

Beta and the Black Capital Asset Pricing Model

Report for Jemena Gas Networks, Jemena Electricity Networks, ActewAGL, Ausgrid, Ausnet Services, Australian Gas Networks, CitiPower, Endeavour Energy, Energex, Ergon, Essential Energy, Powercor, SA Power Networks and United Energy

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1. Background and conclusions

Overview and instructions

1. SFG Consulting (**SFG**) has been retained by a number of energy distribution businesses¹ to provide our views on the estimation of the required return on equity using two asset pricing models – the Sharpe-Lintner Capital Asset Pricing Model (**CAPM**)² and the Black CAPM.³ The required return on equity forms a part of the allowed rate of return under the National Electricity Rules and National Gas Rules (**Rules**).
2. In a series of recent draft determinations, the Australian Energy Regulator (**AER**) relied upon these two asset pricing models to reach its final conclusion on the allowed return to equity holders. The reason we consider these models jointly in the current report is because they are considered jointly by the AER in the draft determinations. In estimating the allowed return to equity holders, the AER relies exclusively on the Sharpe-Lintner CAPM. But the AER makes reference to the Black CAPM in making its estimate of one parameter of the Sharpe-Lintner CAPM, the equity beta.
3. In particular, we have been asked to provide an opinion report that:
 - a) Reviews and responds to matters raised in the draft decision on the use of the equity beta to estimate the return on equity, including on (but not limited to):
 - i) the role of domestic comparators, including whether they have similar risk characteristics to the benchmark efficient entity and can be used to produce equity beta estimates that are reliable and stable;
 - ii) the role of foreign comparators, including whether they have similar risk characteristics to the benchmark efficient entity and can be used to produce equity beta estimates that are reliable and stable;
 - iii) the appropriate time period of data to estimate equity beta;
 - iv) the appropriate range for equity beta estimates from Australian data and separately when also considering foreign data;
 - v) whether the theory of the Black CAPM is relevant for estimating equity beta to be applied in the Sharpe-Lintner CAPM, and if so, how this theory affects estimation of the Sharpe-Lintner CAPM equity beta;
 - vi) what adjustments, if any, should be made to empirical estimates of the Sharpe-Lintner CAPM equity beta in order to ensure that the resulting return on equity estimate complies with the requirements of the National Gas Law and Rules and National Electricity Law and Rules, including as highlighted above;
 - b) Reviews and, where appropriate, responds to matters raised in the draft decision on the use of the Black CAPM to estimate the return on equity, including (but not limited to):

¹ The businesses are Jemena Gas Networks, Jemena Electricity Networks, ActewAGL, Ausgrid, Ausnet Services, CitiPower, Endeavour, Energex, Ergon, Essential Energy, Powercor, SA Power Networks and United Energy.

² Sharpe (1964) and Lintner (1965).

³ Black (1972).

- i) whether the Black CAPM is a relevant estimation method, financial model or other evidence for determining the allowed rate of return, and, more specifically, the return on equity;
 - ii) whether the Black CAPM is a relevant estimation method, financial model or other evidence for estimating the equity beta parameter of the Sharpe-Lintner CAPM or other capital asset pricing models that have an equity beta parameter;
 - iii) the reliability of Black CAPM estimates;
 - iv) the relationship between the low beta bias and the Black CAPM and whether the low beta bias is a priced risk in the Sharpe-Lintner CAPM; and
 - v) the use of the Black CAPM in practice by regulators, practitioners, academics or others.
4. In preparing the report, we have been asked to:
- a) consider different approaches to estimating the equity beta for the benchmark efficient entity, including any theoretical restrictions on empirical estimates or any adjustments made in practice (e.g. Vasicek and Blume);
 - b) consider how sample size, daily, weekly or monthly data affects the reliability of equity beta estimates and approaches for overcoming this, including using foreign data;
 - c) consider how leverage affects the equity beta;
 - d) consider different approaches to applying the Black CAPM and estimating the zero-beta premium, including any theoretical restrictions on empirical estimates;
 - e) consider any comments raised by the AER and other regulators about (i) whether the Black CAPM informs the equity beta estimate for the Sharpe-Lintner CAPM, and if so how, (ii) how leverage affects equity beta, (iii) whether and how foreign data is relevant to estimating an Australian equity beta, (iv) whether the Black CAPM applies in Australia and (v) the best estimate of the zero-beta premium for Australia;
 - f) use robust methods and data; and
 - g) use the sample averaging period of 2 January to 30 January 2015 (inclusive) to estimate any prevailing parameter estimates needed to populate the Sharpe-Lintner CAPM and Black CAPM.
5. Our instructions are set out in Appendix 1 to this report.
6. This report has been authored by Professor Stephen Gray and Dr Jason Hall. Stephen Gray is Professor of Finance at UQ Business School, The University of Queensland and Director of SFG Consulting, a specialist corporate finance consultancy. He has Honours degrees in Commerce and Law from The University of Queensland and a PhD in financial economics from Stanford University. He teaches graduate level courses with a focus on cost of capital issues, has published widely in high-level academic journals, and has more than 15 years' experience advising regulators, government agencies and regulated businesses on cost of capital issues. Jason Hall is Lecturer in Finance at the Ross School of Business, The University of Michigan and Director of SFG Consulting. He has an Honours degree in Commerce and a PhD in finance from The University of Queensland. He teaches

graduate level courses with a focus on valuation, has published 15 research papers in academic journals and has 17 years practical experience in valuation and corporate finance. Copies of the authors' curriculum vitas are attached as an appendix to this report.

7. The opinions set out in this report are based on the specialist knowledge acquired from our training and experience set out above.
8. We have read, understood and complied with the Federal Court of Australia Practice Note CM7 *Expert Witnesses in Proceedings in the Federal Court of Australia*.

Context

9. This report needs to be read in context of a series of reports that have previously been submitted to the AER in relation to the use of three asset pricing models – Sharpe-Lintner CAPM,⁴ the Black CAPM,⁵ and the Fama-French Model⁶ – and the estimation of specific parameters, namely beta and the zero beta premium. We refer to the relevant reports in specific places throughout this report.

Areas of agreement and disagreement

10. We agree with the AER that:
 - a) The Sharpe-Lintner CAPM is a relevant financial model for the purposes of estimating the required return on equity for the benchmark efficient entity;
 - b) The form of the Sharpe-Lintner CAPM is:

$$r_e = r_f + \beta_e (r_m - r_f)$$

- c) The Black CAPM is a relevant financial model for the purposes of estimating the required return on equity for the benchmark efficient entity;
- d) The form of the Black CAPM is:

$$r_e = r_z + \beta_e (r_m - r_z)$$

where r_z represents the return on a zero beta asset, which is the sum of the risk-free rate and the zero beta premium;

- e) Regression-based beta estimates for domestic listed comparators are relevant evidence for the purposes of estimating beta; and
 - f) Regression-based beta estimates for international listed comparators are relevant evidence for the purposes of estimating beta.
11. The key points of disagreement between us and the AER concern *the way* in which the evidence that we all agree to be relevant is taken into account. In particular:

⁴ SFG (2014 ROE).

⁵ SFG (2014 Black).

⁶ SFG (2014 FFM) and Fama and French (1993).

- a) Our view is that since the Sharpe-Lintner and Black models are both considered to be relevant, both should be estimated. By contrast, the AER's approach is to estimate only the Sharpe-Lintner model, but to adjust the beta parameter in order to have regard to the "theoretical principles underpinning"⁷ the Black CAPM. In our view, this involves an implementation that is not true to either model. Our view is that each model should be estimated as it was intended to be estimated. Having done that, one should then consider the relative strengths and weaknesses when determining the relative weight that should be assigned to each; and
- b) Our view is that since the domestic and international evidence is considered to be relevant, both data sources should be used to produce beta estimates. Having done that, one should then consider the relative strengths and weaknesses when determining the relative weight that should be assigned to each. By contrast, the AER's approach is to anoint the domestic evidence as being primary evidence that establishes a primary range and to relegate the international evidence to the secondary role of assisting only in the selection of a point estimate from within the primary range – even if that secondary evidence is inconsistent with the AER's primary range. Indeed, the AER never even specifies the beta estimate that it considers the international evidence to support.

Estimates of the cost of equity for a benchmark energy network

12. For the reasons set out in this report, we consider that:

- a) The best available estimate of the equity beta of the efficient benchmark entity is 0.82, and this same estimate should be used in the Sharpe-Lintner CAPM and in the Black CAPM, both of which define beta in the same way;
- b) The best available estimate of the zero-beta premium is 3.34%, and this should be used when estimating the Black CAPM; and
- c) If it is determined that the Sharpe-Lintner CAPM must be parameterised in a way that reflects the evidence from the Black CAPM, an equity beta of 0.91 should be used.

⁷ Jemena Draft Decision, Attachment 3, p. 265. The AER makes identical or similar statements in the other draft decisions that it has recently published. We provide references to the Jemena Gas Networks Draft Decision by way of example throughout this report.

2. Beta and the Black CAPM in the context of the AER's draft decisions

The AER beta estimate

13. In its recent draft decisions the AER has adopted a beta estimate of 0.7 for use in the Sharpe-Lintner CAPM. In reaching this conclusion the AER has proceeded through a series of steps, as outlined below:⁸
- a) **Conceptual analysis.** The AER conducted a conceptual analysis and concluded that the equity beta of the efficient benchmark firm is likely to be less than 1.0.⁹
 - b) **Range.** The AER decided that beta would be estimated from within a range of 0.4 to 0.7. This range was formed with reference to empirical beta estimates for nine Australian-listed stocks, compiled by Henry (2014). The AER stated that if it was to arrive at a point estimate for beta on the basis of empirical estimates from Australian-listed stocks, the point estimate would be 0.5. The basis for this conclusion was that, across a number of beta estimates made for different firms and portfolios over different time periods, the beta estimates appear to be concentrated near 0.5.
 - c) **Black CAPM.** The AER decided not to make a separate estimate of the cost of equity from the Black CAPM. The rationale for this decision was that the Black CAPM requires an estimate of the zero beta premium, and the AER considers that this parameter cannot be estimated with any degree of confidence. However, the AER considered that the theory underlying the Black CAPM has some merit. In theory, the cost of equity for stocks with low beta estimates will lie above the return expected under the Sharpe-Lintner CAPM. So the AER used this theory as support for a beta estimate towards the upper end of the AER's initial range.
 - d) **International listed firms.** The AER decided not to make a separate estimate of beta from analysis of firms listed in markets other than Australia. The AER refers to beta estimates from several reports, considers that the beta estimates implied by these reports range from 0.45 to 1.14, and that in general the empirical beta estimates from international listed firms support a beta estimate towards the upper end of the AER's initial range.
 - e) **Predictability.** The AER considered that certainty and predictability was important for stakeholders in setting the estimated rate of return, and noted that a beta estimate at the top of the AER's initial range was a modest step down from its prior estimate of 0.8.¹⁰
14. In its determinations, the AER makes clear that it does not quantify the impact that its consideration of the Black CAPM has on its beta estimate. The AER also makes clear that it does not make a specific estimate of the beta estimate that is implied by a consideration of firms listed in markets

⁸ Jemena Draft Decision, Attachment 3, Appendix D.

⁹ In our view, the AER's conceptual analysis is contaminated by fundamental errors. Specifically, the AER confuses leverage (the proportion of debt financing) with some elements of operating risk that have a financial flavour. However, the AER appears to make no use of this conceptual analysis other than as corroboration of any estimate less than 1.0. Since all submitted estimates are less than 1.0, the errors in the AER's conceptual analysis would seem to be a moot point. For this reason, we relegate our discussion of the conceptual analysis to Appendix 3.

¹⁰ The AER also noted that its beta estimate provided a balance between the views expressed by consumers and the views expressed by service providers. Consumers advocated for a lower regulated rate of return and businesses advocated for a higher regulated rate of return. It is unclear whether balancing these two views is used as a separate criteria for estimating the regulated rate of return, or whether the AER is merely emphasising that it has had regard to submissions received from all stakeholders. For the purpose of this report we do not consider this a relevant issue.

other than Australia. The predictability consideration also represents a qualitative consideration because we do not know what the beta estimate would be if predictability mattered, or did not matter.

15. This means that the AER's beta point estimate of 0.7 relies entirely on the AER's conclusion that its initial range of 0.4 to 0.7 acts as a binding constraint on its other considerations, namely the Black CAPM, international listed firms, and predictability. That is, 0.7 has been adopted because the secondary evidence supports a higher beta (albeit without any precise quantification by the AER) and 0.7 is the top of the primary range. If the AER had instead adopted the recommendation of Henry (2014) that "the point estimate for β lies in the range 0.3 to 0.8,"¹¹ there would be no basis for arriving at a point estimate of 0.7. Because the AER's process does not quantify any evidence other than the primary range, there is no basis for the selection of any particular point within the range. If the AER had adopted a range of 0.3 to 0.8, it might have set the point estimate to 0.8 on the basis that the secondary evidence pointed to a higher estimate. That is, under the AER's staged process for having regard to the relevant evidence, the primary range is determinative.
16. Consider the alternative case in which the AER starts with a point estimate for beta of 0.5 from its analysis of domestic comparators but without a range. The AER could then establish what the beta estimate would be if the AER took account of the other evidence that it considers to be relevant: the Black CAPM, international listed firms, and predictability. However, such adjustments to account for the other relevant evidence are not possible because the AER does not reach a decision as to how much beta should be adjusted to account for any of the evidence that it relegates to the secondary category.
17. The key point is that the AER can only reach its final beta estimate if it begins with a binding constraint that beta must lie within the range of 0.4 to 0.7.

An alternative approach to evaluating the evidence

18. In our previous submissions to the AER we supported the use of cost of equity estimates from a number of models, and supported placing specific weights on those cost of equity estimates according to their relevance and reliability. Under this process, regulatory judgement is still used to determine how much weight should be given to each cost of equity estimate, but it is made transparent. With specific application to the current issue, we adopted weights of 12.5% for the cost of equity estimate derived from the Sharpe-Lintner CAPM, and 25.0% for the cost of equity estimate derived from the Black CAPM.¹² This means that, in the context of just considering the issues of beta and the Black CAPM, on a relative basis we assigned one-third weight to the cost of equity from the Sharpe-Lintner CAPM, and two thirds weight to the cost of equity from the Black CAPM.
19. There is general agreement between the AER and us that consideration of the Black CAPM should lead to a higher cost of equity estimate for the benchmark efficient entity than if just the Sharpe-Lintner CAPM was considered in isolation. The point of disagreement is how to measure the impact on the cost of equity. We make an estimate of the zero beta premium, we compute the cost of equity from each of the two approaches, and we set out our reasons for the relative weight that we propose to apply to each approach given their strengths and weaknesses. By contrast, the AER sets the beta range to 0.4 to 0.7 based on its primary evidence and then selects a point estimate of 0.7 based, in part, on its consideration of the "theoretical underpinnings"¹³ of the Black CAPM.

¹¹ Henry (2014), p. 63.

¹² We also adopted weights of 37.5% from the Fama-French model and 25.0% from the dividend discount model.

¹³ Jemena Draft Decision, Attachment 3, p. 265.

20. We adopted the same process when considering how much weight to apply to beta estimates from firms listed in markets other than Australia. We analysed a sample of 9 Australian-listed firms and 56 U.S. listed firms, and used judgement to allocate twice as much weight to a beta estimate from an Australian listed firm. This means that we assigned 24% weight to the small sample of Australian listed firms, and 76% weight to the large sample of U.S. listed firms.¹⁴
21. Again, there is general agreement between the AER and us that consideration of firms listed in markets other than Australia implies a beta estimate that is higher than if the small sample of Australian-listed firms was considered in isolation. The point of disagreement is how to measure this impact on the beta estimate, and indeed whether that impact needs to be measured at all. We compute a weighted average of the beta estimates from the two samples, setting out our reasons for the weights that we adopt. This enables discussion about the merits of our weights and transparency about the effect that our judgment has on the final estimate. The AER makes an estimate of the beta range from the sample of Australian-listed firms, and then uses qualitative discussion to select a single point estimate from within the range of 0.4 to 0.7.
22. These two different approaches to evaluating the evidence on beta and the Black CAPM have important implications for the final estimate of the regulated rate of return. The approach adopted by the AER means that there is no chance that the allowed return to equity holders will lie above that implied by the upper bound of the AER's primary beta range. It is a binding constraint as a result of the following two points.
- a) The AER has embedded something stronger than a persuasive evidence test into its decisions. The AER's range is formed entirely with respect to its favoured subset of the relevant evidence – the empirical beta estimates of Australian-listed firms. The AER states that it will first form an initial range using a subset of the evidence that it considers to be relevant. All other relevant evidence is then limited to “the selection of a point estimate from within the range.”¹⁵ The initial range that is selected then limits the role of all other relevant evidence.
 - b) However, under the AER's estimation process there will never be evidence put forward which allows the upper bound of the primary range (0.7) to be altered for the following reasons:
 - i) **Black CAPM.** The AER's consideration of the Black CAPM does not involve any measurement of the zero beta premium, and it does not quantify any specific uplift to the beta estimate. The AER has made this clear by having regard only to the theoretical underpinnings of the Black CAPM. In the absence of any measurement of the relevance of the Black CAPM to the cost of equity it is not possible that the upper bound of the range could be altered because there is no basis for determining what it might be altered to.

