GGT
GOLDFIELDS
GAS
TRANSMISSION

GOLDFIELDS GAS TRANSMISSION PTY LTD

ACN 004 273 241
ABN 87 004 273 241

Level 5
EastPoint Plaza
233 Adelaide Terrace
PERTH WA 6000

Telephone: +61 8 6189 4300
Facsimile: +61 8 6189 4349

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14 February 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 Discussion Paper on 2022 Gas Rate of Return Instrument Review

Goldfields Gas Transmission Pty Limited operates the Goldfields Gas Pipeline for the participants in the Goldfields Gas Transmission Joint Venture. The Goldfields Gas Pipeline is gas transmission pipeline which is fully regulated under the regime of the National Gas Law and the National Gas Rules, and Goldfields Gas Transmission appreciates the opportunity to provide the Economic Regulation Authority (ERA) with feedback on its December 2021 discussion paper, *2022 gas rate of return instrument review*.

GGT's feedback is in the submission attached.

If you would like GGT to elaborate on any of the views in the submission, please feel free to reach out to Ignatius Chin, who can be contacted directly [redacted], or at [redacted].

Yours sincerely

[redacted]

Peter Bolding
General Manager Economic Regulatory and External Policy

Response to ERA Discussion Paper on 2022 Gas Rate of Return Instrument Review

14 February 2022

Executive Summary

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 Group companies. The Goldfields Gas Pipeline is gas transmission pipeline which is fully regulated under the regime of the National Gas Law and the National Gas Rules, and GGT appreciates the opportunity to provide the Economic Regulation Authority (ERA) with feedback on its December 2021 discussion paper, *2022 gas rate of return instrument review* (Discussion Paper).

In this submission, GGT lists each of the 20 questions which the ERA has asked in the Discussion Paper. Our key points of feedback are summarized immediately after each question. Our supporting arguments follow each of the key points of feedback.

The ERA's questions ask whether we agree or support proposed positions on allowed rate of return determination set out in the Discussion Paper. GGT supports more than half of those proposed positions. On the remainder, we have views which seem to differ from those of the ERA. Our views on four issues are significantly different. They would lead to a significantly different estimate of the allowed rate of return under the 2022 gas rate of return instrument.

The issues where GGT's view are different from those of the ERA are the following.

Question 1

GGT does not agree with the use of a five-year term for all of the estimates used in setting the allowed rate of return.

If the CAPM is used to estimate the return on equity component of the allowed rate of return, there is no term to be associated with the risk free rate and no term to be associated with the estimated rate of return on equity.

The risk free rate is a market parameter unrelated to any of the risky assets available in the market, and does not have a five-year term derived from the regulatory period.

GGT does not agree with the use of a five-year term for the rate of return on equity component of the allowed rate of return when equity returns are estimated using the CAPM.

Estimation of the risk free rate of return for application of the CAPM should use extensively traded government bonds with the longest terms to maturity. Australian Government bonds with terms to maturity of 10 years continue to be extensively traded and should now be used to estimate the risk free rate, rather than bonds with terms of 5 years. With over $50 billion of bonds with terms longer than 10 years on issue, consideration should also be given to using, in risk free rate estimation, Australian Government bonds with terms to maturity longer than 10 years.

Question 6

GGT does not support the use of a benchmark credit rating of BBB+ for the 2022 gas rate of return instrument. If a credit rating is required for rate of return determination, it should be BBB.

Question 12

GGT does not support estimation of the historical market risk premium using an average of arithmetic means and geometric means.

Estimation of the historical market risk premium should use only the arithmetic mean of historical excess returns. Using the arithmetic mean, we would expect to see, in the 2022 gas rate of return instrument, an estimate of the MRP of at least 6.4%.

The efficient markets hypothesis and the constant expected returns model provide the rationale for estimating the MRP from historical excess returns. They imply:

- there is little to be learned from looking at differences in the means of historical excess returns across sub-series within the longest available series of excess returns; and
- the use of conditioning variables permits arbitrary changes to be made to the MRP estimated using historical excess returns, and should be avoided.

Question 14

GGT sees little scope, at the present time, for moving away from the sample of potential domestic comparators which was used for equity beta estimation in 2018.

Prior assessments of the degree of service provider risk are necessary for the choice of comparators, domestic or international.

GGT has not found any assessment of whether potential comparators have degrees of risk similar to the degrees of risk of the Western Australian service providers in respect of the provision of pipeline services. This assessment is required.

Goldfields Gas Pipeline is a relatively high-risk asset, and this should be reflected in the estimate of the equity beta used in the 2022 gas rate of return instrument: that beta should be around 1.2.

A broader set of domestic and international comparators may need to be considered for future equity beta estimation. GGT does not support the use of broader set of comparators (domestic or international) in the setting of betas for the 2022 instrument.

ERA questions and GGT responses

1. Do you agree with the use of a five-year term of estimates of the rate of return? If not, please explain why and your alternative approach.

GGT does not agree with the use of a five-year term for all of the estimates used in setting the allowed rate of return.

If the CAPM is used to estimate the return on equity component of the allowed rate of return, there is no term to be associated with the risk free rate and no term to be associated with the estimated rate of return on equity.

The risk free rate is a market parameter unrelated to any of the risky assets available in the market, and does not have a five-year term derived from the regulatory period.

GGT does not agree with the use of a five-year term for the rate of return on equity component of the allowed rate of return when equity returns are estimated using the CAPM.

Estimation of the risk free rate of return for application of the CAPM should use extensively traded government bonds with the longest terms to maturity. Australian Government bonds with terms to maturity of 10 years continue to be extensively traded and should now be used to estimate the risk free rate, rather than bonds with terms of 5 years. With over $50 billion of bonds with terms longer than 10 years on issue, consideration should also be given to using, in risk free rate estimation, Australian Government bonds with terms to maturity longer than 10 years.

To explain why GGT does not agree with the use of a five-year term for the rate of return on equity component of the allowed rate of return when equity returns are estimated using the CAPM, we need to take a closer look at the Sharpe-Lintner Capital Asset Pricing Model (CAPM).

The CAPM is a simple model of financial market equilibrium in an exchange economy.

Underlying the CAPM is a view of agents buying and selling financial assets to form portfolios which will transfer wealth to a time one period in the future. The assets in question are no more than one-period claims to future income. The ways in which this income is generated are not specified. There is no production of goods and services, and no distribution of those goods and services, in the CAPM. There is no physical capital. There is no supply of new assets and, in consequence, there is no adjustment of portfolios to accommodate new supply.

In equilibrium in this economy, the expected rate of return on any particular asset is the sum of the rate of return on a risk free asset, and a premium for risk. This is the CAPM. The premium for risk is the product of the beta for the asset in question and the market risk premium (MRP). The MRP is the difference between the expected rate of return on the portfolio of assets held by all agents in the economy (held by "the market") and the rate of return on the risk free asset.

Although some agents may be net sellers of assets, we refer, in the paragraphs which follow, to all agents using the more common term "investors".

Each investor chooses a portfolio from all of the risky assets available in the market. Given a target expected rate of return, a rational investor will choose weights for the assets in her or his portfolio so that, overall, the portfolio has minimum variance of returns (each investor chooses a portfolio on the "portfolio frontier"). Furthermore, if each investor's utility is an increasing and strictly concave function of expected return and variance of return, as is usually assumed for portfolio theory, the investor will choose only those weights which are for a portfolio represented by a point in the space of return variance and expected return which is on the portfolio frontier above and to the right of the point of minimum portfolio variance.[1] Each investor will choose only a "mean-variance efficient" portfolio.

Portfolio theory, as outlined in the preceding paragraph, addresses only the question of how investors best allocate the wealth with which they are initially endowed among the risky financial assets available in the market. It is not a theory of asset market equilibrium and asset pricing. Portfolio theory must be augmented if an explanation is to be provided for the prices at which particular assets are traded or, equivalently, for the rates of return on those assets.

As Sharpe, Lintner and others have shown, an asset market equilibrium can be identified in this view of investors buying and selling assets to form portfolios if one of the assets available to those investors is a risk free asset.

When the risk free asset is added to the set of risky assets from which investors form portfolios, every investor will choose, to maximize her or his utility, a portfolio which is a linear combination of the risk free asset and the market portfolio. This establishes asset market equilibrium in which the expected rate of return on any particular risky asset is the sum of the risk free rate of return and the contribution which that particular asset makes to the total risk of the market portfolio. A risky asset's contribution to the total risk of the market portfolio is the product of its beta and the MRP, where beta is the covariance of the return on the asset with the return on the market divided by the variance of the return on the market. In asset market equilibrium, the expected rate of return on any particular risky asset is given by the CAPM.[2]

The risk free asset of the CAPM is, then, a riskless asset available to all investors. It is an asset quite independent of any of the risky assets available for portfolio formation, including (risky) regulated infrastructure assets.

The riskless asset provides a riskless return. The riskless rate of return - the risk free rate - does not vary over the single period of the CAPM and does not vary across states of nature (the asset in question is riskless). The yield curve for the return on the risk free asset is flat: it is neither upward sloping nor downward sloping. The return on the risk free asset does not have a term structure which might the be imparted to an expected rate of return on equity determined using the CAPM.

1 The portfolio frontier is a parabola in the space of return variance and expected return.

2 Chi-fu Huang and Robert H Litzenberger (1988), *Foundations for Financial Economics*, New York: Elsevier, provides a comprehensive textbook presentation of portfolio theory and CAPM derivation

GGT is aware that others have argued, in the context of setting rates of return and prices for regulated businesses, that application of the NPV = 0 principle to the cash flows of the business requires the term of the risk free rate, and hence the term of the estimated rate of return on equity, to be the regulatory period, which is typically five years.

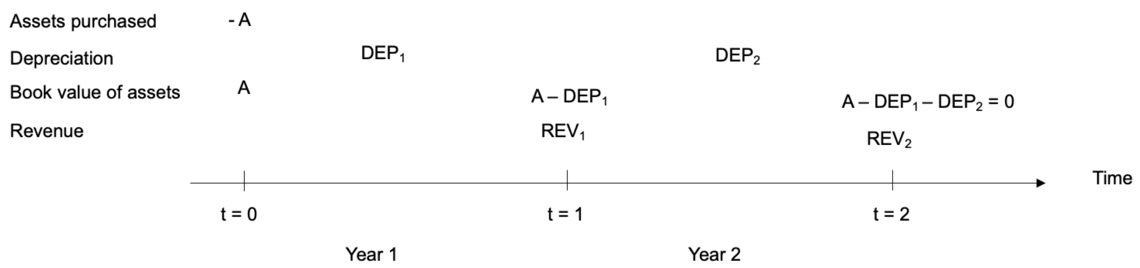
These arguments, we think, are invalid.

Dr Lally's application of the NPV = 0 principle

A succinct but careful application of the NPV = 0 principle to assessment of the term for the rate of return on equity can be found in Dr Martin Lally's paper, *The Appropriate Term for the Allowed Cost of Capital*, prepared for the Australian Energy Regulator (AER) in April 2021. In the following paragraphs, we set out Dr Lally's argument in some detail for the purpose of subsequently making clear what we see as a conceptual error which leads, in our view incorrectly, to the conclusions that the rate of return on equity has a term, and that term should be the regulatory period.

Application of NPV = 0 principle proceeds as follows. Regulated assets are purchased at time t = 0 (now), and the purchase price is A. These assets have a life of two years, and the services they provide are subject to price regulation. The regulatory period is one year, and prices are set at the beginning of each regulatory period. Revenues are received at the end of each year. There are no operating expenditures, no new capital expenditures and no taxes.

The timing of cash flows and the book value of the assets over their life are shown in the following diagram.



The initial regulated asset value is A, and regulatory depreciation in Year 1 is DEP_1. Regulatory depreciation in Year 2, the last year of asset life, is $DEP_2 = A - DEP_1$. The book value of assets at time t = 2 is, then, zero.

