue its past practice of using a beta of 0.8 (ERA, 2011, paragraph 486-82).

5.147 This is also not particularly different from standard commercial practice. Appendix 29 of the Explanatory Statement to the Guidelines (paragraph 55 to 57) highlights several surveys of market practice that show that analysts regularly form an estimate via the SL-CAPM, and then adjust this to reflect other information. This might take the form of a simple additive adjustment (indeed, the evidence from Grant Samuel cited by the ERA in its ATCO Draft Decision - paragraph 786 - adjusts the SL-CAPM due to the "shortcomings and limitations" of the model) or it might take the form of an adjustment in beta as we have done. The ERA, by calculating an estimate of beta of 0.48, but then not using this estimate in implementing the SL-CAPM, has done essentially the same thing as we have done, and indeed, in response to the same problem, albeit, the methodology used for the ERA's adjustment is a non-transparent exercise of regulatory judgment. The key differences are that the ERA has made a smaller adjustment; and not tested the result.

5.148 Our approach of using the SL-CAPM formula and a beta formed exogenous to the SL-CAPM is no different from standard practice amongst regulators and in the wider commercial world, except that we have chosen a particular means of adjusting beta which we can show has a solid theoretical basis, and we actually test the results of our model formed in this way.

5.149 With this in mind, we now turn to the examination of our final model in Table 11.

Table 11: Betastar model - Wald and t-test results

		Method A		Method B	
Wald test		8.733		9.379	
Portfolio	*Betas*	*mean forecast error*	*t tests*	*mean forecast error*	*t tests*
1	1.057	-1.43%	-0.604	-2.75%	-1.202
2	1.042	-1.88%	-0.756	-3.13%	-1.513
3	1.044	-1.19%	-0.467	-2.48%	-1.295
4	1.028	-2.93%	-1.098	-4.08%	-2.312
5	1.016	-1.40%	-0.461	-2.55%	-1.480
6	1.009	-0.06%	-0.019	-1.24%	-0.839
7	0.999	2.02%	0.605	0.87%	0.509
8	0.974	1.09%	0.286	0.00%	0.001
9	0.956	4.81%	1.100	3.74%	1.480
10	0.952	3.45%	0.640	2.37%	0.604

Source: DBP analysis. Note – mean forecast errors are in percentage points per annum.

5.150 Comparing Table 11 with Table 8 above examining the Black CAPM, the mean forecast errors, t-tests and Wald test results are identical for Method A.[65] This ought not be surprising, as the two models give the same predictions. Note, however, the difference in beta; whereas it is around 0.53 in the Black CAPM, betastar is now 1.06. This is the issue that we raise in paragraph 5.140 above; there is a difference in the assumptions between the Black CAPM and the SL-CAPM in respect of the rates at which investors can lend and borrow (the intercept of the security market line), and if one ignores the fact that investors cannot in fact lend and borrow at the risk free rate, because there are so few parameters in the model, one has to adjust beta in order to make the model give predictions that reflect actual returns.

5.151 This is important in interpreting betastar. DBP does not claim that energy firms in general, or the BEE in particular, are riskier than the market. The evidence from the SL-CAPM and Black CAPM shows that this is not the case. What leads to biased predictions in the SL-CAPM (but not the Black CAPM) appears to be the incorrect assumption that investors can borrow and lend at the risk-free rate. We attempt to correct for bias the bias in the SL-CAPM by adjusting beta in the betastar model, and since we load all of the correction onto a single parameter, the adjustment is very large. [66] However, the resultant beta is an adjustment for bias, not a statement about the level of systematic risk faced by the BEE, this is exemplified by the level of the beta in the Black CAPM; around 0.53.

5.152 The same issue we face is faced by the ERA; it attempts to correct for bias (though it does not specify its potential source) by adjusting beta. We do not believe that the ERA is claiming, by making the adjustment, that the BEE actually faces a level of systematic risk similar to that of a firm with a beta of 0.7, but rather that bias in the empirical SL-CAPM means that the beta needs to be adjusted to obtain better estimates of the rate of return needed to reward an efficient firm for the risks it faces in the provision of reference services. This is the same argument that we make, though in our case, this issue of relative risk is thrown into sharp relief because the range of the "headline" beta we compute extends above one, and this might lead an uninformed reader who pays little attention to the way in which an adjusted estimate of beta has been generated, to conclude that we are claiming a high level of systematic risk for the BEE. As noted above, we are not doing this.

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65 *They are not the same for Method B, and the reason why is explained in Appendix D:*

66 *SFG (2014, paragraph 348-9) present similar evidence, showing how much a beta to be used with the SL-CAPM would need to be adjusted to provide the same estimate of the return required on a portfolio to that generated, with an unadjusted beta, by the Black CAPM. So long as the zero-beta premium differs from zero, some adjustment will need to be made to the beta for the two models to deliver the same estimate of the return. While SFG's focus is different to ours, we are hardly the first to address this issue of adjusting beta. .*

5.153 The bias which is associated with the empirical SL-CAPM has now vanished, just as it does for the Black CAPM. The mean betastar provides a result which is unbiased for both methods across all portfolios (with the exception of Portfolio Four, method B), and it could be considered sufficient to stop at this point and use the mean betastar as the best estimate of this model capable of providing an unbiased answer. However, even though this would be entirely consistent with standard statistical practice (and would in fact be methodologically correct), it does not answer the question of which model outputs provide an unbiased, or NPV=0 outcome. This set is a range, not a point estimate, and it is a range we want to take forward into Stage Four of the analysis.

5.154 Thus, to form a range, we follow the approach the ERA has used, and consider different points on the confidence interval of betastar. We then estimate the model using these different point estimates of betastar, record the forecast errors and examine whether the forecast errors are statistically biased or not. The range of unbiased outcomes which this model is capable of producing extends from the 20th to the 99th per centile of the confidence interval around betastar.[67] This is a very wide range, which ought not be surprising given the high variance of finance data.

5.155 This is shown in Table 12 overleaf. The 20th per centile is the point at which the model becomes biased downwards for method B. Method A has a wider range but, as noted previously (see also Appendix D) it has less precision and less power than Method B, and we therefore take the 20th per centile as an appropriate lower bound.

Box 5: Is a naïve model sufficient?

In endeavouring to understand what the rate of return ought to be, there is a preference for simplicity over complexity, all else being equal. For example, the Consumption CAPM is a very elegant model from a theoretical perspective, but we would agree with the ERA's assessment (see Guideline Appendix 8 paragraph 57-65) that it is probably too difficult to implement. The simplest model of all is a naïve model which assumes that the mean return to any portfolio is the same as the mean return to the market. If other models add complexity, they ought to at least perform better than this naïve model in a model adequacy test.

The SL-CAPM adds complexity by suggesting that the mean returns to portfolios will depend on how the returns to portfolios covary with the return to the market. This is what beta measures. If one were starting from a blank slate, rather than more than a decade of regulatory practice which has used the SL-CAPM, and a service provider proposed the model, the ERA would probably seek to test and see whether the additional complexity was worth the effort involved in estimating beta, and the debate which it inevitably causes.

We examine such a test in Appendix D. The Wald statistics for the naïve model for Methods A and B are 10.01 and 9.99. This suggests that the model is not biased; in fact, as we discuss in Appendix D, it performs much better than the SL-CAPM (including the ERA's implementation of it, and almost as well as the Black CAPM. This suggests that, it would be very difficult to make an empirical case (via a model adequacy test such as we propose) that the SL-CAPM was worth the effort, were it not for the regulatory history involved of using this model in the past.

[67] *Actually, it extends further upwards than this. However, since this upper bound itself sits above the upper bound from our consistency test in Chapter Six, there is little to be gained by considering points above this.*

Table 12: Unbiased betastar estimates

		Method A		Method B			Method A		Method B	
Wald test		11.637		13.398			9.935		7.265	
Portfolio	Betas	mean forecast error	t tests	mean forecast error	t tests	Betas	mean forecast error	t tests	mean forecast error	t tests
1	0.843	-2.79%	-1.183	-4.03%	-2.008	1.647	2.41%	0.997	0.87%	0.246
2	0.859	-3.04%	-1.229	-4.22%	-2.265	1.549	1.40%	0.554	-0.06%	-0.020
3	0.844	-2.46%	-0.974	-3.69%	-2.166	1.597	2.42%	0.935	0.94%	0.296
4	0.919	-3.61%	-1.359	-4.67%	-2.789	1.329	-1.01%	-0.376	-2.44%	-1.081
5	0.948	-1.83%	-0.605	-2.90%	-1.706	1.204	-0.19%	-0.062	-1.60%	-0.824
6	0.950	-0.44%	-0.145	-1.60%	-1.093	1.170	1.00%	0.330	-0.24%	-0.145
7	0.974	1.85%	0.554	0.74%	0.436	1.070	2.50%	0.744	1.21%	0.695
8	0.892	0.56%	0.146	-0.49%	-0.236	1.201	2.59%	0.672	1.38%	0.726
9	0.788	3.69%	0.847	2.72%	0.991	1.418	7.98%	1.800	6.60%	2.782
10	0.775	2.27%	0.423	1.32%	0.321	1.443	6.78%	1.238	5.35%	1.398

Source: DBP analysis. Note – mean forecast errors are in percentage points per annum

5.156 Having assessed a variety of models via our model adequacy test, and found a model which can be shown to be relevant and adequate in respect of contributing towards the achievement of the ARORO, we turn to the estimation of this model using the same weekly Bloomberg data that the ERA itself uses. This allows us to form an estimate of the relevant parameters (Stage Two in the ERA's process) and of the relevant rate of return on equity (Stage Three) which is then subject to the relevant cross checks (Stage Four).

5.157 Before doing so, we make two brief diversions. The first is to examine the results of a properly constructed Mincer Zarnowitz test which, as we note in paragraph 5.104, is a test that will be of limited use but which the ERA has suggested that one employ. The second is to examine model precision. Table 13 provides the results of Mincer-Zarnowitz tests.

Table 13: Mincer-Zarnowitz test results

Model	Intercept	Slope
95th percentile SL-CAPM	1.033 (0.239)	-0.869 (0.578)
Black CAPM	0.511 (1.120)	0.463 (1.951)
Fama-French Model	1.583 (0.356)	-2.150 (0.894)
SL-CAPM	0.997 (0.219)	-0.938 (0.559)
betastar	0.511 (1.120)	0.463 (1.951)

Source: DBP analysis. Note: Intercepts are in per cent per month and standard errors are in parentheses.

5.158 The Mincer-Zarnowitz tests provide evidence that both the SL-CAPM and the ERA's implementation of the model, the 95th percentile SL-CAPM, provide inefficient forecasts. In other words, the slope coefficient estimates differ significantly from one. The forecasts generated by the Black CAPM, on the other hand, or identically, by the betastar model, do not appear to be inefficient or biased – although, as one would expect, the tests have low power – that is, the standard errors attached to both the intercept and slope coefficient estimates for the two models are large. The standard errors are large because the models, looking back find little relation in past data between returns and estimates of beta and forecast little variation in returns across the 10 portfolios. This lack of variation, however, while it produces forecasts that are closer to being unbiased than is true of forecasts generated by the various versions of the SL-CAPM, undermines the effectiveness of the Mincer-Zarnowitz tests. The Mincer-Zarnowitz tests rely on variation in the forecasts made to determine whether the forecasts are efficient or otherwise.

5.159 The Mincer-Zarnowitz test of the Fama-French model indicate that the model produces inefficient forecasts. This result is not surprising because to construct Mincer-Zarnowitz tests of the model requires we use very short time series of returns to estimate the premiums attached to the Fama-French factors. Using short time series of returns to estimate the premiums generates imprecise forecasts and the Mincer-Zarnowitz tests detect this imprecision. In practice, however, one would not estimate the Fama-French factor premiums using such short time series. Thus, for this model, the Mincer-Zarnowitz tests do not provide a practical guide as to how useful the model may prove to be.