The AER's reason for not making a specific estimate of the zero beta premium is that this parameter is estimated with a degree of imprecision, which is correct. Our own estimate of the zero beta premium (3.34%) has a high standard error. However, this does not, in itself, imply that the best available estimate of the zero-beta premium is 0. For example, the AER's beta and MRP estimates are also estimated imprecisely. Some of the AER's estimates of MRP are statistically insignificant, but that does not imply that the

¹⁴ The weights are computed as $(2 \times 9) \div (2 \times 9 + 56) = 18 \div 74 = 24\%$, and $56 \div (2 \times 9 + 56) = 56 \div 74 = 76\%$.

¹⁵ AER Rate of Return Guideline, p. 15.

best available estimate is zero. Even more important, though, is the reason for imprecision in the estimate of the zero beta premium.

The reason the estimate of the zero beta premium is imprecise is *because* there is such a weak association between realised stock returns and empirical beta estimates. Not only do stocks with low beta estimates have higher returns than predicted by the Sharpe-Lintner CAPM, but the beta estimates themselves are so imprecisely estimated that there is imprecision in the relationship between stock returns and beta estimates.

So the AER's first stage analysis is to presume the Sharpe-Lintner CAPM holds, and that a beta estimate from 0.4 to 0.7 provides a sound basis for estimating the cost of equity. The AER's second stage analysis is to consider revisions to this range, and the selection of a point estimate within the range, if it can be convinced that its initial presumption is not correct. However, the initial presumption (based on the "primary" subset of the relevant evidence) cannot possibly be overturned because the poor empirical performance of the Sharpe-Lintner CAPM is the very reason why the zero-beta premium is estimated with imprecision.

- ii) **International listed firms.** The AER's consideration of international listed firms does not involve making a specific estimate from any given sample, or making an estimate on the basis of the aggregated evidence. In its recent draft decisions, the AER states that it was not persuaded to alter its initial range on the basis that there was a wide range of beta estimates from different firms (the AER reports a range of 0.45 to 1.14) and beta estimates from firms listed in other markets have less relevance than beta estimates from firms listed in Australia.¹⁶

The AER's consideration of international listed firms is performed in such a way that the conclusion that the upper bound for beta is equal to 0.7 could never be overturned. The lowest estimate from the international evidence of 0.45 is a market capitalisation weighted average of beta estimates from three United Kingdom (**U.K.**) listed firms, computed without adjustment to leverage of 60%, using one year of daily data ending on 9 May 2012. The highest estimate from the international evidence of 1.14 is an equal-weighted average of beta estimates from three U.S. listed firms, computed with adjustment to leverage of 60%, using three years of daily returns.

Given the imprecision in beta estimates, if one year of data is used to estimate beta for samples of three firms in different markets using different adjustments for leverage, there will always be a mean beta estimate somewhere that lies below 0.7, and there will always be another mean beta estimate that lies above 0.7. This means that the de facto persuasive evidence test for altering the AER's initial range for beta estimates will never be rejected.

- 23. The key point is that the AER reaches a conclusion on the basis of a sequential consideration of the relevant evidence, and that the conclusions that are drawn from the first stage consideration of the primary subset of evidence severely restrict the impact of any other relevant evidence considered in the second stage. Under the AER's decision-making process, the initial range will never be revised because the subsequent evidence is evaluated in manner that will never be persuasive enough:

¹⁶ The specific words used by the AER are "there are inherent uncertainties when relating foreign estimates to Australian conditions." Jemena Draft Determination, Attachment 3, p. 265.

- a) The zero beta premium will never be precise enough (*because* beta estimates are noisy estimates of risk and there is doubt over whether the Sharpe-Linter CAPM is a good model for estimating the cost of capital); and
- b) The beta estimates for international listed firms will be too wide (*because* beta estimates are noisy estimates of risk and the AER simply lists a wide range of noisy beta estimates without regard to the differential quality of each).
24. This means that the cost of equity is constrained for the very reasons that suggest we need to consider a wide range of evidence – the imprecision in beta estimates and doubts over the usefulness of the Sharpe-Lintner CAPM.
25. In our opinion, the process that the AER has developed for the staged consideration of evidence is neither required by the Rules nor consistent with them. The Rules require the AER to make an estimate of efficient financing costs of the benchmark efficient entity that reflects the prevailing conditions in the market for funds. The Rules also require the AER to have regard to all relevant evidence in making its determination.¹⁷ The multi-stage process that the AER adopts to estimate the equity beta leads to a binding constraint on beta, and that binding constraint leads to a cost of equity estimate that is below the efficient financing costs.¹⁸
26. In writing the Rules, the AEMC was mindful of the risk that embedding persuasive evidence tests in the Rules would lead to cost of capital estimates that did not reflect efficient financing costs. Persuasive evidence tests were excluded from the Rules in order to allow the AER to consider all relevant evidence in a holistic manner. The AEMC understood that it is difficult to overturn a presumption embedded in a persuasive evidence test, because of the imprecision in cost of capital estimates. In this regard, the AEMC stated that:
- ...the persuasive evidence test is problematic. Although regulatory certainty is desirable, it should not be attained at the expense of limiting the regulator’s ability to make the highest-quality rate of return estimate at any particular time.¹⁹
- and:
- ...the final rule requires the regulator to take a more holistic approach in estimating the return on equity and debt and the overall allowed rate of return.²⁰
27. In our view, the AER’s approach is not one of considering all of the relevant evidence holistically. Rather, the AER’s approach is to use a small subset of the relevant evidence to determine a primary range and has not departed from that primary range in relation to any of its parameter estimates.

¹⁷ NGR 87, NER 6.5.2, 6A.6.2.

¹⁸ We consider this issue in more detail in our companion report, SFG (2015 ROE).

¹⁹ AEMC Final Determination, p. 41.

²⁰ AEMC Final Determination, p. 19.

3. Weighing up the relevant evidence

Beta estimates from the domestic comparators – the AER’s primary evidence

Selection of comparators

28. The AER adopts a set of nine domestic comparator firms,²¹ only four of which remain listed.²² Two of the firms have not been listed since 2006 and one has not been listed since 2007. The AER’s approach is to maintain the beta estimates for these firms in its sample, even though those estimates become progressively more dated with the passage of time. That is, the beta estimate at the time a firm delists becomes a permanently determinative observation in the AER’s sample. By the time the current Guideline expires, three of the nine beta estimates will be more than 10 years out of date. These estimates will, by definition, not reflect anything that has transpired in financial markets for over a decade.
29. This problem cannot be fixed by simply culling the stale observations. If this were done, we would be left with only the four currently listed comparators, a sample which we consider to be too small to provide reliable estimates, in and by itself. Rather, our view is that the tiny sample of domestic comparators that is currently available must be augmented by the consideration of other comparators, as set out below.
30. In our view, the AER should clearly set out:
 - a) How dated a domestic beta estimate would have to be before the AER would remove it from the sample or apply less weight to it; and
 - b) The minimum number of domestic comparators that could be used to fix a determinative range for beta, whereby all other evidence could only be used to select a point estimate from within that range.

The reliability of estimates from domestic comparators only

31. In our previous report on equity beta (SFG Beta 2014), we concluded that estimates based exclusively on the small sample of domestic comparators were statistically unreliable. The reasons for this conclusion included:
 - a) The estimates are imprecise with wide standard errors;
 - b) The estimates span a wide range²³ with the vast majority of estimates for comparable firms falling outside the AER’s proposed range of 0.4 to 0.7;
 - c) Many of the estimates varied materially across different estimation methods;
 - d) Many of the estimates varied materially across different sampling frequencies;
 - e) Many of the estimates varied materially across time;
 - f) Over the same period where the estimates for some comparators increase by 20%, others decrease by 20%. This indicates that either (a) the true systematic risk of the two firms

²¹ Jemena Draft Decision, Attachment 3, Table 3-53, p. 243

²² SKI, SPN, DUE, APA.

²³ From less than 0.2 to more than 1.0.

moved materially in the opposite direction, in which case it is impossible that those two firms are both comparable, or (b) beta *estimates* are statistically unreliable; and

g) Many of the estimates varied materially depending on the day of the week used to measure returns.

32. In addition, the set of domestic comparators is far from perfect. For example, the ownership of unregulated assets is inconsistent with the definition of the benchmark efficient entity.

33. In its recent draft decisions, the AER notes the issues set out above, but concludes that none of them affect its conclusion that its domestic sample alone is sufficient to produce a reliable range for the equity beta:

...our Australian comparator set is sufficient to produce a reliable equity beta range for the benchmark efficient entity.²⁴

34. This issue has now reached the stage where different parties have reached different conclusions from the same evidence. Our view is that the evidence suggests that the available sample of domestic comparators is not sufficient to, by itself, produce a determinative range for the equity beta of the benchmark efficient entity. The AER has reached the opposite conclusion from its consideration of the same evidence.

The use of international comparators to form the primary range

35. In its recent draft decisions, the AER concludes that international comparators should not be considered when estimating the primary range for the equity beta:

We consider including international energy network firms in our comparator set is not necessary in this case because our Australian comparator set is sufficient to produce a reliable equity beta range for the benchmark efficient entity.²⁵

36. The AER's view is that international comparators are not sufficiently comparable to the benchmark efficient entity:

We do not consider SFG has provided satisfactory evidence that the suggested sample of 56 US energy firms are sufficiently comparable to the benchmark efficient entity.²⁶

37. The AER further explains that international comparators have been rejected because the benchmark efficient entity is Australian.²⁷ The AER's Guideline set out a number of reasons why it considered that international comparators might not provide an unbiased estimate of the beta of an Australian network business. The recent draft decisions downplay some of those reasons²⁸ and focus on the differences between the US market index and the Australian market index.²⁹

²⁴ Jemena Draft Decision, Attachment 3, p. 249.

²⁵ Jemena Draft Decision, Attachment 3, p. 249.

²⁶ Jemena Draft Decision, Attachment 3, p. 248.

²⁷ Jemena Draft Decision, Attachment 3, p. 244.

²⁸ For example, the recent draft decisions appear to place less reliance on the possibility that differences in geography and weather might materially affect beta estimates – Jemena Draft Decision, Attachment 3, p. 246. There is also less reliance on the AER's point about the vertical integration of some US firms causing an upward bias in beta estimates, given that a Frontier Economics report for the AER indicated that vertical integration is likely to cause a downward bias in beta estimates for water

38. In an ideal world there would be a very large number of domestic comparators and there may be no need to consider international comparators at all. At the other extreme, if there were no domestic comparators one would have to rely exclusively on international comparators. If there were only one, or two, or three domestic comparators, they would be considered, but it would be necessary to supplement that evidence with evidence from international comparators. That is, it would be wrong to conclude that international comparators can never be used because of differences in the composition of the respective market indices.
39. If the goal is to obtain the best and most reliable estimate of beta, one would have regard to international comparators unless it was the case that the estimate from the available set of domestic comparators is so robust and reliable and precise that having any regard at all to the international comparators could only serve to diminish the quality of the domestic estimate. For the reasons set out above, our view is that the set of domestic comparators (that currently consists of four listed companies) does not produce a domestic estimate that reaches this high threshold.

Beta estimates from international comparators

[International evidence considered in the Guideline](#)

40. The Guideline indicates that the AER considers that empirical estimates of beta for overseas energy networks are also relevant evidence,³⁰ but that this evidence can only be used to select a point estimate from within the primary range of 0.4 to 0.7 based on the (now) four domestic comparators.
41. In our previous report to the AER³¹ and in the previous section of this report, we noted that the separation of relevant evidence to primary and secondary classes can cause problems when evaluating that evidence. This can occur, for example, where the relevant evidence that is assigned to the secondary class is inconsistent with what the AER considers to be the primary evidence. Under the AER's approach, the secondary evidence can only be used to inform the selection of a point estimate from within the primary range. Consequently, the secondary evidence is disregarded to the extent that it is inconsistent with the primary range.
42. In our view, a better approach is to set out all of the evidence that the AER considers to be relevant to the estimation of beta in a single step of its estimation approach. All of that relevant evidence can then be used to inform the estimate of beta, properly taking into account the relevant strengths and weaknesses of that evidence. By contrast, the AER's approach effectively caps the equity beta estimate at 0.7 based on evidence from what is now a set of only four domestic comparators – irrespective of the quantum of other evidence that might suggest a higher beta.
43. The AER's Guideline considered a number of pieces of evidence in relation to international comparators, set out in Appendix C to the Explanatory Statement.³² We summarise that evidence in Figure 1 below.³³

utilities, although the AER does raise the (unlikely, in our view) possibility that vertical integration might have the opposite effect on water vs. electricity utilities – Jemena Draft Decision, Attachment 3, p. 246.

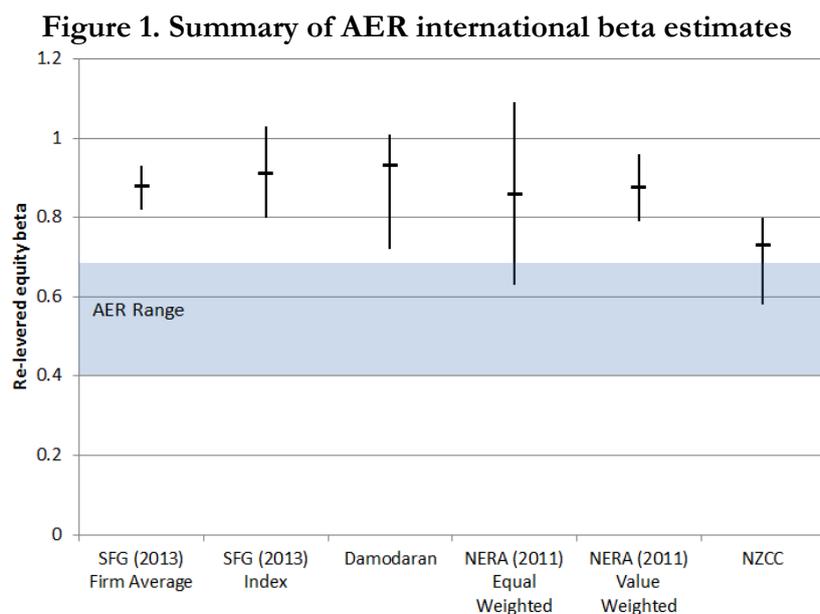
²⁹ Jemena Draft Decision, Attachment 3, p. 246.

³⁰ AER Rate of Return Guideline, p. 15.

³¹ SFG (2014 Beta).

³² Specifically, at pp. 66–67.

³³ Note that the figure does not contain estimates from prior to 2010, such as the 2007 and 2008 Damodaran estimates that were referenced by McKenzie and Partington (2012).



Source: AER Appendix C, pp. 66–67.

Notes: The AER only reports the point estimates from SFG (2013), so ranges have been obtained directly from the SFG (2013) report. The figure shows the range and mean of the four point estimates from Damodaran that are set out in the AER's appendix. The AER sets out only the ranges from NERA (2013); the figure shows the mid-point in each case. The AER sets out four estimates from the NZCC; the figure shows the range and mean.

44. Two additional points are relevant to the interpretation of the evidence set out in Figure 1:

- a) The NZCC estimates are based on a sample that includes:
 - i) The Australian firms that have already been taken into account elsewhere in the estimation process; and
 - ii) A number of very small U.S. listed firms that trade so infrequently that their betas cannot be reliably estimated, as explained by SFG (2013 Beta); and
- b) Updated 2014 estimates provided by Damodaran indicate a mean re-levered equity beta estimate of 1.00 for utilities.³⁴

45. Quite clearly, this international evidence supports an equity beta estimate above the 0.7 estimate that is proposed in the Guidelines.

46. In its recent draft decisions, the AER states that:

In the Guideline, we set out a number of international empirical equity beta estimates that ranged from 0.5 to 1.3.³⁵

47. However, this range includes the contemporaneous estimates of beta that are set out in Figure 1 above as well as several estimates of beta that use small samples and which are now more than five years out of date. Indeed, the AER's Guideline specifically distinguishes between the dated pre-GFC estimates of beta and the more contemporaneous estimates of beta:

³⁴ See <http://www.stern.nyu.edu/~adamodar/pc/datasets/betas.xls>.

³⁵ Jemena Draft Decision, Attachment 3, p. 262.

In the equity beta issues paper, we also presented new estimates of equity beta for overseas electricity and gas networks—that is, estimates that consider data after the onset of the GFC.³⁶

48. All of the contemporaneous estimates of beta are set out in Figure 1 above and they all point to an equity beta above 0.7.

International evidence considered in recent draft decisions

49. The AER's recent draft decisions also present new evidence of contemporaneous estimates of equity beta from international comparators. However, there are some severe problems with a number of these estimates. For example:

- a) Some of the estimates have not been regearged to 60% debt and therefore cannot be compared with the proposed estimate of 0.7. The level of gearing is an important component of equity beta and all of the domestic estimates of equity beta that the AER has ever relied upon have been regearged to 60%, including the recent Henry (2014) estimates where the AER's terms of reference required beta estimates to be regearged to 60% and all of the estimates in Henry's report were in fact regearged to 60%.³⁷ In our view it would be a clear error to make an apples-with-oranges comparison of regearged equity beta estimates with raw equity beta estimates. Such an error would lead to a downward bias in the beta estimate for the benchmark efficient entity; and
- b) Some of the estimates are based on the analysis of only three comparator firms using only one year of daily data. In our view, the analysis of such a small and short-term data set cannot possibly produce a beta estimate that has even a modicum of reliability. In this regard, we note that the AER's terms of reference for Henry (2014):
 - i) Instructed the consultant to use a minimum data period of 5 years;
 - ii) Instructed the consultant to use a minimum return frequency of weekly data;
 - iii) Instructed the consultant to use a minimum sample size of 9 companies.