At t = 1, regulated prices are set to earn revenue REV_2. These prices should provide the service provider with the opportunity to recover, in Year 2, depreciation in that year, and the allowed cost of capital (k_1) applied to the book value of assets at the beginning of the year (at t = 1):

$REV_2 = A - DEP_1 + k_1(A - DEP_1) = (A - DEP_1)(1 + k_1)$

V_1, the value of the regulated assets at t = 1, is the future revenue (REV_2) discounted one year at k_{e12}, the one year cost of equity at t = 1:

$$V_1 = \frac{(A - DEP_1)(1 + k_1)}{1 + k_{e12}}$$

At time t = 0, regulated prices are set to earn revenue REV_1 at the end of Year 1. Those prices should provide the service provider with the opportunity to recover, in Year 1, depreciation in that year, and the allowed cost of capital (k_0) applied to the book value of assets at the beginning of the year (at t = 0):

$REV_1 = DEP_1 + k_0A$

The value of the regulated assets at t = 0, V_0, is the revenue at the end of Year 1 (REV_1), plus the value of the regulated assets at t = 1 (V_1), discounted one year at k_{e01}, the one year cost of equity at t = 0:

$$V_0 = \frac{DEP_1 + k_0A + V_1}{1 + k_{e01}} = \frac{1}{1 + k_{e01}}\left[DEP_1 + k_0A + \frac{(A - DEP_1)(1 + k_1)}{1 + k_{e12}}\right]$$

The NPV = 0 principle requires that the value of the regulated assets at t = 0 be equal to the value of the regulated asset base at that time: it requires $V_0 = A$. This can only be the case if:

- the allowed cost of capital, k_1, in Year 2 matches the discount rate k_{e12} in that year (the cost of equity at t = 1); and
- the allowed cost of capital, k_0, in Year 1 matches the discount rate k_{e01} in that year (the cost of equity at t = 0).

In the context of the model outlined above, the NPV = 0 principle requires that the allowed cost of capital in each year be equal to the one year cost of equity in that year.

Now, the cost of equity is to be estimated using the CAPM. In that model, according to Dr Lally, the one year cost of equity is the risk free rate plus the product of the market risk premium and the beta, all defined over the one year period in question.

Dr Lally then generalizes the argument on pages 21 and 22 of his paper. He notes:

By definition, the cost of equity capital is forward looking. If equity finance is raised at time 0, the cost at that time is the set of expected rates of return, one for each of the time spans from 0 to the realization of future cash flows that the firm will receive. If the business is regulated with a cycle of five years, the relevant set of expectations are those for each of the next five years, which can be. compressed into a single expectation within which the risk free rate component is that on a bond with a five-year term to maturity and a coupon rate matching the ratio of regulatory cash flows per year to the current regulatory asset base. As time moves forward, the set of expected rates of return changes, as each is now defined from the new current time until the realization of future cash flows. So, in five years' time, the relevant expectations are from then until the end of that regulatory cycle.

We do not disagree with the conclusion that, if the business is regulated over a cycle of five years, the set of expectations relevant in the context of rate of return setting are those for each of the next five years.

Our concern is with the subsequent assertion that the relevant set of expectations can be compressed into a single expectation within which the risk free rate component is that on a bond with a five-year term to maturity and a coupon rate matching the ratio of the regulatory cash flows per year to the current regulatory asset base. At this point in the argument, the term to maturity of the bond used to estimate the risk free rate of the CAPM is assumed to be related to the regulated business and to impart a term to its estimated cost of equity.

This, in our view, is conceptually incorrect.

As we explained above:

- the risk free asset of the CAPM is the riskless asset available to all investors; it is an asset quite independent of any of the risky assets available to those investors for portfolio formation, including (risky) regulated infrastructure assets;
- the riskless asset provides a riskless return, a rate of return - the risk free rate - which does not vary over the single period of the CAPM, and does not vary across states of nature; and
- the rate of return on the risk free asset does not have a term structure, which might be imparted to the expected rate of return on equity determined using the CAPM.

If the CAPM is to be used to estimate the cost of equity, then an estimate must be made of the risk free rate. CAPM application does not call for substitution of a low risk - but still risky - asset (a government bond) for the risk free asset of the model. To substitute a low risk asset for the risk free asset, in the way implied by the assumption made explicit by Dr Lally, would be inconsistent with the underlying economic theory of the CAPM.

Professor Davis has also used NPV = 0 to establish the term of the risk free rate

In a report for the Australian Competition and Consumer Commission, in 2003, Melbourne University Professor Kevin Davis also advised that, when applying the CAPM in the context of economic regulation, the term to maturity of the bonds used to estimate the risk free rate should match the regulatory period.[3] Again, the supporting argument was that, by setting the term equal to the regulatory period (five years), the NPV = 0 principle was satisfied. Unfortunately, Professor Davis's supporting argument was flawed.

Professor Davis, in effect, set out a necessary condition for NPV = 0: the number used as the estimate the risk free rate of the CAPM must be the same as the number used for the risk free rate in a portfolio tracking investment in the regulated asset. This necessary condition was not, however, sufficient to characterise the risk free asset and the risk free rate.

If the risk free rate of the rate of the CAPM were to be estimated using government bonds with terms to maturity of 10 years, or of 20 years, and bonds of the same term to maturity were used in determining the return on Professor Davis's tracking portfolio, the NPV = 0 principle would still be satisfied. In Professor Davis's 2003 analysis, the term of the bond to be used to estimate the risk free rate is indeterminate.

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3 Kevin Davis, *Report on "Risk Free Interest Rate and Equity and Debt Beta Determination in the WACC*, August 2003, page 4.

In subsequent, similar, work - a report for New South Wales Independent Pricing and Regulatory Tribunal (IPART) in 2011, and a working paper (2012) - Professor Davis did not refer to the issue of the term to maturity of the risk free asset.[4] He addressed only the assumption to be made about the term to maturity of the debt issued by the regulated firm when determining regulated access prices. When the working paper was subsequently published in the *Economic Record*, in September 2014, Professor Davis did not address the question of whether the use of yields on bonds with terms to maturity of 10 years, or on bonds with any other term to maturity, was appropriate for estimation of the risk free rate of return.[5]

The use of yields on bonds with term to maturity equal to the regulatory period (typically, five years) has purportedly been justified by a requirement that the NPV = 0 principle is satisfied. However, such justifications, as we have explained, are based either on an invalid assumption (Dr Lally's assumption about expectations), or on models (like those of Professor Davis) which leave the term of the bonds to be used to estimate the risk free rate indeterminate.

Irrespective of the term of the bond used to estimate the risk free rate, the risk free rate itself, as used in the CAPM, has no term which is imparted to the resulting estimate of the cost of equity. If the CAPM is used and, consistent with the assumptions of the model, no term is assigned to the resulting estimate of the cost of equity, the NPV = 0 principle is not violated: NPV continues to be zero. However, the question of how the risk free rate is to be estimated is left open.

How, then, is the risk free rate of the CAPM to be estimated?

The risk free asset is a theoretical construct, and any estimate of the risk free rate must be made from the rates of return on traded assets for which returns can be observed. No traded asset is risk free, although investors view some assets as having significantly less risk than others.

Which assets, among all of the assets traded, do investors (all investors, and not just those investing in regulated infrastructure assets) regard as being close to risk free?

Extensively traded financial assets - bonds - issued by reputable government borrowers are generally regarded as low risk among all traded assets.

Now, investors do not desire, for its own sake, the wealth which is transferred through time via asset portfolios. Wealth is desired for the consumption of goods and services which it makes possible. A risk averse investor will choose a stable - non-random - consumption plan but will be unable to realize that plan by transferring wealth over time using a series of bonds with short terms to maturity. Although a bond with a short term may be close to riskless over its term to maturity, transferring wealth over longer horizons by rolling over short bonds is risky because future bond yields are stochastic. Facing uncertain and time varying short-term yields, investors can finance relatively stable consumption plans with long term bonds.[6] The ideal bond for this purpose is an

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[4] Kevin Davis, Determining Debt Costs in Access Pricing: A Report to IPART, Appendix A to IPART, Developing the approach to estimating the debt margin, Other Industries - Draft Decision, February 2011; and Kevin Davis, "The debt Maturity Issue in Access Pricing, Draft 3, 2 September 2012.

[5] Kevin Davis (2014), "The Debt Maturity Issue in Access Pricing," Economic Record, 90(290): pages 271-281.

[6] That long term bonds rather than short term bonds were relevant to consideration of the risk free asset appears to have been first raised by Franco Modigliani and Richard Sutch (1966), "Innovations in Interest

inflation indexed bond without a maturity date - an inflation indexed "consol". Inflation indexed consols are, however, unusual, and may not be among the traded assets for which returns can be observed. In practice, risk free rate estimation must be confined to extensively traded bonds with the longest terms to maturity.

Returns on extensively traded government bonds with the longest terms to maturity should be used in estimation of the risk free rate for CAPM application.

The ERA has previously used yields on Australian Government bond with terms to maturity of five years to estimate the risk free rate. However, Australian Government bonds with terms to maturity of around 10 years are extensively traded.

The Australian Office of Financial Management has indicated, in its January 2022 Mid-Year Economic and Fiscal Outlook update, that, of the $778 billion of Australian Government bonds on issue, some $93.6 billion had maturities around five years, $144.1 billion had maturities around 10 years, and a further $36.2 billion had maturities around 20 years. An issue of $15.6 billion matured in June 2051.

A rate estimated using yields on bonds with terms to maturity of around five years is likely to be a downward-biased estimate of the risk free rate. Risk free rate estimation should use the yields on Australian Government bonds with terms to maturity of at least 10 years. With over $50 billion of bonds with terms longer than 10 years now on issue, consideration should also be given to using, in risk free rate estimation, Australian Government bonds with terms to maturity longer than 10 years.

Rate Policy", American Economic Review, 56(1/2), pages 178-197. The argument was subsequent developed by, among others, Joseph E Stiglitz (1970), "A Consumption-Oriented Theory of the Demand for Financial Assets and the Term Structure of Interest Rates", Review of Economic Studies, 37(3), pages 321-351; John Y Campbell and Luis M Viceira (2001), "Who Should Buy Long Term Bonds?", American Economic Review, 91(1), pages 99-127; and Jessica A. Wachter (2003), "Risk aversion and allocation to long term bonds", Journal of Economic Theory, 112, pages 325-333.

2. Do you agree with the standardised averaging period process? If not, please explain why and your alternative approach.

GGT agrees with the standardised averaging period process.

Generally, the changes proposed make more specific the requirements for the setting of averaging periods without departing from current practice.

Paragraph 121 of the Discussion Paper raises the question of whether an averaging period of up to 40 trading days (rather than 20 days as is currently the case, and as is proposed) might better mitigate the effects of market volatility. Perhaps, but a longer period might also result in rate of return parameters being overstated or understated if market rates are systematically falling or rising. We favour an averaging period of 20 trading days.

3. Do you support the use of a gearing level of 55 per cent for the 2022 gas instrument? If not, please explain why and your alternative approach.

GGT supports retention of the current benchmark gearing of 55% for the 2022 gas rate of return instrument.

Further work on appropriate comparators for the purpose of establishing rate of return parameters for regulated Australian gas pipeline service providers is required. There is, now, insufficient time for this work, and for subsequent consultation, in the current review. It should be deferred until the next rate of return review, along with any reassessment of a benchmark for gearing.

In previous reviews of the allowed rate of return, experts have advised, and stakeholders (including GGT) have accepted, that market values of equity and debt provide the correct measure of gearing. The book values of these financing instruments are historical and of little relevance to current resource allocation decisions. Market values, not book values, are consistent with the theory of financial economics. Although market values of equity are relatively easily calculated from current share prices, market values for corporate debt, which is not extensively traded, are more difficult to obtain. GGT concurs with the current approach of estimating gearing from market values of equity and book values of debt. The gearings noted in the following paragraphs have been calculated in this way; they have not been calculated from book values.

The data summarised in Table 3 of the Discussion Paper indicate that average gearings for Ausnet Services and Spark Infrastructure are similar: 56% and 57%, respectively. They clearly differ from the APA Group average gearing of 47%.

An average for three businesses, one of which is quite dissimilar to the other two, is not the measure required for the setting of gearing for the gas rate of return instrument. A benchmark - a level of gearing which can be achieved by an efficient regulated gas pipeline business - is required.

At present, there seem to be too few regulated Australian energy infrastructure businesses which can provide data for determination of a gearing benchmark. The issue is similar to the issue of appropriate comparators for beta estimation (see below). Like the issue of the comparators for beta estimation, the issue of data for determination of a gearing benchmark probably cannot be resolved before a draft rate of return instrument must be published. It should be addressed in a review leading to the 2026 instrument.

The data for Ausnet Services and Spark Infrastructure indicate gearing for a regulated business which is a little above the current (2018) benchmark of 55%.

In anticipation of subsequent work on appropriate comparators for the purpose of establishing rate of return parameters (as part of the next rate of return review), GGT supports the use of a gearing level of 55% for the 2022 gas rate of return instrument.

4. When determining gearing do you support the ERA adjusting debt and equity to recognise hybrid securities and what is a suitable method for allocating hybrid securities between debt and equity? If not, please explain why and your alternative approach.

GGT does not support adjustment of the debt and equity values used in determining gearing to recognise hybrid securities.

Ausnet Services and Spark Infrastructure have issued hybrid securities.

