AusNet Transmission Group Pty Ltd

Transmission Revenue Review 2017-2022

Appendix 10B: The Cost of Equity: Response to the AER's Final Decisions for the NSW & ACT Electricity Distributors, & for Jemena Gas Networks (NERA Economic Consulting)

Submitted: 30 October 2015

NERA
ECONOMIC CONSULTING

The Cost of Equity: Response to the AER's Final Decisions for the NSW and ACT Electricity Distributors, and for Jemena Gas Networks

A report for ActewAGL Distribution, AGN, APA, AusNet Services, CitiPower, Ergon Energy, Jemena Electricity Networks, Powercor, SA Power Networks and United Energy

June 2015

Project Team

Simon Wheatley

NERA Economic Consulting
Darling Park Tower 3
201 Sussex Street
Sydney NSW 2000
Australia
Tel: 61 2 8864 6500 Fax: 61 2 8864 6549
www.nera.com

CONFIDENTIALITY

We understand that the maintenance of confidentiality with respect to our clients' plans and data is critical to their interests. NERA Economic Consulting rigorously applies internal confidentiality practices to protect the confidentiality of all client information.

Similarly, our approaches and insights are proprietary and so we look to our clients to protect our interests in our proposals, presentations, methodologies and analytical techniques. Under no circumstances should this material be shared with any third party without the prior written consent of NERA Economic Consulting.

Contents

List of Tables

List of Figures

Executive Summary

This report has been prepared for ActewAGL Distribution, AGN, APA, AusNet Services, CitiPower, Ergon Energy, Jemena Electricity Networks, Powercor, SA Power Networks and United Energy (the networks) by NERA Economic Consulting (NERA). The networks have asked NERA to critically review the analyses by the Australian Energy Regulator (AER), Handley, Partington and Satchell of reports submitted by NERA to the AER in February 2015 and March 2015.[1] NERA's February 2015 report provides the results of both in-sample and out-of-sample tests of a naïve model, the Sharpe-Lintner (SL) Capital Asset Pricing Model (CAPM), the AER's implementation of the SL CAPM (the AER CAPM) and the Black CAPM.[2] The AER has for some years used a version of the SL CAPM to estimate the cost of equity for a regulated energy utility. The Black CAPM and a naïve model are alternative models that the AER could use to estimate the cost of equity. NERA's March 2015 report provides a review of the empirical evidence on the SL CAPM, the Black CAPM and the Fama-French three-factor model.[3] The Fama-French three-factor model is another alternative model that the AER could use to estimate the cost of equity.

---

[1] AER, *Final Decision Ausgrid distribution determination 2015−16 to 2018−19 Attachment 3 – Rate of return*. April 2015.

AER, *Final Decision Jemena Gas Networks (NSW) Ltd Access Arrangement 2015–20 Attachment 3 − Rate of return*, June 2015.

Handley, J.C., *Report prepared for the Australian Energy Regulator Further advice on the return on equity*, 16 April 2015.

Handley, J.C., *Advice on the rate of return for the 2015 AER Energy Network Determination for Jemena Gas Networks*, 20 May 2015.

NERA, *Empirical performance of Sharpe-Lintner and Black CAPMs: A report for Jemena Gas Networks, Jemena Electricity Networks, ActewAGL, AusNet Services, CitiPower, Energex, Ergon Energy, Powercor, SA Power Networks, and United Energy*, February 2015.

NERA, *Review of the literature in support of the Sharpe-Lintner CAPM, the Black CAPM and the Fama-French three-factor model: A report for Jemena Gas Networks, Jemena Electricity Networks, AusNet Services, Australian Gas Networks, CitiPower, Ergon Energy, Powercor, SA Power Networks, and United Energy*, March 2015.

Partington, G., *Report to the AER: Return on equity (updated)*, April 2015.

Partington, G. and S. Satchell, *Report to the AER: Return of (sic) equity and comment on submissions in relation to JGN*, May 2015.

[2] The SL CAPM and Black CAPM predict that the market portfolio of all risky assets should be mean-variance efficient – that is, the models predict that the portfolio should have the highest mean return for given variance of return. One cannot observe the return to the market portfolio of all risky assets and so empirical versions of the models use proxies for the market portfolio of all risky assets. All references in this report to tests of the two models are to tests of empirical versions of the models that use the market portfolio of stocks as a proxy for the market portfolio of all risky assets.

Black, Fischer, *Capital market equilibrium with restricted borrowing*, Journal of Business 45, 1972, pages 444-454.

Lintner, John, *The valuation of risk assets and the selection of risky investments in stock portfolios and capital budgets*, Review of Economics and Statistics 47, 1965, pages 13-37.

Sharpe, William F., *Capital asset prices: A theory of market equilibrium under conditions of risk*, Journal of Finance 19, 1964, pages 425-442.

[3] Fama, Eugene and Kenneth French, *Common risk factors in the returns to stocks and bonds*, Journal of Financial Economics 33, 1993, pages 3-56.

In particular, the networks have asked NERA to:

- describe the differences between the SL CAPM, the Black CAPM and the Fama-French three-factor model;
- describe the tests that NERA performs in its February 2015 report of a naïve model, the SL CAPM, the AER CAPM and the Black CAPM;
- review what the AER, Handley, and Partington and Satchell have or have not had to say about the tests that NERA uses in its February 2015 report;
- explain what the Vasicek (1973) adjustment represents; [4]
- explain whether a tendency for estimates of beta to revert to one over time can explain the evidence that NERA provides in its February 2015 report against the SL CAPM and the AER CAPM;
- explain what issues Ray, Savin and Tiwari (2009) raise, whether NERA addresses the issues in its February 2015 report and whether the AER, Handley, Partington and Satchell acknowledge that NERA has addressed the issues; [5]
- explain what Da, Guo and Jagannathan (2012) have to say, what NERA has to say about what the work of Da, Guo and Jagannathan and whether the AER, Handley, Partington and Satchell acknowledge that NERA has addressed the issues that Da, Guo and Jagannathan raise; [6] and
- address any other relevant issues that the AER, Handley, Partington and Satchell raise or do not raise that need to be addressed.

Empirical Results

The central empirical result that NERA provides in its February 2015 report is that models like the SL CAPM and AER CAPM that use beta as a measure of risk and a restriction that a zero-beta portfolio earn either the risk-free rate or, as in the AER CAPM, a rate that sits only a small distance above the risk-free rate provide poor estimates of the return required on equity. [7] In particular, the models tend to underestimate the returns required on low-beta equity portfolios and overestimate the returns required on high-beta equity portfolios. [8] In

---

4 Vasicek, O.A., *A note on using cross-sectional information in Bayesian estimation of security betas*, Journal of Finance, 1973, pages 1233-1239.

5 Ray, S., N.E. Savin and A. Tiwari, *Testing the CAPM revisited*, Journal of Empirical Finance, 2009, pages 721-733.

6 Da, Z., R-J. Guo and R. Jagannathan, *CAPM for estimating the cost of equity capital: Interpreting the empirical evidence*, Journal of Financial Economics, 2012, pages 204-220.

7 The AER reports that its range for the equity beta of a regulated energy utility is 0.4 to 0.7 and it chooses a value from the range of 0.7. A method by which it could have reached this decision would have been to have placed a weight of two thirds on the midpoint of its range, 0.55, and a weight of one third on one. That is, $0.55 \times (2/3) + 1 \times (1/3) = 0.7$. Alternatively, the AER could have produced the same return on equity using a beta of 0.55, the Black CAPM and an estimate of the zero-beta premium that places a weight of two thirds on zero and a weight of one third on the market risk premium. An estimate of the zero-beta premium that places a weight of two thirds on zero and a weight of one third on the *MRP* will deliver a zero-beta rate that sits a small distance above the risk-free rate.

8 By construction, of course, the SL CAPM will correctly estimate the return required on a risk-free asset.

other words, models that use beta as a measure of risk and a restriction that a zero-beta portfolio earn either the risk-free rate or a rate that sits only a small distance above the risk-free rate produce estimates of required returns that are biased – especially for low-beta and high-beta equity portfolios. Thus it is very difficult to see that estimates of the return required on equity that use the SL CAPM or the AER CAPM can represent the best estimates possible in the circumstances.

The SL CAPM and the AER CAPM perform so badly that even a naïve model that states that the mean returns to all equities are identical performs better. One cannot reject the hypothesis that the naïve model generates estimates of the return required on an equity portfolio that are unbiased. Similarly, one cannot reject the hypothesis that the Black CAPM generates estimates of the return required on an equity portfolio that are unbiased. Thus estimates of the return required on equity that use the naïve model or the Black CAPM display characteristics that one would expect the best estimates possible in the circumstances to display.

We emphasise here that the results that NERA reports are similar to the results that Fama and French (1992), Campbell and Vuolteenah (2005) and Lewellen, Nagel and Shanken (2010) provide using US data. [9]

The AER's own advisors are also, not surprisingly, aware of this evidence. As Partington and Satchell point out: [10]

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

Similarly, Handley notes that: [11]

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

This recent statement contradicts the statement that Handley makes in a 2011 peer review of a report written by Davis on behalf of the AER. In that report, Handley states that: [12]

> 'CEG is incorrect to suggest that:

---

[9] Campbell, J. and T. Vuolteenaho, *Bad beta, good beta*, American Economic Review, 2004, pages 1249-1275.

Fama, Eugene and Kenneth French, *The cross-section of expected returns*, Journal of Finance 47, 1992, pages 427-465.

Lewellen, J., S. Nagel and J. Shanken, *A skeptical appraisal of asset pricing tests*, Journal of Financial Economics, 2010, pages 175-194.

[10] Partington, G. and S. Satchell, *Report to the AER: Return of (sic) equity and comment on submissions in relation to JGN*, May 2015, page 9.

[11] Handley, J.C., *Advice on the rate of return for the 2015 AER Energy Network Determination for Jemena Gas Networks*, 20 May 2015, page 5.

[12] Handley, J.C., *Peer review of draft report by Davis on the cost of equity*, 18 January 2011, page 4.

> "The existence of bias in the AER implementation of the CAPM can reasonably be regarded as being universally accepted by those who have examined the empirical data. ... This is one of the few areas of consensus amongst finance experts."'

Market Proxies

The AER uses difficulties in testing the predictions that the SL CAPM makes about the behaviour of the return to the market portfolio of all risky assets to shield the version of the model that it employs from scrutiny. [13] NERA emphasises in its February 2015 and March 2015 reports that the AER does not employ a version of the SL CAPM that uses the return to the market portfolio of all risky assets. The version of the model that the AER employs uses the market portfolio of stocks alone as a proxy for the market portfolio of all risky assets. Thus whether the model works when one employs the return to the market portfolio of all risky assets is irrelevant to the issue of how the AER should set the return on equity for a regulated energy utility. The AER employs a version of the SL CAPM that uses the market portfolio of stocks as a proxy for the market portfolio of all risky assets. Thus, what is relevant to the issue of how the AER should set the return on equity for a regulated energy utility is whether the version of the SL CAPM that the regulator employs works. The empirical version of the SL CAPM that the AER employs matches the empirical version of the model that NERA tests in its February 2015 report. So the evidence provided in that report is relevant to determining whether estimates provided by the empirical version of the SL CAPM that the AER employs represent the best possible estimates in the circumstances.

Ray, Savin and Tiwari (2009)

The AER and McKenzie and Partington refer to the work of Ray, Savin and Tiwari (2009) who show that the finite-sample distribution of the Wald statistic for a test of the SL CAPM need not conform closely to its theoretical asymptotic distribution. [14] A Wald statistic uses unrestricted parameter estimates and an estimate of the covariance matrix of the unrestricted parameter estimates to test whether a set of restrictions are true. [15] The finite-sample distribution refers to the distribution in samples that are not very, very large while the asymptotic distribution refers to the distribution in very, very large samples. Asymptotic results are ones that are strictly true only in the limit as the sample size tends to infinity. [16] As a result of the differences that can occur between the finite-sample and asymptotic distributions of the Wald statistics used to test the SL CAPM, Ray, Savin and Tiwari note that tests of pricing models that rely on the asymptotic distributions of the statistics can reject more frequently than the stated sizes of the tests would suggest. To examine the extent to which the finite-sample distribution of the Wald statistic, which NERA uses in its February

---

[13] AER, *Better Regulation Explanatory Statement Rate of Return Guideline (Appendices)*, December 2013, pages 11-12.

[14] AER, *Better Regulation Explanatory Statement Rate of Return Guideline (Appendices)*, December 2013, page 12.
McKenzie, M. and G. Partington, Report to the AER Part A: Return on equity, SIRCA, October 2014, page 9.
Ray, S., N.E. Savin and A. Tiwari, Testing the CAPM revisited, Journal of Empirical Finance, 2009, pages 721-733.

[15] Davidson, R. and J.G. MacKinnon, *Estimation and inference in econometrics*, Oxford University Press, 1993, page 89.

[16] Davidson, R. and J.G. MacKinnon, *Estimation and inference in econometrics*, Oxford University Press, 1993, page 42.

2015 report to test the SL CAPM, differs from its theoretical asymptotic distribution, NERA conducts bootstrap simulations. A bootstrap simulation involves creating simulated data by drawing observations at random with replacement from a particular set of data.[17] NERA reports that the results of the bootstrap simulations that it conducts indicate that, regardless of how significance is assessed, one can conclude that estimates of the return required on equity that use the SL CAPM are biased. We note here that the AER and its advisors have not acknowledged that NERA has addressed the issues that Ray, Savin and Tiwari raise.

The AER suggests that a 'limitation' of NERA's results is that they appear 'counterintuitive' and so the AER places little weight on the results. We note, however, that neither the AER nor its advisors have generated any empirical evidence using either the data that we employ, provided by SIRCA, or any other data to produce support for the use of either the SL CAPM or the AER's implementation of the model.[18] The AER's advisors, McKenzie and Partington, instead have looked to the work of Da, Guo and Jagannathan (2012) for support for the SL CAPM. [19]

Da, Guo and Jagannathan (2012)

Da, Guo and Jagannathan argue that growth options that firms possess may be largely responsible for the weak relation between return and beta. McKenzie and Partington state in their October 2014 report that:[20]

> 'Da, Guo and Jagannathan (2012) argue that the empirical evidence against the capital asset pricing model (CAPM) based on stock returns does not invalidate its use for estimating the cost of capital for projects in making capital budgeting decisions ... their findings justify the continued use of the CAPM irrespective as to one's interpretation of the empirical literature on asset pricing.'

NERA in its February 2015 report states that:

> 'What McKenzie and Partington do not explain is that Da, Guo and Jagannathan do not suggest that the SL CAPM be used in the same way that the AER has been using the model. To construct estimates of beta that can be used in project evaluation, unadjusted common or garden estimates of beta have to be adjusted. Da, Guo and Jagannathan (2012) state that:
>
> > 'In general, both the equity risk premium and the equity beta of a firm are complex functions of the firm's project beta and real option characteristics. If we project them on a set of variables capturing the features of real options using linear regressions, the residual risk premium and the residual beta are option-adjusted and more closely resemble the underlying project risk premium and project beta.'

---

17 Davidson, R. and J.G. MacKinnon, *Estimation and inference in econometrics*, Oxford University Press, 1993, page 753.

18 SIRCA Australian Share Price and Price Relative (SPPR) information supplied by RoZetta Technology Pty Ltd (www.rozettatechnology.com).

19 Da, Z., R-J. Guo and R. Jagannathan, *CAPM for estimating the cost of equity capital: Interpreting the empirical evidence*, Journal of Financial Economics, 2012, pages 204-220.

20 McKenzie, M. and G. Partington, *Report to the AER Part A: Return on equity*, SIRCA, October 2014, pages 9-10.

> Since beta is a relative measure of risk, an adjustment must be made even to the betas of firms that have no growth options. Da, Guo and Jagannathan construct option-adjusted betas as the residuals from a cross-sectional regression, without an intercept, of unadjusted betas on book-to-market, idiosyncratic volatility and the return on assets where the three regressors are measured relative to averages for the market. Neither the AER nor its advisers construct estimates of beta in this way. Thus the evidence that Da, Guo and Jagannathan provide is not relevant to assessing estimates of the cost of equity provided by the empirical version of the SL CAPM that the AER employs.'

In its June 2015 Jemena *Final Decision*, the AER quotes the passage from McKenzie and Partington's October 2014 report above and ignores what NERA has to say. [21] Similarly, in his April 2015 report, Partington ignores what NERA has to say about the work of Da, Guo and Jagannathan and reproduces the comments made in the report of McKenzie and Partington of October 2014. [22] Partington's report of April 2015 has been placed on the AER's web site on the page on which the AER's Jemena *Final Decision* appears. [23]

In his May 2015 report with Satchell, Partington does acknowledge that Da, Guo and Jagannathan do not endorse the use of the AER's implementation of the SL CAPM but endorse an alternative implementation that uses option-adjusted betas. Partington and Satchell state that: [24]

> 'We agree with NERA that Da, Guo and Jagannathan (2012) use option adjusted measures of return and beta. This is an interesting idea, but at its current stage of development we would not recommend its adoption by the AER.'

The report of Partington and Satchell has also been placed on the AER's web site on the page on which the AER's Jemena *Final Decision* appears. [25]

Characteristics or Risk?

Handley acknowledges that a low-beta bias exists but argues that since there is not uniform agreement that the bias represents compensation for risk not accounted for by the SL CAPM, then one should ignore the bias in computing an estimate of the cost of equity. [26] That is, one should ignore the evidence that the SL CAPM is wrong. He argues that the allowed rate of

---

[21] AER, *Final Decision Jemena Gas Networks (NSW) Ltd Access Arrangement 2015–20 Attachment 3 – Rate of return*, June 2015, page 65.

[22] McKenzie, M. and G. Partington, *Report to the AER Part A: Return on equity*, SIRCA, October 2014, pages 9-10.

Partington, G., *Report to the AER Return on equity (updated)*, April 2015, pages 29-30.

[23] https://www.aer.gov.au/node/24741

[24] Partington, G. and S. Satchell, *Report to the AER: Return of (sic) equity and comment on submissions in relation to JGN*, May 2015.

[25] https://www.aer.gov.au/node/24741

[26] Handley, J.C., *Advice on the rate of return for the 2015 AER Energy Network Determination for Jemena Gas Networks*, 20 May 2015, page 5.

return objective requires the allowed rate of return to reflect the risk of a benchmark efficient entity. We note, however, that Rule 6.5.2 (c) of the National Electricity Rules states that: [27]

> 'The *allowed rate of return objective* is that the rate of return for a *Distribution Network 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 *Distribution Network Service Provider* in respect of the provision of *standard control services* (the *allowed rate of return objective*).'

The rule does not state, as Handley asserts, that the rate of return should solely *reflect* the risk of a benchmark efficient entity – that is, it does not state that the rate of return should constitute solely *compensation* for risk. The rule states only that the rate of return be *commensurate* with the costs of a benchmark efficient entity with a similar degree of risk – even if some of those costs do not represent compensation for risk, measured in some way. In other words, the allowed rate of return objective implies that a benchmark efficient entity should be rewarded on the basis of the costs that it faces and not on the basis of the costs that it would face were some asset pricing model to be true. Thus if the evidence indicates that the market requires firms with low equity betas to deliver returns that are, on average, significantly above those that the SL CAPM indicates that they should deliver, then the allowed rate of return objective implies that the return on equity provided to low-equity-beta firms should include the additional costs that the firms face beyond those that they would face were the SL CAPM to be true.

Fama-French Three-Factor Model

The AER advisors Handley, Partington and Satchell argue that the evidence that Lewellen, Nagel and Shanken (2010) provide indicates that there is little benefit to using the Fama-French three-factor model relative to the SL CAPM. [28] Lewellen, Nagel and Shanken examine zero-beta versions of a number of pricing models and provide evidence that the Fama-French three-factor model offers an improvement in terms of performance, measured by the GLS R^2, over the CAPM but provide no formal test of the null hypothesis of no improvement. In more recent work, however, Kan, Robotti and Shanken, provide formal tests and conclude that: [29]

> 'Over the years, many asset pricing studies have employed the sample cross-sectional regression (CSR) R^2 as a measure of model performance. We derive the asymptotic distribution of this statistic and develop associated model comparison tests, taking into account the inevitable impact of model misspecification on the variability of the two-pass CSR estimates. We encounter several examples of large R^2 differences that are not statistically significant. A version of the intertemporal CAPM exhibits the best overall performance, followed by the "three-factor model" of Fama and French (1993).'

---

[27] See also Rule 6A 6.2 (c) of the National Electricity Rules and Rule 87 (3) of the National Gas Rules.

[28] Lewellen, J., S. Nagel and J. Shanken, *A skeptical appraisal of asset pricing tests*, Journal of Financial Economics, 2010, pages 175-194.

[29] Kan, R., C. Robotti and J. Shanken, *Pricing model performance and the two-pass cross-sectional regression methodology*, Journal of Finance, 2013, pages 2617-2649.

Kan, Robotti and Shanken show that while they cannot reject the hypothesis that the GLS R^2 delivered by a version of the intertemporal CAPM does not exceed the GLS R^2 that the Fama-French three-factor model delivers, they can reject the hypothesis that the GLS R^2 delivered by the Fama-French three-factor model does not exceed the GLS R^2 that the CAPM delivers. In other words, they find no significant evidence that a version of the intertemporal CAPM outperforms the Fama-French three-factor model but they do find significant evidence that the Fama-French three-factor model outperforms the CAPM. In addition, Kan, Robotti and Shanken find a negative relation between mean return and beta rather than the positive relation that the SL CAPM predicts one should find.

1. Introduction

This report has been prepared for ActewAGL Distribution, AGN, APA, AusNet Services, CitiPower, Ergon Energy, Jemena Electricity Networks, Powercor, SA Power Networks and United Energy (the networks) by NERA Economic Consulting (NERA). The networks have asked NERA to critically review the analyses by the Australian Energy Regulator (AER), Handley, Partington and Satchell of reports submitted by NERA to the AER in February 2015 and March 2015. [30] NERA's February 2015 report provides the results of both in-sample and out-of-sample tests of a naïve model, the Sharpe-Lintner (SL) Capital Asset Pricing Model (CAPM), the AER's implementation of the SL CAPM (the AER CAPM) and the Black CAPM. [31] The AER has for some years used a version of the SL CAPM to estimate the cost of equity for a regulated energy utility. The Black CAPM and a naïve model are alternative models that the AER could use to estimate the cost of equity. NERA's March 2015 report provides a review of the empirical evidence on the SL CAPM, the Black CAPM and the Fama-French three-factor model. [32] The Fama-French three-factor model is another alternative model that the AER could use to estimate the cost of equity.