50. In the remainder of this section we consider each of the new pieces of international evidence reported in the AER's recent draft decisions:

- a) Damodaran (2013). The AER reports an updated estimate from Damodaran of 0.83 (regearged to 60%) using data through to the end of 2013. This estimate is for U.S. comparators only. Beta estimates for three comparator groups are:
 - i) U.S. comparators (20 firms): 0.83;
 - ii) European comparators (20 firms): 1.30;
 - iii) Global comparators (55 firms): 0.90.

³⁶ AER Rate of Return Guideline, Explanatory Statement Appendices, p. 66.

³⁷ Henry (2014) sets out some raw beta estimates in the final appendix to his report, but the 30 tables in the body of the report all contain estimates that have been regearged to 60%.

- b) FTI (2012). This report provided raw beta estimates for three comparators using daily data over one- and two-year periods. For the reasons set out above, it is our view that it would be a gross error to place any weight on the resulting figures when seeking to estimate the regearred equity beta for the benchmark efficient entity.

Moreover, the AER's recent draft decisions only report the raw equity betas for the three comparators and imply that they can be compared with its regearred equity beta estimate of 0.7. The AER does not mention that the FTI (2012) study itself notes that the estimates that are cited by the AER are just one of the pieces of evidence that are used to inform the estimate of beta. The FTI report notes that Ofgem has previously adopted a beta range of 0.9 to 0.95³⁸ after considering all of the relevant evidence and that "[r]ecent regulatory precedent suggests a range of 0.9 to 1.1".³⁹ The FTI report itself then concludes that:

We have not identified any evidence to suggest that Ofgem should update its range for beta in light of either recent regulatory precedent or recent market conditions.⁴⁰

The draft decisions also do not mention that Ofgem has subsequently adopted equity betas of 0.95 for NGET⁴¹ (with 60% gearing) and 0.91 for NGGT⁴² (with 62.5% gearing) after considering the FTI (2012) study.⁴³

- c) Alberta Utilities Commission (2013). This report documents *submissions* to the regulator in relation to equity beta – it does not present any *estimates* of beta. Unsurprisingly, user groups such as the Canadian Association of Petroleum Producers (CAPP) submitted that a low equity beta should be used. The report provides no information at all about the basis for the equity beta submissions. There is no information about how many, or which comparator firms were used. There is no information about what statistical techniques were employed or how the range of resulting estimates was distilled into a point estimate or range.

Moreover, the process for determining the allowed return on equity in Alberta is fundamentally different from the process that is adopted by the AER. Specifically, the Alberta process begins with the assignment of an equity beta. The regulator then checks whether the allowed revenue will be sufficient to satisfy three key credit rating metrics. If these metrics are not achieved, the regulator will adjust the assumed level of gearing and/or add an increment to the allowed return on equity – the so-called “adder” premium to ensure that the metrics are achieved. The equity beta estimates that form the lower bound of the range that was submitted to the Alberta regulator involve material adder adjustments. That is, the role and the use of the equity beta are very different in Alberta than in the Australian regulatory setting.

For the reasons set out above, it is our view that the Alberta Utilities Commission report does not contain any evidence that is relevant to the regearred equity beta for use in the Australian regulatory framework.

- d) PWC (2013). In its recent draft decisions, the AER summarises the evidence from the PWC report for the NZCC as follows:

³⁸ FTI (2012), Paragraph 4.3.

³⁹ FTI (2012), Paragraph 4.46.

⁴⁰ FTI (2012), Paragraph 4.57.

⁴¹ National Grid Electricity Transmission.

⁴² National Grid Gas Transmission.

⁴³ OfGem (2012) Paragraphs 3.45 and 3.47.

PwC's June 2014 report presents the following raw equity beta estimates for New Zealand energy network firms as at 31 December 2013: 0.6 for the average of the individual firm estimates.⁴⁴

The AER implies that this estimate of 0.6 can be compared with its allowed equity beta of 0.7. However, such a comparison would be an error for the reasons set out below. First, the 0.6 estimate does not appear anywhere in the PwC report. The beta estimates set out in the “Utilities” section of the report are set out in the table below.⁴⁵

Table 1. PwC beta estimates for the NZCC

Company	Raw beta	Leverage	Regeared beta (to 60% debt)
Contact	0.9	0.27	1.64
Horizon	0.5	0.31	0.86
NZ Windfarms	0.5	0.33	0.84
NZ Refining	0.8	0.17	1.66
TrustPower	0.5	0.36	0.80
Vector	0.7	0.50	0.88

The AER’s estimate of 0.6 is the average of the raw beta estimates for Horizon and Vector,⁴⁶ which are considered to be the firms most comparable to the benchmark efficient entity. The average of the regeared estimates for these two firms is 0.87.⁴⁷

In our view, it is misleading at best to suggest that the PwC (2013) report provides any support at all for the AER’s regeared equity beta of 0.7.

- e) Brattle Group (2013). This report examined seven European comparators and three US comparators using daily data over three years. In our view, three years is too short a period to provide reliable beta estimates. Nevertheless, the AER reports re-g geared equity beta estimates from this report of:
 - i) 0.65 for the average of European individual firm estimates;
 - ii) 1.14 for the average of U.S. individual firm estimates; and
 - iii) 0.79 for the average of European and U.S. individual firm estimates.

The Brattle Group (2013) also note that the relevant regulatory rules require that the set of comparators must include at least ten firms – in contrast to the AER’s set of domestic comparators, which now numbers four.

51. In summary:

- a) The Damodaran estimates all support an equity beta materially above the AER’s estimate of 0.7;

⁴⁴ Jemena Draft Decision, Attachment 3, p. 264.

⁴⁵ The regeared beta estimates are our computations.

⁴⁶ Jemena Draft Decision, Attachment 3, p. 264.

⁴⁷ The average of 0.86 and 0.88 for Horizon and Vector, respectively.

- b) The FTI (2012) analysis of three companies using one year of daily data is incapable, by itself, of producing a reliable estimate of equity beta. FTI (2012) and OfGem (2012) conclude that the appropriate equity beta is in excess of 0.9;
- c) The Alberta Utilities Commission (2013) report does not contain beta estimates, but rather beta submissions. Since there is no information about the basis of those submissions, it would be an error to place any material weight on them;
- d) The PWC (2013) report indicates that the relevant regeared equity beta estimates are 0.80 and 0.88;
- e) The Brattle Group (2013) estimates are based on such a short period of data that they are unreliable. The average re-gearred equity beta estimate reported by the AER is 0.79, which is materially above the AER's estimate of 0.7.

52. In relation to the evidence from international comparators:

- a) All of the contemporaneous evidence considered by the AER during its Guideline process (set out in Figure 1) is consistent with an equity beta estimate materially above the AER's estimate of 0.7; and
- b) All of the additional international evidence set out above is consistent with an equity beta estimate materially above the AER's estimate of 0.7.

53. By contrast, in its recent draft decisions the AER concludes that:

We consider empirical equity beta estimates from a range of different countries. These estimates (presented above) show it is not clear that the international evidence supports an equity beta estimate above the top of our range. The range of the international empirical estimates is wide, with a number of estimates both above and below the top of our empirical range. We note the pattern of international results is not consistent and there are inherent uncertainties when relating foreign estimates to Australian conditions.⁴⁸

54. The AER appears to have based its conclusion that “it is not clear that the international evidence supports an equity beta estimate above the top of our range” on:

- a) The FTI estimates that are based on three comparators using a year or two of daily data. These estimates were part of a range of evidence that resulted in OfGem adopting equity betas of 0.9 to 0.95;
- b) Submissions (not empirical estimates, but submissions) to the Alberta Utilities Commission by user groups;
- c) Raw beta estimates computed by PwC for two NZ companies, which when regeared to 60%, are materially above 0.7; and
- d) Raw beta estimates computed by the Brattle Group for seven European and three US firms, which when regeared to 60% are materially above 0.7 for the overall sample.

⁴⁸ Jemena Draft Decision, Attachment 3, p. 265.

55. Moreover, the AER's recent draft decisions contain no analysis or even any commentary about the relative reliability of the international evidence. There is no assessment at all about which pieces of international evidence are more comprehensive and more reliable and which might be less reliable. Rather, the AER simply concludes that it considers that the international evidence spans its primary estimate of 0.7 and that therefore it does not lead the AER to alter or review that primary estimate. In our view, there are two problems with the AER's approach:
- a) As set out above, the international evidence does *not* span the AER's 0.7 estimate. Rather, the international evidence is uniformly consistent with a regressed equity beta materially above 0.7. The AER's rationale is that, provided there are some beta estimates that fall below 0.7 and some beta estimates that fall above 0.7 (regardless of the length of estimation period, or whether they have been adjusted to 60% gearing or not) the entire set of evidence is consistent with a beta estimate of 0.7.
 - b) In any event, it would not be enough to simply show that the international evidence spans the AER's estimate of 0.7. The AER would also have to consider the relative reliability of each piece of evidence. For example, consider the case where one piece of relatively unreliable evidence is less than 0.7 and the weight of more reliable evidence is materially above 0.7. In that case, it would be quite unreasonable to conclude that the international evidence is broadly consistent with the primary estimate of 0.7. Our point here is simply that it would be wrong to conclude that the international evidence is consistent with the primary estimate of 0.7 without any consideration of the relative reliability of each piece of evidence.
56. As a particular example of this last point, we note that the AER has treated the following two pieces of evidence symmetrically:
- a) The SFG (2013 Beta) study of 56 international comparators, selected by CEG (2013) on the basis of a detailed analysis of the activities of each firm, from which re-gearred beta estimates were compiled with reference to 11 years of historical returns (and which were computed using 20 different start days for computing four-weekly returns); and
 - b) The FTI raw beta estimates for three firms using one year of daily data, which was not relied upon by the regulator that commissioned it.

Evidence from the Black CAPM

AER's reasons

57. In its recent draft decisions, the AER states that its reasons for not using the Black CAPM to estimate the required return on equity for the benchmark efficient entity are as follows:

we remain of the view empirical estimate (sic) of the return on equity from the Black CAPM are not suitable for any use for the following key reasons:

- the model is not empirically reliable
- the model is not widely used to estimate the return on equity by equity investors, academics or regulators.⁴⁹

⁴⁹ Jemena Draft Decision, Attachment 3, p. 56.

58. We address both of the AER's reasons below.

Empirical reliability of the model

59. The AER explains why it considers the Black CAPM to be empirically unreliable as follows:

The empirical implementation of the Black CAPM model is unreliable because a) in contrast to the risk-free rate, the return on the zero beta asset is unobservable, and b) methods for estimating the zero-beta asset are unreliable.⁵⁰

60. That is, the AER considers the empirical implementation of the Black CAPM to be unreliable because the estimate of the zero-beta premium is unreliable. In turn, the AER appears to consider the estimate of the zero-beta premium to be unreliable because different approaches for estimating it produce different results. In this regard, the AER makes a point about differences between the CEG, NERA and SFG estimates of the zero-beta premium.⁵¹ Having considered the various estimates of the zero-beta premium, the AER concludes that:

While we consider SFG's latest estimate of the zero beta premium appears more plausible, we remain of the view that the large range of zero beta estimates by consultants for the NSPs indicates the model is unsuitable to use to estimate the RoE of our benchmark efficient entity.⁵²

61. Similarly, the AER notes that McKenzie and Partington (2014) conclude that:

...while the model might be used for estimating the RoE on the benchmark efficient entity, the problem is the model can be very sensitive to implementation choices.⁵³

62. That is, the evidence before the AER includes one estimation approach that produces what the AER considers to be a plausible estimate and other estimation approaches that produce what the AER considers to be implausible estimates. The AER concludes from this that the model should be rejected because different approaches for estimating this parameter produce different estimates.

63. In our view, such a conclusion does not logically follow. When faced with different approaches that produce different estimates of a parameter, the appropriate response is to consider the relative merits of each approach. The AER does not reject the SFG estimate because it considers the estimation approach to be inappropriate or because it considers the estimate to be implausible – it rejects the SFG estimate because there are other estimates that use different approaches that produce estimates that the AER considers to be implausible.

64. The AER's approach in this regard is also inconsistent with its approach to estimating Sharpe-Lintner CAPM parameters. There are a range of approaches that can be used to estimate beta and MRP that produce a wide range of estimates for each of those parameters. This does not lead the AER to conclude that the Sharpe-Lintner CAPM is empirically unreliable and should not be estimated. Rather, the AER presents its reasons for disregarding those techniques and estimates that it considers to be unreliable and its reasons for giving more weight to the approaches and estimates that it

⁵⁰ Jemena Draft Decision, Attachment 3, p. 182.

⁵¹ Jemena Draft Decision, Attachment 3, pp. 182-184.

⁵² Jemena Draft Decision, Attachment 3, p. 182.

⁵³ Jemena Draft Decision, Attachment 3, p. 182.

considers to be more reliable. It is not clear why precisely the same approach could not have been applied to the zero-beta premium.

65. It should also be noted that SFG (2014 Black) documented the very reason why its estimate of the zero beta premium was different to the other estimates of the zero beta premium. The other estimates of the zero-beta premium are affected by the empirical fact that stocks with a high book-to-market ratio for equity have historically earned high returns, and these stocks more often than not had low beta estimates. The SFG analysis was done in such a way that the high returns to high book-to-market stocks did not affect the estimate of the zero-beta premium.
66. This means that SFG was able to explain the context in which its estimate of the zero-beta premium would be relevant for estimating the cost of equity. The context is that the SFG estimate of the zero-beta premium accounts for the empirical fact that stocks with low beta estimates earn higher returns than those predicted by the Sharpe-Lintner CAPM, but in addition to this the cost of capital should account for the empirical fact that stocks with high book-to-market ratios earn higher returns than stocks with low book-to-market ratios.
67. The AER's consideration of the Black CAPM ignores this context. The AER rejected the use of the earlier estimates of the zero-beta premium because they were considered implausibly high. Then, the AER was presented with a clear statement of why the previous estimates were high, and a set of plausible estimates that address the reasons for the high initial estimates. According to the AER's rationale, the Black CAPM will never be relied upon to estimate the cost of equity because there was once some analysis conducted that led to high estimates for a parameter input.

Use of the Black CAPM in practice

68. The AER contends that the Black CAPM is not widely used in practice. Of course, this is not, of itself, a reason to disregard the model from further consideration. In any event, it is not clear that the use of the Black CAPM is as rare as the AER suggests. To see why this is the case, first note that the Sharpe-Lintner CAPM states that the required return on equity is given by:

$$r_e = r_f + \beta(r_m - r_f)$$

and the Black CAPM suggests that the required return on equity is given by:

$$r_e = r_z + \beta(r_m - r_z)$$

where r_z represents the sum of the risk-free rate and the zero beta premium.

69. That is, the structure of the formula is the same for both models and both models require the same estimates of the equity beta and the required return on the market. The only difference is whether one inserts an estimate of the contemporaneous risk-free rate (Sharpe-Lintner CAPM) or something greater than the contemporaneous risk-free rate (Black CAPM) as the intercept term.
70. In this regard, SFG (2013 IER) note that it is common for independent expert reports to adopt a risk-free rate in excess of the contemporaneous risk-free rate. The use of an intercept above the risk-free rate is more consistent with the Black CAPM. In this regard, Incenta (2015) conclude that:

■ The AER has asserted that independent experts apply a market risk premium to the 'spot' risk free rate. However, this masks the actual behaviour of independent experts, almost

90 per cent of which adjust the risk free rate and / or the market risk premium in response to changes in the risk free rate.⁵⁴

71. Moreover, it is common for U.S. regulatory cases to use what is known as “the empirical CAPM.” This is an implementation of the CAPM formula with an intercept above the contemporaneous risk free rate – to be consistent with the Black CAPM and the empirical evidence that supports it. The AER’s contention that the Black CAPM is not widely used in practice relies only on the label of the model, and not on its substance. It is common for practitioners to rely upon an estimate of the risk free rate in excess of the contemporaneous risk free rate, even if they do not label this analysis as the Black CAPM. For example, a leading textbook on US economic regulation refers to the “Empirical CAPM,” which is defined in precisely the same way as the Black CAPM,⁵⁵ noting that:

The ECAPM is a formal recognition that the observed risk-return tradeoff is flatter than predicted by the [Sharpe-Lintner] CAPM based on myriad empirical evidence.⁵⁶

Incorporation of Black CAPM evidence

72. The AER concludes that the Black CAPM is sufficiently relevant that it should be used to inform its estimation of the equity beta for use in the Sharpe-Lintner CAPM:

...we use the theoretical principles underpinning the Black CAPM to inform the equity beta point estimate from within our empirical range.⁵⁷

73. The AER goes on to explain that:

...for firms with an equity beta below 1.0, the Black CAPM may predict a higher return on equity than the SLCAPM. We consider this information points to the selection of an equity beta point estimate above the best empirical estimate implied from Henry's 2014 report. However, we do not consider the theory underlying the Black CAPM warrants a specific uplift or adjustment to the equity beta point estimate. The theory underlying the Black CAPM is qualitative in nature, and we are satisfied that this information is consistent with an equity beta point estimate towards the upper end of our range.⁵⁸

74. The Black CAPM (empirical relationship) is contrasted with the Sharpe-Lintner CAPM in Figure 2 below. Relative to the Sharpe-Lintner CAPM, the Black CAPM posits a higher required return on equity for low-beta stocks. This is consistent with the empirical evidence that returns for low-beta stocks are systematically higher than the Sharpe-Lintner CAPM would predict.