These hybrid securities have some of the characteristics of debt, and some of the characteristics of equity. The issuance of hybrid securities is typically limited to larger borrowers financing in international capital markets, and these markets are not always "open" for new issues of such securities.

The way in which the characteristics of debt and equity are combined in a particular issue of hybrid securities is specific to that issue. There is no simple method whereby the value of hybrid securities can be allocated between debt and equity.

In these circumstances, GGT does not see hybrid securities as forming part of the portfolio of financing instruments used by a benchmark provider providing services using assets regulated under the regime of the National Gas Law and the National Gas Rules.

When determining gearing the ERA should not adjust debt and equity to recognise hybrid securities. A simple debt/equity balance sheet structure should be retained.

5. Do you support the use of a hybrid trailing average approach for cost of debt estimation. If not, please explain why and your alternative approach, including transitionary arrangements.

GGT is cautiously supportive of use of the ERA's current hybrid trailing average approach for cost of debt estimation in the 2022 gas rate of return instrument.

GGT has concerns that, as a matter of practice, debt financing and refinancing are not sufficiently flexible to allow correct estimation of the cost of debt using a hybrid trailing average approach, in which the base cost is fixed by reference to the on-the-day 5 years bank bill swap rate.

We understand that the on-the-day base rate can be hedged, and that the ERA explicitly allows for hedging costs in its rate of return determination.

We consider a risk premium determined as a 10-years trailing average of the current and past premiums to be reasonably reflective of the circumstances of a regulated infrastructure business when those premiums are estimated using the revised bond yield approach (see response to Question 7).

We have concerns, but our experience to date, in Western Australia and in other jurisdictions, has been such that we see the ERA's current hybrid trailing average approach as a reasonable approach to cost of debt estimation, and are cautiously supportive of its continued use in the 2022 gas rate of return instrument.

6. Do you support the use of a benchmark credit rating of BBB+ for the 2022 gas instrument? If not, please explain why and your alternative approach.

GGT does not support the use of a benchmark credit rating of BBB+ for the 2022 gas rate of return instrument.

If a credit rating is required for rate of return determination, it should be BBB.

GGT is supportive of using the revised bond yield approach for debt risk premium estimation for the in the 2022 gas rate of return instrument (see response to Question 7 below). We are, however, concerned with the use of BBB+ as the benchmark credit rating in the implementation of that approach.

Two of the entities in the Goldfields Gas Transmission Joint Venture, Southern Cross Pipelines Australia Pty Limited and Southern Cross Pipelines Australia (NPL) Pty Limited, are APA Group entities. APT Pipelines Ltd, the rated issuer within the APA group of companies is currently rated BBB, and has been rated BBB since it was first rated in June 2009. (The third of the participants in the Joint Venture, Alinta Energy GGT Pty Ltd, is a company within the Alinta Energy group. None of the companies in that group is publicly rated, and the parent, Chow Tai Fook Enterprises, is not publicly rated.)

Between them, Southern Cross Pipelines Australia Pty Limited and Southern Cross Pipelines Australia (NPL) Pty Limited, hold an 88.2% ownership interest in the Goldfields Gas Pipeline.

APA Group companies might aspire to the BBB+ benchmark but, for the higher rating to be achieved, gearing would have to be lower - lower than the 55% which the ERA is currently considering for its 2022 gas rate of return instrument.

The benchmark credit rating, and the benchmark gearing, appear, to GGT, to be inconsistent.

GGT noted this inconsistency in its rate of return submissions to the ERA in 2018. We advised that it arises from the elevated credit ratings of the companies included in the sample from which the benchmark has been calculated. These elevated credit ratings are, in part, attributable to the financial strength and support of a parent entity.

The Discussion Paper advises that the ERA has retained its definition of a benchmark entity.[7] The benchmark is to be a pure play network service provider operating within Australia without parental ownership.

When the credit ratings of the companies which were in the sample used to establish the 2018 benchmark rating were downgraded by one "notch" to, at least partially, remove the parental "halo effect", the average credit rating was BBB.

In its reporting of developments since 2018, the Discussion Paper indicates, at paragraph 211, that not much has changed. Credit ratings for the three Australian regulated energy networks businesses

[7] Discussion Paper, paragraph 51.

were set out in Table 4: APA Group's rating was BBB, Spark Infrastructure was rated BBB+, and AusNet Services was rated A-. On 8 February 2022, AusNet Services advised the Australian Stock Exchange that both Moody's and Standard and Poor's had revised the group's credit rating downwards. The Standard and Poor's rating is now BBB+.

In these circumstances, GGT maintains that the benchmark credit rating, consistent with the ERA's definition of the benchmark, is BBB.

Rate of return determination in accordance with the 2022 gas rate of return instrument should use a benchmark credit rating of BBB.

7. Do you support the use of the revised bond yield approach for estimating the debt risk premium? If not, please explain why and your alternative approach.

As our response to Question 5 indicates, GGT is supportive of continued use of the revised bond yield approach for debt risk premium estimation in the 2022 gas rate of return instrument.

As we noted in our response to Question 6, we are, however, concerned with the use of BBB+ as the benchmark credit rating in implementation of the revised bond yield approach. The credit rating used to select the sample of bonds from which the debt risk premium is estimated should be BBB.

The contractual structure of a business - the set of contracts with suppliers of inputs, including providers of finance, and the buyers of its outputs - allocates the underlying risks of the business between its various stakeholders.

Providers of debt finance - lenders - like other input suppliers (but not providers of equity), contract for rights to a predetermined part of the income stream of the business. Unlike other input suppliers, the providers of debt also contract for rights to make certain decisions about the business in the event of default. The providers of equity - the shareholders - have rights to the residual income stream and retain rights of control over the business as long as lenders' entitlements to the income stream are satisfied. Ultimate rights of control may rest with the shareholders and, in specific circumstances of default, with lenders, but senior management has considerable discretion over the direction of the business, and strongly influence key decisions. The potential for agency problems between shareholders and senior managers, and between shareholders and lenders, and the ways in which these can be at least partially controlled by contracts, in particular, agreements with lenders, are now reasonably well understood.

In the case of debt, agreements with lenders are negotiated by management. The pricing of debt, and the debt risk premium negotiated, reflect the allocation of risk to lenders through the contractual structure of the business. Debt contracts and pricing for small businesses are standardised to lower transaction costs. For larger businesses - energy infrastructure businesses - debt contract negotiation involves prospective lenders closely examining the business and its contractual structure to ascertain risks and to determine the ways in which those risks are allocated and managed. The parties have considerable discretion in specifying cash flow rights, control rights, other rights (for example, in relation to collateral and the issue of options), and in specifying the contingent circumstances in which these rights are exercised. Debt risk premiums will differ.

Debt risk premiums will differ, not because service providers fail to expend effort on minimizing those premiums, but because the underlying risks of the businesses are different, lender perceptions of those risks (based on specific inquiry, and not on reference to credit ratings) are different, and there are different options available for risk management. With different technologies (electricity transmission, electricity distribution, gas transmission and gas distribution), different scales of operation (electricity distribution businesses are often much larger than gas transmission and distribution businesses), different equity financing arrangements (private or publicly listed; and less directly, through public ownership), and different market risks and contracting (regulated and partly implicit contracts with large numbers of end users in the case of electricity and gas distribution, small numbers of explicitly contracted large end users in the case of gas transmission), the premiums will be different.

This makes difficult the benchmarking of the cost of debt for the application of incentive regulation. If the sample of businesses used for determining the debt risk premium is small (like the sample which underpins the Australian Energy Regulator's Energy Industry Credit Spread Index), businesses with relatively higher costs of debt, because they are seen by lenders as being more risky, are unable to achieve the benchmark. Businesses in a small sample with relatively low costs of debt, not because of superior negotiating skills, but because they are seen by lenders as less risky, are not provided with any incentive to lower their debt costs.

If the debt cost, or at least the debt risk premium, is to be benchmarked, a small sample 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 a wide range of contractual responses to risk management.

GGT sees the revised bond yield approach as using the largest sample available at the time the debt risk premium is to be estimated. This is why we are supportive of its continued use in the 2022 gas rate of return instrument. We note though, that averaging across a wide range of contractual responses will reduce, but not entirely eliminate, the problem that some businesses are seen by lenders as being more risky than others, and have to accept higher premiums in the pricing they negotiate for debt. This causes us to doubt whether, in the case of the debt risk premium, benchmarking is entirely feasible.

8. When estimating the return on equity do you support the use of Commonwealth Government bonds as the risk free asset? If not, please explain why and your alternative approach.

When estimating the return on equity, GGT supports the use of Commonwealth Government bonds as the risk free asset.

GGT's response to Question 1 clearly signalled our support for the use of Commonwealth Government bonds as the risk free asset.

Commonwealth - Australian Government - securities are essentially free from default risk, are denominated in the same currency (Australian dollars) as regulated cash flows (eliminating the need to consider currency risk), and are extensively traded (and have little or no liquidity risk).

Some private sector securities have been proposed as alternatives to Commonwealth Government bonds for the purpose of risk free rate estimation, but no private sector issuer has the same low default risk as a reputable government borrower.

When estimating the return on equity, GGT supports the use of Commonwealth Government bonds as the risk free asset.

9. When estimating the historical market risk premium do you support the sampling periods post-1958? If not, please explain why and your alternative approach.

GGT does not support the use of multiple sampling periods post-1958 when estimating the historical market risk premium.

We cautiously support the use of data for a single long period post-1958 for MRP estimation.

There is no strong case for dividing the data into a number of sub-series.

In the discussion on estimation of the MRP in our response to Question 12, GGT concludes that, if historical excess returns are to be used to make the estimate, then use should be made of the longest available series of those returns.

The principal dataset of historical excess returns available for estimating the historical market risk premium is the dataset published by Brailsford, Handley and Maheswaran (BHM).[8] The published data span the period 1883 to 2010. Others have extended these data to 2017, and beyond, using the methods set out by BHM. We have extended the data to 2021.

Assuming a constant expected excess return, reducing the sampling period from 1883-2021 (139 observations) to 1958-2021 (64 observations) increases the width of a 95% confidence interval for expected excess return from (3.7%, 9.1%) to (1.5%, 11.9%). There is a substantial loss of precision.

BHM advise:

If the equity premium is stationary over time, then a naive statistical approach would suggest the longer the estimation period the better. However, we conclude that residual concerns about data quality become increasingly important the further back into the past one looks. . . .

We find that estimates based on data before 1958 should be treated with caution because of concerns over data quality and the imprecision of the underlying series.[9]

Given the advice of BHM, excess returns data for the period post-1958 should be used in MRP estimation.

With sampling periods of shorter duration, there is a further loss in the precision with which the historical market risk premium can be estimated. The inclusion of provisions for dividend imputation into Australia taxation law may be a reason for consideration of the period post-1988, but we are unaware of any careful consideration of this issue.

GGT cautiously supports the use of data for a single period long period post-1958 for MRP estimation.

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[8] Tim Brailsford, John C Handley, Krishnan Maheswaran (2008), "Re-examination of the historical equity risk premium in Australia", Accounting and Finance, 48(1), pages 73-97; and Tim Brailsford, John C Handley, Krishnan Maheswaran (2012), "The historical equity risk premium in Australia: post-GFC and 128 years of data", Accounting and Finance, 52(1), pages 237-247.

[9] Brailsford, Handley, Maheswaran (2008), page 75.

10. When estimating the historical market risk premium do you support the sampling periods to include a new period of 2000 to current? If not, please explain why and your alternative approach.

GGT does not support the use of a new sampling period "2000 to current" in the calculation of historical excess returns.

If historical excess returns are used in estimation of the MRP then a long data series is required.

Our 95% confidence interval for the sampling period 2000-2021 (22 observations) is (-0.8%, 14.2%).

The period "2000 to current" is too short for any meaningful inference to be made about the MRP.

11. When estimating the historical market risk premium do you support the approach to only consider the Brailsford, Handley and Maheswaran (BHM) dataset? If not, please explain why and your alternative approach.

GGT supports consideration of only the BHM data set when estimating the historical market risk premium within the context of the setting of rate of return parameters for the 2022 gas rate of return instrument.

As the Discussion Paper notes, consultant NERA has expressed concerns about the quality of the data for the early years of the historical excess returns series published by BHM and has compiled its own series. However, after 1936, the NERA series and the BHM series are similar.

Whether the NERA dataset is superior to the BHM data prior to 1936 is a matter on which there are varying opinions. The fundamental problem remains the decreasing quality of the source data the further back into the past one looks.

The BHM data are readily available (they have been published in the journal *Accounting and Finance*), the methods used for their compilation have been documented, and are reasonably well understood, and stakeholders have been able to replicate at least part of the dataset, allowing its extension, with some confidence, beyond its most recent date (2010).

