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6 September 2022

Ms Jenness Gardner
Chief Executive Officer
Economic Regulation Authority

By e-mail: publicsubmissions@erawa.com.au

Dear Ms Gardner

GGT's response to ERA 2022 Draft Gas Rate of Return Instrument

Goldfields Gas Transmission Pty Limited (**GGT**) operates the Goldfields Gas Pipeline for the participants in the Goldfields Gas Transmission Joint Venture. The Goldfields Gas Pipeline is a gas transmission pipeline which is regulated under the regime of the National Gas Law and the National Gas Rules.

On 17 June 2022, the Economic Regulation Authority (**ERA**) published the *2022 Draft Gas Rate of Return Instrument*. This draft instrument was accompanied by an Explanatory Statement.

GGT appreciates the opportunity to provide a submission on the draft instrument.

Please see the attached for the GGT's submission.

If you would like GGT to elaborate on any of the views in the submission, please feel free to reach out to our Regulatory Manager, Ignatius Chin. He can be contacted directly on +61 8 9223 7889, or at ignatius.chin@apa.com.au.

Yours sincerely

Barrie Sturgeon
General Manager
Goldfields Gas Transmission

GGT

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Submission on *2022 draft gas rate of return instrument*

6 September 2022

Executive Summary

The Goldfields Gas Transmission Joint Venture Participants and Goldfields Gas Transmission Pty Limited (GGT) have few concerns about the Economic Regulation Authority's *2022 draft gas rate of return instrument* (2022 Draft Gas Instrument) and would expect to see most of the draft retained in the 2022 final instrument.

Estimation of the market risk premium from historical excess returns

Our principal concern is estimation of the market risk premium (MRP), from historical excess returns (HER), using a weighted average of the arithmetic and geometric averages of those excess returns.

To propose that the MRP be estimated as a weighted average of arithmetic and geometric averages of historical excess returns, with a substantial weight (40 per cent) to be given to the geometric average, involves a serious misreading of the evidence available to the ERA.

In estimation of the MRP for the 2022 Draft Gas Instrument, there is no forecasting of the HER series forward at a rate of return implied by the historical series available at the time. The unbiased estimator of the mean of the series is, in these circumstances, the arithmetic average. This is unaffected by any considerations of the presence of autocorrelation in the excess return series, or by variance volatility.

The error - use of the geometric average where only the arithmetic average is required - should be corrected before proceeding to the 2022 final instrument. An estimate of the MRP made from historical excess returns should be made as the arithmetic average of those returns.

Term of the proxy for the risk-free asset of the Capital Asset Pricing Model

We agree with the ERA's use of a 10-year Commonwealth Government bond for estimation of the risk-free rate of return of the Sharpe-Lintner Capital Asset Pricing Model (CAPM).

Like the ERA, GGT was concerned that the model developed by Dr Martin Lally relied on an assumption that investors were certain that the market value of regulated assets at the end of the regulatory period was equal to the regulatory asset base. Equity investors were, however, unlikely to make such an assumption. The requirement for NPV = 0 did not, then, specifically require that the term of a proxy for the risk free asset of the CAPM match the length of the regulatory period.

If this were the case, the question of how a proxy for the risk-free asset was to be established was left open. GGT's asked this question of Professor Stephen Wright. Professor Wright has, for the last two decades, advised economic regulators in the United Kingdom on rate of return issues. His response is attached to this submission.

Professor Wright's key conclusions are:

- the term of the proxy should be set equal to the assumed investment horizon of equity investors since the return on even a default-free long term bond is only risk-free if the bond is held to maturity;
- establishing the investment horizon of equity investors is not clear-cut, but there is a strong case for assuming an investment horizon, and hence a term for the risk-free asset, that is distinctly longer than five years (the length of the regulatory period); and
- the preceding conclusions are consistent with well-established practice by regulators both in the United Kingdom and (until recently) in Australia; the terms of the bonds used to estimate the risk-free rate of the CAPM in recent United Kingdom regulatory decisions are as follows:

Regulator	Price control	Term of bond (years)
CAA	RP3	10
Ofwat	PR19	15
CMA	RP3	10-20
Ofgem	GD2 & T2	20
CMA	PR19	20
Ofcom	WFTMR	10-15
UR	PR21	10 and 20
CAA	H7	20

The ERA has arrived at a conclusion on estimation of the risk-free rate of return which is the same as the conclusion GGT reached in its February 2022 submission: a 10-year Commonwealth Government bond should be used for estimation of the risk-free rate of return. Professor Wright's response shows that this conclusion is supported by both financial economic argument and the practice of regulators in other jurisdictions.

The 2022 final instrument should require use of the CAPM for estimation of the rate of return on equity, and use of a 10-year Commonwealth Government bond for estimation of the risk-free rate of return of the model.

Our comments on other aspects of the 2022 Draft Gas Instrument

Form of the rate of return

The form of the allowed rate of return, a nominal vanilla weighted average of returns on equity and debt, as set out in the 2022 Draft Gas Instrument, should be retained in the 2022 final instrument.

Gearing

Gearing of 55 per cent continues to be appropriate for the 2022 final instrument.

Cross checks

The use of cross checks should not be required in the 2022 final instrument.

Averaging periods

The proposal for averaging periods for parameters estimated from market data (risk-free rate of the CAPM, swap (base) rate of the rate of return on debt estimate, debt risk premium, expected inflation) in the 2022 Draft Gas Instrument should be incorporated in the 2022 final instrument.

The proposal for averaging periods for the annual update of the debt risk premium in the 2022 Draft Gas Instrument should also be incorporated in the 2022 final instrument.

Return on debt

The ERA's hybrid trailing average approach should continue to provide the framework for the setting of the rate of return on debt in the 2022 final instrument.

Use of the five-year swap mid-rate as the base rate for rate of return on debt estimation should continue in the 2022 final instrument.

The assumption that a benchmark efficient debt strategy is service provider maintenance of a portfolio of 10-year fixed-rate debt with 10 per cent refinanced each year should be retained in the 2022 final instrument.

GGT does not support the use of a benchmark credit rating of BBB+ for the 2022 final instrument. The BBB+ benchmark is not derived from data for stand-alone businesses (the benchmark efficient entity of paragraph 57 of the Draft Explanatory Statement is "stand-alone"), but from businesses with financially strong parent entities. GGT is of the view that the benchmark credit rating (for the "stand-alone" benchmark) should be BBB.

Use of the revised bond yield approach to estimate the debt risk premium should be retained in the 2022 final instrument.

The proposal for the annual updating of the return on debt in the 2022 Draft Gas Instrument should be incorporated in the 2022 final instrument.

Use of the CAPM

In earlier submissions GGT noted the limitations of the Sharpe-Lintner Capital Asset Pricing Model (CAPM), but has acknowledged that, properly applied, the model can be used to estimate equity returns.

Market risk premium

GGT has previously supported use of the Energy Networks Australia (ENA) calibrated dividend growth model (DGM). The growth calibration undertaken when applying the ENA model contributed to confidence in the resulting DGM MRP estimates greater than might be attributed to estimates from an uncalibrated model.

However, the ERA has identified problems with the ENA calibrated DGM. GGT does not have access to the model itself and cannot directly address the ERA's concerns. We understand that the ENA and the model developer Frontier Economics intend making further submissions on use of the calibrated DGM.

GGT remains of the view that use of the DGM provides an approach to MRP estimation very different from MRP estimation using historical excess returns. Use of the DGM better captures the changes in asset risks and investor willingness to bear those risks that seem to underlie time variation in the MRP.

Through use of a DGM estimate, the MRP might be updated, as required, throughout the period of 2022 Gas Rate of Return Instrument. Updating would require clear specification, in the Instrument, of a "mechanical" method of updating. If, however, as paragraph 114 of the 2022 Draft Gas Instrument indicates, the MRP estimate is to remain fixed for the term of the instrument, GGT sees less need for a more mechanical approach to MRP estimation.

GGT remains strongly of the view that no weight should be given to conditioning variables when estimating the MRP. No relationship has been established between any of the proposed conditioning variables and the MRP.

Equity beta

GGT is of the view that the ERA's estimation of beta, as explained in the Draft Explanatory Statement, makes good use of the limited data available.

The equity beta estimates for the ERA's Australian and international comparators, for 5-year and 10-year estimation windows, set out in Table 14 of the Draft Explanatory Statement, indicate a single point estimate of 0.7.

This single point estimate should now be the equity beta estimate of the 2022 final instrument.

GGT remains of the view that an equity beta estimate of 0.7 is a low estimate for the Goldfields Gas Pipeline. Inclusion of international energy firms in the comparator set for beta estimation should provide the opportunity for GGT to establish an equity beta estimate appropriate to the market circumstances and risks of the pipeline.

Debt and equity raising costs

The 2022 Draft Gas Instrument proposes increasing debt raising and hedging costs to:

- 0.165 per cent for debt raising costs; and
- 0.123 per cent for hedging costs.

The proposed increases should be retained in the 2022 final instrument.

Inflation

GGT understands the reasons for the ERA's adoption of the Treasury bond implied inflation approach.

If the Treasury bond implied inflation approach is to be retained as part of the 2022 final instrument, the instrument should be explicit about:

- the inputs to the expected rate of inflation calculation (yields on Australian Government bonds with 5 years to maturity, and yields on Australian Government indexed bonds);
- the ways in which those yields are to be obtained from the source data; and

- the way in which the estimate of expected inflation is to be made (calculated using the Fisher equation).

The risk-free rate has no place in the estimation of expected inflation. The risk-free rate is the rate of return on the hypothetical riskless asset of the CAPM. Reference to the risk-free rate should not appear in the rules for expected inflation in the 2022 final instrument.

Valuation of imputation credits (gamma)

The Monkhouse approach to the valuation of imputation credits, and the estimates of 0.9 for the distribution rate and 0.6 for the utilization rate should be retained for the 2022 final instrument. The 2022 final instrument should require an estimate of gamma of 0.5 (as proposed in the 2022 Draft Gas Instrument).

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1 This submission

Goldfields Gas Transmission Pty Limited (GGT) operates the Goldfields Gas Pipeline for the participants in the Goldfields Gas Transmission Joint Venture. The current Joint Venture participants are Alinta Energy GGT Pty Ltd, Southern Cross Pipelines Australia Pty Limited and Southern Cross Pipelines Australia (NPL) Pty Limited. Alinta Energy GGT is a company within the Alinta Energy Group. Southern Cross Pipelines Australia and Southern Cross Pipelines Australia (NPL) are APA companies.

The Goldfields Gas Transmission Joint Venture Participants and GGT are pleased to be able to provide, in this submission, feedback on the *2022 draft gas rate of return instrument* (2022 Draft Gas Instrument) and on the accompanying *Explanatory statement for the 2022 draft gas rate of return instrument* (Draft Explanatory Statement), which were published by the Economic Regulation Authority (ERA) on 17 June 2022.

Our submission comments briefly on each of the key aspects of the 2022 Draft Gas Instrument, and on the reasoning supporting each of those key aspects as set out in the Draft Explanatory Statement.

Our comments broadly follow the order in which each of the key aspects appears in the instrument itself. The principal sections of the remainder of the submission are as follows:

- rate of return framework (section 2);
- averaging periods (section 3);
- return on debt (section 4);
- return on equity (section 5);
- debt and equity raising costs (section 5);
- inflation (section 7); and
- value of imputation credits (section 8).

2 Rate of return framework

In this section of our submission, GGT provides feedback on the rate of return framework which the ERA intends to adopt in the 2022 final instrument. We consider, briefly:

- the form of the rate of return;
- gearing; and
- the use of cross checks in setting the rate of return.