5.160 Finally, we diverge briefly to examine the mean squared forecast error of the five different models we consider. Of particular importance is the difference between the ERA's implementation of the empirical SL-CAPM and the betastar model. Whilst our main focus is (correctly, we believe) statistical bias, if removing bias resulted in a model which is much less precise, then this would be a cause for concern. The results shown in Table 14 suggest that this is not a concern.

Table 14: Mean squared error of forecast errors

	Portfolio 1	Portfolio 2	Portfolio 3	Portfolio 4	Portfolio 5	Portfolio 6	Portfolio 7	Portfolio 8	Portfolio 9	Portfolio 10
SL-CAPM - Method A	0.002	0.002	0.002	0.002	0.003	0.003	0.003	0.004	0.005	0.008
SL-CAPM - Method B	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.002	0.004
95th per centile beta SL-CAPM Method A	0.002	0.002	0.002	0.002	0.003	0.003	0.003	0.004	0.005	0.008
95th per centile beta SL-CAPM Method B	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.002	0.004
99th per centile beta SL-CAPM Method A	0.002	0.002	0.002	0.002	0.003	0.003	0.003	0.004	0.005	0.008
99th per centile beta SL-CAPM Method B	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.002	0.004
Black CAPM - Method A	0.002	0.002	0.002	0.002	0.003	0.003	0.003	0.004	0.005	0.008
Black CAPM - Method B	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.002	0.004
Fama-French Model - Method A	0.002	0.002	0.002	0.002	0.003	0.003	0.003	0.004	0.005	0.008
Fama-French Model - Method B	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.002	0.004
Betastar model - Method A mean betastar	0.002	0.002	0.002	0.002	0.003	0.003	0.003	0.004	0.005	0.008
Betastar model - Method B mean betastar	0.002	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.002	0.004
Betastar model - Method A 20th pct betastar	0.002	0.002	0.002	0.002	0.003	0.003	0.003	0.004	0.005	0.008
Betastar model - Method B 20th pct betastar	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.002	0.005
Betastar model - Method A 99th pct betastar	0.002	0.002	0.002	0.002	0.003	0.003	0.003	0.004	0.005	0.008
Betastar model - Method B 99th pct betastar	0.003	0.002	0.002	0.001	0.001	0.001	0.001	0.001	0.002	0.004

Source: DBP analysis

Stage Two - estimation of parameters

5.161 Having undertaken out model adequacy test, and established which models are capable of meeting both criteria for relevance discussed in paragraph 5.26, we now turn to the task of estimating these models for the purposes of establishing an appropriate rate of return for the upcoming AA period, which forms Stages Two and Three of the ERA's process. In order to estimate our model, we require the estimation of three parameters; the risk-free rate, betastar and the market risk premium. We discuss the formation of each below. We have, in our implementation of the model adequacy test above, estimated the relevant models a number of time, but we have done so using the SPPR database, in order to test model predictions against actual outcomes. In this section, we make use of current Bloomberg data, for the purpose of estimating the appropriate rate of return for the upcoming access period. The distinction between data used for testing models, and for implementing them in the context of the AA is discussed in paragraphs 5.87 to 5.89.

Beta and betastar

5.162 A bias-adjusted estimate of beta (betastar), from Equation (6), (paragraph 5.145) uses an unadjusted estimate of beta and so we first construct the unadjusted estimate using weekly Bloomberg data. We do so using five years of weekly data from September 2009 to September 2014 from the 6 companies which form our BEE for the purposes of estimating the return on equity (See Chapter 3). We form the equity returns for the six companies into a value-weighted portfolio. We apply similar weights to the de-leveraging and re-leveraging of the raw-beta estimate, as described in Appendix 20 and 21 of the Explanatory Statement to the Guidelines.

5.163 The data are sourced from Bloomberg, and we follow the same process of analysis as the ERA does in its Guidelines (See Explanatory Statement Chapter 12), although we make use of only one value-weighted portfolio. We differ from the ERA in that we consider both discrete ("pct" in Table 15 below) and continuous returns ("log" in Table 15 below), and we also consider returns to each day of the week, rather than just considering returns to a Friday (Mon, Tue, Wed, Thu and Fri in Table 15 below). We also examine models which are based on gross returns (ie - not in excess of the risk-free rate; "gross" in Table 15 below) and models based on returns in excess of the five ("xs5" in Table 15 below) and ten-year ("xs10" in Table 15 below) CGS return. This gives rise to a wide range of beta estimates, which are shown in Table 15 below. All our estimation has been undertaken using ordinary least squares (OLS), as we find the ERA's deviation from standard practice in empirical finance into the realm of "robust regressions" does not represent best practice (see discussion below). Also, the results for beta are very similar to the results found by the ERA, and by Henry (2014). This is not surprising, as we have used essentially the same data, and essentially the same approach.

Table 15: Range of beta estimates

	Raw beta	De-levered and relevered betas	De-levered and re-levered beta lower CI	De-levered and re-levered beta upper CI	Beta t-stat	R-squared	F-stat
mongrosslog	0.525	0.604	0.504	0.705	11.833	0.377	140.026
tuegrosslog	0.568	0.654	0.549	0.758	12.315	0.386	151.666
wedgrosslog	0.471	0.541	0.433	0.650	9.823	0.276	96.487
thugrosslog	0.479	0.551	0.440	0.662	9.813	0.273	96.291
frigrosslog	0.500	0.575	0.467	0.682	10.548	0.309	111.258
mongrosspct	0.526	0.605	0.503	0.706	11.714	0.372	137.213
tuegrosspct	0.566	0.651	0.546	0.756	12.204	0.381	148.936
wedgrosspct	0.472	0.543	0.434	0.652	9.806	0.276	96.166
thugrosspct	0.481	0.554	0.442	0.665	9.772	0.271	95.494
frigrosspct	0.503	0.578	0.470	0.687	10.499	0.307	110.223
monxs5log	0.524	0.603	0.502	0.704	11.770	0.374	138.529
tuexs5log	0.579	0.666	0.559	0.774	12.204	0.388	148.925
wedxs5log	0.473	0.544	0.435	0.653	9.816	0.276	96.348
thuxs5log	0.481	0.553	0.442	0.664	9.789	0.272	95.822
frixs5log	0.501	0.576	0.468	0.684	10.523	0.308	110.734
monxs5pct	0.526	0.605	0.503	0.706	11.720	0.372	137.354
tuexs5pct	0.578	0.664	0.556	0.772	12.123	0.385	146.967
wedxs5pct	0.472	0.543	0.434	0.652	9.809	0.276	96.211
thuxs5pct	0.481	0.554	0.442	0.665	9.777	0.271	95.596
frixs5pct	0.503	0.579	0.470	0.687	10.509	0.308	110.429
monxs10log	0.526	0.605	0.504	0.705	11.840	0.377	140.184
tuexs10log	0.580	0.667	0.560	0.775	12.244	0.390	149.906
wedxs10log	0.471	0.541	0.433	0.650	9.826	0.277	96.553
thuxs10log	0.479	0.551	0.441	0.662	9.818	0.273	96.399
frixs10log	0.500	0.575	0.468	0.682	10.557	0.310	111.453
monxs10pct	0.526	0.605	0.503	0.706	11.720	0.372	137.365
tuexs10pct	0.578	0.664	0.556	0.772	12.124	0.385	146.981
wedxs10pct	0.472	0.543	0.434	0.652	9.809	0.276	96.224
thuxs10pct	0.482	0.554	0.442	0.665	9.777	0.271	95.591
frixs10pct	0.503	0.579	0.470	0.687	10.508	0.308	110.408
Overall average	0.511	0.587	0.480	0.695			
Mon av	0.525	0.604	0.503	0.705			
Tue av	0.575	0.661	0.554	0.768			
Wed Av	0.472	0.542	0.434	0.651			
Thurs Av	0.481	0.553	0.442	0.664			
Fri Av	0.502	0.577	0.469	0.685			

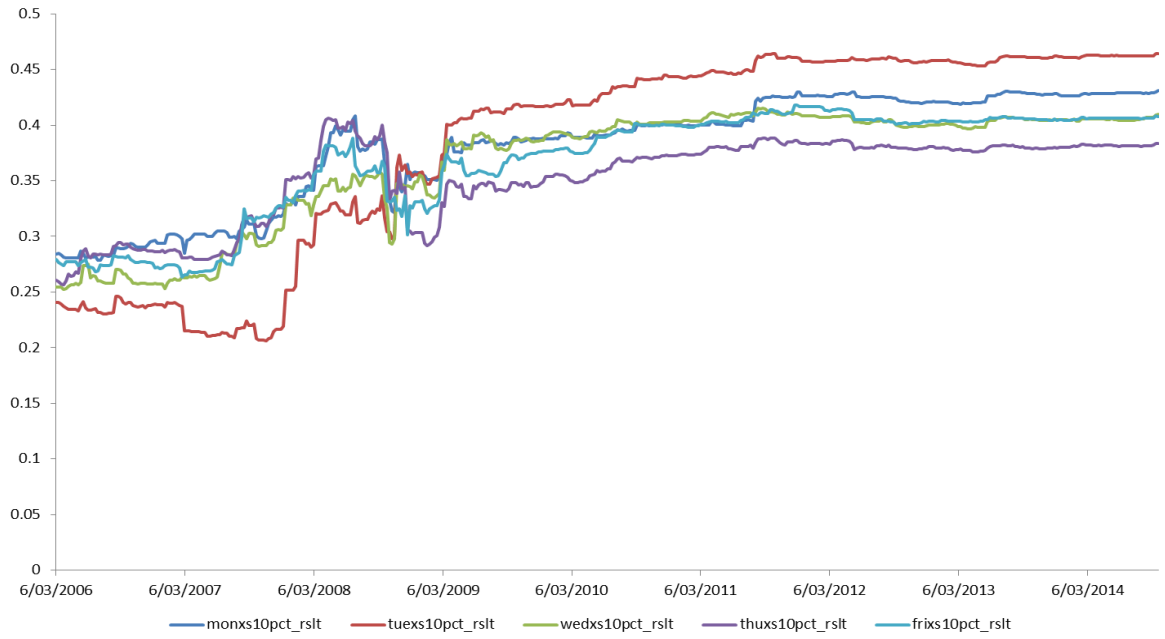
Source: DBP analysis of Bloomberg data - note average gearing for de-levering and re-levering is approximately 54 per cent based upon the average from September 2009 to September 2014 of the daily value-weighted average of gearing levels of the firms in the BEE.

5.164 We examine such a wide range of beta estimates because there is no basis, in terms of the theory of the SL-CAPM, to choose between any of the estimation methods noted above.[68] Within the

[68] *The assumptions underpinning the SL-CAPM are neatly summarised in this submission to the AER (http://www.aer.gov.au/sites/default/files/Attachment%209.6%20NERA%20-%20Black%20CAPM%20Report%20March%202012_0.pdf, p3). As is clear, there is no assumption made about*

dataset we use in our final analysis, there are differences in the estimates for different days of the week, as shown in Figure 9 below. Figure 9 shows the beta for the SL-CAPM calculated on a five-year rolling average basis using data starting in 2000, for the same BEE portfolio as in Table 15 above. At certain points in time, sometimes because particular firms come into or drop out of the portfolio, the estimates differ, and it is worth making sure that one is not in one of these periods before assuming that an analysis using only one day of the week is correct.