GGT supports consideration of only the BHM data set when estimating the historical market risk premium within the context of the setting of rate of return parameters for the 2022 gas rate of return instrument.

12. When estimating the historical market risk premium do you support the approach to calculate the historical market risk premium through the average of the arithmetic and geometric means? If not, please explain why and your alternative approach.

GGT does not support estimation of the historical market risk premium using an average of arithmetic means and geometric means.

Estimation of the historical market risk premium should use only the arithmetic mean of historical excess returns. Using the arithmetic mean, we would expect to see, in the 2022 gas rate of return instrument, an estimate of the MRP of at least 6.4%.

The efficient markets hypothesis and the constant expected returns model provide the rationale for estimating the MRP from historical excess returns; they further imply:

- **there is little to be learned from looking at differences in the means of historical excess returns across sub-series within the longest available series of excess returns; and**
- **the use of conditioning variables is the arbitrary change of the MRP estimated using historical excess returns, and should be avoided.**

For nearly two decades, historical excess returns have guided estimation of the MRP for determination of the rate of return on equity component of the allowed rate of return. This use of historical excess returns has its foundations in the efficient market hypothesis, which gained currency during the 1960s and 1970s.[10] One implication of the efficient market hypothesis is that the true MRP is constant. As more data become available, estimates of the premium should converge to the true underlying value.

Market efficiency and constant expected returns

The efficient market hypothesis is the proposition that the information which market participants use, at any time, to determine the prices of financial assets is all of the information available at that time.[11] This information which market participants currently use includes the implications of currently available information for the joint probability distributions of asset prices at future times. If $p_{t+\tau}$ is the vector of prices of all assets available in the market at time $t + \tau$ (including any interest or dividend payments at $t + \tau$), then the joint density function of prices at $t + \tau$, as assessed by market participants at $t - 1$ on the basis of the information in the set ${}^{m}\phi_{t-1}$, is

$$f_m(p_{t+\tau} \mid {}^{m}\phi_{t-1}),\ \tau = 0, 1, 2, \ldots .$$

10 John Y Campbell, "Estimating the Equity Premium", National Bureau of Economic Research Working Paper 13423, September 2007.

11 See Eugene F Fama (1976), *Foundations of Finance*, New York: Basic Books, chapter 5. The explanation of the implications of the efficient market hypothesis in the paragraphs which follow is drawn from chapter 5 but, in that chapter, Fama's primary concern is testing of the hypothesis rather than its implications for estimation of the MRP.

Market efficiency implies that the set of information market participants use to determine asset prices at time t - 1 is the set ϕ_{t-1} of all information relevant to determining prices at that time:

$$^m\phi_{t-1} = \phi_{t-1},$$

Since ϕ_{t-1} includes the implications of currently available information for the joint probability distributions of asset prices at future times, market participants understand the implications of currently available information (at time t - 1) for the future asset prices (at time t):

$$f_m(p_t \mid {}^m\phi_{t-1}) = f(p_t \mid \phi_{t-1}),$$

where f is the true probability density function of asset prices implied by the information set ϕ_{t-1}. More specifically, given the information available at t - 1, market participants correctly assess the joint distribution of asset prices at time t.

If the assessment of the joint distribution of asset prices at time t is used to determine equilibrium asset prices at time t - 1, market participants must have a model of how those t - 1 prices are determined from the market assessed joint distribution of prices at time t. Tests of the efficient market hypothesis are then, simultaneously, tests of efficiency and of the model of how current equilibrium prices are determined from the joint distribution future prices. A number of models have been proposed and testing of the efficient market hypothesis has commonly used a model in which expected returns are constant through time. Testing, Fama advised, has not led to the rejection of market efficiency, or to rejection of the model in which expected returns are constant through time.[12]

This model of constant expected returns provides the rationale for estimation of the MRP using historical excess returns. Before turning to MRP estimation, we look at some of the implications of the model. They are important for the way in which the MRP is estimated.

If, as discussed above, market participants assess, at t = 1, the joint distribution of asset prices at time t, $f_m(p_t \mid {}^m\phi_{t-1})$, this implies a distribution at t - 1, $f_m(p_{j,t} \mid {}^m\phi_{t-1})$, for the price of each asset j at t. Let the mean of this distribution of the price of asset j be $E_m(p_{j,t} \mid {}^m\phi_{t-1})$.

If expected returns are constant, at every time t - 1, the market sets the current price of financial asset j, $p_{j,t-1}$, so that the expected return on the asset given its expected future price is the constant $E(R_j)$:

$$E_m(R_{j,t} \mid {}^m\phi_{t-1}) = \frac{E_m(p_{j,t} \mid {}^m\phi_{t-1}) - p_{j,t-1}}{p_{j,t-1}} = E(R_j)$$

If the market is efficient, and market participants use all of the information available to assess $f_m(p_t \mid {}^m\phi_{t-1})$, then this assessed distribution is the true distribution $f(p_t \mid \phi_{t-1})$. This implies:

$$E_m(p_{j,t} \mid {}^m\phi_{t-1}) = E(p_{j,t} \mid \phi_{t-1})$$

and

$$E_m(R_{j,t} \mid {}^m\phi_{t-1}) = E(R_{j,t} \mid \phi_{t-1}) = E(R_j).$$

12 Fama (1976), chapter 5, pages 142-151.

That is, market efficiency and constant expected returns imply:

- at time t - 1, market participants correctly assess the distribution of the price of any specified financial asset at time t;
- the expected value of the future price (the price at t) as assessed by market participants is the true expected value of that future price;
- when the market sets the prices of financial assets at t - 1, the assessment of expected return on any asset is the true expected return: the constant $E(R_j)$ is the true expected return on financial asset j.

MRP estimation using historical excess returns

The efficient market hypothesis and the model of constant expected returns provide the rationale for using the mean of historical excess returns as an estimate of the expected excess return on the market: they provide the rationale for using historical excess returns as an estimate of the MRP.

Moreover, since the MRP is a constant, the estimate obtained is also an estimate of the forward looking MRP required for application of the CAPM.

We note that the relevant mean for estimation is the arithmetic mean: no reference is made to the geometric mean in the preceding analysis.

Neither the efficient market hypothesis, nor the constant expected return model, places any restriction on the second and higher moments of the price and return distributions. Volatility has no role to play in estimation of the MRP from historical excess returns.

In the Discussion Paper, the ERA refers to this approach to estimation of the MRP as the Ibbotson approach.[13] Writing in 1980, Robert Merton described the Ibbotson approach to MRP estimation as "state-of-the-art".[14]

Returns predictability

Research since 1980 has suggested that excess returns can be predicted by regressing those returns on lagged financial variables including valuation ratios (dividend-price ratios, earnings-price ratios, and smoothed earnings price ratios) and interest rates. This research draws into question the validity of the efficient markets hypothesis and the constant expected returns model. However, its findings have been challenged on methodological and other grounds.

Surveying the literature in 2003, Goyal and Welch concluded that neither dividend yields nor dividend price ratios had both the in-sample and out-of-sample performance that should have led to a belief that they could outperform the simple prevailing equity premium average in an economically or statistically significant manner.[15]

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13 Roger Ibbotson received his doctorate in financial economics from the University of Chicago in 1974. Eugene Fama was the chairman of his PhD committee.

14 Robert C Merton (1980), "On Estimating the Expected Return on the Market: An Exploratory Investigation", Journal of Financial Economics, 8, page 327.

15 Amit Goyal, Ivo Welch (2003), "Predicting the Equity Premium with Dividend Ratios", Management Science, 49(5), page 653.

Goyal and Welch reviewed the literature again in 2008 and reported:

Our article comprehensively reexamines the performance of variables that have been suggested by the academic literature to be good predictors of the equity premium. We find that by and large, these models have predicted poorly both in-sample (IS) and out-of-sample (OOS) for 30 years now; these models seem unstable, as diagnosed by their out-of-sample prediction and other statistics; and these models would not have helped an investor with access only to available information to profitably time the market.[16]

In a working paper, Goyal, Welch and Zafirov report on an examination of 29 variables from 26 papers published after Goyal and Welch 2008, and on the 17 variables identified in the earlier paper as being useful in predicting the equity premium.[17] They find that most of the variables they examine have now lost their empirical support as predictors, a few seem to perform reasonably well, but overall the ability of models using these variables to predict the equity premium remains disappointing. (We note that the working paper appears to be at an early stage of preparation.)

The work by Goyal and Welch points to a relatively large and continuing stream of research into the nature of the MRP. This research may not have identified good predictors for the premium (as Goyal and Welch report), but it strongly suggests that the MRP is time varying. In 1997, Campbell, Lo and MacKinlay observed that there had been an explosion of research into the determinants of time varying returns.[18]

The issues of returns predictability and time variation in returns was examined in a working paper for the Australian Competition and Consumer Commission (ACCC) and the Australian Energy Regulator (AER) prepared in 2013. In that paper, ACCC Principal Economist, Peter Gibbard, concluded from a review of the relevant research that the recent literature had developed a range of models that was increasingly diverse and complex. This diversity and complexity of models, many of which are difficult to implement, make challenging evidence-based selection of a particular model by a regulator considering conditional models of the MRP. More recent studies, Gibbard advised, have found that the values of the parameters in returns models are unstable. How a regulator might, then, set the MRP as a function of some specific variable, and allow the MRP to be adjusted in response to movements in that variable, was unclear.

Gibbard concluded that research which reported apparently significant relationships between various economic variables and excess returns reflected data mining. This may have been the case in 2013. But the risk free rate is estimated from yields on government bonds, and these yields are impacted by monetary policy. Recent research has begun to investigate the ways in which monetary

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[16] Ivo Welch, Amit Goyal (2008), "A Comprehensive Look at The Empirical Performance of Equity Premium Prediction", Review of Financial Studies, 21(4), page 1455.

[17] Amit Goyal, Ivo Welch, Athanasse Zafirov, "A Comprehensive Look at the Empirical Performance of Equity Premium Prediction II", Swiss Finance Institute Research Paper Series No 21-85, 23 September 2021.

[18] John Y Campbell, Andrew W Lo and A Craig MacKinlay (1997), *The Econometrics of Financial Markets*, Princeton: Princeton University Press, page 287.

policy settings are transmitted to risk premiums on financial assets.[19] Gibbard's conclusion may not now be appropriate. However, in GGT's view, research on the relationship between government bond yields and asset risk premiums has not yet advanced to a stage where it can provide guidance to the setting of regulated rates of return.

In 2022, the view that the MRP is constant can be questioned.[20] In another four years, when the gas rate of return instrument is, once again, to be reviewed and replaced, consideration may need to be given to time variation in the MRP and its implications. At the present time, the relevant research would seem, to GGT, not to offer models and methods of estimation which can be applied in the context of the setting of rates of return allowed for regulation.

For the remainder of 2022, we must continue to assume that the MRP is constant and can be estimated from historical excess returns.

Assuming the MRP is constant has two further implications for its estimation from historical excess returns.

The first of these implications is that there is little to be gained from looking at differences in the means of historical excess returns across sub-series within the longest available series of excess returns. The means for different periods will be different, with increasing imprecision for shorter series, and to infer difference would be inconsistent with the underlying constant expected return model.

The second implication also follows from the underlying constant expected return model and the efficient market hypothesis. Conditioning variables provide no further information to that already embedded in the returns data. The use of conditioning variables to adjust an estimate made from a long series of historical excess returns represents an arbitrary change to the estimate of the underlying constant MRP and should be avoided.

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19 See, for example, Mark Gertler, Peter Karadi (2015), "Monetary Policy Surprises, Credit Costs and Economic Activity", American Journal of Macroeconomics, 7(1), pages 44-76; and Francesco Bianchi, Martin Lettau, Sydney Ludvigson, "Monetary Policy and Asset valuation", Journal of Finance, in press.

20 See Australian Energy Regulator, *Overall rate of return, equity and debt omnibus: Final working paper*, December 2021, page 34.

Arithmetic or geometric mean?

The appropriate estimator for estimation of the MRP from historical excess returns is, as we have noted above, the arithmetic mean. It is not the geometric mean.

