

Jemena Gas Networks (NSW) Ltd - Initial response to the draft decision

Appendix 5.1

NERA: Fama French report - Response to the Draft Decision

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Jemena Access Arrangement Proposal for the NSW Gas Networks: AER Draft Decision

A report for Jemena

NERA

Economic Consulting

Project Team

Simon Wheatley

Brendan Quach

Greg Houston

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

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Executive Summary

On August 2009 Jemena Gas Networks NSW (JGN) submitted a revised access arrangement proposal for its distribution network for the period 2010-2014 to the Australian Energy Regulator (AER). An important element in determining its revenues during the access period is the allowed return on equity. JGN engaged NERA Economic Consulting together with Jeff Balchin to estimate the cost of equity for a gas distributor using the Fama-French three-factor model (FFM). Our report entitled *Cost of Equity – Fama-French Three-Factor Model: A Report for Jemena Gas Networks (NSW)*, also of August 2009, was attached to the JGN access arrangement proposal.

The National Gas Rules (NGR) contain a number of important conditions that a financial model used to estimate of the cost of equity must satisfy. Four of the conditions are particularly important:

- § Rule 87(2)(b) states that an estimate of the cost of equity must be computed using a financial model that is ‘well accepted’;
- § Rule 74(2)(b) requires that an estimate of the cost of equity be the ‘best forecast or estimate possible in the circumstances’;
- § Rule 74(2)(a) requires that estimates of the cost of equity be ‘arrived at on a reasonable basis’; and
- § Rule 87(1) requires that ‘the rate of return on capital is to be commensurate with prevailing conditions in the market for funds and the risks involved in providing reference services’.

In this report we provide evidence to show that the estimate of the cost of equity for a gas distributor in excess of the risk-free rate contained in our August 2009 report satisfies the NGR.

We provide evidence that the FFM is well accepted by both the academic community and by practitioners. Evidence that the model is well accepted by the academic community includes quotes stating that the model is well accepted drawn from papers introduced by the AER into the debate. It also includes citation statistics that indicate that the model has attracted an enormous amount of interest among academics. We show that the model is taught at every major university in Australia and that the model has a theoretical basis. We also show that the model has attracted the attention of the wider community.

Evidence that the model is well accepted by practitioners includes the fact that students who study for the Chartered Financial Analysts exams are required to know how the model works. It also includes the fact that Morningstar, a major provider of financial information, sells inputs for the model and the fact that McKinsey, a major provider of consulting services, includes an explanation of how to use the model in a valuation guide that it publishes. We note that Morgan Stanley, a global financial services firm, has awarded Eugene Fama, one of the developers of the model, the inaugural Morgan Stanley – AFA Prize in Financial Economics, in part for producing the model, and we provide evidence that the model is used in research by fund managers.

We therefore conclude that there is ample evidence that the FFM is ‘well accepted’ by the academic community and by practitioners, and so estimates of the cost of equity produced using the model satisfy Rule 87(2)(b).

The Australian Energy Regulator (AER) has rejected the use of the FFM in its draft decision and requires JGN to amend its access arrangement proposal to use the Sharpe-Lintner Capital Asset Pricing Model (SL CAPM) to estimate the cost of equity for a gas distributor.¹ While this model may be well accepted – it is used as a teaching device by the academic community – it has been known for many years that it does not provide the best estimate of the cost of equity. For many years now it has been used only rarely as a benchmark in research by the academic community.

In this report we review evidence that shows that the FFM provides a better estimate of the cost of equity than does the SL CAPM. In particular, we review evidence that shows that an Australian version of the FFM provides a better estimate of the cost of equity than does an Australian version of the SL CAPM. Much of this evidence arises from material that the AER itself introduces into the debate. In its draft decision the AER reviews seven papers that test an Australian version of the FFM. Of the seven, five also test an Australian version of the SL CAPM. All of the papers that compare the FFM and SL CAPM conclude that the FFM provides better estimates of the cost of equity than does the SL CAPM.

We therefore conclude that the available evidence indicates that an estimate of the cost of equity for a gas distributor produced using an Australian version of the FFM satisfies Rule 74(2)(b) which requires that an estimate of the cost of equity be the ‘best forecast or estimate possible in the circumstances’.

We also emphasise that in our August report we have applied the FFM in a conventional way to estimate the cost of equity for a gas distributor. For example, our estimate of the cost of equity uses the relevering mechanism that the AER endorses. This mechanism is consistent with an assumption that a benchmark gas distributor maintains a constant debt gearing ratio of 60 per cent through time. Further, our estimate of the cost of equity uses the same nine regulated Australian energy businesses that form the sample of companies that the AER employs to estimate the cost of equity with the SL CAPM. Our FFM estimate also uses a value for the market risk premium provided by the AER combined with the longest period available to estimate the factor premiums (necessary inputs for the FFM), which is consistent with advice provided by the AER on how one should estimate the market risk premium (a necessary input for both the SL CAPM and FFM). Finally, our August 2009 report carefully considers whether our FFM estimate of the cost of equity is sensitive to the use of an alternative source for data and finds that it is not.

We therefore conclude that we have produced an estimate of the cost of equity that has been ‘arrived at on a reasonable basis’ and so satisfies Rule 74(2)(a).

Finally, we note that the FFM estimates of the cost of equity for a gas distributor in excess of the risk-free rate contained in our August 2009 report use recent market data. For example,

¹ AER, *Jemena Access arrangement proposal for the NSW gas networks 1 July 2010 – 30 June 2014: Draft Decision (Public)*, February 2010, page 121.

consistent with AER advice, we use weekly data from 1 January 2002 onwards on the sample of nine regulated energy businesses to compute measures of risk. We note that the AER has not in its Draft Decision questioned whether our estimate represents a current market estimate of the cost of equity.

We conclude that the estimate of the cost of equity that we compute in our August 2009 report using the FFM also satisfies the requirement of Rule 87(1) such that ‘the rate of return on capital is to be commensurate with prevailing conditions in the market for funds and the risks involved in providing reference services’.

Table 1 contains the estimates of the parameters of the FFM that we provided in our August 2009 report.²

Table 1
FFM parameter estimates for a gas distributor

Factor	Beta	Risk premium
Market minus risk-free rate	0.59	6.50
HML	0.48	6.24
SMB	0.30	-1.23

Note: Risk premiums are in percent per annum. The beta estimates are computed using weekly data from 1 January 2002 to 29 May 2009. The HML risk premium is computed using monthly data from January 1975 to December 2008. The SMB risk premium is computed using monthly data from January 1980 to December 2008. The market risk premium is from Table 5.7 of AER, Jemena Access arrangement proposal for the NSW gas networks 1 July 2010 – 30 June 2014: Draft Decision (Public), February 2010.

² The estimate of the market risk premium is from Table 5.7 of AER, *Jemena Access arrangement proposal for the NSW gas networks 1 July 2010 – 30 June 2014: Draft Decision (Public)*, February 2010. Table 5.7 of the AER’s draft decision uses estimates of the beta of a gas distributor and the market risk premium taken from AER, *Electricity transmission and distribution network service providers, Review of the weighted average cost of capital (WACC) parameters: Final Decision*, May 2009 that not have been updated. We, similarly, do not update our August 2009 estimates.

The FFM states that the cost of equity for a gas distributor must be:

$$E(R_e) = R_f + b_e MRP + h_e HMLP + s_e SMBP \quad (1)$$

where

R_f is the risk-free rate,

b_e is the market beta;

h_e is the *HML* beta;

s_e is the *SMB* beta;

MRP is the market risk premium;

HMLP is the *HML* risk premium; and

SMBP is the *SMB* risk premium.

Consistent with AER advice, we use the arithmetic average of the annualised yields of 10-year Government bonds over a recent 20-day period as a measure of the risk-free rate. Using the parameter estimates that appear in Table 1 and a risk-free rate which was 5.5813 percent for the 20 business days up to and including the 12 February 2010 produces a post-tax cost of equity for a gas distribution business of:³

$$5.5813 + 0.59 \times 6.50 + 0.48 \times 6.24 + 0.30 \times -1.23 = 12.043 \text{ percent}$$

³ Note that the sample period used to estimate the risk-free rate is only indicative and that a different sample period may result in a different return on equity. Our FFM estimate indicates that the cost of equity for a gas distribution business is 6.46 percentage points above the risk-free rate.

1. Introduction

This report has been prepared for Jemena Gas Networks NSW (JGN) by NERA Economic Consulting (NERA). In August 2009 JGN submitted a revised access arrangement proposal for its distribution network for the period 2010-2014 to the AER. An important element in determining its revenues during the access period is the allowed return on equity. JGN initially engaged NERA together with Jeff Balchin to estimate the current cost of equity for a gas distributor. Our August 2009 report entitled, *Cost of Equity – Fama-French Three-Factor Model: A Report for Jemena Gas Networks (NSW)* was attached to the JGN access proposal.

The NERA report estimated that the current cost of equity for a gas distributor was 12.06 per cent which was a 6.46 per cent margin above the risk-free rate at the time that the report was written of 5.60 per cent.⁴ The cost of equity was estimated using a domestic version of the Fama-French three-factor model (FFM).

In February 2010, the AER released its draft decision on JGN's access arrangement (AA) proposal for the period 1 July 2010 to 30 June 2014 (Draft Decision).⁵ In section 5.5 of the Draft Decision the AER rejected the use the FFM to estimate the cost of equity and instead required JGN to amend its AA proposal to use the Sharpe-Lintner Capital Asset Pricing Model (SL CAPM).⁶

JGN has asked NERA to provide:

1. *A review of the AER's draft decision on the cost of equity*—an assessment of the AER's analysis and conclusions on the cost of equity in section 5, including whether the AER's cost of equity estimate is: (a) a return on capital that is commensurate with prevailing conditions in the market for funds and the risks involved in providing reference services; (b) estimated using a well accepted financial model; and (c) a forecast or estimate that is arrived at on a reasonable basis and represents the best forecast or estimate possible in the circumstances; and
2. *A cost of equity*—a cost of equity estimate for an efficient gas network that is: (a) a return on capital that is commensurate with prevailing conditions in the market for funds and the risks involved in providing reference services; (b) estimated using a well accepted financial model; and (c) a forecast or estimate that is arrived at on a reasonable basis and represents the best forecast or estimate possible in the circumstances. This estimate

⁴ Consistent with AER advice, we use the arithmetic average of the annualised yields of 10-year Government bonds over a recent 20-day period as a measure of the risk-free rate. As we make clear in the Executive Summary to this document, based on a risk-free rate of 5.5813 per cent computed from data for the 20 days up to and including the 12 February 2010 produces a post-tax cost of equity for a gas distribution business of 12.043 per cent per annum.

⁵ AER, *Jemena Access arrangement proposal for the NSW gas networks 1 July 2010 – 30 June 2014: Draft Decision (Public)*, February 2010.

⁶ AER, *Jemena Access arrangement proposal for the NSW gas networks 1 July 2010 – 30 June 2014: Draft Decision (Public)*, February 2010, page 121.

should incorporate a gamma estimate of 0.2 and a risk free rate estimate of 5.5813 per cent for the 20 business days from 15 January 2010 to 12 February 2010.⁷

The remainder of this report is structured as follows:

- § Section 2 – sets out the framework for assessing whether the FFM better meets the requirements of the National Gas Law (NGL) and National Gas Rules (NGR) than does the SL CAPM;
- § Section 3 – considers the requirement under 87(2) of the NGR for the financial model to be well accepted;
- § Section 4 – outlines the available evidence on the question of whether the FFM or SL CAPM provides the best estimate of the current cost of equity for a gas distribution business;
- § Section 5 – explains why our application of the FFM to estimating the current cost of equity of a gas distributor was arrived at on a reasonable basis; and
- § Section 6 – outlines our conclusions about whether the FFM meets the requirements of the NGL and NGR and proposes a current cost of equity for a gas distributor.

Attached to this report are a number of appendices. Appendix A provides a guide to the empirical application of the FFM. Appendix B outlines the relationship between the SL CAPM and the FFM. Appendix C describes a number of statistical tests that one can use to determine the accuracy of a financial model. Appendix D reproduces the terms of reference for this report. Finally Appendix E provides the Curriculum Vitae of each of the authors.

1.1. Statement of Credentials

This report has been jointly prepared by **Simon Wheatley**, **Brendan Quach** and **Greg Houston**.

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

Brendan Quach is a Senior Consultant at NERA with ten years experience as an economist, specialising in network economics and competition policy in Australia, New Zealand and Asia Pacific. Since joining NERA in 2001, Brendan has advised a wide range of clients on regulatory finance matters, including approaches to estimating the cost of capital for regulated infrastructure businesses.

⁷ Note: 26 January 2010 was a public holiday.

Greg Houston is a Director of NERA and head of its Australian operations, while also serving on the Board of Directors and the Management Committee of National Economic Research Associates Inc. Greg has twenty years experience in the economic analysis of markets and the provision of expert advice in litigation, business strategy, and policy contexts. Greg has directed a wide range of competition, regulatory and financial economics assignments since joining NERA in 1989, and has acted as expert witness in finance, competition antitrust and regulatory proceedings before the courts, in various arbitration and mediation processes, and before regulatory and judicial bodies in Australia, Fiji, New Zealand, the Philippines, Singapore and the United Kingdom.

In preparing this report, each of the joint authors (herein after referred to as either 'we' or 'our') confirms that we have made all the inquiries we believe are desirable and appropriate and no matters of significance that we regard as relevant have, to our knowledge, been withheld from this report. We have been provided with a copy of the Federal Court guidelines *Guidelines for Expert Witnesses in Proceedings in the Federal Court of Australia* dated 5 May 2008. We have reviewed those guidelines and this report has been prepared consistently with the form of expert evidence required by those guidelines.

2. Framework

In this report we show that our use of the FFM to compute the cost of equity for a gas distributor satisfies the NGR.⁸ In particular, we show that our use of the FFM satisfies Rules 74 and 87. In this section we explain how we go about the task.

Rule 74 (Forecasts and estimates) states that:

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

Rule 87 (Rate of return) states that:

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

In Section 3 we provide evidence that the FFM is a model that is ‘well accepted’ by both the academic community and market practitioners, and thus satisfies Rule 87(2)(b).

The evidence that the FFM is well accepted by the academic community includes statements drawn from papers introduced by the Australian Energy Regulator (AER) into the debate. The evidence that the model is well accepted by practitioners includes that the model is taught as part of the Chartered Financial Analyst program and in finance programs at major Australian universities. We also provide evidence that the work of Fama and French has received substantive media attention.

The alternative to using the FFM to compute the cost of equity for a gas distributor is for the AER to continue to use the SL CAPM. Thus the choice to be made is between a domestic version of two models:

§ the FFM; and

§ the SL CAPM.