---

[30] AER, *Final Decision Ausgrid distribution determination 2015−16 to 2018−19 Attachment 3 – Rate of return*. April 2015.

AER, *Final Decision Jemena Gas Networks (NSW) Ltd Access Arrangement 2015–20 Attachment 3 − Rate of return*, June 2015.

Handley, J.C., *Report prepared for the Australian Energy Regulator Further advice on the return on equity*, 16 April 2015.

Handley, J.C., *Advice on the rate of return for the 2015 AER Energy Network Determination for Jemena Gas Networks*, 20 May 2015.

NERA, *Empirical performance of Sharpe-Lintner and Black CAPMs: A report for Jemena Gas Networks, Jemena Electricity Networks, ActewAGL, AusNet Services, CitiPower, Energex, Ergon Energy, Powercor, SA Power Networks, and United Energy*, February 2015.

NERA, *Review of the literature in support of the Sharpe-Lintner CAPM, the Black CAPM and the Fama-French three-factor model: A report for Jemena Gas Networks, Jemena Electricity Networks, AusNet Services, Australian Gas Networks, CitiPower, Ergon Energy, Powercor, SA Power Networks, and United Energy*, March 2015.

Partington, G., *Report to the AER: Return on equity (updated)*, April 2015.

Partington, G. and S. Satchell, *Report to the AER: Return of (sic) equity and comment on submissions in relation to JGN*, May 2015.

[31] The SL CAPM and Black CAPM predict that the market portfolio of all risky assets should be mean-variance efficient – that is, the models predict that the portfolio should have the highest mean return for given variance of return. One cannot observe the return to the market portfolio of all risky assets and so empirical versions of the models use proxies for the market portfolio of all risky assets. All references in this report to tests of the two models are to tests of empirical versions of the models that use the market portfolio of stocks as a proxy for the market portfolio of all risky assets.

Black, Fischer, *Capital market equilibrium with restricted borrowing*, Journal of Business 45, 1972, pages 444-454.

Lintner, John, *The valuation of risk assets and the selection of risky investments in stock portfolios and capital budgets*, Review of Economics and Statistics 47, 1965, pages 13-37.

Sharpe, William F., *Capital asset prices: A theory of market equilibrium under conditions of risk*, Journal of Finance 19, 1964, pages 425-442.

[32] Fama, Eugene and Kenneth French, *Common risk factors in the returns to stocks and bonds*, Journal of Financial Economics 33, 1993, pages 3-56.

In particular, the networks have asked NERA to:

- describe the differences between the SL CAPM, the Black CAPM and the Fama-French three-factor model;
- describe the tests that NERA performs in its February 2015 report of a naïve model, the SL CAPM, the AER CAPM and the Black CAPM;
- review what the AER, Handley, and Partington and Satchell have or have not had to say about the tests that NERA uses in its February 2015 report;
- explain what the Vasicek (1973) adjustment represents; [33]
- explain whether a tendency for estimates of beta to revert to one over time can explain the evidence that NERA provides in its February 2015 report against the SL CAPM and the AER CAPM;
- explain what issues Ray, Savin and Tiwari (2009) raise, whether NERA addresses the issues in its February 2015 report and whether the AER, Handley, Partington and Satchell acknowledge that NERA has addressed the issues; [34]
- explain what Da, Guo and Jagannathan (2012) have to say, what NERA has to say about what the work of Da, Guo and Jagannathan and whether the AER, Handley, Partington and Satchell acknowledge that NERA has addressed the issues that Da, Guo and Jagannathan raise; [35] and
- address any other relevant issues that the AER, Handley, Partington and Satchell raise or do not raise that need to be addressed.

The remainder of this report is structured as follows:

- section 2 reviews the analysis and empirical evidence provided by NERA in its February 2015 and March 2015 reports; and
- section 3 examines whether the AER and its advisors, Handley, Partington and Satchell, have responded to the analysis that NERA provides in its February 2015 and March 2015 reports and what the AER, Handley, Partington and Satchell have had to say.

In addition:

- Appendix A explains how NERA evaluates AER CAPM and Black CAPM forecasts of the cost of equity;
- Appendix B provides the terms of reference for this report;

---

[33] Vasicek, O.A., *A note on using cross-sectional information in Bayesian estimation of security betas*, Journal of Finance, 1973, pages 1233-1239.

[34] Ray, S., N.E. Savin and A. Tiwari, *Testing the CAPM revisited*, Journal of Empirical Finance, 2009, pages 721-733.

[35] Da, Z., R-J. Guo and R. Jagannathan, *CAPM for estimating the cost of equity capital: Interpreting the empirical evidence*, Journal of Financial Economics, 2012, pages 204-220.

- Appendix C provides a copy of the Federal Court of Australia's *Guidelines for Expert Witnesses in Proceeding in the Federal Court of Australia*; and
- Appendix D provides the curriculum vitae of the author of the report.

Statement of Credentials

This report has been prepared by **Simon Wheatley**.

Simon Wheatley is an Affiliated Industry Expert with NERA, and was until 2008 a Professor of Finance at the University of Melbourne. Since 2008, Simon has applied his finance expertise in investment management and consulting outside the university sector. Simon's interests and expertise are in individual portfolio choice theory, testing asset-pricing models and determining the extent to which returns are predictable. Prior to joining the University of Melbourne, Simon taught finance at the Universities of British Columbia, Chicago, New South Wales, Rochester and Washington.

In preparing this report, the author (herein after referred to as 'I' or 'my' or 'me') confirms that I have made all the inquiries that I believe are desirable and appropriate and that no matters of significance that I regard as relevant have, to my knowledge, been withheld from this report. I acknowledge that I have read, understood and complied with the Federal Court of Australia's *Practice Note CM 7, Expert Witnesses in Proceedings in the Federal Court of Australia*. I have been provided with a copy of the Federal Court of Australia's *Practice Note CM 7, Expert Witnesses in Proceedings in the Federal Court of Australia*, dated 4 June 2013, and my report has been prepared in accordance with those guidelines.

I have undertaken consultancy assignments for United Energy in the past. However, I remain at arm's length, and as an independent consultant.

2. Review of NERA's February 2015 Report

The desirable characteristics of forecasts or estimates are that they be: [36]

- arrived at on a reasonable basis; and
- represent the best possible forecasts or estimates possible in the circumstances.

NERA was asked, in its February 2015 report, to assess whether two well recognised forms of the CAPM: [37]

- the SL CAPM; and
- the Black CAPM

deliver forecasts or estimates that have these characteristics. These two models have been widely used by finance academics over the last 50 years.

NERA also assessed the performances of a naïve model that states that the mean returns to all equities are identical and the AER's implementation of the SL CAPM (the AER CAPM). A naïve model will deliver the same return on equity as setting beta to one and using either the SL CAPM or Black CAPM. NERA assumes that the AER, in implementing the SL CAPM, acts as if it adjusts an estimate of the equity beta of a regulated energy utility solely on the basis of the principles underpinning the Black CAPM. NERA does so, because to evaluate a method for estimating the return required on equity, it must clearly specify the method. Methods that NERA cannot clearly specify, it cannot evaluate. It cannot, for example, evaluate the use by a regulator of its discretion in a way that is not specified and in a way that may vary through time. Based on recent decisions made by the AER, NERA assumes that the AER's implementation of the SL CAPM uses the Black CAPM and an estimate of the zero-beta premium that places a weight of two thirds on zero and a weight of one third on the market risk premium (*MRP*) – or equivalently, that the AER uses the SL CAPM and an adjusted estimate of beta that places a weight of two thirds on an unadjusted estimate and a weight of one third on one.

Figure 2.1 below shows that using the Black CAPM and an estimate of the zero-beta premium that places a weight of two thirds on zero and a weight of one third on the market risk premium *MRP* will deliver the same return on equity as using the SL CAPM and an adjusted estimate of beta that places a weight of two thirds on an unadjusted estimate and a weight of one third on one. The figure uses numbers from the AER's Jemena *Final Decision*. The midpoint of the AER's range for beta is 0.55 but it chooses to use an estimate instead of 0.70 – which could have been arrived at by multiplying 0.55 by two thirds and adding one third to the result. The use of the SL CAPM, a beta of 0.70 and an *MRP* of 6.50 per cent per annum will deliver a mean excess return to equity of 4.55 per cent per annum. This mean

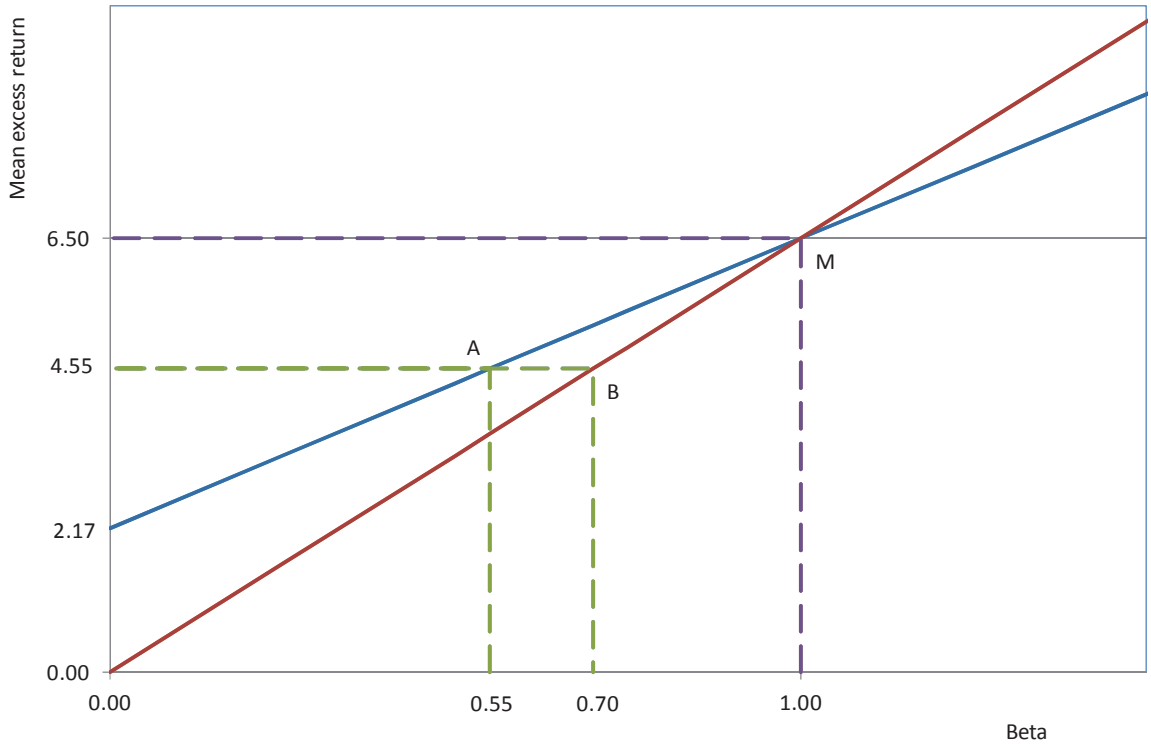
---

[36] While these are clearly very general rules, they also form part of Rule 74 of the National Gas Rules.

[37] NERA, *Empirical performance of Sharpe-Lintner and Black CAPMs: A report for Jemena Gas Networks, Jemena Electricity Networks, ActewAGL, AusNet Services, CitiPower, Energex, Ergon Energy, Powercor, SA Power Networks, and United Energy*, February 2015.

excess return could also have been produced using the Black CAPM, a beta of 0.55 and a zero-beta premium that places a weight of two thirds on zero and a weight of one third on the *MRP* of 6.50 per cent per annum – that is, a zero-beta premium of 2.17 per cent per annum.

Figure 2.1
The AER's implementation of the SL CAPM



Notes: The SL CAPM is represented by the red line while the Black CAPM is represented by the blue line. The two lines cross at the point where beta is one.

In its February 2015 report, NERA uses both in-sample and out-of-sample tests to determine whether there is evidence against the restrictions that each model imposes. If the restrictions imposed by an asset pricing model do not hold, the model will, in general, produce biased estimates of the return required on equity. Consequently, evidence against the restrictions imposed by a model is evidence that the model will generate biased estimates of the return required on equity.

In-sample tests are full-sample tests whereas out-of-sample tests split the full sample up, typically in a recursive manner, into data used to estimate a model and data used to evaluate forecasts generated by the model. Inoue and Kilian (2004) and Diebold (2014) emphasise that in-sample tests of models represent an efficient use of data. [38] In other words, they

[38] Diebold, F., *Comparing predictive accuracy, twenty years later: A personal perspective on the use and abuse of Diebold-Mariano tests*, University of Pennsylvania, December 2013.

Inoue, A. and L. Kilian, In-*sample or out-of-sample tests of predictability: Which one should we use*? Econometric Reviews, 2004, pages 371-402.

emphasise that in-sample tests are more likely to detect that a null hypothesis is untrue than are out-of-sample tests. They also emphasise, however, that out-of-sample tests are simple to interpret and allow one to assess how successful forecasts might be in real time.

Both the SL CAPM and the Black CAPM imply that variation across portfolios in mean return should be completely explained by beta and so NERA uses 10 portfolios formed on the basis of past unadjusted estimates of beta to test the SL CAPM, the Black CAPM, a naïve model and the AER CAPM. [39]

2.1. Empirical Results

The central empirical result that NERA provides in its February 2015 report is that models like the SL CAPM and AER CAPM that use beta as a measure of risk and a restriction that a zero-beta portfolio earn either the risk-free rate or a rate that sits only a small distance above the risk-free rate provide poor estimates of the return required on equity. [40] In particular, the models tend to underestimate the returns required on low-beta equity portfolios and overestimate the returns required on high-beta equity portfolios. [41] In other words, models that use beta as a measure of risk and a restriction that a zero-beta portfolio earn either the risk-free rate or a rate that sits only a small distance above the risk-free rate produce estimates of required returns that are biased – especially for low-beta and high-beta equity portfolios. Thus it is very difficult to see that estimates of the return required on equity that use the SL CAPM or the AER CAPM can represent the best estimates possible in the circumstances.

The SL CAPM and the AER CAPM perform so badly that even a naïve model that states that the mean returns to all equities are identical performs better. One cannot reject the hypothesis that the naïve model generates estimates of the return required on an equity portfolio that are unbiased. Similarly, one cannot reject the hypothesis that the Black CAPM generates estimates of the return required on an equity portfolio that are unbiased. Thus estimates of the return required on equity that use the naïve model or the Black CAPM display characteristics that one would expect the best estimates possible in the circumstances to display.

Appendix B of NERA's February 2015 report provides some intuition for why the results for a naïve model and the Black CAPM are similar. In particular, the appendix provides intuition for why the out-of-sample results for the two models are similar. Grasping the intuition can help one understand why the performance of the SL CAPM and the AER CAPM is so poor and so we review the intuition here.

---

[39] NERA uses monthly data from SIRCA's Share Price and Price Relative database.

SIRCA Australian Share Price and Price Relative (SPPR) information supplied by RoZetta Technology Pty Ltd (www.rozettatechnology.com).

[40] Again, note that we assume that the AER's implementation of the SL CAPM uses an adjusted estimate of beta that places a weight of two thirds on an unadjusted estimate and a weight of one third on one – or, equivalently, uses the Black CAPM and an estimate of the zero-beta premium that places a weight of two thirds on zero and a weight of one third on the *MRP*. An estimate of the zero-beta premium that places a weight of two thirds on zero and a weight of one third on the *MRP* will deliver a zero-beta rate that sits a small distance above the risk-free rate.

[41] By construction, of course, the SL CAPM will correctly estimate the return required on a risk-free asset.

NERA in its February 2015 report examines the out-of-sample performance of forecasts of the return on equity generated by the Black CAPM that use at each point in time past data to assess the relation between mean return and beta across portfolios. NERA generates these forecasts in the same way as the AER implicitly does in using: [42]

> 'the theoretical principles underpinning the Black CAPM to inform the equity beta point estimate'

that it employs for use with the SL CAPM. In other words, NERA uses an adjusted estimate of beta that with the SL CAPM delivers the same return as an adjusted estimate used with the Black CAPM. However, whereas the AER uses theory to guide its choice of an adjusted equity beta, NERA uses past empirical evidence. Appendix A describes how NERA does so. If past data suggests that there is little relation between mean return and beta across portfolios, estimates of the zero-beta premium and *MRP* will come close to matching one another. If estimates of the zero-beta premium and *MRP* come close to matching one another, then adjusted estimates of equity betas selected for use with the SL CAPM to generate forecasts of the return on equity will sit close to one. In other words, under these circumstances estimates produced by the Black CAPM will come close to matching estimates generated by a naïve model.

Figure 2.2 below plots rolling ordinary least squares unadjusted estimates of the betas of the 10 portfolios formed on the basis of past unadjusted estimates of beta that NERA uses in its February 2015 report against time. Figure 2.3, on the other hand, plots the rolling adjusted estimates that NERA uses in constructing forecasts of the return on equity that employ the Black CAPM. A comparison of the two figures indicates that at each point in time, the Black model looks back at past data, finds little relation between mean return and beta across portfolios and so sets the adjusted betas of the 10 portfolios close to one. Following this strategy provides forecasts of the return on equity that are similar to the forecasts generated by a naïve model. NERA's tests cannot reject the hypothesis that both models generate forecasts that are unbiased. In contrast, NERA's tests can reject the hypothesis that forecasts generated by the SL CAPM and the AER CAPM are unbiased.

Table 2.1 below summarises the results of NERA's tests. The table indicates whether a Wald test of each model accepts or rejects the model. A Wald statistic uses unrestricted parameter estimates and an estimate of the covariance matrix of the unrestricted parameter estimates to test whether a set of restrictions are true. [43] The tests use monthly data from January 1974 to December 2013.

---

[42] AER, *Draft decision Jemena Gas Networks (NSW) Ltd Access arrangement 2015–20: Attachment 3: Rate of return*, November 2014, page 265.

[43] Davidson, R. and J.G. MacKinnon, *Estimation and inference in econometrics*, Oxford University Press, 1993, page 89.

Figure 2.2
Unadjusted rolling OLS estimates of beta for 10 past beta-sorted portfolios

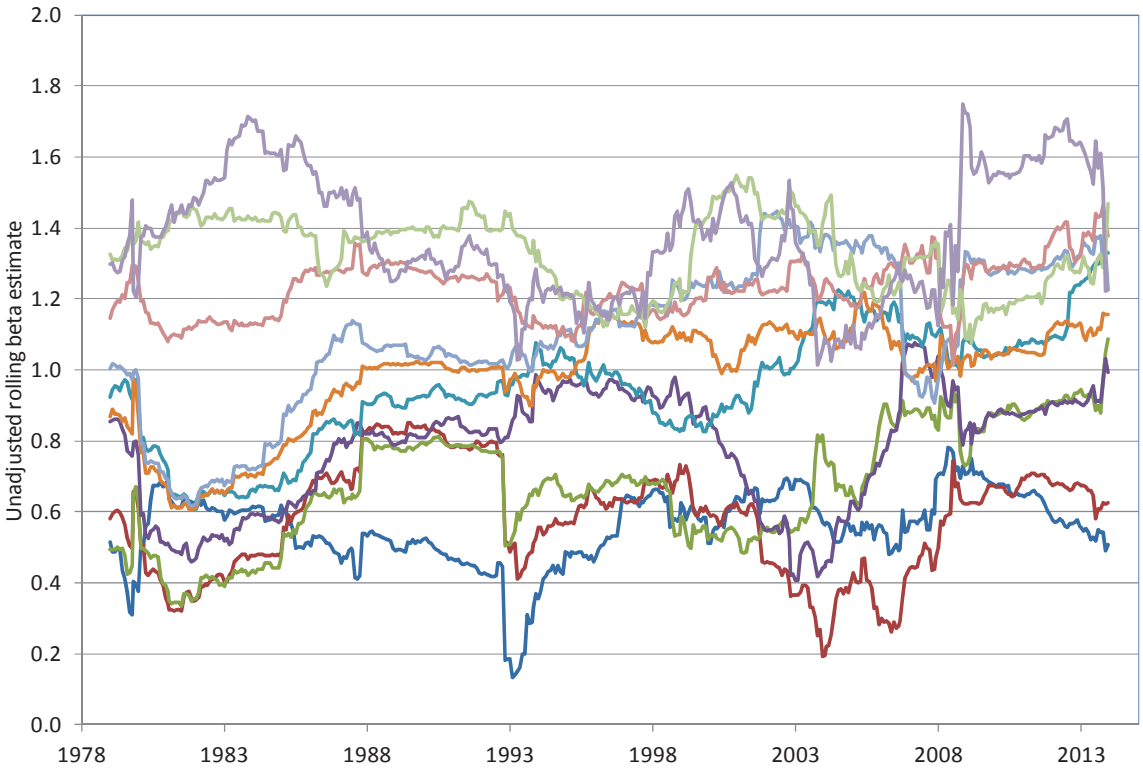


Figure 2.3
Black adjusted rolling estimates of beta for 10 past beta-sorted portfolios

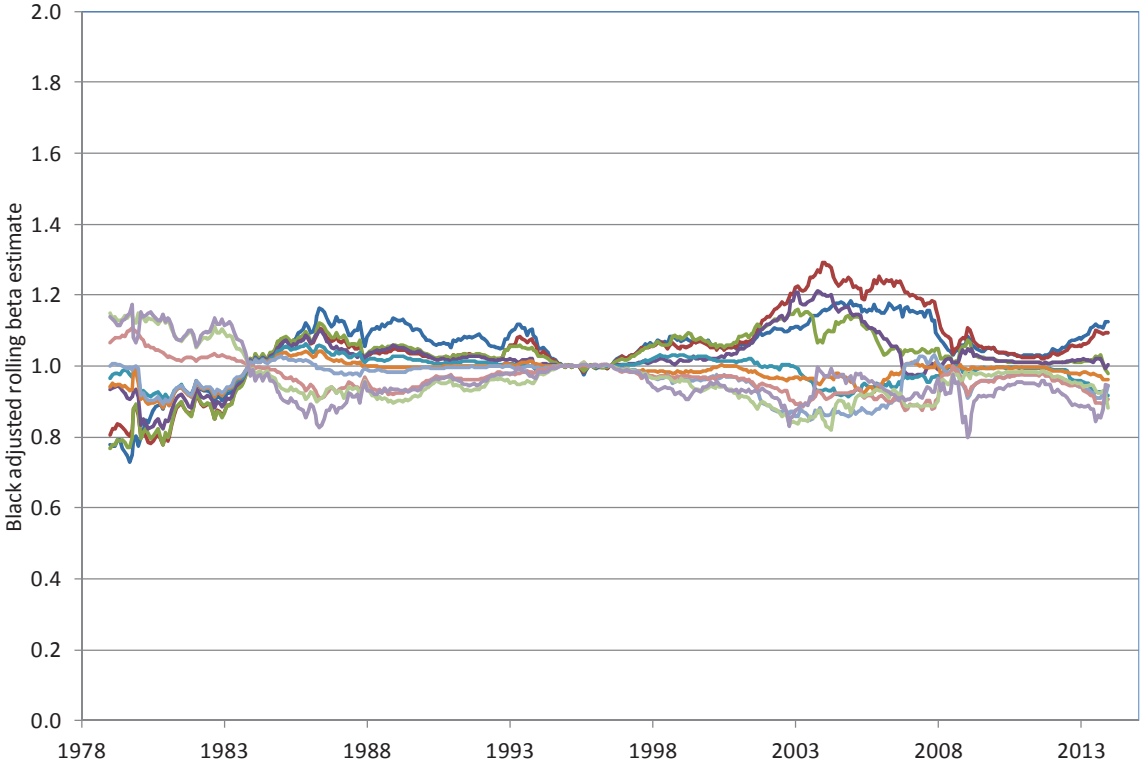


Table 2.1
Summary of test results

	In-sample	Out-of-sample
Naïve model	Accept	Accept
SL CAPM	Reject	Reject
AER CAPM		Reject
Black CAPM	Accept	Accept

Notes: The table indicates whether a Wald test of each model accepts or rejects the model. The tests use monthly data from January 1974 to December 2013.