Why, then, are both the arithmetic mean and the geometric mean often reported when estimates of the MRP have been made from long series of historical excess returns (as, for example, in the work of Dimson, Marsh and Staunton[21])? The answer is provided in a series of reports prepared for the Office of Gas and Electricity Markets (Ofgem) in the United Kingdom. In 2003, finance academics, Professors Stephen Wright, Robin Mason and David Miles, advised Ofgem that:

Standard theory requires that the appropriate measure of any given return used in determining the cost of capital should be $E(R_{jt})$, i.e. the true arithmetic mean. This requirement holds whatever the nature of the process that generates R_{jt}.[22]

Wright, Mason and Miles noted, however, that historical studies frequently quoted two closely related measures: an arithmetic mean and a geometric mean. The rationale for this, they advised, was the very common assumption that returns on financial assets are log-normally distributed rather than normally distributed. Use of the log-normal distribution, among other things, allowed skewness in the distribution of returns to be taken into account, and appropriately truncated the support of the distribution by ruling out returns less than -100%, recognizing that most financial assets have the attribute of limited liability, and the largest loss that could be realised was the investor's total investment.

The assumption of log-normality means that the (natural) logarithm of returns, r_{jt},

$$r_{jt} = \log(1 + R_{jt}),$$

is normally distributed with mean $E(r_{jt})$ and standard deviation $\sigma(r_{jt})$. R_{jt} is the return on the financial asset in question defined in the usual way:

$$R_{jt} = \frac{P_{jt} + D_{jt}}{P_{j\,t-1}} - 1$$

where P_j is the price of the asset, and D_j is any dividend.

The properties of the log-normal distribution function imply:

$$1 + E(R_{jt}) = \exp\left(E(r_{jt}) + \frac{\sigma^2(r_{jt})}{2}\right)$$

Approximating, using the first two terms of the power series for exp(x):

21 See, for example, Elroy Dimson, Paul Marsh, Mike Staunton (2002), *Triumph of the Optimists: 101 Years of Global Investment Returns*, Princeton: Princeton University Press.

22 Stephen Wright, Robin Mason, David Miles, *A Study into Certain Aspects of the Cost of Capital for Regulated Utilities in the U.K.*, 13 February 2003, page 24. See also Stephen Wright, Robin Mason, Steve Satchell, Kenjiro Hori, Meltem Baskaya, *Report on the Cost of Capital provided to Ofgem*, 1 September 2006;

$$E(R_{jt}) \approx E(r_{jt}) + \frac{\sigma^2(r_{jt})}{2}$$

Define $G(R_{jt})$ as:

$$1 + G(R_{jt}) = \exp\big(E(r_{jt})\big)$$

$G(R_{jt})$ is, approximately, the geometric mean defined as the compound - geometric - average of $(1 + R_{jt})$ minus 1. $G(R_{jt})$ is, effectively, the geometric mean of the returns R_{jt}. Approximating, again, using the first two terms of the power series for exp(x):

$$G(R_{jt}) \approx E(r_{jt})$$

so that

$$E(R_{jt}) \approx G(R_{jt}) + \frac{\sigma^2(r_{jt})}{2}$$

That is, the arithmetic mean of returns assumed to be log-normally distributed is approximately equal to the sum of the geometric mean of those returns plus one half of the variance of the log-returns.

The arithmetic mean required for estimation of expected returns when applying models like the CAPM can be estimated as the geometric mean plus an adjustment for the difference between the two means. This adjustment is for the volatility in log-returns.

We note that the AER has recently advised that both the arithmetic mean and the geometric mean should be considered when estimating the forward looking MRP using historical excess returns. The best estimate of historical excess returns over a 10-year period is, the AER concluded, somewhere between the geometric and arithmetic mean.[23]

The proposal in the (ERA's) Discussion Paper is more specific: when estimating the forward looking MRP using historical excess returns, an average of the arithmetic and geometric means should be used.

But the arithmetic mean and the geometric mean are not bounds to be considered, for estimating the mean of historical excess returns as the AER proposes. Nor are they two numbers which might be averaged, as the ERA proposes, for the purpose of estimating that mean.

The AER advises that use of the geometric mean is to be considered because:

- there remains uncertainty over whether an arithmetic or geometric average or some combination of the two) provides a better estimate of expected excess returns due to the variability of returns from year to year;
- there are studies and academic examples showing there are periods in which the geometric average is the best estimator; others show the arithmetic mean to be superior; and

[23] Australian Energy Regulator, *Overall rate of return, equity and debt omnibus: Final working paper*, December 2021, page 43.

- over periods of changing volatility, the arithmetic mean can be upwardly biased whereas the geometric mean is not impacted as much by volatility changes over time in long series.[24]

There is, in GGT's view, no uncertainty over whether an arithmetic or geometric average or some combination of the two) provides a better estimate of expected excess returns. The mean of historical excess returns required as an estimate of the MRP is the arithmetic mean; it is not the geometric mean. However, the geometric mean can be used to estimate the required arithmetic mean by adjusting the former by a factor which measures the volatility in log-normal returns.

There are studies and academic examples showing there are periods in which the geometric average appears to be the better estimator. But these studies are not concerned with estimation of the MRP from historical excess returns. As Wright, Mason and Miles noted that the geometric mean is the natural metric of returns from the perspective of an investor: an investment with a positive geometric mean return will grow over time. If, as might be the case in portfolio planning, returns are compounded over an extended period then, as Marshall Blume has argued, the geometric mean is the better estimator of the compound growth rate to be applied over the period.[25] This can be seen from the following simple example.[26]

Suppose an investment has a return of 20% after one year, and has a return of -20% at the end of a second year. The arithmetic mean of the returns is:

$$\frac{20\% + (-20\%)}{2} = 0\%$$

The geometric mean is:

$$[(1 + 0.20)(1 - 0.20)]^{1/2} - 1 = -2.02\%$$

The geometric mean is also the overall rate of return on the investment:

Year		**0**	**1**	**2**
Net cash flow		-1.00	0.00	0.96
			=1.00*(1 + 0.20) -1.2	= 1.20*(1 - 0.20)
Return	**-2.02%**			

When returns are compounded over an extended period, the geometric mean is the better estimator of the overall rate of return on an investment than the arithmetic mean. Using an arithmetic mean of periodic (year-by-year) rates of return to estimate the rate of return over the extended period

24 Australian Energy Regulator, *Overall rate of return, equity and debt omnibus: Final working paper*, December 2021, page 43.

25 Marshall E Blume (1074), "Unbiased Estimators of Long-run Expected Rates of Return", Journal of the American Statistical Association, 69(347), pages 634-638.

26 The example is from Jonathan Berk and Peter DeMarzo (2014), *Corporate Finance*, third ed., Pearson: Boston, page 326.

imparts an upward bias to the end-of-period portfolio balance. The bias imparted if the arithmetic mean is used has been further examined by others.[27]

This issue of upward bias when estimating expected future portfolio value using the arithmetic mean of period-by-period returns over an extended period is not the same as the issue of estimating the mean of a returns distribution using historical time series data. The upward bias imparted to a future portfolio value calculated using an arithmetic mean of period-by-period rates of return is not the issue which arises when using historical excess returns to estimate the MRP. When estimating the MRP, there is no compounding of returns year-by-year over the period for which historical data are available.

As Dr Martin Lally noted in a 2012 report for the AER, there may be compounding of the regulatory rate of return over the regulatory period, but this is not the issue of using historical excess returns to estimate the MRP.[28] Dr Lally advised:

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.[29]

We note that in their seminal paper on the MRP published in 1985, Mehra and Prescott used the arithmetic mean of historical excess returns.[30] They continued to use the arithmetic mean in their paper "The Equity Premium in Retrospect", published in the *Handbook of The Economics of Finance* in 2003, advising that the arithmetic mean is the correct statistic if one is interested in the mean value of excess returns.[31]

Similar advice is given in the well-known textbook by Jonathan Berk and Peter DeMarzo. Berk and DeMarzo note that the MRP can be estimated as the average of the historical excess of returns on the market over the risk free rate. They caution: because we are interested in the expected return, the correct average to use is the arithmetic mean.[32]

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27 See, for example, Daniel C Indro, Wayne Y Lee (1997), "Biases in Arithmetic and Geometric Averages as Estimates of long Run Expected Returns and Risk Premia", Financial Management, 26(4), pages 81-90; Eric Jacquier, Alex Kane, Alan J Marcus, "Optimal Estimation of the Risk Premium for the Long Run and Asset Allocation", Journal of Financial Econometrics, 3(1), pages 37-55.

28 Martin Lally, *The Cost of Equity and the Market Risk Premium*, 25 July 2012.

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

30 Rajnish Mehra, Edward C Prescott (1985), "The Equity Premium: A Puzzle", Journal of Monetary Economics, 15, pages 145-161.

31 Rajnish Mehra, Edward C Prescott (2003), "The Equity in Retrospect", in George M Constantinides, Milton Harris, Rene M Stulz, *Handbook of The Economics of Finance, vol. 1B, Financial Markets and Asset Pricing*, Amsterdam: Elsevier, pages 889-938.

32 Jonathan Berk, Peter DeMarzo (2014), Corporate Finance, 3rd edition, Boston: Pearson, page 406.

In GGT's view, there is no support for the AER's contentions that there is uncertainty over whether an arithmetic or geometric average or some combination of the two provides the better estimate of expected excess returns, and that there are studies and academic examples showing periods in which the geometric average is the better estimator, and others which show the arithmetic mean to be superior.

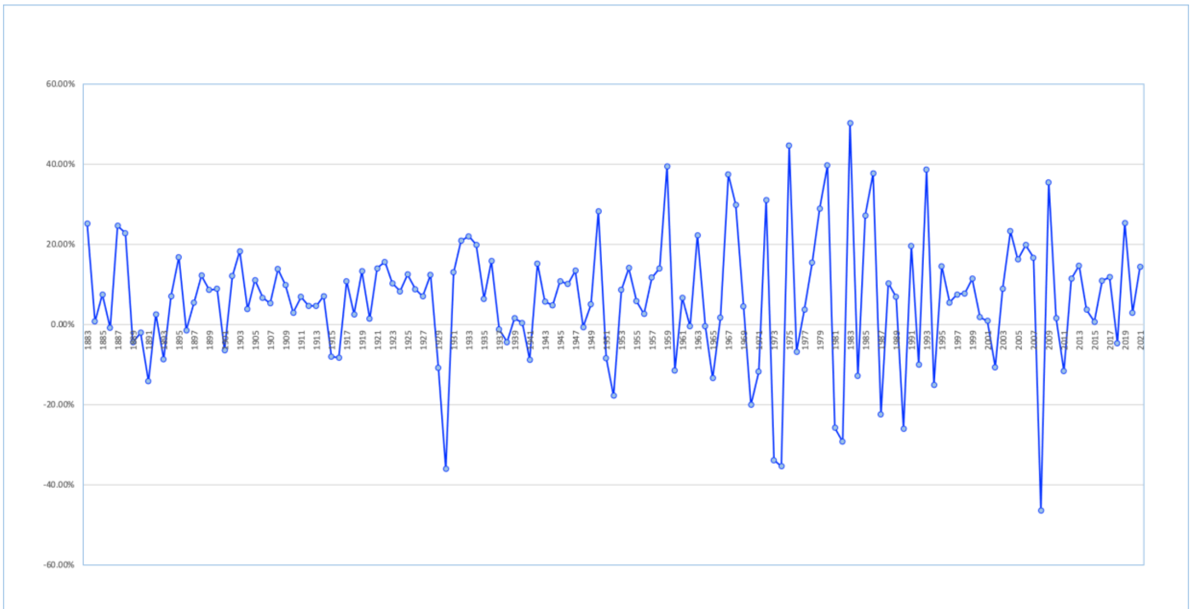
The third of the reasons why the AER proposes consideration of the geometric mean is that, in periods of changing volatility, the arithmetic mean can be upwardly biased whereas the geometric mean is not impacted as much by volatility changes over time in long series. This may be the case, but it does not, in itself, provide any support for use of the geometric mean when estimating the mean of historical excess returns.

To maintain the assumption of a constant MRP, and to suggest that the geometric mean should be considered in periods of changing volatility, are inconsistent and would give to the geometric mean a role which is without foundation in economic and statistical theory. If, as the AER suggests, returns are time varying, then that time variation should be explicitly modelled and the model (or models) should be properly estimated. This, Gibbard advised the ACCC and the AER in 2013, may be challenging.

Looking at the data

Continuing to assume the MRP is a constant to be estimated as the arithmetic mean of historical excess returns does not remove the problem of the high variability in those excess returns (see Figure 1 below). Given this variability, the longest available series of excess returns should be used when estimating the arithmetic mean.

Figure 1: excess returns: Australia 1883- 2021



Source: Brailsford, Handley and Maheswaran (2012) for the period 1883-2010; AER for 2011 to 2017; and GGT calculations for 2018-2021.