2.1 Form of the rate of return

The 2022 Draft Gas Instrument (paragraphs 22 and 23) advises that the ERA intends that the allowed rate of return in the 2022 final instrument take the form of a nominal vanilla weighted average of rates of return on equity and debt.

Use of a vanilla weighted average of rates of return on equity and debt gives implicit recognition to accounting for taxation in other revenue building blocks.[1]

The nominal vanilla weighted average is the form of the allowed rate of return in the current (2018) *Final Rate of Return Guidelines*, which incorporated prior regulatory practice.

In earlier submissions, GGT accepted the use of this nominal vanilla weighted average as a measure of the allowed rate of return, as did other stakeholders.[2]

The form of the allowed rate of return, as set out in the 2022 Draft Gas Instrument, should be retained in the 2022 final instrument.

2.2 Gearing

Paragraph 23 of the 2022 Draft Gas Instrument indicates that, in the nominal vanilla weighted average used to estimate the allowed rate of return, debt is to be weighted by the proportion of debt in total financing. This proportion is the gearing defined in paragraph 31.

1 Draft Explanatory Statement, paragraph 115.

2 Draft Explanatory Statement, section 5.3.

Paragraph 37 advises that a gearing level of 55 per cent will be set until the next review of the gas instrument.

The gearing, the Draft Explanatory Statement advises, was estimated from data for firms in a benchmark sample of Australian energy networks.[3]

Market gearing should, the Draft Explanatory Statement notes, be used. However, in practice, the market value of debt is difficult to observe because the debt of firms in the benchmark sample is not frequently traded.

In earlier submissions GGT agreed with estimation of the gearing ratio using, wherever possible, market data. Market data, and not historical book values, provide the conceptually correct measure of gearing to be used in calculating the forward-looking allowed rate of return of the rate of return instrument.

In GGT's February 2022 submission responding to the ERA's December 2021 *Discussion Paper*, we were of the view that:

- there was no simple method whereby specific hybrid securities could be allocated between equity and debt; and
- those securities did not form part of the portfolio of financing instruments used by a benchmark service provider.

The Draft Explanatory Statement advises that the ERA has sought to identify hybrid securities that have predominantly equity characteristics and to remove them in making its estimates of debt. With access to the relevant loan documentation for a small number of firms, this may have been feasible.

Data used by the ERA for estimation of the gearing were series, to 2021, for four energy network businesses. Gearing was examined for a longer period (10 years), and for a shorter period of five years (with one less network business). The average gearing for the shorter term of five years was 53 per cent. For the longer period it was 55 percent.[4]

Gearing of 55 per cent is used in the current *Final Gas Rate of Return Guidelines* and, in GGT's view, continues to be appropriate for the 2022 final instrument.

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3 Draft Explanatory Statement, paragraph 214.

4 Draft Explanatory Statement, paragraph 262.

2.3 Cross checks

Three sets of broad cross checks have been considered by the ERA:

- financeability;
- regulated asset base multiples; and
- historical profitability.

There were, the Draft Explanatory Statement advises, significant practical issues with the use and application of these cross checks. The ERA was not satisfied that they should be applied formulaically or mechanically in rate of return parameter estimation, and was of the view that they should not be used deterministically to set the allowed rate of return.[5]

The 2022 Draft Gas Instrument did not, therefore, incorporate the use of cross checks.[6]

GGT is of the view that the cross checks which the ERA has considered are broad indicators, and there is no clear logic linking these broad indicators with specific elements of the rate of return, or with the overall rate of return. Cross checks may provide "sense checks" on the rate of return parameter estimates and on the overall rate of return but, beyond this, they cannot inform rate of return determination.

The use of cross checks should not, now, be required in the 2022 final instrument.

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5 Draft Explanatory Statement, paragraph 134.

6 Draft Explanatory Statement, paragraph 132.

3 Averaging periods

The 2022 Draft Gas Instrument separately specified:

- averaging periods for rate of return parameters estimated from market data (risk-free rate of the CAPM, swap (base) rate of the rate of return on debt estimate, debt risk premium, expected inflation); and
- averaging periods for the annual update of the debt risk premium.

3.1 Averaging periods for parameters estimated from market data

For rate of return parameters to be estimated from market data, the 2022 Draft Gas Instrument proposes:

- a service provider may nominate averaging periods;
- averaging periods must be nominated within 30 business days following the release of an access arrangement draft decision;
- nominations must made be prior to the averaging periods nominated;
- averaging periods will have durations of 20 consecutive trading days;
- an averaging period must fall within a window of at least two months, but no longer than six months, before the start of the relevant regulatory period;
- if an averaging period is not nominated as required, the ERA will use a default averaging period of 20 consecutive trading days ending two months prior to the start of the relevant regulatory period;
- expected inflation forecasting will use the same rules; and
- an averaging period will remain confidential until the period has passed.

GGT has no concerns with this proposal. As we noted in our February 2022 submission, the proposal will formalize in the rate of return instrument, and make more specific, the requirements for the setting of averaging periods without departing from current practice.

The Draft Explanatory Statement advises that, in earlier submissions, stakeholders had generally supported the ERA's proposal for averaging periods.

The proposal for averaging periods for parameters estimated from market data in the 2022 Draft Gas Instrument should be incorporated in the 2022 final instrument.

3.2 Averaging periods for the annual update of the debt risk premium

For the annual update of the debt risk premium, the 2022 Draft Gas Instrument proposes:

- a service provider may nominate averaging periods;
- an averaging period is to be nominated for each year of an access arrangement period;
- the first debt risk premium averaging period must be nominated within 30 days following the release of the relevant access arrangement draft decision;
- the remaining debt risk premium averaging periods must be nominated prior to the relevant final access arrangement decision;
- nominations must made be prior to the averaging periods nominated;
- averaging periods will have durations of 20 consecutive trading days;
- averaging periods for different years need not be the same;
- an averaging period must fall within a window of at least three months, but no longer than seven months, before the start of the relevant regulatory year;
- if an averaging period is not nominated as required, the ERA will use a default averaging period of 20 consecutive trading days ending three months prior to the start of the relevant regulatory year; and
- an averaging period will remain confidential until the period has passed.

Again, the proposal makes more specific the requirements, in the current (2018) *Final Rate of Return Guidelines*, for the setting of averaging periods for annual update of the debt risk premium without a major departure from current practice.

The principal change is, as the Draft Explanatory Statement notes, the shifting back by one month of the averaging period window.[7] GGT agrees that this will facilitate the annual update of the debt risk premium and allow more time for subsequent annual reference tariff variation.

Earlier submissions from other stakeholders seem to have generally supported the ERA's proposal.

The proposal for averaging periods for the annual update of the debt risk premium in the 2022 Draft Gas Instrument should be incorporated in the 2022 final instrument.

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7 Draft Explanatory Statement, paragraph 190.

4 Return on debt

The 2022 Draft Gas Instrument proposes continuing the approach to estimation of the rate of return on debt which is in the current (2018) *Final Rate of Return Guidelines*. In this approach, the total rate of return on debt is to be determined as:

RATE OF RETURN ON DEBT
= RISK-FREE RATE + DEBT RISK PREMIUM + DEBT RAISING COSTS + HEDGING COSTS

Debt raising costs and hedging costs are the administrative and other costs of raising debt. These costs have been revised and we comment briefly on them in section 6 of this submission.

In this section of the submission, we comment on the rate of return on debt itself, which is a component of the allowed rate of return determined as a nominal vanilla weighted average of returns on equity and debt.

To estimate the rate of return on debt, the Draft Explanatory Statement advises, the ERA will continue to use the hybrid trailing average approach, in which a benchmark efficient service provider is assumed to:

- follow the strategy of maintaining a portfolio of 10-year fixed-rate debt, with 10 per cent of the portfolio refinanced each year; and
- use interest rate swaps to lock in, at the start of a regulatory period, the rate of return on the portfolio for the duration of that period.[8]

The rate of return on debt is updated annually by updating the debt risk premium.

In its February submission on the ERA's December 2021 *Discussion Paper*, GGT was cautiously supportive of retaining the hybrid trailing average for rate of return on debt estimation in the 2022 gas rate of return instrument. As we advised, we have some concerns, but our experience to date has been such that we see the current hybrid trailing average approach as providing reasonable estimates of a benchmark rate of return on debt. This remains our view.

The ERA's hybrid trailing average approach should continue to provide the framework for the setting of the rate of return on debt in the 2022 final instrument.

8 Draft Explanatory Statement, paragraph 289.

In the following subsections of this section of our submission, we comment briefly on the proposal for each of the key elements of the hybrid trailing average in the 2022 Draft Gas Instrument. These key elements are:

- debt risk-free rate;
- term of debt;
- benchmark credit rating;
- debt risk premium; and
- annual updating of the return on debt.

GGT has, as we advised in earlier submissions, concerns about the benchmark credit rating but, otherwise, we are broadly of the view that the proposals of the draft instrument should be incorporated in the 2022 final instrument.

4.1 Debt risk-free rate

Paragraph 64 of the 2022 Draft Gas Instrument proposes that, for estimating the risk-free rate in the rate of return on debt, the ERA will use the five-year swap mid-rate, as published by Bloomberg (Last Price), over the relevant averaging period.

The five-year swap mid-rate is a commonly used base rate and is published regularly by an independent provider (Bloomberg). The Draft Explanatory Statement notes that the swap rate is relatively easily hedged; the hedging of interest rate risk on government bonds is more difficult.[9]

Use of the five-year swap mid-rate is required by the current (2018) *Final Rate of Return Guidelines*. GGT sees no reason to not continue its use in the 2022 final instrument.

4.2 Term of debt

For the purposes of the 2022 gas rate of return instrument, the ERA will adopt, for the benchmark efficient service provider, a strategy of maintaining a portfolio of 10-year fixed-rate debt with 10 per cent refinanced each year.[10]

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9 Draft Explanatory Statement, 352.

10 2022 Draft Gas Instrument, paragraph 67.

GGT's cautious acceptance of the hybrid trailing average approach in its February 2022 submission implied acceptance of 10-year fixed-rate debt as the benchmark, with 10 per cent refinanced each year.

The 2018 *Final Rate of Return Guidelines* had implemented the hybrid trailing average approach assuming a portfolio of 10-year fixed-rate debt with 10 per cent refinanced each year. Continued reliance on that assumption had, the Draft Explanatory Statement advises, was accepted in all five submissions which the ERA had received on its December 2021 *Discussion Paper*.[11] The use of a benchmark 10-year term for debt was also common practice among other Australian regulators.[12]

The assumption, that the benchmark efficient debt strategy is service provider maintenance of a portfolio of 10-year fixed-rate debt with 10 per cent refinanced each year, should be retained in the ERA's 2022 final instrument.

4.3 Benchmark credit rating

A credit rating of BBB+, paragraph 75 of the 2022 Draft Gas Instrument proposes, is to be fixed until the next review of the gas instrument.

GGT does not support the use of a benchmark credit rating of BBB+ for the 2022 final instrument for the reasons set out in its February 2022 submission on the ERA's *Discussion Paper*. The BBB+ benchmark is not derived from data for stand-alone businesses (the benchmark efficient entity of paragraph 57 of the Draft Explanatory Statement is "stand-alone"), but from businesses with financially strong parent entities.

GGT is of the view that the benchmark credit rating (for a "stand-alone" benchmark) should be BBB.