2.2. Related Results

The results that NERA provides in its February 2015 report that use Australian data are similar to results that others provide using US data.

As an example, the results that NERA provides are similar to the results that Lewellen, Nagel and Shanken (2010) provide using US data.[44] Davis (2011), Handley (2014) and McKenzie and Partington (2014), in reports written for the AER, endorse the use of the SL CAPM and review, favourably, the work of Lewellen, Nagel and Shanken.[45] The evidence that Lewellen, Nagel and Shanken provide, however, indicates that the SL CAPM does not generate unbiased estimates of the cost of equity.

Lewellen, Nagel and Shanken use, in their empirical work, quarterly data from 1963 to 2004 on the returns to 25 portfolios formed on the basis of book-to-market and size and 30 industry portfolios. Figure 2.4 below plots the sample mean returns in excess of the risk-free rate for the 25 portfolios formed on the basis of book-to-market and size against estimates of their betas, indicated by the 25 blue markers, together with the relation that Lewellen, Nagel and Shanken estimate exists between mean excess return and beta for the portfolios, indicated by the red line.[46] The figure shows that Lewellen, Nagel and Shanken find the relation between mean return and beta to be a negative one – as we find in Australian data. Figure 2.5 plots the sample mean returns in excess of the risk-free rate on all 55 portfolios against estimates of their betas, indicated by the 55 blue markers, together with the relation that Lewellen, Nagel and Shanken estimate exists between mean excess return and beta for the portfolios, again

---

[44] Lewellen, J., S. Nagel and J. Shanken, *A skeptical appraisal of asset pricing tests*, Journal of Financial Economics, 2010, pages 175-194.

[45] Davis, K., *Cost of Equity Issues: A Report for the AER*, University of Melbourne, January 2011.

Davis, K., *Cost of Equity Issues: A further report for the AER*, University of Melbourne, May 2011.

Handley, J., *Advice on the return on equity*, University of Melbourne, October 2014.

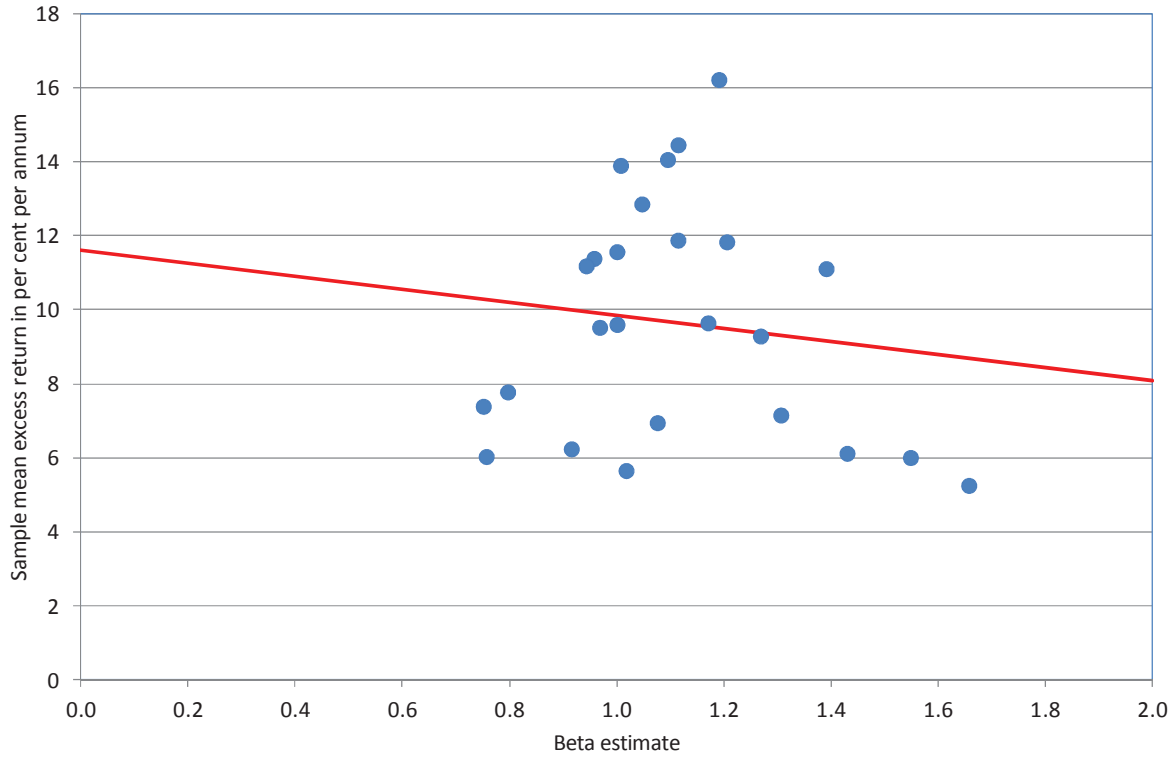
McKenzie, M. and G. Partington, *Report to the AER Part A: Return on equity*, SIRCA, 2014.

[46] See Table 1 on page 188 of their paper.

Lewellen, J., S. Nagel and J. Shanken, *A skeptical appraisal of asset pricing tests*, Journal of Financial Economics, 2010, page 188.

indicated by the red line.[47] Figures 2.4 and 2.5 indicate that there is little relation between the sample mean return to a portfolio and an estimate of its beta.

Figure 2.4
Sample mean excess return against beta estimate for 25 US portfolios formed on the basis of book-to-market and size: Quarterly data from 1963 to 2004



Notes: Data are from Ken French's web site and are those used by Lewellen, Nagel and Shanken (2010). The red line plots Lewellen, Nagel and Shanken's estimate of the relation between mean excess return and beta constructed from the 25 portfolios formed on the basis of book-to-market and size. Sample mean excess returns have been annualised by multiplying the quarterly returns by four and are in per cent per annum.

Sources: http://mba.tuck.dartmouth.edu/pages/faculty/ken.french/data_library.html

Lewellen, J., S. Nagel and J. Shanken, A skeptical appraisal of asset pricing tests, Journal of Financial Economics, 2010, Table 1, page 188.

Other authors reach the same conclusion. For example, Fama and French (1992) state in the abstract to their paper that.[48]

---

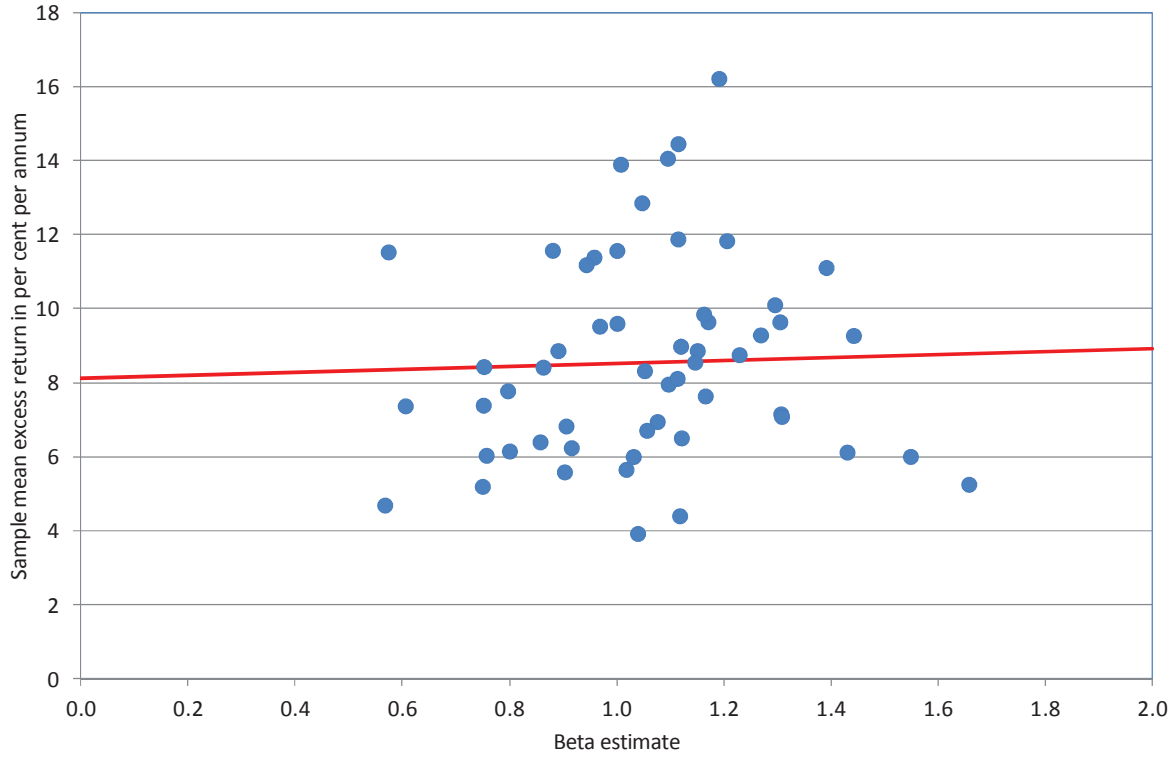
[47] See Table 1 on page 188 of their paper.

Lewellen, J., S. Nagel and J. Shanken, *A skeptical appraisal of asset pricing tests*, Journal of Financial Economics, 2010, page 188.

[48] Commonsense dictates that there may be a choice of portfolios whose mean returns one wishes to explain, for which deviations from the SL CAPM will be hidden from view. Fama and French (1992, 1996) and Kothari, Shanken and Sloan (1995) show that in US data the SL CAPM can explain the cross-section of mean returns to portfolios formed on the basis of size alone. However, the same authors show that when each size portfolio is further sorted into a set of

'the relation between market β and average return is flat, even when β is the only explanatory variable.'

Figure 2.5
Sample mean excess return against beta estimate for 25 US book-to-market and size sorted portfolios and 30 US industry portfolios: Quarterly data from 1963 to 2004



Notes: Data are from Ken French's web site and are those used by Lewellen, Nagel and Shanken (2010). The red line plots Lewellen, Nagel and Shanken's estimate of the relation between mean return and beta constructed from the 25 portfolios formed on the basis of book-to-market and size and the 30 industry portfolios.

Sources: http://mba.tuck.dartmouth.edu/pages/faculty/ken.french/data_library.html

Lewellen, J., S. Nagel and J. Shanken, A skeptical appraisal of asset pricing tests, Journal of Financial Economics, 2010, Table 1, page 188.

---

portfolios on the basis of past estimates of beta, the deviations from the model that exist are revealed. Fama and French (1993) and Cochrane (2001) similarly show that when each size portfolio is further sorted into a set of portfolios on the basis of book-to-market, the deviations from the model that exist are revealed.

Cochrane, J., *Asset pricing*, Princeton University Press, 2001, chapter 20.

Fama, Eugene and Kenneth French, *The cross-section of expected returns*, Journal of Finance 47, 1992, pages 427-465.

Fama, Eugene and Kenneth French, *Common risk factors in the returns to stocks and bonds*, Journal of Financial Economics 33, 1993, pages 3-56.

Fama, Eugene and Kenneth French, *The CAPM is wanted, dead or alive*, Journal of Finance 51, 1996, pages 1947-1958.

Kothari, S.P., Jay Shanken, and Richard G. Sloan, *Another look at the cross-section of expected stock returns*, Journal of Finance, 1995, pages 185–224.

Similarly, Campbell and Vuolteenah (2005) summarise the evidence in the following way:[49]

> 'It is well known that the CAPM fails to describe average realized stock returns since the early 1960s, if a value-weighted equity index is used as a proxy for the market portfolio. In particular, small stocks and value stocks have delivered higher average returns than their betas can justify. Adding insult to injury, stocks with high past betas have had average returns no higher than stocks of the same size with low past betas.'

2.3. Market Proxies

The SL CAPM and the Black CAPM predict that the market portfolio of all risky assets will be mean-variance efficient.[50] As Roll (1977) makes clear, however, one cannot observe the return to the market portfolio of all risky assets and so one may never know whether the models are true.[51]

The AER uses difficulties in testing the predictions that the SL CAPM makes about the behaviour of the return to the market portfolio of all risky assets to shield the version of the model that it employs from scrutiny. The AER, for example, states in the *Appendices* to its *Rate of Return Guidelines* that:[52]

> 'Many of the empirical tests of the Sharpe–Lintner CAPM, however, are themselves the subject of ongoing academic debate. For example, a common test used to demonstrate low beta bias is to plot the average beta of share portfolios against the realised returns on these portfolios. Indeed, similar evidence was included in the report by NERA, and submitted by ENA. In previous decisions we have highlighted the limitations of these tests, as suggested in the academic literature. These limitations include (that) they use a market proxy that does not accord with the Sharpe–Lintner CAPM market.'

NERA emphasises in its February 2015 and March 2015 reports that the AER does not employ a version of the SL CAPM that uses the return to the market portfolio of all risky assets.[53] The version of the model that the AER employs uses the market portfolio of stocks alone as a proxy for the market portfolio of all risky assets. Thus whether the model works when one employs the return to the market portfolio of all risky assets is irrelevant to the issue of how the AER should set the return on equity for a regulated energy utility. The AER employs a version of the SL CAPM that uses the market portfolio of stocks as a proxy for the market portfolio of all risky assets. Thus, what is relevant to the issue of how the AER

---

[49] Campbell, J. and T. Vuolteenaho, *Bad beta, good beta*, American Economic Review, 2004, page 1249.

[50] A portfolio that is mean-variance efficient is one that has the highest mean return for given variance of return.

[51] Roll, R., *A critique of the asset pricing theory's tests: Part I*, Journal of Financial Economics 4, 1977, pages 129-176.

[52] AER, *Better Regulation Explanatory Statement Rate of Return Guideline (Appendices)*, December 2013, pages 11-12.

[53] NERA, *Empirical performance of Sharpe-Lintner and Black CAPMs: A report for Jemena Gas Networks, Jemena Electricity Networks, ActewAGL, AusNet Services, CitiPower, Energex, Ergon Energy, Powercor, SA Power Networks, and United Energy*, February 2015.

NERA, *Review of the literature in support of the Sharpe-Lintner CAPM, the Black CAPM and the Fama-French three-factor model: A report for Jemena Gas Networks, Jemena Electricity Networks, AusNet Services, Australian Gas Networks, CitiPower, Ergon Energy, Powercor, SA Power Networks, and United Energy*, March 2015.

should set the return on equity for a regulated energy utility is whether the version of the SL CAPM that the regulator employs works. The empirical version of the SL CAPM that the AER employs matches the empirical version of the model that NERA tests in its February 2015 report. So the evidence provided in that report is relevant to determining whether estimates provided by the empirical version of the SL CAPM that the AER employs will provide a return that is commensurate with the efficient financing costs of a benchmark efficient entity with a similar degree of risk. Unless otherwise stated, all references to tests of the SL CAPM or Black CAPM in this report are to tests of empirical versions of the models that use the return to a portfolio of stocks as a proxy for the market portfolio of all risky assets.

Roll (1977) also points out that: [54]

> 'There is an 'if and only if' relation between return/beta linearity and market portfolio mean-variance efficiency.'

Thus the results that NERA provides in its February 2015 report using Australian data and the results that Fama and French (1992), Campbell and Vuolteenah (2005) and Lewellen, Nagel and Shanken (2010) provide using US data indicate that there is evidence that neither the market portfolio of Australian stocks nor the market portfolio of US stocks is efficient. [55]

2.4. Test Size

The AER and McKenzie and Partington refer to the work of Ray, Savin and Tiwari (2009) who show that the finite-sample distribution of the Wald statistic for a test of the SL CAPM need not conform closely to its theoretical asymptotic distribution. [56] A Wald statistic uses unrestricted parameter estimates and an estimate of the covariance matrix of the unrestricted parameter estimates to test whether a set of restrictions are true. [57] The finite-sample distribution refers to the distribution in samples that are not very, very large while the asymptotic distribution refers to the distribution in very, very large samples. Asymptotic results are ones that are strictly true only in the limit as the sample size tends to infinity. [58] As a result of the differences that can occur between the finite-sample and asymptotic distributions of the Wald statistics used to test the SL CAPM, Ray, Savin and Tiwari note that tests of pricing models that rely on the asymptotic distributions of the statistics can reject more frequently than the stated sizes of the tests would suggest. The size of a test or

---

[54] Roll, R., *A critique of the asset pricing theory's tests: Part I*, Journal of Financial Economics 4, 1977, page 130.

[55] Campbell, J. and T. Vuolteenaho, *Bad beta, good beta*, American Economic Review, 2004, pages 1249-1275.

Fama, Eugene and Kenneth French, *The cross-section of expected returns*, Journal of Finance 47, 1992, pages 427-465.

Lewellen, J., S. Nagel and J. Shanken, *A skeptical appraisal of asset pricing tests*, Journal of Financial Economics, 2010, pages 175-194.

[56] AER, *Better Regulation Explanatory Statement Rate of Return Guideline (Appendices)*, December 2013, page 12.

McKenzie, M. and G. Partington, *Report to the AER Part A: Return on equity*, SIRCA, October 2014, page 9.

Ray, S., N.E. Savin and A. Tiwari, *Testing the CAPM revisited*, Journal of Empirical Finance, 2009, pages 721-733.

[57] Davidson, R. and J.G. MacKinnon, *Estimation and inference in econometrics*, Oxford University Press, 1993, page 89.

[58] Davidson, R. and J.G. MacKinnon, *Estimation and inference in econometrics*, Oxford University Press, 1993, page 42.

significance level refers to the probability that the test will reject the null hypothesis when the null is true. To examine the extent to which the finite-sample distribution of the Wald statistic, which NERA uses in its February 2015 report to test the SL CAPM, differs from its theoretical asymptotic distribution, NERA conducts bootstrap simulations. Each simulation uses 10,000 replications. A bootstrap simulation involves creating simulated data by drawing observations at random with replacement from a particular set of data.[59]

NERA reports that it finds that, consistent with what Ray, Savin and Tiwari find, the finite-sample behaviour of the Wald statistic for a test of the SL CAPM differs from its theoretical asymptotic distribution. The difference between the finite-sample and theoretical asymptotic distributions, however, is not sufficient to reverse the inference that NERA draws from its results. The evidence that NERA provides indicates that the SL CAPM can be rejected at conventional levels of significance whether inference is based on the finite-sample or theoretical asymptotic distribution of the Wald statistic. In other words, regardless of how significance is assessed, the results that NERA provides indicate that it is very unlikely that estimates of the return required on equity that use the SL CAPM will represent the best estimates possible in the circumstances.

[59] Davidson, R. and J.G. MacKinnon, *Estimation and inference in econometrics*, Oxford University Press, 1993, page 753.

3. Response of the AER and its Advisors

The AER and its advisors have had very little to say about NERA's February 2015 and March 2015 reports and in several instances have ignored NERA's reports altogether. Here we will review what the AER and its advisors have had to say and make it clear, where it is necessary to do so, that the AER and its advisors have ignored arguments that NERA has made or evidence that NERA has provided. [60]

3.1. Costs Associated with Poor Estimates of the Cost of Equity

In our March 2015 report, we emphasise that both regulated and unregulated firms use asset pricing models to construct estimates of the cost of equity but that the costs of choosing a model that delivers a poor estimate of the cost of equity will in general be greater for a regulated firm than for an unregulated firm. Handley states that: [61]

> 'the comparison of the implications of an incorrectly estimated cost of capital for a regulated firm verses an unregulated firm is unnecessary.'