⁵⁴ Incenta (2015), p. 1.

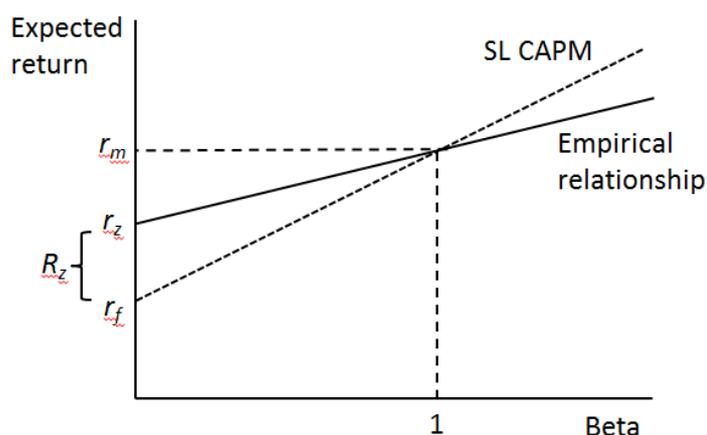
⁵⁵ Morin (2006), p. 189.

⁵⁶ Morin (2006), p. 191.

⁵⁷ Jemena Draft Decision, Attachment 3, p. 265.

⁵⁸ Jemena Draft Decision, Attachment 3, p. 269.

Figure 2. Sharpe-Lintner CAPM vs. empirical relationship.



75. The AER’s recent draft decisions contain detailed discussions about how the fact that it has given weight to the Black CAPM does not imply that it considers that the Sharpe-Lintner CAPM produces downwardly-biased estimates of the required return on equity for low-beta stocks.⁵⁹ In our view, the key point is not whether the AER’s acceptance of the Black CAPM amounts to a concession that the Sharpe-Lintner CAPM produces downwardly biased estimates of the required return on equity for low-beta stocks. Rather, the key point is that both versions of the CAPM are relevant financial models and the AER intends to have regard to both.
76. This leads to the question of *how* the AER intends to have regard to each of these relevant financial models. As set out above, both models are written in terms of the same beta and the same market return. The only difference is that for the Sharpe-Lintner CAPM the intercept is the risk-free rate, and for the Black CAPM the intercept is the zero-beta return. As set out in SFG (2014 Black), our view is that the proper way to have regard to these two financial models is to insert the best possible parameter estimates into each model. The result will then be estimates of the required return on equity from each model.
77. For example, SFG (2014 Black) estimates the zero beta premium to be 3.34%, which the AER describes as “plausible.” The Jemena Draft Decision⁶⁰ adopts a risk-free rate of 3.55% and a market risk premium of 6.5%, which jointly imply a market return of 10.05%. The zero-beta return is simply the sum of the risk-free rate and the zero-beta premium which, in this example, is 6.89%.⁶¹ Consequently the AER’s Sharpe-Lintner CAPM estimates can be combined with SFG’s “plausible” estimate of the zero-beta premium to parameterize the Black CAPM. At the lower end of the AER’s range for beta,⁶² we have:

$$\begin{aligned}
 r_e &= r_z + \beta(r_m - r_z) \\
 &= 6.89\% + 0.4(10.05\% - 6.89\%) = 8.2\%
 \end{aligned}$$

and at the upper end of the range for beta we have:

⁵⁹ Jemena Draft Decision, Attachment 3, pp. 266-267.

⁶⁰ By way of example.

⁶¹ 3.55%+3.34%.

⁶² We certainly do not accept that 0.4 is in any way a reasonable estimate of the levered equity beta for the benchmark efficient entity, but the purpose of this section is to consider the *process* of having regard to the Black CAPM evidence. We illustrate that process with reference to the AER’s own parameter estimates.

$$\begin{aligned} r_e &= r_z + \beta(r_m - r_z) \\ &= 6.89\% + 0.7(10.05\% - 6.89\%) = 9.1\%. \end{aligned}$$

78. That is, given the AER's estimates of the Sharpe-Lintner CAPM parameter estimates and the SFG estimate of the zero-beta premium, the Black CAPM evidence is that the required return on equity for the benchmark efficient entity is in the range of 8.2% to 9.1%. This evidence would then be compared with the AER's allowed return on equity of 8.1%.
79. By contrast, the AER has regard to the Black CAPM evidence in a quite convoluted manner. The AER's approach is to use the evidence that it considers to be relevant from the Black CAPM to adjust the equity beta that it uses in the Sharpe-Lintner CAPM. In this convoluted process, the AER considers the equity beta it would need to insert into the Sharpe-Lintner CAPM to have what it considers to be proper regard to the Black CAPM. This process is explained in Section 3 of SFG (2014 Black) and Appendix C to the AER's Guideline Explanatory Statement. In this regard, the AER is not being true to either model, both of which define beta in the same way and require an "unadjusted" estimate.
80. We can see no benefit whatsoever to this convoluted approach – relative to the simpler and correct approach of inserting the Black CAPM parameters into the Black CAPM formula and the Sharpe-Lintner CAPM parameters into the Sharpe-Lintner CAPM formula. In order to derive the adjusted equity beta (i.e., the beta that when inserted into the Sharpe-Lintner CAPM formula produces an estimate of the required return on equity that is consistent with the Black CAPM) one already needs to have an estimate of the cost of equity from the Black CAPM. We see no reason why that Black CAPM cost of equity estimate cannot be simply compared with the Sharpe-Lintner CAPM cost of equity estimate with both used to inform the final estimate of the required return on equity for the benchmark efficient entity.
81. In its recent draft decisions, the AER appears to be suggesting that by using "the theoretical principles underpinning the Black CAPM to inform the equity beta point estimate"⁶³ it is able to have regard to the Black CAPM without estimating its parameters. The Black CAPM, and the empirical evidence that motivated it, suggest that the Sharpe-Lintner CAPM systematically under-estimates the required return on equity for low-beta stocks. The AER indicates that it has used this qualitative information to increase its point estimate of beta.⁶⁴ But the AER provides no information about what it considers to be the required return (or adjusted beta) that is supported by the Black CAPM. The AER also provides no information about the relative weights that it has applied to the Sharpe-Lintner and Black CAPMs. The AER does not even report the amount by which it has increased its beta estimate in light of the Black CAPM evidence.
82. The AER reaches the conclusion that, based upon historical stock returns of nine Australian-listed firms (four of which are currently listed), its beta estimate lies within a range of 0.4 to 0.7 and that its selection of a point estimate of 0.7 at the top of the range is motivated by consideration of the Black CAPM and evidence from firms listed in other jurisdictions. The AER does not state which of these two considerations carries more weight, or what the beta estimate would be if only the Black CAPM was considered (and evidence from international listed stocks ignored) or if only evidence from international listed stocks was included (and the Black CAPM ignored).
83. This means that the AER has essentially computed an unspecified estimate of the zero beta premium, on the basis of the equity beta range compiled from Australian-listed stocks. And the AER has given unspecified consideration to beta estimates compiled from stocks listed in other countries. There is

⁶³ Jemena Draft Decision, Attachment 3, p. 265.

⁶⁴ Jemena Draft Decision, Attachment 3, p. 266.

no reason why the most reasonable estimate of the zero beta return should depend upon the AER's assessment of the beta estimates from a small sample of Australian-listed firms. Further, there is no reason why the AER cannot specify what the separate impact of the Black CAPM and the evidence from international listed firms has on its cost of equity estimate. These are two distinct types of relevant information, yet they are bundled together by the AER in a manner that means no inference can be drawn as to how much consideration was given to either set of information.

84. We agree that it is open to the AER to have regard to evidence from the Sharpe-Lintner CAPM. We also agree that it is open to the AER to have regard to evidence from the Black CAPM. We also agree that it is open to the AER to give different weight to different pieces of evidence. However, if the AER is to have regard to evidence from the Black CAPM, then it should be transparent about what it considers that evidence to be. This requires nothing more than setting out what the AER considers to be the required return (or adjusted beta) that is supported by the Black CAPM. If the AER does not accept the SFG estimate of the zero-beta premium, then it should state why (rather than simply noting that there are other estimates of the zero-beta premium that it considers to be implausible), and set out what it considers to be a more reasonable estimate of the zero-beta premium. At the very least, the AER should report the effect that its consideration of the Black CAPM evidence has had on its calculation of the allowed return on equity. In its recent draft decisions there is no way for stakeholders to determine (a) what return on equity (or beta) the AER considers to be supported by the Black CAPM or evidence, or (b) what weight the AER has applied to the Black CAPM evidence. Consequently, there is no means for determining whether the AER's interpretation of the Black CAPM evidence is reasonable, or whether the weight the AER has applied to it is reasonable, or even whether the AER has applied any weight to it at all.

Other regulatory considerations

85. In its 2009 WACC Review, the AER selected a final equity beta estimate from outside its 0.41 to 0.68 range on the basis of regulatory stability and the asymmetry of the risks of over- and under-investment:

Market data suggests a value lower than 0.8. However, the AER has given consideration to other factors, such as the need to achieve an outcome that is consistent with the NEO (in particular the need for the efficient investment in electricity services for the long term interests of consumers of electricity), the revenue and pricing principles (in particular providing the service providers with a reasonable opportunity to recover at least efficient costs, providing service providers with efficient incentives for efficient investment, and having regard to the economic costs and risks of the potential for under and over investment), the importance of regulatory stability. Having taken a broad view, the AER considers the value of 0.8 is appropriate.⁶⁵

86. There have been no changes to the NEO (or NGO) or Revenue and Pricing Principles since the 2009 WACC Review. Consequently, the regulatory considerations that led the AER to select a point estimate of 0.8, above the top of its primary range, continue to apply. However, the AER's recent draft decisions make no mention at all of these regulatory considerations and conclude that the point estimate of 0.7 is justified on the basis of the evidence set out above. It seems likely that these considerations alone would have been sufficient to justify a point estimate of at least 0.7 – even before consideration of the expanded evidence of international comparators and the theoretical underpinnings of the Black CAPM.

⁶⁵ AER 2009 WACC Review Final Decision, p. xvii.

87. If the AER no longer has regard to these regulatory considerations it should explain why. For example, if the AER considers that these consideration are no longer relevant under the new Rules, that should be clearly stated. If consideration has been given to them, the AER should explain how they have impacted upon its beta estimate. Over the last 10 years, the AER appears to have placed progressively more reliance on the statistical estimates from domestic comparators that, in our view, is not warranted given the ongoing concerns about the reliability of those estimates.

Prior evidence submitted to the AER

88. In prior reports to the AER, we have applied the following specific parameter estimates and assumptions relating to beta and the Black CAPM:

- a) We estimated beta from a sample of nine Australian listed firms at 0.58 on the basis of returns from 2002 to 2014, and accounting for leverage of 60%.⁶⁶
- b) We estimated beta from a sample of 56 U.S. listed firms at 0.90 on the basis of returns from 2002 to 2014, and accounting for leverage of 60%.⁶⁷
- c) We estimated the zero beta premium at 3.34% on the basis of the relationship between portfolio returns and portfolio beta estimates from 1994 to 2014.⁶⁸

89. We had regard to this evidence in a holistic manner by:

- a) Giving more relative consideration to beta estimates from U.S. listed stocks compared to Australian listed stocks (because there is a much bigger sample of U.S. listed stocks, offset by allocating double the weight to an observation for an Australian listed stock compared to a U.S. listed stock); and
- b) Giving more consideration to the Black CAPM compared to the Sharpe-Lintner CAPM because the empirical estimation of the zero-beta premium provides a better empirical association between actual returns and expected returns that account for systematic risk.⁶⁹

90. The beta estimate of 0.90 for U.S. listed stocks is 0.20 above the AER's upper bound for the beta range derived on the basis of Australian listed stocks. Yet the AER has determined that this mean empirical beta estimate does not represent sufficiently persuasive evidence to allow the AER to adjust the bounds of its primary range for beta estimates. The AER was not persuaded by our analysis of U.S.-listed firms for two reasons. We only considered stocks listed in the U.S., and the AER considers stocks listed in other countries to be relevant as well.⁷⁰ The AER also considers that the beta estimates from our sample of U.S.-listed firms could be too high because the sample has more vertically integrated firms than another sample of 18 firms considered to be "almost exclusively electricity and/or gas distribution businesses."⁷¹

⁶⁶ The figure of 0.58 is an average of the mean beta estimate for individual listed firms of 0.60 and the beta estimate from an equal-weighted index of 0.55.

⁶⁷ The figure of 0.90 is an average of the mean beta estimate for individual listed firms of 0.88 and the beta estimate from an equal-weighted index of 0.91.

⁶⁸ Portfolios have been constructed to have approximately equal composition of stocks in terms of industry, market capitalisation and book-to-market ratio in order to specifically identify the relationship between beta estimates and returns, uncontaminated by the influence of industry, size and book-to-market ratio.

⁶⁹ The analysis does not account for the empirical evidence that stocks with high book-to-market ratios earn higher returns than stocks with low book-to-market ratios. That empirical evidence is considered in a separate report related to the Fama-French Model.

⁷⁰ Jemena Draft Determination, Attachment 3, Sub-section D.3, p. 265.

⁷¹ Jemena Draft Determination, Attachment 3, Sub-section D.1.3, p. 241.

91. Given the AER's concerns about sample composition, the AER could have adopted two alternative approaches to the evidence before it. One approach would have been to say that the beta estimate could be as high as 0.90 on the basis of the evidence from U.S.-listed firms, and revise the range for beta estimates. Then determine a beta estimate that lies somewhere from 0.58 to 0.90 on the basis of considerations of relevance and reliability of the sample. This was our approach. Another approach is to say that beta remains bounded above at 0.7, despite a sample of 56 listed energy networks having a mean beta estimate of 0.90. This latter approach is adopted by the AER. There is no change to the upper bound of the AER's range because the AER has not been persuaded to depart from its view formed in the first stage of its analysis.

92. Now consider the Black CAPM. For the purposes of this report we use a current estimate of the risk free rate of 2.64%,⁷² the AER's 6.50%⁷³ estimate of the market risk premium, and our 3.34% estimate of the zero beta premium. If we were to incorporate the impact of the Black CAPM on the cost of equity into the beta component of the Sharpe-Lintner CAPM, as the AER has done *and rely exclusively on beta estimates for Australian-listed stocks*, we would have a beta estimate of 0.80. This is computed as follows.

$$\begin{aligned}
 \text{a) Cost of equity} &= \text{Zero beta return} + \text{Beta} \times (\text{Expected market return} - \text{Zero beta return}) \\
 &= (\text{Risk free rate} + \text{Zero beta premium}) + \text{Beta} \times (\text{Market risk premium} - \text{Zero beta premium}) \\
 &= (2.64\% + 3.34\%) + 0.58 \times (6.50\% - 3.34\%) \\
 &= 5.98\% + 0.58 \times 3.16\% \\
 &= 5.98\% + 1.83\% \\
 &= 7.80\%.
 \end{aligned}$$

$$\begin{aligned}
 \text{b) Implied Sharpe-Lintner beta} &= (\text{Cost of equity} - \text{Risk free rate}) \div \text{Market risk premium} \\
 &= (7.80\% - 2.64\%) \div 6.50\% \\
 &= 5.16\% \div 6.50\% \\
 &= 0.79.
 \end{aligned}$$

93. If we repeat the computations above using the risk free rate of 3.55% adopted by the AER, the cost of equity from the Black CAPM would be 8.71% but the implied beta estimate for the Sharpe-Lintner CAPM would still be 0.79. If we were to repeat the analysis using an initial beta estimate of 0.5, which the AER states is its estimate of beta based entirely upon the analysis of Australian-listed stocks, the implied beta that gives the same cost of equity as the Black CAPM would be 0.76.⁷⁴

94. The AER was not persuaded to adopt any direct estimate of the cost of equity from the Black CAPM, but decided that the model only had relevance for selection of the point estimate of beta from within the AER's initial range. The AER was not persuaded to adjust its initial estimate of the upper bound for beta. The AER is concerned that making a direct estimate of the cost of equity from the Black CAPM is not appropriate because of imprecision in the estimate of the zero-beta premium.

95. Our view is that the AER's concern with imprecision does not imply that an appropriate way to deal with imprecision is to constrain the upper bound of beta to a figure of 0.7. According to our estimate

⁷² This is the annualised yield on 10 year government bonds for the month of January, based upon the average yield over the month reported by the Reserve Bank of Australia.

⁷³ Jemena Draft Determination, Attachment 3, Sub-section 3.1, Table 3-1, p. 10. We do not endorse the AER's 6.50% estimate of the market risk premium. But we want our analysis in this report to be unaffected by any disagreement over estimates of the market risk premium. In a separate report we discuss estimation of the market risk premium.

⁷⁴ Cost of equity = (2.64% + 3.34%) + 0.50 × (6.50% - 3.34%) = 7.56%. implied Sharpe-Lintner beta = (7.56% - 2.64%) ÷ 6.50% = 0.76.

of the zero-beta premium the implied beta estimate for the AER's implementation of the Sharpe-Lintner CAPM is 0.80.⁷⁵ Our estimate of the zero beta premium relies upon a sample of all Australian-listed stocks with at least a ten year returns history over a 20 year period ending in 2014. And we ensured that the key stock characteristics likely to affect returns – industry, size and book-to-market ratio – did not distort the results.