4.4 Estimating the debt risk premium

Estimation of the debt risk premium, paragraph 77 of the 2022 Draft Gas Instrument proposes, is to use the revised bond yield approach. Actual debt issues with terms of 10 years are to be used to construct a 10-year trailing average of observed premiums, and the trailing average is to be updated annually.

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11 Draft explanatory Statement, paragraph 368.

12 Draft Explanatory Statement, paragraph 372.

The ERA began developing the bond yield approach in 2010 and, soon after, began using it as part of rate of return on debt estimation in its regulatory decisions. Use of a revised version of the bond yield approach was required by the 2018 *Final Rate of Return Guidelines*.

In its February 2022 response to the ERA's *Discussion Paper*, GGT was supportive of continued use of the revised bond yield approach for debt risk premium estimation in the 2022 gas rate of return instrument.

GGT was of the view that if the debt risk premium were to be benchmarked, a small sample of actual debt issues cannot be used. A large sample of similar issues is required. If the debt risk premium is calculated from a large sample, any inefficiencies in debt raising will be averaged out as intended, and there will be averaging across the wide range of contractual responses to risk management found in debt instruments. GGT saw the revised bond yield approach as using the largest sample available at the time the debt risk premium is to be estimated.

The Draft Explanatory Statement notes that all submissions which the ERA had received on the December 2021 *Discussion Paper* supported use of the revised bond yield approach to estimate the debt risk premium for the 2022 gas rate of return instrument.

Use of the revised bond yield approach to estimate the debt risk premium should be retained in the 2022 final instrument.

4.5 Annual updating of the return on debt

A return on debt determined using the hybrid trailing average approach is to be used in setting the initial revenue path established at each gas access arrangement revision.[13]

In each subsequent year of the period of an access arrangement, the rate of return on debt is to be updated to incorporate an updated debt risk premium. The ERA will:

- make a current estimate of the debt risk premium using data for the averaging period immediately prior to the year ahead (the year for which the revenue path is to be varied);
- include that current estimate in the 10-year trailing average; and

[13] 2022 Draft Gas Instrument, paragraph 48.

- remove from the trailing average the estimate made 10 years earlier.[14]

No change is to be made to debt risk-free rate or to the allowances for debt raising and hedging costs.[15]

Any change in the return on debt resulting from the update of the debt risk premium is to be incorporated in the total revenue for the year ahead, and in each remaining year of the access arrangement period. A variation in reference tariffs for the year ahead is to follow automatically from the variation in the revenue path.[16]

The proposed annual updating of the return on debt - and of total revenue and reference tariffs - set out in the 2022 Draft Gas Instrument is the annual updating of the current (2018) *Final Rate of Return Guidelines*. Those guidelines formalized a practice which the ERA had earlier adopted and implemented through the revisions the regulator required service providers to make to access arrangement proposals.

The proposal for the annual updating of the return on debt in the 2022 Draft Gas Instrument should be incorporated in the 2022 final instrument.

14 2022 Draft Gas Instrument, paragraphs 49 and 50.

15 2022 Draft Gas Instrument, paragraph 53.

16 2022 Draft Gas Instrument, paragraph 51.

5 Return on equity

The 2022 Draft Gas Instrument sets out the ERA's proposed approach to rate of return on equity estimation in, essentially, four rules:

- the Sharpe-Lintner Capital Asset Pricing Model (CAPM) is to be used to estimate the rate of return on equity (paragraph 98);
- the risk-free rate of return of the CAPM is to be estimated from yields on Commonwealth Government bonds with terms of 10 years (paragraph 105);
- the market risk premium (MRP) of the CAPM is to be 6.2% (paragraph 113); and
- the equity beta of the CAPM is to be 0.7 (paragraph 120).

Behind these four rules lies a comprehensive process of reasoning, which is set out in the Draft Explanatory Statement.

As we explain in this section of our submission:

- we have acknowledged use of the CAPM;
- we concur with estimation of the risk-free rate of the CAPM from yields on 10-year Commonwealth Government bonds;
- we are concerned about the use of a geometric average in MRP estimation which leads to an estimate of 6.2%; and
- we are of the view that the ERA's estimation of beta has made good use of the limited data available.

5.1 Use of the Sharpe-Lintner CAPM

Paragraph 98 of the 2022 Draft Gas Instrument states that the ERA will use the CAPM for making a single point estimate of the rate of return on equity.

In earlier submissions GGT noted the limitations of the CAPM, but has acknowledged that, properly applied, the model can be used to estimate equity returns.

5.2 Risk-free rate

A 10-year Commonwealth Government bond is to be used for estimation of the risk-free rate of return of the CAPM.[17]

The estimate of the risk-free rate is to be made using data selected in accordance with the rules for averaging periods for parameters estimated from market data, and is to be fixed for the duration of the regulatory period.[18]

The issue of the term of the bond to be used to estimate the risk-free rate of the CAPM has been extensively discussed, not only in earlier submissions to the ERA, but also in other regulatory rate of return review processes. In the Draft Explanatory Statement, the ERA examines and assesses much of this earlier discussion.

Earlier submissions, the Draft Explanatory Statement notes, commented on a key report for the Australian Energy Regulator (AER) by Dr Martin Lally.[19] In this report, Dr Lally advised:

- the valuation problem facing a regulator with a five-year regulatory cycle is different from that of valuing an unregulated business;
- the terms for the return of equity, return on debt and expected inflation do not need to align and these terms can be determined separately by applying the NPV = 0 principle; and
- in respect of the cost of equity, the NPV = 0 principle implies that the term must match the regulatory cycle.[20]

The ERA had sought Dr Lally's views on the earlier submissions on this advice.[21]

Paragraph 594 of the Draft Explanatory Statement summarises the ERA's assessment of Dr Lally's report to the AER, stakeholder comments and Dr Lally's views on those comments. The ERA found:

- Dr Lally's mathematical model established only that NPV = 0 is met when the allowed return incorporated into regulatory revenues is equal to the discount rate used by investors; this would support an indeterminate number of allowed

17 2022 Draft Gas Instrument, paragraph 105.

18 2022 Draft Gas Instrument, paragraph 106.

19 Dr Martin Lally (Capital Financial Consultants), *The appropriate term for the allowed cost of capital*, April 2021.

20 Draft Explanatory Statement, paragraph 576.

21 Draft Explanatory Statement, paragraph 585.

returns from which the regulator must select the rate that it considers is the true discount rate;

- Dr Lally's mathematical model relied on an assumption that investors were certain that the market value of regulated assets at the end of the regulatory period was equal to the regulatory asset base (RAB); but equity investors were unlikely to make such an assumption;
- the RAB, the residual value of the assets, is not returned in cash at the end of the regulatory period, and remains at risk from future regulatory decisions and changes in the market (both technological changes and changes to customer preferences); the market value of equity would not equal equity's share of the RAB value at the end of a regulatory period but would, instead, reflect the present value (at that time) of all expected future cashflows;
- the value of regulated assets always depends on the long-run expected future net cashflows earned by those assets; as equity investors do not sell the assets at end of each regulatory period, those investors are only able to realise their expected returns over the long-run.

The ERA concluded, as paragraph 595 of the Draft Explanatory Statement advises:

- consistent with standard finance practice the term of the discount rate is equal to the period of the cashflows being considered; if investors consider cashflows over the long-term (or even beyond the regulatory period) they will discount those cashflows with a long-term discount rate;
- if regulated revenues are set with reference to a 10-year term for equity and equity investors discount cashflows with a 10-year term this ensures that NPV = 0 is maintained; and
- if regulated revenues are set with reference to a five-year term of equity and equity investors require a 10-year term, this will produce negative NPV outcomes.

That equity investors did, in fact, take a long-term view, the Draft Explanatory Statement notes, was supported by submissions from the Global Infrastructure Investor Association and Network Shareholders Group.[22] Other Australian regulators, and international regulators, had also recognised, when setting rates of return, that a long-term rate was required for long-lived assets.[23]

[22] Draft Explanatory Statement, paragraph 596.

[23] Draft Explanatory Statement, paragraph 597.

The ERA, therefore, considers that the weight of the evidence supports a change to longer-term market rate when setting the return on equity, consistent with common market practice for long-lived assets.[24] The 2022 Draft Gas Instrument then requires, as we noted above, the use of a 10-year Commonwealth Government bond for estimation of the risk-free rate of return.

In its February 2022 submission, GGT drew, from Dr Lally's 2021 report on "term", a conclusion similar to that of the ERA. The report established only that, for NPV = 0, the term of the discount rate used should match the term of the cashflows discounted. It provided no further guidance on how the rate of return on equity was to be determined.

The appropriateness of the use of that longer term perspective has been set out in advice which GGT has received from Professor Stephen Wright. Professor Wright has, for the last two decades, advised economic regulators in the United Kingdom on rate of return issues.

Like the ERA, GGT is of the view that Dr Lally's model relied on an assumption that investors were certain that the market value of regulated assets at the end of the regulatory period was equal to the regulatory asset base (RAB). However, equity investors were unlikely to make such an assumption. The requirement for NPV = 0 did not, then, specifically require that the equity term match the length of the regulatory period.

If this were the case, the question of how a proxy for the risk-free asset of the CAPM was to be established was left open. GGT asked this question of Professor Wright. His response is attached to this submission.

Professor Wright's key conclusions are:

- the term of the proxy should be set equal to the assumed investment horizon of equity investors since the return on even a default-free long term bond is only risk-free if the bond is held to maturity;
- establishing the investment horizon of equity investors is not clear-cut, but there is a strong case for assuming an investment horizon, and hence a term for the risk-free asset, that is distinctly longer than five years (the length of the regulatory period); and
- the preceding conclusions are consistent with well-established practice by regulators both in the United Kingdom and (until recently) in Australia; the

24 Draft Explanatory Statement, paragraph 598.

terms of the bonds used to estimate the risk-free rate of the CAPM in recent UK regulatory decisions are as follows:

Regulator	Price control	Term of bond (years)
CAA	RP3	10
Ofwat	PR19	15
CMA	RP3	10-20
Ofgem	GD2 & T2	20
CMA	PR19	20
Ofcom	WFTMR	10-15
UR	PR21	10 and 20
CAA	H7	20

The ERA has arrived at a conclusion on estimation of the risk-free rate of return which is the same as the conclusion GGT reached in its February 2022 submission: a 10-year Commonwealth Government bond should be used for estimation of the risk-free rate of return. Professor Wright's response shows that this conclusion is supported by both financial economic argument and the practice of regulators in other jurisdictions.

The proposal, in the 2022 Draft Gas Instrument, for estimation of the risk-free rate of return using a 10-year Commonwealth Government bond should be retained in the 2022 final instrument.

5.3 Estimation of the market risk premium

Paragraphs 113 and 114 of the 2022 Draft Gas Instrument state, respectively:

- the 2022 gas instrument will use a market risk premium of 6.2 per cent; and
- the market risk premium will remain fixed for the term of the instrument.

GGT concurs with much of the approach proposed in the 2022 Draft Gas Instrument but considers the proposed market risk premium (MRP) as leading to an allowed rate of return, and to regulated prices, which are inconsistent with the requirements of the national gas objective for the promotion of efficient investment in, and efficient operation and use of, natural gas services.

One reason for this is that the ERA gives weight (40 percent) to the geometric average when estimating the MRP from historical excess returns. Giving weight to the geometric average leads to downward bias in the MRP.

In the paragraphs which follow:

- we explain why giving weight to the geometric average leads to a downward bias in the MRP, and why MRP estimation from historical excess returns should use only the arithmetic average;
- note use of the dividend growth model (DGM);
- reiterate our earlier concerns about conditioning variables; and
- comment on the ERA's process for determination of a point estimate for the MRP.