We disagree and believe that the comparison is important. As Grout (1995) makes clear: [62, 63]

> 'For non-regulated activity prices are not directly dependent o(n) the cost of capital. Firms aim to maximize profit and the precise value of the cost of capital, since it is used as a hurdle rate, will only affect the marginal projects. If the cost of capital is mistakenly set too high then some marginal projects that are good are rejected and if it is too low then some bad projects are accepted. However, almost all will be unaffected by the exact value that is attached to the cost of capital. In contrast, for regulated activities almost all regulated prices will be affected by the cost of capital. If the cost of capital is over-estimated then the price of all these activities will be set

---

[60] NERA, *Empirical performance of Sharpe-Lintner and Black CAPMs: A report for Jemena Gas Networks, Jemena Electricity Networks, ActewAGL, AusNet Services, CitiPower, Energex, Ergon Energy, Powercor, SA Power Networks, and United Energy*, February 2015.

NERA, *Review of the literature in support of the Sharpe-Lintner CAPM, the Black CAPM and the Fama-French three-factor model: A report for Jemena Gas Networks, Jemena Electricity Networks, AusNet Services, Australian Gas Networks, CitiPower, Ergon Energy, Powercor, SA Power Networks, and United Energy*, March 2015.

[61] Handley, J.C., *Advice on the rate of return for the 2015 AER Energy Network Determination for Jemena Gas Networks*, 20 May 2015, page 3.

[62] Grout, P., *The cost of capital in regulated industries*, in M. Bishop, J. Kay and C. Mayer (eds.), The regulatory challenge, Oxford University Press, 1995, pages 386-407.

[63] It is obvious that here Grout intends a 'precise estimate' to be an accurate estimate rather than solely an estimate to which is attached a low standard error.

The Oxford Dictionary definition of precision is:

> 'accuracy or exactness.'

In statistics the precision of a random variable is the reciprocal of its variance. So in statistics a precise estimator can be exact but inaccurate.

Davidson, R. and J. G. MacKinnon, *Estimation and inference in econometrics*, Oxford University Press, Oxford, 1993, page 144.

Fowler, F.G. and H.W. Fowler, *Pocket Oxford Dictionary*, Oxford University Press, Oxford, 1966, page 623.

> too high, and if it is under-estimated then all prices will be too low. Obviously, the relationship will be stronger and more direct for rate of return regulation than for price cap regulation, but the general principle holds good. *The economic implications of errors in the cost of capital are far greater in the regulated sector than in the private non-regulated sector and, not surprisingly, the pressure to provide precise estimates is greater both from the regulators and those within the regulated industries than in the private non-regulated sector.*'
>
> [The emphasis is ours]

3.2. Empirical Results

NERA shows in its February 2015 report that the SL CAPM and the AER CAPM tend to provide downwardly biased estimates of the returns required on low-beta equity portfolios and upwardly biased estimates of the returns required on high-beta equity portfolios. NERA shows, on the other hand, that one cannot reject the hypothesis that a naïve model that states that the mean returns to all equities are identical delivers unbiased estimates of the returns required on equity portfolios. Again, a naïve model will deliver the same return on equity as setting beta to one and using either the SL CAPM or Black CAPM. [64] NERA also shows that one cannot reject the hypothesis that the Black CAPM delivers unbiased estimates of the returns required on equity portfolios.

The AER's response to the evidence that NERA provides that the SL CAPM and the AER CAPM provide downwardly biased estimates of the returns required on equity portfolios is that: [65]

> 'Several service providers submitted an empirical test of the SLCAPM and the Black CAPM by NERA. We observe that the results in NERA's report appear counterintuitive. For instance, NERA's in-sample tests indicated there was a negative relation between returns and beta—which is not consistent with the theory underpinning the SLCAPM or the Black CAPM. NERA also provided an estimate of the zero-beta premium of 10.75 per cent. It has been acknowledged that it is implausible for the zero beta premium to be equal to or greater than the MRP.'
>
> 'We consider the empirical information submitted in relation to the ex post performance of the different models does not show our application of the SLCAPM will undercompensate the benchmark efficient entity for it efficient cost of equity.'

One way of interpreting this very limited response to the evidence that NERA provides is that because the regulator believes the results of the work to be counterintuitive, the AER is suspicious that there is something wrong with NERA's empirical work. We do not believe that there is anything wrong with NERA's empirical work. We have already noted in

---

[64] Australian regulators have in the past set the beta of a regulated energy utility to one. See, for example:

AER, *Final decision Electricity transmission and distribution network service providers Review of the weighted average cost of capital (WACC) parameters*, May 2009, page 241.

[65] AER, *Final Decision Jemena Gas Networks (NSW) Ltd Access Arrangement 2015–20 Attachment 3 – Rate of return*, June 2015, pages 251-252.

section 2 that NERA's results based on Australian data are similar to results produced using US data.

The AER's own advisors are also, not surprisingly, aware of this evidence. As Partington and Satchell point out: [66]

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

Similarly, Handley notes that: [67]

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

This recent statement contradicts the statement that Handley makes in a 2011 peer review of a report written by Davis on behalf of the AER. In that report, Handley states that: [68]

> 'CEG is incorrect to suggest that:
>
> > "The existence of bias in the AER implementation of the CAPM can reasonably be regarded as being universally accepted by those who have examined the empirical data. ... This is one of the few areas of consensus amongst finance experts."'

We should also note that NERA's results are similar to results produced independently by CEG using Australian data in a September 2008 report. [69] SFG in May 2014 use a relatively short time series and find a relation between mean return and beta that depends on how the equity portfolios used in the analysis are formed but that is, regardless of how the portfolios are formed, insignificant at conventional levels. [70]

We note that, in contrast, neither the AER nor its advisors have generated any empirical evidence using either the data that we employ, provided by SIRCA, or any other data to

---

66 Partington, G. and S. Satchell, *Report to the AER: Return of (sic) equity and comment on submissions in relation to JGN*, May 2015, page 9.

67 Handley, J.C., *Advice on the rate of return for the 2015 AER Energy Network Determination for Jemena Gas Networks*, 20 May 2015, page 5.

68 Handley, J.C., *Peer review of draft report by Davis on the cost of equity*, 18 January 2011, page 4.

69 CEG, *Estimation of, and correction for, biases inherent in the Sharpe CAPM formula*, September 2008.

70 SFG, *Cost of equity in the Black Capital Asset Pricing Model Report for Jemena Gas Networks, ActewAGL, Networks NSW, Transend, Ergon and SA Power Networks*, 22 May 2014, page 3.

produce support for the use of either the SL CAPM or the AER's implementation of the model. [71]

The AER's statement that: [72]

> 'It has been acknowledged that it is implausible for the zero beta premium to be equal to or greater than the MRP.'

cites as its sources page 92 of NERA's May 2014 report and page 3 of SFG's May 2014 report. [73] Neither NERA's report nor SFG's report, however, support the AER's statement.

Page 92 of NERA's report states that: [74]

> 'our specification of the Black CAPM assumes that the zero-beta premium is equal to the *MRP*. In other words, our specification of the Black CAPM will result in the same mean return for all stocks. This result may appear implausible, but it merely reflects the inability of estimates of beta computed relative to the market portfolio of stocks to track variation in returns across stocks.'

Page 3 of SFG's report states that: [75]

> 'In theory, we would also expect the zero beta return ... to lie below the expected market return ... However, this basic theory will not necessarily show up in the data because two things are measured with imprecision. First, the proxy for the market portfolio of all risky assets is an index of listed stocks. Second, analysis is performed with respect to realised returns and not expected returns, so relies upon the assumption that there is enough historical information in realised returns for noise in different directions to cancel out.'

Only once in SFG's May 2014 report does the word 'implausible' appear and that is on page 18 in a quote taken from page 71 of the appendices to the AER's own 2013 *Rate of Return Guideline*. [76]

Handley suggests that NERA argues that: [77]

> 'the Black-CAPM explains the low-beta bias.'

---

[71] SIRCA Australian Share Price and Price Relative (SPPR) information supplied by RoZetta Technology Pty Ltd (www.rozettatechnology.com).

[72] AER, *Final Decision Jemena Gas Networks (NSW) Ltd Access Arrangement 2015–20 Attachment 3 – Rate of return*, June 2015, page 251.

[73] NERA, *Return on Capital of a Regulated Electricity Network: A report for Ashurst*, May 2014, page 92.

SFG, *Cost of Equity in the Black Capital Asset Pricing Model*, 22 May 2014, page 3.

[74] NERA, *Return on Capital of a Regulated Electricity Network: A report for Ashurst*, May 2014, page 92.

[75] SFG, *Cost of Equity in the Black Capital Asset Pricing Model*, 22 May 2014, page 3.

[76] AER, *Better regulation: Rate of return guideline – Explanatory Statement (Appendices),* December 2013, page 71.

[77] Handley, J.C., *Advice on the rate of return for the 2015 AER Energy Network Determination for Jemena Gas Networks*, 20 May 2015, page 7.

NERA does not do so. NERA states that: [78]

> 'by construction, the Black CAPM eliminates the tendency of the SL CAPM to underestimate the returns to low-beta assets and overestimate the returns to high-beta assets.'

Eliminating and explaining the low-beta bias are two different tasks.

3.3. Market Proxies

We note in section 2 that the AER has in the past criticised tests of the SL CAPM that use the return to the market portfolio of stocks as a proxy for the market portfolio of all risky assets – even though the regulator itself uses the return to the market portfolio of stocks as a proxy for the market portfolio of all risky assets in using the model. We also note that NERA makes clear in its February 2015 and March 2015 reports that whether the model works when one employs the return to the market portfolio of all risky assets is irrelevant to the issue of how the AER should set the return on equity for a regulated energy utility. The AER employs a version of the SL CAPM that uses the market portfolio of stocks as a proxy for the market portfolio of all risky assets. Thus, what is relevant to the issue of how the AER should set the return on equity for a regulated energy utility is whether the version of the SL CAPM that the regulator employs works. NERA states that: [79]

> 'The argument that tests of the SL CAPM 'use a market proxy that does not accord' with the model is irrelevant as we have already pointed out. The AER and its advisors use estimates of beta computed relative to the value-weighted market portfolio of stocks and so do the vast majority of empirical tests.'

The AER and its advisors in their most recent reports do not explicitly criticise NERA and other consultants for using – as the AER does when it uses the SL CAPM – the return to the market portfolio of stocks as a proxy for the return to the market portfolio of all risky assets. The AER does, however, quote a passage from Partington's (2015) report that could easily be interpreted as suggesting that there is something unusual or wrong about the 'reference' portfolio or proxy for the market portfolio of all risky assts that NERA uses. [80] Partington states that: [81]

> 'the results of NERA's various empirical analyses (most recently NERA, 2015) show that the reference portfolio they use is not on the efficient set ex-post. If it were, then there would be a perfect linear relation between the returns on securities and their

---

[78] NERA, *Review of the literature in support of the Sharpe-Lintner CAPM, the Black CAPM and the Fama-French three-factor model: A report for Jemena Gas Networks, Jemena Electricity Networks, AusNet Services, Australian Gas Networks, CitiPower, Ergon Energy, Powercor, SA Power Networks, and United Energy*, March 2015, page 15.

[79] NERA, *Empirical Performance of Sharpe-Lintner and Black CAPMs: A report for Jemena Gas Networks, Jemena Electricity Networks, ActewAGL, AusNet Services, CitiPower, Energex, Ergon Energy, Powercor, SA Power Networks, and United Energy*, February 2015, page 52.

[80] AER, *Final Decision Jemena Gas Networks (NSW) Ltd Access Arrangement 2015–20 Attachment 3 – Rate of return*, June 2015, page 251.

[81] Partington, G., *Report to the AER Return on equity (updated)*, April 2015, page 25.

> betas calculated relative to the reference portfolio. Empirically, however, this is not the case. Therefore, the reference portfolio is not on the efficient set.'

As we note in section 2, there is an 'if and only if' relation between return/beta linearity and market portfolio mean-variance efficiency. Thus a rejection of the hypothesis that there is a positive linear relation between mean return and beta indicates that the equivalent hypothesis that the reference portfolio or proxy for the market portfolio is mean-variance efficient can also be rejected. NERA's rejection of the two hypotheses does not mean that the wrong reference portfolio has been used. It means that there is evidence that the empirical version of the SL CAPM that the AER employs does not work – that is, the model produces biased estimates of the return required on equity.

Handley also makes the implicit suggestion that NERA uses a proxy for the market portfolio or reference portfolios that differs from the portfolio chosen by the AER. He states that: [82]

> 'I interpret the AER's reference to Roll's critique in the Guideline in a different way – being, Roll also showed how sensitive empirical tests of the CAPM can be to the particular market proxy that is used in the test.'

The implicit suggestion is false. Both the AER and NERA use as a proxy for the market portfolio a value-weighted portfolio of Australian stocks. Indeed, NERA deliberately chooses to use the same portfolio as the AER because it wishes to avoid the tests that it performs being subject to this criticism.

A related issue is that Partington and Satchell state about tests of the SL CAPM that: [83]

> 'another difficulty is that betas cannot be directly observed and have to be estimated.'

The fact that betas cannot be directly observed and have to be estimated may provide problems in testing whether the SL CAPM is literally true. We are, however, not interested in whether the SL CAPM is literally true but in whether, in practice, using the SL CAPM to estimate the cost of equity delivers unbiased estimates. In practice, regulators must estimate the equity beta of a regulated energy utility and so in evaluating estimates of the cost of equity produced, in practice, using the SL CAPM we should also use estimates of equity betas.

3.4. AER's Implementation of the SL CAPM

In using the SL CAPM, the AER uses what it calls the 'theory' behind the Black CAPM to influence its choice of an equity beta. For example, the AER states that: [84]

---

[82] Handley, J.C., *Advice on the rate of return for the 2015 AER Energy Network Determination for Jemena Gas Networks*, 20 May 2015, page 4.

[83] Partington, G. and S. Satchell, *Report to the AER: Return of (sic) equity and comment on submissions in relation to JGN*, May 2015, page 8.

[84] AER, *Final Decision Jemena Gas Networks (NSW) Ltd Access Arrangement 2015–20 Attachment 3 – Rate of return*, June 2015, page 448.

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

The AER also states that it places some weight on foreign estimates of beta. While it sees: [85]

> 'there are inherent uncertainties when relating foreign estimates to Australian conditions'

the AER concludes that foreign estimates of beta: [86]

> 'provide some limited support for an equity beta point estimate towards the upper end of our range.'

We cannot be sure what weight the AER places on the principles underpinning the Black CAPM and what weight the AER places on foreign estimates of beta because the AER does not reveal this information. In our February 2015 report, we assume that the AER acts as if it adjusts an estimate of the equity beta of a regulated energy utility solely on the basis of the principles underpinning the Black CAPM. We do so, because to evaluate a method for estimating the return required on equity, one must clearly specify the method. Methods that one cannot clearly specify, one cannot evaluate. One cannot, for example, evaluate the use by a regulator of its discretion in a way that is not specified and in a way that may vary through time.

Based on recent decisions made by the AER, NERA assumes in its February 2015 report that the AER's implementation of the SL CAPM uses the Black CAPM and an estimate of the zero-beta premium that places a weight of two thirds on zero and a weight of one third on the *MRP* – or equivalently, that the AER uses the SL CAPM and an adjusted estimate of beta that places a weight of two thirds on an unadjusted estimate and a weight of one third on one.

The evidence that NERA provides indicates that the adjustment that the AER makes is not sufficient to eliminate the problems associated with the SL CAPM. NERA rejects the hypothesis that the AER's implementation of the SL CAPM provides unbiased estimates of the return on equity – particularly for low-beta stocks. Handley, in his May 2015 report, however, states that: [87]

> 'In my opinion, the AER has taken into account the empirical evidence relating to the potential for low beta bias in deciding not to use the Black-CAPM and in deciding to take a beta estimate from the high end of its estimated range.'

This statement is directly contradicted by the evidence that NERA provides in its February 2015 report. The average (post-formation) least squares estimate of the beta of the low-beta portfolio in NERA's tests is 0.55 – identical to the midpoint of the range that the AER uses –

---

[85] AER, *Final Decision Jemena Gas Networks (NSW) Ltd Access Arrangement 2015–20 Attachment 3 – Rate of return*, June 2015, page 448.

[86] AER, *Final Decision Jemena Gas Networks (NSW) Ltd Access Arrangement 2015–20 Attachment 3 – Rate of return*, June 2015, page 448.

[87] Handley, J.C., *Advice on the rate of return for the 2015 AER Energy Network Determination for Jemena Gas Networks*, 20 May 2015, page 17.

and yet NERA provides evidence that even when this estimate is adjusted upwards to 0.7, the SL CAPM continues to underestimate the return on equity. Handley ignores this evidence.

3.5. Multifactor Models

Partington suggests that the concerns that the consultants raise are largely driven by the ability of multifactor pricing models to better explain the cross-section of mean returns. In particular, Partington states that:[88]

> 'The consultants raise concerns with the ability of the CAPM to provide an adequate characterisation of the relationship between risk and return. Their concerns are largely driven by the ability of modern multifactor asset pricing models to provide a more adequate explanation of the cross section of realised average returns.'

The statement is incorrect. It is true that many multifactor pricing models are better able to explain the cross-section of mean returns but it is untrue that the concerns of the consultants about the performance of the SL CAPM are largely confined to this issue. It has been known for well over 40 years that a major flaw with the SL CAPM is that it tends to underestimate the returns required on low-beta equities and we and other consultants have expressed concerns about this low-beta bias numerous times in the past. Moreover, as Fama and French (2014) make clear in a recent paper to which McKenzie and Partington refer in their October 2014 report, multifactor models also suffer from a low-beta bias. [89]

3.6. Ray, Savin and Tiwari (2009)

The AER in its *Guidelines* and McKenzie and Partington in their October 2014 report refer to the work of Ray, Savin and Tiwari (2009) who show that the finite-sample distribution of the Wald statistic for a test of the SL CAPM need not conform closely to its theoretical asymptotic distribution. [90] As we explain in section 2, for this reason, NERA in its February 2015 report conducts bootstrap simulations to ensure that inference is correctly drawn. The simulation results reveal that the SL CAPM can be rejected at conventional levels of significance regardless of whether inference is based on the finite-sample or theoretical asymptotic distribution of the Wald statistic. Thus NERA responds to the concerns that the AER and McKenzie and Partington raise.

Partington in his April 2015 report, however, ignores NERA's response and states that: [91]

> 'recent work suggests that the evidence against the CAPM may not be as robust as previously thought. For example, Ray, Savin and Tiwari (2009) show that the

---

88 Partington, G., *Report to the AER Return on equity (updated)*, April 2015, page 29.

89 Fama, E.F. and K.R. French, *A five-factor asset pricing model*, University of Chicago, IL, March 2014.
McKenzie, M. and G. Partington, *Report to the AER Part A: Return on equity*, SIRCA, October 2014, pages 16-18.

90 AER, *Better Regulation Explanatory Statement Rate of Return Guideline (Appendices)*, December 2013, page 12.
McKenzie, M. and G. Partington, Report to the AER Part A: Return on equity, October 2014, page 9.
Ray, S., N.E. Savin and A. Tiwari, Testing the CAPM revisited, Journal of Empirical Finance, 2009, pages 721-733.

91 Partington, G., *Report to the AER Return on equity (updated)*, April 2015, page 29.

> statistical evidence for rejecting the CAPM is weaker than previously thought when more appropriate statistical tests are used.'

The AER in its June 2015 Jemena *Final Decision* quotes a passage from McKenzie and Partington's October 2014 report that refers to the problem that Ray, Savin and Tiwari (2009) identify without acknowledging that NERA responds to this problem in its February 2015 report.[92] Partington and Satchell quote the same passage and also do not acknowledge that NERA responds to the problem in its February 2015 report.[93]

3.7. Da, Guo and Jagannathan (2012)

In recent work, Da, Guo and Jagannathan (2012) argue that growth options that firms possess may be largely responsible for the weak relation between return and beta.[94] McKenzie and Partington state in their October 2014 report that:[95]

> 'Da, Guo and Jagannathan (2012) argue that the empirical evidence against the capital asset pricing model (CAPM) based on stock returns does not invalidate its use for estimating the cost of capital for projects in making capital budgeting decisions. Their argument is that stocks are backed not only by projects in place, but also by the options to modify current projects and even undertake new ones. Consequently, the expected returns on equity need not satisfy the CAPM even when expected returns of projects do. Thus, their findings justify the continued use of the CAPM irrespective as to one's interpretation of the empirical literature on asset pricing.'

NERA in its February 2015 report states that:[96]

> 'What McKenzie and Partington do not explain is that Da, Guo and Jagannathan do not suggest that the SL CAPM be used in the same way that the AER has been using the model. To construct estimates of beta that can be used in project evaluation, unadjusted common or garden estimates of beta have to be adjusted. Da, Guo and Jagannathan (2012) state that:
>
> > 'In general, both the equity risk premium and the equity beta of a firm are complex functions of the firm's project beta and real option characteristics. If we project them on a set of variables capturing the features of real options using linear regressions, the residual risk premium and the residual beta are option-

---

92 AER, *Final Decision Jemena Gas Networks (NSW) Ltd Access Arrangement 2015–20 Attachment 3 – Rate of return*, June 2015, page 65.

McKenzie, M. and G. Partington, *Report to the AER Part A: Return on equity*, October 2014, page 9.

Ray, S., N.E. Savin and A. Tiwari, *Testing the CAPM revisited*, Journal of Empirical Finance, 2009, pages 721-733.

93 Partington, G. and S. Satchell, *Report to the AER: Return of (sic) equity and comment on submissions in relation to JGN*, May 2015, page 9.

94 Da, Z., R-J. Guo and R. Jagannathan, *CAPM for estimating the cost of equity capital: Interpreting the empirical evidence*, Journal of Financial Economics, 2012, pages 204-220.

95 McKenzie, M. and G. Partington, *Report to the AER Part A: Return on equity*, SIRCA, October 2014, pages 9-10.

96 NERA, *Empirical Performance of Sharpe-Lintner and Black CAPMs: A report for Jemena Gas Networks, Jemena Electricity Networks, ActewAGL, AusNet Services, CitiPower, Energex, Ergon Energy, Powercor, SA Power Networks, and United Energy*, February 2015, page 47.