When we look at the Brailsford, Handley and Maheswaran dataset extended forward to 2017, we find:

- arithmetic mean of excess returns = 6.29%
- geometric mean of excess returns = 4.95%
- mean of log-returns = 4.84%
- sample variance of log-returns = 2.69%
- arithmetic mean estimated from geometric mean (using the sample variance as an estimator of the variance of the log-returns distribution):

$$4.95\% + \frac{2.69\%}{2} = 6.30\%$$

The geometric mean of excess returns (4.95%) is approximately equal to the mean of log-returns (4.84%), and the arithmetic mean estimated from the geometric mean (6.30%) is very close to the arithmetic mean estimated directly from the data (6.29%).

The estimates of MRP in the AER's 2018 Rate of Return Instrument, 6.1%, and in the ERA's Final Rate of Return Guideline (2018), 6.0%, appear, to GGT, to be biased downwards by around 20-30 basis points.

If the Brailsford, Handley and Maheswaran data set is extended forward to 2021:

- arithmetic mean of excess returns = 6.38%
- geometric mean of excess returns = 5.07%
- mean of log returns = 4.94%
- sample variance of log-returns = 2.65%
- arithmetic mean estimated from geometric mean (using the sample variance as an estimator of the variance of the log-returns distribution):

$$5.07\% + \frac{2.65\%}{2} = 6.39\%$$

Again, the arithmetic mean estimated from the geometric mean (6.39%) is very close to the arithmetic mean estimated directly from the data (6.38%).

Other things being equal, we would expect to see, in the 2022 gas rate of return instrument, an estimate of the MRP of at least 6.4%.

But are "other things equal"? The BHM dataset of the historical excess returns from which the arithmetic mean has been calculated by ERA includes observations which are inconsistent with the asset market equilibrium described by the CAPM. A necessary condition for that equilibrium is that the expected return on the market must be greater than the risk free rate.[33]

[33] See, for example, Robert C Merton (1982), "On the Microeconomic Theory of Investment Under Uncertainty", in K J Arrow and M Intriligator (eds.), *Handbook of Mathematical Economics*, vol. II, Amsterdam: North-Holland, Proposition 4.6, page 628.

In the original BHM dataset of 128 excess return observations, 35 are negative: the return on the market is less than the risk free rate. When the BHM dataset is extended to 2017, 36 of the 135 observations are negative. If the dataset is reduced to the period post-1958, some 20 of the excess return observations are negative.

Does this impart a downward bias to the estimate of the MRP which is required for application of the CAPM?

Is this possibility of downward bias in the estimate of the MRP made from historical excess returns one of the reasons why estimates made using the dividend growth model appear to be "too high"?

These are, we think, important questions on which expert advice should be sought before proceeding.

13. When estimating the historical market risk premium do you support the approach of estimating and considering the market risk premium and the risk free rate independently from one another? If not, please explain why and your alternative approach. Specifically, the ERA is interested in:

- ***The empirical relationship (magnitude and direction) between the ex ante market risk premium and the ex ante risk free rate in Australia and the conceptual logic underpinning such a relationship.***
- ***Whether the relationship is sufficiently stable and persistent (that is not volatile and transitory) on an ex ante basis.***
- ***Ways in which the relationship can be implemented to estimate the market risk premium in a manner suitable for regulatory purposes.***

GGT supports the approach of estimating and considering the MRP and the risk free rate independently from one another.

We are of the view that, at the present time, there is no theory or strong empirical evidence which supports a relationship between the risk free rate of return and the ex ante MRP in Australia.

Work like that undertaken by CEPA for the AER may suggest a negative relationship between the risk free rate of return and the MRP. But, as CEPA's report notes, this work was exploratory. Whether such a relationship can be sufficiently well specified and estimated, with stable parameters, are still open questions, precluding its use for regulatory purposes.[34]

GGT supports the current approach of estimating and considering the MRP and the risk free rate independently from one another.

[34] CEPA, *Relationship between the RFR and the MRP*, 16 June 2021, page 43.

14. Do you support the continued use of a sample of domestic and international comparators to estimate equity beta? If not, please explain why and your alternative approach.

GGT sees little scope, at the present time, for moving away from the sample of potential domestic comparators which was used for equity beta estimation in 2018.

Prior assessments of the degree of service provider risk are necessary for the choice of comparators, domestic or international.

GGT has not found any assessment of whether potential comparators have degrees of risk similar to the degrees of risk of the Western Australian service providers in respect of the provision of pipeline services. This assessment is required.

Goldfields Gas Pipeline is a relatively high-risk asset, and this should be reflected in the estimate of the equity beta used in the 2022 gas rate of return instrument: that beta should be around 1.2.

A broader set of domestic and international comparators may need to be considered for future equity beta estimation. GGT does not support the use of broader set of comparators (domestic or international) in the setting of betas for the 2022 instrument.

In this question, and in the next three, the ERA asks about equity beta estimation for the three covered pipeline service providers in Western Australia. These questions focus on the choice of comparators.

The prior questions of why this choice is being made, and what is being compared, are answered by reference to a definition: the ERA's definition of the benchmark efficient entity. The benchmark efficient entity, the Discussion Paper advises (at paragraph 51), is a pure-play pipeline service provider operating within Australia without parental ownership, with a similar degree of risk as that which applies to the service provider in respect of the provision of gas pipeline services.

Before this definition can be applied in the choice of comparators for equity beta estimation, an assessment must be made of the degree of risk which applies to the service provider in respect of the provision of pipeline services.

GGT does not see that assessment of the degree of service provider risk as having been made to allow the subsequent choice of comparators. This, we think, has important implications for the estimate of the equity beta.

Different degrees of risk imply different betas

Businesses, including pipeline service providers, are not independent entities, but are closely linked, and closely linked to their customers (who may be intermediaries supplying to ultimate end-users). They are also closely linked to the individuals who provide the skills and expertise required for business operation. The pipeline service providers with whom we are concerned are also closely linked to the institutions of the State through the regime of economic regulation implemented by the National Gas Law and the National Gas Rules.

The links between businesses, between businesses and employees at all levels, and between businesses and their customers are primarily contractual (see our response to Question 7, although the focus there is on contractual relationships with lenders). The links between regulated businesses and the State are set down in the law.

The contractual structure of a particular business - the set of contracts it has with other businesses for the supply of inputs, including the provision of finance, with employees, and with customers - allocates risks between the business in question and its various stakeholders.[35] That allocation of risks is mediated by the relationships the business has with the State, which are mostly generic (for example, the relationships implied by corporations law, competition law, laws pertaining to the sales of goods and services, and employment law), but in some cases the relationships are industry specific (for example, technical and economic regulation applying to particular activities, including the provision of pipeline services).

There are, in Western Australia, three covered pipelines for which equity beta estimation is required: the Mid-West and South West Gas Distribution Systems. the Dampier to Bunbury Natural Gas Pipeline, and the Goldfields Gas Pipeline. To the extent that assessments have been made for the purpose of comparison, some consideration has been given to the implications of economic regulation for risk allocation. Economic regulation does not mitigate risk, as is sometimes asserted. Economic regulation affects, or mediates, the risks which are allocated via the contracts a regulated business has with its customers.

We have seen no assessment of the way in which the contracts the regulated pipeline service providers in Western Australia have with their customers allocate risk, and no explicit assessment of the way in which that risk allocation is affected by economic regulation. We have seen no prior assessment of the degree of service provider risk to allow the subsequent choice of comparators. This, GGT believes, imparts a bias to equity beta estimates for the Western Australian service providers.

That we have seen no assessment of the degree of service provider risk to allow the subsequent choice of comparators may be partly explained by the small number of potential comparators which meet the benchmark criterion of being pure-play pipeline service providers operating within Australia without parental ownership.

In 2018, the ERA saw the set of potential comparators as comprising only four businesses: APA Group, AusNet Services, Duet Group, and Spark Infrastructure.

Duet Group was an owner and operator of gas transmission and gas distribution pipeline systems. Its principal pipeline assets were the Dampier to Bunbury Natural Gas Pipeline, and the Multinet gas

35 For detailed case study of this risk allocation, and the way it impacts financing costs, see Mansoor Dailami and Robert Hauswald (2007), "Credit-spread determinants and interlocking contracts: A study of the Ras Gas project", Journal of Financial Economics, 86, pages 248-278.

distribution system in Victoria. In 2017, the Duet assets were acquired by Hong Kong-based Cheung Kong Infrastructure (CKI), and Duet was delisted.

AusNet services is primarily an electricity transmission and distribution network service provider, although it is also the owner and operator of gas distribution assets. In the year ended 31 March 2021, the company reported that 79% of its revenue was earned from electricity transmission and distribution. A further 10% of revenue was from its Growth and Future Networks business segment, which appears to have a strong focus on business opportunities in the electricity sector.

Spark Infrastructure's 2020 financial statements show all of the company's revenues earned by business segments in the electricity sector: Victorian Power Networks, SA Power Networks, Transgrid and Bomen Solar Farm. Some 86% of revenue reported for the year was earned by Victorian Power Networks, SA Power Networks and Transgrid which are predominantly electricity distribution and transmission businesses.

In 2018, the ERA used this full set of potential comparators to estimate an equity beta of 0.7 for the Western Australian regulated pipeline service providers. The Discussion Paper advises that the ERA's working view for the 2022 gas rate of return instrument is an estimate of 0.7.

We have concerns with the way in which this estimate appears to have been made.

Two of the four businesses in the set of potential comparators, AusNet Services and Spark Infrastructure, clearly do not satisfy the benchmark criterion of being pure-play pipeline service providers. However, no assessment seems to have been made of whether these two businesses have degrees of risk similar to the degrees of risk of the Western Australian service providers in respect of the provision of pipeline services.

The technologies of electricity transmission and electricity distribution are very different from those of gas transmission and gas distribution. The scales of operation are also different: electricity distribution businesses are often much larger than gas transmission and distribution businesses. Furthermore, market risks and contracting with customers are different: regulated and partly implicit contracts with large numbers of end users in the case of electricity and gas distribution, small numbers of explicitly contracted large end users in the case of gas transmission. If two of the four businesses in the set of potential comparators do not satisfy the benchmark criterion, the equity beta estimate may be biased because the underlying risks of the comparators are not those of the service providers.

GGT's concerns are, of course, in respect of the Goldfields Gas Pipeline, and we are not well placed to understand the ways in which risks are allocated through the contracts which the other regulated pipeline service providers in Western Australia have with their customers.

Some gas is transported in the Goldfields Gas Pipeline to commercial and residential users supplied from the ATCO gas distribution network in Kalgoorlie, but the volume is small (around 0.5% of the volume of gas transported in the pipeline). Some gas (around 0.2% of the total volume transported) is transported to Leonora for power generation in the town. Gas was also transported, through the Goldfields Gas Pipeline, to the receipt point of the Kalgoorlie Kambalda Pipeline, for onward transportation to Esperance for town power generation. That transportation has ceased with remote area power generator, Horizon Power, installing an integrated renewables system (solar PV and wind generation with battery storage) at Esperance in 2021.

Goldfields Gas Pipeline users - currently around 20 - are primarily mining and minerals processers operating in the Pilbara and Goldfields regions of the State, or companies providing gas transportation or energy services to mining and minerals processing operations in those regions. Three users are large multinational mining companies; the remainder are smaller businesses with widely varying degrees of creditworthiness. The Goldfields Gas Pipeline has a customer base which is exposed to volatile international commodity demands and prices - principally for iron ore, gold and nickel. Given the remote location of the pipeline and its customers, and given the geographies of the Pilbara and Goldfields regions, the owners of the Goldfields Gas Pipeline have few opportunities to reduce the risks to which they are exposed by developing a more diversified customer base.

Contracts with the three multinational mining companies are long term agreements with terms exceeding 10 years. Other users are, however, on relatively short-term transportation agreements, with terms between 5 to 10 years. These agreements provide the owners of the Goldfields Gas Pipeline with little protection against the risk of market downturn and company failure. When commodity prices fall, and mining operations become unviable, users seek renegotiation of their contracts. A renegotiated contract is usually preferable to the closure of a mining operation but may come at the cost of lower transportation prices, or periods of "care and maintenance" during which the user can effectively suspend the agreement.

Regulated price setting which, in other contexts, might mitigate service provider risk through a lift in prices as volumes fall is of little value here: any rise in the gas transportation price may lead to further failures among the pipeline users.

Today, Goldfields Gas Pipeline users are actively exploring opportunities to reduce carbon emissions by replacing gas fired generation with renewables and battery storage. The replacement of gas fired generation with renewables and storage, to reduce carbon emission, is accelerating influenced by government policies targeted at addressing the effects of climate change.

Although not a user of the Goldfields Gas Pipeline, Fortescue Metals Group is a very prominent example of mining and minerals processing operations in the Pilbara replacing carbon-based fuels with energy from renewables.