Figure 9: Beta through time for the BEE portfolio - expanding window



Source: DBP analysis. Note that this figure shows beta calculated on the basis of a discrete model of returns in excess of the ten-year CGS return as per our preferred model below. The calculations use expanding windows (the first is 60-months, the second 61, the third 62 and so on; the same approach we use in our model adequacy test) which show more stability than rolling 60-month windows. The other forms of the model produce a very similar pattern

5.165 Based on the Figure 9, returns to a Friday appear to be a mid-point amongst different days of the week. However, the trading week does not always end on a Friday due to public holidays, and so we follow advice from NERA (the AER proposes the same approach in its recent Jemena Draft Decision , pp3-253) and use returns to the end of the week which eliminates missing variables. The results of this approach are shown in Table 16 below. We provide estimates for beta, betastar, and the points on the confidence interval for betastar that represent unbiased model predictions. To covert beta to betastar requires information on the zero-beta premium and the MRP, and we use relevant figures from the end of the period.[69] In order to calculate points on the confidence interval for betastar, we follow the approach outlined in Appendix D, using the Bloomberg data. Our comments from paragraph 5.151 apply here as well; DBP is not claiming that the BEE is riskier than the market, but rather betastar combines systematic risk and the fact that investors cannot borrow and lend at the risk-free rate into a single variable.[70]

the day of the week one ought to use, or even if weekly returns are appropriate. This is unsurprising as the SL-CAPM is a single period model, and its theoretical basis provides no indication what that period should be.

[69] *These figures are actually from December 2013, since this is the last available data-point for each variable. However, each is relatively stable, and this makes very little difference in practical terms. SIMON??*

[70] *As shown in Table 5, investors facing the level of systematic risk exemplified by the BEE have earned much higher rewards than a mechanistic empirical implementation of the SL-CAPM would suggest. Our model shows the returns that an investor facing the level of systematic risk exemplified by the BEE would earn in practice.*

Table 16: Beta and betastar

Estimate type	Estimate
Beta	0.55
Betastar	1.11
20th per centile of betastar (lower bound of unbiased results)	0.94
99th per centile of betastar (upper bound of unbiased results)	1.57

Source: DBP analysis. Note that the standard error for betastar is 0.195.

5.166 As a final point, all our estimation has been done using ordinary least squares (OLS); we have not sought to estimate any of the "robust regression" models the ERA has favoured in the past. There are several reasons for this. Firstly, as outlined in Appendix F, these "robust" techniques are almost never used in the academic literature, and it seems highly unlikely that their use could meet the ERA's own criteria of empirical work being implemented in accordance with best practice (Explanatory Statement Appendix 1 paragraphs 30-42).

5.167 Secondly, OLS will deliver consistent estimates under a wide array of conditions (see Huber, 1973), departures from the assumptions under which robust regression estimators are derived can lead to the estimators losing the property of consistency. An estimator is said to be consistent if it converges in probability to the correct population value as the sample size grows. As Imbens and Wooldridge (2007, p2) note:

> *'so-called "robust" estimators, which are intended to be insensitive to outliers or influential data, usually require symmetry of the error distribution for consistent estimation. Thus, they are not "robust" in the sense of delivering consistency under a wide range of assumptions*

5.168 Moreover, M-estimators such as LAD have high breakdown points (the smallest fraction of the data that can be changed by an arbitrarily large amount and still cause a arbitrarily large change in the estimate of the model) and perform no better than OLS in the face of outliers in the explanatory variable (see Seber & Lee, 2003, pp77-88). In the SL-CAPM, the only explanatory variable is the return on the market, so LAD will be no better than OLS in accounting for extreme market events, the rationale Henry (2009) gave for its use (see Explanatory Statement -paragraph 777).

5.169 The screening strategy that the ERA appears to endorse (Explanatory Statement Appendix 22) in which one employs LAD estimators unless Laplace goodness-of-fit tests suggests that it unwise to do so does not appear to work well. NERA (2014) uses bootstrap simulations to examine the merits of robust regression techniques and the strategy that the ERA employs and finds that:

(a) the three robust regression techniques that the ERA uses typically provide biased estimates of beta whereas the OLS estimates exhibit no significant bias; and

(b) a strategy of using a Laplace goodness-of-fit test to determine whether to use OLS or LAD does not perform well –OLS estimates typically display both less bias and a lower variability than estimates that use the screening strategy

5.170 For these reasons, we decided not to use robust regression techniques or the screening strategy that the ERA appears to endorse. This is covered in more detail in Appendix F.

5.171 As a final issue, we did undertake some experimentation with different robust techniques. However, they tended to perform worse in our model adequacy tests than OLS and thus there seemed to be little benefit in exploring them further. As such, we have followed normal practice in finance, and used OLS.

Market risk premium

5.172 To obtain a prediction of rates of return on equity for the coming access period, beta is multiplied by an estimate of the MRP. In the Guidelines (paragraph 128), the ERA suggests that historical estimates and the DGM are both relevant for estimating the MRP, which can then be checked using several of the cross checks summarised in Appendix 29 of the Guidelines. Consideration of

these methods leads it to conclude that the MRP is between 5 and 7.5 per cent. There is a problem with this range in that a majority of the studies used to inform it examine the MRP with respect to the ten-year CGS yield and not the five-year CGS yield which the ERA favours. As determined by the Competition Tribunal ([2003] ACompT 6, Paragraph 46), the tenor used for the risk-free rate needs to match the tenor implied by the MRP, that would mean that the ERA needs to consider a range of roughly 5.5 to 8 per cent if it proposes to continue to use the five-year risk-free rate.

5.173 In the ATCO Draft Decision, the ERA has introduced a novel method of determining the MRP, and it is worthwhile examining this method for robustness. The ERA conducts its assessment of its MRP results at Stage Four in the ATCO Draft Decision, but we reserve Stage Four for an assessment of model outputs, not model inputs, and thus discuss and assess MRP below.

5.174 The ERA utilises an MRP of 5.5 per cent based upon the movement of four hypothesised driver variables normalised to move within the range determined by the ERA in its Guidelines (paragraph 131) of 5 to 7.5 per cent. There are several problems with the ERA's cross check of this result, and with the formation of the estimate in the first instance.

5.175 In respect of the cross checks, the ERA asserts that its estimate of MRP is sound because estimates of the long-run return on equity of 10.9 per cent fall within the band of 10.7 to 15.2 per cent from a recent Grant Samuel report on the likely future return to the market (ATCO Draft Decision paragraph 786).[71] However, this estimate of 10.9 per cent is the ERA's estimate of the actual return on equity that has been earned in the market since 1993; it has nothing to do with the ERA's estimate of the MRP at all (see Tables 43 and 44, p176 in the ATCO Draft Decision).

5.176 The ERA also benchmarks against a number of other sources, including other regulatory decisions. However, it is difficult to ensure that apples are being compared with apples, because some of the results are "current" (they are setting a rate of return for the next access period, or are estimates of returns over the next few years) whilst other are long-term estimates of the return on the market. To assist in comparing the different numbers cited by the ERA, we have created Table 17 below. "Current" estimates are estimates cited by the ERA from either regulatory determinations or market analysts. They are the same numbers as in the ATCO Draft Decision. "Long Run" estimates take the market risk premium from the source cited by the ERA, and add it to the long run average of the five-year risk-free rate from June 1993 to June 2014 (the period used by the ERA to represent the long run in the ATCO Draft Decision) to develop a picture of what the long-run expectation of market returns actually are, as distinct from what different parties have suggested are likely returns over the coming period.[72] By way of an example, the ERA estimates that the long run MRP, based on its driver variables, is 5.6 per cent. The average risk-free rate from June 2006 to June 2014 is 5.58 per cent, which means the long-run return on the market implied by the ERA's MRP is 11.16 per cent, not 10.9 per cent. The results of the analysis are shown in Table 17.

[71] *It is interesting that the ERA has benchmarked against this source because, in contrast to the ERA's assertion that it has "no view to the prospect of higher rates over the next five years" (ATCO Draft Decision paragraph 786), Grant Samuel increases the risk-free rate it uses in its assessment because it believes that government bond rates are currently at "unsustainably low levels (ATCO Draft Decision paragraph 787). Moreover, the ERA notes that Grant Samuel "disavows the impact of imputation credits" (ATCO Draft Decision, paragraph 786) but elsewhere in the decision the ERA asserts that such credits have a relatively high value, in its discussion on gamma.*

[72] *We do not correct for the fact that most estimates of the MRP are made in excess of the ten, not the five-year risk free rate, because it is not clear in the individual cases cited in the ATCO Draft Decision which risk-free rate was used. This means that our estimates of market returns are probably too low; by the difference between five and ten-year risk-free rates.*

Table 17: Comparing different estimates of the return to the market

Source	Long Run	Current
ERA	11.16%	8.45%
Grant Samuel	11.28% to 15.58%	10.7% to 15.2%
AER	12.08%	10.6%
IPART	12.58%	11.3%
Alberta Utilities Commission	13.28%	10.9%
Other regulators	10.88%-14.78%	NA

Source: ATCO Draft Decision paragraphs 786-97.

5.177 When like is compared with like, it is clear that the ERA is significantly below almost every estimate. The only range within which its estimates fall is the "other regulators", and the ERA does not stipulate (ATCO Draft Decision paragraph 797) who all these regulators are or the conditions under which the lowest point of the range occurred. On the basis of Table 17, it is difficult to share the ERA's assertion (ATCO Draft Decision) that it has "similar metrics" to other regulators.

5.178 Not only is the ATCO Draft Decision very different in respect to its MRP compared to other regulators and market analysts, but it also very different from the ERA's own views about market risk premia in rail, where both the methodology and the actual numbers are substantially different to the ATCO Draft Decision.

5.179 In respect of methodology, the ERA notes in its Rail Guidelines (ERA, 2014 paragraph 493):

> *The Authority considers that the so-called 'Wright approach' provides the best estimate of the return on equity for the benchmark firm over the long term. The Wright approach adopts a constant real return on equity. Wright notes:*
>
> *Both the real market cost of equity and the MRP are inherently unobservable. But of necessity regulators have to commit themselves to a particular set of assumptions about these unobservable magnitudes. My view… is that regulators should work on the assumption that the real market cost of equity is constant. This approach is supported by quite strong evidence. For any firm with β reasonably close to one, the assumed real market cost of equity is by far the most important figure affecting the cost of capital for regulated companies. Thus this methodology has the added advantage of providing a stable regulatory regime… as a direct implication, whatever assumption is made on the risk-free rate, the implied equity premium must move point by point in the opposite direction.*

5.180 This is a very different approach to the approach outlined in the Guidelines, where the ERA notes (Explanatory Statement, Appendix 16, paragraph 49) that:

> *The empirical evidence indicates that there is no statistically reliable relationship between the risk-free rate of return and the return on equity.*

5.181 In respect of numbers for the MRP, the Rail Guidelines suggest (paragraph 492):

> *The starting point for estimating the MRP for the long term rail WACC is the Authority's estimate of the expected return on equity for the longer term, of 11.2 per cent. For the indicative estimate of the rail WACC (see Appendix 7), the 'on the day' estimate of the 10 year risk free rate is 3.3 per cent. It follows that the current estimate of the long term nominal MRP at the current time is (11.2 – 3.3 per cent) 7.9 per cent.*

5.182 In the Rail Guidelines, the ERA advocates the use of ten-year, not a five-year CGS (see paragraph 3.21), and the use of a five-year CGS of three per cent (the relevant rate for the 40 trading days to September 30th 2014) results in a market risk premium of 8.2 per cent. Both 8.2 and 7.9 per cent sit outside the range the ERA has deemed relevant for the MRP in its energy Guidelines, and that its estimate of the long run MRP in the ATCO Draft Decision is 5.6 per cent. It is unclear why the ERA would believe the market risk premium, which has nothing whatsoever to do with the firm being assessed should be more than 200 basis points higher for railways than for gas pipelines.

5.183 We now turn to the issue of the construction of the index used by the ERA in the Guidelines to deliver a forecast for the MRP of 5.5 per cent. We look at two issues. Firstly, whether the index is

related to the MRP and market returns in the way that the ERA asserts that it is, and secondly, whether each of the individual driver variables are related to the MRP and market returns. If the former is false but that latter true, this suggests the formation of a different weighted average, but if both are false, it would suggest that the entire approach has no backing. Detail of our assessment is contained in Appendix E.