> adjusted and more closely resemble the underlying project risk premium and project beta.'
>
> Since beta is a relative measure of risk, an adjustment must be made even to the betas of firms that have no growth options. Da, Guo and Jagannathan construct option-adjusted betas as the residuals from a cross-sectional regression, without an intercept, of unadjusted betas on book-to-market, idiosyncratic volatility and the return on assets where the three regressors are measured relative to averages for the market. Neither the AER nor its advisers construct estimates of beta in this way. Thus the evidence that Da, Guo and Jagannathan provide is not relevant to assessing estimates of the cost of equity provided by the empirical version of the SL CAPM that the AER employs.'

In his April 2015 report, Partington ignores what NERA has to say about the work of Da, Guo and Jagannathan and reproduces the comments made in the report of McKenzie and Partington of October 2014. [97] Partington states that: [98]

> 'More importantly, Da, Guo and Jagannathan (2012) argue that the empirical evidence against the capital asset pricing model (CAPM) based on stock returns does not invalidate its use for estimating the cost of capital for projects in making capital budgeting decisions. Their argument is that stocks are backed not only by projects in place, but also by the options to modify current projects and even undertake new ones. Consequently, the expected returns on equity need not satisfy the CAPM even when expected returns of projects do. Thus, their findings justify the continued use of the CAPM irrespective as to one's interpretation of the empirical literature on asset pricing.'

In its June 2015 Jemena *Final Decision*, the AER quotes the passage from McKenzie and Partington's October 2014 report above and ignores what NERA has to say. [99] Partington's report of April 2015 has been placed on the AER's web site on the page on which the AER's June 2015 Jemena *Final Decision* appears. [100]

In his May 2015 report with Satchell, Partington does acknowledge that Da, Guo and Jagannathan do not endorse the use of the AER's implementation of the SL CAPM but endorse an alternative implementation that uses option-adjusted betas. Partington and Satchell state that: [101]

> 'We agree with NERA that Da, Guo and Jagannathan (2012) use option adjusted measures of return and beta. This is an interesting idea, but at its current stage of development we would not recommend its adoption by the AER.'

---

97 McKenzie, M. and G. Partington, *Report to the AER Part A: Return on equity*, SIRCA, October 2014, pages 9-10.

98 Partington, G., *Report to the AER Return on equity (updated)*, April 2015, pages 29-30.

99 AER, *Final Decision Jemena Gas Networks (NSW) Ltd Access Arrangement 2015–20 Attachment 3 – Rate of return*, June 2015, page 65.

100 https://www.aer.gov.au/node/24741

101 Partington, G. and S. Satchell, *Report to the AER: Return of (sic) equity and comment on submissions in relation to JGN*, May 2015, page 9.

We again note that as beta is a relative measure of risk, an option adjustment must be made even to the betas of firms that have no growth options. Da, Guo and Jagannathan construct option-adjusted betas as the residuals from a cross-sectional regression, without an intercept, of unadjusted betas on book-to-market, idiosyncratic volatility and the return on assets where the three regressors are measured relative to averages for the market. Neither the AER nor its advisers construct estimates of beta in this way. Thus the evidence that Da, Guo and Jagannathan provide is not relevant to assessing estimates of the cost of equity provided by the empirical version of the SL CAPM that the AER employs.

The May 2015 report of Partington and Satchell has also been placed on the AER's web site on the page on which the AER's Jemena *Final Decision* appears. [102]

3.8. Characteristics or Risk?

There has been some debate in the literature about whether the low-beta bias associated with the SL CAPM represents compensation for risk or market inefficiency. With regards to this issue, Handley states that: [103]

> 'the key point is:
>
> (i) given there are multiple possible (but not necessarily mutually exclusive) explanations for the low beta bias – some of which are risk based explanations and some of which are not; and
>
> (ii) the allowed rate of return objective makes it clear that the rate of return should reflect the risk of the benchmark efficient entity,
>
> then there is doubt as to whether the empirical finding of a low beta bias is relevant for the purposes of determining an appropriate level of compensation since there is doubt as to whether the low beta bias reflects risk (over and above that already captured by the Sharpe-CAPM).'

In other words, Handley argues that if the low-beta bias does not represent compensation for risk not accounted for by the SL CAPM, then one should ignore the bias in computing an estimate of the cost of equity. That is, one should ignore the evidence that the SL CAPM is wrong.

We note firstly that Fama and French (2004) point out that: [104]

> 'The conflict between the behavioral irrational pricing story and the rational risk story for the empirical failures of the CAPM leaves us at a timeworn impasse. Fama (1970) emphasizes that the hypothesis that prices properly reflect available information must be tested in the context of a model of expected returns, like the CAPM. Intuitively, to test whether prices are rational, one must take a stand on what the market is trying to

---

[102] https://www.aer.gov.au/node/24741

[103] Handley, J.C., *Report prepared for the Australian Energy Regulator Further advice on the return on equity*, 16 April 2015, pages 5-6.

[104] Fama, Eugene and Kenneth French, *The Capital Asset Pricing Model: Theory and Evidence*, Journal of Economic Perspectives 18, 2004, page 40.

> do in setting prices-that is, what is risk and what is the relation between expected return and risk? When tests reject the CAPM, one cannot say whether the problem is its assumption that prices are rational (the behavioral view) or violations of other assumptions that are also necessary to produce the CAPM (our position).
>
> Fortunately ... when estimating the cost of equity capital, one might be unconcerned with whether expected return premiums are rational or irrational since they are in either case part of the opportunity cost of equity capital (Stein, 1996).'

Thus even if the low-beta bias represents a market inefficiency rather than a compensation for risk not accounted for by the SL CAPM, it should be taken into account in determining the cost of equity – at least unless one can be assured that the bias is a temporary phenomenon.

We note secondly that Rule 6.5.2 (c) of the National Electricity Rules states that: [105]

> 'The *allowed rate of return objective* is that the rate of return for a *Distribution Network 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 *Distribution Network Service Provider* in respect of the provision of *standard control services* (the *allowed rate of return objective*).'

The rule does not state, as Handley asserts, that the rate of return should solely *reflect* the risk of a benchmark efficient entity – that is, it does not state that the rate of return should constitute solely *compensation* for risk. The rule states only that the rate of return be *commensurate* with the costs of a benchmark efficient entity with a similar degree of risk – even if some of those costs do not represent compensation for risk, measured in some way. In other words, the allowed rate of return objective implies that a benchmark efficient entity should be rewarded on the basis of the costs that it faces and not on the basis of the costs that it would face were some asset pricing model to be true. Thus if the evidence indicates that the market requires firms with low equity betas to deliver returns that are, on average, significantly above those that the SL CAPM indicates that they should deliver, then the allowed rate of return objective implies that the return on equity provided to low-equity-beta firms should include the additional costs that the firms face beyond those that they would face were the SL CAPM to be true.

3.9. Black CAPM

The AER and its advisors have characterised the Black CAPM as a more difficult model to use than the SL CAPM because in using the Black CAPM not only must one estimate the equity beta of a firm and the *MRP* but one must also estimate the return required on a zero-beta portfolio. One could also characterise the SL CAPM, though, as a more difficult model to use than a naïve model because in using the SL CAPM not only must one estimate the *MRP* but one must also estimate the equity beta of a firm. One might then ask, as the AER and its advisors have not, whether it is in fact worthwhile moving from a simple model, a naïve model, which gives unbiased results to a complex model, the SL CAPM, which gives biased results.

---

[105] See also Rule 6A 6.2 (c) of the National Electricity Rules and Rule 87 (3) of the National Gas Rules.

A naïve model states that the mean return to an asset and its beta are unrelated. The SL CAPM states that there should be a particular positive linear relation between the mean return to an asset and the beta of the asset. The Black CAPM allows one to use the data to determine what relation exists between mean return and beta across assets. We note that while the AER and its advisors have had little to say about NERA's tests of the SL CAPM and the AER's implementation of the model, they have had nothing whatsoever to say about NERA's tests of a naïve model – even though NERA's tests show that a naïve model outperforms the SL CAPM in delivering unbiased estimates of the return required on equity. Partington and Satchell, however, have had something to say about NERA's tests of the Black CAPM and it is to these arguments that we now turn.

3.9.1. Basics

We begin with some basic issues. Partington in his April 2015 report states that: [106]

> 'In mean variance space, the efficient frontier is described by a parabolic shape. The sensitivity of the zero beta return to the choice of a reference portfolio (market proxy) will depend on the curvature of the parabola segment separating alternative reference portfolios. It is curvature that determines the slope of tangents to the parabola. In turn, it is the slope of the tangent to the point represented by the reference portfolio that determines where the tangent cuts the return axis and this intercept determines the magnitude of the return on the zero beta portfolio. The greater the curvature, the greater the resulting difference in the estimated zero beta returns for different reference portfolios.'

This analysis is incorrect. In mean-variance space the efficient frontier is a parabola but the zero-beta rate is not located by drawing a line tangent to the frontier at the point where the reference portfolio sits and seeing where the line cuts the mean return axis. Instead, one must draw a line from the reference portfolio through the global minimum variance portfolio and see where this line cuts the mean return axis. In mean return-standard deviation of return space the efficient frontier is a hyperbola and the zero-beta rate is located by drawing a line tangent to the frontier at the point where the reference portfolio sits and seeing where the line cuts the mean return axis. These basic issues are covered in chapter 3 of the graduate level text *Foundations of Financial Economics* authored by Huang and Litzenberger. [107]

3.9.2. Labels

In its February 2015 report NERA notes that Black (1972) examines a world in which investors face no short-sale restrictions but cannot borrow or lend, Vasicek (1971) examines a world in which investors face no short-sale constraints but cannot borrow and Brennan (1971) examines a world in which investors face no short-sale restrictions and can borrow and lend at risk-free rates that differ from one another. [108] NERA also notes, however, as it

---

[106] Partington, G., *Report to the AER Return on equity (updated)*, April 2015, page 24.

[107] Huang, C-F. And R.H. Litzenberger, *Foundations of Financial Economics*, North-Holland, 1988.

[108] Black, Fischer, *Capital market equilibrium with restricted borrowing*, Journal of Business 45, 1972, pages 444-454.

Brennan, Michael, *Capital market equilibrium with divergent borrowing and lending rates*, Journal of Financial and Quantitative Analysis 6, 1971, pages 1197-1205.

has done previously, that all three frameworks – aside from restrictions placed on the zero-beta rate – make the same predictions about the mean returns to purely risky assets. In addition, NERA notes Black's framework is a special case of Vasicek's framework and Vasicek's framework is a special case of Brennan's framework. Vasicek's framework is a special case of Brennan's framework because if the borrowing rate is sufficiently high, no borrowing will take place. Black's framework is a special case of Vasicek's framework because if the lending rate is sufficiently low, no lending will take place. NERA also notes, as it has done before, that despite this the three frameworks are often referred to as the Black CAPM and that it follows this convention.

McKenzie and Partington are critical of this choice and ask in their October 2014 report for the AER: [109]

> 'why (do) NERA (2012, p.4) and NERA (2013b, p. 6) appear to be treating the Brennan and Black models as substitutes?'

Similarly, Partington in his April 2015 states that: [110]

> 'It is unhelpful to continue to refer to the Black, Vasicek and Brennan models as the 'Black' model. Notwithstanding the lengthy arguments of NERA (2015, pp. 17-18), to the best of our knowledge, there is no general usage, such that the Brennan model is referred to as the Black model. This distinction is important if these models are being considered as supplementary sources of information to augment the SL-CAPM model.
>
> In the Black model calculating a zero beta premium above the risk free rate makes little sense. To compute such a premium we have to estimate a return on Black's minimum variance zero beta portfolio, a return that cannot be directly observed, and then subtract from that a risk free rate that does not exist in the world of the Black CAPM. This hardly seems to be a compelling basis for computing a regulated return.'

There are two points to make about these passages. First, the views that Partington holds in 2015 and the views that McKenzie and Partington held in 2014 were not the views that McKenzie and Partington held in 2012 because they state in their first report on the Black CAPM in August 2012 that: [111]

> 'The return on the zero beta portfolio for the Black CAPM should lie between the lending and borrowing rates, which are unlikely (sic) have negative values.'

The current position of Partington – as distinct from the position that he held in August 2012 – is that lending and borrowing rates do not exist in the Black model. The historical position held by Partington in 2012 – that lending and borrowing rates can exist in what is commonly labelled the Black model – clearly allows for a zero-beta premium to exist. This is because if the risk-free borrowing rate is sufficiently high, no borrowing will take place, there will exist

---

Vasicek, Oldrich, *Capital market equilibrium with no riskless borrowing*, Memorandum, Wells Fargo Bank, 1971.

[109] McKenzie, M. and G. Partington, Report to the AER Part A: Return on equity, October 2014, page 22.

[110] Partington, G., *Report to the AER Return on equity (updated)*, April 2015, pages 22-23.

[111] McKenzie, M. and G. Partington, *Review of the NERA report on the Black CAPM*, SIRCA, 24 August 2012, page 214

lending at a single risk-free rate and the zero-beta rate will, at least in theory, lie above the risk-free rate.

Second, we note that it is standard practice to estimate the zero-beta rate in excess of the risk-free rate. [112] For example, Ferson and Harvey (1991) and Campbell and Vuolteenaho (2004) estimate zero-beta premiums. Harvey was the editor of the Journal of Finance from 2006 to 2012 while Campbell was President of the American Finance Association in 2005.

Partington in his April 2015 report also repeats statements that McKenzie and Partington make in their October 2014 report incorrectly attributing statements made by SFG to NERA. [113] Partington states that: [114]

> 'The implication of the Black model under either of his two scenarios is that borrowing cost (sic) are higher when there are restrictions on trading the riskless asset. This differs from the proposition "that investors would have to pay a premium above the risk-free rate when borrowing" as in the scenario where there is no risk-free security, such a statement is meaningless. Only under the Brennan (1971) model is the proposition that restrictions on trading in the riskless security result in the investor having to pay a premium above the risk-free rate when borrowing.
>
> Returning to the arguments of SFG ...'

As NERA notes in its February 2015 report, in this passage McKenzie and Partington appear to suggest that the quote 'that investors would have to pay a premium above the risk-free rate when borrowing' is from one of NERA's reports. It is not but is a quote from SFG's May 2014 report. [115] SFG quite reasonably, like McKenzie and Partington in 2012, uses the label 'Black CAPM' to describe the three very similar frameworks that Black, Vasicek and Brennan examine. On a more substantive note, the first and second sentences of the passage above, viewed together, make little sense. The first sentence says that in Black's model borrowing costs are higher while the second sentence says that this is not the same as paying more when borrowing. While the third sentence is correct, there is nothing to prevent the borrowing and lending rates in Brennan's framework from being sufficiently high and sufficiently low that all borrowing and lending will cease.

3.9.3. Regressions

Partington also notes in his April 2015 report, as do McKenzie and Partington in their August 2012 report, that if the reference portfolio or proxy is not mean-variance efficient, then not

---

[112] We note that estimating the zero-beta rate in excess of the risk-free rate will eliminate the concerns expressed by Partington and Satchell over the impact of inflation.

Partington, G. and S. Satchell, *Report to the AER: Return of (sic) equity and comment on submissions in relation to JGN*, May 2015, page 11.

[113] McKenzie, M. and G. Partington, Report to the AER Part A: Return on equity, October 2014.

[114] Partington, G., *Report to the AER Return on equity (updated)*, April 2015, page 42.

[115] SFG, *Cost of equity in the Black Capital Asset Pricing Model: Report for Jemena Gas Networks, ActewAGL, Networks NSW, Transend, Ergon and SA Power Networks*, May 2014, page 12.

only will there be more than one way of forming a zero-beta portfolio but the zero-beta portfolios formed can have different mean returns. Partington states, for example, that: [116]

> 'The implication of a reference portfolio that is not on the efficient set is that there is an infinite set of zero beta portfolios with differing returns that can be associated with the reference portfolio. In this case, the zero beta return can be more or less arbitrarily chosen. NERA and SFG restrict the choice by fitting a regression model to the data in order to obtain a single estimate.'

To understand what Partington means it will be helpful to look again at Figure 2.5 which we have reproduced below as Figure 3.1. Figure 3.1 plots the sample mean returns in excess of the risk-free rate on the 55 portfolios, that Lewellen, Nagel and Shanken (2010) use, against estimates of their betas, indicated by the 55 blue markers, together with the relation that Lewellen, Nagel and Shanken estimate exists between mean excess return and beta for the portfolios, again indicated by the red line. [117] As Partington points out, the red regression line is not the only line that one could draw through the scatter plot of blue markers. One could, for example, draw the green dashed line through portfolios A and B. A zero-beta portfolio that is long portfolio A and short portfolio B could be formed that would have a sample mean return of around -2.4 per cent per annum. Clearly, however, the use of an estimate of the zero-beta rate of -2.4 per cent per annum will lead to a poor fit in-sample and is likely to lead to poor predictions of returns. It is for this reason that NERA and SFG follow convention and fit regression models. This means that, although there could be an infinite number of zero-beta premiums, there is only one which provides a best fit to the data, and NERA uses this rate. Again, NERA finds in its February 2015 report that it cannot reject the hypothesis that the Black CAPM delivers unbiased estimates of the returns required on equities. Partington does not mention this fact.

3.9.4. Consistency

In his most recent report, co-authored with Satchell, Partington states that: [118]

> 'it is our contention that estimates of (the zero-beta rate) are very inaccurate'

but Partington and Satchell do not quantify what is meant by very inaccurate or provide evidence to substantiate the claim. Instead, Partington and Satchell note that since an estimator for the zero-beta rate is a ratio of two estimators and there will be a chance, albeit very small, that the denominator will be arbitrarily close to zero, the mean of the estimator for the zero-beta rate will not exist. Partington and Satchell examine an estimator for the zero-beta rate that uses a regression of the return to a single stock. With a single stock, an estimator for the zero-beta rate will be:

---

[116] Partington, G., *Report to the AER Return on equity (updated)*, April 2015, page 25.

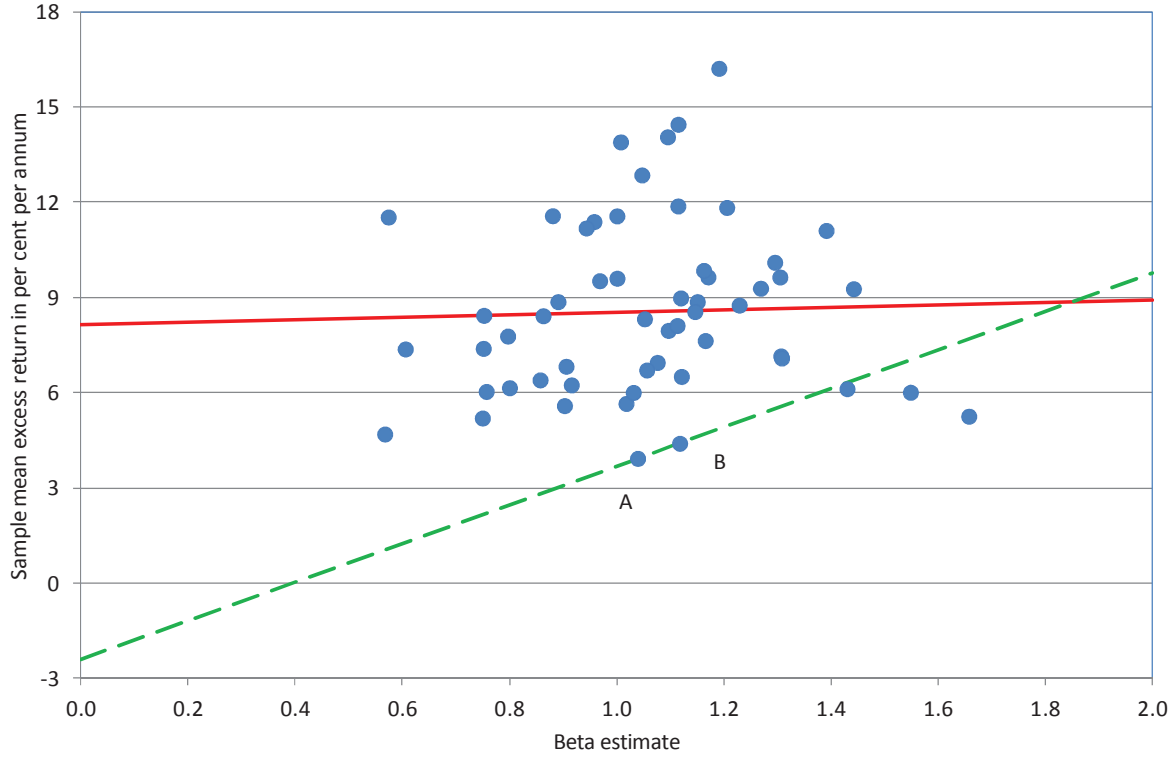
[117] Lewellen, J., S. Nagel and J. Shanken, *A skeptical appraisal of asset pricing tests*, Journal of Financial Economics, 2010, pages 175-194.

[118] Partington, G. and S. Satchell, *Report to the AER: Return of (sic) equity and comment on submissions in relation to JGN*, May 2015, page 13.

$$\frac{\hat{\alpha}_j}{(1-\hat{\beta}_j)}, \tag{1}$$

where $\hat{\alpha}_j$ and $\hat{\beta}_j$ are estimators of the intercept and slope coefficient in a regression of the return on the stock on the return on the market portfolio.

Figure 3.1
Sample mean excess return against beta estimate for 25 US book-to-market and size sorted portfolios and 30 US industry portfolios: Quarterly data from 1963 to 2004



Notes: Data are from Ken French's web site and are those used by Lewellen, Nagel and Shanken (2010). The red line plots Lewellen, Nagel and Shanken's estimate of the relation between mean return and beta constructed from the 25 portfolios formed on the basis of book-to-market and size and the 30 industry portfolios.

Sources: http://mba.tuck.dartmouth.edu/pages/faculty/ken.french/data_library.html

Lewellen, J., S. Nagel and J. Shanken, A skeptical appraisal of asset pricing tests, Journal of Financial Economics, 2010, Table 1, page 188.

The argument that Partington and Satchell make is that there is a chance that an estimate of the beta of the stock will be arbitrarily close to one. If the true beta of the stock differs from one, then the probability of this happening will decline as the sample size gets larger – but there will still be a chance, albeit a very small chance, that an estimate of beta will be one. So the mean of the estimator will not exist.