⁸ NERA, *Cost of equity: Fama-French three-factor model: Jemena Gas Networks (NSW)*, 12 August 2009.

In Section 4 we provide evidence that the FFM provides *better* estimates of the cost of equity both in Australia and in the US than does the SL CAPM. That evidence includes material from papers introduced by the AER into the debate. We demonstrate that the FFM as employed in our August 2009 report produces a cost of equity for a gas distributor that satisfies Rule 74(2)(b) since it represents the ‘best forecast or estimate possible in the circumstances’ when compared to the alternative of applying the SL CAPM.

While it is important for the FFM to be well accepted and for it to deliver estimates of the cost of equity that are the best possible, the NGL also requires that the estimates produced using the FFM be arrived at on a *reasonable* basis. In Section 5 we emphasise that in every respect the FFM as applied in our August 2009 report was specified and applied in a conventional way to estimate the cost of equity for a benchmark gas distributor. For example, in using the FFM we:

- § adopt a relevering mechanism which is endorsed by the AER to ensure that our estimate of the cost of equity is consistent with the assumption that a benchmark business has a 60 per cent debt gearing ratio;
- § employ the same nine regulated Australian energy businesses that form the sample of comparable companies that the AER uses to estimate the SL CAPM;
- § use the longest period available to estimate the factor premiums (necessary inputs for the FFM), consistent with advice provided by the AER on how one should estimate the market risk premium (a necessary input for both the SL CAPM and FFM); and
- § use an alternative source for data to determine whether an estimate of the cost of equity is sensitive to the use of a different data source.

Thus in Section 5 we show that the estimate of the cost of equity for a gas distributor that we provide satisfies Rule 74(2)(a) which requires that estimates of the cost of equity be ‘arrived at on a reasonable basis’.

Finally, we note that our estimate of the cost of equity for a gas distributor uses recent market data. For example:

- § consistent with AER advice, we use the arithmetic average of the annualised yields of 10-year Government bonds over a recent 20-day period as a measure of the risk-free rate; and
- § consistent with AER advice, we use weekly data from 1 January 2002 onwards for the sample of nine regulated energy businesses to compute measures of risk.

The estimate of the cost of equity that we produce is therefore computed in a manner consistent with Rule 87(1), which requires that ‘the rate of return on capital is to be commensurate with prevailing conditions in the market for funds and the risks involved in providing reference services’.

3. Is the FFM Well Accepted?

Rule 87(2)(b) requires that a ‘well accepted’ financial model be used to compute the return the market requires on equity. In our August 2009 report, we presented evidence that:

- § the FFM is a well accepted model among academics;
- § the FFM is used by market practitioners; and that
- § while the FFM has not yet been adopted by regulators, an expert panel commissioned by the NZ Commerce Commission recommended its use as a model to check the reasonableness of estimates of the cost of equity.

Notwithstanding this evidence, in section 5.5 of its Draft Decision the AER concluded that the FFM is not a well accepted financial model.⁹

In this section we provide additional evidence that establishes that the FFM is a well accepted financial model among both academics and practitioners. First, however, we put the development of both the SL CAPM and FFM into a historical perspective. Emphasising that the FFM was developed to *correct* known problems with the SL CAPM.

3.1. Historical overview

Modern portfolio theory can be traced to the work of Markowitz (1952).¹⁰ Markowitz examined how a risk-averse investor who cares only about the mean and variance of his or her future wealth should distribute his or her capital across a portfolio.¹¹ His insight was that the variance of the return to a portfolio depends largely on how the returns to the assets that make up the portfolio covary, or move together, with one another and not on the variances of the returns to individual elements of the portfolio.

Sharpe (1964) and Lintner (1965) subsequently examined how the prices of assets will be determined if all investors choose portfolios in the way that Markowitz suggested they should.¹² Sharpe and Lintner found that the return that investors require on an individual asset will be determined not by how risky the asset would be if held alone, but rather by the way in which the asset contributes to the risk of the market portfolio. A rational risk-averse investor will never invest solely in a single risky asset. In other words, a rational investor will never place all of his or her eggs in one basket; rather the investor will diversify. So an investor will care not about how risky an individual asset would be if held alone, but by how the asset contributes to the risk of a diversified portfolio like the market portfolio. The

⁹ AER, *Jemena Access arrangement proposal for the NSW gas networks 1 July 2010 – 30 June 2014: Draft Decision (Public)*, February 2010, page 121.

¹⁰ Markowitz, Harry, *Portfolio selection*, Journal of Finance 7, 1952, pages 77-91.

¹¹ The mean of a random variable is its expected value while the variance of the random variable measures the uncertainty that exists about how far the random variable will deviate from its mean.

¹² Sharpe, William F., *Capital asset prices: A theory of market equilibrium under conditions of risk*, Journal of Finance 19, 1964, pages 425-442.

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.

insights of Markowitz and Sharpe led to their being awarded the Nobel Prize in Economics in 1990.

Although the SL CAPM is an attractive theory, within 10 years of its development two carefully executed US studies showed that the model does not adequately describe the behaviour of returns. Black, Jensen and Scholes (1972) and Fama and MacBeth (1973) both showed that the SL CAPM underestimates the returns to low-beta assets (beta measures the extent to which an asset contributes to the risk of the market portfolio),¹³ ie, assets that have betas below one. Black, Jensen and Scholes and Fama and MacBeth found instead that the behaviour of returns is better described by a more general model, the Black CAPM, which allows the returns to low-beta assets to be higher than under the SL CAPM.¹⁴ These empirical results lead to finance academics abandoning the SL CAPM as a research tool and using instead the Black CAPM.

However, problems were also uncovered with the Black CAPM. Banz (1981) found that the Black CAPM underestimates the returns to the equities of US small firms and Rosenberg, Reid and Lanstein (1985) found that the model underestimates the returns to US high book-to-market or 'value' stocks.¹⁵ Book-to-market is the ratio of the book value of equity to the market value of equity. High book-to-market equities are supposed to provide good value because one pays less for a dollar of book value than one does in purchasing low book-to-market equities. Subsequently, Fama and French (1992) found that size and book-to-market are better predictors of return than beta, contrary to the predictions of both the SL CAPM and Black CAPM.¹⁶ This led Fama and French to theorise that size and book-to-market were proxies for an exposure to additional sources of risk and so to develop their three-factor model.¹⁷ Thus the FFM was developed by Fama and French to explain behaviour they knew the SL CAPM could *not* explain.

Recent US evidence indicates that the FFM also misprices some assets.¹⁸ Like the SL CAPM, the FFM underestimates the returns to low-beta assets. Since the equity of a gas distributor has a low beta, this indicates that our use of the FFM will produce a *conservative* estimate (that is, an underestimate) of the cost of the equity.

¹³ Black, F, M. Jensen and M. Scholes, *The Capital Asset Pricing Model: Some empirical tests*, in *Studies in the Theory of Capital Markets*, ed. M. Jensen, Praeger, New York, 1972.

Fama, E and J. MacBeth, *Risk, return, and equilibrium: Empirical tests*, *Journal of Political Economy* 71, pages 607-636.

¹⁴ Black, Fischer, *Capital market equilibrium with restricted borrowing*, *Journal of Business* 45, 1972, pages 444-454.

¹⁵ Banz, R., *The relationship between return and market value of common stocks*, *Journal of Financial Economics* 9, 1981, pages 3-18.

Rosenberg, B., K.Reid and R. Lanstein, *Persuasive evidence of market inefficiency*, *Journal of Portfolio Management* 11, 1985, pages 9-17.

¹⁶ Fama, Eugene and Kenneth French, *The cross-section of expected returns*, *Journal of Finance* 47, 1992, pages 427-465.

¹⁷ Fama, Eugene and Kenneth French, *Common risk factors in the returns to stocks and bonds*, *Journal of Financial Economics* 33, 1993, pages 3-56.

¹⁸ Lewellen, J., S. Nagel and J. Shanken, *A skeptical appraisal of asset pricing tests*, *Journal of Financial Economics*, forthcoming.

3.2. Acceptance among academics

In our August 2009 report we emphasised that there was evidence that the FFM is a well accepted model among academics.¹⁹ In this section we provide additional evidence, including that on the standing of Eugene Fama and Ken French, the developers of the FFM, in the academic community.

3.2.1. Reputations of Fama and French

One way of judging the reputations of financial economists is to ascertain how often their published work has been cited. Arnold, Butler, Crack and Altintig (2003) find that Fama is a co-author of five of the 50 papers most widely cited in top finance journals from 1990 through 1999 while French is a co-author of three of the 50 papers.²⁰ The Journal of Financial Economics ranks the authors of work published in the Journal by the number of times the work has been cited over the period from 1974 through 2004.²¹ The Journal finds that among authors whose work has been published in the Journal, Fama ranks first and French ranks third.²²

Another way of judging the reputations of financial economists is to ascertain how often their unpublished work has been downloaded. The Social Science Research Network (SSRN) ranks Fama second among the over 100,000 authors whose work is carried by the network in terms of the number of times his work has been downloaded, while French is ranked fifth.²³ The SSRN is the primary way in which unpublished work in the social sciences is distributed.

The esteem with which the leading professional association in finance holds an individual is also a gauge of the individual's standing in the profession. French was president of the American Finance Association in 2007. Fama has never been president of the American Finance Association but was elected the first fellow of the Association in 2001. The next four fellows elected in 2002, 2003, 2004 and 2005 were Samuelson, Arrow, Lucas and Engle – all Nobel Prize winners.²⁴

3.2.2. Media attention

The work of Fama and French has also attracted the attention of the media. By way of an example, the New York Times of 18 February 1992 carried an article entitled 'A study shakes

¹⁹ NERA, *Cost of equity: Fama-French three-factor model: Jemena Gas Networks (NSW)*, 12 August 2009.

²⁰ Arnold, T., A. Butler, T. Crack and A. Altintig, *Impact: What influences finance research?*, Journal of Business 76, 2003, pages 348-349.

²¹ <http://jfe.rochester.edu/authorcites04.htm>

²² As of 2008, the Journal of Finance and the Journal of Financial Economics were the two leading finance journals in terms of their impact assessed by the Institute for Scientific Information. See <http://jfe.rochester.edu/ssci.htm> and <http://jfe.rochester.edu/ssciife08.gif>

²³ www.ssrn.com

²⁴ <http://www.afajof.org/association/fellows.asp>

confidence in the volatile-stock theory' that describes the evidence that Fama and French (1992) provide against the SL CAPM.²⁵ The article states that:

'Eugene F. Fama and Kenneth R. French, business professors at the University of Chicago, traced the performance of thousands of stocks over 50 years but found no link between relative volatility [beta] and long-term returns.'

As another example, the New York Times of 9 March 2008 carries an article entitled 'Can you beat the market? It's a \$100 billion question' that describes a study authored by French that estimates that US investors spent \$100 billion in fees and other costs in 2007 trying to beat the market. The article states that:

'The study, "The Cost of Active Investing," began circulating earlier this year as an academic working paper. Its author is Kenneth R. French, a finance professor at Dartmouth; he is known for his collaboration with Eugene F. Fama, a finance professor at the University of Chicago, in creating the Fama-French model that is *widely used* to calculate risk-adjusted performance.'

[*Emphasis added*]

Similarly, the Guardian of 12 October 2009 carried an article entitled 'Nobel prize for economics awarded to US academics' commenting on the award of the 2009 Nobel Prize in Economics. The article states that:

'The bookmaker's favourite for the prize was Eugene Fama, the University of Chicago professor who is known as the father of the "efficient market hypothesis". This theory, which essentially states that the price of a traded asset, such as a share, fully reflects its true value, has been discredited by the market turmoil of the last two years.'

Along with fellow academic Kenneth French, another favourite for the Nobel prize, Fama went on to develop the "Fama-French three-factor model".'

The assertion that the article makes that the market turmoil of the last two years has discredited the efficient markets hypothesis is – at least in its application to the stock market – untrue. The efficient markets hypothesis does not predict that stock markets will be tranquil, but rather only that, as a first approximation, changes in stock prices will be unpredictable.²⁶

3.2.3. Citations to Fama and French (1992) and Fama and French (1993)

The number of times a paper is cited can provide a guide to how influential a paper is. There can be, of course, problems in assessing citation statistics. For example, a paper in which an unusual error appears may be frequently cited because of that error. Alternatively, a paper that brings an end to a particular line of research – perhaps because it points to a problem with the research – may not be cited often. Nevertheless a large amount of resources are brought to bear by commercial enterprises like Thomson Reuters, through the ISI Web of Knowledge, tracking citations, demonstrating that citation statistics are commonly used to gauge the impact of authors and papers.

²⁵ Fama, Eugene and Kenneth French, *The cross-section of expected returns*, Journal of Finance 47, 1992, pages 427-465.

²⁶ Lo, Andrew, *Efficient markets hypothesis*, in *The New Palgrave: A dictionary of economics*, ed: L. Blume and S. Durlauf, Palgrave MacMillan, New York, 2007.

Arnold, Butler, Crack and Altintig (2003) find that the work of Fama and French (1992) showing that there is a substantial amount of evidence against the SL CAPM was the ninth most widely cited paper in top finance journals over the period 1990 to 1999.²⁷ They found that the work of Fama and French (1993) introducing the FFM was the 17th most widely cited paper in top finance journals over the same period. These statistics are impressive because the papers were published during the period over which citations were counted whereas all of the other papers ranked in the top 20 were published before the start of the period.

The Journal of Financial Economics finds that the paper published by Fama and French (1993) introducing the FFM is the third most widely cited paper published in the Journal when papers are ranked by the number of cites per year over the period 1974 through 2003.²⁸

Less direct, but interesting evidence is provided by a search of the Federal Reserve System web site for various relevant expressions.²⁹ A search for the expression 'CAPM' delivers 1,390 hits while a search for the keywords 'Fama', 'French', 'three' and 'factor' delivers 905 hits. Note that the label 'CAPM' is also associated with other models besides the SL CAPM.

As the AER points out, though, besides published work being cited, it is important to know what is being said about the work. Our view is that the FFM is well accepted. To support our assertion we provide two quotes – both from papers that the AER has introduced into the debate.

The first quote is from Da, Guo and Jagannathan (2009) who state on the first page of their National Bureau of Economic Research working paper:³⁰

'The Fama-French (1993) three-factor model has received wide attention and has become the standard model for computing risk adjusted returns in the empirical finance literature.'

The second quote is from Gharghori, Lee and Veeraraghavan (2009) who state that:³¹

'the Fama-French model has become quite popular. It is reasonable to say that it has now supplanted the CAPM as the dominant asset pricing model in the finance literature.'

Again, both of these quotes are from papers introduced into the debate by the AER.³²

²⁷ Arnold, T., A. Butler, T. Crack and A. Altintig, *Impact: What influences finance research?*, Journal of Business 76, 2003, pages 348-349.