5.184 In respect of the index, using KPSS (Kwaitowski et al, 1992), Phillips Perron (1998) and Dickey-Fuller (1979) tests, we find that the ERA's weighted index, the MRP and market returns are all I(1). Moreover, none of them are cointegrated with each other, which means that it is simply not possible to use the ERA's index to predict levels of either the MRP or market return. It is potentially possible to use changes in the index to predict changes in the MRP or market returns, but two problems arise. Firstly, vector autoregression tests show that the relationship between the index and the MRP and market returns is negative; a drop in the index leads to an increase in both the MRP and market returns. Thus, if the ERA's index is valid, recent falls in the indicators would seem to suggest an increasing MRP. However, it appears from examining Granger (1969) causality test results that the MRP and market returns Granger-cause the ERA's index, and not the other way around. Thus, it is incorrect to call the index a forward-looking indicator, as it is something that is predicted by, not something that predicts the MRP and market returns.

5.185 Turning now to the individual components of the index, there is no evidence of a cointegrating relationship between any one of the ERA's forward indicators and either the return on the market or the MRP, which suggests that any regression between them would be spurious. It is possible to form just one cointegrating relationship between an index made up of the four driver variables and the return on the market, but the coefficients on each are very different to those used by the ERA, and some are negative (see Appendix E). Moreover, there is no evidence that this new index either Granger-causes or is Granger caused by market returns of the MRP, which means that it is not a leading indicator as the ERA believes, but rather that, at best, both the market and the driver variables are in fact driven by some other economic process. In short, there does not appear to be anything to be gained by using any combination of the indicators which the ERA believes are forward-looking indicators of market returns and the MRP. For this reason, we do not do so.

5.186 The ERA has not reached a firm conclusion for MRP. The indices it uses in the ATCO Draft Decision have clear problems, and the Rail Guidelines, which were revised to accommodate the ERA's developing views about rate of return matters through the ATCO Draft Decision,[73] have not used the same approach that the ERA uses in its Draft Guidelines. We have instead used the long-run historical average for MRP developed by NERA (2013a,b), based upon earlier work by Brailsford, Handley & Maheswaran (2012).[74] This results in an MRP of 6.5 per cent, which is the same as the estimate used by the AER in its recent Jemena Draft Decision (p194), even though the AER appears to have made use of more than just historical averages. This MRP is in excess of the 10-year risk-free rate, and, as per the recent GasNet decision ([2003] ACompT 6 paragraph 46), if the five-year risk-free rate were used, the MRP would need to be 6.95 per cent, reflecting the 45 bps difference in the five and ten-year CGS for the 40 days to September 30th 2014, in order to be consistent with the choice of risk-free rate.

5.187 As a final point, our estimate of the MRP is essentially a point estimate through time; although there is some variation through time in the MRP estimate in NERA (2013a,b), it is essentially constant within our timeframe.[75] Thus, we do not propose to carry forward a range for the MRP.

Risk-free rate

5.188 Finally, to obtain a prediction, the product of beta and the MRP is added to an estimate of the risk-free rate. We follow the ERA's approach of using linear interpolation, but instead of using just two bonds straddling the terminal date (ten years in our case) we use all bonds, with decreasing weights the further a bond is from the target date. We understand this approach is consistent with that used by firms regulated by the AER, and it produces no difference in the number for the risk

[73] *See ERA website Link*
[74] *We use the same measure in our model adequacy test, as the data are available as a long time series*.
[75] *The estimate itself has a standard error of around 1.5 per cent per annum*

free rate in our data compared to using only two bonds. We use multiple bonds because each bond contains potentially different information, and it does not seem appropriate to discard information from particular bonds. The ERA follows a similar philosophy in respect of the debt risk premium, where it uses a wide range of bonds and not just the ones closest to the target tenor.

5.189 Our risk-free rate predictions are based on the 40 trading days to 30 September 2014, and would be updated for the Final Decision. The rate is 3.54 per cent. This is a single market value based on a single 40-day estimating period, and as such does not have a confidence interval. As with the MRP, we propose that this be carried forward as a point estimate to Stage Three of the ERA's process, meaning the range for the return on equity is formed by the range in beta.

Stage Three – calculating the return on equity

5.190 The third stage of the ERA's process in the Guidelines involves combining the parameter estimates for the model(s) estimated and combining them into a single estimate for the return on equity. The range of estimates for the rate of return on equity is 9.67 per cent to 13.72 per cent, as summarised in Table 18.

Table 18: Overall return on equity range

	beta	RFR	MRP	Re
20th per centile estimate of betastar	0.94	3.54	6.5	9.67
99th per centile estimate of betastar	1.57	3.54	6.5	13.72

5.191 This is refined at the end of Chapter 6 after the nature of the consistency test between debt and equity has been more fully explored, completing Stage Four and Stage Five of the ERA's five-stage process.

6. CROSS CHECKS AND CONSISTENCY

6.1 As discussed at the beginning of Chapter Five above, the process contemplated in the ERA's Guidelines requires, as the fourth stage in its process for estimating the return on equity, the implementation of cross checks, including a cross check to ensure whether the proposed return on equity is likely to contribute to the achievement of the ARORO in NGR 87(3).

6.2 This chapter commences where Chapter Five leaves off, by considering that fourth stage in the ERA's process. Specifically the process can be used to, first determine whether the range of estimates for the return on equity (9.67% to 13.72%) is reasonable and, secondly, to narrow that range via our test for consistency between the return on debt as determined in Chapter Four and the range for the return on equity as determined in Chapter Five. This Chapter concludes by implementing Stage Five of the ERA's process by forming a point estimate of the return on equity.

Cross checks

6.3 The Black CAPM, as implemented through our betastar model, is considered relevant via our model adequacy test, and is used for calculating the permissible ranges of the return on equity in stages two and three of the ERA's process.

6.4 The SL-CAPM has relevance as a theoretical model, but the extent of the downward bias means that empirical estimates using it have limited relevance even as a cross-check. Other models are of some relevance as a part of the cross-checking process, particularly the Fama-French model (which, whilst not a perfect model, does not suffer from the problems of bias which affect the SL-CAPM (as that model is applied in the traditional sense or in the way the ERA has applied it in the guidelines). The DGM (which we did not test) is also a relevant model for the purposes of cross checking the reasonableness of the return on equity. Moreover, estimates made by market professionals, such as brokers, may also have relevance as cross-checks, and the actual returns made by firms with the same level of systematic risk as the BEE ought also to be considered relevant as a cross check.

6.5 There are currently several access arrangement revision proposals for gas pipelines currently being considered by the ERA and the AER, with many different estimations of rates of return for different models or other data being proposed in these processes. We present the results of those from the ATCO (2014), Jemena (2014) and GGT (2014) proposals below, as well as some relevant estimates by brokers.

Table 19: Model results for cross check

Source	Result
Jemena proposal	
SL-CAPM	10.01%
Black CAPM	10.62%
Fama-French Model	10.87%
Dividend Discount Model	10.92%
ATCO proposal	
Required return for average firm on the market	11.2%
SL-CAPM	9.9%
Fama-French Model	10.8%
Dividend Growth Model	10.9%
Previous ERA regulatory decisions for ATCO	10.41-12.72%
GGT proposal	
GGT model	12.28%
SFG range from return on debt	9.66-12.97%
Incenta on expert assessments of low beta firms	9.6% to 14.3% (average = 11.8%)

Source	Result
Actual returns for Portfolios One and Three (betas of 0.53 and 0.57 respectively	7.5 to 8.2 per centage points above 10-year risk-free rate (11.04 to 11.74% with current risk-free rate of 3.54%)(Table 5)
Ernst & Young (2102) review of independent experts	2.2% above AER regulatory decisions (AER Jemena: 8.1+2.2=10.3%)
SFG(2013) review of independent experts	1-2% above "mechanistic" SL-CAPM (implies for AER Jemena 9.1% to 10.1%)

Source: Jemena (2014), ATCO(2014), SFG (2013), Ernst & Young (2012), Incenta (2014)

6.6 It must be noted, of course, that the ERA and the AER in each of the recent draft decisions have not applied the results from these models or this data (and, other than for very limited purposes relating to the selection of the values for certain inputs within the SL-CAPM, have not had regard to them at all in the process of assessing whether the return on equity estimated using the regulators' preferred model (being the SL-CAPM) contributes towards the achievement of the ARORO). Instead each of the regulators has indicated a continued preparedness to rely on the SL-CAPM to estimate the return on equity.

6.7 While the models used by ATCO (in its access arrangement proposal to the ERA of March 2014) and Jemena (in its access arrangement proposal to the AER of June 2014) are models which pass our test of theoretical relevance (see paragraphs 5.39 to 5.48), these models were not actually used by us in Stages Two and Three of the process. However, these models have relevance as a cross-check in this Stage Four.

6.8 Moreover, reports of independent experts have been cited by the ERA (e.g. the ERA, at page 203 of Appendix 29 of the Explanatory Statement to the Guidelines) as being one source of information capable of performing a cross check. Indeed the ERA discusses at length in the ATCO Draft Decision a recent Grant Samuel report on Envestra to cross check its estimates of the market risk premium (see discussion at paragraphs 5.172 to 5.187). There may be real questions as to whether the ERA has had sufficient regard, even as a cross check, to the Grant Samuel report which it cites in the ATCO Draft Decision. In particular, SFG (2014d) in response to the ATCO Draft Decision observes, among other things, that the mid-point of the Grant Samuel estimate for the return on the market is in fact 53% higher than the ERA's own estimate of the overall equity market- see paras 146 to 152). Be that as it may, DBP considers that independent expert reports, such as the Grant Samuel report are relevant evidence capable of providing a meaningful cross check of the overall return on equity

6.9 The model estimates above from Jemena (2104) and ATCO (2014) are relevant in the same sense that Henry (2014) is relevant for the ERA in its assessment of its beta estimates calculated for ATCO (see ATCO Draft Decision, paragraphs 807 to 816). That is, they use similar data to that which we have used, and the same modelling approaches. If they came up with very different numbers to our results, then this may indicate a problem with our estimation approaches for the return on equity; just as different beta estimates between Henry (2014) and the ERA's ATCO Draft Decision would indicate potential problems in the ERA's beta estimates. The results, which all sit above our 20th per centile for betastar are all similar to the results we obtain in our predictions for the relevant models via the model adequacy test. This provides further confidence that our estimation methods are sound.

6.10 The estimates of brokers, and more particularly, the actual returns on portfolios with a beta similar to the BEE move beyond mechanical estimation of models. All of the estimates from brokers sit within our range shown in Table 18 from Chapter Five as does the range of returns that were actually earned by portfolios with a beta similar to the BEE. This gives further confidence that the range shown in Table 18, although wide, is a reasonable reflection of the views of investors who do not necessarily rely upon the mechanistic application of any particular asset pricing model.

6.11 The evidence from ATCO in respect to previous ERA decisions suggests that the ERA has, in the past, given estimates of rate of return that fall within the range shown to be unbiased in Table 18and which is comparable to actual rates of return earned by firms with a similar beta. Ernst & Young (2012, Figure 2) provides similar evidence, showing how regulators have, in the past, made

decisions which are in line with the views of professional investors but now make decisions which are considerably lower than the rates of return which market analysts believe are relevant for energy utilities. This does not appear to be because differences have emerged between regulators and investors about levels of systematic risk faced by regulated energy firms (indeed, we are not aware of a regulator suggesting that systematic risk has changed substantially through time). Instead, the differences appear to be driven by the risk-free rate and market risk premium; professional investors appear either to adjust expectations about risk-free rates upward when they are low (as Grant Samuel did in the Envestra assessment; see ATCO Draft Decision paragraph 786) or adopt higher market risk premia at points in time when the risk-free rate is low, in a manner similar to the Wright (2012) model. Regulators, by contrast tend to adopt a mechanistic application of the SL-CAPM with no change in the market risk premium as risk-free rates decline.[76] This appears to account for much of the emerging differences between regulators and market professionals.