With N stocks, an estimator for the zero-beta rate will be:

$$\left(\sum_{j=1}^{N} (1-\hat{\beta}_j)^2 \right)^{-1} \sum_{j=1}^{N} (1-\hat{\beta}_j)\hat{\alpha}_j \qquad (2)$$

There will be a chance, albeit a very small chance, that all N estimates of beta will be simultaneously equal to one. Thus again the mean of the zero-beta rate will not exist. The probability that all N estimates of beta will be simultaneously equal to one, though, will be very, very small if N is large.

The estimates of the zero-beta premium that we use in our February 2015 report do not employ the simple estimator given by (2). Instead they employ a related estimator that Litzenberger and Ramasswamy (1979) provide with a degrees of freedom adjustment that Shanken (1992) recommends one use. [119] While the mean of this estimator may also not exist, Shanken shows that it has other attractive properties. The estimator, for example, under a reasonable set of conditions, will be *N*-consistent, where N is the number of assets. An estimator for a parameter is said to be consistent if the distribution of the estimator becomes more and more concentrated around the parameter as the sample size grows. In other words, an estimator for a parameter is said to be consistent if the probability of the estimator lying more than a microscopically small distance from the parameter tends towards zero as the sample size grows.

3.10. Reversion Confusion

The AER asks Partington whether the following statement is true: [120]

> 'The Foundation Model approach if applied now (as set out in the Guideline, but with updated market information) would be expected to result in a return on equity estimate that is systematically downwardly biased relative to the true unobservable cost of equity capital of a benchmark efficient entity.'

Partington responds by discussing the evidence on whether estimates of the beta of a benchmark efficient entity are likely to be downwardly biased and whether there is evidence that the beta of a regulated energy utility tends to revert to one over time. In other words, he discusses whether it makes sense to apply the adjustments that Blume (1975) and Vasicek (1973) suggest one might use. [121] Blume shows that betas tend to revert to one over time while Vasicek shows how one can use prior information to produce better estimates of beta. Partington ignores the far more important question of whether estimates of the return required on the equity of a benchmark efficient entity that use the SL CAPM are likely to be

---

[119] Litzenberger, R. and K. Ramaswamy, *The effects of personal taxes and dividends on capital asset prices: Theory and empirical evidence*, Journal of Financial Economics, 1979, pages 163-195.

Shanken, Jay, *On the estimation of beta pricing models*, Review of Financial Studies, 1992, pages 1-33.

[120] Partington, G., *Report to the AER Return on equity (updated)*, April 2015, page 6.

[121] Blume, M., *Betas and their regression tendencies*, Journal of Finance, 1975, pages 785-795.

Vasicek, O.A., *A note on using cross-sectional information in Bayesian estimation of security betas*, Journal of Finance, 1973, pages 1233-1239.

downwardly biased. He concludes that there is little evidence in the data for mean reversion in betas and so concludes that the use of the SL CAPM will not generate downwardly biased estimates of the cost of equity capital for a benchmark efficient entity. An absence of mean reversion in betas, however, will not guarantee that the use of the SL CAPM will generate estimates of the cost of equity capital for a benchmark efficient entity that are not downwardly biased.

3.11. Levy and Roll (2010)

Kevin Davis of the University of Melbourne notes in a January 2011 report for the AER that: [122]

> 'Levy and Roll (2010) address the question of testing the CAPM when the market portfolio used in practice is mean-variance inefficient. As is well known, tests which reject the CAPM may be instead rejecting the hypothesis that the market portfolio chosen is mean-variance efficient. They ask the question of whether it is possible to adjust estimated CAPM parameters (stock returns and variances) in such a way as to make the assumed market portfolio mean-variance efficient while keeping those adjusted parameters relatively close to their estimated values.'

It is important to note that the CAPM to which Levy and Roll (2010) refer is the Black CAPM – that is, a model in which the zero-beta rate need not match the risk-free rate. Levy and Roll suggest that one can use the Black CAPM – even though there is evidence against the model – by making changes to the parameters that one would otherwise use. Levy and Roll state that: [123]

> 'to obtain an improved expected return estimate for any stock, first calculate the adjusted mean return for the market index proxy and for its corresponding zero-beta portfolio. Plugging these numbers along with the sample beta (because it is close to the adjusted beta) into the usual CAPM formula delivers the improved estimate of expected return.'

There is no evidence that the AER uses the Black CAPM in this way and so while the method that Levy and Roll introduce is interesting, it is difficult to see that it has any bearing on the issue of determining whether the AER's implementation of the SL CAPM provides estimates of the cost of equity for a regulated energy utility that are the best possible in the circumstances.

3.12. Fama-French Three-Factor Model

Lewellen, Nagel and Shanken (2010) examine zero-beta versions of a number of pricing models. We note in our March 2012 report that the evidence that Lewellen, Nagel and

---

[122] Davis, K., *Cost of Equity Issues: A Report for the AER*, University of Melbourne, January 2011, page 7.

[123] Levy, M. and R. Roll, *The market portfolio may be mean/variance efficient after all*, Review of Financial Studies, 2010, pages 2487.

Shanken provide suggests that the Fama-French three-factor model performs the best out of a range of pricing models that includes the CAPM. [124]

To illustrate the improvement that the original version of the Fama-French model in which the zero-beta rate matches the risk-free rate offers over the SL CAPM, in our March 2015 report, we follow Cochrane (2001) and plot the sample mean excess return to each portfolio against the mean excess return that the Fama-French three-factor model predicts the portfolio should earn. [125] Figure 3.2 provides the results of this exercise for the 25 portfolios formed on the basis of book-to-market and size, that Lewellen, Nagel and Shanken use, while Figure 3.3 provides the results for the 25 portfolios formed on the basis of book-to-market and size together with the 30 industry portfolios that they use. [126] These figures use the quarterly data that Lewellen, Nagel and Shanken employ from 1963 to 2004. Consistent with the results that Lewellen, Nagel and Shanken report, the figures show that the Fama-French three-factor model provides better predictions of the mean excess returns to the portfolios than does the SL CAPM in Figure 2.3 and 2.4, which use the same data.

Handley in his April 2015 report suggests that the results of Lewellen, Nagel and Shanken provide little evidence that the Fama-French three-factor model offers a significant improvement over the CAPM. He suggests that while the Fama-French three-factor model delivers a higher GLS R^2, the difference between the GLS R^2 delivered by a zero-beta version of the Fama-French model and the GLS R^2 that the CAPM delivers should not be viewed as significant.

3.12.1. GLS R^2

To understand the evidence that Lewellen, Nagel and Shanken provide and that Kan, Robotti and Shanken (2013) provide in a related paper, it will be helpful to understand what the GLS R^2 does and does not measure. [127] It is well known that generalised least squares (GLS) can provide more efficient estimates than ordinary least squares (OLS). Thus, absent small-sample issues, GLS is to be preferred.

Fama and French (1992) provide evidence using OLS that, at least since 1963, there has been little relation in US data between mean return and beta. [128] Roll and Ross (1994) show that when a proxy for the market portfolio is inefficient, the slope coefficient from an OLS regression of mean return on beta can take on almost any value and need bear no relation to where the portfolio plots in mean return-variance of return space. Roll and Ross state about

---

[124] Lewellen, J., S. Nagel and J. Shanken, *A skeptical appraisal of asset pricing tests*, Journal of Financial Economics, 2010, page 176.

[125] Cochrane, J., *Asset pricing*, Princeton University Press, 2001, chapter 20.

[126] Our March 2015 report inadvertently excluded some portfolios from the plot that uses the 25 portfolios formed on the basis of book-to-market and size together with the 30 industry portfolios. Figure 3.3 now includes all of the 55 portfolios.

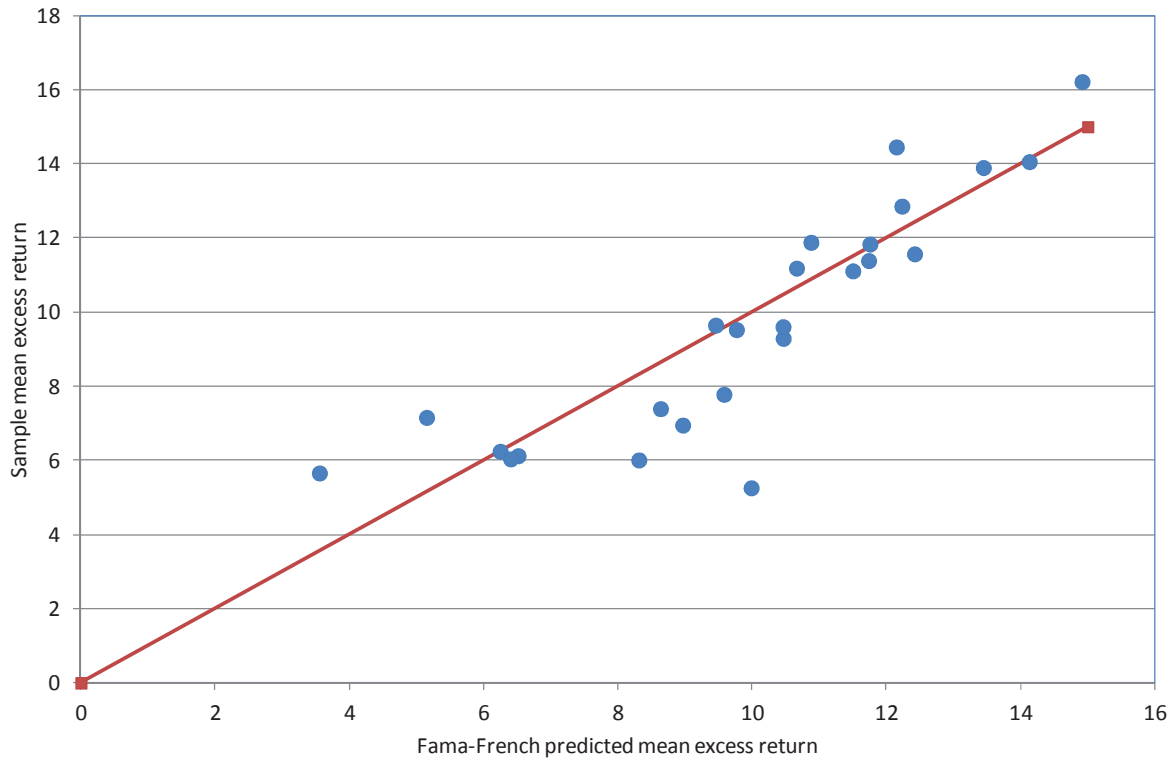
[127] Kan, R., C. Robotti and J. Shanken, *Pricing model performance and the two-pass cross-sectional regression methodology*, Journal of Finance, 2013, pages 2617-2649.

[128] Fama, Eugene and Kenneth French, *The cross-section of expected returns*, Journal of Finance 47, 1992, pages 427-465.

the evidence that Fama and French (1992) provide on the Sharpe-Lintner-Black (SLB) CAPM that: [129]

> 'An alternative interpretation of their results is that the SLB Model may be of little use in explaining cross-sectional returns no matter how close the index is to the efficient frontier unless it is exactly on the frontier. Since such exactitude can never be verified empirically, we would endorse (again, as we have in the past when we first asserted the proposition; see, e.g., Roll (1977), and Chen, Roll, and Ross (1986)), that the SLB is of little practical use in explaining stock returns.'

Figure 3.2
Sample mean excess return against Fama-French prediction for 25 US portfolios formed on the basis of book-to-market and size: Quarterly data from 1963 to 2004



Notes: Data are from Ken French's web site and are those used by Lewellen, Nagel and Shanken (2010). The red line plots a line with slope one that passes through the origin. Sample mean excess returns and the Fama-French predictions have been annualised by multiplying the quarterly returns by four and are in per cent per annum.

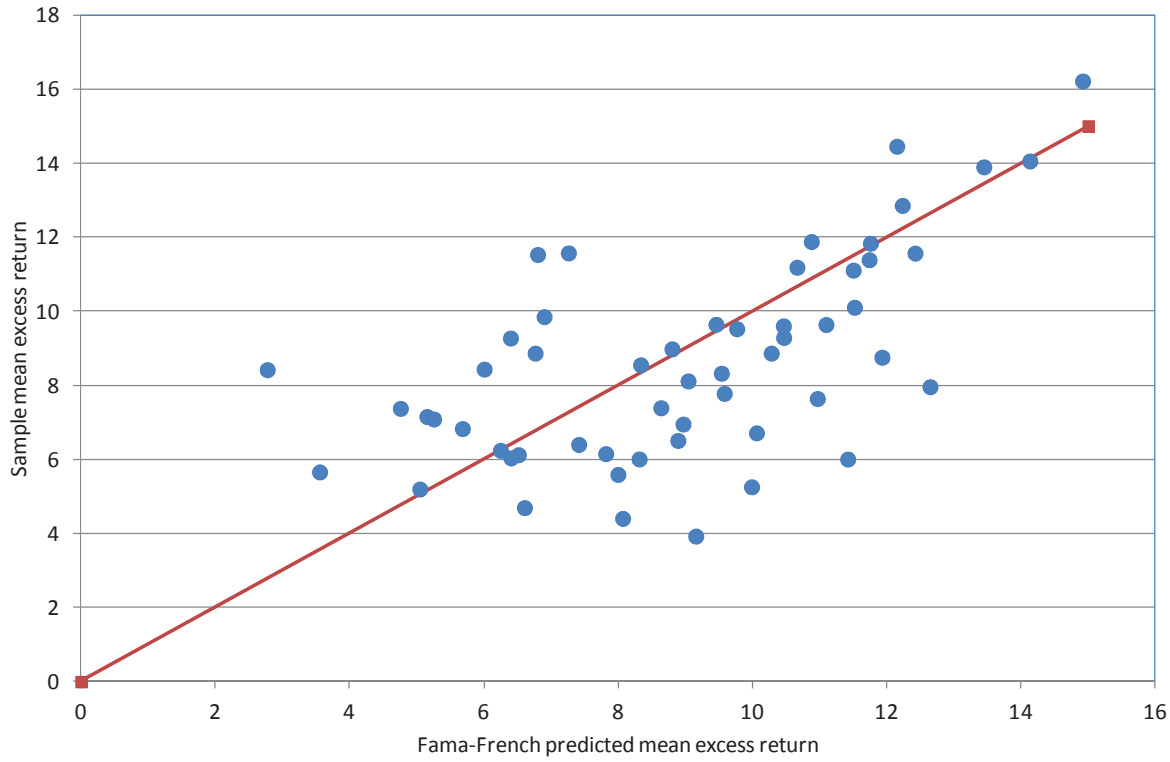
Sources: http://mba.tuck.dartmouth.edu/pages/faculty/ken.french/data_library.html

Lewellen, J., S. Nagel and J. Shanken, A skeptical appraisal of asset pricing tests, Journal of Financial Economics, 2010, Table 1, page 188.

[129] Roll, R. and S. Ross, *On the cross-sectional relation between expected returns and betas*, Journal of Finance, 1994, page 111.

In contrast, Roll and Ross note that when a proxy for the market portfolio is inefficient, the slope from a GLS regression of mean return on beta will provide a clear guide as to where the portfolio plots in mean return-variance of return space. Kandel and Stambaugh (1995) show that the GLS R^2 will indicate how far the portfolio sits from the minimum variance frontier. It is important to note that the minimum variance frontier includes not only those portfolios that have the highest mean return for given variance of return, those portfolios that are efficient, but also those portfolios that have the lowest mean return for given variance of return, portfolios that are as far away from being efficient as is possible. So a high GLS R^2 need not be a sign that a proxy for the market portfolio is efficient.

Figure 3.3
Sample mean excess return against Fama-French prediction for 25 US portfolios formed on the basis of book-to-market and size and 30 US industry portfolios: Quarterly data from 1963 to 2004



Notes: Data are from Ken French's web site and are those used by Lewellen, Nagel and Shanken (2010). The red line plots a line with slope one that passes through the origin. Sample mean excess returns and the Fama-French predictions have been annualised by multiplying the quarterly returns by four and are in per cent per annum.

Sources: http://mba.tuck.dartmouth.edu/pages/faculty/ken.french/data_library.html

Lewellen, J., S. Nagel and J. Shanken, A skeptical appraisal of asset pricing tests, Journal of Financial Economics, 2010, Table 1, page 188.

Lewellen, Nagel and Shanken provide no formal tests of whether the GLS R^2 delivered by one pricing model exceeds the GLS R^2 delivered by another pricing model. They do, however, provide confidence intervals for the estimates that they provide and emphasise that these can be informative. [130] Using 25 portfolios formed on the basis of book-to-market and size, they report a 95 per cent confidence interval for the GLS R^2, computed using the CAPM, of 0.00 to 0.25 and, computed using the Fama-French three-factor model, of 0.05 to 0.65. Using these 25 portfolios and 30 industry portfolios, they report a 95 per cent confidence interval for the GLS R^2, computed using the CAPM, of 0.00 to 0.05 and, computed using the Fama-French three-factor model, of 0.05 to 0.35. This second set of results suggests that there may be evidence that the GLS R^2 associated with the Fama-French three-factor model sits significantly above the GLS R^2 associated with the CAPM.

In a subsequent 2013 Journal of Finance paper, Shanken, with co-authors Kan and Robotti, provides formal tests of the hypothesis that the GLS R^2 associated with one model exceeds the GLS R^2 associated with another. [131]

3.12.2. Kan, Robotti and Shanken (2013)

Kan, Robotti and Shanken state in the abstract to their paper that:

> 'Over the years, many asset pricing studies have employed the sample cross-sectional regression (CSR) R^2 as a measure of model performance. We derive the asymptotic distribution of this statistic and develop associated model comparison tests, taking into account the inevitable impact of model misspecification on the variability of the two-pass CSR estimates. We encounter several examples of large R^2 differences that are not statistically significant. A version of the intertemporal CAPM exhibits the best overall performance, followed by the "three-factor model" of Fama and French (1993).'

Kan, Robotti and Shanken show that while they cannot reject the hypothesis that the GLS R^2 delivered by a version of the intertemporal CAPM does not exceed the GLS R^2 that the Fama-French three-factor model delivers, they can reject the hypothesis that the GLS R^2 delivered by the Fama-French three-factor model does not exceed the GLS R^2 that the CAPM delivers. In other words, they find no significant evidence that a version of the intertemporal CAPM outperforms the Fama-French three-factor model but they do find significant evidence that the Fama-French three-factor model outperforms the CAPM. This evidence contradicts Handley's assertion that the difference between the GLS R^2 delivered by the Fama-French model and the GLS R^2 that the CAPM delivers should not be viewed as significant.

It is also worthwhile, however, delving into the results that Kan, Robotti and Shanken provide a little further. Kan, Robotti and Shanken use data from 1959 to 2007 and 25 portfolios sorted on the basis of book-to-market and size together with five industry portfolios. They report that the GLS R^2 associated with the CAPM is 0.107 and the GLS R^2

---

[130] Lewellen, J., S. Nagel and J. Shanken, *A skeptical appraisal of asset pricing tests*, Journal of Financial Economics, 2010, page 188.

[131] Kan, R., C. Robotti and J. Shanken, *Pricing model performance and the two-pass cross-sectional regression methodology*, Journal of Finance, 2013, pages 2617-2649.

associated with the Fama-French three-factor model is 0.298. Thus these point estimates suggest that the Fama-French three-factor model performs better than the CAPM. As we note, formal tests confirm this suggestion. This is not, however, the entire story. As we note above, the GLS R^2 will indicate how far a proxy for the market portfolio sits from the minimum variance frontier, not from the positively sloped efficient portion of the frontier. A close inspection of the results that Kan, Robotti and Shanken provide shows that the GLS R^2 associated with the CAPM exceeds zero not because of a positive relation between the mean returns to their 29 portfolios and their betas computed relative to a value-weighted portfolio of stocks but because of a significant negative relation between the mean returns and betas. The evidence that Kan, Robotti and Shanken provide using US data is, therefore, similar to the evidence that we provide in our February 2015 report using Australian data.

3.12.3. Cross sections and time series

A time series R^2 will show what fraction of the variability in realised returns through time is explained by the realisations of one or more factors. A cross-sectional R^2 will show what fraction of the variability in mean returns across assets is explained by variability in the predictions that a pricing model makes about the mean returns. Handley shows that he is confused about the difference between a time series R^2 and a cross-sectional R^2 and the roles that the two measures play. He states that: [132]

> 'NERA states: *"The R^2 values attached to these time series regressions range from 0.83 to 0.97 … the evidence that Fama and French provide suggests that the HML and SMB factors capture pervasive sources of risk – at least in US data."*
>
> As explained under (f) above, Lewellen, Nagel and Shanken (2010) show that the OLS R^2 is not an appropriate measure of the success of an asset pricing model.'

Cochrane (2001) explains that the high time series R^2 values that Fama and French (1993) report indicate that one could almost replicate the returns to the 25 portfolios that they assemble using the three Fama-French factors. [133] Thus, as Cochrane points out, the three-factor model must be approximately true to avoid near arbitrage opportunities. Cochrane states that:[134]

> 'given the average returns and the failure of the CAPM to explain those returns, there would be near-arbitrage opportunities if value and small stocks did not move together in the way described by the Fama-French model.'

If the R^2 values were all equal to 1.00, the three-factor model would have to hold *exactly* to rule out arbitrage opportunities.

---

[132] Handley, J.C., *Advice on the rate of return for the 2015 AER Energy Network Determination for Jemena Gas Networks*, 20 May 2015, pages 8-9.

[133] Fama, Eugene and Kenneth French, *Common risk factors in the returns to stocks and bonds*, Journal of Financial Economics 33, 1993, pages 3-56.

[134] Cochrane, John H., *Asset pricing*, Princeton University Press, 2001, page 442.

As Lewellen, Nagel and Shanken and Kan, Robotti and Shanken explain, cross-sectional R^2 values measure the performance of a pricing model.