²⁸ <http://jfe.rochester.edu/allstar.htm>

²⁹ <http://www.federalreserveonline.org/>

³⁰ Da, Z., R. Guo and R. Jagannathan, *CAPM for Estimating the Cost of Equity Capital: Interpreting the Empirical Evidence*, National Bureau of Economic Research Working Paper 14889, April 2009.

³¹ Gharghori, P., R. Lee and M. Veeraraghavan, *Anomalies and stock returns: Australian evidence*, Accounting and Finance 49, 2009, pages 555-576.

³² The AER introduces Da, Guo and Jagannathan (2009) into the debate on page 63 of AER, *ActewAGL Access arrangement proposal for the ACT, Queanbeyan and Palerang gas distribution network: 1 July 2010 – 30 June 2015*, 2009.

The AER introduces Gharghori, Lee and Veeraraghavan (2009) into the debate on page 114 of AER, *Jemena access arrangement proposal for the NSW gas networks: Draft Decision*, February 2010.

3.2.4. Use of the FFM in coursework

Another measure of whether a model is well accepted is the extent to which it is used in the classroom. We have contacted the Group of Eight universities together with Macquarie University and asked for documentary evidence that the FFM is used in the classroom. Table 3.1 summarises the evidence of what occurs in the form of either a course outline that indicates that a student enrolled in the course must read about the FFM or class notes that discuss the FFM.³³

Table 3.1
Evidence that the FFM is well accepted from courses taught at major Australian universities

Institution	Evidence
Australian National University	Investments FINM 3001 course outline
Macquarie University	Investments ECFS 865 course outline
Monash University	Funds Management AFF 5270 course outline
University of Adelaide	Portfolio Theory and Management CORPFIN 3501 course outline
University of Melbourne	Economics of Financial Markets 316-351 course outline
University of New South Wales	Financial Decision Making FINS 5574 course outline
University of Queensland	Empirical Finance FINM 6402 course outline
University of Sydney	Investments and Portfolio Theory FINC 3017 course notes
University of Western Australia	Advanced Investments FINA 7481 course outline

Sources: Various course outlines and course notes provided by universities, university staff and former students.

Table 3.1 shows that the FFM is taught in finance courses to students at all of the major universities within Australia.

3.2.5. Theoretical basis

For a model to be well accepted by the academic community it is important that it have some theoretical basis. The AER argues that while the empirical version of the SL CAPM, that it has used in the past, has a strong theoretical basis, the FFM has no theoretical basis.³⁴ This argument is incorrect. The FFM has a theoretical basis, as Fama and French (1993) make

³³ The course outlines require students to have read at least one of the following articles or chapters.

Bodie, Z., A. Kane and A. Marcus, *Investments*, McGraw-Hill/Irwin, 8th Edition, 2008, Chapter 13.

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 Capital Asset Pricing Model: Theory and Evidence*, Journal of Economic Perspectives 18, 2004, pages 25-46.

³⁴ AER, *Jemena access arrangement proposal for the NSW gas networks: Draft Decision*, February 2010, page 117.

clear, and the theoretical basis for the empirical version of the SL CAPM that the AER employs is weaker than the AER claims.³⁵

In what follows we examine the theoretical bases for both models. We also ask whether each model can clear the hurdles that Friedman (1953) states a model must clear to be of any practical use.³⁶ The two hurdles are that a model must explain what it sets out to explain and that a model can explain other facts not known at the time of its development.

The AER states that:³⁷

‘the CAPM has a strong theoretical basis and is used to predict rates of return—as a model of expectations.’

This statement is misleading. As Roll (1977) makes clear, the SL CAPM states that the market portfolio of *all* assets – not just stocks – should be mean-variance efficient.³⁸ The SL CAPM does *not* state that a portfolio of stocks alone should be efficient. As Ibbotson, Siegel and Love (1985) point out, stocks make up a relatively small fraction of total wealth, so the return to a portfolio of stocks need not track closely the return to total wealth.³⁹ In Australia, for example, real estate makes up a substantial portion of total wealth, but while real estate has appreciated in value over the last two years, stocks have fallen. So it is misleading to say that the empirical version of the SL CAPM used by the AER has a ‘strong theoretical basis.’ The SL CAPM states that the risk of an asset should be measured relative to total wealth whereas the empirical version of the model that the AER uses measures the risk of an asset relative to a portfolio of stocks alone.

The AER also states that:⁴⁰

‘the FFM has no theoretical grounding, and is driven by an econometric search for variables exhibiting correlations in historical data.’

As Fama and French (1993) make clear, the FFM, like the SL CAPM, *has* a theoretical grounding. They argue that:⁴¹

‘if assets are priced rationally, variables that are related to average returns, such as size and book-to-market equity, must proxy for sensitivity to common (shared and thus undiversifiable) risk factors in returns.’

³⁵ Fama, Eugene and Kenneth French, *Common risk factors in the returns to stocks and bonds*, Journal of Financial Economics 33, 1993, pages 4-5 and pages 31-35.

³⁶ Friedman, Milton, *The methodology of positive economics*, in *Positive Economics*, University of Chicago Press, 1953, pages 12-14.

³⁷ AER, *Jemena access arrangement proposal for the NSW gas networks: Draft Decision*, February 2010, page 117.

³⁸ Roll, Richard, *A critique of the asset pricing theory's tests: Part I*, Journal of Financial Economics 4, 1977, pages 129-176.

³⁹ Ibbotson, Roger G., Laurence Siegel and Kathryn S. Love, *World Wealth: U.S. and Foreign Market Values and Returns*, Journal of Portfolio Management, Fall, 1985.

⁴⁰ AER, *Jemena access arrangement proposal for the NSW gas networks: Draft Decision*, February 2010, page 117.

⁴¹ Fama, Eugene and Kenneth French, *Common risk factors in the returns to stocks and bonds*, Journal of Financial Economics 33, 1993, pages 4-5 and pages 31-35.

‘Suppose the explanatory returns have minimal variance due to firm specific factors, so they are good mimicking returns for the underlying state variables or common risk factors of concern to investors. Then the multifactor asset-pricing models of Merton (1973) and Ross (1976) imply a simple test of whether the premiums associated with any set of explanatory returns suffice to describe the cross-section of average returns: the intercepts in the time-series regressions of excess returns on the mimicking portfolio returns should be indistinguishable from zero.’

Merton was awarded the 1997 Nobel Prize in Economics in part for developing the intertemporal pricing model to which Fama and French refer.⁴² In his model investors care about whether assets are likely to pay off unexpectedly well or badly when future investment opportunities are unexpectedly good.⁴³ In the SL CAPM, investors behave myopically and do not consider whether an asset will pay off unexpectedly well when future investment opportunities are attractive or pay off badly. In practice, investors are likely to view assets that pay off well when future opportunities are attractive as more valuable than assets that pay off badly because they will be better able to take advantage of the opportunities. So, all else constant, it is likely that, in practice, investors will be willing to accept a lower return on these assets. As Merton shows, this means that in general risks other than just the risk of an asset relative to the market will be priced.

The SL CAPM assumes that investors care only about the mean and variance of the return to a portfolio. For this to be true, a strong assumption must be made either about the preferences of individuals or the distribution of returns. Ross (1976) develops a model in which weaker assumptions are made.⁴⁴ Ross assumes only that there are a limited number of common risks and that there are no arbitrage opportunities. With these assumptions, Ross shows that only risks that cannot be diversified away will be priced. These risks may include market risk but may also include, as in Merton’s model, other risks.⁴⁵

Some authors believe that the relations that Fama and French identify between returns and book-to-market reflect investor irrationality rather than risk. A problem with this explanation, however, is that a value premium has been found going back over 80 years in the US and has been found across a large number of other countries.⁴⁶ It seems unlikely that investors would have been irrational for so long and would not have learnt from their mistakes.

The AER also criticises the FFM because Fama and French developed the model knowing that there is a positive relation between returns and book-to-market and a negative relation between returns and size in US data from 1963 through 1990.⁴⁷ The AER refers to the FFM

⁴² See http://nobelprize.org/nobel_prizes/economics/laureates/1997/press.html

⁴³ Merton, Robert C., *An intertemporal capital asset pricing model*, *Econometrica* 41, 1973, pages 867-887.

⁴⁴ Ross, Stephen, *The arbitrage theory of capital asset pricing*, *Journal of Economic Theory* 13, pages 341-360.

⁴⁵ Our August 2009 report also includes a discussion of the theoretical basis for the FFM. See pages 14-15 of NERA, *Cost Of Equity – Fama-French Three-Factor Model: Report for Jemena Gas Networks (NSW)*, August 2009.

⁴⁶ Davis, James, Eugene Fama and Kenneth French, *Characteristics, covariances, and average returns: 1929-1997*, *Journal of Finance* 55, 2000, pages 389-406.

Fama, Eugene and Kenneth French, *Value versus growth: The international evidence*, *Journal of Finance*. 53, 1998, pages 975-999.

⁴⁷ AER, *Jemena access arrangement proposal for the NSW gas networks: Draft Decision*, February 2010, page 110.

as the result of a 'data mining exercise'.⁴⁸ This characterisation of the model reveals a misunderstanding of how theories are developed, of how they are tested and, in particular, about the tests that have been conducted of the FFM.

Nobel Prize winner Milton Friedman (1953) explains clearly how theories should be developed and tested in economics. He states that:⁴⁹

A more serious effect of the difficulty of testing economic hypotheses by their predictions is to foster misunderstanding of the role of empirical evidence in theoretical work. Empirical evidence is vital at two different, though closely related, stages: in constructing hypotheses and in testing their validity. Full and comprehensive evidence on the phenomena to be generalized or "explained" by a hypothesis, besides its obvious value in suggesting new hypotheses, is needed to assure that a hypothesis explains what it sets out to explain – that its implications for such phenomena are not contradicted in advance by experience that has already been observed. Given that the hypothesis is consistent with the evidence at hand, its further testing involves deducing from it new facts capable of being observed but not previously known and checking these deduced facts against additional empirical evidence. For this test to be relevant, the deduced facts must be about the class of phenomena the hypothesis is designed to explain; and they must be well enough defined so that observation can show them to be wrong.

The two stages of constructing hypotheses and testing their validity are related in two different respects. In the first place, the particular facts that enter at each stage are partly an accident of the collection of data and the knowledge of the particular investigator. The facts that serve as a test of the implications of a hypothesis might equally well have been among the raw material used to construct it, and conversely. In the second place, the process never begins from scratch; the so-called "initial stage" itself always involves comparison of the implications of an earlier set of hypotheses with observation; the contradiction of these implications is the stimulus to the construction of hypotheses or revision of old ones. So the two methodologically distinct stages are always proceeding jointly.

The impetus for developing the FFM was the inability, that Fama and French (1992) document, of the SL CAPM to explain the relation between returns, size and book-to-market from 1963 through 1990.⁵⁰ While this observation provided the impetus, it is not the case that the FFM was bound to succeed when tested on these data. As Cochrane (2001) points out:⁵¹

'the Fama-French model is not a tautology despite the fact that factors and test portfolios are based on the same set of characteristics.'

The FFM nevertheless does a reasonable job of explaining the mean returns to the 25 US portfolios sorted on size and book-to-market that Fama and French (1993) use to test the model, and a better job than the Sharpe-Lintner CAPM.⁵² The mean absolute FFM alpha

⁴⁸ AER, *Jemena access arrangement proposal for the NSW gas networks: Draft Decision*, February 2010, page 110.

⁴⁹ Friedman, Milton, *The methodology of positive economics*, in *Positive Economics*, University of Chicago Press, 1953, pages 12-14.

⁵⁰ Fama, Eugene and Kenneth French, *The cross-section of expected returns*, *Journal of Finance* 47, 1992, pages 427-465.

⁵¹ Cochrane, John H., *Asset pricing*, Princeton University Press, 2001, page 441.

⁵² Fama, Eugene and Kenneth French, *Common risk factors in the returns to stocks and bonds*, *Journal of Financial Economics* 33, 1993, pages 4-5 and pages 31-35.

across the 25 portfolios that Fama and French (1993) use is 1.06 percent per annum while the mean absolute SL CAPM alpha is 3.12 percent per annum.⁵³ The alpha associated with an asset is the error with which a model measures the return required on the asset (Appendix C of this report explains briefly how tests of the FFM and SL CAPM are typically executed). So the FFM passes the first of Friedman's tests.

More importantly, the model also does well in explaining facts it was not originally designed to explain and data beyond the 1963 through 1990 period that Fama and French (1993) examine. For example, Fama and French (1996) find the model can explain the tendency of five-year US returns to reverse while Davis, Fama and French (2000) find that the model works well in US data prior to 1963.⁵⁴ So the FFM also passes the second of Friedman's tests. The model can explain related facts it was not originally engineered to explain.

In contrast, Black, Jensen and Scholes (1972) and Fama and MacBeth (1973) show that the SL CAPM does not work in US data before 1964.^{55,56} So the SL CAPM does not even pass the first of Friedman's tests. In addition, Fama and French (1992) show that the SL CAPM does not work in US data after 1963.⁵⁷ So the SL CAPM does not pass the second of Friedman's tests.

It would be wrong to provide the impression that there is no evidence against the FFM. Again, as we have pointed out, in recent work, Lewellen, Nagel and Shanken (2008) show that the FFM, like the SL CAPM, underestimates the returns to low-beta US assets.⁵⁸ Again, a low beta is a beta that is below one. The portfolio of nine Australian energy businesses that we and the AER employ has a low beta and so their evidence suggests that our use of the FFM will produce an *underestimate* of the cost of the equity.

While acceptance by the academic community is critical, evidence that practitioners use a model is also important, although the evidence suggests that practitioner acceptance lags academic acceptance. For example, while Sharpe's paper introducing the CAPM was published in 1964, Gitman and Mercurio (1982) find that only 30 percent of respondents to

⁵³ Fama, Eugene and Kenneth French, *Common risk factors in the returns to stocks and bonds*, Journal of Financial Economics 33, 1993, pages 36-37.

⁵⁴ Fama, Eugene and Kenneth French, *Multifactor explanations of asset-pricing anomalies*, Journal of Finance 47, 1996, pages 426-465.

Davis, James, Eugene Fama and Kenneth French, *Characteristics, covariances, and average returns: 1929-1997*, Journal of Finance 55, 2000, pages 389-406.

⁵⁵ Black, F., M. Jensen and M. Scholes, *The capital asset pricing model: Some empirical tests*, in Studies in the theory of capital markets, ed. M. Jensen, 1972.

Fama, E. and J. MacBeth, *Risk, return and equilibrium: Empirical tests*, Journal of Political Economy 81, 1973, pages 607-636.