96. Yet the evidence is not persuasive enough for the AER to revise its upper bound to the range for beta, with the rationale that the analysis is not sufficiently precise. As mentioned above, there is an important reason that the zero-beta premium estimate is imprecise – beta estimates compiled from a regression of stock returns on market returns have a very weak association with realised stock returns. So the imprecision in the estimate of the zero-beta premium implies that we should give *less* credence to the AER's initial beta range, not more. If the Sharpe-Lintner CAPM, populated with regression-based estimates of beta was very useful in explaining stock returns, the zero-beta premium would be closer to zero and estimated with more precision.
97. The key point is that the AER's consideration of the evidence on the Black CAPM does not allow this evidence to be fully reflected in its estimate of the cost of equity. The implication of the zero-beta premium evidence available to the AER is that the implied beta estimate for the Sharpe-Lintner CAPM lies above 0.7. Yet there is a binding constraint on the impact that this evidence can have in setting the cost of capital. The maximum beta estimate that the AER can adopt is 0.7.
98. Suppose we consider the implications of this evidence together. The AER has available to it a beta estimate of 0.90 from a sample of 56 U.S.-listed stocks. It also has available to it an estimate of the zero-beta premium using all Australian-listed firms with available data over 20 years that leads to an implied beta estimate of 0.79.⁷⁶ If the sample of U.S.-listed firms was considered together with the estimate of the zero-beta premium, the implied beta estimate for the Sharpe-Lintner CAPM would be 0.95.⁷⁷
99. However, the aggregate interpretation of this evidence remains that the beta estimate cannot be higher than 0.7. The AER does not disclose what relative impact its consideration of the Black CAPM and international listed firms had in maintaining the upper bound. The AER simply writes down that it does not consider a change to the AER's initial range is warranted. Our contention is that the AER's process for having regard to evidence does not allow it to achieve the rate of return objective of estimating the return commensurate with the cost of funds. There is no mechanism whereby all relevant information will be reflected in the AER's estimate of the cost of equity.

The best way to have regard to the relevant evidence

100. We agree with the AER that the Sharpe-Lintner CAPM and the Black CAPM are relevant financial models that should be considered. We also agree that equity beta estimates from domestic comparators and international comparators are relevant evidence that should be considered. However, we disagree with the *way* the AER proposes to have regard to this evidence. The AER's process determines the Sharpe-Lintner CAPM to be the primary model and the domestic comparators to be the primary evidence for beta. The other evidence is disregarded to the extent that it is inconsistent with this primary evidence.
101. Our approach is to set out all relevant financial models, estimate each of them, consider their relative strengths and weaknesses and to assign weight to each accordingly. We apply the same approach to

⁷⁵ It is worth reiterating that this figure of 0.80 ignores any consideration of beta estimates from firms listed in other markets.

⁷⁶ Or an implied beta estimate of 0.76 if the AER's 0.5 beta estimate is used as a starting point.

⁷⁷ Cost of equity = (2.64% + 3.34%) + 0.90 × (6.50% - 3.34%) = 8.81%. Implied Sharpe-Lintner beta = (8.81% - 2.64%) ÷ 6.50% = 0.95.

individual parameter estimates – we set out all relevant evidence, consider the relative strengths and weaknesses of each piece of evidence, and assign weight to each accordingly. We consider this approach to be straightforward and transparent and reasoned. We also consider that it allows each piece of relevant evidence to have an effect that is consistent with its quality. Our approach is consistent with our understanding of the requirements of the Rules.

102. Consequently:

- a) We separately estimate the Sharpe-Lintner CAPM and the Black CAPM, obtaining from each model an estimate of the required return on equity for the benchmark efficient firm. We then assign weight to each estimate commensurate with our assessment of the relative strengths and weaknesses of each. We do not use the “theoretical underpinnings of the Black CAPM” to adjust our estimate of beta. We estimate beta using standard accepted techniques for estimating beta and we use that beta estimate, as appropriate, separately in the Sharpe-Lintner CAPM and Black CAPM.
- b) We estimate equity beta by having regard to the domestic comparators and the international comparators, weighting each domestic comparator twice as much as each international comparator due to the higher level of comparability.⁷⁸ We do not use the very small set of domestic comparators to constrain the range of final estimates.

⁷⁸ See the discussion on this point below, and in SFG (2014 Beta).

4. Estimates of beta

Introduction

103. In this section we provide parameter estimates for beta and discuss the implications for the cost of equity using the Sharpe-Lintner CAPM and the Black CAPM.⁷⁹ As discussed above there is general agreement between the AER and us that empirical beta estimates from historical stock and market returns are relevant, for listed energy networks from Australia and other countries. There is also general agreement that, all else being equal, for stocks with beta estimates below one, the cost of equity should lie above what is implied by incorporating regression-based estimates of beta into the Sharpe-Lintner CAPM. This is the directional implication of the Black CAPM. We begin with consideration of beta estimates for Australian-listed firms, then consideration of firms listed in other markets, and follow with discussion of implications of the Black CAPM.

Estimation procedures and sample

Estimation procedures

104. In its recent draft determinations the AER referred to beta estimates compiled by Henry (2014) for Australian-listed energy networks. In drawing primary conclusions, Henry refers to beta estimates from weekly returns, computed on a continuously-compounded basis and Henry does not include an estimate of the risk free rate in the regression analysis. Henry reports beta estimates for individual firms as well as beta estimates for portfolios.

105. We have reported our equity beta estimates in previous reports to the AER, SFG (2013 Beta) and SFG (2014 Beta). Those reports set out the data sources and empirical estimation process that we employed, as well as a set of final estimates.

106. Our analysis differs from Henry's analysis in the following ways.

- a) **Start day for weekly returns.** Henry (2014) compiles returns on the basis of Friday to Friday returns. We have previously submitted to the AER that beta estimates can vary by a material amount simply on the basis of the start day for computing returns. So the beta estimates can vary depending upon whether Wednesday to Wednesday returns are used, or Thursday to Thursday returns are used, and so on. A simple way to mitigate estimation error is simply to repeat the analysis five times and take an average of the results.

In its draft determinations the AER rejected the contention that this is an appropriate estimation technique. The AER suggests that the differences in beta estimates from different start days might not be statistically significant,⁸⁰ that if we extend the argument we would need to repeat the analysis using different points in time during the day rather than just referring to closing prices,⁸¹ and that using Friday to Friday returns is common practice.⁸²

The AER states that it has no reason to think a beta estimate computed using any particular start point in the week will under-estimate or over-estimate equity beta. But the beta

⁷⁹ We consider that the best estimate of the cost of equity will result from also including cost of equity estimates from the Fama-French Model and the dividend discount model. But consideration of these models is considered in separate reports. In the current report we only consider the implications of the Sharpe-Lintner CAPM and the Black CAPM.

⁸⁰ Jemena Draft Determination, Sub-section D.2.2, p. 3-252.

⁸¹ Jemena Draft Determination, Sub-section D.2.2, p. 3-252.

⁸² Jemena Draft Determination, Sub-section D.2.2, p. 3-253.

estimates *do* vary depending upon the start day used in computations, and there is no reason to think that we will have a better estimate of beta if we just use Friday to Friday returns instead of an average from repeating the analysis five times.

As a specific illustration, for our sample of nine Australian-listed firms, the mean beta estimate on an individual firm basis, adjusted for leverage of 60%, is 0.55 if we use Friday to Friday returns, and is 0.62 if we use Tuesday to Tuesday returns. If we take an average across all five beta estimates we have a beta estimate of 0.59. We submit that the average beta estimate of 0.59 is more precise and more reliable than an estimate that is based exclusively on Friday to Friday returns, and our computation can be performed in a matter of minutes.

We have previously noted that this issue also applies to the Henry (2008) and Henry (2009) analyses of domestic and international comparators – the estimates would be higher if one simply averaged over the different days of the week.⁸³

- b) **Portfolio analysis.** In the report prepared by Henry (2014) portfolios are formed in which all stock returns are available for all stocks in the portfolio for each week. For example, the portfolio P1 comprises two stocks (APA and ENV)⁸⁴ which both have returns available over the period 16 June 2000 to 28 June 2013; the portfolio P2 comprises five stocks (AAN, AGL, APA, ENV and GAS)⁸⁵ which all have returns available over the period 21 December 2001 to 6 December 2006; and so on. These portfolios are what Henry (2014) calls *fixed portfolios* because the stocks in the portfolios do not change over the estimation period.

Another way to think about portfolio composition is to consider portfolios which comprise different stocks at different points in time. This is what Henry (2014) calls *time varying portfolios*. For example, in the longest dated time varying portfolio considered by Henry, there are two stocks in the portfolio for the first three years (APA and ENV), three stocks in the portfolio for the next four months (AGL, APA and ENV)⁸⁶ and so on.⁸⁷

Henry (2014) does not believe it is appropriate to interpret the beta estimates from the time varying portfolios going so far as to state that “no reliable evidence about the value of beta”⁸⁸ can be obtained from analysis of these portfolios. The reason for Henry’s reluctance to interpret beta estimates from time-varying portfolios is important. Henry was concerned that changing portfolio weights from one sub-period to another leads to a large amount of estimation error in the beta estimate. He goes so far as to identify a problem with “structural instability” in the estimates of beta from the time varying portfolios.⁸⁹

In other words, Henry considers that adding or dropping stocks from the portfolios over time leads to serious distortions on the beta estimates computed from those portfolios. But this will only happen if the stocks within those portfolios actually have different levels of systematic risk. If we construct a pool of stocks that have the same level of systematic risk, and randomly put stocks into a portfolio each week (allowing the number of stocks to increase or decrease by any amount) the beta estimate for that portfolio will not be distorted by time varying portfolio weights. The return on each stock will be determined by the risk

⁸³ SFG (2014 Beta), pp. 29-31.

⁸⁴ Neither of which are currently listed.

⁸⁵ Only APA remains listed today.

⁸⁶ Only APA remains listed today.

⁸⁷ Henry (2014), Sub-section 3.5, Table 25, p. 53.

⁸⁸ Henry (2014), Sub-section 3.6, p. 59.

⁸⁹ Henry (2014), Sub-section 3.6, pp. 57 and 58.

free rate, its beta, the market return, and noise due to events uncorrelated with the market. It doesn't matter whether we have 10 stocks in the portfolio one week, and five stocks in the portfolio in another week, we would expect the beta estimate to be the unaffected because on *average* the portfolio returns will be determined by the stocks' beta and the market return.

The only reason the time varying weights will lead to distortions in the portfolio beta estimate is if the stocks actually have different levels of systematic risk. Then the portfolio's systematic risk and non-systematic risk varies over time purely due to sample composition.

This means that Henry's concerns over the interpretation of the results from time-varying portfolios mirror our concerns over the reliability of beta estimates for estimating the cost of equity. If the true risk of comparable firms was the same, and regressions of stock returns on market returns is a useful measure of that risk, then the number of stocks in the portfolio at each point in time does not matter. The implication of Henry's commentary is that the true risk of comparable firms might not be the same and regressions of stock returns on market returns might not provide reliable estimates of risk. This is a particular problem for the very small set of domestic comparators, especially where one includes data that is more than 10-years old because the "portfolios" include only one or two stocks.

- c) **Vasicek adjustment.** We incorporate the Vasicek adjustment into our beta estimates, which has a minor positive impact on our overall conclusion of just 0.01. The Vasicek adjustment has been considered extensively in prior submissions to the AER, and in the AER's response to those submissions. Our view is that this adjustment is simply a correction for statistical bias in regression-based estimates of beta. The length of the estimation period now under consideration is so long that the adjustment is small. But we maintain that this small adjustment provides a more reliable beta estimate, and over shorter estimation periods will be more relevant. The AER disagrees on the basis that we do not observe mean reversion in beta estimates on stocks that have been used in submissions to the AER, and that there is no reason to adjust the regression based estimate to any particular prior expectation. This is one area in which we will continue to disagree and we report beta estimates using the Vasicek adjustment.

Results

Beta estimates

107. In Table 2 we summarise beta estimates from our two samples, nine Australian listed firms and 56 firms listed in the United States. The beta estimates have been adjusted to reflect 60% gearing. The results in the "Combined" column are based upon applying twice as much weight to an Australian listed firm, which means that the Australian sample is assigned 21% weight and the rest of the world is assigned 79% weight.⁹⁰ The reasons for this approach, and all other details of our estimation approach, are set out in SFG (2013 Beta). The table presents 95% confidence intervals in brackets.

⁹⁰ $(9 \times 2) \div [(9 \times 2) + 68] = 18 \div 86 = 21\%$

Table 2. Summary of beta estimates

	Australia	International	Combined
Mean estimate from individual firms	0.60 (0.37 to 0.83)	0.88 (0.82 to 0.93)	0.81
Estimate from an equal-weighted index	0.55 (0.39 to 0.70)	0.91 (0.80 to 1.03)	0.82
Average from firms and index analysis	0.58	0.90	0.82

Figures in parentheses are 95% confidence intervals.

108. Our conclusion is that the best estimate of equity beta for the benchmark efficient entity, as defined in the CAPM, is 0.82. This is an estimate of the “pure” equity beta defined as the covariance between stock returns and market returns divided by the variance of market returns. It does not reflect any adjustment for any low-beta bias, or for the theoretical underpinnings of the Black CAPM, or for any value premium under the Fama-French model.
109. The equity beta is defined in the same way and represents the same thing in the Sharpe-Lintner CAPM and the Black CAPM. For the reasons set out above, and in our previous reports, our preferred estimate for the equity beta is 0.82. Our approach is to use that estimate in the Sharpe-Lintner and Black models.

The zero-beta premium

110. Relative to the Sharpe-Lintner model, the Black model requires the estimation of one additional parameter, the zero-beta premium. We have set out our approach to estimating the zero beta premium in our previous report, SFG (2014 Black). Our preferred estimate for that parameter is 3.34% and the AER has stated that this estimate is “plausible.”⁹¹ Since the AER has not provided any alternative estimate, we adopt an estimate of 3.34% for the remainder of this report.

The implications of the Black CAPM

111. We now consider the cost of equity implied by the Black CAPM. In the table below we report the cost of equity from the Black CAPM, and the implied beta estimate that would result in the same cost of equity if the Sharpe-Lintner CAPM was adopted. In computations we assume a risk free rate of 2.64%, zero beta premium of 3.34% and market risk premium of 6.5%.⁹²

⁹¹ Jemena Draft Decision, Attachment 3, p. 182.

⁹² We do not endorse the use of 6.5% as the market risk premium and discuss what we consider to be an appropriate estimate of the market risk premium in SFG (2015 ROE). We use 6.5% as the market risk premium assumption in this instance because we want to focus on the issues of beta and the Black CAPM, rather than have the analysis confounded by debate over the market risk premium. So we use the AER’s 6.5% estimate of the market risk premium here.

Table 3. Black CAPM cost of equity estimates

	Australia	International	Combined
Cost of equity			
Mean estimate from individual firms	7.88%	8.76%	8.55%
Estimate from an equal-weighted index	7.72%	8.86%	8.58%
Average from firms and index analysis	7.80%	8.81%	8.56%
Beta in the Sharpe-Lintner CAPM that gives the same cost of equity as that from the Black CAPM			
Mean estimate from individual firms	0.81	0.94	0.91
Estimate from an equal-weighted index	0.78	0.96	0.91
Average from firms and index analysis	0.79	0.95	0.91

112. Our conclusion is that application of the Black CAPM implies a cost of equity of 8.56% (using the AER's 6.5% estimate for MRP),⁹³ which is the combined sample result in the right hand column. To achieve the same cost of equity estimate using the Sharpe-Lintner CAPM would require a beta estimate of 0.91, which appears in the bottom right hand corner of the table. That is, there is an equivalence between the required return on equity estimated by:

- a) Inserting an equity beta of 0.91 into the Sharpe-Lintner CAPM; and
- b) Inserting our preferred beta estimate of 0.82 into the Black CAPM.

113. All of the implied beta estimates in the lower portion of Table 3 are materially above 0.7. This runs contrary to the AER's view that the implied beta estimate *cannot* lie above 0.7, on the basis of the AER's analysis of Australian-listed stocks.

Results conclusion

114. We agree with the AER that the Sharpe-Lintner CAPM and the Black CAPM are both relevant financial models for the purposes of determining the allowed return on equity. Our preferred approach is that both of these models should be estimated in a way that is true to the model. Having obtained estimates of the required return on equity from each of the models, we then set out our views about the relevant strengths and weaknesses of each estimate and we assign weight to each accordingly.⁹⁴

115. The equity beta is defined in the same way and represents the same thing in these two models. For the reasons set out above, and in our previous reports, our preferred estimate for the equity beta is 0.82. Our approach is to use that estimate in the Sharpe-Lintner and Black models.

116. The AER's approach is very different. The AER estimates the required return on equity for the benchmark efficient entity by inserting one set of parameter estimates into the Sharpe-Lintner formula. No other relevant financial models are estimated for the purposes of determining the required return on the benchmark efficient entity. The AER states that it has regard to the (relevant) Black CAPM by adjusting the beta parameter that it inserts into the Sharpe formula. In our view, if that approach is to be followed, a beta of 0.91 would have to be used to be consistent with the 3.34% estimate of the zero-beta premium that the AER considers to be "plausible."⁹⁵

⁹³ Cost of equity = $(0.0264 + 0.0334) + 0.82 \times (0.0650 - 0.0334) = 8.56\%$.

⁹⁴ See our companion report, SFG (2015 ROE).

⁹⁵ Jemena Draft Decision, Attachment 3, p. 182.