6.12 The last element from Table 19 is the "GGT proposal" (the access arrangement proposal filed by Goldfields Gas Transmission Pty Ltd dated 5 September 2014), which makes use of information about the return on debt to estimate the return on equity. This is, to our understanding, the first time in the Australian regulatory sphere that information about the return on debt has been used to as anything other than a reference point for the lower bound for the return on equity. It represents a new source of useful market data that can be used to cross-check model results that use information that comes purely from considering the return on equity.[77] Notably, it provides results that sit within our range from Table 18. We have also developed a formal way of investigating the relationship between debt and equity and using that information to ensure consistency between the two estimates to act as a cross check of our return on equity range in Table 18. Further, we have used that test to narrow the range in Table 18 to produce a final estimate for the return on equity that is unbiased, and consistent with the return on debt estimated in Chapter 4. It is to this consistency test that we now turn.

Consistency between debt and equity

6.13 NGR 87(4)(a) provides that the allowed rate of return for a regulatory year is to be a weighted average of the return on equity for that regulatory year and the return on debt for that regulatory year.

6.14 DBP considers that achieving the ARORO requires a consideration of the interrelationship between the return on debt and the return on equity. That includes a requirement to apply each of these elements in a consistent manner and in a manner which yields commercially sensible result. Not only does that requirement arise on a proper construction of NGR 87; it is also consistent with economic theory. In this chapter, we summarise the way in which we approach the issue of consistency between the return on debt and the return on equity.

6.15 NGR 87(5)(b) and (c) and 87(11) establish a regime which requires a consideration of the relationship between the return on equity and the return on of debt. In particular:

> *(5) In determining the allowed rate of return, regard must be had to:*
>
> *…..*
>
> *(b) the desirability of using an approach that leads to the consistent application of any estimates of financial parameters that are relevant to the estimates of, and that are common to, the return on equity and the return on debt; and*
> *(c) any interrelationships between estimates of financial parameters that are relevant to the estimates of the return on equity and the return on debt.*
>
> *….*

[76] *The ERA's recent Rail Guidelines explicitly adopts the Wright model as the best model, and avoids the problems of mechanistic application of the SL-CAPM.*

[77] *The AER, in the recent Jemena decision (AER, 2014, p88), examines the difference between debt and equity premia it proposes to allow Jemena (250 bps) and concludes that this is not too low based on an exercise of regulatory judgement which involves some consideration of past premia.*

> *(11) In estimating the return on debt under sub-rule (8), regard must be had to the following factors:*
>
> *(a) the desirability of minimising any difference between the return on debt and the return on debt of a benchmark efficient entity referred to in the allowed rate of return objective;*
>
> *(b) the interrelationship between the return on equity and the return on debt;*

6.16 At the very least, each of NGR 87(5)(b) and (c), suggest some degree of consistency or similarity of approach to estimating the return on equity and the return on debt. NGR 87(11)(b) provides further support to this notion in the narrower context of the return on debt.

6.17 This view is also consistent with the approach preferred by the AEMC that, in determining the allowed rate of return, the ERA is required to consider how the return on debt and the return on equity combine to create the allowed rate of return and that the two components are not to be considered in isolation. Within the Rule Change Determination, at section 6.5, page 67, penultimate paragraph, the AEMC says this:

> *"In determining the allowed rate of return, the regulator would be required to consider the return on equity and the return on debt as the allowed rate of return comprises a weighted average these two components. Although, for practical purposes, the regulator may turn its mind to separately estimating the return on equity and return on debt, the Commission considers that the process is a joint estimation exercise and that the regulator must ensure that the overall estimate of the rate of return satisfies the overall objective."*

6.18 Further, in the Rule Change Determination (at p 68, fifth paragraph), the AEMC observed:

> *"Estimating the return on equity and return on debt are likely to be necessary components to determine the overall rate of return that meets the overall objective. However, as achieving the overall objective has primacy the regulator would need to consider the overall estimate against the overall objective and not just add together and weight its estimates of the cost of equity and debt. Guidance has been provided in estimating both these components through factors that the regulator must have regard to."*

6.19 In similar terms, when discussing the return on debt, at section 7.5, pages 89-90, the AEMC observes:

> *"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. Therefore, those aspects of the final rule that relate to the return on debt estimate should be seen as part of the analysis to inform the estimate of an overall rate of return."*

6.20 In respect of relevant evidence, as the discussion below will show, the return on debt is relevant for the return on equity because of the relationship between the two; both in theory and empirically.

6.21 In respect of consistent application, and perhaps unsurprisingly given that debt and equity are part of the same weighted average which determines the WACC, the ERA notes the need to take into account the prevailing market conditions for both. The ERA has suggested in the Guidelines (Explanatory Statement, Appendix 29, paragraph 30-32 and 70-3) that a relevant check would be that the return on debt is lower than the return on equity, given that equity bears a higher risk. This is a necessary, but not sufficient, condition as it fails to take into account the relationship between the two.

6.22 The ERA has also recognised the relevance of using information from debt to inform equity. One of the cross checks it mentions (Explanatory Statement Appendix 29) is the relationship between debt and equity premia; though, it has yet to determine how that relationship is structured. We do so in this chapter. This can be viewed as an extension of the conceptual framework of the ERA to a practical implementation of that framework which gives effect to a consistency check between debt and equity risk premia.

6.23 With this preamble in mind, we now turn to a detailed discussion of the approach we have developed.

Merton and contingent claims analysis

6.24 Merton noted that equity and debt are contingent claims over the assets of the same firm. Both become less valuable as the assets of the firm decline in value and both become more valuable as the assets of the firm rise in value. Both are linked to the value of the assets of the firm. Thus, if there are certain factors that drive changes in the value of the assets of the firm, those same factors will drive the returns to debt and equity in that firm. This means that there is a positive relationship between the return on debt and the return on equity in the same firm. Indeed, equity is a call, and debt a put option on the assets of a firm.

6.25 A call option is a financial security that provides the holder with the right, but not the obligation to buy a particular asset at a particular price on a particular future date. The holder is free to exercise the option (by buying the asset at the specified price) or to let the option lapse. The price paid when exercising the option is known as the strike price. For example, consider a $5 call option on Telstra shares that matures at the end of March. If the Telstra share price is $6 at the end of March, the holder will exercise the option, which involves paying $5 for a Telstra share, which is worth $6 at the time. In this case, the holder of the call option makes a gain of $1 by exercising, and whoever sold them that call option makes a loss of $1 when the option is exercised against them. If the Telstra share price is $4.50 at the end of March, the holder will let the option lapse – they will not want to pay $5 for an asset that is worth only $4.50.

6.26 Merton (1974) models the equity of a firm as a call option on the firm's assets, with a strike price equal to the face value of the firm's debt. To see how this insight works, consider the following example. Suppose that a firm has a single source of debt funding with repayment of $5 million due in one year. Consider two cases at the time the repayment is due:

(a) Scenario 1: The assets of the firm are worth $9 million; and

(b) Scenario 2: The assets of the firm are worth $3 million

6.27 In Scenario 1 the lenders will receive the full $5 million repayment that they were promised and the equity holders receive the residual $4 million ($9 million - $5 million). In Scenario 2 the firm defaults on its debt, the lenders take over the assets and receive $3 million and the equity holders receive nothing (though due to limited liability they have no further obligations). In this case, the payment to the equity holders is identical to the payoff of a call option written on the assets of the firm with a strike price equal to the face value of the debt (in this case $5 million).

6.28 A put option is a financial security that provides the holder with the right, but not the obligation to sell a particular asset at a particular price on a particular future date. The holder is free to exercise the option (by selling the asset at the specified price) or to let the option lapse. The price received when exercising the option is known as the strike price. For example, consider a $5 put option on Telstra shares that matures at the end of March. If the Telstra share price is $6 at the end of March, the holder will allow the option to lapse – the holder will not want to sell a Telstra share for $5 if it is worth $6. If the Telstra share price is $4.50 at the end of March, the holder will exercise the put option. This involves selling a Telstra share for $5 when it is worth only $4.50 at the time. In this case, the holder of the put option makes a gain of $0.50 by exercising the option, and whoever sold them that put option makes a loss of $0.50 when the option is exercised against them.

6.29 Lenders to a firm can be modelled as owning a riskless bond and being short (i.e., having sold) a put option on the firm assets for the value of the risk associated with debt. Consider the two scenarios outlined above. The bond pays off a fixed $5 million in both scenarios. In Scenario 1 the put option will expire without being exercised and the lenders keep their $5 million bond payoff. The put option provides the holder with the right, but not the obligation, to sell the firm's assets for $5 million. Put differently, it allows the holder to walk away from a debt of $5 million with no further consequences, which is, mathematically, the same thing). If those assets are actually worth $9 million, the option to sell will not be exercised. In Scenario 2, the put option will be exercised against the lenders. Exercise of the option means that the lenders are forced to pay the strike price of $5 million to buy the assets of the firm, which are worth only $3 million. This involves a loss of $2 million. The put option component provides payoff of $0 in Scenario 1 and -$2 million in

Scenario 2 – a standard short put payoff. The lenders have a combination of a riskless bond (which pays off $5 million in both Scenarios) and this short put option, so the net payoff to them is $5 million in Scenario 1 and $3 million in Scenario 2. This is why lenders require a risk-premium and do not lend at the risk-free rate.

6.30 Just as with any derivative security, the value of the contingent claims on the firm are driven by the value of the underlying asset. In the Merton model the underlying asset is the value of the firm assets, equity is modelled as a call option on the firm's assets and debt is modelled as the combination of a riskless bond and a short put over the firm's assets:

$$Value\ of\ firm = Value\ of\ equity + Value\ of\ debt$$
$$= Call\ option + (Riskless\ bond - Put\ option)$$

6.31 The limited liability of equity means that no matter how bad the firm's performance, equity holders can walk away from firm's debt in exchange for payoff of zero. Limited liability is equivalent to equity holders issuing riskless debt but lenders giving equity holders a put on the firm's assets with a strike price equal to the face amount of the debt (the "default put").

6.32 Since it can be clearly established that the value of both debt and equity are linked to the value of the assets of the firm, it must be the case that the factors that drive changes in the value of the assets of the firm also drive the returns to debt and equity in that firm. Thus, there must be a relationship between the return on debt and the return on equity in the same firm.

6.33 The basic framework Merton developed has been widely used in the 40 years since his seminal paper (see Appendix L). The approach has been extended and expanded to incorporate different relaxations of the underlying assumptions Merton originally used. It has underpinned many commercial valuation products; Moodys KMV, for example, is an application of the same framework used by Merton. Finally, there has been considerable empirical assessment of whether the approach actually does correctly price, debt (particularly) and equity.

6.34 A key finding of the empirical literature is that the model does not price the level of the return on debt particularly well, because its assumptions leave out some key information about the market as a whole which is necessary to price debt. However, what it does do particularly well is track the relative movements of debt and equity; how changes in the return on debt influence the return on equity and vice versa. This makes it ideally suited for a consistency test between the return on debt and equity as required under NGR 87(5). It is therefore this part of the literature to which we turn for our consistency test. Within this literature, it is the elasticity between debt and equity which is the primary consideration, and this gives rise to the following relationship (Campello, Chen and Zhang (2008):

$$(r_e) - r_f = \Omega_{e,d}\big(E(r_d) - r_f\big) \qquad (10)$$

6.35 Here r(e) and r(d) refer to the return on equity and debt respectively, r(f) to the risk-free rate and Ω to the elasticity. This elasticity can be established in a number of different ways; Merton originally suggested it is a function of leverage, volatility and the risk-free rate, and Freiwald, Wagner and Zechner (2013) show that it is equal to the ratio of the volatilities between debt and equity. Schaefer and Strebulaev, (2008) show that it is the inverse of the hedging ratio.