⁵⁶ Black, Jensen and Scholes and Fama and MacBeth use some data from *after* 1963 to test the SL CAPM. As their results over sub-periods show, though, excluding these data from their tests does not alter their conclusion that the zero-beta rate significantly exceeds on average the risk-free rate.

⁵⁷ Fama, Eugene and Kenneth French, *The cross-section of expected returns*, Journal of Finance 47, 1992, pages 427-465.

⁵⁸ Lewellen, J., S. Nagel and J. Shanken, *A skeptical appraisal of asset pricing tests*, Journal of Financial Economics, forthcoming.

their survey use the model. Graham and Harvey (2001), on the other hand, find, nearly 20 years later, that 73 percent of respondents to their survey use the model.⁵⁹

3.3. Acceptance among practitioners

In our August 2009 report we pointed to evidence that the FFM is used by practitioners. In this section we respond to criticisms the AER makes in its draft decision and provide additional evidence that practitioners either use the FFM or judge the model to be important.

3.3.1. Portfolio choice

In our August 2009 report we pointed out that a review by Mercer showed that many funds display a tilt either towards value stocks or towards growth stocks. The SL CAPM predicts that all individuals will hold combinations of the risk-free asset and the market portfolio of risky assets. In other words, the SL CAPM predicts that all investors will hold the same portfolio of risky assets. No investor in the SL CAPM will hold a portfolio that exhibits a value or growth tilt. In the FFM, in contrast, individuals may choose to hold portfolios with a value tilt or a growth tilt depending on their personal circumstances. For example, an individual with non-marketable assets that are value assets may choose to hold marketable assets that are growth assets so as to better diversify.

The AER points out that there may be reasons why funds exhibit a style tilt that have nothing to do with the desire of investors to display value and growth tilts. For example, the AER states that it:⁶⁰

‘notes that the existence of these portfolios is necessary but not sufficient to establish that the FFM is used by Australian investment fund managers to determine their investment portfolios. Fund managers may have adopted these investment portfolios for a reason entirely different than the factors which the FFM seeks to account for.’

The AER’s argument may not be entirely without merit. One reason a fund may exhibit a style tilt is because the managers of the fund may have a comparative advantage in actively managing a portfolio exhibiting a particular style – although there is not a great deal of evidence that there are benefits to holding a portfolio that is actively managed.⁶¹ The evidence that NERA provides may then be consistent with the predictions of the SL CAPM because individuals can in principle combine the value and growth funds they find available to construct a portfolio that is similar to the market portfolio. A difficulty with this argument is that there are a large number of Australian and US passively managed funds that exhibit a

⁵⁹ Sharpe, William F., *Capital asset prices: A theory of market equilibrium under conditions of risk*, Journal of Finance 19, 1964, pages 425-442.

Gitman, L.J. and V. Mercurio, *Cost of capital techniques used by major U.S. firms: survey and analysis of Fortune's 1000*, Financial Management 14, 1982, 21-29.

Graham, J. and C. Harvey, (2001), *The theory and practice of corporate finance: Evidence from the field*, Journal of Financial Economics 60, pages 187-243.

⁶⁰ AER, *Jemena access arrangement proposal for the NSW gas networks: Draft Decision*, February 2010, page 107.

⁶¹ Fama, Eugene and Kenneth French, *Luck versus skill in the cross-section of mutual fund returns*, Journal of Finance, 2009, forthcoming.

value or growth tilt and it is difficult to see why investors would incur the additional cost of building up a portfolio to mimic the market from passively managed value and growth portfolios.⁶² There are cheaper and easier ways for an investor to hold the market portfolio than for he or she to hold a portfolio of passively managed value and growth portfolios.

3.3.2. Project evaluation

In our August 2009 report we noted that there is some survey evidence that managers use multi-factor models to evaluate projects, but the evidence is limited. Graham and Harvey (2001) find that there is some use by US managers of size and value factors when computing an equity cost of capital.⁶³ A more recent survey that Truong, Partington, and Peat (2008) conduct of the behaviour of Australian managers suggests that none use the Fama-French three-factor model when estimating the cost of equity.⁶⁴

There are two reasons that may explain why these surveys suggest that the use of the FFM is limited. First, the evidence in Graham and Harvey (2001) is based on a survey conducted in February 1999, less than six years after the publication of the paper by Fama and French (1993) introducing the FFM.⁶⁵ Managers in 1999 may not have had sufficient time to learn about the benefits of using an alternative framework for estimating the cost of equity. Again, Graham and Harvey provide evidence that suggests that practitioner acceptance of the SL CAPM was slow. Second, there are few sources for Fama-French betas available commercially in Australia at present. In contrast, there are US sources for these measures of risk. One of those sources is Morningstar, a leading provider of independent investment research in North America, Europe, Australia, and Asia. The fact that a large company like Morningstar sells Fama-French betas in the US indicates that the FFM is used by practitioners.

3.3.3. Morningstar

Morningstar is a source for information on stocks, mutual funds, variable annuities, closed-end funds, exchange-traded funds, separate accounts, hedge funds, and college savings plans and offers an extensive line of Internet, software, and print-based products for individual investors, financial advisors, and institutional clients. It has operations in 20 countries and provides data on more than 325,000 investment offerings worldwide.

⁶² Two examples of such portfolios are DFA's Australian Value Trust, see

http://www.dfaau.com/strategies/au/value_trust/

and Vanguard's Value Index Fund Investor Shares, see

<https://personal.vanguard.com/us/funds/snapshot?FundId=0006&FundIntExt=INT>

⁶³ Graham J., and Harvey C., (2001), 'The theory and practice of corporate finance: Evidence from the field', *Journal of Financial Economics*, Vol. 60 (2-3), pp. 187-243.

⁶⁴ Truong G., Partington G., and Peat M., *Cost of capital estimation and capital budgeting practice in Australia*, Australian Journal of Management 33, 2008, pages 95-122.

⁶⁵ Fama, Eugene and Kenneth French, *Common risk factors in the returns to stocks and bonds*, Journal of Financial Economics 33, 1993, pages 3-56.

Through its subsidiary Ibbotson Associates, Morningstar provides betas relative to the three Fama-French factors for a wide range of companies.⁶⁶ These risk measures can be used to compute equity costs of capital and to evaluate funds. An explanation of how to use the FFM to compute equity costs of capital is contained in a widely used book published by McKinsey.

3.3.4. McKinsey

McKinsey & Company is a global management consulting firm and serves more than 70 percent of *Fortune* magazine's most admired list of companies.⁶⁷ McKinsey publishes a guide to measuring value entitled 'Valuation: Measuring and Managing the Value of Companies'. The book, authored by Koller, Goedhart and Wessels, is now in its fourth edition and is highly regarded.⁶⁸ For example, Amazon.com lists the following recommendations:⁶⁹

"The bible in its field. Anyone wanting to understand what drives corporate value should read this latest edition."

—Dr. Raymund Breu, Chief Financial Officer, Novartis AG

"Valuation gets to the heart of how to measure and manage value in a company. Whether you are evaluating an acquisition, restructuring a corporation, or formulating strategy, this book will help you do it well."

—John A. Manzoni, Chief Executive Refining and Marketing, BP plc

Praise for the First Edition:

"A 'how-to' guide for corporate executives who want to get at the unrealised shareholder values trapped in public companies."

—*The New York Times*

"The book's clarity and comprehensive coverage make it one of the best practitioners' guides to valuation."

—*Financial Times*

The book explains on pages 315-317 how to use the FFM to compute the return required on the equity of a company. This is direct evidence that the FFM is used by practitioners. Other direct evidence is provided by the CFA Institute.

3.3.5. CFA exam

The Chartered Financial Analysts (CFA) designation is the most widely accepted professional qualification for finance practitioners worldwide. To pass the CFA exams, practitioners must have a thorough understanding of the tools most widely used in finance. One such tool is the FFM. Study session 10, for examines:⁷⁰

⁶⁶ <http://corporate.morningstar.com/IB/asp/subject.aspx?xmlfile=5532.xml>

⁶⁷ <http://www.mckinsey.com/aboutus/whoweare/index.asp>

⁶⁸ Koller, Tim, Marc Goedhart and David Wessels, *Valuation: Measuring and managing the value of companies*, 2005, McKinsey.

⁶⁹ http://www.amazon.com/gp/product/product-description/0471702218/ref=dp_proddesc_0?ie=UTF8&n=283155&s=books

⁷⁰ CFA, Program Curriculum – Volume 4: Equity, Level II 2010, page 3.

‘the well-established methodologies of security analysis’

and provides a review of the theory behind the FFM and an illustration of how to use the FFM. CFA course participants:⁷¹

‘demonstrate the use of the capital asset pricing model (CAPM), the Fama-French model (FFM)’

Appendix A reproduces the section from Reading 35 for the CFA’s Level II exam relating to the FFM, including an example of how to use the FFM to estimate the cost of equity for Microsoft using Morningstar data.

Other indirect evidence also exists that practitioners view the development of the FFM as an important contribution to the field of finance.

3.3.6. Morgan Stanley

One such piece of evidence is the fact that in 2005 the first Morgan Stanley – AFA Prize in Financial Economics, which is awarded every two years, was awarded to Eugene Fama, in part for producing:⁷²

‘a model that has replaced the Capital Asset Pricing Model in applied and empirical work.’

We interpret this as evidence that senior executives at Morgan Stanley together with senior members of the American Finance Association view the FFM as an empirically important and well accepted model.

Morgan Stanley is a leading global financial services firm providing a wide range of investment banking, securities, investment management and wealth management services. The firm’s employees serve clients worldwide including corporations, governments, institutions and individuals from more than 600 offices in 32 countries.

Besides its use in measuring the cost of equity, the FFM is used by practitioners to evaluate fund performance and trading strategies.

⁷¹ http://www.cfainstitute.org/cfaprog/resources/pdf/LII_SS10.pdf

⁷² <http://www.morganstanley.com/about/press/articles/5558.html>

3.3.7. Vanguard

A recent study by Vanguard shows that low-turnover strategies such as rebalancing are beneficial, while high-turnover trading is costly.⁷³ Vanguard reaches this conclusion by computing the abnormal returns to various strategies relative to the FFM. The result of the study is consistent with Vanguard's view that active strategies deliver few benefits.

⁷³ <https://institutional.vanguard.com/iip/pdf/VCRRDTW.pdf>

4. Does the FFM Deliver the Best Estimate?

Rule 74(2)(b) requires that an estimate of the cost of equity be the ‘best forecast or estimate possible in the circumstances’. In its Draft Decision the AER requires that the JGN adopt the SL CAPM.⁷⁴ In this section we provide evidence that the FFM provides *better* estimates of the cost of equity both in Australia and the US than does the SL CAPM. The evidence that we provide includes evidence drawn from papers introduced by the AER into the debate.

The AER expresses concern that because the FFM was developed in the US it may not be a suitable model to use to compute the cost of equity for an Australian gas distributor. For example, the AER states that:⁷⁵

‘the FFM was developed in the US, but the regulatory framework is concerned with Australian capital markets, and therefore the FFM does not reflect prevailing market conditions in which pipeline services are provided’

This concern could also be expressed about the use of the SL CAPM, which was also developed in the US. However, the relevant criterion, laid out in Rule 74(2)(b), is that an estimate of the cost of equity be the ‘best forecast or estimate possible in the circumstances’. It follows that any concern about whether the SL CAPM or FFM are suitable models to use to compute the cost of equity for an Australian gas distributor must be settled empirically. There are concerns that one could express about using either the Australian version of the SL CAPM that the AER employs or the Australian version of the FFM proposed by JGN. Both models, for example, ignore the fact that large numbers of Australian investors hold foreign assets. So neither model is perfect. The question to which Rule 74(2)(b) requires an answer, however, is: Which model provides the better estimate of the cost of equity for an Australian gas distributor? For this reason, to begin with, we first review the most recent evidence on the performance of the two models in Australia.

4.1. Evidence that the FFM provides a better estimate of the cost of capital in the Australian market

The AER reviews the evidence provided by eight papers on the ability of Australian versions of the FFM to correctly measure the cost of equity. We focus our attention on these papers. Six are papers that the AER introduces and two are papers that we introduce.⁷⁶ All of the papers form portfolios based on some set of characteristics and test whether the FFM (or, in one paper, an augmented version of the model) correctly measures the returns required on the portfolios. Some of the papers also test whether the SL CAPM correctly measures the returns required on the portfolios.

The AER’s review of the eight papers involves counting the number of portfolios for which the FFM can and cannot be rejected.⁷⁷ There are two problems with relying on counts of this

⁷⁴ AER, *Jemena access arrangement proposal for the NSW gas networks: Draft Decision*, February 2010, page lix.

⁷⁵ AER, *Jemena access arrangement proposal for the NSW gas networks: Draft Decision*, February 2010, page 118.

⁷⁶ AER, *Jemena access arrangement proposal for the NSW gas networks: Draft Decision*, February 2010, page 114.

⁷⁷ AER, *Jemena access arrangement proposal for the NSW gas networks: Draft Decision*, February 2010, page 114.

kind. First, our interest is not so much in whether the FFM is true but in whether it is *better* to use the FFM than the SL CAPM. Thus it is essential that the evidence on whether the SL CAPM can correctly measure the returns required on the portfolios also be examined. Second, the returns to the portfolios are not independent and so counting the number of portfolios for which the FFM can and cannot be rejected can provide a *misleading* guide as to whether or not the model is true. There are multivariate tests that take into account the fact that the returns to portfolios typically covary with one another (move up and down together) and some of the papers report the results of such tests. Note that Appendix C to this report explains how tests can be constructed of the FFM and SL CAPM.

Of the eight papers that the AER reviews, only one, a recent working paper by O'Brien, Brailsford and Gaunt (2008) sponsored by an Australian Research Council grant, uses more than 13 years' worth of data.⁷⁸ Since it is difficult to draw reliable inferences about pricing models from short time series we focus much of our attention on the results provided by their work.

O'Brien, Brailsford and Gaunt (2008) form 25 portfolios, like Fama and French (1993), on the basis of size and book-to-market and examine the performance of the SL CAPM and FFM in measuring the returns required on the portfolios over the 25-year period from 1982 through 2006.⁷⁹ Table 4.1 summarises their results. The table provides estimates of the alphas associated with each model and each portfolio in percent per annum. Again, the alpha associated with an asset is the error with which a model measures the return required on the asset. Thus a model that produces large alphas is a model that will provide poor estimates of the cost of equity. Table 4.1 contains two panels. Panel A provides estimates of the alphas associated with an Australian version of the SL CAPM while Panel B provides estimates of the alphas associated with an Australian version of the FFM.