117. By contrast, the AER uses a beta estimate of 0.7. The AER does not state that its beta estimate of 0.7 is consistent with any particular estimate of the zero-beta premium parameter, but rather that it is consistent with the “theoretical principles underpinning”⁹⁶ the Black CAPM.
118. We discuss the strengths and weaknesses of our approach relative to the AER’s approach in detail in our companion report, SFG (2015 ROE).

⁹⁶ Jemena Draft Decision, Attachment 3, p. 265.

5. Summary and conclusions

120. We maintain the view that the best estimate of the cost of equity for a benchmark energy network can be determined as a weighted average of the cost of equity from several models, namely the Sharpe-Lintner CAPM, the Black CAPM, the Fama-French Model and the dividend discount model. We explain this point in more detail in our companion report (SFG (2015 ROE)).
121. Given that the Sharpe-Lintner CAPM and the Black CAPM are both relevant financial models for the purposes of determining the allowed return on equity, our preferred approach is that both of these models should be estimated in a way that is true to the model. Having obtained estimates of the required return on equity from each of the models, we then set out our views about the relevant strengths and weaknesses of each estimate and we assign weight to each accordingly.
122. Given that domestic and international evidence is considered to be relevant, both data sources should be used to produce beta estimates. Having done that, one should then consider the relative strengths and weaknesses when determining the relative weight that should be assigned to each. In our view, the AER's approach of using the very small sample of domestic comparators to fix boundaries for the final equity beta estimate even before the other relevant evidence is considered serves to neutralise that other relevant evidence, reducing the quality of the resulting estimate.
123. For the reasons set out in this report, we consider that:
- a) The best available estimate of the equity beta of the efficient benchmark entity is 0.82, and this same estimate should be used in the Sharpe-Lintner CAPM and in the Black CAPM, both of which define beta in the same way;
 - b) The best available estimate of the zero-beta premium is 3.34%, and this should be used when estimating the Black CAPM; and
 - c) If it is determined that the Sharpe-Lintner CAPM must be parameterised in a way that reflects the evidence from the Black CAPM, an equity beta of 0.91 should be used.

6. Declaration

124. We confirm that we have made all the inquiries that we believe are desirable and appropriate and no matters of significance that we regard as relevant have, to our knowledge, been withheld from the Court.



Professor Stephen Gray.



Dr Jason Hall.

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Appendix 1: Instructions



Expert Terms of Reference

Applying the and Sharpe-Lintner and Black CAPM sin Australia, update

**Jemena Gas Networks
2015-20 Access Arrangement Review**

AA15-570-0062

Version D – 12 February 2015

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1 Background

Jemena Gas Networks (**JGN**) is the major gas distribution service provider in New South Wales (**NSW**). JGN owns more than 25,000 kilometres of natural gas distribution system, delivering approximately 100 petajoules of natural gas to over one million homes, businesses and large industrial consumers across NSW.

JGN submitted its revised Access Arrangement proposal (**proposal**) with supporting information for the consideration of the Australian Energy Regulator (**AER**) on 30 June 2014. The revised access arrangement will cover the period 1 July 2015 to 30 June 2020 (July to June financial years). The AER published its draft decision on this proposal on 27 November 2014. JGN must submit any additions or other amendments to its proposal by 27 February 2015.

As with all of its economic regulatory functions and powers, when assessing JGN's revised Access Arrangement under the National Gas Rules and the National Gas Law, the AER is required to do so in a manner that will or is likely to contribute to the achievement of the National Gas Objective, which is:

“to promote efficient investment in, and efficient operation and use of, natural gas services for the long term interests of consumers of natural gas with respect to price, quality, safety, reliability and security of supply of natural gas.”

For electricity networks, the AER must assess regulatory proposals under the National Electricity Rules and the National Electricity Law in a manner that will or is likely to achieve the National Electricity Objective, as stated in section 7 of the National Electricity Law.

Where there are two or more possible decisions in relation to JGN's revised Access Arrangement that will or are likely to contribute to the achievement of the National Gas Objective, the AER is required to make the decision that the AER is satisfied will or is likely to contribute to the achievement of the National Gas Objective to the greatest degree.

The AER must also take into account the revenue and pricing principles in section 24 of the National Gas Law and section 7A of the National Electricity Law, when exercising a discretion related to reference tariffs. The revenue and pricing principles include the following:

“(2) A service provider should be provided with a reasonable opportunity to recover at least the efficient costs the service provider incurs in—

- a) providing reference services; and
- b) complying with a regulatory obligation or requirement or making a regulatory payment.

(3) A service provider should be provided with effective incentives in order to promote economic efficiency with respect to reference services the service provider provides. The economic efficiency that should be promoted includes—

- (a) efficient investment in, or in connection with, a pipeline with which the service provider provides reference services...



[...]

(5) A reference tariff should allow for a return commensurate with the regulatory and commercial risks involved in providing the reference service to which that tariff relates.

(6) Regard should be had to the economic costs and risks of the potential for under and over investment by a service provider in a pipeline with which the service provider provides pipeline services.”

Some of the key rules that are relevant to an access arrangement and its assessment are set out below.

Rule 74 of the National Gas Rules, relating generally to forecasts and estimates, states:

- (1) Information in the nature of a forecast or estimate must be supported by a statement of the basis of the forecast or estimate.
- (2) A forecast or estimate:
 - (a) must be arrived at on a reasonable basis; and
 - (b) must represent the best forecast or estimate possible in the circumstances.

Rule 87 of the National Gas Rules, relating to the allowed rate of return, states:

- (1) Subject to rule 82(3), the return on the projected capital base for each regulatory year of the access arrangement period is to be calculated by applying a rate of return that is determined in accordance with this rule 87 (the allowed rate of return).
- (2) The allowed rate of return is to be determined such that it achieves the allowed rate of return objective.
- (3) The allowed rate of return objective is that the rate of return for a service provider is to be commensurate with the efficient financing costs of a benchmark efficient entity with a similar degree of risk as that which applies to the service provider in respect of the provision of reference services (the allowed rate of return objective).
- (4) Subject to subrule (2), the allowed rate of return for a regulatory year is to be:
 - (a) a weighted average of the return on equity for the access arrangement period in which that regulatory year occurs (as estimated under subrule (6)) and the return on debt for that regulatory year (as estimated under subrule (8)); and
 - (b) determined on a nominal vanilla basis that is consistent with the estimate of the value of imputation credits referred to in rule 87A.
- (5) In determining the allowed rate of return, regard must be had to:
 - (a) relevant estimation methods, financial models, market data and other evidence;

- (b) the desirability of using an approach that leads to the consistent application of any estimates of financial parameters that are relevant to the estimates of, and that are common to, the return on equity and the return on debt; and
- (c) any interrelationships between estimates of financial parameters that are relevant to the estimates of the return on equity and the return on debt.

Return on equity

- (6) The return on equity for an access arrangement period is to be estimated such that it contributes to the achievement of the allowed rate of return objective.
- (7) In estimating the return on equity under subrule (6), regard must be had to the prevailing conditions in the market for equity funds.

[Subrules (8)–(19) omitted].

The equivalent National Electricity Rules are in clauses 6A.6.2 (for electricity transmission) and 6.5.2 (for electricity distribution).

In its proposal, JGN submitted expert reports of SFG (the **Earlier Reports**), as a suitable qualified independent expert (**Expert**), on the equity beta to be applied in the Sharpe-Lintner CAPM and on the theory of the Black CAPM and the use of it to estimate a return on equity that complies with the requirements of the National Gas Law and Rules and National Electricity Law and Rules, including as highlighted above.¹ The AER draft decision considered these expert reports.

In this context, JGN seeks a further report from SFG that reviews and, where appropriate, responds to matters raised in the draft decision on equity beta and on the use of the Black CAPM as a relevant estimation method, financial model or other evidence in determining the allowed rate of return, and which provides an estimate of the cost of equity from the Sharpe-Lintner CAPM and Black CAPM. JGN seeks this expert report on behalf of itself, Jemena Electricity Networks, ActewAGL, Ausgrid, Ausnet Services, Australian Gas Networks, CitiPower, Endeavour Energy, Energex, Ergon, Essential Energy, Powercor, SA PowerNetworks and United Energy.

2 Scope of Work

- 1. Reviews and responds to matters raised in the draft decision on the use of the equity beta to estimate the return on equity, including on (but not limited to):
 - (a) the role of domestic comparators, including whether they have similar risk characteristics to the benchmark efficient entity and can be used to produce equity beta estimates that are reliable and stable;

¹ SFG, 12 May 2014, *Equity beta*.

SFG, 22 May 2014, *Cost of equity in the Black Capital Asset Pricing Model*.

- (b) the role of foreign comparators, including whether they have similar risk characteristics to the benchmark efficient entity and can be used to produce equity beta estimates that are reliable and stable;
 - (c) the appropriate time period of data to estimate equity beta;
 - (d) the appropriate range for equity beta estimates from Australian data and separately when also considering foreign data;
 - (e) whether the theory of the Black CAPM is relevant for estimating equity beta to be applied in the Sharpe-Lintner CAPM, and if so, how this theory affects estimation of the Sharpe-Lintner CAPM equity beta;
 - (f) what adjustments, if any, should be made to empirical estimates of the Sharpe-Lintner CAPM equity beta in order to ensure that the resulting return on equity estimate complies with the requirements of the National Gas Law and Rules and National Electricity Law and Rules, including as highlighted above;
2. Reviews and, where appropriate, responds to matters raised in the draft decision on the use of the Black CAPM to estimate the return on equity, including (but not limited to):
- (a) whether the Black CAPM is a relevant estimation method, financial model or other evidence for determining the allowed rate of return, and, more specifically, the return on equity
 - (b) whether the Black CAPM is a relevant estimation method, financial model or other evidence for estimating the equity beta parameter of the Sharp-Lintner CAPM or other capital asset pricing models that have an equity beta parameter;
 - (c) the reliability of Black CAPM estimates;
 - (d) the relationship between the low beta bias and the Black CAPM and whether the low beta bias is a priced risk in the Sharpe-Lintner CAPM; and
 - (e) the use of the Black CAPM in practice by regulators, practitioners, academics or others.

In preparing the report, the Expert will:

- A. consider different approaches to estimating the equity beta for the benchmark efficient entity, including any theoretical restrictions on empirical estimates or any adjustments made in practice (e.g. Vasicek and Blume);
- B. consider how sample size, daily, weekly or monthly data affects the reliability of equity beta estimates and approaches for overcoming this, including using foreign data;
- C. consider how leverage affects the equity beta;
- D. consider different approaches to applying the Black CAPM and estimating the zero-beta premium, including any theoretical restrictions on empirical estimates;
- E. consider any comments raised by the AER and other regulators about (i) whether the Black CAPM informs the equity beta estimate for the Sharpe-Lintner CAPM, and if so how, (ii) how leverage affects equity beta, (iii) whether and how foreign data is relevant to estimating an

Australian equity beta, (iv) whether the Black CAPM applies in Australia and (v) the best estimate of the zero-beta premium for Australia;

F. use robust methods and data; and

G. use the sample averaging period of 2 January to 30 January 2015 (inclusive) to estimate any prevailing parameter estimates needed to populate the Sharpe-Lintner CAPM and Black CAPM.

3 Information to be Considered

The Expert is also expected to consider the following information:

- such information that, in Expert's opinion, should be taken into account to address the questions outlined above;
- relevant literature on the value of imputation credits;
- the AER's Rate of Return Guideline, including explanatory statements and supporting expert material;
- material submitted to the AER as part of its consultation on the Rate of Return Guidelines; and
- previous decisions of the AER, other relevant regulators and the Australian Competition Tribunal on the value of imputation credits and any supporting expert material, including the recent draft decisions for JGN and electricity networks in ACT, NSW and Tasmania.

4 Deliverables

At the completion of its review the Expert will provide an independent expert report which:

- is of a professional standard capable of being submitted to the AER;
- is prepared in accordance with the Federal Court Practice Note on Expert Witnesses in Proceedings in the Federal Court of Australia (CM 7) set out in Attachment 1, and includes an acknowledgement that the Expert has read the guidelines²;
- contains a section summarising the Expert's experience and qualifications, and attaches the Expert's curriculum vitae (preferably in a schedule or annexure);
- identifies any person and their qualifications, who assists the Expert in preparing the report or in carrying out any research or test for the purposes of the report;
- summarises JGN's instructions and attaches these term of reference;

² Available at: <http://www.federalcourt.gov.au/law-and-practice/practice-documents/practice-notes/cm7>.

- 
- includes an executive summary which highlights key aspects of the Expert's work and conclusions; and
 - (without limiting the points above) carefully sets out the facts that the Expert has assumed in putting together his or her report, as well as identifying any other assumptions made, and the basis for those assumptions.

The Expert's report will include the findings for each of the five parts defined in the scope of works (Section 2).

5 Timetable

The Expert will deliver the final report to Jemena Regulation by **13 February 2015**.

6 Terms of Engagement

The terms on which the Expert will be engaged to provide the requested advice shall be:

- as provided in accordance with the Jemena Regulatory Consultancy Services Panel arrangements applicable to the Expert.

ATTACHMENT 1: FEDERAL COURT PRACTICE NOTE

Practice Note CM 7

EXPERT WITNESSES IN PROCEEDINGS IN THE FEDERAL COURT OF AUSTRALIA

Commencement

1. This Practice Note commences on 4 June 2013.

Introduction

2. Rule 23.12 of the Federal Court Rules 2011 requires a party to give a copy of the following guidelines to any witness they propose to retain for the purpose of preparing a report or giving evidence in a proceeding as to an opinion held by the witness that is wholly or substantially based on the specialised knowledge of the witness (see **Part 3.3 - Opinion** of the *Evidence Act 1995* (Cth)).
3. The guidelines are not intended to address all aspects of an expert witness's duties, but are intended to facilitate the admission of opinion evidence³, and to assist experts to understand in general terms what the Court expects of them. Additionally, it is hoped that the guidelines will assist individual expert witnesses to avoid the criticism that is sometimes made (whether rightly or wrongly) that expert witnesses lack objectivity, or have coloured their evidence in favour of the party calling them.

Guidelines

1. General Duty to the Court⁴

- 1.1 An expert witness has an overriding duty to assist the Court on matters relevant to the expert's area of expertise.
- 1.2 An expert witness is not an advocate for a party even when giving testimony that is necessarily evaluative rather than inferential.
- 1.3 An expert witness's paramount duty is to the Court and not to the person retaining the expert.

2. The Form of the Expert's Report⁵

- 2.1 An expert's written report must comply with Rule 23.13 and therefore must
 - (a) be signed by the expert who prepared the report; and
 - (b) contain an acknowledgement at the beginning of the report that the expert has read, understood and complied with the Practice Note; and
 - (c) contain particulars of the training, study or experience by which the expert has acquired specialised knowledge; and
 - (d) identify the questions that the expert was asked to address; and
 - (e) set out separately each of the factual findings or assumptions on which the expert's opinion is based; and

³ As to the distinction between expert opinion evidence and expert assistance see *Evans Deakin Pty Ltd v Sebel Furniture Ltd* [2003] FCA 171 per Allsop J at [676].

⁴ The "*Ikarian Reefer*" (1993) 20 FSR 563 at 565-566.

⁵ Rule 23.13.

- 
- (f) set out separately from the factual findings or assumptions each of the expert's opinions; and
 - (g) set out the reasons for each of the expert's opinions; and
 - (ga) contain an acknowledgment that the expert's opinions are based wholly or substantially on the specialised knowledge mentioned in paragraph (c) above⁶; and
 - (h) comply with the Practice Note.
- 2.2 At the end of the report the expert should declare that “[the expert] has *made all the inquiries that [the expert] believes are desirable and appropriate and that no matters of significance that [the expert] regards as relevant have, to [the expert's] knowledge, been withheld from the Court.*”
- 2.3 There should be included in or attached to the report the documents and other materials that the expert has been instructed to consider.
- 2.4 If, after exchange of reports or at any other stage, an expert witness changes the expert's opinion, having read another expert's report or for any other reason, the change should be communicated as soon as practicable (through the party's lawyers) to each party to whom the expert witness's report has been provided and, when appropriate, to the Court⁷.
- 2.5 If an expert's opinion is not fully researched because the expert considers that insufficient data are available, or for any other reason, this must be stated with an indication that the opinion is no more than a provisional one. Where an expert witness who has prepared a report believes that it may be incomplete or inaccurate without some qualification, that qualification must be stated in the report.
- 2.6 The expert should make it clear if a particular question or issue falls outside the relevant field of expertise.
- 2.7 Where an expert's report refers to photographs, plans, calculations, analyses, measurements, survey reports or other extrinsic matter, these must be provided to the opposite party at the same time as the exchange of reports⁸.

3. Experts' Conference

- 3.1 If experts retained by the parties meet at the direction of the Court, it would be improper for an expert to be given, or to accept, instructions not to reach agreement. If, at a meeting directed by the Court, the experts cannot reach agreement about matters of expert opinion, they should specify their reasons for being unable to do so.

J L B ALLSOP
Chief Justice
4 June 2013

⁶ See also *Dasreef Pty Limited v Nawaf Hawchar* [2011] HCA 21.

⁷ The *“Ikarian Reefer”* [1993] 20 FSR 563 at 565

⁸ The *“Ikarian Reefer”* [1993] 20 FSR 563 at 565-566. See also Ormrod *“Scientific Evidence in Court”* [1968] Crim LR 240

Appendix 2: Curriculum Vitas of Professor Stephen Gray and Dr Jason Hall

Stephen F. Gray

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Academic Qualifications

- 1995** Ph.D. (Finance), Graduate School of Business, Stanford University.
Dissertation Title: Essays in Empirical Finance
Committee Chairman: Ken Singleton
- 1989** LL.B. (Hons), Bachelor of Laws with Honours, University of Queensland.
- 1986** B.Com. (Hons), Bachelor of Commerce with Honours, University of Queensland.