5.3.1 Arithmetic or geometric mean?

Paragraph 771 of the Draft Explanatory Statement advises that, for the 2022 Draft Gas Instrument, the ERA considers that an unbiased estimate of the historical MRP is an estimate between the arithmetic mean and the geometric mean. After considering the evidence, the ERA will calculate the historical MRP as a weighted average of the arithmetic mean, with weight 60 percent, and the geometric mean, with weight 40 per cent.[25]

ERA's reasoning

From the evidence available to the ERA, the regulator appears to have reasoned as follows:

- an arithmetic average will tend to overstate returns, a geometric average will tend to understate them, and the biases are empirically significant;[26]
- bias is a function of both sampling error and the choice of forecast horizon;[27]
- in a 1997 academic paper, Indro and Lee:
    - confirmed Marshall Blume's earlier finding of biases in arithmetic and geometric averages;
    - found that biases tend to be exacerbated in the presence of autocorrelation in returns;

25 Draft Explanatory Statement, paragraph 773.

26 Draft Explanatory Statement, paragraph 747.

27 Draft Explanatory Statement, paragraph 747.

  - found that bias arising from the use of the arithmetic average increases as the investment horizon increases, and as volatility in returns increases; and
  - found that bias arising from the use the geometric average increases as volatility in returns increases.[28]

- the academic literature concludes that there is no unequivocal case for relying on either the arithmetic or the geometric average to estimate the forward looking MRP;[29]
- an unbiased estimate of the MRP is likely to be somewhere between the geometric average and the arithmetic average; Indro and Lee, among others, propose minimizing bias using a combination of the two averages in a formula which takes into account the length of the period for which historical data are available, and the length of the forecast period;[30]
- both arithmetic and geometric averages have an appropriate role to play as a combination, and one should not be used to the exclusion of the other; given the nature of the regulatory task, greater weight should be given to the arithmetic average but use of the geometric average is still necessary;[31]
- full reliance cannot be placed on the arithmetic average in the presence of serial correlation and sampling error, which would bias the arithmetic average.[32]

We are concerned that the ERA has drawn conclusions from a specific statistical model which has been well-researched in the academic literature but, in drawing those conclusions, the ERA has ignored the model itself.

The conclusions which the ERA reaches are technical statistical propositions which cannot be fully understood without consideration of the model from which they were derived.[33] They are not matters of opinion or judgement. When explicit consideration is given to the underlying model, a different conclusion must be drawn:

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28 Draft Explanatory Statement paragraph 748. The paper by Indro and Lee (referenced in footnote 413 of the Draft Explanatory Statement) is one of several papers in the statistics literature which have examined the issue of bias first raised in a paper by Marshall Blume in 1974. Blume's paper is referenced in footnote 410. Other key papers on the same issue, include Jacquier, Kane and Marcus (2003), which is referred to footnote 409.

29 Draft Explanatory Statement, paragraph 749.

30 Draft Explanatory Statement, paragraphs 750-752.

31 Draft Explanatory Statement, paragraph 757.

32 Draft Explanatory Statement, paragraph 762.

33 For this reason, we do not closely consider the other "evidence" presented by the ERA. The concurrent evidence sessions were loose discussions and did not closely examine the issue of the use of arithmetic and geometric averages. Stakeholder feedback either did not address the issue in its context or referred back to the statistical literature referenced by the ERA.

only the arithmetic average has a role to play in estimating the MRP from historical excess returns.

The underlying model

The model which underlies the work of Indro and Lee, and of others, from which the ERA draws its conclusions about the need to use both the arithmetic average and the geometric average, and to give those averages appropriate weighting in an unbiased estimate of the MRP, is a simple model of accumulation.

A quantity, for example the value of a portfolio of shares, accumulates over time as that quantity generates returns period by period. The process by which these returns are generated is “noisy” (stochastic). The question being addressed is: given observations on the accumulation over the previous T periods, what is the appropriate way to forecast accumulation a further H periods ahead? Should the arithmetic average of the observed returns over the previous T periods be used, should it be the geometric average of those previous returns, or should it be some combination of the arithmetic and geometric averages?

Indro and Lee take a general view, describing the accumulation in terms of continuous-time stochastic processes. Others assume the returns themselves vary period by period but are independent from one period to the next, and the cumulative return has a specific probability distribution. Blume assumed (in 1974) that the distribution of returns was normal but was not able to proceed far with this assumption. Jacquier, Kane and Marcus assume the distribution of returns is lognormal.

The assumption of lognormality allows Jacquier, Kane and Marcus to derive a specific formula for the rate of return which provides an unbiased forecast of the final value of the accumulation (the forecast final value of the portfolio) H periods ahead. That rate, which we denote r, is given by:

$$r = r_A\left(1 - \frac{H}{T}\right) + r_G\left(\frac{H}{T}\right) .$$

r_A is the arithmetic average of returns over the previous T periods, and r_G is the geometric average of those returns.

This is equation 5 from Jacquier, Kane and Marcus. They note that the rate r which gives an unbiased forecast of final portfolio value will be very close to the arithmetic average for short forecast horizons (that is, for H/T close to zero). However, as the forecast horizon extends, the weight on the geometric average will increase. For H =

T, the unbiased forecast is obtained by accumulating the portfolio value at the geometric average of previous returns.[34]

In a second paper (not referenced by the ERA), Jacquier, Kane and Marcus extend the analysis noted above.[35] They re-examine the arithmetic and geometric averages as estimators of the rate r, and derive unbiased and minimum mean square error estimators in conditions in which there is autocorrelation in the returns observed over period T and in returns over the forecast horizon H.

All of the estimators examined in this second paper by Jacquier, Kane and Marcus take the form:

$$r = r_A k + r_G (1 - k)$$

With k = 1, the estimator of r is the arithmetic average; with k = 0, it is the geometric average.

An unbiased estimator of r is obtained by setting k = 1 – H/T, and the minimum mean square error estimator is obtained with k = 1 – 3H/T.

For the unbiased and the minimum mean square error estimators, when H, the forecast period, is close to zero, r is close to the arithmetic mean.

Recognising the large literature which points to autocorrelation in long-run returns, Jacquier, Kane and Marcus derive values for k which incorporate:

- a correction factor F_T for autocorrelation in returns observed during the previous period T; and
- a correction factor F_H for autocorrelation in returns during the forecast period H.[36]

The estimator remains:

$$r = r_A k + r_G (1 - k) \ ,$$

but now with:

34 Jacquier, E, A Kane and A J Marcus (2003), "Geometric or Arithmetic Mean: A Reconsideration", Financial Analysts Journal, 59(6): page 49.

35 Jacquier, E, A Kane, A J Marcus (2005), "Optimal Estimation of the Risk Premium for the Long Run and Asset Allocation: A Case of Compounded Estimation Risk", Journal of Financial Econometrics, 3(1): pages 37-55.

36 See Jacquier, Kane and Marcus (2005), page 48 for the derivation of F_T and F_H.

- $k = 1 – (H \times F_T/T \times F_H)$ for the unbiased estimator; and
- $k = 1 – (3 \times H \times F_T/T \times F_H)$ for the minimum means square estimator.

The implications of autocorrelation must be examined through assignment of specific representations to, and specific parameter values for, the autocorrelation structures in F_T and F_H, and simulation of the resulting models. Jacquier, Kane and Marcus report that their simulations indicate the forecasts of accumulated portfolio value are "barely affected" by the corrections for autocorrelation.[37]

This aside, with H close to zero, even with autocorrelation in the returns observed during period T, r is approximately equal to r_A.

Indro and Lee examine the same underlying model of accumulation in which portfolio values and returns are observed over the previous T periods, and accumulation is then forecast at a horizon of H periods.[38] However, their more general analysis of the stochastic behaviour of r does not yield specific formulae similar to those obtained by Jacquier, Kane and Marcus. Indro and Lee therefore rely on simulations for the results they report.

Indro and Lee first confirm, through their simulations, that the arithmetic average of returns produces a portfolio value at the end of the forecast horizon which is too high relative to the value produced by the true mean, and the geometric average produces a value which is too low. The bias, in each case, is proportional to:

- the total variance of portfolio return; and
- the length of the forecast horizon (H) relative to the length of the historical sample period (T).

Furthermore, the horizon-weighted average of the arithmetic average and the geometric average was less biased and more efficient than alternative estimators.[39]

The Indro and Lee simulations examined the properties of a weighted average of the arithmetic and geometric averages, which had been proposed earlier by Blume:

$$r = \frac{T - H}{T - 1} r_A + \frac{H - 1}{T - 1} r_G \quad .$$

37 Jacquier, Kane and Marcus (2005), page 49.

38 We standardize using, largely, the notation from Jacquier, Kane and Marcus (2003).

39 Daniel C Indro and Wayne Y Lee (1997), "Biases in Arithmetic and Geometric Averages as Estimates of Long-Run Expected Returns and Risk Premia", Financial Management, 26(4), page 82.

Indro and Lee noted:

- when H = 1, the arithmetic average r_A receives all the weight; and
- as H approaches T, more weight is given to the geometric average r_G.[40]

In the generalized view of return generation which serves as the starting point for the Indro and Lee analysis, returns are generated in a process in which the conditional mean is mean reverting around the unconditional mean, and a single period autocorrelation between conditional means captures the time variation in expected return.[41] The simulations then show:

- the existence of negative autocorrelation in long-horizon returns (which has been observed by others) exacerbates bias; and
- in general, the horizon-weighted average of arithmetic and geometric averages has least bias; and is more efficient than other estimators in the presence of autocorrelation and time varying variances.[42]

From the preceding discussion of the results obtained by Jacquier, Kane and Marcus, and by Indro and Lee, the critical issue is the weighting to be given to an arithmetic average and a geometric average of previous returns when determining the unbiased rate of return applicable to portfolio value during forecast horizon H. That weighting depends on the ratio of the length of the forecast horizon H to the period T over which returns have been observed. Even with autocorrelation in the data and variance volatility, if H is close to zero, the unbiased estimate of the rate of return is approximately equal to the arithmetic average, and the geometric average has no role to play.

The ERA's error

As the ERA notes, Indro and Lee, among others, propose minimizing bias using a combination of the arithmetic and geometric averages in a formula which takes into account the length of the period for which historical data are available (T), and the length of the period over which a forecast of portfolio value is to be made (H). However, the reasoning of the Draft Explanatory Statement does not consider the length of the forecast period (H) in the context of estimation of the MRP from historical excess returns.

40 Indro and Lee (1997), page 84.

41 Indro and Lee (1997), page 82.

42 Indro and Lee (1997), page 89.

Over what period are historical excess returns to be forecast when estimating the MRP? Using the annual data used by the ERA, the length of that period is close to zero, if not zero. The MRP is estimated from the series of historical excess returns which ends in the year preceding promulgation of the rate of return instrument. The most recent data in this series could precede promulgation of the instrument by up to one year but, in the process of estimating the MRP from historical excess returns, no attempt is made to forecast the historical returns series forward one year (or more).

Even if the ERA were to adopt some form of annual updating of the MRP, there would still be no forecast made of the historical excess return series using the excess returns observed in previous years. MRP estimation would use only the series of historical excess returns available at the time of updating.

If there is no forecasting of the excess returns series forward at a rate of return implied by the historical series available at the time, the formulae of Jacquier, Kane and Marcus, and of Indro and Lee, reduce to the proposition that the unbiased estimate of the mean of return in the series is the arithmetic average of the historical excess returns. This is unaffected by any considerations of the presence of autocorrelation in the return series, or by variance volatility.