Table 4.1 shows that on average the absolute values of the alpha estimates associated with the FFM are 22 percent smaller than their Sharpe-Lintner counterparts. The mean absolute value of the FFM alpha estimates is 6.69 percent per annum while the mean absolute value of the Sharpe-Lintner alpha estimates is 8.58 percent. Although not shown in the table the standard errors associated with the FFM alpha estimates are also lower on average than their Sharpe-Lintner counterparts. The average standard error attached to a FFM estimate is 3.16 percent per annum while the average standard error attached to a Sharpe-Lintner estimate is 4.77 percent. This means that tests are better able to detect a FFM alpha that differs from zero than a Sharpe-Lintner alpha that differs from zero. Possibly as a result, despite the lower FFM alpha estimates, O'Brien, Brailsford and Gaunt are still able to reject the hypothesis that all of the FFM alphas are simultaneously zero. The evidence they provide against the FFM, though, is less than the evidence that they provide against the SL CAPM. For example, the Newey-West D-statistic for a test that all of the FFM alphas are zero is 148.27 while the corresponding statistic for a test that all of the Sharpe-Lintner alphas are zero is 245.13. A

⁷⁸ O'Brien, Brailsford, and Gaunt, *Size and book-to-market factors in Australia*, University of Queensland, 2008.

⁷⁹ Fama, Eugene and Kenneth French, *Common risk factors in the returns to stocks and bonds*, Journal of Financial Economics 33, 1993, pages 36-37.

O'Brien, Brailsford, and Gaunt, *Size and book-to-market factors in Australia*, University of Queensland, 2008.

larger value for the statistic means that there is more evidence against the hypothesis that all of the alphas are zero.

Table 4.1
The SL CAPM and FFM: Australian evidence from 1982 to 2006

Size	Portfolio alpha					Mean absolute alpha
	Low BM	2	3	4	High BM	
Panel A: SL CAPM						
Small	21.36	19.80	26.64	21.60	27.84	23.45
2	-2.04	8.76	3.24	6.48	7.08	5.52
3	-19.56	-4.20	-0.60	2.52	4.32	6.24
4	-10.32	-2.52	-1.44	-0.12	4.44	3.77
Big	-5.64	-2.76	1.08	2.88	7.20	3.91
Mean absolute alpha	11.78	7.61	6.60	6.72	10.18	8.58
Panel B: FFM						
Small	14.64	13.20	16.92	12.96	16.92	14.93
2	-5.52	3.24	-3.72	-1.92	-3.48	3.58
3	-22.08	-7.92	-5.28	-2.76	-3.60	8.33
4	-11.52	-6.00	-4.56	-3.24	-2.16	5.50
Big	-0.96	-1.56	0.60	-1.80	-0.60	1.10
Mean absolute alpha	10.94	6.38	6.22	4.54	5.35	6.69

Notes: Alpha estimates are in percent per annum. Stocks are allocated to one of 25 portfolios on the basis of market capitalisation and book-to-market (BM).

Source: O'Brien, Brailsford, and Gaunt, Size and book-to-market factors in Australia, University of Queensland, 2008.

Since O'Brien, Brailsford and Gaunt provide more evidence against the hypothesis that the SL CAPM correctly measures the cost of equity than against the hypothesis that the FFM correctly measures the cost of equity, they conclude that:⁸⁰

‘the three-factor model is found to be consistently superior to the CAPM.’

⁸⁰ O'Brien, Brailsford, and Gaunt, *Size and book-to-market factors in Australia*, University of Queensland, 2008.

As the AER notes, Gharghori, Lee and Veeraraghavan (2009) provide perhaps the most recent published evidence on the performance of the FFM in the Australian market.^{81,82} Like Fama and French (1996), Gharghori, Lee and Veeraraghavan ask whether the FFM can explain a number of empirical regularities in the Australian financial data that are not explained by the CAPM. We note that the AER introduces this paper.⁸³

The published version of the paper provides evidence on the ability of the FFM to measure correctly the returns required on a large number of portfolios sorted on the basis of eight characteristics. An earlier version of the same paper that uses exactly the same data provides evidence, in addition, on the ability of the SL CAPM to measure correctly the returns required on the same portfolios. Since we wish to ascertain whether an Australian version of the SL CAPM or an Australian version of the FFM measures the return required to a portfolio better, we discuss the evidence provided by the earlier version of the paper.⁸⁴

Gharghori, Lee and Veeraraghavan use data from 1993 to 2005 and find that the FFM measures the return required on an asset better than does the SL CAPM. The mean absolute alpha across the 48 portfolios they examine is 7.65 percent per annum for the FFM but 14.38 percent per annum – that is, nearly twice as large – for the SL CAPM. Also, the mean absolute alpha across each of the eight sets of six portfolios that they construct is less for the FFM than for the SL CAPM and the corresponding multivariate statistics for tests of the FFM are less than their Sharpe-Lintner counterparts. Thus, while both models perform poorly, the performance of the SL CAPM is far worse than the performance of the FFM.

The AER notes that Gharghori, Lee and Veeraraghavan state that:⁸⁵

‘Our asset pricing tests show that the Fama–French model fails to explain the returns of our test portfolios and is thus less than satisfactory in pricing assets in Australia. While the Fama–French model has been shown to work well in the USA (Fama and French, 1996), this study reveals the inadequacy of the Fama–French model in Australia.’

This is a statement, though, about the absolute performance of the FFM in pricing the set of 48 portfolios they use and not a statement about the performance of the FFM *relative* to the SL CAPM. In the abstract to the earlier version of their paper, Gharghori, Lee and Veeraraghavan state that:⁸⁶

‘our results indicate that the FFM is superior to the CAPM in explaining cross-sectional variation in equity returns.’

⁸¹ AER, *Jemena access arrangement proposal for the NSW gas networks: Draft Decision*, February 2010, page 114.

⁸² Gharghori, P., R. Lee and M. Veeraraghavan, *Anomalies and stock returns: Australian evidence*, *Accounting and Finance* 49, 2009, pages 555–576.

⁸³ AER, *Jemena access arrangement proposal for the NSW gas networks: Draft Decision*, February 2010, page 114.

⁸⁴ The FFM results in the published version and the earlier version of their paper are identical.

⁸⁵ Gharghori, P., R. Lee and M. Veeraraghavan, *Anomalies and stock returns: Australian evidence*, *Accounting and Finance* 49, 2009, pages 555–576.

⁸⁶ Gharghori, P., R. Lee and M. Veeraraghavan, *Anomalies and stock returns: Australian evidence*, Monash University, 2008.

Although the evidence that they report appears to bolster the case for using the FFM, we suspect that there is an error in their empirical work. A close inspection of their results suggests that Gharghori, Lee and Veeraraghavan did not deduct the risk-free rate from the returns to the 48 portfolios they examine and that as a result all of the alphas that they compute are around six percent too high. They find, for example, that the Sharpe-Lintner alpha of a portfolio of big firms is 5.04 per cent per annum but that the returns to the portfolio and to the market portfolio are almost perfectly correlated. If this were really true, a near-arbitrage opportunity would exist. An approximate correction is to subtract six percent from each alpha that they report. If we do this, we find that the mean absolute alpha across the 48 portfolios they examine is 5.86 percent per annum for the FFM but 9.98 percent per annum – still nearly twice as large, but a more sensible number – for the SL CAPM.

The AER also introduces the recent evidence that Kassimatis (2008) provides.⁸⁷ Kassimatis forms 25 portfolios, like Fama and French, on the basis of size and book-to-market. He uses Australian data from 1993 to 2005 to conduct tests of the SL CAPM and the FFM augmented with a momentum factor and concludes that:⁸⁸

‘For space considerations we do not report the regressions for the CAPM. Similar regressions have been reported by several researchers and our results confirm the existing evidence. The static CAPM is rejected for the Australian stock market because the intercept for most regressions is statistically significant (see, Gaunt 2004). The four factor model does a much better job at explaining realised returns.’

His inclusion of a fourth momentum factor is unnecessary because the portfolios he forms are passively managed. He finds, for example, that only three of 25 momentum betas differ significantly from zero and estimates of the betas are small. In contrast, he finds that 11 of the 25 *HML* betas differ significantly from zero and 20 of the 25 *SMB* betas differ significantly from zero.

Kassimatis also conducts tests of the SL CAPM and the FFM augmented with a momentum factor over rolling 12-month periods. Twelve monthly observations are insufficient data with which to measure the exposures of a portfolio to the market or the Fama-French factors with any precision. Henry (2009) in his report for the AER, for example, uses 348 weekly observations to estimate the beta of a portfolio of energy businesses with a reasonable level of precision.⁸⁹ The small data set results in Kassimatis finding that the rolling forecasts he produces using both models are poor. As a result, he is unable to find any evidence against the SL CAPM. There is too much variation in his forecasts to be able to conclude at conventional significance levels that they are biased.⁹⁰ The interpretation that Kassimatis puts on his results is that:⁹¹

⁸⁷ Kassimatis, K., *Size, book-to-market and momentum effects in the Australian stock market*, Australian Journal of Management, 2008, pages 145-168.

⁸⁸ Kassimatis, K., *Size, book-to-market and momentum effects in the Australian stock market*, Australian Journal of Management, 2008, page 154.

⁸⁹ Olan T. Henry, *Estimating *b**: Report for the Australian Energy Regulator, 23 April 2009.

⁹⁰ Kassimatis claims that there is evidence from his rolling regressions against the FFM. The observation that he views as evidence against the FFM is the observation that the p-values associated with univariate tests that each FFM alpha is zero – none of which indicate a rejection of the model – are not uniformly distributed across the portfolios he examines.

‘The latest studies by Fama and French argue that the value premium is pervasive in almost all major stock markets and cannot be explained by the CAPM. Our findings combined with the results of other researchers suggest that the Australian market is an exception to this rule (and maybe not the only one).’

However, even if this inference were valid – and it is not – it is not clear that the results of the rolling regressions that Kassimatis conducts are relevant because the AER does not use estimates of the exposures of a portfolio to the market or the Fama-French factors computed from just 12 monthly observations.

Rather than describe in detail the results of the remaining five papers reviewed by the AER in its Draft Decision, we have listed a number quotes drawn from these papers in which the authors of the papers summarise their own results.

The AER introduces a paper by Halliwell, Heaney and Sawicki (1999). Halliwell, Heaney and Sawicki use Australian data from 1980 to 1991 to test the SL CAPM and FFM. They conclude that:⁹²

‘The results of the analysis are similar to those reported in Fama and French (1993). The market risk premium does not appear to be the sole explanatory variable for Australian equity returns over the period 1981 to 1991.’

In two other papers that the AER introduces, Faff (2001) provides tests of the FFM using Australian data from 1991 through 1999 and concludes that:⁹³

‘the evidence seems to quite strongly support the three-factor Fama and French model’

while Faff (2004) uses daily data from 1996 through 1999 to test the FFM and concludes:⁹⁴

‘In general, evidence obtained is quite favourable to the model based on formal asset pricing tests. However, when one takes into account the estimated risk premia, support for the Fama French model is less persuasive. In particular, a negative size premium is uncovered that adds to the recent findings questioning its continued existence over recent years.’

Neither study compares the FFM to the SL CAPM.

Gaunt (2004) uses Australian data from 1993 through 2001 to test the FFM and the SL CAPM and concludes that:⁹⁵

There is no requirement, though, that under the FFM these p-values be uniformly distributed across the portfolios. An assertion that the p-values should be uniformly distributed ignores, for example, the fact that the p-values will not be distributed independently of one another. So one cannot interpret the observation that the p-values are not uniformly distributed as evidence against the FFM.

⁹¹ Kassimatis, K., *Size, book-to-market and momentum effects in the Australian stock market*, Australian Journal of Management, 2008, page 165.

⁹² Halliwell, J., R. Heaney and J. Sawicki, *Size and book to market effects in Australian share markets: a time series analysis*, Accounting Research Journal 12, 1999, pages 122–137.

⁹³ Faff, R., *An examination of the Fama and French three-factor model using commercially available factors*, Australian Journal of Management 26, 2001, pages 1–17.

⁹⁴ Faff, *A simple test of the Fama and French model using daily data: Australian evidence*, Applied Financial Economics 14, 2004, pages 83–92.

‘Overall, the present study indicates that the three factor model provides a better explanation of observed Australian stock returns than the CAPM.’

However, we note that it is difficult to know on what this conclusion is based because Gaunt does not provide the results of any multivariate tests.

Finally, in work the AER introduces, Gharghori, Chan and Faff (2007) use Australian data to examine whether the Fama-French factors are proxying for default risk. They find that the Fama-French factors are not proxying for default risk but conclude that:⁹⁶

‘our findings suggest that the Fama-French model is vastly superior to the CAPM in explaining returns.’

To summarise, we review the results of eight papers that provide evidence on the ability of Australian versions of the FFM and SL CAPM to correctly measure the cost of equity.⁹⁷ The two studies that restrict their attention to the FFM find evidence in support of the model while the five papers that compare the FFM and SL CAPM all conclude that the FFM provides better estimates of the cost of equity than does the SL CAPM.^{98,99}

⁹⁵ Gaunt, C., *Size and book-to-market effects and the Fama–French three factor asset pricing model: Evidence from the Australian stock market*, Accounting and Finance 44, 2004, pages 27–44.

⁹⁶ Gharghori, P., H. Chan and R. Faff, *Are the Fama–French factors proxying default risk?*, Australian Journal of Management 32, 2007, pages 223–249.

⁹⁷ We note that of the eight papers reviewed in this section six were first introduced into the debate by the AER.

⁹⁸ The two studies that restrict their attention to the FFM are:

Faff, R., *An examination of the Fama and French three-factor model using commercially available factors*, Australian Journal of Management 26, 2001, pages 1–17.

Faff, *A simple test of the Fama and French model using daily data: Australian evidence*, Applied Financial Economics 14, 2004, pages 83–92.

The five studies that compare the performance of the FFM and SL CAPM are:

Halliwel, J., R. Heaney and J. Sawicki, *Size and book to market effects in Australian share markets: a time series analysis*, Accounting Research Journal 12, 1999, pages 122–137.

Gaunt, C., *Size and book-to-market effects and the Fama–French three factor asset pricing model: Evidence from the Australian stock market*, Accounting and Finance 44, 2004, pages 27–44.

Gharghori, P., H. Chan and R. Faff, *Are the Fama–French factors proxying default risk?*, Australian Journal of Management 32, 2007, pages 223–249.

O’Brien, Brailsford and Gaunt (2008) O’Brien, Brailsford, and Gaunt, *Size and book-to-market factors in Australia*, University of Queensland working paper, 2008.

Gharghori, P., R. Lee and M. Veeraraghavan, *Anomalies and stock returns: Australian evidence*, Accounting and Finance 49, 2009, pages 555–576.