Employment History

- 2000-Present** Professor of Finance, UQ Business School, University of Queensland.
- 1997-2000** Associate Professor of Finance, Department of Commerce, University of Queensland and Research Associate Professor of Finance, Fuqua School of Business, Duke University.
- 1994-1997** Assistant Professor of Finance, Fuqua School of Business, Duke University.
- 1990-1993** Research Assistant, Graduate School of Business, Stanford University.
- 1988-1990** Assistant Professor of Finance, Department of Commerce, University of Queensland.
- 1987** Specialist Tutor in Finance, Queensland University of Technology.
- 1986** Teaching Assistant in Finance, Department of Commerce, University of Queensland.

Academic Awards

- 2006 Outstanding Professor Award, Global Executive MBA, Fuqua School of Business, Duke University.
- 2002 Journal of Financial Economics, All-Star Paper Award, for Modeling the Conditional Distribution of Interest Rates as a Regime-Switching Process, JFE, 1996, 42, 27-62.
- 2002 Australian University Teaching Award – Business (a national award for all university instructors in all disciplines).
- 2000 University of Queensland Award for Excellence in Teaching (a University-wide award).
- 1999 Outstanding Professor Award, Global Executive MBA, Fuqua School of Business, Duke University.
- 1999 KPMG Teaching Prize, Department of Commerce, University of Queensland.
- 1998 Faculty Teaching Prize (Business, Economics, and Law), University of Queensland.
- 1991 Jaedicke Fellow in Finance, Doctoral Program, Graduate School of Business, Stanford University.
- 1989 Touche Ross Teaching Prize, Department of Commerce, University of Queensland.
- 1986 University Medal in Commerce, University of Queensland.

Large Grants (over \$100, 000)

- Australian Research Council Linkage Grant, 2008—2010, Managing Asymmetry Risk (\$320,000), with T. Brailsford, J.Alcock, and Tactical Global Management.
- Intelligent Grid Cluster, Distributed Energy – CSIRO Energy Transformed Flagship Collaboration Cluster Grant, 2008-2010 (\$552,000)
- Australian Research Council Research Infrastructure Block Grant, 2007—2008, Australian Financial Information Database (\$279,754).
- Australian Research Council Discovery Grant, 2006—2008, Capital Management in a Stochastic Earnings Environment (\$270,000).
- Australian Research Council Discovery Grant, 2005—2007, Australian Cost of Equity.
- Australian Research Council Discovery Grant, 2002—2004, Quantification Issues in Corporate Valuation, the Cost of Capital, and Optimal Capital Structure.

- Australian Research Council Strategic Partnership Grant, 1997—2000, Electricity Contracts and Securities in a Deregulated Market: Valuation and Risk Management for Market Participants.

Current Research Interests

Benchmark returns and the cost of capital. Corporate Finance. Capital structure. Real and strategic options and corporate valuation. Financial and credit risk management. Empirical finance and asset pricing.

Publications

- Gray, S., I. Harymawan and J. Nowland, (2014), “Political and government connections on corporate boards in Australia: Good for business?” *Australian Journal of Management*, forthcoming.
- Brailsford, T., S. Gray and S. Treepongkaruna, (2013), “Explaining the bid-ask spread in the foreign exchange market: A test of alternate models,” *Australian Journal of Management*, forthcoming.
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- Parmenter, B, A. Breckenridge, and S. Gray, (2010), ‘Economic Analysis of the Government’s Recent Mining Tax Proposals’, *Economic Papers: A Journal of Economics and Policy*, 29(3), September, 279-91.
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Teaching

Fuqua School of Business, Duke University, Student Evaluations (0-7 scale):

- Financial Management (MBA Core): Average 6.5 over 7 years.
- Advanced Derivatives: Average 6.6 over 4 years.
- Empirical Issues in Asset Pricing: Ph.D. Class

1999, 2006 Outstanding Professor Award, Global Executive MBA, Fuqua School of Business, Duke University.

UQ Business School, University of Queensland, Student Evaluations (0-7 scale):

- Finance (MBA Core): Average 6.6 over 10 years.
- Corporate Finance Honours: Average 6.9 over 10 years.

2002 Australian University Teaching Award – Business (a national award for all university instructors in all disciplines).

2000 University of Queensland Award for Excellence in Teaching.

1999 Department of Commerce KPMG Teaching Prize, University of Queensland.

1998 Faculty Teaching Prize, Faculty of Business Economics and Law, University of Queensland.

1998 Commendation for Excellence in Teaching, University-wide Teaching Awards, University of Queensland.

1989 Touche Ross Teaching Prize, Department of Commerce, University of Queensland.

Board Positions

2002 - Present: Director, Financial Management Association of Australia Ltd.

2003 - Present: Director, Moreton Bay Boys College Ltd. (Chairman since 2007).

2002 - 2007: External Risk Advisor to Board of Enertrade (Queensland Power Trading Corporation Ltd.)

Consulting

Managing Director, Strategic Finance Group: www.sfgconsulting.com.au.

Consulting interests and specialties, with recent examples, include:

- **Corporate finance**
 - ⇒ **Listed multi-business corporation:** Detailed financial modeling of each business unit, analysis of corporate strategy, estimation of effects of alternate strategies, development of capital allocation framework.
- **Capital management and optimal capital structure**
 - ⇒ **State-owned electricity generator:** Built detailed financial model to analyze effects of increased leverage on cost of capital, entity value, credit rating, and stability of dividends. Debt of \$500 million issued.
- **Cost of capital**
 - ⇒ **Cost of Capital in the Public Sector:** Provided advice to a government enterprise on how to estimate an appropriate cost of capital and benchmark return for Government-owned enterprises. Appearance as **expert witness** in legal proceedings that followed a regulatory determination.
 - ⇒ **Expert Witness:** Produced a written report and provided court testimony on issues relating to the cost of capital of a cable TV business.
 - ⇒ **Regulatory Cost of Capital:** Extensive work for regulators and regulated entities on all matters relating to estimation of weighted-average cost of capital.
- **Valuation**

- ⇒ **Expert Witness:** Produced a written report and provided court testimony. The issue was whether, during a takeover offer, the shares of the bidding firm were affected by a liquidity premium due to its incorporation in the major stock market index.
- ⇒ **Expert Witness:** Produced a written report and provided court testimony in relation to valuation issues involving an integrated mine and refinery.
- **Capital Raising**
 - ⇒ Produced comprehensive valuation models in the context of capital raisings for a range of businesses in a range of industries including manufacturing, film production, and biotechnology.
- **Asset pricing and empirical finance**
 - ⇒ **Expert Witness:** Produced a written report on whether the client's arbitrage-driven trading strategy caused undue movements in the prices of certain shares.
- **Application of econometric techniques to applied problems in finance**
 - ⇒ **Debt Structure Review:** Provided advice to a large City Council on restructuring their debt portfolio. The issues involved optimisation of a range of performance measures for each business unit in the Council while simultaneously minimizing the volatility of the Council's equity in each business unit.
 - ⇒ **Superannuation Fund Performance Benchmarking:** Conducted an analysis of the techniques used by a large superannuation fund to benchmark its performance against competing funds.
- **Valuation of derivative securities**
 - ⇒ **Stochastic Volatility Models in Interest Rate Futures Markets:** Estimated and implemented a number of models designed to predict volatility in interest rate futures markets.
- **Application of option-pricing techniques to real project evaluation**
 - ⇒ **Real Option Valuation:** Developed a framework for valuing an option on a large office building. Acted as arbitrator between the various parties involved and reached a consensus valuation.
 - ⇒ **Real Option Valuation:** Used real options framework in the valuation of a bio-tech company in the context of an M&A transaction.

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Experience

2013-15 Ross School of Business, The University of Michigan (Lecturer in Finance)
 2008 Ross School of Business, The University of Michigan (Visiting Assistant Professor in Finance)
 2014-15 Frontier Economics (Director)
 2000-15 SFG Consulting (Director)
 2000-12 University of Queensland Business School, The University of Queensland (Senior Lecturer)
 1997-99 Credit Suisse First Boston (Equities analyst)

Education

2005 PhD in finance from The University of Queensland
 2003 Chartered Financial Analyst designation by the CFA Institute
 1996 Bachelor of Commerce with First Class Honours from The University of Queensland

Research

Journal articles

Impact of sector versus security choice on equity portfolios, with Ben McVicar, *Applied Financial Economics*, 2013, 23 (12), 991 – 1004.
 Unconstrained estimates of the equity risk premium, with Stephen Gray, Tristan Fitzgerald and Ravi Jeyaraj, *Review of Accounting Studies*, 2013, 18 (2), 560 – 639.
 Market risk exposure of merger arbitrage in Australia, with Matthew Pinnuck and Matthew Thorne, *Accounting and Finance*, 2013, 53 (1), 185 – 215.
 The value of imputation credits on hybrid securities, with Clinton Feuerherdt and Stephen Gray, *International Review of Finance*, 2010, 10 (3), 365 – 401.
 Forecast accuracy and stock recommendations, with Paul Tacon, *Journal of Contemporary Accounting and Economics*, 2010, 6 (1), 18 – 33.
 Speculation and e-commerce: The long and the short of IT, with Colin Ferguson, Matthew Pinnuck and Frank Finn, *International Journal of Accounting Information Systems*, 2010, 11 (2), 79 – 104.
 Bias, stability and predictive ability in the measurement of systematic risk, with Stephen Gray, Drew Klease and Alan McCrystal, *Accounting Research Journal*, 2009, 22 (3), 220 – 236.
 Leveraged superannuation, with Peter Dunn and Scott Francis, *Accounting and Finance*, 2009, 49 (3), 505 – 529.
 Persistence in growth versus market expectations, with Matthew Tochterman, *Australian Journal of Management*, 2008, 33 (1), 169 – 199.
 Relationship between franking credits and the market risk premium: A reply, with Stephen Gray, *Accounting and Finance*, 2008, 48 (1), 133 – 142.
 Comment on 'Regulation and the term of the risk free rate: Implications of corporate debt', *Accounting Research Journal*, 2007, 20 (2), 81 – 86.
 Valuation of mining projects using option pricing techniques, with Shannon Nicholls, *JASSA*, 2007, Issue 4 (Summer), 22 – 29.
 Relationship between franking credits and the market risk premium, with Stephen Gray, *Accounting and Finance*, 2006, 46 (3), 405 – 428.
 Electronic commerce investments, the resource-based view of the firm, and firm market value, with Colin Ferguson and Frank Finn, *International Journal of Accounting Information Systems*, 2005, 6 (1), 5 – 29.
 Auditor conservatism and voluntary disclosure: Evidence from the Year 2000 systems issue, with Peter Clarkson and Colin Ferguson, *Accounting and Finance*, 2003, 43 (1), 21 – 40.

Working papers

Portfolio rebalancing and mutual fund tournament behavior, with Paul Tacon, Finance and Corporate Governance Conference 2011, FIRN Frontiers in Finance Conference 2011, Financial Management Association Annual Meeting 2012.

The impact of security analyst recommendations on the trading of mutual funds, with David Costello, AFAANZ Conference 2010 (Winner Best Paper in Finance), Australasian Finance and Banking Conference 2010.
Forecasting stock returns using investor flows under short-sales constraints, with Paul Tacon, Australasian Finance and Banking Conference 2011, Finance and Corporate Governance Conference 2012, AFAANZ Conference 2012, Financial Management Association Annual Meeting 2012, Southern Finance Association Annual Meeting 2012.

Presentations

Accounting and Finance Association of Australia and New Zealand Conference (5) 2005, 2007, 2009-10, 2012
Asian Finance Association Conference 2009
Australasian Finance and Banking Conference (2) 2008, 2010
Australian National University Seminar Series 2012
Coal Trade, hosted by AIC Worldwide 1999
Coaltrans Asia, hosted by Coaltrans Conference Limited 1999
Contemporary Accounting Research/Journal of Contemporary Accounting and Economics Joint Symposium 2009
CPA Mining and Energy Conference 2006
Financial Management Association 2012
First Annual Private Equity Conference, hosted by Television Education Network 2007
JBWere Family Business Conference 2010
Melbourne Centre for Consumer Finance Investment & Regulatory Symposium 2008
PhD Conference in Economics and Business, hosted by University of Western Australia 2003
Southern Finance Association 2012
University of Melbourne Seminar Series (2) 2005, 2010
University of Queensland Seminar Series 2008

Referee activity

Accounting and Finance (8 reviews) 2003, 2005, 2009-13
Accounting Research Journal (3 reviews) 2002, 2006, 2010
Applied Financial Economics (3 reviews) 2012-13
Australian Journal of Management 2012
Contemporary Economic Policy 2011
European Financial Management 2014
Financial Review 2013
International Journal of Emerging Markets 2013
International Review of Finance 2012
MIS Quarterly 2003
Quarterly Journal of Finance and Accounting 2010
Quarterly Review of Economics and Finance 2012

Research grants

PricewaterhouseCoopers/Accounting and Finance Association of Australia and New Zealand 2006: Returns, tax and volatility – Superannuation choice with a complete information set (\$8,500)
Australian Research Council Discovery Grant 2002-4: Quantification issues in corporate valuation, the cost of capital and optimal capital structure (\$126,000)
UQ New Staff Research Start-up Fund: The competitive advantage of investments in electronic commerce (\$10,000)

Research students

PhD (1 student)

2012 – Paul Tacon

Honours (20 students)

2012 – Edward Parslow (Carnegie Wylie)

2011 – James Lamb (Port Jackson Partners)

2010 – Jeremy Evans (JP Morgan), Sarah Thorne (JP Morgan), Alexandra Dwyer (Reserve Bank of Australia)

2009 – Tristan Fitzgerald (UNSW), David Costello (National Australia Bank), William Toe (Ernst & Young)

2008 – Ben McVicar (Credit Suisse), Matthew Thorne (Credit Suisse)

2007 – Sam Turner (ABN Amro Morgans)

2006 – Paul Tacon (PhD, UQ), Ravi Jeyaraj (Navis Capital), Thomas Green (Crescent Capital), Alexander Pascal-Bossy (Macquarie)

2005 – Angela Gill (Wilson HTM), Andrew Wagner (Macquarie)

2004 – Matthew Tochtermann (M. Fin. Eng., UC Berkeley), Justyna Lewandowska (JP Morgan), An Pham (UBS)

Masters (2 students)

2003 – Scott Francis (A Clear Direction Financial Planning), Hernando Barrero (PricewaterhouseCoopers)

PhD reader

Damien Cannavan 2012

Teaching

Ross School of Business, The University of Michigan

Valuation (2014-2015; MBA students; avg. rating 4.0)

Corporate Investing Decisions (2014; BBA students avg. rating 4.2)

Corporate Financing Decisions (2015; BBA students)

Corporate Financial Policy (2008; MBA students; avg. rating 4.3)

UQ Business School, The University of Queensland (Mean teacher ratings out of a possible 5.0)

Awarded undergraduate teaching prize 2009

Empirical Finance Honours (2009-12; PhD and Honours students; avg. rating 4.1)

Corporate Finance Honours (2005 & 2011; PhD and Honours students; avg. rating 4.7)

Investments & Portfolio Management (2002-7, 2009-10 & 2012; B.Com, MBA & M.Com students; avg. rating 3.8)

Corporate Finance (2002-4, 2006-10 & 2012; B.Com, MBA and M.Com students; avg. rating 3.8)

Finance (2005-6; M.Com students; avg. rating 3.7)

Corporate Finance and Investments (Mt Eliza Business School, Beijing 2003; MBA students)

Technology Valuation and Project Evaluation (Singapore 2004; Masters of Technology Management students)

Auditing (Summer 2000/1-2001/2; B.Com, MBA and M.Com students; avg. rating 3.8)

Executive education

Risk Management and Financial Analysis (Rabobank 2000-10)

Financial Analysis of Innovative Investments (UQ Business School 2007)

Credit Analysis (Queensland Treasury Corporation 2005)

Capital Management (UQ Business School 2004)

Making Critical Financial Decisions (UQ Business School 2003)

Business Valuation and Analysis (UQ Business School 2003)

Cost of Capital Estimation (UQ Business School 2003)

Analysis of Real Options (Queensland Treasury 2003)

Student competitions

Rotman International Trading Competition

Manager of the UQ Business School trading team (2007 & 2009-12) which competes annually at the University of Toronto amongst 50 teams. UQ is the 9th most successful entrant from 66 schools which have competed in any of the same years, finishing 3rd in 2010, 6th in 2007, 11th in 2009, 14th in 2011 and 18th in 2012.

UBS Investment Banking Competition

Judge for the UQ section 2006-7 & 2009-12. Faculty representative at the national section 2008.

JP Morgan Deal Competition

Judge for the UQ section 2007-8.

Wilson HTM Research Report Competition

Delivered two workshops as part of the 2006 competition and was one of three judges.

Industry engagement

From 2000-15, I have provided consulting services as a director of SFG Consulting and Frontier Economics (from November 2014). A selection of projects is listed below.