An excellent reference that will explain the difference between cross-sectional and time series regressions is the 2013 book *Introductory Econometrics: A Modern Approach*, authored by Jeffrey Wooldridge. [135]

3.12.4. Fama and French (2014)

In recent work Fama and French (2014) examine a five-factor pricing model and find it outperforms their three-factor model. [136] We emphasise in our March 2015 report, however, that an implicit suggestion that Handley and McKenzie and Partington make about the 2014 work of Fama and French is that Fama and French have abandoned their three-factor model and are ready to accept the use of the SL CAPM. This is not the case. What Fama and French find in their 2014 paper is that one can improve upon their three-factor model – by replacing the *HML* factor with a *CMA* factor and a *RMW* factor – not by using the SL CAPM in its place. In other words, Fama and French are not abandoning their long-held position that the Fama-French three-factor model provides a better description of the cross-section of mean returns than the SL CAPM. They are suggesting that there may be a four or five-factor model that performs better than their three-factor model.

If it is found that model B outperforms model A, and later it is found that model C might outperform model B, it is difficult to see that this would then propel one towards using model A – the worst performing of the three models.

We also note in our March 2015 report that Fama and French make it clear in December 2014 in their online Fama/French Forum that they are not suggesting that there is no value premium. We note in our March 2015 report that Fama and French state that: [137]

> 'There is some confusion about the interpretation of the evidence in Fama and French (2014, "A Five-Factor Model of Expected Returns") that *HML* is redundant for explaining average U.S. stock returns for 1963-2013.
>
> It doesn't imply that there is no value premium. When *HML* is defined in the usual way (2×3 sorts on *Size* and *B/M*), its average value for 1963-2013 is a hefty 5.21% per year with a standard deviation of 13.70% and a *t*-statistic of 2.72. This is similar to the market premium in excess of the bill rate, 6.74% per year with a standard deviation of 17.97% and a t-statistic of 2.68. The t-statistics tell us that the underlying expected premiums are reliably greater than zero.'

3.13. Regulator Usage

Finally, we note that Partington has ignored NERA's analysis of his examination with McKenzie of the use of models by regulators in six countries. NERA states that: [138]

---

[135] Wooldridge, J., *Introductory Econometrics: A Modern Approach*, South-Western, 2013.

[136] Fama, E.F. and K.R. French, *A five-factor asset pricing model*, University of Chicago, IL, March 2014.

[137] http://www.dimensional.com/famafrench/questions-answers/qa-what-does-it-mean-to-say-hml-is-redundant.aspx

> 'McKenzie and Partington (2014) examine the use of models by regulators in a number of countries and state that:[139]
>
> > 'It remains that (sic) case that the majority of international regulators currently base their decisions primarily on the CAPM framework. (see Table 1).'
>
> Their Table 1 provides a list of the primary and secondary models used by a single regulator in each of six countries. One of the countries is the US and the single regulator chosen is the New York State Public Services Commission. Each state in the US, however, has a public utilities commission as does the District of Columbia and so the table is missing data for 50 US public utilities commissions. Without data for these other public utilities commissions and for regulators from other countries that are also missing it is difficult to see that much weight should be attached to the conclusion that McKenzie and Partington draw.
>
> Another way of assessing the importance to be placed on the choice by regulators in each country of primary and secondary models is to examine the GDP of each country – which should provide a guide as to the relative sizes of the businesses being regulated on aggregate in each country. The CIA Factbook reports that US GDP in 2013 is estimated to be US $16.72 trillion while New Zealand GDP in 2013 is estimated to be US $181.1 billion. [140] This evidence suggests that more weight should be placed on the choices made by US regulators than on regulators in New Zealand. We note that the primary model used by US public utilities commissions is the dividend growth model while the primary model used in New Zealand is the SL CAPM.'

Partington has completely ignored this analysis and has instead reproduced the table that he provided in his report with McKenzie in October 2014 which invites the reader to place equal weights on what regulators do in New Zealand and in (part of) the US. [141]

---

138 NERA, *Empirical performance of Sharpe-Lintner and Black CAPMs: A report for Jemena Gas Networks, Jemena Electricity Networks, ActewAGL, AusNet Services, CitiPower, Energex, Ergon Energy, Powercor, SA Power Networks, and United Energy*, February 2015, page 46.

139 McKenzie, M. and G. Partington, *Report to the AER Part A: Return on equity*, October 2014, page 9.

140 https://www.cia.gov/library/publications/the-world-factbook/index.html

141 Partington, G., *Report to the AER Return on equity (updated)*, April 2015, page 29.

Appendix A. Out-Of-Sample Forecasts

This appendix describes how NERA evaluates out-of-sample forecasts generated by the AER CAPM and the Black CAPM in its February 2015 report. [142]

NERA assumes that the AER acts as if it adjusts an estimate of the equity beta of a regulated energy utility solely on the basis of the principles underpinning the Black CAPM. NERA does so because to evaluate a method for estimating the return required on equity, it must clearly specify the method. Methods that it cannot clearly specify, it cannot evaluate. NERA cannot, for example, evaluate the use by a regulator of its discretion in a way that is not specified and in a way that may vary through time.

To understand how a regulator might adjust an estimate of the equity beta of a regulated energy utility on the basis of the principles underpinning the Black CAPM, recall that the SL CAPM implies that:

$$\mathrm{E}_{t-1}(z_{jt}) = \beta_{jt}\mathrm{E}_{t-1}(z_{mt}) \tag{A.1}$$

where:

$\mathrm{E}_{t-1}(z_{jt})$ = the mean return on risky asset j in excess of the risk-free rate from $t-1$ to t conditional on what is known at $t-1$;

$\mathrm{E}_{t-1}(z_{mt})$ = the mean return to the market portfolio of risky assets in excess of the risk-free rate conditional on what is known at $t-1$

and

$$\beta_{jt} = \frac{\mathrm{Cov}_{t-1}(z_{jt}, z_{mt})}{\sigma^2_{t-1}(z_{mt})}, \tag{A.2}$$

where:

$\mathrm{Cov}_{t-1}(z_{jt}, z_{mt})$ = the covariance between z_{jt} and z_{mt} conditional on what is known at $t-1$; and

$\sigma^2_{t-1}(z_{mt})$ = the variance of z_{mt} conditional on what is known at $t-1$.

The Black CAPM, on the other hand, implies that:

---

[142] NERA, *Empirical performance of Sharpe-Lintner and Black CAPMs: A report for Jemena Gas Networks, Jemena Electricity Networks, ActewAGL, AusNet Services, CitiPower, Energex, Ergon Energy, Powercor, SA Power Networks, and United Energy*, February 2015.

$$\mathrm{E}_{t-1}(z_{jt}) = (1-\beta_{jt})\gamma_{0t} + \beta_{jt}\mathrm{E}_{t-1}(z_{mt}) \tag{A.3}$$

where:

γ_{0t} = the mean return in excess of the risk-free rate on a portfolio that has a zero beta relative to the market portfolio of risky assets – the zero-beta premium.

A regulator using the Black CAPM explicitly would set the cost of equity for a firm equal to:

$$(1-\hat{\beta}_{jt})\hat{\gamma}_{0t} + \hat{\beta}_{jt}\hat{z}_{mt}, \tag{A.4}$$

where a hat denotes a forecast generated from data prior to month *t*. The expression (A.4), however, can also be rewritten as:

$$\beta^{*}_{jt}\hat{z}_{mt}, \tag{A.5}$$

where

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

Thus a regulator using the Black CAPM implicitly could use (A.5) to set the cost of equity for a firm instead of (A.4) and would come up with exactly the same result. In other words, the regulator could use the SL CAPM together with an adjusted estimate of the equity beta of a firm to compute the estimate that would have been generated by an explicit use of the Black CAPM. The adjusted estimate of beta is, from (A.6), a weighted average of the unadjusted estimate of beta and one.

To be able to evaluate forecasts of the cost of equity that a regulator would have generated using this scheme, one must know what weight the regulator places on an unadjusted estimate of beta.

In both its Jemena *Draft Decision* and *Final Decision*, the AER states that: [143]

> 'We adopt an equity beta point estimate of 0.7 from a range of 0.4 to 0.7.'

Thus it is reasonable to assume that the AER adjusts upwards an estimate of 0.55 – the midpoint of the range of 0.4 to 0.7 – to 0.7. Simple arithmetic indicates that the AER places a weight of two thirds on an unadjusted estimate of beta and one third on one in deriving its adjusted point estimate of beta. That is:

---

[143] AER, *Draft decision Jemena Gas Networks (NSW) Ltd Access arrangement 2015–20: Attachment 3: Rate of return*, November 2014, page 267.

AER, *Final decision Jemena Gas Networks (NSW) Ltd Access arrangement 2015–20: Attachment 3: Rate of return*, November 2014, page 267.

$$\frac{2}{3}\times 0.55+\frac{1}{3}\times 1=0.7 \tag{A.7}$$

From (A.6), the use of a weight of two thirds on an unadjusted estimate of beta implies that the AER currently acts as if it believes that the zero-beta premium should be one third of the value of the *MRP*. That is:

$$\left(1-\frac{\hat{\gamma}_{0t}}{\hat{z}_{mt}}\right)=\frac{2}{3}\Rightarrow \hat{\gamma}_{0t}=\frac{1}{3}\hat{z}_{mt} \tag{A.8}$$

Since the AER chooses a value for the *MRP* of 6.5 per cent per annum, then, with the assumptions made, the AER currently acts as if it believes that the zero-beta premium is 2.17 per cent per annum.

NERA in its February 2015 report labels forecasts, generated using the SL CAPM and an estimate of beta that is one third plus two thirds of an unadjusted estimate, forecasts generated by the AER CAPM.

NERA also examines forecasts generated by an empirical version of the Black CAPM and follows the scheme outlined above to compute an adjusted estimate of beta for use with the SL CAPM – but instead of relying on 'theory' NERA relies on past empirical evidence.

Appendix B. Terms of Reference

Expert Terms of Reference

The Cost of Equity: Response to the AER's Final Decisions for the NSW and ACT Electricity Distributors, and for Jemena Gas Networks

23 June 2015

Background

The Australian Energy Regulator (AER) is empowered to make five yearly regulatory determinations that control the aggregate average prices charged by regulated energy network businesses. The National Electricity Rules provide for a Regulated Asset Base (RAB) to be established and updated annually and for an operational expenditure allowance. A further key component of the regulatory determination is the allowed rate of return for debt and equity (or weighted average cost of capital) for funding the business. The principal Rules governing how the AER sets the allowed rate of return on debt for electricity distribution businesses are contained in Rule 6.5.2 of the National Electricity Rules (see attached). The same Rules in essentially the same terms apply to gas distribution businesses.

When the AER exercises the relevant regulatory powers under the National Electricity Rules, it is also required to apply section 16 of the National Electricity Law (see attached). Specifically, section 16 provides that *the AER must, in performing or exercising an AER economic regulatory function or power – (a) perform or exercise that function or power in a manner that will or is likely to contribute to the achievement of the national electricity objective*.…That national electricity objective is set out in section 7 of the National Electricity Law as: '*The objective of this Law is to promote efficient investment in, and efficient operation and use of, electricity services for the long term interests of consumers of electricity with respect to- (a) price, quality, safety, reliability and security of supply of electricity; and (b) the reliability, safety and security of the national electricity system.*'

Additionally, the Rules require the AER to publish a Rate of Return Guideline which explains how the regulator intends to apply the Rules (attached). The AER has recently published final determinations for the NSW and ACT electricity networks, and for Jemena Gas Networks[144]. Preliminary determinations have also been published for the Queensland electricity distributors, and for SA Power Networks[145].

---

144 See, for instance:

AER (2015), Ausgrid distribution determination, 2015−16 to 2018−19, Attachment 3 – Rate of return, April 2015.

AER (2015), FINAL DECISION, Jemena Gas Networks (NSW) Ltd, Access Arrangement 2015-20, Attachment 3 – Rate of return, June 2015.

145 See, for instance:

AER (2015), PRELIMINARY DECISION, SA Power Networks determination, 2015−16 to 2019−20, Attachment 3 – Rate of return, April 2015

Engagement

You are engaged by Jones Day on behalf of United Energy and a consortium of other businesses to provide the work (set out below). Specifically, you have been retained by ActewAGL distribution, Australian Gas Networks, APA Group, AusNet Services, Citipower, Ergon Energy, Jemena Electricity Networks, Powercor, SA Power Networks, and United Energy.

Scope of work

The AER made a number of consultancy reports available when it released its final decision for Jemena Gas Networks[146].

NERA Economic Consulting is asked to consider the reports prepared by the AER's advisers and to prepare an overall assessment of the return on equity. The analysis to be undertaken by NERA should encompass a broader set of considerations which can be set out as follows:

(a) A review of the earlier empirical work by NERA to investigate the performance of the Black CAPM, the SL CAPM, and other asset pricing models[147].

(b) A response to comments on the empirical work made by the AER and its advisers.

(c) An examination of the evidence about the interpretation of the results from empirical tests provided by Ray, Savin, and Tiwari (2009) [148].

(d) An assessment of the way in which the AER's advisers have interpreted the empirical evidence about the SL CAPM provided by Da, Guo and Jagannathan[149].

(e) An evaluation of comments made about the Black CAPM by Mackenzie and Partington in their reports of August 2012, October 2014, and in the report by Partington from April 2015[150].

(f) An investigation of the contention advanced by Partington and Satchell that "estimates of the zero beta rate are very inaccurate" [151].

---

146 The reports, some of which had been released previously, included the following:

Partington (2015), Return on Equity (Updated), Graham Partington, April 2015.

Handley (2015), Further Advice on the Return on Equity, John C. Handley, University of Melbourne, 16 April 2015.

Partington and Satchell (2015), Report to the AER, Return of Equity and Comment on Submissions in Relation to JGN, Graham Partington and Steven Satchell, May 2015.

147 NERA, Empirical performance of Sharpe-Lintner and Black CAPMs: A report for Jemena Gas Networks, Jemena Electricity Networks, ActewAGL, AusNet Services, CitiPower, Energex, Ergon Energy, Powercor, SA Power Networks, and United Energy, February 2015.

148 Ray, S., N.E. Savin and A. Tiwari, Testing the CAPM revisited, Journal of Empirical Finance, 2009, pages 721-733.

149 Da, Z., R-J. Guo and R. Jagannathan, CAPM for estimating the cost of equity capital: Interpreting the empirical evidence, Journal of Financial Economics, 2012, pages 204-220.

150 McKenzie, M. and G. Partington, Review of the NERA report on the Black CAPM, SIRCA, 24 August 2012.

McKenzie, M. and G. Partington, Report to the AER Part A: Return on equity, October 2014.

Partington, G., Report to the AER Return on equity (updated), April 2015, pages 22 to 23.

(g) A review of other issues about the rate of return on equity that have been raised by the AER's advisers.

(h) A discussion of other relevant evidence about the measurement of the rate of return on equity.

In preparing the report, NERA Economic Consulting will:

A. Consider any comments made by the AER, its experts and other regulators; and

B. Use robust methods and data in producing any statistical estimates.

C. Respond to any other matters raised by the Australian Energy Regulator (AER) in its recently published Final decision, Jemena Gas Networks (NSW) Ltd, Access arrangement 2015-20 and in other recent AER decisions.

Timeframe

The consultant should provide a final report by no later than 25th June, 2015.

Reporting

Jeremy Rothfield of United Energy and Multinet Gas will serve as the primary contact for the period of the engagement. His contact details are as follows:

Jeremy Rothfield
Economist
United Energy and Multinet Gas
Level 1
Pinewood Corporate Centre
43-45 Centreway Place
Mount Waverley VICTORIA 3149
P.O. Box 449
Mount Waverley VICTORIA 3149

Email: Jeremy.Rothfield@ue.com.au

Telephone: (03) 88469854

The consultant will prepare reports showing the work-in-progress on a regular basis. The consultant will make periodic presentations on analysis and advice as appropriate.

Conflicts

The consultant is to identify any current or potential future conflicts.

---

[151] Partington and Satchell (2015), Report to the AER, Return of Equity and Comment on Submissions in Relation to JGN, Graham Partington and Steven Satchell, May 2015; page 13.

Compliance with the Code of Conduct for Expert Witnesses

Attached as **Annexure 1** is a copy of the Federal Court's Practice Note CM 7, entitled "Expert Witnesses in Proceedings in the Federal Court of Australia", which comprises the guidelines for expert witnesses in the Federal Court of Australia (Expert Witness Guidelines).

Please read and familiarise yourself with the Expert Witness Guidelines, and comply with them at all times over the course of your engagement with United Energy and Multinet Gas.

In particular, your report prepared for United Energy and Multinet Gas should contain a statement at the beginning of the report to the effect that the author of the report has read, understood and complied with the Expert Witness Guidelines.

Your report must also:

1. contain particulars of the training, study or experience by which the expert has acquired specialised knowledge;
2. identify the questions that the expert has been asked to address;
3. set out separately each of the factual findings or assumptions on which the expert's opinion is based;
4. set out each of the expert's opinions separately from the factual findings or assumptions;
5. set out the reasons for each of the expert's opinions; and
6. otherwise comply with the Expert Witness Guidelines.

The expert is also required to state that each of the expert's opinions is wholly or substantially based on the expert's specialised knowledge.

The declaration contained within the report should be 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 report".

Please also attach a copy of these terms of reference to the report.

Fees

The consultant is requested to submit:

- A fixed total fee for the project and hourly rates for the proposed project team should additional work be required; and
- Details of the individuals who will provide the strategic analysis and advice.

Contacts

Any questions regarding this terms of reference should be directed to:

Nick Taylor (Jones Day)

Email: njtaylor@jonesday.com

Phone: 02 8272 0500

Kind regards

Nicolas Taylor

Partner

Appendix C. Federal Court Guidelines

FEDERAL COURT OF AUSTRALIA

Practice Note CM 7

EXPERT WITNESSES IN PROCEEDINGS IN THE FEDERAL COURT OF AUSTRALIA

Practice Note CM 7 issued on 1 August 2011 is revoked with effect from midnight on 3 June 2013 and the following Practice Note is substituted.

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 evidence[152], 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 Court[153]

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.

---

[152] 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].

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

2. The Form of the Expert's Report[154]

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

(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) above[155]; 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 Court[156].

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.

---

[154] Rule 23.13.

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

[156] The *"Ikarian Reefer"* [1993] 20 FSR 563 at 565

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 reports[157].

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

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

Appendix D. Curriculum Vitae

Simon M. Wheatley

5 Maple Street
Blackburn VIC 3130
Tel: +61 3 9878 7985
E-mail: swhe4155@bigpond.net.au

Overview

Simon is a consultant and was until 2008 a Professor of Finance at the University of Melbourne. Since 2008, Simon has applied his finance expertise in investment management and consulting outside the university sector. Simon's interests and expertise are in individual portfolio choice theory, testing asset-pricing models and determining the extent to which returns are predictable. Prior to joining the University of Melbourne, Simon taught finance at the Universities of British Columbia, Chicago, New South Wales, Rochester and Washington.

Personal

Nationalities:	U.K. and U.S.
Permanent residency:	Australia

Employment

- Affiliated Industry Expert, NERA Economic Consulting, 2014-
- Special Consultant, NERA Economic Consulting, 2009-2014
- External Consultant, NERA Economic Consulting, 2008-2009
- Quantitative Analyst, Victorian Funds Management Corporation, 2008-2009
- Adjunct, Melbourne Business School, 2008
- Professor, Department of Finance, University of Melbourne, 2001-2008
- Associate Professor, Department of Finance, University of Melbourne, 1999-2001
- Associate Professor, Australian Graduate School of Management, 1994-1999
- Visiting Assistant Professor, Graduate School of Business, University of Chicago, 1993-1994
- Visiting Assistant Professor, Faculty of Commerce, University of British Columbia, 1986

- Assistant Professor, Graduate School of Business, University of Washington, 1984-1993

Education

- Ph.D., University of Rochester, USA, 1986; Major area: Finance; Minor area: Applied statistics; Thesis topic: Some tests of international equity market integration; Dissertation committee: Charles I. Plosser (chairman), Peter Garber, Clifford W. Smith, Rene M. Stulz
- M.A., Economics, Simon Fraser University, Canada, 1979
- M.A., Economics, Aberdeen University, Scotland, 1977

Publicly Available Reports

Review of the Literature in Support of the Sharpe-Lintner CAPM, the Black CAPM and the Fama-French Three-Factor Model A report for Jemena Gas Networks, Jemena Electricity Networks, AusNet Services, Australian Gas Networks, CitiPower, Ergon Energy, Powercor, SA PowerNetworks, and United Energy, March 2015, https://www.aer.gov.au/sites/default/files/United%20Energy%20-%20Submission%20on%20JGN%20draft%20decision%20-%20NERA%20Sharpe-Lintner%20Black%20CAPMs%20-%2027%20March%202015.pdf

Estimating Distribution and Redemption Rates from Taxation Statistics A report for Jemena Gas Networks, Jemena Electricity Networks, AusNet Services, Australian Gas Networks, CitiPower, Ergon Energy, Powercor, SA PowerNetworks and United Energy, March 2015, https://www.aer.gov.au/sites/default/files/United%20Energy%20-%20Submission%20on%20JGN%20draft%20decision%20-%20NERA%20Redemption%20rates%20-%2027%20March%202015.pdf

Empirical performance of Sharpe-Lintner and Black CAPMs: A report for Jemena Gas Networks, Jemena Electricity Networks, ActewAGL, AusNet Services, CitiPower, Energex, Ergon Energy, Powercor, SA Power Networks, and United Energy, February 2015, http://jemena.com.au/Gas/Jemena/media/jemenagasnetworksmedia/community-engagement-document/our-revised-regulatory-proposal/Appendix%2007.08%20NERA%20Empirical%20performance%20of%20the%20Sharpe-Lintner%20and%20Black%20CAPMs%20-%2026%20Feb%2015.pdf

Historical estimates of the market risk premium: A 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, February 2015, http://jemena.com.au/Gas/Jemena/media/jemenagasnetworksmedia/community-engagement-document/our-revised-regulatory-proposal/Appendix%2007.07%20NERA%20Historical%20estimates%20of%20the%20MRP%20-%2013%20Feb%2015.pdf

Robust regression techniques: A report for DBP, December 2014, https://www.erawa.com.au/cproot/13287/2/Submission%2012%20-%20Appendix%20F%20-%20Robust%20Regression.PDF