6.36 In Appendix L, SFG show how the papers of Campello et al (2008) and Friewald et al (2013) are related, and also how the basic modelling framework derives exactly the same outcomes as would be the case under a CAPM framework which took different potential states of the world into account. The core element in both of them is the elasticity between debt and equity; the degree to which changes in one drive changes in the other. This is derived directly from the structural framework of contingent claims that Merton created in his original model.

Implementing the consistency model

6.37 We now turn to the task of estimating the Merton model. This requires five pieces of information (depending upon which way the consistency check is to be implemented:

(a) the expected return on equity;

(b) the market or promised return on debt;

(c) the probability of default;

(d) the expected recovery rate in the event of default; and

(e) the elasticity between debt and equity.

6.38 The model itself inter-relates the expected return on debt and the expected return on equity. The market return on debt, such as the value taken from a Bloomberg terminal, is not the expected return on debt, but rather the promised rate; the return investors expect is tempered by their notions of the possibility of default and their expected recovery in the event of such a default.[78] This is why junk bonds have higher yields (lower prices) than AAA bonds. It is worth noting, as SFG do in Appendix L, that in respect of equity, the rate provided in regulation is not an expected return, but is rather an allowed return. Equity holders receive nothing if a regulated firm goes bankrupt. There is therefore also a need to consider the (admittedly small) probability of default when using the analysis of Campello et al (2008) to link debt and equity. This is covered in more detail in Appendix L, where it is noted that even a very small probability of default can create a reasonable difference between the allowed and expected returns on equity.

6.39 Information on the return on equity is obviously generated from the process of determining a model which meets our model adequacy test described in Chapter Five, and would commonly be the output of a model like the SL-CAPM. This allowed rate of return is then turned into an expected rate of return by consideration of data on likely default rates. Unlike debt, recovery rates are not an issue, because equity holders receive nothing in the event of default.

6.40 The expected return on debt is the market return on debt for the BEE, determined via the process outlined in Chapter 4. It is then tempered by the same data on likely default rates, and also by data on potential recovery in the event of default. Using data from Standard and Poors on default and recovery rates for BBB+ bonds, SFG have determined a conservative (that is, a relatively high default rate; which gives rise to a lower inferred return on equity) default premium of 82 basis points (see Appendix L). This is therefore subtracted from the allowed debt risk premium to obtain the expected debt risk premium.[79]

6.41 The elasticity between debt and equity is determined by reference to the work of Schaefer and Strebulaev, (2008) who show that it is the inverse of the hedge ratio. The hedge-ratio is, in turn, a function of leverage and the standard call-option delta from Black and Scholes (1973).

6.42 SFG use this approach to calculate the elasticity between debt and equity, but they do not do so only once, but rather for many different values of the relevant input parameters. In so doing, they discover that the elasticity is never lower than six, and thus make use of this as a conservative lower bound to give a return on equity inferred from the return on debt that is as close as is feasible to the return on debt.

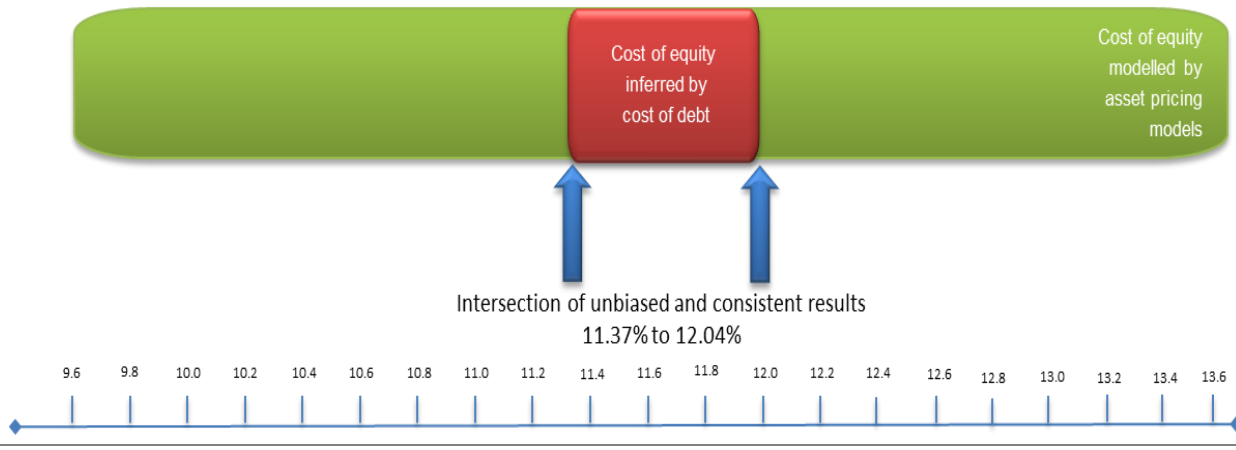
Application as a cross check and Stage Five of the ERA's assessment process for equity

6.43 From the conclusion of Chapter 5, we have that the range of unbiased model outcomes of the return on equity is from 9.67 to 13.72 per cent (Table 18). From Table 2, the allowed return on debt ranges from 5.66 to 5.77 per cent (without the premium for debt issuance and hedging or the

[78] *The ERA recognises this fact; see Explanatory Statement paragraph 523.*
[79] *The allowance for issuance and hedging costs is not included because they are not part of the premium for risk.*

new issue premium),[80] which translates into an expected debt risk premium of between 131 and 142 bps once the risk free rate (3.54 per cent) and default premium (82 bps) are subtracted. Using the most conservative value for the elasticity between debt and equity of six, we show the intersection between the return on debt inferred from the return on equity, and the calculated return on equity from Chapter 4 in Figure 10. This intersection represents the range of estimates of the return on equity that are both unbiased and consistent with the return on debt.

Figure 10: Return on equity from unbiased asset pricing models and inferred from return on debt



Source: type reference here

6.44 The true return on equity, which is unbiased and consistent with the return on debt, lies in the portion of the indicated by the arrows in Figure 10. One could choose any point in this range and, on the strength of the data alone, reach equally valid conclusion. We choose the mean, which leads to a point estimate for the return on equity that is both unbiased and consistent of 11.71 per cent.

[80] *The 15 bps for debt raising and hedging costs is an administrative cost which is quite clearly unrelated to the underlying relationship between debt and equity premia. Similarly, we consider that the new issue premium represents the risks associated with getting the debt to market and not the fundamental underlying relationship between debt and equity as options. Including these costs would increase the inferred cost of equity in a way which we do not consider to be consistent with the theory underlying Merton's model.*

7. ISSUES OUTSIDE DEBT AND EQUITY

7.1 In this chapter, we cover three issues that sit in the Guidelines, but sit outside the direct determination of the return on debt and equity. These are:

(a) gamma;

(b) inflation; and

(c) the use of the post-tax revenue model.

Gamma

7.2 In this section, we discuss our approach towards the estimation of gamma. The section draws upon Appendix O, which discusses each of the issues addressed below in considerably more detail. The most important point to make is that, save for a minor technical issue, we intend to follow the Guidelines in respect to the estimation of gamma. The ERA has disregarded its own Guidelines in respect of the estimation of gamma in the recent ATCO Draft Decision, and we do not consider it has made a compelling case for doing so. We explain our reasons for this conclusion below.

7.3 Firstly, gamma is the product of the distribution rate and theta, which measures the value equity investors obtain from franking credits. Despite giving some credence to work by Lally (2014b), which we do not believe is sufficiently robust to warrant consideration (see Appendix O for a detailed discussion), the ERA stays with an estimate for the distribution rate of 0.7 in the ATCO Draft Decision, which has been widely used by regulators in the past. This does not represent a departure from the Guidelines, and we agree with the ERA that this is the most robust value to use.

7.4 In respect of theta, however, the ERA has decided to consider evidence that it states is new, but which was available at the time of the Guidelines. This has led it to consider four different types of evidence (ATCO Draft Decision paragraph 968):

(a) dividend drop off studies – which suggest an estimate of θ in the range of 0.3 to 0.7 (this is given low weight);

(b) equity ownership – which suggests an estimate of θ of 0.7, based on the ownership of listed and unlisted equities (this estimate is given most weight);

(c) taxation statistics – which suggest θ is in the range of 0.4 to 0.8 (these estimates are given low weight); and

(d) the conceptual goal posts – which suggest θ is in the range of 0.6 to 1 (these estimates are given some weight).

7.5 There are significant issues associated with the use of taxation statistics and the conceptual goalposts, which are discussed in detail in Appendix O. The ERA has given both relatively low weight, and we would consider that even this is being overly generous. In particular, the conceptual goalposts do not appear to have any validity in a real-world setting outside the model which created them (see Appendix O) and in any case, cannot be used to support a theta that is "significantly different from one" like the lower end of the range the ERA proposes. Tax statistics have previously been dismissed by the ERA as irrelevant (see Explanatory Statement paragraph 932) and thus it is difficult to see why they are now given any weight by the ERA.

7.6 The main focus of our argument is whether formal studies of market value, which were previously given sole weight by the ERA in its Guidelines should have been relegated to having essentially no weight in the ERA's considerations, which appear to have been based solely on equity ownership.[81] We believe this is an error on the part of the ERA, which we discuss in the first section below. We also believe that some of the criticisms the ERA makes of dividend drop-off studies are in error, which means not only that they ought to be given higher weight, but that the range of theta estimates produced by them is not 0.35 to 0.55. We discuss this in a second section below. A third section of this chapter provides DBP's conclusions in respect of gamma, which depart only slightly from those in the Guidelines.

7.7 Before commencing the discussion, however, much of the ERA's change in approach in respect of theta appears to have been driven by a change in consideration about the regulatory framework, which it states that it believes should reflect the "Officer framework", based upon the theoretical work of Lally (2012, 2013, 2013a, 2014b). However, Lally is quite clear in his framework, that it is based on either a perfectly segmented (Australia is isolated from world markets) or a perfectly integrated financial market. Neither is true, and the perfect segmentation assumption would require significant changes to other aspects of the WACC, such as the risk-free rate and the market risk premium, which have not been implemented. We do not think it should do so, but if the ERA is going to implement regulation within the restrictive framework of Lally's theoretical models, it must do so consistently. This issue is addressed in considerably more detail in Appendix O.

Equity ownership, redemption rates and value

7.8 The ERA places most weight on the share of equity ownership held by Australians as a measure of value for theta. This conflicts directly with the closed-system theoretical framework from Lally (ibid) which it uses to motivate much of its change in approach on theta and Lally himself (Lally, 2013a, p13) says:

> *"The AER (2013, p237) also defines the utilisation rate (theta) as the proportion of distributed credits that investors redeem. This is incorrect."*

7.9 Despite the ERA's strong preference for a solid theoretical background elsewhere in WACC determination, such as in estimates of the return on equity, as argued in Appendix O, it does not appear to have based its new approach to gamma on any kind of theoretical basis at all.

7.10 The use of equity ownership is essentially an argument about redemption; one dollar of franking credit allows an investor to offset one dollar of tax, but only Australian taxpayers can do this, so if 70 per cent of equity in Australian markets is owned by Australian taxpayers then the redemption rate (if everyone actually redeems franking credits, which evidence presented in Appendix O suggests they do not) must be the same as the domestic share of equity ownership.