This was the conclusion reached by GGT in its earlier submissions by applying standard time series estimation methods in the absence of any issue of forecasting future value.

This is the view in well-known finance textbooks as noted in GGT's earlier submissions, and in submissions to the ERA made by others.

This was the view of Dr Lally in advice he provided to the AER in 2012. Dr Lally summarised:

The AER's belief that geometric averages are useful apparently arises from a belief that there is a compounding effect in their regulatory process (AER, 2012, Appendix A.2.1), and therefore the analysis of Blume (1974) and Jacquier et al (2003) applies. However, I do not think that there is any such compounding effect in regulatory situations and the absence of a compounding effect leads to a preference for the arithmetic mean over the geometric mean.[43]

To propose, as the ERA has done, that the MRP be estimated as a weighted average of arithmetic and geometric averages of historical excess returns, with a

43 Martin Lally, The Cost of Equity and the Market Risk Premium, 25 July 2012, page 31.

substantial weight (40 per cent) to be given to the geometric average involves a serious misreading of the evidence available to the ERA.

This misreading of the evidence has the effect of imparting a downward bias to the estimate of the MRP made from historical excess returns, and to the estimate of the MRP ultimately adopted for the gas rate of return instrument. A downward biased MRP will impart a downward bias to the allowed rate of return, and to regulated prices determined using that allowed rate of return. This, in turn, will be inconsistent with the requirements of the national gas objective for the promotion of efficient investment in, and efficient operation and use of, natural gas services.

The error should be corrected before proceeding to the 2022 final instrument. An estimate of the MRP made from historical excess returns should be made as the arithmetic average of those returns.

5.3.2 Use of the dividend growth model

In our submission made following the ERA's focused consultation in April 2022, GGT advised that it was supportive of the Energy Networks Australia (ENA) development of a calibrated DGM. GGT was of the view that the growth calibration undertaken when applying the ENA model contributed to greater confidence in the resulting DGM MRP estimates than might be attributed to estimates from an uncalibrated model.

Use of the calibrated DGM could, we thought, allow estimation of a forward-looking MRP in a completely mechanical way, and would allow periodic re-estimation of the MRP as an equally weighted average of a historical excess returns estimate and a (calibrated) DGM estimate. An MRP estimate made in this way could be updated periodically over the term of the gas rate of return instrument.

Paragraph 805 of the Draft Explanatory Statement now advises that the ERA has examined the calibrated DGM and has found:

- sensitivity of the MRP estimates to the time period over which the premium is estimated;
- large variability in the MRP estimates obtained using the model;
- an unbiased result may not be achieved as the calibrated DGM would be adopted late in the calibration cycle and was currently producing high implied MRP estimates;
- the dividend growth rate produced by the model was static and may not reflect actual growth rates over a period leading to distorted results; and

- calibration reduces the usefulness of the calibrated DGM as a forward-looking model.

The ERA has concluded that these findings reduce the confidence which might be had in the calibrated DGM and has decided not to use the model in estimation of the MRP for the 2022 Draft Gas Instrument.[44]

Paragraph 813 of the Draft Explanatory Statement advises that the ERA continues to have concerns about DGM use in general and does not place much reliance on MRP estimates made using the model relative to historical estimates.

GGT does not have access to the ENA calibrated DGM and cannot directly address the ERA's concerns. We understand that the ENA and the model developer, Frontier Economics, intend making further submissions on use of the calibrated DGM.

5.3.3 Conditioning variables

The Draft Explanatory Statement advises that, for the 2022 Draft Gas Instrument, the ERA will continue to consider conditioning variables when estimating the MRP.[45]

The ERA's conditioning variables are:

- bond default spreads (relative to government bond rates);
- 5-year interest rate swap rate spread;
- dividend yields; and
- implied volatility in equity returns as measured by the ASX 200 volatility index.

GGT remains of the view we set out in our submission responding to the ERA's March 2022 focused consultation:

- before any conditioning variable might be used in MRP estimation, a relationship between that variable and the MRP must be established;
- the returns predictability literature points to the difficulty of establishing the necessary relationships;
- we are not aware of any work to establish relationships between the MRP and any of the proposed conditioning variables; and

44 Draft Explanatory Statement, paragraphs 806 and 807.

45 Draft Explanatory Statement, paragraph 814

- without these relationships having been established, any use of conditioning variables amounts to the making of arbitrary adjustments in the process of estimating the MRP.

GGT is therefore strongly of the view that no weight should be given to conditioning variables when estimating the MRP.

5.3.4 Determination of a point estimate for the market risk premium

The estimate of the MRP of 6.2 per cent in paragraph 113 of the 2022 Draft Gas Instrument, the Draft Explanatory Statement advises, is the outcome of the ERA's consideration of an estimate from historical excess returns, DGM estimates and conditioning variables.[46]

Our view that no weight should be given to conditioning variables when estimating the MRP was noted in the previous section of this submission.

In our submission following the March 2022 focused consultation, we indicated that GGT favoured a more mechanical approach to MRP estimation, especially if the MRP were to be updated periodically during the period of the gas rate of return instrument.

We are less inclined to a more mechanical approach if, as paragraph 114 of the 2022 Draft Gas Instrument indicates, the MRP estimate is to remain fixed or the term of the instrument.

GGT understands that the estimate of the MRP is just that: an estimate. It is also an estimate of a variable about which economists continue to research and speculate given its importance in current theories of the pricing of financial assets. In the course of estimating the MRP for the gas rate of return instrument, that the ERA carefully appraises the choices it makes, including the choice of the final estimate, is entirely appropriate. A little more discussion, in the Explanatory Statement, of how those choices have been appraised would, we think, assist our understanding, if not acceptance, of a final MRP estimate which is to remain in place for a further four years.

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[46] Draft Explanatory Statement, paragraph 839.

5.4 Equity beta

Paragraph 120 of the 2022 Draft Gas Instrument proposes an equity beta estimate of 0.7. This estimate is to remain fixed for the term of the instrument (paragraph 121).

GGT is of the view that the ERA's estimation of beta, as explained in the Draft Explanatory Statement, makes good use of the limited data available.

In its December 2021 *Discussion Paper*, the ERA had proposed that beta be estimated using five years of weekly data. However, data in the current "five-year window" incorporates the effects of two "shocks" to the international economy, the effects of which may not be fully understood for many years. Those shocks are, of course, the Covid-19 pandemic and the conflict in the Ukraine. Paragraph 982 of the Draft Explanatory Statement advises that the ERA will retain its proposed use of a five year estimation window, but will also examine beta estimates made using data from a 10-year estimation window. This should reduce the impact of any "structural breaks" which might now be appearing in the data. GGT thinks that, in the circumstances, this is reasonable.

A five-year estimation window allows share price data for four Australian energy network businesses to be used in beta estimation. Those four network businesses are:

- APA;
- AusNet Services;
- DUET Group; and
- Spark Infrastructure.[47]

AusNet Services, DUET Group, and Spark Infrastructure have now all been delisted, and the ERA will use the last five years of data available for each of those businesses.

The Draft Explanatory Statement advises that, on balance, the ERA considers that maintaining the sample of the four Australian businesses in the near term will lead to the best estimate of beta.[48] Given the ERA's observation that realized equity betas have generally not been stable for the last decade, GGT agrees.[49]

47 Draft Explanatory Statement, paragraph 1009.

48 Draft Explanatory Statement, paragraph 1020.

49 The stability of Australian network betas over time is noted in paragraph 1015 of the Draft Explanatory Statement.

The ERA has decided not to use share price data for other Australian (non-energy) infrastructure businesses in equity beta estimation.[50] However, some 58 international comparators are considered, by the ERA, to be sufficiently comparable to the Australian benchmark efficient service provider to contribute to the development of a robust estimate of the equity beta for the 2022 gas rate of return instrument.[51]

By the time of its response to the ERA's March 2022 focused consultation, GGT had arrived at a view on international comparators similar to the view now being advanced in the Draft Explanatory Statement: market circumstances necessitate the examination of international energy networks in the benchmark sample.[52]

The share prices of comparators, whether Australian or international, may be affected by merger and acquisition activity. There is, GGT thinks, little that can be done in these circumstances, but have the regulator examine the data and make adjustments for any anomalies, including possible exclusion of an affected firm from the sample used for beta estimation.[53]

Paragraph 1073 of the Draft Explanatory Statement summarizes the ERA's approach to making a point estimate for beta for the 2022 gas rate of return instrument. The ERA will:

- use Australian and international comparator firms;
- consider 5-year and 10-year data windows
- estimate betas:
    - using a domestic CAPM for each country;
    - including only firms for which a majority of observations are present in the data window;
    - check and, if necessary, adjust for merger and acquisition activity;
    - consistently de-lever raw beta estimates and re-lever to the benchmark gearing;
- pool beta estimates by country;
- examine the distribution of equity betas; and

[50] Draft Explanatory Statement, paragraph 1027.

[51] Draft Explanatory Statement. paragraph 1041.

[52] Draft Explanatory Statement, paragraph 1044.

[53] See Draft Explanatory Statement, paragraph 1064.

- exercise its discretion to establish the appropriate point estimate.

GGT thinks such an approach is reasonable given the data currently available to the ERA for beta estimation and the economic circumstances in which those data have been generated.

Equity beta estimates for the ERA's Australian and international comparators, for 5-year and 10-year estimation windows, are set out in Table 14 of the Draft Explanatory Statement. As the ERA concludes, those estimates indicate a single point estimate of 0.7.[54]

This single point estimate should now be the equity beta estimate of the 2022 final instrument.

We note that paragraph 1065 of the Draft Explanatory Statement advises that GGT's earlier concerns about an equity beta appropriate to the Goldfields Gas Pipeline are inconsistent with a benchmark approach and with the concept of incentive-based regulation. We disagree. Both benchmarking and incentive-based regulation can apply to individual businesses or to classes of businesses. Inconsistency arises where a benchmark or scheme of incentives developed for one particular business or class of businesses is inappropriate in the circumstances of another business or class of businesses.

The ERA's benchmark is, among other things, a service provider with a degree of risk similar to that which applies to the service provider in respect of the provision of gas network services.[55] A gas distribution service provider supplying a large and diverse group of end-users has a degree of risk which is quite different to a transmission pipeline which supplies a small group of end-users all of whom are exposed to the risks of selling a small number of commodities in international markets. On the ERA's definition of the benchmark, we would expect to see the Goldfields Gas Pipeline benchmarked differently from a gas distribution system. The benchmarks would be different, but they would still incentivize the behaviours an incentive-based regulatory regime was designed to promote.

The difference we describe in the preceding paragraph is the principal reason advanced by the ERA for other regulated assets operating in the Pilbara having

54 Draft Explanatory Statement, paragraphs 1084-1086.

55 Draft Explanatory Statement, paragraph 57.

equity betas significantly higher than the betas for similar regulated assets used to provide services in the more urbanised and industrially diverse region around Perth.

We do not understand how, when assessed at a common gearing (55%), an equity beta of 0.7 can be assigned to the Goldfields Gas Pipeline when the beta for the Pilbara Railway assets is 2.3, the beta for the Horizon Power electricity network assets is 1.0, and the beta for the Alinta Energy electricity network assets in the North West is 1.2.

An explanation of these differences does not lie in the underlying drivers of risk being systematic in the case of the other regulated Pilbara assets but non-systematic in the case of the Goldfields Gas Pipeline (as the Draft Explanatory Statement proposes). Nor can it lie in an unexplained assertion that the relevant regulatory regimes are not comparable.

GGT does not have the data needed to further pursue this matter at present.