⁹⁹ As we have already outlined, Kassimatis (2008) uses an augmented version of the FFM rather than the original version of the FFM and provides inconclusive results.

Kassimatis, K., *Size, book-to-market and momentum effects in the Australian stock market*, Australian Journal of Management, 2008, pages 145–168.

4.2. Evidence that the FFM provides a better estimate of the cost of capital in the US market

Fama and French (2004) provide a comprehensive survey of the US empirical evidence on the SL CAPM. They state that:¹⁰⁰

‘The attraction of the CAPM is that it offers powerful and intuitively pleasing predictions about how to measure risk and the relation between expected return and risk. Unfortunately, the empirical record of the model is poor – poor enough to invalidate the way it is used in applications.’

‘Fama and French (1993, 1996) find that the [FFM] captures much of the variation in average return for portfolios formed on size, book-to-market equity and other price ratios that cause problems for the CAPM.’

‘Among practitioners like Ibbotson Associates, the [FFM] is offered as an alternative to the CAPM for estimating the cost of equity capital.’

Rather than attempt to review the significant body of academic literature on the performance of the FFM in the US, in the section that follows, we illustrate that the AER in its draft decision has been selective in reviewing the academic literature and has made arguments that are not relevant.

4.2.1. The academic literature

In our August 2009 report we provided a simple citation statistic to support our claim that the FFM is well accepted. The statistic is that there are 12 papers in the *Journal of Finance* in 2007 that cite the paper published by Fama and French in 1993 introducing the FFM and just one paper citing Sharpe’s 1964 paper in which the SL CAPM is derived. The AER considers an analysis of only one year of citations from one journal to be selective and so in Section 3 we provide a more complete analysis across more years and journals.

The AER also notes that some of the 12 papers cited in the *Journal of Finance* in 2007 provide evidence against the FFM. This is a reflection of the fact that the model is being used as a benchmark and is not surprising. However, the AER exaggerates the importance of some of this evidence and neglects to point out that some of the papers also provide strong evidence against the SL CAPM. We take as an example the AER’s analysis of the work of Boudoukh, Michaely, Richardson and Roberts (2007).¹⁰¹

The AER states that the work of Boudoukh, Michaely, Richardson and Roberts is one of three papers published in the *Journal of Finance* in 2007 that uses:¹⁰²

‘the FFM as the benchmark predictor of returns, but only in the context of showing shortcomings of the FFM that can be corrected by the use of a different model or factor specification. These papers do not support the FFM as proposed in the NERA report on the FFM’

¹⁰⁰ Fama, Eugene and Kenneth French, *The Capital Asset Pricing Model: Theory and Evidence*, *Journal of Economic Perspectives* 18, 2004, pages 25-46.

¹⁰¹ Boudoukh, J., R. Michaely, M. Richardson and M. Roberts, *On the importance of measuring payout yield: Implications for empirical asset pricing*, *Journal of Finance* 62, 2007, pages 877-916.

¹⁰² AER, *Jemena access arrangement proposal for the NSW gas networks: Draft Decision*, February 2010, page 104.

‘Boudoukh, Michaely, Richardson and Roberts state that using payout yields (rather than dividend yields) explains share returns and subsumes the HML factor.’

Boudoukh, Michaely, Richardson and Roberts provide weak support for the idea that augmenting the FFM with an additional payout factor can improve the model’s performance. At no stage do they state that a payout factor ‘subsumes the HML factor’. Their evidence is weak because whether augmenting the FFM with an additional payout factor improves or worsens the performance of the FFM depends on the set of portfolios that they use and the way in which they measure payout.

However, the AER omits to mention that Boudoukh, Michaely, Richardson and Roberts provide overwhelming evidence against the SL CAPM. Table 4.2 summarises some of the evidence that Boudoukh, Michaely, Richardson and Roberts provide on the SL CAPM. The table shows the means of the slope coefficients from a series of ordinary least squares regressions of returns on beta and measures of size, book-to-market and payout.

The SL CAPM states that the cross-section of mean returns should be completely explained by cross-sectional variation in beta. No other variable should matter. Table 4.2 provides substantial evidence against this proposition and so *against* the SL CAPM. There is no significant relation between return and beta, a negative relation between return and size, a positive relation between return and book-to-market and some evidence of a relation between return and payout.

Table 4.2
Returns, size, book-to-market, payout and the SL CAPM: US evidence from 1984 to 2003

Payout measure	Beta	Size	Book-to-market	Payout
Dividend yield	-0.03	-0.16	0.26	0.03
Cash flow based payout	0.05	-0.16	0.26	0.15
Treasury stock based payout	0.02	-0.17	0.24	0.11
Net payout	0.10	-0.15	0.27	0.03

Note: The table provides the means of a series of ordinary least squares estimates of the slope coefficients from regressions of monthly returns on beta and measures of size, book-to-market and payout. Estimates in bold differ significantly from zero at the 5 percent level.

Source: Panel A of Table IV in Boudoukh, J., R. Michaely, M. Richardson and M. Roberts, On the importance of measuring payout yield: Implications for empirical asset pricing, Journal of Finance 62, 2007, pages 877–916.

The AER also remarked that:¹⁰³

‘Two papers (Huang, Wei and Yan; Chhaochharia and Grinstein) use the Carhart (1997) four-factor model as the benchmark predictor of share returns, not the FFM. These papers do not support the use of the FFM without addition of a momentum factor.’

It has been known for some time that stocks whose prices have risen substantially relative to other stock prices over the previous year or so, perform well over the following six months and similarly, that stocks whose prices have fallen substantially relative to other stock prices over the previous year, perform badly over the following six months. In other words, there is evidence of momentum in returns, albeit short-lived. As Fama and French (1996) point out, the FFM does not explain momentum in returns. So to measure the performance of mutual funds, many of which use momentum strategies, Carhart (1997) adds a fourth, momentum factor to the FFM. A momentum strategy is one in which a fund loads up on recent past winners and may short recent past losers. A momentum strategy is an *active* strategy because what today is a recent past winner will in all probability not be a recent past winner one year from now. In contrast, a benchmark gas distribution business is a *passive* strategy. A gas distributor is not in the business of loading up on stocks that are past winners and shorting past losers. So its exposure to Carhart’s momentum factor is likely to be close to zero and the use of a four-factor momentum augmented version of the FFM to estimate the required rate of return on its equity is unnecessary.

As Fama and French (2004) point out:¹⁰⁴

‘since the momentum effect is short-lived, it is largely irrelevant for estimates of the cost of equity capital.’

The AER argues that there is evidence in the work of Da, Guo and Jagannathan (2009) that the SL CAPM will provide a better measure of the return required on an asset than the FFM. We explain in what follows that the AER misrepresents the evidence.¹⁰⁵

4.2.2. Da, Guo and Jagannathan (2009)

In much of their empirical work Da, Guo and Jagannathan follow Hoberg and Welch (2007) and use betas computed from data that excludes the recent past. They do so because they believe that investors may be slow to recognise changes in betas. They call these betas

¹⁰³ AER, *Jemena access arrangement proposal for the NSW gas networks: Draft Decision*, February 2010, page 104.

Huang, J., K. Wei and H. Yan, *Participation costs and the sensitivity of fund flows to past performance*, *Journal of Finance* 62, 2007, pages 1273–1312

Chhaochharia, V. and Y. Grinstein, *Corporate governance and firm value: The impact of the 2002 governance rules*, *Journal of Finance* 62, 2007, pages 1789–1826.

¹⁰⁴ Fama, Eugene and Kenneth French, *The Capital Asset Pricing Model: Theory and Evidence*, *Journal of Economic Perspectives* 18, 2004, pages 25-46.

¹⁰⁵ Da, Guo and Jagannathan, *CAPM for Estimating the Cost of Equity Capital: Interpreting the Empirical Evidence*, 2009, NBER Working Paper.

‘aged’ betas. In our report to the AER in December 2009,¹⁰⁶ we point out that there is little theoretical support for the idea that investors are slow to recognise changes in betas and, moreover, that Hoberg and Welch have withdrawn their work from circulation because they ‘no longer believe that the theory (of slow recognition by investors) is correct.’¹⁰⁷ For this reason, the AER now limits its focus to a *subset* of the results that Da, Guo and Jagannathan provide that do not use ‘aged betas’.

Table 4.3 displays the cross-sectional results from Da, Guo and Jagannathan to which Table A.2 in Appendix A of the AER’s draft decision refers.¹⁰⁸ The tests in Table 4.3 use three groups of portfolios. The first set of tests uses 10 portfolios sorted on the basis of past estimates of beta. Sorting on the basis only of past estimates of beta creates very little variation in the betas of the portfolios relative to the *HML* and *SMB* factors as Da, Guo and Jagannathan’s Table 2B makes clear. The *HML* and *SMB* betas range from 0.06 to 0.20 and from -0.21 to 0.39. In contrast, Fama and French (1993) report that the *HML* and *SMB* betas of their 25 portfolios range from -0.46 to 0.70 and from -0.23 to 1.46.

Table 4.3
Risk and return: US evidence from 1932 to 2007

	Risk premia	10 beta-sorted portfolios		30 industry and book-to-market portfolios		10 industry portfolios with maximum book-to- market dispersion	
		CAPM	FFM	CAPM	FFM	CAPM	FFM
Intercept		7.56	3.12	4.08	6.00	0.72	8.76
		[1.83]	[2.64]	[2.33]	[2.51]	[3.13]	[3.79]
Market	8.04	2.28	4.92	6.96	4.56	10.56	0.96
	(2.04)	[3.40]	[3.78]	[3.76]	[3.86]	[4.40]	[4.80]
<i>HML</i>	5.04		9.84		2.04		7.44
	(1.44)		[5.79]		[2.32]		[3.26]
<i>SMB</i>	2.52		-4.92		4.92		1.20
	(1.32)		[3.81]		[2.86]		[4.29]

Note: The table provides the means of a series of ordinary least squares estimates of the slope coefficients from regressions of monthly returns on market, HML and SMB betas in percent per annum. Conventional standard errors are in parentheses while Shanken standard errors are in brackets. Estimates in bold are significantly different from zero at the 5 percent level using a two-tailed test.

*Sources: Da, Guo and Jagannathan, CAPM for Estimating the Cost of Equity Capital: Interpreting the Empirical Evidence, 2009, NBER Working Paper, Tables 2D, 3A and 3D.
http://mba.tuck.dartmouth.edu/pages/faculty/ken.french/data_library.html*

¹⁰⁶ NERA, *Review of Da, Gou and Jagannathan Empirical Evidence on the CAPM: A Report for Jemena Gas Networks (NSW)*, December 2009.

¹⁰⁷ See <http://welch.econ.brown.edu/academics/>.

¹⁰⁸ AER, *Jemena access arrangement proposal for the NSW gas networks: Draft Decision*, February 2010, page 359.

The second set of tests uses 30 portfolios sorted first by industry and then by book-to-market. The third set of tests uses 10 portfolios chosen from these 30 portfolios to maximise the variation across the 10 portfolios in book-to-market. Thus the second and third tests are not independent tests. Not surprisingly, the 10 portfolios sorted on book-to-market display a larger variation in their *HML* betas, although not in their *SMB* betas, than the 10 beta-sorted portfolios. For the 10 portfolios sorted on book-to-market the *HML* betas range from -0.32 to 0.88 while the *SMB* betas range from -0.25 to 0.45.

The tests regress the returns to each set of portfolios on their betas and on their Fama-French betas. Both the SL CAPM and FFM predict the zero-beta portfolio should earn the risk-free rate and so both models restrict the intercepts in the regressions to be zero. Both models also restrict the slope coefficients from the regressions to match the risk premiums on the factors.

The AER argues, on the other hand, that the slope:¹⁰⁹

‘coefficients ... should be statistically significant from zero.’

Estimates of the slope coefficients will only differ significantly from zero if the pricing model is true *and* the estimates are sufficiently precise. The fact that estimates of the slope coefficients are not significantly different from zero need not imply that the pricing model is wrong, rather, it may reflect the fact that the estimates are imprecise. If there is little variation in the factor betas of the portfolios that the investigator has constructed, for example, the estimates that he or she produces will be imprecise.

The earliest and simplest tests of the SL CAPM use beta-sorted portfolios.¹¹⁰ As we have already noted, these tests find that the return to a zero-beta portfolio is too high relative to the risk-free rate. In other words, the tests reject the SL CAPM. The first set of tests whose results Table 4.3 summarises produces similar results. While there is no evidence from the tests that the slope coefficient on beta differs significantly from the market risk premium, there is evidence that the zero-beta rate exceeds the risk-free rate. An estimate of the difference between the zero-beta rate and the risk-free rate is 7.56 percent per annum and this estimate differs significantly from zero at the 5 percent level. Thus the SL CAPM *fails* perhaps the most basic test: Can the model explain the returns to portfolios formed on the basis of beta?

Tests of the FFM that use the same set of portfolios produce indeterminate results. There is no evidence in Table 4.3 that the three slope coefficients differ significantly from the three corresponding risk premiums and no evidence that the zero-beta rate differs significantly from the risk-free rate.¹¹¹ In other words, the tests *do not* reject the FFM. There is also no

¹⁰⁹ AER, *Jemena access arrangement proposal for the NSW gas networks: Draft Decision*, February 2010, page 358.

¹¹⁰ Black, F., M. Jensen and M. Scholes, *The capital asset pricing model: Some empirical tests*, in *Studies in the theory of capital markets*, ed. M. Jensen, 1972.

Fama, E. and J. MacBeth, *Risk, return and equilibrium: Empirical tests*, *Journal of Political Economy* 81, 1973, pages 607-636.

¹¹¹ An estimate of the price of *SMB* risk, for example, is -4.92 with a standard error of 3.81 while an estimate of the corresponding risk premium is 2.52 with a standard error of 1.32. If the two estimates are uncorrelated, then the test statistic for a test that the two estimates differ is $(-4.92-2.52)/\sqrt{(3.81^2+1.32^2)} = 1.85$. Thus a test of the null that the market price of *SMB* risk equals the mean value of *SMB* cannot be rejected at the 5 per cent level. Joint tests across the

evidence, as the AER notes, against the hypothesis that the three slope coefficients are zero. On its face, this is surprising because the slope coefficient on the *HML* beta is 9.84 percent per annum. A glance at the large standard error associated with the estimate, though, explains why one cannot reject the hypothesis that the market price of *HML* risk is zero. The tests lack power. This low power – that is, an inability to distinguish between alternative hypotheses – arises from the low dispersion in *HML* and *SMB* betas that we noted earlier.