7.11 However, redemption is not the same thing as market value, because it ignores the fact that investors incur costs associated with redeeming franking credits that means that they do not necessarily value them at one dollar per credit, despite this being what they can redeem them for. This is something the ERA has noted in the past, and indeed has used as a motivation for using market values (Guidelines Explanatory Statement, paragraph 932):

> *The Authority considers that tax statistics, while not suffering methodology issues, are irrelevant for the direct estimation of theta because they fail to take into account the costs investors incur in obtaining franking credits. These costs result in franking credits being valued at less than their face value. In order to qualify for franking credits, investors must take on risk by purchasing and/or holding stocks. In addition, domestic investors forgo the benefits of international diversification and incur transaction costs by qualifying for franking credits.*

7.12 The key question is therefore whether the NGR require the use of market value or not. NGR 87A(1) requires that gamma be an estimate of "the value of imputation credits". In previous

[81] *Since, by the ERA's own calculation, dividend drop-off studies suggest a range for theta of between 0.3 and 0.7, even if they were given a low weight (in a weighted average sense), one would expect the final conclusion to be different from the equity ownership figure of 0.7. Thus, whilst the ERA may have considered dividend drop-off studies, it clearly did not use the findings of such studies in its conclusions.*

Tribunal decisions, as detailed in Appendix O, this has been taken to mean "market value", and this is also how the ERA has interpreted this itself in the past, as well as in its own equation for the value of a stock (ATCO Draft Decision p431). However, the ERA now interprets "value" to mean:

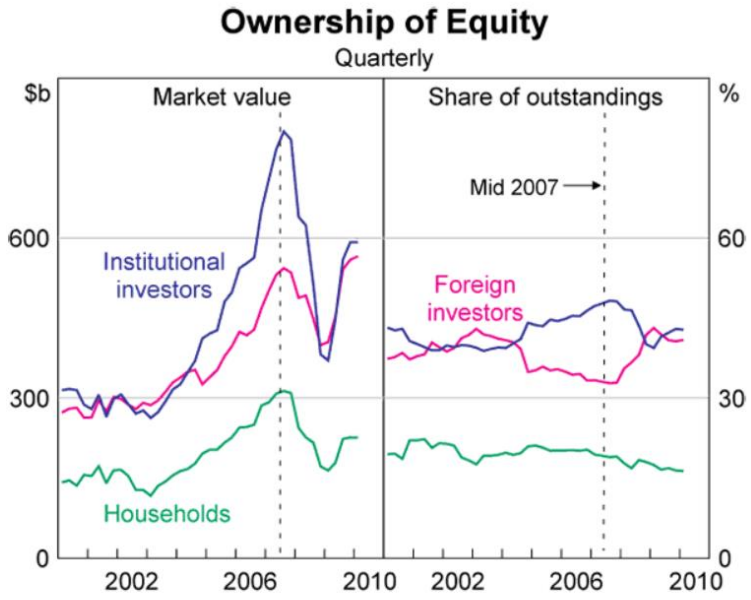
> *"this value is not a market value, but instead a numerical value"*[82]

7.13 DBP would suggest that a correct interpretation of NGR 87A(1) is that gamma, rather than just being any number, needs to be a market value, and we agree with the conclusions the ERA made to that effect in its Guideline.

7.14 This is an important distinction to make, because the ERA's own work on theta as a market value in the ATCO Draft Decision supports a value of 0.5, but it proposes a "value" of 0.7. This effectively means that it proposes not to reward investors with a revenue stream that reflects the value they place on the relevant asset, but instead proposes to reward them less than this value (see Appendix O for more detail on this point. The ERA appears to recognise this point in the ATCO Draft Decision (p439) when it notes that under the Officer framework, the costs that need to be incurred to obtain imputation credits are irrelevant for the estimation of gamma. This may or may not be true, but it does not follow that, if these costs are part of the efficient costs of providing the reference service, that they can be totally ignored.

7.15 It is for this reason that we suggest the value for gamma needs to be the market value, not some numerical "value" associated with equity ownership, and we devote the next section to a discussion on how that value ought to be established. First, however, it is useful to examine whether the figure of 0.7 is actually correct, within the context of the ERA's approach. Figure 11 shows the proportion of foreign ownership of Australian equity through time.

Figure 11: Foreign ownership of Australian equity over time



Source: Black & Kirkwood 2010, RBA (see Appendix O)

7.16 As can be seen, the level of 30 per cent corresponds with the nadir of foreign ownership of Australian equity; in 2007. Moreover, the ABS figures which underpin Figure 11 (which the ABS itself notes are subject to large margins of error - see Appendix O) include privately-owned equity, equity in government-owned trading enterprises, general government and the Reserve Bank. This produces a downward bias on the level of foreign ownership of private equity in Australia, which is

[82] *ATCO Draft Decision, para 942*

what is supposed to be measured by the ERA's proposed equity share approach. If more recent data on the share of private equity in the Australian stock market were used, then the foreign share is 46 per cent, not 30 per cent (see Appendix O and also Lally, 2012). This would give a theta of 0.54, not 0.7, and would lead to a gamma of 0.38. This sits slightly below the upper end of the range originally proposed by the ERA in its Guidelines. Also, it is almost the same as the recent AER Jemena Draft Decision, where theta was reduced to reflect more recent information in respect of equity ownership shares.

Measuring market value

7.17 We consider that the key requirement for theta is that it be a measure of market value, not some other measure such as redemption rates. The key question then is how market value ought to be estimated, and how reliable such studies are. In the Guidelines, the ERA note that, of the available empirical techniques, dividend drop-off studies appear to be the most reliable (Guidelines paragraph 151). We agree, and have used just such an approach.

7.18 In the ATCO Draft Decision, the ERA made four criticisms of dividend drop-off studies:

(a) they only measure returns on a particular day, not over the longer term, and are subject to bias because of selling at the time dividends are paid;

(b) they tend to be highly imprecise;

(c) the coefficient used in such regressions does not measure market value per se, but needs to be adapted to do so (based on the advice of Lally, 2013a); and

(d) if all of these issues were not pertinent, the ERA's approach to dividend drop-off studies is the superior approach.

7.19 We address each of these assertions below.

Daily versus long-term measures, and bias

7.20 The discussion on the use of long term versus daily figures and the problem of bias appears to be related to the issue of market movements around the time that dividends are issued; more succinctly, could unusual market trading conditions around the time dividends are paid influence the price of a stock, and thus skew the estimate of gamma? This issue is addressed in Appendix O. While it might be hypothetically possible for such a thing to happen, no empirical evidence has been presented which suggests that it has actually happened (save some work done in Hong Kong, which has a totally different tax system to Australia). Moreover, as argued in Appendix O, the most likely direction of bias in gamma is upwards, not downwards.

Precision

7.21 The ERA notes concerns about precision such as multicollinearity (for which it provides no test results) and problems associated with influential variables. However, as SFG report in the ATCO Submission (Appendix O), the ERA's tests of stability are non-standard in that they remove one extreme observation at a time, which has the natural tendency to create instability. When the more standard approach of removing extreme observations in pairs (one high and one low) is employed, instability is much less of a concern. Moreover, instability is much more of a concern in the ERA's models, where the heterodox assumption about the movement of stock prices on non-dividend days is used, than it is in SFG's models. This suggests that the ERA's model results ought to be given less weight, and accordingly, we do so.

7.22 The ERA notes numerous issues about the precision of estimates from dividend drop-off studies, citing the range of outcomes which come from these studies. However, as pointed out in Appendix O, the range in the studies undertaken by SFG is relatively narrow; it is only once the ERA uses its heterodox assumption about movement of stock prices on non-dividend days (see below) that imprecision in estimates appears to be an issue. We submit that this might be another good

reason to give the ERA estimates very little weight, and indeed we do so in our estimation of gamma below.

Inappropriate regression coefficient

7.23 Lally (2013a) has argued that the regression coefficient used in dividend drop-off studies does not actually represent what he calls the utilisation rate (theta), but rather needs to be divided by the dividend drop-off estimate. It is difficult to understand how this can be the case, which might be why nobody, to our knowledge, other than Lally has advanced such a notion. In particular, the equation which is estimated in empirical studies on gamma can be directly derived from the ERA's own equation for the value of a stock, with no divisor in the parameter for the value of the imputation credit. The ERA's equation for the value of a stock is:

$$S_0 = \frac{Div_1 + IC_1 U + S_1}{1 + E\left[\hat{R}\right]}$$ (see ATCO Gas Draft Decision, Equation (6), p. 431, Paragraph 34)

7.24 This can be re-arranged thus:

$$S_0\left(1 + E\left[\hat{R}\right]\right) - S_1 = Div_1 + U \times IC_1 .$$

7.25 This is the very equation that is implemented in a dividend drop-off analysis. The left hand side of the equation is the regressor – the change in the stock price over the ex-dividend day (with the standard market adjustment). The right hand side sets out the two regressands – the cash dividend and the imputation credit. That is, the equation that is estimated via drop-off analysis is derived precisely from the equation the ERA purports to adopt.

7.26 There are also several other reasons why the conclusion that the regression coefficient needs to be modified is incorrect (see Appendix O):

(a) Lally has been consistently recommending that same adjustment to regulators for over ten years[83] and it has never been adopted by any of them;

(b) even if applied, the adjustment would have a small effect. It would result in the SFG estimate of gamma changing from 0.25 to 0.28, and the ERA mid-point estimate changing from 0.32 to 0.36;

(c) when theta takes a value interpretation within the regulatory framework, what is required is an estimate of the price that investors would be prepared to pay for an imputation credit. Dividend drop-off analysis is specifically designed to estimate the price that investors would be prepared to pay for imputation credits. The standard dividend drop-off estimate of theta provides a direct estimate of the value of distributed credits;

(d) the proposed scaling has perverse outcomes. A decrease in the estimated value of cash dividends should (other things being equal) result in an increase in the allowed revenues – because shareholders do not value dividends as highly, they would need to receive more of them in order to be left equally well off.[84] However, under the proposed approach the only effect of a decline in the estimated value of cash dividends is that the drop-off estimate of theta would be increased, which would in turn result in perversely lower allowed revenues. That is, under the proposed approach, as the dividends paid by the firm become less valuable to investors, the allowed revenues are further reduced – which is the exact opposite of what should occur; and

(e) it would be inconsistent and wrong for a regulator to adjust the estimate of theta on the basis that cash dividends were less than fully valued, but then to estimate the required return on equity in the same WACC estimation process on the basis that cash dividends are fully valued. That is, if cash dividends are less than fully valued when estimating theta, they should be less than fully valued throughout the WACC estimation process.

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[83] *See, for example, Lally (2004), pp. 33-34.*
[84] *See for example, Lally and van Zijl (2003).*

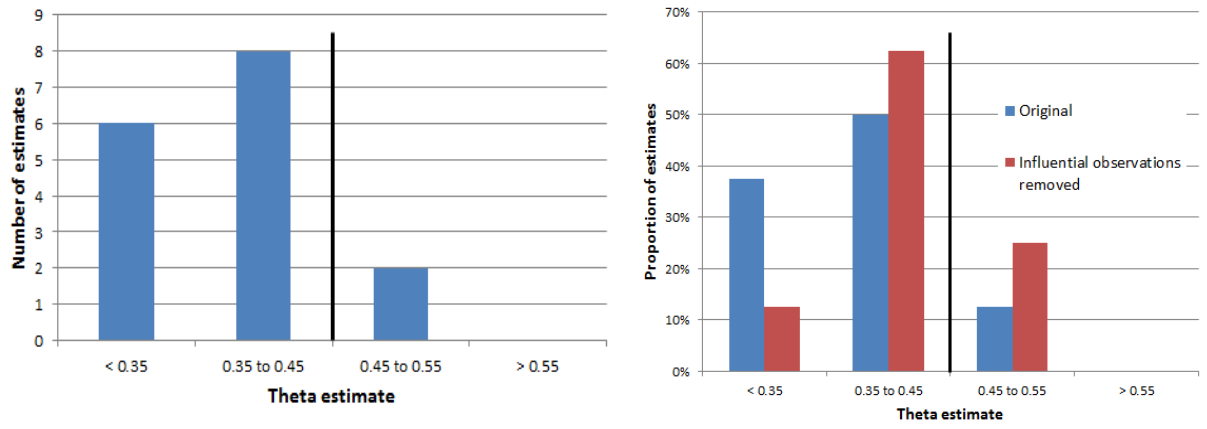
ERA vs SFG approaches

7.27 The major difference between the ERA's approach to dividend drop-off studies and that followed by SFG in its case before the Competition Tribunal (and, it must be said, in all of the academic literature) concerns the assumed movement of stock prices on non-dividend days. SFG, as per the standard in the academic literature, assume that the stock moves to the same degree as the market as a whole. The ERA, by contrast, assumes the movement to be zero. When the ERA undertakes its analysis in the same way that SFG does, it obtains essentially the same results (see Appendix O).