BHP, an important user of gas transportation services provided by the Goldfields Gas Pipeline, has announced that, to meet its emissions reduction targets, and to deliver sustainably produced nickel to its customers, it was developing a 27.4 MW solar PV facility at its Mount Keith operations, and a10.7 MW solar farm and 10.1 MW of battery storage at Leinster. BHP has advised that these projects - together, the Northern Goldfields Solar Project, being undertaken with partner TransAlta - will displace power currently supplied by diesel and gas turbine generation.[36]

A number of smaller mining operations have also begun to "decarbonize", using electricity generated from renewables, and reducing (although not eliminating) their dependence on natural gas.

[36] See https://www.bhp.com/news/media-centre/releases/2021/07/two-new-solar-farms-and-battery-to-help-power-mines-at-bhps-nickel-west

Gold Fields Australia has developed, at Agnew, near Leinster, the largest hybrid renewable energy microgrid in Australia, and is the first mining operation to use electricity generated from wind at a mine site.[37] In 2020, five wind turbines were installed at Agnew with a total generating capacity of 18 MW. Wind is generally available at the site during the night, and the turbines complement 4 MW of solar PV capacity, and a 13 MW battery storage system. Renewables generation at Agnew is expected to, at least partly, displace gas transported in the Goldfields Gas Pipeline.

Gold Fields has also installed 8 MW of solar PV capacity, together with a 2 MW battery storage system, at its Granny Smith mine**.** Again, renewables generation is expected to, at least partly, displace gas transported through the Goldfields Gas Pipeline.[38]

Some 10.6 MW of solar PV capacity was installed at Sandfire Resources Limited's De Grussa copper mining and concentrate processing operations in 2016, supplying about 20% of the site's power requirements. De Grussa is in the Mid-West, about 200 km north-west of Wiluna. Although the mine is about 75 km west of the Goldfields Gas Pipeline, Sandfire Resources is not a user of the pipeline. The solar PV facility is integrated with the diesel generation, and with 6 MW of battery storage.

Independence Group Limited mines, and processes to concentrates, nickel, copper and cobalt, at its Fraser Range Nova project south east of Kalgoorlie. Gas, to have been transported in the GGP and the Kalgoorlie Kambalda Pipeline, was once considered for the project, but was not competitive with diesel. In December 2019, Independence Group commissioned a 5.5 MW solar farm, which was integrated with its existing diesel fired power station, and which has subsequently been producing about 10% of project power requirements.

Major companies in the mining sector are well advanced in making changes to their operations to reduce carbon emissions. Smaller companies in the sector are increasingly taking action on climate change consistent with broader public policy goals of net zero emissions. They are investing in technologies – solar PV, wind, battery storage – to reduce mine site emissions. These technologies have not yet developed to the point where they can displace power generation using carbon-based fuels, but the combination of renewables plus diesel backup is now a competitive alternative to generation using pipeline-transported gas.

The Goldfields Gas Pipeline is, in consequence, one of the higher risk assets in APA Group's portfolio.

In 2018, the ERA estimated an equity beta for APA Group of approximately 0.9. Beta estimates for APA were, at that time, rising, and have continued to rise (see Figure 2 below). They have fallen significantly with the on-set of the Covid-19 pandemic (as have the betas of the other potential comparators, AusNet Services and Spark Infrastructure, which were still listed at the beginning of December 2021).

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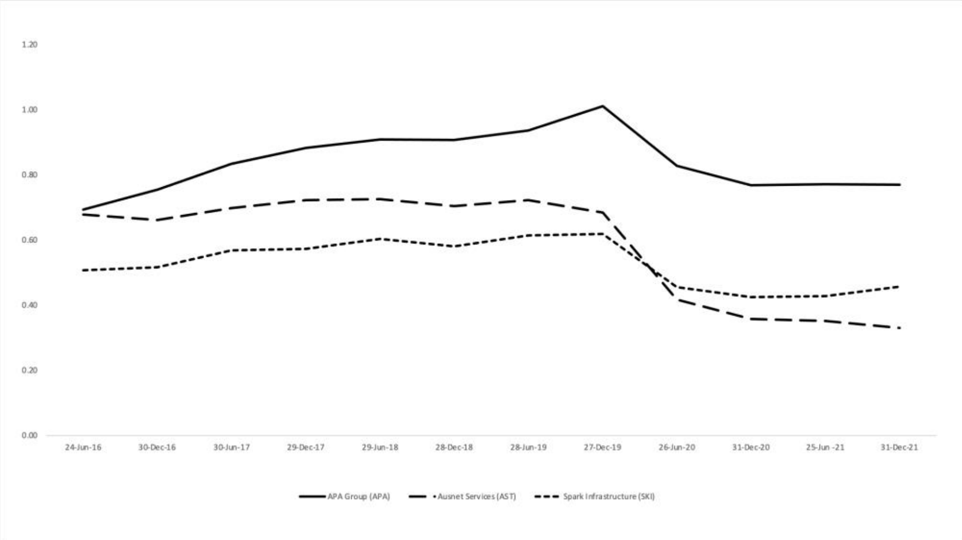
37 See https://careers.goldfields.com.au/australian-locations/agnew/.

38 Gold Fields, Integrated Annual Report 2020. page 101.

Figure 2: relevered (gearing = 55.0%) equity beta estimated: APA, AST and SKI



Although the APA Group beta has fallen, it is still around 0.77. If, as we contend, the Goldfields Gas Pipeline is one of the riskier assets in the APA portfolio then we would expect to see a beta for that pipeline which is above the Group beta estimate (the Group estimate being an average across all APA assets).

The ERA's equity beta estimates for other regulated assets which serve the mining sector in the Pilbara, and which therefore have similar risk characteristics to the Goldfields Gas Pipeline, are:

- the Pilbara railway assets: 1.30 (with gearing of 20%);
- the Horizon Power electricity network assets: 0.8 (with gearing of 45%); and
- the Alinta Energy electricity network assets: 0.9 (with gearing of 40%).

When delevered and relevered to the proposed pipeline benchmark gearing of 55%, the corresponding betas are:

- the Pilbara railway assets: 2.3;
- the Horizon Power electricity network assets: 1.0; and
- the Alinta Energy electricity network assets: 1.2.

We do not understand how the Goldfields Gas Pipeline could have a higher gearing than the Horizon Power and Alinta Energy electricity network assets and, after delevering and relevering to a common gearing of 55%, a lower equity beta (the proposed 0.7). We would appreciate the ERA's reasons for the higher gearing and lower beta.

For the reasons we have set out above, we think the Goldfields Gas Pipeline is a relatively high risk asset, and this should be reflected in the estimate of the equity beta used in the 2022 gas rate of return instrument. That beta should be around 1.2, the beta for the electricity network assets of Goldfields Gas Transmission Joint Venture participant Alinta Energy. It should certainly be above the current APA Group beta of 0.77.

A broader comparator set is required

GGT recognises that we are close to having only one Australian listed regulated business for inclusion in the comparator set. Spark Infrastructure was delisted in December 2021, and the takeover of AusNet Services, by Brookfield, is close to being concluded. APA Group will soon be the only Australian listed business with significant gas pipeline assets.

Future equity beta estimation for allowed rate of return determination may need to use information from a broader set of comparators. That broader set of comparators might include listed Australian infrastructure businesses which are not gas pipeline service providers. It might also include international comparators.

GGT does not support the use of a broader set of domestic comparators, or of international comparators, for equity beta estimation for the 2022 gas rate of return instrument.

We doubt whether methods for use, other than in a limited and qualitative way, of domestic or international comparators could be developed, and openly discussed through consultation, before the draft instrument is released (as proposed) in June. After June, the draft instrument must be reviewed (as required under the National Gas Law) by the Independent Panel, and the Panel must report back to the ERA. There is unlikely to be sufficient time for development and review of new methods, and for consultation, before 1 January 2023. Even if there were sufficient time, the making of what would be a significant change in the way the allowed rate of return was to be determined after the Independent Panel had reported would, in GGT's view, be inappropriate.

A broader set of domestic comparators

Beyond the 2022 gas rate of return instrument, use of a broader set of domestic comparators might assist beta estimation (and would not have a number of the problems - discussed below - which would arise from the use of international comparators).

There is, however, no prior reason to expect that Australian infrastructure businesses based on different technologies, with different operating environments and different markets, and subject to different schemes of regulation, will have risks similar to those of regulated pipeline service providers. That similarity will have to be assessed.

On assessment, some businesses may be excluded from the comparator set because they are found to be dissimilar. This may be an issue given the relatively small number of listed Australian infrastructure businesses (currently around 7: Auckland International Airport, Atlas Arteria, Aurizon, Meridian Energy, Qube, Sydney Airport and Transurban), and the prospect of some of them being delisted because they are currently takeover targets.

International comparators

Carefully selected international comparators could be used to expand the dataset for beta estimation. These comparators could be sought in Canada, the United Kingdom and the United States, each of which has a legal system broadly similar to the Australian system.

However, comparator selection may not be straight-forward. The question of how the ERA's benchmark specification is to be applied would arise. We should be able to ascertain whether a business in another jurisdiction is a pure-play pipeline service provider without parental ownership, but assessing whether it has a similar degree of risk as that which applies to the service provider in respect of the provision of gas pipeline services is likely to be challenging.

In North America, at least, companies that provide gas pipeline services are typically not pure-play businesses without parental ownership. Pipeline services are provided by the business units of larger and diversified corporations, and consideration will have to be given to the extent to which a potential comparator is a provider of pipeline services and to what extent the risks associated with pipeline service provision are affected by corporate structure.

If a comparator is to have a similar degree of risk as that which applies to the service provider, consideration will have to be given to the way in which economic regulation mediates risk. The challenge here will be comparison of the regulatory regime in the jurisdiction in which a potential comparator is located with the Australian pipeline regulatory regime. The Australian regime was originally designed to secure, in circumstances of natural monopoly, the economic outcomes which would be achieved in a competitive market. More recently regime design has been changed to provide incentives for the provision of services sought by users, for low-cost production of those services, and for cost-based pricing. Incentive regulation is also found in North America, where regulatory design has undergone recent change, but must continue to provide adequate compensation for private property taken for a public purpose. Comparison of regulatory regimes across jurisdictions, with a view to ascertaining the effects on the risks of potential comparators will not be a simple task.

Once international comparators are selected, betas for those comparators must be estimated. We doubt whether estimates made using the return on a market portfolio for the jurisdiction in question will have validity in the Australian context. The composition of the Australian stock market is likely to be different from the composition of markets in North America and the United Kingdom. We might expect, that relative to the United States economy, for example, the Australian economy has a relatively larger natural resources sector and a relative smaller high-technology industry sector. Adjustments might then be made by re-weighting the industry subsectors represented in the jurisdictional market portfolio to better reflect relative riskiness in the Australian economy.

Raw beta estimates for the international comparators will, then, need to be delevered and relevered to the assumed benchmark gearing (as is currently done with the beta estimates of Australian firms). But before this can be done, consideration should be given to the way in which gearing is affected by differences in monetary policies, in financing strategies, and in tax regimes.

The AER has suggested use of an international CAPM incorporating an international market risk premium. This might be done, but an international CAPM would raise new issues additional to those which might arise from the use of international comparators. CAPM derivation essentially assumes price formation in a perfect financial market. This may be a reasonable assumption for each of the jurisdictions which might be considered, but it is inconsistent with the observed volatility of international capital flows, and with "home country bias" (the significant underweighting of the shares of foreign corporations in the portfolios of domestic investors). Implementation of an international CAPM would also raise a number of questions which are not easily answered. How would the international market portfolio be defined, and the rate of return on that portfolio measured? In an international context, what traded financial assets might be considered low risk by all investors and suitable for use in estimating the risk free rate of return?

The use of international comparators might need to be considered in the context of the small, and further declining, number Australian listed regulated businesses. However, the issues arising in the selection of suitable comparators, and in the incorporation of their beta estimates into equity beta estimates for allowed rate of return determination, are, in GGT's view, difficult and, at the present time, largely unexamined. No considered basis for sample selection, beta estimation, and incorporation of the results into equity betas for the rate of return instrument currently exists.

There are, we think, difficulties in using international comparators.

15. Do you support the use of domestic energy networks to estimate equity beta? If not, please explain why and your alternative approach.

GGT supports use of domestic energy networks to estimate equity beta for 2022 gas rate of return instrument.

The circumstances in which information from domestic energy networks might be used to estimate the equity beta for 2022 gas rate of return instrument were set out in our response to Question 14.

16. If an international sample is to be used for estimating equity beta, which jurisdictions and companies should be considered as part of the sample?

GGT does not agree with use of an international sample for equity beta estimation for the 2022 gas rate of return instrument.