Retail electricity and gas margins in NSW (Independent Pricing and Regulatory Tribunal 2012)

In 2006-7 and 2009-10 I acted as part of a team which was engaged to estimate electricity costs and margins for electricity and gas retailers in NSW. We have been reappointed for 2012-13. My role related to the estimation of a profit margin which would allow the retailer to earn a return commensurate its systematic risk. The approach developed was novel in that the margin was derived without reference to any pre-defined estimate of the asset base. Rather, the margin was a function of the potential increases or decreases in cash flows which would result from changes in economic conditions. Reports are available from IPART.

Advice on rules to determine regulated rates of return (Australian Energy Markets Commission 2012)

The AEMC is considering changes to the rules relating to regulation of electricity and gas networks. Independent rule change proposals have been put forward by the Australian Energy Regulator and the Energy Users Association of Australia. Both groups argue that application of the existing rules by the regulator generate upwardly-biased estimates of the regulated rate of return. As part of a team I am currently providing advice to the commission on whether the rule change proposals provide evidence on an upward bias, and if so, whether the proposed amendments are likely to reduce the extent of any bias.

Expert evidence relating to regulated rates of return (Electricity network businesses 2011)

In April 2011 the Australian Competition Tribunal heard an appeal by electricity networks on the regulated rate of return set by the Australian Energy Regulator. The issue was the value of dividend imputation tax credits. The Tribunal directed us to perform a dividend drop-off study to estimate the value of a distributed credit. Largely on the basis of our evidence the Tribunal determined that an appropriate value for a distributed credit was 35 per cent of face value. The Tribunal determination is available on its website and our expert report is available on request.

Estimation of risks associated with long-term generation contracts (New South Wales Treasury 2010)

In 2010 the NSW Government privatised a segment of its electricity industry, by selling three electricity retailers and entering into two generation agreements termed GenTrader contracts. The state-owned generators agreed to provide generation capacity in exchange for a charge. The generators also agreed to pay penalties in the event that their availability was less than agreed. As part of a team, I provided advice to NSW Treasury on the risks associated with the contracts. The estimated penalties resulting from this analysis are used by NSW Treasury in their budgeting role and in providing forward-looking analysis to the Government.

Litigation support relating to asset valuation (Alcan 2006-7)

In 2006-7 I acted as part of a team which provided litigation support to Alcan in a dispute with the taxation authority in the Northern Territory. The dispute related to whether Alcan was required to pay stamp duty as a result of its acquisition of an additional 30 per cent interest in Gove Alumina Limited. One issue was whether the acquisition was land-rich, meaning that the proportion of the asset considered to be land exceeded a threshold triggering stamp duty.

Methodology for evaluating public-private partnerships (Queensland Treasury Corporation 2005)

In 2005 I acted as part of a team which advised QTC on evaluating public-private partnerships, which typically require subsidies to appeal to the private sector. We rebutted the conventional wisdom, adopted in NSW and Victoria, that the standard valuation approach is flawed for negative-NPV projects. Furthermore, we developed a technique to incorporate systematic risk directly into expected cash flows, which are then discounted at the risk-free rate.

Litigation support

Insolvency proceedings relating to the collapse of Octaviar (Public Trustee of Queensland 2008-9)

Valuation of resource assets (Compass Resources 2007-8, Westpac Banking Corporation 2007)

Appeals against regulatory determinations (Envestra 2007-8, Telstra 2008)

Advice on whether loan repayments correspond to contract terms (Qld Dept. of Fair Trading 2005)

Advice on whether port and channel assets were contributed and hence not part of regulated assets (Comalco 2004-5)

Valuation

Management performance securities (Collins Foods Group 2006-11, GroundProbe 2008-9)

Ordinary shares in the context of an equity raising (Auscript 2007-8)

Intangible assets (Inbartec 2007)

Resources assets (Senex Energy 2012, Chalco 2007, Bank of Queensland 2007)

Cost of capital estimation, advice and regulatory submissions

Transport (Qantas 2008, QR National 2005 & 2012)

Water (Essential Services Commission of South Australia 2012, ActewAGL 2012, IPART 2011, Metropolitan utilities in Victoria 2004 & 2006-7, QCA 2002-3)

Energy networks (Economic Regulation Authority in Western Australia 2009, Hong Kong Electric 2007, Envestra 2006-7 & 2012, Powercor 2005, AGL 2004, Energex 2003-4, Ergon Energy 2003-4)

Local government networks (Queensland Competition Authority 2009)

Electricity generation (National Generators Forum 2008)

Environmental consulting (Ecowise 2007)

Listed vs unlisted infrastructure funds across alternative European equity markets (ABN AMRO Rothschild 2007)

Forestry assets (Queensland Department of Natural Resources 2004)

Portfolio performance measurement

Performance evaluation and benchmark derivation (Friday Investments 2010-12, Zupp Property Group 2011-12)

Corporate finance

Economic impact assessment of a proposed development of a retail shopping complex (Lend Lease 2006)

Impact of an acquisition on dividend growth, earnings per share and share price (AGL 2003-4)

Estimation of the optimal capital structure for electricity generation and distribution (NSW Treasury 2001-2)

Review of the debt valuation model used by the Snowy Hydroelectric Authority (NSW Treasury 2002)

Estimation of the optimal contract terms for coal sales to an electricity generator (NSW Treasury 2001-2)

Econometrics

Scoping study into the determinants of changes in tax debt in Australia (Australian Taxation Office 2007)

Interests

I am interested in sport as a participant and spectator. I finished 3rd on three occasions in the Brisbane Half Marathon (2005 & 2009-10), 8th in the Toronto Half Marathon (2002) and 3rd in the Australian Universities Marathon Championships (2003). I have finished 21 marathons, recording a best time of 2:47:54 in the Chicago Marathon 2011. From 1994-96 I was a member of The University of Queensland tennis team, which placed 1st at the Australian University Games in 1994.

Appendix 3: Conceptual analysis

The role of the AER's conceptual analysis

125. In its recent draft decisions, the AER cites the conceptual analysis in relation to beta that was performed as part of its Guidelines process.⁹⁷ The draft decisions conclude that:

...we consider there are reasonable conceptual grounds to expect the equity beta of a benchmark efficient regulated energy network will be below 1.0. However, we recognise the limitations of this approach. The conceptual analysis does not indicate the magnitude of the difference between the benchmark efficient entity and the market average (1.0). Therefore, we use our conceptual analysis as a cross check on the results of our empirical analysis, although we note we consider the empirical analysis alone is sufficient to support an equity beta point estimate of 0.7.⁹⁸

126. That is, the AER's conceptual analysis appears to have had no impact on its estimate of the equity beta for the benchmark efficient firm. The AER's "empirical analysis alone is sufficient to support an equity beta point estimate of 0.7"⁹⁹ and the conceptual analysis is only used "as a cross check on the results of our empirical analysis."¹⁰⁰ Thus, any empirical estimate below 1.0 would seem to satisfy the cross check and require no further modification. Our understanding is that all of the equity beta estimates that have been submitted by stakeholders are below 1.0, in which case all of them would pass this conceptual cross check.

Points of agreement

127. In its recent draft decisions, the AER states that:

Two key types of systematic risk are relevant for this conceptual assessment: business risk and financial risk.¹⁰¹

128. We agree that systematic risk has two components: business risk and leverage. Other things being equal:

- a) Firms with stable cash flows have low business risk and low equity betas, and
- b) Firms with high leverage (i.e., a high proportion of debt finance) have high equity beta.

129. For the second component of equity beta, we consider the term "leverage" to be a more accurate term than "financial risk." The reason for this is that the term "financial risk" is subject to misinterpretation, as set out below, and because equity beta depends directly on leverage, defined as the proportion of debt financing to total financing. The draft decisions note that a number of different formulas have been proposed, but they all link equity beta with the firm's leverage.¹⁰² The formula that the AER adopts in all of its empirical estimates of beta is set out in Figure 3 below.

⁹⁷ Jemena Draft Decision, Attachment 3, pp. 234-241.

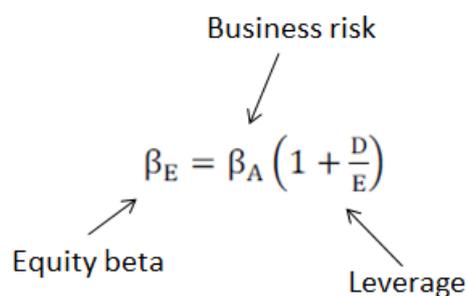
⁹⁸ Jemena Draft Decision, Attachment 3, p. 241.

⁹⁹ Jemena Draft Decision, Attachment 3, p. 241.

¹⁰⁰ Jemena Draft Decision, Attachment 3, p. 241.

¹⁰¹ Jemena Draft Decision, Attachment 3, p. 235.

¹⁰² Jemena Draft Decision, Attachment 3, p. 239.

Figure 3. Business risk, leverage and equity beta

Source: Jemena Draft Decision, Attachment 3, p. 239.

130. The AER notes that the average firm has an equity beta of 1.0 and leverage of approximately 30% debt. Using the formula employed by the AER, this implies a business risk (β_A) of 0.7:

$$\beta_E = \beta_A \left(1 + \frac{D}{E}\right)$$

$$1.0 = 0.7 \left(1 + \frac{0.3}{0.7}\right)$$

131. The AER's recent draft decisions also conclude that:

It is generally accepted that the benchmark efficient entity has lower business risk than the market average firm,¹⁰³

and that:

It is generally accepted that the benchmark efficient entity has higher financial risk [leverage] than the market average firm.¹⁰⁴

and that:

The conceptual assessment of equity beta relative to the market average is determined by the direction and relative magnitude of these two systematic risk factors: business risk and financial risk [leverage].¹⁰⁵

We agree with all of this. Relative to the average firm, the benchmark firm has lower business risk and higher leverage. The question is which of these effects outweighs the other, and by how much.

¹⁰³ Jemena Draft Decision, Attachment 3, p. 235.

¹⁰⁴ Jemena Draft Decision, Attachment 3, p. 236.

¹⁰⁵ Jemena Draft Decision, Attachment 3, p. 237.

Conclusions relative to the average firm

132. The AER concludes that its conceptual analysis supports an equity beta below 1.0. For the benchmark firm (with 60% leverage) to have an equity beta less than 1.0, its business risk would have to be less than 0.4:

$$\beta_E = \beta_A \left(1 + \frac{D}{E} \right)$$
$$1.0 = 0.4 \left(1 + \frac{0.6}{0.4} \right)$$

133. That is, the question is whether conceptual reasoning alone is sufficient to lead one to the conclusion that the benchmark firm has less than 57% of the business risk of the average firm. In its recent draft decisions, the AER sets out a number of reasons why one might expect the benchmark firm to have lower-than-average business risk. This supports a directional effect (about which there is no disagreement) but tells us nothing about quantum. In our view, there is no way to conceptually reason whether the benchmark firm has 50% or 70% or 90% of the business risk of the average firm.

134. Moreover, in its recent draft decisions, the AER notes that other formulas have been proposed to combine the firm's business risk and leverage to its equity beta:

we consider the exact nature of the relationship between financial leverage and equity beta is not straightforward and cannot be known with certainty.¹⁰⁶

135. That is, the AER is unsure about whether the threshold is 57% (based on the formula that the AER uses) or 50% or 70% based on some other formula. In our view, it is impossible to conceptually reason whether the business risk of the benchmark firm is above or below a known 57% threshold relative to the average firm. This task is made even more difficult if there is also uncertainty about what the threshold should be. We cannot see how qualitative directional evidence can be used to quantify the extent to which the business risk of the benchmark firm is below the business risk of the average firm, and to compare that against an unknown threshold.

AER analysis

136. As set out in the AER's formula above, the equity beta is a function of business risk and leverage (which is 60% for the benchmark firm). Whether the equity beta for the benchmark firm is below 1.0 depends on whether its lower-than-average business risk more than offsets its higher-than-average leverage. However, rather than comparing business risk and leverage, the AER compares:

- a) The components of business risk that have a non-financial flavour, which the AER calls "business risk" with
- b) The components of business risk that have a financial flavour, which the AER calls "financial risk".

137. In our earlier report to the AER, we pointed out that the second component of equity beta is leverage and not financial-type components of business risk such as default risk, financial counterparty risk,

¹⁰⁶ Jemena Draft Decision, Attachment 3, pp. 238-239.

illiquidity risk, refinancing risk, and interest rate risk.¹⁰⁷ We know that the leverage of the benchmark firm is 60%. This is one of the inputs into the AER's formula above. The other input is business risk, five components of which have a financial favour. The AER concludes that the five components of business risk that have a financial flavour are largely "low to medium."¹⁰⁸ But it is already widely accepted that the business risk of the benchmark firm is lower-than-average. Knowing that a component of business risk is low to medium tells us nothing about whether the lower-than-average business risk more than offsets leverage that is double that of the average firm. The AER has erred by confusing (a) components of business risk that have a financial flavour with (b) leverage of 60%.

138. We explained this point in our previous report to the AER.¹⁰⁹ In particular, we noted that in its Guideline, the AER referred to the five components of business risk that have a financial flavour that were discussed by Frontier Economics (2013). The AER:

- a) Compared these components of business risk against the other components of business risk; instead of
- b) Comparing leverage (60%) against all of the components of business risk.

139. In its recent draft decisions, the AER states that:

SFG stated the Guideline material appears to suggest that leverage affects equity beta via the five financial risks set out in the 2013 Frontier report. This is a mischaracterisation of our view. We do not consider that leverage affects equity beta via the five financial risks set out in the 2013 Frontier report.¹¹⁰

140. But then the AER concludes that the benchmark firm's lower-than-average business risk more than offsets its higher-than-average "finance risk." In this regard, the AER's recent draft decisions repeat that Frontier Economics (2013) "disaggregated financial risk...into five different subcategories" and concluded that the benchmark firm would have medium to low exposure to the majority of the five subcategories.¹¹¹ That is, the AER continues to confuse (a) elements of business risk that have a financial flavour with (b) the 60% leverage of the benchmark firm.

Empirical analysis

141. The AER also introduces two pieces of empirical evidence into its conceptual analysis.

[Damodaran equity beta estimates](#)

142. In its recent draft decisions, the AER refers to the McKenzie and Partington (2012) report that it relied upon in its Guideline.¹¹² That report compares raw equity beta estimates¹¹³ for US utilities against raw equity beta estimates for other industries. The AER now reports that equity beta estimates that have been re-levered to 60% to match the benchmark efficient entity range between

¹⁰⁷ SFG (2014 Beta), p. 21.

¹⁰⁸ Jemena Draft Decision, Attachment 3, p. 236.

¹⁰⁹ SFG (2014 Beta), pp. 20-22 and Appendix 3.

¹¹⁰ Jemena Draft Decision, Attachment 3, p. 241.

¹¹¹ Jemena Draft Decision, Attachment 3, p. 236.

¹¹² Jemena Draft Decision, Attachment 3, p. 239-241.

¹¹³ That is, equity beta estimates that have not been re-levered to match the 60% leverage that the AER adopts for the benchmark efficient entity.

0.99 and 1.05 for gas and electric utilities.¹¹⁴ That is, when the lower-than-average business risk is combined with the higher-than-average leverage of the benchmark firm, the result is an equity beta that is close to that of the average firm.

143. However, the AER concludes that McKenzie and Partington were correct to draw conclusions about the benchmark efficient entity from a consideration of raw equity betas rather than relevered equity betas.¹¹⁵ In our view this is an error. The AER reports that the Damodaran gas and electric utilities have leverage of 40% to 46%,¹¹⁶ which is materially below the 60% leverage that the AER has adopted for the benchmark firm. One cannot draw any conclusions about the beta of the benchmark efficient entity (with 60% leverage) from the raw betas of firms with 40-46% leverage. The AER itself shows that after the appropriate relevering adjustment, the Damodaran evidence suggests that a gas or electric utility with 60% leverage would have a beta close to that of the average firm.

Schleuter and Sievers

144. In its recent draft decisions, the AER refers to an analysis of accounting data for North American firms performed by Schleuter and Sievers (2014). The AER relies on this paper to support the conclusion from its conceptual analysis that the equity beta of the benchmark efficient entity will be less than 1.0.¹¹⁷ In our previous report, we concluded that it would be unreasonable to conclude from this paper anything about the appropriate beta for the benchmark efficient entity, and we remain of that view.

145. The AER makes two points in relation to this paper in its recent draft decisions:

- a) The fact that the analysis is based on North American accounting data does not affect the conclusions that can be drawn from it because the article is motivated by general academic literature;¹¹⁸ and
- b) The fact that Table 1 reports higher financial risk sensitivity for utilities than any other industry is not relevant because a robustness test using industry indicator variables confirms the conclusion that intrinsic risk is the main component of equity beta for all industries.¹¹⁹

146. Schleuter and Sievers (2014, p. 559) devote two sentences to their discussion of this robustness test – one to say that they performed it and one to explain that they do not report the results of it, but that it confirms their general results.

147. This paper presents no results for the utilities industry other than the result in Table 1 set out above. It certainly presents no results for the benchmark efficient entity with 60% leverage. We remain of the view that this paper should have no impact on the equity beta that is adopted for the benchmark efficient entity.

¹¹⁴ Jemena Draft Decision, Attachment 3, Table 3-52, p. 240.

¹¹⁵ Jemena Draft Decision, Attachment 3, p. 240.

¹¹⁶ Jemena Draft Decision, Attachment 3, Table 3-52, p. 240. Note that $D/V = (D/E) \div (1+D/E)$.

¹¹⁷ Jemena Draft Decision, Attachment 3, p. 241.

¹¹⁸ Jemena Draft Decision, Attachment 3, p. 241.

¹¹⁹ Jemena Draft Decision, Attachment 3, p. 241.