The second and third sets of tests – which, again, are not independent – similarly provide no evidence that the slope coefficients from the regressions differ from their theoretical counterparts. The tests also provide little evidence that the coefficients differ significantly from zero. Thus again, the tests lack power. In contrast to the first set of tests, though, there is no evidence from tests of the SL CAPM that the zero-beta and risk-free rates differ but there is evidence from tests of the FFM that the zero-beta rate exceeds the risk-free rate.¹¹²

Taken together, the results of the three sets of tests provide some evidence to suggest that zero-beta versions of the SL CAPM and FFM may better describe the data than versions of the models in which the zero-beta and risk-free rates are constrained to be equal. Since the evidence in Table 4.3 suggests that the zero-beta rate may exceed the risk-free rate, the evidence suggests that both the SL CAPM and FFM may *underestimate* the returns required on low-beta assets like the equity of a gas distributor.

While it is important to know how a pricing model fares in tests that use a broad cross-section of assets, it is also important to know how a pricing model fares in tests that use a sample of equities similar to the one whose required return one wishes to measure. Unfortunately, the time series of returns to the sample of comparable Australian companies that the AER uses in its WACC review is short and so tests of the FFM and SL CAPM that use the series will have low power. In other words, with so few data it will be difficult to distinguish between alternative hypotheses. For this reason, in our August 2009 report on behalf of Jemena we use a time series of returns to a portfolio of comparable US companies.

three factors are difficult to conduct because Da, Guo and Jagannathan do not provide enough information to conduct them.

¹¹² The tests of the FFM can also be viewed as tests of the SL CAPM. To see this, note that while estimates of the beta of the SL CAPM and the market beta of the FFM can, in principle, differ, because one is from a univariate regression and the other is from a multivariate regression, in practice, as Table 2B and 3C of Da, Guo and Jagannathan's paper show, they are very similar. They are very similar because the relations between the three Fama-French factors are weak. For example, in Table 2B, the correlation between the two beta estimates is 0.997 while in Table 3C, it is 0.961. The SL CAPM implies that there should be a relation only between return and the beta of a portfolio relative to the market and that a zero-beta portfolio should earn the risk-free rate. The second and third set of tests provide evidence against both hypotheses and so evidence against the SL CAPM.

4.3. Evidence that the FFM provides a better estimate of the cost of capital for US energy businesses

We find that an estimate of the FFM alpha for this portfolio of comparable US energy utilities is substantially smaller than an estimate of the Sharpe-Lintner alpha for the portfolio. Again, a portfolio's alpha is the error with which a pricing model measures the return required on the portfolio. Moreover, while the estimate of the FFM alpha is not significantly different from zero, there is evidence that the Sharpe-Lintner alpha differs significantly from zero. In other words, we find evidence that for the regulated energy utility sector in the US over a 30-year period (1980 to 2009) the FFM provides a better estimate of the cost of equity than does the SL CAPM. Furthermore, since estimates of the alphas are positive for both models, our analysis suggests that both models *underestimate* the return required to a portfolio of comparable US companies. We note that this finding is consistent with the recent evidence that both the FFM and SL CAPM underestimate the returns to low-beta companies.¹¹³ Again, our evidence indicates that the equity of a regulated energy business has a low beta and so the evidence we find is consistent with the idea that the FFM and SL CAPM will underestimate the return required on the equity.

The AER makes a number of criticisms of our methodology. The AER argues *incorrectly* that adding factors to a pricing model will necessarily lead to better in-sample performance.

Adding factors to the SL CAPM offers no guarantee of better in-sample performance. The SL CAPM places no restriction on an asset's factor betas. For example, it does not restrict an asset's *HML* and *SMB* betas to be zero. So adding these factors can in principle lead to a model that measures the cost of equity with more, not less error. Appendix B provides a hypothetical example to illustrate this point.

The AER also argues *incorrectly*:

- § that an assumption about taxes must be made when delevering and relevering betas
- § that the process of delevering and relevering betas cannot be accomplished within the FFM

Since these arguments also bear on the way in which we estimate the cost of equity for an Australian gas distributor, we address the arguments in detail in Section 5. Section 5, again, provides evidence that we compute 'reasonable' estimates of the cost of equity and thus the estimates satisfy Rule 74(2)(a), which requires that estimates of the cost of equity be 'arrived at on a reasonable basis'.

The AER also states that:¹¹⁴

'the NERA report on the FFM does not examine return prediction performance but rather within sample return outcomes'

¹¹³ Lewellen, J., S. Nagel and J. Shanken, *A skeptical appraisal of asset pricing tests*, Journal of Financial Economics, forthcoming.

¹¹⁴ AER, *Jemena access arrangement proposal for the NSW gas networks: Draft Decision*, February 2010, page 118.

and that

‘the conclusions are void unless they first demonstrate the MRPs within the sample are not unexpected or atypical ... although NERA states that certain alpha values are not statistically significant at conventional (5 per cent) levels, the type of statistical test undertaken is not stated nor is the value listed.’

These comments by the AER are puzzling because we have adopted *exactly* the same procedure that Da, Guo and Jagannathan (2009) and Gharghori, Lee and Veeraraghavan (2009) use to assess the SL CAPM and FFM and, again, these are papers that the AER introduces.¹¹⁵

It is *unclear* that an evaluation of out-of-sample performance is superior to an analysis of in-sample performance as the AER appears to assert. Inoue and Kilian (2004), for example:¹¹⁶

‘conclude that results of in-sample tests of predictability will typically be more credible than results of out-of-sample tests.’

The predictive performance of the SL CAPM and FFM will depend on the alphas associated with the two models. For this reason we, like Da, Guo and Jagannathan and Gharghori, Lee and Veeraraghavan, test whether the alphas associated with the models are zero.

Like the majority of other researchers, we use ordinary least squares to estimate the parameters of the two models. In any sample, the sample means of the Fama-French factors will almost surely differ from their population means. The ordinary least squares estimates and conventional standard errors that we compute take into account the fact that the sample means of the factors differ from the corresponding population means – which, of course, one cannot observe.¹¹⁷ Thus the AER’s conclusion that we do not take into account differences between the sample means of the Fama-French factors and their population counterparts is incorrect.

To summarise, the results of our tests that use a portfolio of comparable US companies provide no evidence that the FFM alpha differs significantly from zero, but it does provide evidence that the SL CAPM alpha exceeds zero. In other words, the results indicate that the SL CAPM *underestimates* the return to a portfolio of energy businesses. Like their Australian counterparts, the equities of regulated US energy businesses appear to have a positive exposure to the *HML* factor. Since the FFM rewards an exposure to the *HML* factor, the FFM provides a better fit to the data.

¹¹⁵ Da, Guo and Jagannathan, *CAPM for Estimating the Cost of Equity Capital: Interpreting the Empirical Evidence*, 2009, NBER Working Paper.

Gharghori, P., R. Lee and M. Veeraraghavan, *Anomalies and stock returns: Australian evidence*, Accounting and Finance 49, 2009, pages 555–576.

¹¹⁶ Inoue, A. And L. Kilian, *In-sample and out-of-sample tests of predictability: Which one should we use?* Econometric Reviews, 2004.

¹¹⁷ See Johnston, J., *Econometric methods*, McGraw-Hill, 1972, pages 125-126.

5. Does NERA Provide a Reasonable Estimate?

Rule 74(2)(a) requires that estimates of the cost of equity be ‘arrived at on a reasonable basis’. In this section we emphasise that the FFM has been applied in a conventional way to estimate the cost of equity for a gas distributor. In particular, we emphasise that we use:

- § a relevering mechanism which has been endorsed by the AER to ensure that the estimate of the cost of equity is consistent with the assumption that a benchmark business has a 60 per cent debt gearing ratio;
- § the same nine regulated Australian energy businesses that form the sample of comparable companies that the AER employs to estimate the Sharpe-Lintner equity beta;
- § weekly and monthly data and an estimation period for computing factor betas from 1 January 2002 to present that the AER recommends;
- § a risk-free rate determined in the way in which the AER states that it should be determined;
- § a value for the market risk premium provided by the AER;
- § the longest period available to estimate the factor premiums (necessary inputs for the FFM), consistent with advice provided by the AER on how one should estimate the market risk premium (a necessary input for both the SL CAPM and FFM); and
- § as a cross check, an alternative source for data to determine whether an estimate of the cost of equity is sensitive to the use of a different data source. We find that an estimate of the cost of equity is not sensitive to the use of a different data source.

However, we begin by clearing up a misunderstanding the AER has about the way in which the FFM works.

5.1. Characteristics and exposures

The evidence that Fama and French (1992) provide shows that, contrary to the predictions of the SL CAPM, size and book-to-market are better predictors of return than beta.¹¹⁸ Size and book-to-market are *characteristics*. Beta measures the *exposure* of an asset to market risk. To correct these problems with the SL CAPM, Fama and French (1993) introduce a pricing model that does not link the cost of equity to a set of characteristics but instead links it to the exposure of equity to three sources of risk: market risk; *HML* risk; and *SMB* risk.¹¹⁹

The predictions of a characteristics-based model and an exposure-based model can differ substantially. For example, absent synergies or tax effects, the FFM predicts that the merger of two identical unlevered companies will not affect the return required on each company. A characteristics-based model in which the cost of equity is negatively related to size, on the other hand, will predict that the return required on each company will fall. While an

¹¹⁸ Fama, Eugene and Kenneth French, *The cross-section of expected returns*, Journal of Finance 47, 1992, pages 427-465.

¹¹⁹ Fama, Eugene and Kenneth French, *Common risk factors in the returns to stocks and bonds*, Journal of Financial Economics 33, 1993, pages 3-56.

exposure-based model can be given a theoretical rationale consistent with the idea that investors behave rationally, a theoretical rationale for a characteristics-based model will in general require that some investors do not behave rationally.¹²⁰

The AER's Draft Decision contains a fundamental misunderstanding of how the FFM determines the required return of a stock or portfolio of stocks. The AER states that:¹²¹

'The FFM seeks to adjust for business specific risks, but the regulatory framework for assessment is a benchmark exposure to risks. That is, the FFM posits that a business' return should be based on its specific *characteristics*—the business size and book-to-market ratio'

'in order to derive a cost of capital for a regulated business, the NERA report on the FFM either aggregates data before estimation or averages the outcome for individual firms. However, all the firms have different *sizes* and variations in the *book-to-market* valuations which would lead one to expect, under the FFM, that they should exhibit different costs of capital. By using an average estimate the NERA report on the FFM's implementation of the FFM dilutes the variation in returns that the FFM seeks to explain and model.'

[*Emphasis added*]

The AER's concern is that if the FFM were a *characteristics-based* model – and it is not – then it would not be appropriate to use the model to estimate the return required on equity for a benchmark energy business. This is because the return required on the equity for a benchmark energy business would depend, in what would understandably be seen as an arbitrary fashion, on the characteristics of the companies used to define the benchmark. A merger of some of the companies would produce a benchmark business with different characteristics and so, under a characteristics-based model, a different return required on equity.

The FFM states that the return required on an asset should be explained by its *exposure* to the three factors, that is, its factor betas, irrespective of the asset's *characteristics*. As Davis, Fama and French (2000) point out, for example, the FFM:¹²²

'says expected returns compensate risk loadings *irrespective* of the BE /ME characteristic,'

where risk loadings refer to exposures or factor betas and BE/ME denotes book-to-market. In other words, the required return on an asset depends on its exposures to the three factors *irrespective* of the asset's characteristics. Firms with large *HML* betas may be firms with high book-to-market ratios but they need not be. A firm, for example, may have a large *HML* beta but have a low book-to-market ratio. Similarly firms with high *SMB* betas may be small firms but they need not be. A small firm, for example, may have a low *SMB* beta. As Koller, Goedhart and Wessels (2005) point out, in the FFM:¹²³

¹²⁰ Daniel, K. And S. Titman, *Evidence on the characteristics of cross sectional variation in stock returns*, Journal of Finance 52, 1997, pages 1-33.

¹²¹ AER, *Jemena access arrangement proposal for the NSW gas networks: Draft Decision*, February 2010, pages 109 and 119-120.

¹²² Davis, James, Eugene Fama and Kenneth French, *Characteristics, covariances, and average returns: 1929-1997*, Journal of Finance 55, 2000, pages 389-406.

¹²³ Koller, Tim, Marc Goedhart and David Wessels, *Valuation: Measuring and managing the value of companies*, 2005, McKinsey.

‘a company does not receive a premium for being small. Instead, the company receives a risk premium if its stock returns are correlated with those of small stocks or high book-to-market companies.’

We emphasise, therefore, that the FFM does *not* use size and book-to-market as inputs in determining the cost of equity for a gas distributor.

The AER also states that the FFM can only be used to determine the return required on an individual asset and not on a portfolio. For example the AER states that:¹²⁴

‘the approach in the NERA report on the FFM to manipulating data prior to parameter estimation represents a distortion of the original FFM by ... the pooling of firms of disparate sizes,’

and that:¹²⁵

‘in order to derive a cost of capital for a regulated business, the NERA report on the FFM either aggregates data before estimation or averages the outcome for individual firms. However, all the firms have different sizes and variations in the book-to-market valuations which would lead one to expect, under the FFM, that they should exhibit different costs of capital. By using an average estimate the NERA report on the FFM’s implementation of the FFM dilutes the variation in returns that the FFM seeks to explain and model. As outlined previously, the NERA report on the FFM’s specification of the FFM does not represent a standard application of the FFM.’

The AER’s argument that the FFM can only be used to determine the return required on an individual asset and not on a portfolio is wrong. In the FFM, the factor beta of a portfolio is a weighted average of the factor betas of the assets in the portfolio, where the weights are the weights of the assets in the portfolio. In exactly the same way, in the SL CAPM, the beta of a portfolio is simply a weighted average of the betas of the assets that make up the portfolio, where the weights are, again, the weights of the assets in the portfolio.¹²⁶

Since the return required on a portfolio is a weighted average of the returns required on the assets in the portfolio, it follows that the FFM, like the SL CAPM, can be used to calculate both the returns required on *individual assets* and the returns required on *portfolios*. Indeed, a large number of studies use the FFM to determine the returns required on a range of portfolios. Two such studies are the studies by Da, Guo and Jagannathan (2009) and Gharghori, Lee and Veeraraghavan (2009) that the AER introduces.¹²⁷ Both studies, as we make clear in Section 4, form portfolios on the basis of a number of characteristics and measure the returns required on these portfolios using the SL CAPM and FFM.

To recap, the FFM is *not* a characteristics-based model and so the AER’s concern that the model is an inappropriate one to use in estimating the required return on equity for a benchmark energy business is misplaced. The FFM, like the SL CAPM, is a model in which

¹²⁴ AER, *Jemena access arrangement proposal for the NSW gas networks: Draft Decision*, February 2010, page 110.

¹²⁵ AER, *Jemena access arrangement proposal for the NSW gas networks: Draft Decision*, February 2010, page 119-120.

¹²⁶ Fama, Eugene, *Foundations of Finance*, Basic Books, New York, 1976, page 75.