7.28 The ERA motivates its heterodox approach on the basis that it is simpler than assuming a movement equal to the market as a whole, and by the fact that the relevant information is "contained within the errors" of the regression. The first might be true, but is irrelevant. The mere fact that the ERA was able to follow the standard approach means that complexity is not a reason not to do so. The second objection runs counter to the basic tenets of statistics wherein great care is taken to ensure that variables are measured as accurately as possible and is essentially an argument for flawed statistical work. The sentiment that the ERA expresses in respect of gamma is directly contradicted by the much greater care that it takes in estimating other parameters, such as beta.

7.29 Even without the problem of flawed empirical work, the range the ERA obtains in its various empirical analysis, and the conclusions that it draws from its range are problematic. In particular, most of the estimates it cites are towards the lower end of its range, and below the mid-point it chooses of 0.45. This is shown in Figure 12 and suggests that the lower end of the range from the Guidelines (0.35 to 0.55) is more appropriate than the mid-point.

Figure 12: Range of ERA gamma estimates



Source: Vo et al (2013)

7.30 The ERA obtains almost exactly the same result as SFG when they make standard assumptions about stock price movements on non-dividend days (SFG, 2014b, p8), and that its "robust regression" estimates of theta suggests a value of 0.32; which sits outside the ERA's range. This is further evidence that the ERA's average theta of 0.45 is probably too high.

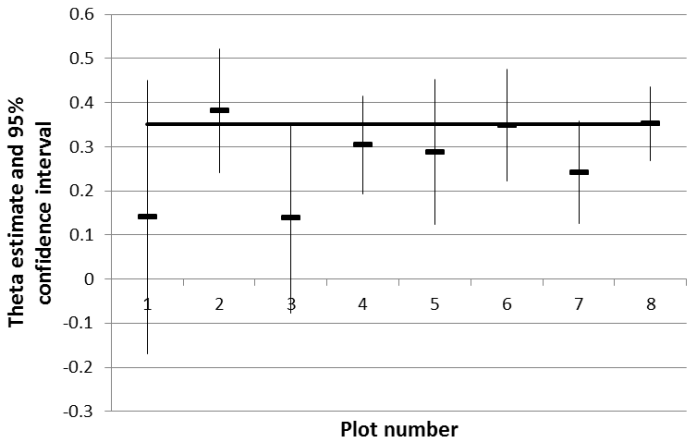
Conclusions on theta

7.31 We consider that theta should be estimated via a dividend-drop-off method, using the standard approach in the academic literature in respect of the movement of stocks on non-dividend days, rather than the ERA's heterodox approach.

7.32 DBP has not undertaken any new studies of gamma, as the most recent study, following exactly the approach accepted by the Competition Tribunal, was submitted by ATCO in March 2014 (SFG, 2014b), and it seems unlikely that the parameter would have changed substantially from this date.

7.33 In work for ATCO, SFG (2014b) note that the two estimates for theta in the Guidelines were an estimate of 0.35 from SFG and a rage from 0.35 to 0.55 from the ERA. However, there is significant evidence, outlined above and covered in more detail in Appendix O that limited weight should be given to many of the ERA estimates towards the top end of its range. Moreover, as shown in Figure 13 below, 0.35 is likely to be an over-estimate of theta.

Figure 13: SFG range of theta estimates



Source: Appendix O

7.34 Based upon a consideration of available evidence, DBP has reached the same conclusion as ATCO; the most appropriate value for theta is 0.35.

Conclusions on gamma

7.35 Given our conclusion on theta above, and a distribution rate of 0.7 (as per the Guidelines), our conclusion is that 0.25 represents the most reasonable and best estimate of gamma for the purposes of NGR 87A.

Inflation

7.36 We have followed the Guidelines in respect of the calculation of inflation, using linear interpolation on the difference between indexed and non-indexed government bonds. The Guidelines suggest that one should use the two which are closest to the end date of the access period for linear interpolation. This means that information contained in other bonds is ignored in the ERA's approach. It is not clear why the ERA has artificially narrowed its bond selection in this way, particularly when it is very careful to ensure that information from a wide range of corporate bonds (with a wide variety of termination dates) is used. We believe the same care the ERA shows for corporate bonds ought also to be applied to government bonds; something which applies both here and in our estimation of the risk-free rate (where we use linear interpolation of many non-indexed bonds).

7.37 It is also clear that the ERA has used an inflation rate that reflects the difference between the two bonds at the end of the period. This need not reflect inflation through the period. For example, if inflation were expected to surge for a period of time, and then return to the mean, this could be seen by applying a linear interpolation approach in each year of the access period, but would be hidden if only the final year were used. This could result in errors in inflation estimation.

7.38 Our approach has therefore been to follow exactly the same approach as the ERA proposes in its Guidelines; making use of linear interpolation where the weights for each bond reflect the distance from the target date of that bond's maturity, and the Fischer equation to do the inflation calculation.

The only differences are that we use all government bonds and not just the two maturing closest to the end of the access period (with progressively lower weights for those expiring further from the target date), and we do an inflation calculation quarterly (using the same linear interpolation approach and Fischer equation), not once for the whole five years. This gives rise to the inflation schedule shown in Table 20.

Table 20: Inflation by quarter during the access period

	quarterly (annualised) rates	Annual averages
Dec-14	2.05	2.05
Mar-15	2.03	2.02
Jun-15	2.02	
Sep-15	2.02	
Dec-15	2.02	
Mar-16	2.03	2.04
Jun-16	2.03	
Sep-16	2.04	
Dec-16	2.05	
Mar-17	2.06	2.09
Jun-17	2.08	
Sep-17	2.09	
Dec-17	2.11	
Mar-18	2.13	2.16
Jun-18	2.15	
Sep-18	2.17	
Dec-18	2.19	
Mar-19	2.19	2.22
Jun-19	2.21	
Sep-19	2.23	
Dec-19	2.25	
Mar-20	2.27	2.30
Jun-20	2.29	
Sep-20	2.30	
Dec-20	2.32	

Source: DBP analysis

7.39 Our results are slightly smaller than those found by the ERA, despite our input data being drawn from roughly the same time period (September 2014). The differences arise because the market (as expressed by the difference in the relevant indexed and non-indexed bonds) clearly believes that inflation will be lower at the start of the next access period than at the end. By using only the one interpolation at the end of the access period, the ERA has slightly over-estimated the cost of inflation.

Post tax nominal model

7.40 Consistent with the Guidelines, we propose to adopt the AER's PTRM.

8. OVERALL WACC

8.1 This submission has examined the formation of a suitable WACC for DBP for its forthcoming AA Period, from 2016 through to 2020. The approach is grounded in the Guidelines and is also informed by the ERA's recent ACTO Draft Decision. However, it takes as its primary basis, the provisions of the NGL and NGR. This forces, in some instances, departures from the ERA's Guidelines, where we believe these Guidelines are not supportive of the NGO, ARORO or RPPs.

8.2 A key underlying philosophy has been to test each empirical estimate we have made, wherever possible, against actual data, rather than simply estimating particular models in what we believe to be a competent fashion and assuming that the results will thereby be sound. This is particularly the case in the estimation of the return on equity, which is generally far more subject to debate than is the case for the return on debt, simply because it cannot be observed in the marketplace, but must be inferred from model outputs and other data.

8.3 To ascertain whether we have sound models for the return on equity, we first put each model that we find is theoretically sound through a model adequacy test, which examines the issue of whether each model would or would not have been able to deliver an unbiased forecast of returns during the past forty years when compared with actual returns subsequently earned.

8.4 This test of bias is crucial in respect of achieving the ARORO, for a model which is biased upwards or downwards cannot, over the long term, reward a service provider for the efficient costs associated with the provision of reference services; it must, through mathematical necessity, either over or under-reward against this benchmark. Finance data are notoriously noisy, and obtaining clear signals from these data has long been difficult. This results in the range of model outcomes, in terms of returns to equity, which can be shown to be unbiased being relatively large. However, only one model really provides solid evidence of being unbiased, and this is the Black CAPM. Importantly, the ERA's approach of using the 95th percentile for beta in the empirical SL-CAPM to overcome the bias which the literature on the Black CAPM shows besets the SL-CAPM does not in fact perform this role and would still leave an efficient firm unable to meet the ARORO.

8.5 Having assessed the reasonableness of the range for the return on equity using available data on equity, we then see how information on the return to debt can inform the return to equity, and vice versa. We do this by making use of the relationship which options theory says must exist between the premium of risky debt and the premium on risky equity when both are options on the same underlying asset. This is useful because the range of return on debt outputs is relatively narrow, and allows us to significantly reduce the range of the return on equity estimate.

8.6 Our assessments of the return on equity using just the information from asset pricing models indicate that unbiased models would predict a range from 9.67 to 13.72 per cent. Considering information from the return on debt narrows that range to between 11.37 and 12.04 per cent. We choose the mean of this range, which is 11.71 per cent. This figure is combined with an estimate of the return on debt of 6.13 per cent and a gearing of 60 per cent to give a WACC of 8.36 per cent.

8.7 The allowed rate of return has been calculated using the following formula (consistent with the formula used in the Guidelines):

$$WACC_{vanilla} = E(r_e)\frac{E}{V} + E(r_d)\frac{D}{V}$$

where

$E(r_e)$ is the expected return on equity;

$E(r_d)$ is the expected return on debt;

E/V is the proportion of equity in total financing (comprising equity and debt); and

D/V is the proportion of debt in total financing.

8.8 Other key matters addressed in this submission are gamma, and the nature of annual updates to the return on debt. In respect of gamma, we find that there is very limited compelling evidence to shift from the approach the ERA used in its Guidelines of using dividend drop-off studies to estimate the value of imputation credits. We believe the ERA has erred by shifting from this approach in its ATCO Draft Decision. Using methods from the peer-reviewed academic literature, we find that the best estimate of gamma is 0.25.

8.9 In respect of the annual updates to the return on debt, we find that there is limited evidence to adopt the methodology in the Guidelines or the ATCO Draft Decision. Instead, we conclude that there is more evidence to adopt the methodology in the AER's rate of return guidelines, albeit with a modification to the treatment of updating in circumstances where there has been significant amounts of capital expenditure made during an access arrangement period.

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APPENDIX A: DEPARTURES FROM AND ADDITIONS TO THE GUIDELINES

APPENDIX B: APPROPRIATE TERM FOR DEBT AND EQUITY

APPENDIX C: IN-PRINCIPLE MODEL RELEVANCE ASSESSMENT

APPENDIX D: MODEL ADEQUACY TEST BACKGROUND

APPENDIX E: ERA MARKET RISK PREMIUM IN ATCO DRAFT DECISION

APPENDIX F: ROBUST REGRESSION

APPENDIX G: EFFICIENT DEBT STAGGERING BY COMPETITIVE FIRMS

APPENDIX H: NEW ISSUE PREMIA FOR DEBT

APPENDIX I: EFFICIENCY AND THE THEORY OF SECOND BEST

APPENDIX J: ANNUAL UPDATE MODEL FOR RETURN ON DEBT

APPENDIX K: DEBT INSTRUMENTS USED

APPENDIX L: MERTON AND THE CONSISTENCY BETWEEN DEBT AND EQUITY

APPENDIX M: TESTS OF THE IMPACT OF INTEREST RATES ON PRODUCT PRICES

APPENDIX N: DIEBOLD MARIANO TESTS

APPENDIX O: GAMMA