GGT's reasons for not agreeing with use of an international sample for equity beta estimation for the 2022 gas rate of return instrument were set out in our response to Question 14.

17 If an international sample is to be used for estimating equity beta, how should these international estimates be incorporated into the equity beta estimation method?

GGT does not agree with use of an international sample for equity beta estimation for the 2022 gas rate of return instrument.

GGT's reasons for not agreeing with use of an international sample for equity beta estimation for the 2022 gas rate of return instrument were set out in our response to Question 14.

18. When considering equity beta should the ERA consider shocks such as COVID-19 and takeover announcements? If so, please explain why and how these events can be accounted for.

The ERA should be alert to the potential for shocks to affect the estimates of the equity betas used in setting allowed rates of return.

The nature of shocks - unexpected changes, which may or may not have effects on beta - precludes prior specification of how they should be accounted for.

Shocks to the economy, such as the Covid-19 pandemic, and shocks in the form unexpected changes to the circumstances and potential performance of individual firms resulting from, for example, takeover announcements, may affect equity beta estimates. However, the effects of particular shocks are not always easily identified and may not become apparent until a substantial "post-shock" history is available.

GGT's rolling beta estimates (see Figure 2 above) show a significant decline in the equity betas for APA Group, Ausnet Services (AST) and Spark Infrastructure (SKI) at the time Covid-19 began to spread world-wide. However, Figure 2 is not informative about the equity betas of these companies after December 2021.

The ERA should be alert to the potential for shocks to affect the estimates of the equity betas used in setting allowed rates of return, but their nature - unexpected changes, which may or may not have effects on beta - precludes prior specification of how they should be accounted for.

If, by the time the 2022 gas rate of return instrument is to be drafted, equity betas are seen to be returning to pre-pandemic levels, consideration might be given to using an estimation window longer than five years. This would be a specific response to the shock of the Covid-19 pandemic, and not a change to the ERA's general approach with its 5-year estimation window (see response to Question 20).

If a shock is observed, and is thought to have long term effects, equity beta re-estimation may be called for. However, the rate of return provisions of the National Gas Law do not permit a re-estimated beta to be taken into account in setting allowed rates of return until the next review of the rate of return instrument. This, we think, is a major shortcoming in the current regulatory regime, but it is not an issue which can be addressed in a review and replacement of the current instrument.

19. Do you support the ERA's general approach and simplifications for estimating equity beta (regardless of any potential changes to the sample of firms)? If not, please explain why and your alternative approach. Specifically, the ERA is interested in:

- **Use of a 5-year estimation window with weekly returns.**
- **Use of the Bloomberg total return index for individual stocks and market indices.**
- **Use of the Ordinary Least Squares estimator, with the Least Absolute Deviation method as a robust estimator.**

Used carefully, GGT supports the use of a 5-year window, with weekly returns, for estimation of equity betas.

GGT does not object to use of Bloomberg total return indexes for individual stocks and for the market. However, much previous work on beta estimation has used the All Ordinaries total return index for determining market returns, and the S&P ASX 300 index is now commonly used for that purpose. Working with indexes that have previously been used should limit the number of questions which will arise when, inevitably, comparisons are made.

GGT supports the use of the Ordinary Least Squares estimator for beta estimation.

The Least Absolute Deviation estimator should not be part of the ERA's general approach.

GGT supports the use of a 5-year window, with weekly returns, for estimation of equity betas.

Campbell, Lo and MacKinlay, in their now classic text on financial market econometrics, advise that beta estimates are most commonly made using 5 years of monthly data.[39]

Henry, in his work for the Australian Energy Regulator (2008, 2009, 2014), has advised that the use of weekly returns offers a reasonable trade-off between the noise in daily data and the small sample issue which can arise with monthly data for listed Australian electricity network and gas pipeline service providers.[40]

A 5-year window with weekly returns should provide sufficient data for reasonable statistical precision in the resulting equity beta estimate, but should not be adopted uncritically. Faff, Lee and Fry have reported a nontrivial degree of nonstationarity when testing the hypothesis that the betas of Australian listed businesses are stationary against the alternative that they vary according to a first order autoregressive process. Riskier businesses (businesses with higher betas) tended to be less stationary than low beta businesses, but there was no strong pattern between firm size or industry sector and nonstationarity. Portfolios showed increasing beta nonstationarity as portfolio dimension increased. Faff, Lee and Fry concluded that beta estimates made using some form of fixed

[39] John Y Campbell, Andrew W Lo, A Craig McKinlay (1997), *The Econometrics of Financial Markets*, Princeton: Princeton University Press, page 184.

[40] Olan T Henry, *Econometric advice and beta estimation*, 28 November 2008; *Estimating Beta*, 23 April 2009; *Estimating beta: an update*, April 2014.

parameter regression should be interpreted carefully. Consideration needed to be given to whether any beta nonstationarity was significant in economic terms, so as to warrant explicit modelling of the variability.[41]

GGT does not object to use of Bloomberg total return indexes for individual stocks and for the market. However, much previous work on beta estimation has used the All Ordinaries total return index for determining market returns, and the S&P ASX 300 index is now commonly used for that purpose. Working with indexes that have been previously used should limit the number of questions which will arise when, inevitably, comparisons are made.

Estimates of beta are made using the "market model":

$$Z_{jt} = a_j + b_j Z_{Mt} + \epsilon_{jt}$$

where Z_j is the excess return on stock j, Z_M is the excess return on the market portfolio of assets, and a_j and b_j are coefficients to be estimated.

Of particular interest is the estimate of b_j. b_j is no more than the slope of a linear relationship between Z_j and Z_M. b_j is not the beta of the CAPM.

The Ordinary Least Squares estimator of b_j is:

$$b_j^{ols} = \frac{\sum_{t=1}^{T}(Z_{jt} - \bar{Z}_j)(Z_{Mt} - \bar{Z}_M)}{\sum_{t=1}^{T}(Z_{Mt} - \bar{Z}_M)^2}$$

Now, $\frac{\sum_{t=1}^{T}(Z_{jt} - \bar{Z}_j)(Z_{Mt} - \bar{Z}_M)}{\sum_{t=1}^{T}(Z_{Mt} - \bar{Z}_M)^2}$ is the sample estimate of $\frac{cov(Z_j, Z_M)}{var(Z_M)}$.

That is, the OLS estimator of the parameter b_j in the market equation is also an estimator of the beta of the CAPM ($\beta_j = \frac{cov(Z_j, Z_M)}{var(Z_M)}$).

The Least Absolute Deviation estimator of the parameter b_j in the market equation does not have this correspondence with beta.

The Least Absolute Deviation estimator of b_j is the value b_j^{lad} which minimises the absolute value of residuals:

$$\sum_{t=1}^{T} | Z_{jt} - a_j^{lad} - b_j^{lad} Z_{Mt} |$$

The Least Absolute Deviation estimator of b_j may be a robust estimator of b_j, but it is not an estimator of $\frac{cov(Z_j, Z_M)}{var(Z_M)}$.

The Least Absolute Deviation estimator is not relevant to beta estimation, and its use is misleading.

GGT supports the use of the Ordinary Least Squares estimator for beta estimation.

In GGT's view, the Least Absolute Deviation estimator should not be part of the ERA's general approach.

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[41] Robert W Faff, John H Lee, Tim R L Fry (1992), "Time Stationarity of Systematic Risk: Some Australian Evidence", Journal of Business Finance and Accounting, 19(2), pages 253-270.

20. When estimating the expected rate of inflation do you support the use of the Treasury bond implied inflation approach? If not, please explain why and your alternative approach.

GGT does not support the use of the Treasury bond implied inflation approach for the estimation of expected inflation. If the estimation of expected inflation is to be addressed in the 2022 gas rate of return instrument (it does not need to be), then the instrument should provide for its estimation from Reserve Bank of Australia forecasts of inflation for years 1 and 2 of a regulatory period and the midpoint of the Bank's target range for inflation for years 3, 4 and 5.

GGT agrees with the ERA that the Treasury bond implied inflation approach:

- uses measures (nominal and indexed bond yields) which incorporate the expectations of financial market participants;
- uses measures (yields on Australian Government bonds) consistent with measures used in estimating the allowed rate of return;
- provides expected inflation estimates which can be updated daily; and
- is relatively easily applied.

GGT also agrees that use of the Reserve Bank of Australia's forecasts for years 1 and 2 of a regulatory period, and the midpoint of the Bank's target range for inflation for years 3, 4 and 5:

- constrains the estimation of expected inflation to the frequency of the Reserve Bank's Statements on Monetary Policy (currently published in February, May, August and November each year);
- relies on a static target range for inflation when inflation expectations may be changing;
- assumes, possibly incorrectly, relatively rapid adjustment back to the target range in environments of low or high inflation; and
- may be inconsistent with the expectations of inflation "built in" to the yields on the traded securities used in estimating the allowed rate of return.

There are, however, a number of potential problems with Treasury bond implied inflation approach, and these were among the reasons for its not being accepted in the AER's 2019 review of the regulatory treatment of inflation. Dr Martin Lally examined four potential problems in his July 2020 paper (for the AER), *Review of the AER's Inflation Forecasting Methodology*.[42] They were as follow.

- For application of the Treasury bond implied inflation approach, nominal and indexed bonds with the same maturity dates are required. But, given the smaller number of issues of indexed bonds, finding nominal and indexed bonds with the same maturity dates among the bonds on issue by the Australian Government may not always be possible, and some interpolation of yields is likely to be required to apply the approach. This leads to error in the

[42] Dr Martin Lally, *Review of the AER's Inflation Forecasting Methodology*, 8 July 2020, pages 9-14.

estimate of expected inflation because the term structure of bond yields is typically non-linear but interpolation assumes linearity. Dr Lally was of the view that this error is unlikely to be substantial.

- When the Treasury bond implied inflation approach is applied, the assumption is made that the indexed bonds compensate for inflation from the time of application to the date of maturity of the bonds. However, this is not the case: the frequency of indexation is specified and typically lags application of the approach. This leads to error in the estimate of expected inflation, although Dr Lally was of the view that the error in question may not be substantial.

- Indexed bonds are typically less liquid than nominal bonds (the volume of indexed bonds outstanding is much lower, and the ratio of turnover to outstanding bonds is also lower). The yields on indexed bonds may therefore include liquidity premiums which are unrelated to inflation. As Dr Lally explains, if R_N is the current yield on a one-year nominal government bond, and R_R is the yield on an one-year indexed bond, the form of the Fisher equation from which expected inflation, E(i), is obtained is:

  $1 + R_N = (1 + R_R)[1 + E(i)]$. (1)

  If R_R incorporates a liquidity premium, p, that premium should be removed before estimating expected inflation: expected inflation should be estimated from the equation:

  $1 + R_N = (1 + R_R - p)[1 + E(i)]$. (2)

  Using equation (1) to estimate expected inflation when R_R includes a liquidity premium results in inflation being underestimated. However, equation (2) is not easily applied: liquidity premiums are difficult to estimate, and the estimates which have been made are highly variable. Dr Lally cautioned that using equation (1) - the Treasury bond implied inflation approach - could lead to underestimation of expected inflation at times when the liquidity premium was large.

- The Treasury bond implied inflation approach assumes that investors are indifferent to the fact that indexed bonds are essentially risk free, but nominal bonds are risky because their real returns depend on uncertain future inflation. Compensation for this inflation risk requires an inflation risk premium, but whether this premium is positive or negative (in theory, and as a matter of statistical estimation) is a contentious issue among financial economists. Dr Lally concluded that attempting to correct for the inflation risk premium in nominal bond yields before applying the Treasury bond implied inflation approach would lead to a poor estimate of expected inflation because the appropriate correction is unclear.

In GGT's view, there is not yet a sufficiently well-established body of economic theory to guide any correction for inflation risk premiums in nominal bond yields. Furthermore, the use of the complex theoretical and statistical methods required for estimation of both inflation risk premiums and the liquidity premiums in indexed bonds has not been closely examined in the Australian context. Our understanding of these matters relies on a small number of studies made for markets in the United States.

The Treasury bond implied inflation approach has appeal for the reasons set out in the Discussion Paper but, at present, the use of Reserve Bank forecasts is a more feasible, and better understood, approach to the estimation of expected inflation.

GGT does not support the use of the Treasury bond implied inflation approach for the estimation of expected inflation. If the estimation of expected inflation is to be addressed in the 2022 gas rate of return instrument (it does not need to be), then the instrument should provide for its estimation from Reserve Bank of Australia forecasts of inflation for years 1 and 2 of a regulatory period, and the midpoint of the Bank's target range for inflation for years 3, 4 and 5.