With the much larger sample of businesses now available for beta estimation, made possible by the recent recognition of the need to include in the comparator set appropriate international energy businesses, GGT will be looking closely to establish:

- differences between the betas for electricity networks and for gas pipelines; and
- differences between the betas for gas pipeline systems operating in different markets.

6 Debt and equity raising costs

Service providers may, under the current (2018) *Final Rate of Return Guidelines*, recover administrative and other costs of raising and hedging debt associated with the debt financing strategy underlying the hybrid trailing average approach. The current allowances for recovery of these costs are:

- 0.100 per cent for debt raising costs; and
- 0.114 per cent for hedging costs.

Allowances for equity raising costs are currently made in the modelling of capital expenditures, which forms part of the ERA's total revenue modelling. Unlike debt raising costs, equity raising costs are not considered in the rate of return instrument.[56]

The allowances for debt raising and hedging costs had not been recently revised and, appropriately, the ERA sought a review of them by financial consultants, Chairmont, late in 2021. Individual service providers provided, to the ERA and Chairmont, on a confidential basis, information on debt raising and hedging costs.

Chairmont identified five elements of cost increase:

- arranger fees;
- issue price discounts;
- liquidity facilities costs;
- three-month refinancing fees; and
- environmental, social and governance (ESG) issues.

Stakeholders were invited to make submissions on Chairmont's report in March 2022. GGT's submission, like others the ERA received, supported Chairmont's proposal that debt raising and hedging costs be increased.

The structures of debt raising and hedging costs differ across loan instruments and lenders. This makes comparison difficult for individual service providers (each of whom generally seeks financing from a small group of preferred lenders who understand the service provider's business).

56 2022 Draft Gas Instrument, paragraph 131.

GGT is certainly aware that debt raising and hedging costs have risen but has nothing further it can add to its earlier submission on the Chairmont report.

The proposal of the 2022 Draft Gas Instrument is for:

- 0.165 per cent for debt raising costs; and
- 0.123 per cent for hedging costs.

This proposal should be retained in the 2022 final instrument.

7 Inflation

Inflation expectations are not easily forecast. Multiple methods are available and, in the Australian regulatory context, the use of Reserve Bank of Australia inflation forecasts (RBA inflation forecast approach) and the Treasury bond implied inflation approach have received considerable attention. Each of these two methods has both strengths and weaknesses.

GGT's preference, as advised in its February 2022 submission, was for use of the RBA inflation forecast approach.

The ERA, having assessed the strengths and weaknesses of both the RBA inflation forecast approach and the Treasury bond implied inflation approach in the Draft Explanatory Statement, now intends to adopt the Treasury bond implied inflation approach.

Paragraph 139 of the 2022 Draft Gas Instrument states that the ERA will apply the Treasury bond implied inflation approach for estimating expected inflation. This approach will be applied as follows:

- using the yields on five-year Treasury bonds;
- estimating the expected inflation rate consistent with the estimate of the risk-free rate;
- using linear interpolation to derive the daily point estimates of both the nominal five-year risk-free rate and the real five year risk-free rate, for use in the Fisher equation; and
- nomination of the averaging period for inflation in the way proposed for other parameters estimated from market data.

GGT understands the reasons for the ERA's intention to adopt the Treasury bond implied inflation approach.

If the Treasury bond implied inflation approach is to be retained as part of the 2022 final instrument, GGT would prefer the instrument to be explicit about:

- the inputs to the expected rate of inflation calculation (yields on Australian Government bonds with 5 years to maturity, and yields on Australian Government indexed bonds);
- the ways in which those yields are to be obtained from the source data, and

- the way in which the estimate of expected inflation is to be made (calculated using the Fisher equation).

GGT is also of the view that reference to the risk-free rate is out of place in paragraph 139 of the 2022 Draft Gas Instrument. The risk-free rate is the rate of return on the hypothetical riskless asset of the Sharpe-Lintner CAPM. Reference to the risk-free rate should not appear in the drafting of the rules for expected inflation in the 2022 final instrument.

8 Valuation of imputation credits (gamma)

The 2022 Draft Gas Instrument continues use of the Monkhouse approach to estimation of the factor gamma.[57] The Monkhouse approach is well established in financial theory, and GGT is unaware of further theoretical developments which would call for reconsideration of gamma estimation as the product of the franking credit distribution rate and the rate of utilization of the credits.[58]

The ERA's distribution rate estimate of 0.9 is current and consistent with earlier estimates of the rate.

A utilization rate estimate of 0.6 has been obtained from work by Dr Martin Lally.[59] It is reasonably current and consistent with earlier estimates of the utilization rate.

The ERA's distribution rate estimate, and its estimate of the utilization rate, support an estimate of gamma of 0.5, which is the estimate in the 2018 *Final Gas Rate of Return Guidelines*.

Consistency over time in the distribution rate and the utilization rate and, in consequence, an estimate for gamma similar to the estimate in the current guidelines, support keeping gamma fixed for the life of the 2022 gas rate of return instrument.

Paragraphs 143, 144 and 145 of the 2022 Draft Gas Instrument should be retained in the 2022 final instrument.

57 2022 Draft Gas Instrument, paragraph 143.

58 The financial theory of the Monkhouse approach is set out in Peter H L Monkhouse (1993), "The cost of equity under the Australian dividend imputation tax system", Accounting and Finance, 33(2), pages 1-18.

59 Martin Lally, *Estimating the distribution rate for imputation credits for the top 50 ASX companies*, 24 June 2021.

Attachment

Professor Stephen Wright

The Appropriate Term for the Risk-Free Rate: A report prepared for APA

The Appropriate Term for the Risk-Free Rate: A report prepared for APA

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1. Introduction

1.1. APA has asked for an expert view on the appropriate term of the risk-free rate, in the context of the Capital Asset Pricing Model (CAPM) being used to estimate the cost of capital for a regulated company such as APA. This note is provided as background for APA's forthcoming response to the Australian Energy Regulator's (AER) Draft Rate of Return Instrument and Draft Explanatory Statement, on 16 June 2022. While APA has commissioned the work, this report is independent and expresses my own views, which may not necessarily reflect the views of APA. Similarly, while the arguments in this report draw from work done for UK regulators, they should not be interpreted as reflecting the views of any UK regulator or UK regulated company. I also write in a personal capacity; my views are not to be attributed to Birkbeck College.

1.2. I should say at the outset that my experience in working on estimating the cost of capital has been almost exclusively in the UK context. I am very conscious that the Australian system of regulation differs in a number of important ways from the UK. Since I shall not attempt a full comparison between the two approaches, my comments cannot be interpreted as implying that the overall cost of equity assumed by the regulator, the AER, is either too low or too high; I shall focus solely on the issue of the appropriate choice of risk-free rate, and draw any implications on that issue alone.

1.3. I start with the theoretical concept of the risk-free rate in the context of the CAPM; I then proceed to consider how observable measures of the risk-free rate can be related to this context, and at different horizons. I then consider the appropriate horizon, and hence the appropriate term for the risk-free rate from the perspective of different investors, and consider which perspective is most appropriate for a regulated company such as APA with long-lived assets. Finally I provide some background information on the choice of investment horizon (and hence term of the risk-free asset) and choice of risk-free asset that has been assumed in recent UK regulatory discussions.

2. The risk-free rate in the CAPM

2.1. The key relationship in the CAPM is given by the Security Market Line (SML), which is usually written as

$$E(R_i) = R_F + \beta_i \left(E(R_M) - R_F \right)$$

where R_i is the return on an individual asset, R_F is the risk-free rate; and the CAPM "beta" $\beta_i = \frac{\text{cov}(R_{it}, R_{mt})}{\text{var}(R_{mt})}$, captures the sensitivity of asset *i* to the market portfolio, with return R_M.

2.2. While the CAPM is very commonly used in regulation and asset pricing, an immediate problem in any practical implementation of the CAPM is that it is a stylised "two-period model" but does not specify the time period being employed. Conceptually, a more precise specification (which is implicit in the standard textbook version above) would take the form

$$E_t\left(R_{i,t+1}\right) = R_{F,t+1} + \beta_i\left(E_t\left(R_{M,t+1}\right) - R_{F,t+1}\right)$$

where here it is made clear that the expectation terms $E_t\left(R_{i,t+1}\right)$ and $E_t\left(R_{M,t+1}\right)$ are market expectations[1], made in some time period *t*, of the returns on asset *i,* and the market, respectively, in period *t+1*.

2.3. The fact that expectations enter into the equation reflects the key feature that both these returns are unknown at time *t*, and hence must be forecast by market participants. But the more precise specification of the CAPM makes it clear that the return on the risk-free asset will *also* occur in period *t+1*, but does *not* need to be forecast since the nature of the risk-free asset is that its return is known in advance. While this point may seem tautological, it is worth stressing that the CAPM assumes a *complete* lack of uncertainty about the risk-free return in the next period.

2.4. The fact that the CAPM is only a two-period model is not in itself a problem. By assumption, once time moves on to period *t+1* the CAPM will apply again, but with expected returns, formulated at time *t+1*, of returns in period *t+2*. The expected returns on asset *i* in periods *t* and *t+1* will in turn determine the price of asset *i* in both periods, and hence, if new information (e.g., on future profits) changes expected returns, the price will change. The same applies for any two periods into the indefinite future. So conceptually two adjacent periods are enough.

2.5. However, the CAPM does not explicitly specify how *long* each period lasts. In many, if not most contexts, it is assumed that the length of the time period is very short – often as little as a single day, or sometimes even shorter. This is indeed typically the assumption made in estimating the CAPM beta, which is typically estimated on daily, weekly or sometimes monthly data.

2.6. At such short horizons, the theoretical concept of the risk-free rate is reasonably easy to replicate, using overnight, or at most monthly rates, which are indeed set in advance, and which, assuming sufficient collateral, are also risk-free. At a sufficiently short-term horizon, inflation risk is usually also negligible. Proxies such as treasury bill rates are frequently used in empirical analysis.

2.7. In the context of regulation, however, such a short time interval is clearly problematic. The CAPM is required to provide an estimate of the cost of equity, which feeds into the estimate of the weighted average cost of capital (WACC), which is then usually used to set an allowed return

[1] Strictly speaking these are mathematical expectations, hence are the best available forecasts, given all information available to market participants.

on the regulatory asset base (RAB) that is usually fixed[2] for the duration of a price control period, which may be for multiple years (in the case of APA, this period is five years). The standard empirical implementation of the CAPM with a very short assumed time interval simply cannot provide such an estimate, since, as shown below, it only provides it over a single, short period. Clearly therefore it is necessary to move away from this approach, and to assume a longer time period.

2.8. Before considering what is the appropriate choice of period, it is important first to consider how the risk-free rate can be measured over longer horizons.

3. The CAPM risk-free rate at longer horizons

3.1. If we now revisit the explicit two period-model of the CAPM above, but assume a longer horizon, it becomes evident how crucial the assumption is that the future risk-free rate is known with certainty. If we simply attempted to apply the version with a short time period, for example one month, but our horizon is longer than one month, then in order to apply the CAPM today, in period *t*, we would need to know the one-month risk-free rate in one month's time. But since this is only set one month at a time, its value in one month cannot be known – therefore violating the assumption of the CAPM.