Imputation Credits and Equity Returns: A report for the Energy Networks Association, October 2013, http://www.aer.gov.au/sites/default/files/ENA,%20Attachment%204%20-%20NERA%20Report%20-%20Imputation%20Credits%20and%20Equity%20Prices,%20Submission%20to%20draft%20AER%20rate%20of%20return%20guideline%20-%2011%20Oct%202013.pdf

The Fama-French Three-Factor Model: A report for the Energy Networks Association, October 2013, http://www.aer.gov.au/sites/default/files/Essential%20Energy%20-%20Attachment%207.9_NERA_The%20Fama-French%20Three-Factor%20Model%20-%202014.pdf

The Market Risk Premium: Analysis in Response to the AER's Draft Rate of Return Guidelines: A report for the Energy Networks Association, October 2013, http://www.aer.gov.au/sites/default/files/ENA,%20Attachment%203%20-%20NERA%20Report%20-%20The%20Market%20Risk%20Premiuml,%20Submission%20to%20draft%20AER%20rate%20of%20return%20guideline%20-%2011%20Oct%202013.pdf

The Market, Size and Value Premiums: A report for the Energy Networks Association, June 2013, http://www.aer.gov.au/sites/default/files/Report%2015%20-%20ENAMRPReport28062013%20Final.pdf

Estimates of the Zero-Beta Premium: A report for the Energy Networks Association, June 2013, http://www.aer.gov.au/sites/default/files/Report%202%20-%20Black%20CAPM%20Zero%20Beta%20Estimate%20(Final)%20-%2027%20June..pdf

The Payout Ratio: A report for the Energy Networks Association, June 2013, http://www.aer.gov.au/sites/default/files/Report%2012%20-%20Payout%20Ratio%20(Final)%20-%20June%202013.pdf

Review of Cost of Equity Models: A report for the Energy Networks Association, June 2013, http://www.aer.gov.au/sites/default/files/Report%201%20-%20Alternative%20Cost%20of%20Equity%20Models%20(Final)%20-%2026%20June.pdf

The Cost of Equity for a Regulated Energy Utility: A Response to the QCA Discussion Paper on the Risk-Free Rate and the MRP: A report for United Energy and Multinet Gas, March 2013, http://www.qca.org.au/files/CI-UEM-SubNERA-CCR1213-0413.pdf

The Cost of Equity for a Regulated Energy Utility: A report for Multinet, February 2013, http://www.erawa.com.au/cproot/11197/2/20130312%20-%20D103642%20-%20Guidelines%20for%20the%20Rate%20of%20Return%20for%20Gas%20Transmission%20and%20Distribution%20Networks%20-%20United%20Energy%20and%20Multinet%20Gas.pdf

The Black CAPM: A report for APA Group, Envestra, Multinet & SP AusNet, March 2012,
http://www.aer.gov.au/sites/default/files/Attachment%209.6%20NERA%20-%20Black%20CAPM%20Report%20March%202012.pdf

Prevailing Conditions and the Market Risk Premium: A report for APA Group, Envestra, Multinet & SP AusNet, March 2012,
http://www.aer.gov.au/content/item.phtml?itemId=753605&nodeId=418ee68d5b881d58515e4f39d9d3aee3&fn=G-5%20NERA%20%20Prevailing%20Conditions%20and%20the%20Market%20Risk%20Premium%20March%202012.pdf

The Market Risk Premium: A report for CitiPower, Jemena, Powercor, SP AusNet and United Energy, 20 February 2012,
http://www.aer.gov.au/content/item.phtml?itemId=752660&nodeId=fe0280e7e2113c467dfc4b3b076e1623&fn=Vic%20DNSPs%20(NERA)%20-%2020%20February%202012.pdf

Cost of Equity in the ERA DBNGP Draft Decision: A report for DBNGP, 17 May 2011,
http://www.erawa.com.au/cproot/9669/2/20110620%20-%20DBNGP%20(WA)%20%20-%20Sub%2055%20-%20Att%207%20-%20NERA%20Economic%20Consulting%20Cost%20of%20equity%20in%20the%20draft%20decision.pdf

The Market Risk Premium: A report for Multinet Gas and SP AusNet, 29 April 2011,
http://www.aer.gov.au/content/index.phtml/itemId/745782

Cost of Capital for Water Infrastructure Company Report for the Queensland Competition Authority, 28 March 2011,
http://www.qca.org.au/files/W-NERA-EconomicConsulting-FinalReport-WACC-0411.pdf

The Cost of Equity: A report for Orion, 2 September 2010,
http://www.comcom.govt.nz/assets/Pan-Industry/Input-Methodologies/Draft-Reasons-Papers/Draft-Reasons-EDBs/Draft-Determination-X-Sub/Orion-Cross-Submission-Attachment-on-EDBs-and-GPBs-Input-Methodologies-Draft-Determination-and-Reasons-Paper-NERA-Report-2-September-2010.pdf

New Gamma Issues Raised by AER Expert Consultants: A report for JGN, 17 May 2010,
http://www.aer.gov.au/content/item.phtml?itemId=736652&nodeId=dea01451551935038 4275dccc6b56018&fn=JGN%20further%20submission%20on%20gamma%20(18%20May%202010).pdf

The Required Rate of Return on Equity for a Gas Transmission Pipeline: A Report for DBP, 31 March 2010,
http://www.erawa.com.au/cproot/8512/2/20100503%20D29252%20DBNGP%20-%20Submission%208%20-%20Annexure%201%20-%20The%20Required%20Rate%20of%20Return%20on%20Equity%20for%20a%20Gas%20Transmission%20Pipeline.pdf

Jemena Access Arrangement Proposal for the NSW Gas Networks: AER Draft Decision: A report for Jemena, 19 March 2010, http://www.aer.gov.au/content/item.phtml?itemId=735229&nodeId=4dc041cfe6e30a2c2b91e833cad31191&fn=Appendix%205.1%20-%20NERA%20-%20FAMA%20French%20Report.pdf

Payout Ratio of Regulated Firms: A report for Gilbert + Tobin, 5 January 2010, http://www.aer.gov.au/content/item.phtml?itemId=735236&nodeId=10e87413b13d1da23cd55faf20a6918d&fn=Appendix%206.3D%20-%20NERA%20(4%20Jan%2010,%20ETSA)%20Payout%20ratio%20of%20regulated%20firms.pdf

Review of Da, Guo and Jagannathan Empirical Evidence on the CAPM: A report for Jemena Gas Networks, 21 December 2009, http://www.ipart.nsw.gov.au/files/Submission%20-%20Alternative%20approaches%20to%20the%20determination%20of%20the%20cost%20of%20equity%20-%20Jemena%20-%20Sandra%20Gamble%20-%2022%20December%202009%20-%20APD%20-%20Website.PDF

The Value of Imputation Credits for a Regulated Gas Distribution Business: A report for WA Gas Networks, 18 August 2009, summarized in: http://www.erawa.com.au/cproot/8357/2/20100215%20WAGN%20-%20Proposed%20Revisions%20to%20the%20AA%20for%20the%20WAGN%20Gas%20Distribution%20Systems%20Submission%20-%20Public%20Version.pdf

Cost Of Equity - Fama-French Three-Factor Model Jemena Gas Networks (NSW), 12 August 2009, http://www.aer.gov.au/content/item.phtml?itemId=730699&nodeId=4fcc57398775fe84685434e0b749d76a&fn=Appendix%209.1%20-%20NERA%20-%20Cost%20of%20equity%20-%20Fama-French%20Model.pdf

Estimates of the Cost of Equity: A report for WAGN, 22 April 2009, summarized in: http://www.erawa.com.au/cproot/8357/2/20100215%20WAGN%20-%20Proposed%20Revisions%20to%20the%20AA%20for%20the%20WAGN%20Gas%20Distribution%20Systems%20Submission%20-%20Public%20Version.pdf

AER's Proposed WACC Statement – Gamma: A report for the Joint Industry Associations, 30 January 2009, http://www.aer.gov.au/content/item.phtml?itemId=726698&nodeId=80cf978278d317e99c34ae1878525573&fn=JIA%20Appendix%20Q%20-%20NERA%20-%20AER's%20proposed%20WACC%20statement-Gamma.pdf

The Value of Imputation Credits: A report for the ENA, Grid Australia and APIA, 11 September 2008, http://www.ena.asn.au/udocs/24092008aersub/Appendix%20K%20-%20The%20value%20of%20imputation%20credits%20-%20NERA.pdf

Consulting Experience

NERA, 2008-present

Lumina Foundation, Indianapolis, 2009

Industry Funds Management, 2010

Academic Publications

Imputation credits and equity returns, (with Paul Lajbcygier), 2012, *Economic Record* 88, 476-494.

Do measures of investor sentiment predict returns? (with Robert Neal), 1998, *Journal of Financial and Quantitative Analysis* 33, 523-547.

Adverse selection and bid-ask spreads: Evidence from closed-end funds (with Robert Neal), 1998, *Journal of Financial Markets* 1, 121-149.

Shifts in the interest-rate response to money announcements: What can we say about when they occur? (with V. Vance Roley), 1996, *Journal of Business and Economic Statistics* 14, 135-138.

International investment restrictions and closed-end country fund prices, (with Catherine Bonser-Neal, Greggory Brauer, and Robert Neal), 1990, *Journal of Finance* 45, 523-547 (reprinted in International Capital Markets Volume III, 2003, G. Andrew Karolyi and Rene M. Stulz, editors, Edward Elgar Publishing, Cheltenham, Glos).

A critique of latent variable tests of asset pricing models, 1989, *Journal of Financial Economics* 21, 177-212.

Some tests of international equity market integration, 1988, *Journal of Financial Economics* 21, 177-212 (reprinted in International Capital Markets Volume I, 2003, G. Andrew Karolyi and Rene M. Stulz, editors, Edward Elgar Publishing, Cheltenham, Glos).

Some tests of the consumption-based asset pricing model, 1988, *Journal of Monetary Economics* 22, 193-215.

Working Papers

An evaluation of some alternative models for pricing Australian stocks (with Paul Lajbcygier), 2009.

Intertemporal substitution, small-sample bias, and the behaviour of U.S. household consumption (with Kogulakrishnan Maheswaran and Robert Porter), 2007.

Keeping up with the Joneses, human capital, and the home-equity bias (with En Te Chen), 2003.

Evaluating asset pricing models, 1998.

Time-non-separable preferences or artifact of temporal aggregation? (with Robert Porter), 2002.

Testing asset pricing models with infrequently measured factors, 1989.

Refereeing Experience

Referee for Accounting and Finance, the Australian Journal of Management, Economic Letters, Financial Analysts Journal, Financial Management, Journal of Accounting and Economics, Journal of Business, Journal of Empirical Finance, Journal of Finance, Journal of Financial and Quantitative Analysis, Journal of Financial Economics, Journal of Futures Markets, Journal of International Economics, Journal of International Money and Finance, Journal of Money, Credit, and Banking, Journal of Monetary Economics, Management Science, National Science Foundation, Pacific-Basin Finance Journal, and the Review of Financial Studies.

Program Committee for the Western Finance Association in 1989 and 2000.

Teaching Experience

International Finance, Melbourne Business School, 2008

Corporate Finance, International Finance, Investments, University of Melbourne, 1999-2008

Corporate Finance, International Finance, Investments, Australian Graduate School of Management, 1994-1999

Investments, University of Chicago, 1993-1994

Investments, University of British Columbia, 1986

International Finance, Investments, University of Washington, 1984-1993

Investments, Macroeconomics, Statistics, University of Rochester, 1982

Accounting, 1981, Australian Graduate School of Management, 1981

Teaching Awards

MBA Professor of the Quarter, Summer 1991, University of Washington

Computing Skills

User of SAS since 1980. EViews, Excel, EXP, LaTex, Matlab, Powerpoint, Visual Basic. Familiar with the Australian School of Business, Compustat and CRSP databases. Some familiarity with Bloomberg, FactSet and IRESS.

Board Membership

Anglican Funds Committee, Melbourne, 2008-2011

Honours

Elected a member of Beta Gamma Sigma, June 1986.

Fellowships

Earhart Foundation Award, 1982-1983

University of Rochester Fellowship, 1979-1984

Simon Fraser University Fellowship, 1979

Inner London Education Authority Award, 1973-1977

Report qualifications/assumptions and limiting conditions

This report is for the exclusive use of the NERA Economic Consulting client named herein. There are no third party beneficiaries with respect to this report, and NERA Economic Consulting does not accept any liability to any third party.

Information furnished by others, upon which all or portions of this report are based, is believed to be reliable but has not been independently verified, unless otherwise expressly indicated. Public information and industry and statistical data are from sources we deem to be reliable; however, we make no representation as to the accuracy or completeness of such information. The findings contained in this report may contain predictions based on current data and historical trends. Any such predictions are subject to inherent risks and uncertainties. NERA Economic Consulting accepts no responsibility for actual results or future events.

The opinions expressed in this report are valid only for the purpose stated herein and as of the date of this report. No obligation is assumed to revise this report to reflect changes, events or conditions, which occur subsequent to the date hereof.

All decisions in connection with the implementation or use of advice or recommendations contained in this report are the sole responsibility of the client. This report does not represent investment advice nor does it provide an opinion regarding the fairness of any transaction to any and all parties.

NERA
ECONOMIC CONSULTING

NERA Economic Consulting
Darling Park Tower 3
201 Sussex Street
Sydney NSW 2000
Australia
Tel: 61 2 8864 6500 Fax: 61 2 8864 6549
www.nera.com

JONES DAY

AURORA PLACE • LEVEL 41, 88 PHILLIP STREET • SYDNEY NSW 2000

TELEPHONE: +61.2.8272.0500 • FACSIMILE: +61.2.8272.0599

24 June 2015

Partner
Nicolas Taylor
Telephone: +61 2 8272 0715
Email: NJTaylor@JonesDay.com

TERMS OF REFERENCE
The Cost of Equity: Response to the AER's Final Decisions for the NSW and ACT Electricity Distributors, and for Jemena Gas Networks

Background

The Australian Energy Regulator (AER) is empowered to make five yearly regulatory determinations that control the aggregate average prices charged by regulated energy network businesses. The National Electricity Rules provide for a Regulated Asset Base (RAB) to be established and updated annually and for an operational expenditure allowance. A further key component of the regulatory determination is the allowed rate of return for debt and equity (or weighted average cost of capital) for funding the business. The principal Rules governing how the AER sets the allowed rate of return on debt for electricity distribution businesses are contained in Rule 6.5.2 of the National Electricity Rules (see attached). The same Rules in essentially the same terms apply to gas distribution businesses.

When the AER exercises the relevant regulatory powers under the National Electricity Rules, it is also required to apply section 16 of the National Electricity Law (see attached). Specifically, section 16 provides that *the AER must, in performing or exercising an AER economic regulatory function or power – (a) perform or exercise that function or power in a manner that will or is likely to contribute to the achievement of the national electricity objective*….That national electricity objective is set out in section 7 of the National Electricity Law as: '*The objective of this Law is to promote efficient investment in, and efficient operation and use of, electricity services for the long term interests of consumers of electricity with respect to- (a) price, quality, safety, reliability and security of supply of electricity; and (b) the reliability, safety and security of the national electricity system.'*

Additionally, the Rules require the AER to publish a Rate of Return Guideline which explains how the regulator intends to apply the Rules (attached). The AER has recently published final determinations for the NSW and ACT electricity networks, and for Jemena Gas Networks[1].

[1] See, for instance:

AER (2015), Ausgrid distribution determination, 2015−16 to 2018−19, Attachment 3 – Rate of return, April 2015.

Preliminary determinations have also been published for the Queensland electricity distributors, and for SA Power Networks[2].

Engagement

You are engaged by Jones Day on behalf of United Energy and a consortium of other businesses to provide the work (set out below). Specifically, you have been retained by ActewAGL distribution, Australian Gas Networks, APA Group, AusNet Services, Citipower, Ergon Energy, Jemena Electricity Networks, Powercor, SA Power Networks, and United Energy.

Scope of work

The AER made a number of consultancy reports available when it released its final decision for Jemena Gas Networks[3].

NERA Economic Consulting is asked to consider the reports prepared by the AER's advisers and to prepare an overall assessment of the return on equity. The analysis to be undertaken by NERA should encompass a broader set of considerations which can be set out as follows:

(a) A review of the earlier empirical work by NERA to investigate the performance of the Black CAPM, the SL CAPM, and other asset pricing models[4].

(b) A response to comments on the empirical work made by the AER and its advisers.

(c) An examination of the evidence about the interpretation of the results from empirical tests provided by Ray, Savin, and Tiwari (2009) [5].

(continued…)

AER (2015), FINAL DECISION, Jemena Gas Networks (NSW) Ltd, Access Arrangement 2015-20, Attachment 3 – Rate of return, June 2015.

[2] See, for instance:

AER (2015), PRELIMINARY DECISION, SA Power Networks determination, 2015−16 to 2019−20, Attachment 3 – Rate of return, April 2015

[3] The reports, some of which had been released previously, included the following:

Partington (2015), Return on Equity (Updated), Graham Partington, April 2015.

Handley (2015), Further Advice on the Return on Equity, John C. Handley, University of Melbourne, 16 April 2015.

Partington and Satchell (2015), Report to the AER, Return of Equity and Comment on Submissions in Relation to JGN, Graham Partington and Steven Satchell, May 2015.

[4] NERA, Empirical performance of Sharpe-Lintner and Black CAPMs: A report for Jemena Gas Networks, Jemena Electricity Networks, ActewAGL, AusNet Services, CitiPower, Energex, Ergon Energy, Powercor, SA Power Networks, and United Energy, February 2015.

[5] Ray, S., N.E. Savin and A. Tiwari, Testing the CAPM revisited, Journal of Empirical Finance, 2009, pages 721-733.

(d) An assessment of the way in which the AER's advisers have interpreted the empirical evidence about the SL CAPM provided by Da, Guo and Jagannathan[6].

(e) An evaluation of comments made about the Black CAPM by Mackenzie and Partington in their reports of August 2012, October 2014, and in the report by Partington from April 2015[7].

(f) An investigation of the contention advanced by Partington and Satchell that "estimates of the zero beta rate are very inaccurate" [8].

(g) A review of other issues about the rate of return on equity that have been raised by the AER's advisers.

(h) A discussion of other relevant evidence about the measurement of the rate of return on equity.

In preparing the report, NERA Economic Consulting will:

A. Consider any comments made by the AER, its experts and other regulators; and

B. Use robust methods and data in producing any statistical estimates.

C. Respond to any other matters raised by the Australian Energy Regulator (AER) in its recently published Final decision, Jemena Gas Networks (NSW) Ltd, Access arrangement 2015-20 and in other recent AER decisions.

Reporting

Jeremy Rothfield of United Energy and Multinet Gas will serve as the primary contact for the period of the engagement. His contact details are as follows:

Jeremy Rothfield
Economist
United Energy and Multinet Gas
Level 1
Pinewood Corporate Centre
43-45 Centreway Place
Mount Waverley VICTORIA 3149
P.O. Box 449
Mount Waverley VICTORIA 3149
Email: Jeremy.Rothfield@ue.com.au

---

[6] Da, Z., R-J. Guo and R. Jagannathan, CAPM for estimating the cost of equity capital: Interpreting the empirical evidence, Journal of Financial Economics, 2012, pages 204-220.

[7] McKenzie, M. and G. Partington, Review of the NERA report on the Black CAPM, SIRCA, 24 August 2012.

McKenzie, M. and G. Partington, Report to the AER Part A: Return on equity, October 2014.

Partington, G., Report to the AER Return on equity (updated), April 2015, pages 22 to 23.

[8] Partington and Satchell (2015), Report to the AER, Return of Equity and Comment on Submissions in Relation to JGN, Graham Partington and Steven Satchell, May 2015; page 13.

Telephone: (03) 88469854

The consultant will prepare reports showing the work-in-progress on a regular basis. The consultant will make periodic presentations on analysis and advice as appropriate.

Conflicts

The consultant is to identify any current or potential future conflicts.

Compliance with the Code of Conduct for Expert Witnesses

Attached as **Annexure 1** is a copy of the Federal Court's Practice Note CM 7, entitled "Expert Witnesses in Proceedings in the Federal Court of Australia", which comprises the guidelines for expert witnesses in the Federal Court of Australia (Expert Witness Guidelines).

Please read and familiarise yourself with the Expert Witness Guidelines, and comply with them at all times over the course of your engagement with United Energy and Multinet Gas.

In particular, your report prepared for United Energy and Multinet Gas should contain a statement at the beginning of the report to the effect that the author of the report has read, understood and complied with the Expert Witness Guidelines.

Your report must also:

1. contain particulars of the training, study or experience by which the expert has acquired specialised knowledge;
2. identify the questions that the expert has been asked to address;
3. set out separately each of the factual findings or assumptions on which the expert's opinion is based;
4. set out each of the expert's opinions separately from the factual findings or assumptions;
5. set out the reasons for each of the expert's opinions; and
6. otherwise comply with the Expert Witness Guidelines.

The expert is also required to state that each of the expert's opinions is wholly or substantially based on the expert's specialised knowledge.

The declaration contained within the report should be 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 report".

Please also attach a copy of these terms of reference to the report.

Fees

The consultant is requested to submit:

- A fixed total fee for the project and hourly rates for the proposed project team should additional work be required; and
- Details of the individuals who will provide the strategic analysis and advice.

Contacts

Any questions regarding this terms of reference should be directed to:

Nick Taylor (Jones Day)

Email: njtaylor@jonesday.com

Phone: 02 8272 0500

Kind regards

Nicolas Taylor

Partner

Annexure 1

FEDERAL COURT OF AUSTRALIA
Practice Note CM 7
EXPERT WITNESSES IN PROCEEDINGS IN THE FEDERAL COURT OF AUSTRALIA

Practice Note CM 7 issued on 1 August 2011 is revoked with effect from midnight on 3 June 2013 and the following Practice Note is substituted.

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 evidence[9], 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 Court[10]

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 Report[11]

---

9 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].

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

11 Rule 23.13.

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

(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) above[12]; 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 Court[13].

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 reports[14].

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

---

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

13 The "Ikarian Reefer" [1993] 20 FSR 563 at 565

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

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