3.2. For this reason if we wish to operationalise the CAPM concept of the risk-free rate at a longer horizon, we can only do so by increasing the assumed length of the period to be precisely equal to the chosen horizon. If we do so, then it *is* possible to find at least a reasonable proxy: namely the yield on a default-free zero coupon bond with tenor (remaining maturity) equal to the chosen horizon. By definition, the yield on such a bond is simply the compound average return received by an investor in the bond who holds it to maturity given by

$$y_t = \left(\frac{V}{P_t}\right)^{\frac{1}{m}} - 1$$

where *V* is the face value of the bond, which will (assuming no default risk – hence we typically assume a government bond) be repaid with certainty in *m* years' time. Since both *V* and the current price of the bond P_t are known with certainty, then the return if held to maturity (which is the definition of the yield) is also known with certainty even though the return will only actually be realised in *m* years' time. As such, if we set the length of the period in the CAPM to *m,* we do indeed have a viable proxy for the risk-free rate in the CAPM.

3.3. Three caveats are in order at this point.

3.3.1. First, while it is not usually made explicit, the theory underlying the CAPM (the "Consumption CAPM"[3]) means that it should apply in real terms, since the market portfolio is assumed to be the wealth of the representative investor, who is ultimately only concerned with the real value of their consumption, and hence with real returns. As a result, the concept of the risk-free rate should in turn be risk-free in real (CPI) terms. In the UK

[2] There are some instances of at least partial updating of the allowed return, in response to movements in the chosen risk-free rate. This approach is applied for example by Ofgem, the electricity and gas regulator in the UK.

[3] For a summary exposition and critique see for example John H Cochrane (2005) *Asset Pricing* (Princeton University Press)

regulatory framework (as discussed further below) this has led to a near-consensus[4] that the appropriate measure of the risk-free rate should be the yield on an indexed bond. Australian regulators have not, thus far, chosen to take this approach, which means that any yield chosen must be risk-free only in nominal terms, and is therefore subject to inflation risk.

3.3.2. Second, and a relatively minor point: the argument above strictly speaking *only* applies to a zero-coupon bond. The yield on a coupon bond is complicated by the impact of coupon payments in the intervening periods before the bond matures, and thus cannot be treated as a strictly risk-free return to maturity. Since in practice most bonds are coupon bonds, the notional zero-coupon bond yields at any given maturity usually need to be inferred indirectly from yields on coupon bonds. In the UK context, zero-coupon yields are calculated by the Bank of England. If equivalent zero-coupon yields are not available for Australian bonds, then care needs to be taken in ensuring that yields on coupon bonds are not assumed to be identical to those on zero-coupon bonds.

3.3.3. Third, and crucially, it should be stressed that the clear and necessary link between the horizon (the assumed period in the CAPM) and the maturity of the risk-free bond chosen has the immediate corollary that at any horizon other than m, such a bond is *not* risk-free. If, for example the bond is held for some period less than m, then the investor will need sell the bond before it matures, and will therefore face price uncertainty. As a result, bonds with long tenor are very far from being risk-free at short horizons, and can indeed be as volatile as equities in the short-term; nor is the yield equal to the expected return over any shorter period, except under very restrictive circumstances. Similarly, if the chosen horizon is *longer* than m, an investor would need to buy another bond, with unknown price (a generalisation of the problem outlined above, in applying the standard CAPM with a short assumed time period). Thus it is crucial to align the maturity of the bond yield chosen with the preferred horizon, an issue to which I now turn.

4. What is the appropriate horizon for regulatory purposes?

4.1. The AER has argued, on the basis of analysis by Dr Martin Lally (discussed in greater depth in an appendix) that the appropriate horizon, and hence the term of the risk-free rate, should match the length of the regulatory period, which I take to be five years.

4.2. While the focus of this note is on the risk-free rate, it should I hope be clear from the above analysis that the role of the risk-free rate in the CAPM is in providing a basis for the expected return on equity over the chosen horizon. Thus, although this note will not discuss issues relating to the measurement of the cost of equity, it is necessary to take this context into account. Applying the CAPM in regulation means that the assumed cost of equity that is estimated using the CAPM should be the expected return for a notional investor in equities, with a given beta, over the chosen horizon. We thus need to consider what are the appropriate assumptions to make about this notional investor.

4.3. To examine this issue, I first consider 3 alternative investor perspectives.

[4] See below for a brief discussion of this issue.

Investor perspective 1. Consider first a notional investor whose perspective does in principle match up to the AER's chosen approach. This is a prospective investor in the traded shares of APA (or at least the notional subsidiary of APA which is engaged in regulated activities). In order to match up to the AER's assumption, this investor must be assumed to liquidate their portfolio (with certainty) in five years' time, but to have no concern about returns in the meantime. If such an investor is assumed to apply the CAPM in pricing assets, then their chosen horizon will be five years, and the risk-free rate should therefore be estimated from default-free bonds with remaining maturity of five years. If the AER also correctly estimates the beta and the market risk premium, then such an investor would be content to invest in the shares of this notional regulated subsidiary.

The problem with the assumptions underlying this notional investor is that, while such an investor may exist, the choice of a five-year period is essentially arbitrary – it was simply chosen to match the regulatory period.

Investor perspective 2. Now consider an alternative perspective, also of an investor in equities considering buying this notional APA subsidiary, but with a distinctly longer horizon, of perhaps 20 years. We can justify a longer horizon both on grounds of principle and practice. On grounds of principle, because (again reverting to the underlying basis of the CAPM) the underlying investor in equities is engaged in consumption smoothing over their life cycle – and with a working life of around 40 years, the average investment horizon of such an investor is around 20 years. In practice most such long-term investment is not carried out directly by investors, but by financial intermediaries – for example pension funds – but these also will (or should) have the same long-term horizon. For such an investor the appropriate term for the risk-free rate that would provide the basis of their expected return on equity would match this longer horizon. Since such an investor has, by assumption, an investment horizon that is longer than the duration of the price control period, they would by implication be concerned with the likely path of regulation beyond the current control period.

Note that such an investor *could* in principle liquidate their portfolio after five years. But if their horizon was longer than five years, they would need to reinvest the realised proceeds at that point, and the risk-free rate that would prevail beyond five years is clearly unknown.

A complication for both these investor perspectives is that in both cases we need to assume either that no dividends are received until the investor's horizon, or – more plausibly – that any dividends received are simply reinvested in the portfolio, as is indeed the case for most long-term investors in pension funds or other retail products. If this was not the case, but instead some income was received in the interim, then the effective horizon of the investor would be reduced.

Investor perspective 3. A quite distinct, but closely related perspective, is that of a prospective direct investor in long-lived productive assets of a similar nature to APA's pipelines (I defer for now any discussion of whether such assets are in the regulated or unregulated sector). Any investor who is able to make such investments must also by implication always have the outside option of investing in traded equities. Therefore any direct investment must be expected to yield a return at least as high as the expected return from investing in a diversified portfolio of traded equities, at a matching horizon. Hence such an investor who applied the CAPM would do so in the same way as the second investor, and over similarly long horizons. But there are two complications that make the direct comparison more complicated.

The first complication is that while the second investor would in principle be able to liquidate their portfolio of traded shares at any intervening point, the direct investor in long-lived assets would only be able to do so by selling off the underlying asset, with almost certainly some loss of value due to thin markets. For this reason, to the extent that such an investor valued the option of early liquidation, they would probably require some illiquidity premium.

A second complication is of particular relevance to the issue of choice of horizon. In contrast to the first two cases, which implicitly assume all dividends are reinvested, a direct investment in a long-lived asset with any given asset life will normally yield a flow of income throughout the life of the asset. This will certainly be the case for a regulated asset. As a result there is no clear-cut measure of the horizon of such an investment. An asset with a life of 20 years, for example, but which generates revenues in each year, will have an *average* horizon, in terms of the cashflow that it generates, strictly less than 20 years.

There is a clear, but unfortunately only partial, analogy here with the comparison between a zero coupon bond and a coupon bond. A coupon bond will have an *average* maturity, or "duration" given by the average maturity of all its coupon payments, and its principal, weighted by the market value of each component. Its duration will therefore be strictly less than its maturity. In contrast, a zero coupon bond will have duration precisely equal to maturity.

Unfortunately, while there is a clear parallel with the case of both traded equities and physical assets, it is only a partial one. The duration of a default-free coupon bond can be calculated relatively straightforwardly, since the combined value of the coupons and the principal can be viewed as a portfolio of zero coupon bonds, with progressively increasing maturity. The market value of this notional portfolio can be calculated precisely since all components are known ahead of time, and thus can be valued using risk-free rates at any given maturity. The income generated by both traded shares and longlived productive assets at any given point in time is uncertain, and therefore direct calculations of duration are more complex, and usually involve simplifying assumptions. The key feature does however apply: that the associated duration, or average horizon, will typically be less than, and sometimes significantly less than the life of the asset. As a simple illustrative example, if an asset is expected to generate a constant flow of income for 30 years, and the discount rate applied to its cashflows is positive but relatively close to zero, its duration, or average horizon, will be somewhat less than 15 years. But calculating the duration of risky assets is not straightforward, so, in contrast to the first two cases, even if the expected life of an asset is known, its duration, or average horizon, can only be estimated.

4.4. The conclusion I would draw from these three perspectives is that, for a company investing in long-lived assets, some combination of the second and third is the appropriate benchmark. The precise horizon chosen is not clear-cut – especially in the third case - but the arguments above would suggest it it is likely to be longer than five years.

4.5. A contrasting perspective, is provided by the approach of Dr Martin Lally, as set out originally in Lally (2004)[5] and expanded in Lally (2021). This approach has now been adopted by the AER, as outlined in their *Draft Rate of Return Instrument Explanatory Statement* of June 2022. Since the full discussion of this issue is somewhat technical in nature, I relegate the detail of the discussion to a short technical appendix. Here, I focus on the key elements in the argument.

4.6. Lally (2021) argues that it is not valid to draw the comparison, as I do above, between a regulated company and an unregulated company with a long-lived asset. This argument rests on two key elements specific to a regulated company. First, once a given item of capital has been accepted into the Regulated Asset Base (RAB) its depreciated value at any horizon is known with certainty. Second, within a price control period, the regulator sets expected revenues on the asset, up until the end of the price control period. I do not regard either of these claims as being contentious.

4.7. But Lally then goes on to argue, in the context of a regulatory regime that applied the "NPV=0" criterion, that it is possible to value the RAB only in terms of expected cashflow over the course of the price control period, and the (known) value of the RAB at the end of the price control period, and that, as a result the appropriate horizon is the period to the end of the price control (which he takes to be 5 years). He then argues, further that, while the cashflows generated by the asset imply that the average horizon (or duration) of the asset is less than 5 years, the same applies to a coupon bond with maturity 5 years, and therefore argues that the yield to maturity on such a bond is the appropriate measure of the risk-free rate.

4.8. In the appendix I set out the details of this argument, and examine the assumptions. While Lally's argument does have an internal consistency, the weaknesses in the argument stem from a key assumption implicit in the valuation technique he employs. This has the characteristic of many valuation methods, that its validity relies on a particular investment strategy being viable, namely that it should be possible for a company whose investment is accepted into the RAB at the start of the price control period to entirely liquidate their position at the end of the price control period. The weaknesses that result from this assumption can be summarised as follows:

1. The market for the RAB is likely to be thin. This may imply that the liquidation strategy, if applied, would add an illiquidity premium to the relevant 5 year discount rate.
2. Both Lally and the AER, in their discussion of his arguments, also skate over the issue of both the current value of, and fluctuations in, the RAB multiple. The AER (p24) document the evidence of persistent, but time-varying RAB multiples. If such fluctuations are systematic then the notional liquidation strategy that underlies Lally's approach may well have higher systematic risk than a "buy-and-hold" strategy of retaining the RAB over multiple review periods (since the future value of the multiple has a progressively decreasing impact on the present value calculation, the further it is into the future).
3. Both Lally and the AER ignore both the first two points. But in doing so, Lally's argument for a close analogy between the valuation of the RAB and a 5 year bond also begs the question of why, within his restricted framework, he should simultaneously assume a significant risk

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

premium, since in his analysis the primary element in value must come from the terminal RAB, which he assumes to be known: therefore, following his argument to its logical conclusion, it should be valued using the risk-free rate.

4. To the extent that the future depreciated value of an investment accepted into the RAB is perfectly predictable, this applies at *any* horizon up to the end of the life of the asset. Thus the argument for picking the end of the price control period hinges crucially on the assumption that the price control sets the expected cashflows only until the end of the price control period. However, implicit in Lally's argument is that the NPV=0 principle is also expected to hold in future price control periods, so, even in Lally's framework, which ignores my first two points above, the argument for picking the five year horizon, while convenient, does not seem to be completely clear-cut.
5. Finally, Lally's assumption that the terminal value of the RAB at the end of the control period is perfectly predictable at the start of the control period appears to be predicated on a single investment at the start of the control period. To the extent that the actual RAB for a regulated company also includes CAPEX over the course of the price control period there may also be random (and possibly systematic) components in, for example, the regulator's propensity to allow CAPEX into the RAB.

4.9. Overall, while there is a certain degree of internal consistency in Lally's approach, it is certainly not watertight; and, to the extent that the weaknesses in the approach as outlined above are taken into account, they all point to the implied investment horizon being longer, and possibly distinctly longer than five years. As a simple counter-example, if the present value calculation were carried out across the entire life of the depreciated asset, with straight line depreciation (as applied by the AER) the average horizon would simply be half the assumed life of the asset.

4.10. I therefore arrive at the pragmatic view that setting the term for the cost of capital by reference to the average horizon of a representative investor – whether a long-term investor in traded equities (the second example above) or a direct investor in a long-lived asset (the third example) is a more robust approach. This implies a distinctly longer horizon than the length of the price control period.

4.11. Nor am I unique in drawing this conclusion. As shown in the next section, this reasoning has underpinned both the advice I and others have given to UK regulators in recent reports and has been followed through in the setting of allowed returns for UK regulated companies.

5. The UK regulatory context

5.1. The question of the appropriate term for the risk-free asset has received relatively less attention in the UK than in Australia. Nevertheless, some advice has been given; and regulatory practice established over an extended period and across a number of different sectors and regulators.

5.2. The most recent cross-regulator guidance for cost of capital matters is summarised in UKRN (2018), a report to UK regulators, of which I was the lead author. That report does consider the term for the risk-free asset (or more generally, as discussed above, the investment horizon when setting cost of capital), although not at great length: section 4.1 of the report. Recommendation 2 contains this advice:

"Recommendation 2 (Horizon)*: On balance we are in favour of choosing a fairly long horizon, for example, 10 years, in estimating the CAPM-WACC.*[6] *But we would argue that, more important than the choice of horizon per se is that the components of the CAPM-WACC are estimated using a methodology that is consistent with the chosen horizon."*

5.3. The general practice by UK regulators has been to follow this advice, and to estimate the risk-free rate based on yields of bonds with long-term tenors. The major recent debate in the UK has been whether the relevant bonds are RPI-index linked gilts (as recommended by the UKRN 2018 report), or e.g., AAA-rated corporate bonds, as used (along with gilts) by the CMA in its final decision for the appeal against Ofwat's 2019 PR19 water decision. (The CAA has also adopted this approach in its final proposal for the cost of capital for Heathrow.) But in the last 8 regulatory decisions, from August 2019 to June 2022, the terms of the assets used to estimate the risk-free rate are as follows:

Table 1: Bond terms used in estimating the risk-free rate in recent UK regulatory decisions

Regulator	Price control	Term
CAA	RP3	10
Ofwat	PR19	15
CMA	RP3	10-20
Ofgem	GD2 & T2	20
CMA	PR19	20
Ofcom	WFTMR	10-15
UR	PR21	10 and 20
CAA	H7	20

Source: various regulatory reports linked from Table 2 of UKRN Cost of Capital—Annual Update Report (2022).

5.4. As Table 1 demonstrates, regulatory practice in the UK has been to use long maturity bonds to estimate the risk-free rate, in line with the recommendations of the UKRN 2018 report, and in line with the arguments presented in this note.

6. Conclusions

6.1. I was asked by APA to provide an expert view on the appropriate term of the risk-free rate, in the context of the Capital Asset Pricing Model (CAPM) being used to estimate the cost of capital for a regulated company such as APA. My key conclusions are:

1) That the choice of term should be set precisely equal to the assumed investment horizon, since the return on even a default-free long-term bond is only risk-free if the bond is held to maturity.
2) That setting the investment horizon, and hence the chosen term, equal to the length of the price control period is a fragile result, and dependent on strong assumptions.

[6] The CAPM-WACC is the preferred way that the authors of the report referred to the estimate of the weighted average cost of capital that comes from using the capital asset pricing model (CAPM).

3) That the exact choice of investment horizon is not clear-cut; but that there is a strong case for assuming an investment horizon, and hence the term of the risk-free return, that is distinctly longer than five years.
4) That the above conclusions are consistent with well-established practice by regulators in both the UK and (until recently) in Australia.

Despite the above criticisms, it should be noted that the AER, in adopting Lally's proposed methodology, have applied the change consistently, by recalculating the equity premium, primarily on the basis of realised excess stock returns relative to returns on a five year, rather than ten year bond, which pushes up the equity premium by around 30 basis points. It was beyond the scope of this report to investigate whether this adjustment is appropriate, but it does imply that there are significant offsetting impacts of the proposed change. The AER are also being consistent with their own firm adherence to the NPV=0 criterion.[7]

[7] Note that this criterion is not so clear-cut in UK regulation; the UK approach is arguably closer to an $NPV \geq 0$ criterion, on the basis of the assumption that there are asymmetric costs of over- vs under-investment.

Appendix: The argument for a term equal to the length of the regulatory period

There has been a long-running argument in Australia (but not in the UK) that the relevant term should be equal to the length of the regulatory period i.e., 5 years. This argument, based on the so-called NPV=0 principle, appears to have originated (or at least, been given some force) by Lally (2004)[8] and is re-stated, with a number of extensions and generalisations in Lally (2021)

The AER's Draft Rate of Return Instrument Explanatory Statement June 2022, pp 103-104 summarises the arguments put forward by Lally with reference to a seemingly straightforward equivalence between expected returns and discount rates.

The basis for this is the standard (and uncontestable) definition of the return, and hence the expected return, on a traded asset

$$E_0(R_1) = \frac{E_0(P_1 - P_0 + D_1)}{P_0}$$

where expectations are formed in period 0 of the return *R* in period 1 (which may not necessarily be a year), *P* is the price of the asset, and *D* is its dividend (for a stock) or more generally any cashflow generated. As a direct consequence this can be rearranged to solve for the current price

$$P_0 = \frac{E_0(P_1 + D_1)}{1 + E_0(R_1)}$$

Which is the present value of the cash payoff that can be realised in period 1, namely $P_1 + D_1$. As noted by the AER, the fact that the payoff is simply the sum of the two components is an application of the Law of One Price: selling the asset in the next period at price P_1 would generate cash in just the same way as receiving dividends. Hence the two can be added together to be valued, irrespective of whether the share is actually sold in period 1.

The AER use parallel reasoning for the expected return of a 100% equity financed regulated firm, defining it as

$$E_0(R_1) = \frac{E_0(V_1) - V_0 + E_0(CF_1)}{V_0}$$

where V_1 is the market value of regulated assets. A key requirement for this to be a valid application of the concept of the payoff is therefore that the market value is both observable and realizable in cash – i.e., there must be a liquid market in regulated assets.

So a first caveat is that it is unclear how close this is to being the case. If there is a thin market for regulated assets, a strategy of holding the regulated asset for a single period (which may possibly be the duration of the regulatory cycle) and then realizing the investment may require a higher expected return due to an illiquidity premium.

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

A second, and probably more crucial caveat is that *V* is *not* necessarily equal to the book value of the regulatory asset base – whether in principle or in practice. Thus, if expressed in terms of *A*, the RAB,

$$E_0\left(R_1\right)=\frac{E_0\left(M_1A_1\right)-M_0V_0+E_0\left(CF_1\right)}{M_0A_0}$$

so the expected (and actual) return are potentially impacted by movements in the multiple, M . The equivalent market value formula is

$$M_0A_0=\frac{E_0\left(M_1A_1\right)+E_0\left(CF_1\right)}{1+E_0\left(R_1\right)}$$

These expressions provide important insights into Lally's analysis. It corresponds to the formula in the two period version of Lally's (2021) model if, and *only* if, $M_0=1 \;\; E_0\left(M_1A_1\right)=A_1$.

Lally simply assumes the first condition to hold because he takes this to be an intrinsic feature of the "NPV=0" approach: i.e., he simply assumes that markets and the regulator agree on present value calculations. The AER's own evidence suggests strongly that this is not necessarily the case.

Strictly speaking, as Lally acknowledges, the second condition does not require the equivalent condition to hold in the second period, it simply requires that it be *expected* to hold.

Lally (2021) then generalizes to a multiperiod framework, in which the price control period is assumed to be 5 years. By making equivalent assumptions he writes (equation (6) on p19)

$$V_0=A_0=\frac{E(C_1)}{1+k}+\frac{E(C_2)}{(1+k)^2}+\cdots+\frac{E(C_5)+A_5}{(1+k)^5}$$

Where, crucially, he makes the substitution $E_0\left(V_5\right)=A_5$, or, equivalently, using my notation, $E_0\left(M_5A_5\right)=A_5$ along with the additional assumption that A_5, the value of the RAB at the end of the 5 year control period, is known at the *start* of the control period.

On the basis of this combination of assumptions, Lally then draws the analogy between the valuation of the RAB and the valuation of a coupon bond with a five year maturity. He argues that the only conceptual difference between the two is that there may be some expected difference in the cashflow profile during the price control period, but argues, further, that such differences are relatively minor in numerical terms, and that therefore the appropriate benchmark risk-free rate for the expected return is the yield to maturity on a 5 year coupon bond (nb, *not* a zero coupon bond, which, as outlined in the main paper, is the only measure of the risk-free rate that corresponds precisely to the assumptions of the CAPM). He therefore sets *k* equal to this yield to maturity, plus a risk premium which is assumed constant.

Lally argues that, as a direct result, there is a clear distinction between the valuation of the regulated asset base, compared to the valuation of an unregulated company, because there is no equivalent terminal value, therefore unregulated firms need to do present value calculation over an infinite horizon.

It must be acknowledged Lally's assumptions are largely mutually consistent. However, the assumptions underlying Lally's analysis *are* very strong, and are crucially dependent on the assumption that there would in principle be a viable investment strategy of purchasing the RAB at the start of the control period, and liquidating the entire position at the end of the control period. This leads to the significant caveats listed in the main text.

If these limitations in Lally's arguments are taken seriously, would this necessarily lead to the adoption of a longer horizon than 5 years? One fairly clear argument for doing so is that if we consider the alternative "buy-and-hold" strategy of holding the RAB into the indefinite future, then the issue of the RAB multiple ceases to be material, since future market values are simply substituted out into the indefinite future, and thus have no impact on the value of such a strategy – the only thing that matters is the cashflow profile, but in multiple price control periods, not just the current one. As discussed in the main text, if the present value calculation is carried out over the depreciated life of the asset, an obvious alternative horizon would be half the assumed capital life.