¹²⁷ The AER introduces Da, Guo and Jagannathan (2009) into the debate on page 63 of AER, *ActewAGL Access arrangement proposal for the ACT, Queanbeyan and Palerang gas distribution network: 1 July 2010 – 30 June 2015*, 2009.

The AER introduces Gharghori, Lee and Veeraraghavan (2009) into the debate on page 114 of AER, *Jemena access arrangement proposal for the NSW gas networks: Draft Decision*, February 2010.

the return required on an asset is a linear function of a number of factor betas. So the FFM can be used to calculate both the returns required on *individual assets* and the returns required on *portfolios*.

To compute estimates of the three Fama-French betas of the equity of a benchmark energy business, one must take into account that the leverage of each of the sample of nine energy businesses that the AER uses does not match the debt leverage of 60 per cent that the AER accepts that an efficient energy business to have.¹²⁸ Taking this fact into account in computing estimates of the Fama-French betas requires one first to delever and then to relever the estimates.

5.2. Characteristics and relevering

To compute the Fama-French betas of a benchmark business we delever and then relever the estimates from the nine businesses in *exactly* the same way as if one were to use the SL CAPM. Relevering is necessary because the capital structures (that is, the mixes of debt and equity) of the comparable companies differ from the assumed capital structure of the benchmark business.

The AER, however, believes that relevering returns creates a distortion. It states that:¹²⁹

‘in addition, the approach in the NERA report on the FFM to manipulating data prior to parameter estimation represents a distortion of the original FFM by the adjustment of returns for gearing.’

and that:¹³⁰

‘the ... returns have been altered such that they do not reflect the actual firms’ circumstances ... the gearing change would alter other business fundamentals (for instance, changes in interest costs, business distress risks and the book-to-market ratio).’

The AER’s concerns are misplaced since both the SL CAPM and FFM are linear financial models in which the return required on an asset depends on its exposure to a number of factors and not on a set of characteristics. One can apply standard delevering and relevering techniques in exactly the same way with the FFM as one can with the SL CAPM.

Suppose that a levered firm that has default-free debt outstanding maintains a constant leverage through time. Then the relationship between the return to the firm’s equity and the return to an equivalent unlevered firm is:¹³¹

$$R_e = R_a \left(1 + \frac{D}{E} \right) - R_f \frac{D}{E}, \quad (2)$$

¹²⁸ AER, *Jemena access arrangement proposal for the NSW gas networks: Draft Decision*, February 2010, page xvi.

¹²⁹ AER, *Jemena access arrangement proposal for the NSW gas networks: Draft Decision*, February 2010, page 109.

¹³⁰ AER, *Jemena access arrangement proposal for the NSW gas networks: Draft Decision*, February 2010, page 119.

¹³¹ Dempsey, M., The Fama and French three-factor model and leverage: Compatibility with the Modigliani and Miller propositions, *Investment Management and Financial Innovations* 6, 2009, pages 48-53.

where R_e is the return to the levered firm's equity, R_a is the return to an equivalent unlevered firm, R_f is the risk-free rate and D and E are the values of the levered firm's debt and equity. As we emphasise later, this relationship will hold even in the presence of corporate and personal taxes – so long as the levered firm issues or retires debt to maintain a constant leverage.

It follows from (2) that the beta of the levered firm and the beta of an equivalent unlevered firm are related in the following way:

$$b_e = b_a \left(1 + \frac{D}{E} \right) \quad (3)$$

where b_e is the beta of the levered firm's equity and b_a is the beta of an equivalent unlevered firm. Equation (3) is the relation that AER advisor Henry (2009) uses and the AER endorses.¹³²

To illustrate how one can use (3) to delever and relever betas, we consider a simple example. Consider a levered firm whose equity has a beta of one. If the firm's debt-to-equity ratio is one, then, from (3), the beta of the equity of an equivalent unlevered firm must be 0.5. The beta of the equity of an equivalent unlevered firm is the delevered beta. Also, from (3), the beta of the equity of an otherwise identical firm that has a debt-to-equity ratio of 1.5 must be 1.25. This is a relevered beta.

In *exactly* the same way the Fama-French factor betas for a levered firm and for an equivalent unlevered firm are related in the following way:¹³³

$$b_e = b_a \left(1 + \frac{D}{E} \right), \quad h_e = h_a \left(1 + \frac{D}{E} \right) \quad \text{and} \quad s_e = s_a \left(1 + \frac{D}{E} \right), \quad (4)$$

where b_e , h_e and s_e are the market, *HML* and *SMB* betas for the levered firm and b_a , h_a and s_a are the corresponding betas for an unlevered firm.

To summarise, the process of delevering and relevering Fama-French betas is identical to the process of delevering and relevering Sharpe-Lintner betas. So the concern expressed by the AER about estimating the parameters of the FFM using relevered returns is *misplaced*.

¹³² Olan T. Henry, Estimating *b*: Report for the Australian Energy Regulator, 23 April 2009.

¹³³ Dempsey, M., The Fama and French three-factor model and leverage: Compatibility with the Modigliani and Miller propositions, *Investment Management and Financial Innovations* 6, 2009, pages 48-53.

5.3. Taxes and relevering

In our report for Jemena we adjusted the Fama-French betas to reflect an assumption that a regulated business has 60 per cent debt and 40 per cent equity. Our report states that:¹³⁴

‘none of the nine utilities has a debt-to-value ratio of 0.6, ie, the ratio that the AER assumes a benchmark utility should have. We have therefore adjusted (relevered) all of our beta estimates to reflect this benchmark assumption. More specifically, we have followed Henry (2009) and multiplied each return by $(1 - L_j)/(1 - 0.6)$, where L_j is the average net debt-to-value ratio over the period for which net debt and market capitalisation data are available for the utility. If the utility follows a strategy of issuing or retiring debt to ensure its leverage is constant through time, then relevering in this way is appropriate.’

However, the AER’s draft decision states that:¹³⁵

‘the leverage transformation used in the NERA report on the FFM assumes no tax (or that gamma is equal to one)’

and that:¹³⁶

‘the gearing transformation is inconsistent with Jemena’s access arrangement proposal, since it assumes no tax (or that gamma is one) but elsewhere taxation adjustments to returns are proposed to be based on a gamma of 0.2.’

This concern is puzzling since we have adopted the leveraging formula endorsed by the AER in its Explanatory Statement for its Review of the WACC parameters. That Review states that:¹³⁷

‘the AER notes that the ACG prefers a simplified de-levering and re-levering formula (the Brealey and Myers formula with a debt beta of zero), and has adopted this approach in recent reports. This approach has also been adopted by Associate Professor Henry.

The de-levering and re-levering formula under the approach preferred by the ACG and adopted by Associate Professor Henry is:

$$b_e = b_a \left(1 + \frac{D}{E} \right)$$

where each of the parameters are as defined above.

The AER notes that it is generally accepted that the choice of de-levering and re-levering formula, in general, does not make a significant difference to the resultant estimates, so long as the same formula is adopted for both de-levering and re-levering. The AER also notes that the use of the same formula across the ACG’s current and recent reports, and Associate Professor Henry’s report, also allows for ease of comparison across the various reports.

¹³⁴ NERA, *Cost Of Equity – Fama-French Three-Factor Model: Report for Jemena Gas Networks (NSW)*, August 2009.

¹³⁵ AER, *Jemena access arrangement proposal for the NSW gas networks: Draft Decision*, February 2010, page 119.

¹³⁶ AER, *Jemena access arrangement proposal for the NSW gas networks: Draft Decision*, February 2010, page 120.

¹³⁷ AER, *Explanatory Statement: Electricity transmission and distribution network service providers Review of the weighted average cost of capital (WACC) parameters*, December 2008, page 202.

To implement this approach, the ACG and Associate Professor Henry, have multiplied the raw equity beta estimates by the following factor (omega):

$$w = \left(\frac{1-G}{1-0.6} \right), \quad G = \frac{D}{D+E},$$

where D = the book value of debt and E = the market value of equity.

While the market value of equity can be observed continuously, the book value of debt can only be observed in reports from the businesses, which are published semi-annually. Associate Professor Henry has utilised these published book values of debt and market values of equity at the time of publication of the book values of debt. The data was sourced from Bloomberg and provided by the AER. The ACG has adopted the same approach, however has interpolated monthly book values of debt for the periods in between publication. The AER considers both methods are acceptable and should make little difference to the resultant estimates.'

These quotes demonstrate that the delevering and relevering procedure that NERA uses is identical to the delevering and relevering procedure that the AER endorses.

Delevering and relevering betas requires one make an assumption about the debt policy each firm pursues. One policy a firm might pursue is to maintain a constant leverage through time. A policy of maintaining a constant leverage through time requires a firm to continually issue or retire debt (a Miles-Ezzell framework).¹³⁸ A second, policy a firm might pursue is to maintain a constant dollar amount of debt outstanding through time. A third policy might be to issue some new debt when the value of the firm rises and retire some debt when the value of the firm falls but to allow the leverage of the firm to fall as the value of the firm rises and rise as the value of the firm falls. In delevering and relevering betas, one must also make an assumption about whether a firm will ever default on its debt.

Taggart (1991) shows that delevering and relevering is particularly simple if one assumes that a firm follows a strategy of continually maintaining a constant leverage through time and that it never defaults on its debt.¹³⁹ It is particularly simple because one can ignore corporate and personal taxes – and so imputation credits, which are nothing more than negative personal taxes. In contrast, if one assumes that a firm follows a strategy of maintaining a constant dollar amount of debt outstanding through time, then one cannot ignore corporate and personal taxes. It is, perhaps, for this reason that Henry (2009) assumes that a firm follows a strategy of continually maintaining a constant leverage through time and never defaults on its debt in his recent report for the AER.¹⁴⁰ It may also be that Henry recognises that the AER view that an efficient regulated energy business should have a gearing of 0.6 *requires* that the business maintain a constant leverage through time.¹⁴¹

¹³⁸ Miles, James and John Ezzell, *The weighted average cost of capital, perfect capital markets, and project life: A clarification*, Journal of Financial and Quantitative Analysis, 1980, pages 719-730.

Miles, James and John Ezzell, *Reformulating tax shield valuation: A note*, Journal of Finance, 1985, pages 1485-1492.

¹³⁹ Taggart, Robert, *Consistent valuation and cost of capital expressions with corporate and personal taxes*, Financial Management, 1991, page 14.

¹⁴⁰ Olan T. Henry, *Estimating b : Report for the Australian Energy Regulator*, 23 April 2009.

¹⁴¹ An analysis of the third, hybrid policy that we describe is substantially more complicated. For an analysis, see

We reiterate that NERA has followed methodology endorsed by the AER, *precisely*.

5.4. FFM inputs

To compute an estimate of the cost of equity for a gas distributor using the FFM requires the following inputs:

- § the risk-free rate;
- § estimates of the three factor betas for a gas distributor; and
- § estimates of the three factor risk premiums.

We compute a measure of the risk-free rate in exactly the same way as the AER prescribes.

To compute estimates of the factor betas of a gas distributor, we use:

- § the same nine regulated Australian energy businesses that form the sample of companies that the AER employs;
- § weekly and monthly data, like the AER's advisor Henry employs; and
- § an estimation period for computing factor betas from 1 January 2002 to present that the AER recommends.

We use as an estimate of the market risk premium the figure of 6.5 percent per annum that the AER endorses in its WACC Review and in the Draft Decision.¹⁴² To compute estimates of the other two factor risk premiums, we follow the AER's advice and use the longest time series available of reliable data.¹⁴³ This time series is sourced from DFA, a fund manager with whom Fama and French are affiliated.

Although we use the longest possible time series available to estimate the *HML* and *SMB* risk premiums, the AER expresses concern about the sensitivity of estimates to the time period used and way in which the premiums are computed. The AER provides a summary of evidence on the magnitudes of the *HML* and *SMB* risk premiums in Australia and argues that^{144,145}

‘The HML premiums shown in Table 5.4 vary from 14.6 per cent to 6 per cent, a range that is considered too large to be able to confirm its presence as a risk factor in Australia. The SMB premiums

Grinblatt, Mark and Jun Liu, *Debt policy, corporate taxes, and discount rates*, UCLA working paper, 2002.

¹⁴² AER, *Electricity transmission and distribution network service providers, Review of the weighted average cost of capital (WACC) parameters: Final Decision*, May 2009, page iii.

AER, *Jemena access arrangement proposal for the NSW gas networks: Draft Decision*, February 2010, page xvi.

¹⁴³ AER, *Electricity transmission and distribution network service providers, Review of the weighted average cost of capital (WACC) parameters: Final Decision*, May 2009, page 196.

¹⁴⁴ AER, *Jemena access arrangement proposal for the NSW gas networks: Draft Decision*, February 2010, page 115.

¹⁴⁵ Note that our point estimate of the *SMB* premium is negative, although a standard confidence interval for the parameter includes a range of positive values. Even though our estimate of the *SMB* premium is negative, we nevertheless use this estimate. We do not consider dropping the *SMB* factor because we wish to use the FFM in its original form.

are even more of a problem, since they range from 17.2 per cent to negative 9 per cent, a result that is completely at odds with the original FFM.’

There are two reasons why the estimates of the premiums that the AER displays vary. First, the estimates are drawn from a variety of relatively short but different periods. Second, authors of the estimates have computed the premiums using different sets of data.

To illustrate the fact that estimates of risk premiums are bound to vary when they are estimated over relatively short but different periods in Table 5.1 we augment Table 5.4 from the AER’s review with data on the market risk premium. Table 5.1 shows that there is almost as much variation in estimates of the market risk premium as there is in estimates of the HML premium.

Table 5.1
The Fama-French factor risk premiums: Australian evidence from 1975 to 2006

Authors	Period	MRP	HML	SMB
Fama and French, 1998	1975-1995	7.21	12.30	
Halliwell et al., 1999	1980-1991	3.23	14.60	6.00
Faff, 2001	1991-1999	9.55	14.00	-9.00
Faff, 2004	1996-1999	9.31	6.00	-6.50
Gaunt, 2004	1993-2001	8.58	8.50	10.00
Ghargori, Chan and Faff, 2007	1996-2004	6.01	10.40	17.20
O’Brien et al., 2008	1982-2006	6.24	9.40	4.30
Kassimatis, 2008	1993-2005	8.30	12.60	11.50
Standard deviation		1.97	2.75	8.83

Note: All returns are in percent per annum.

Source: AER, Jemena access arrangement proposal for the NSW gas networks: Draft Decision, February 2010, Table 5.4 and data from http://mba.tuck.dartmouth.edu/pages/faculty/ken.french/data_library.html

The estimates also vary, though, because different authors measure the Fama-French factors in different ways. For example, Faff (2001) uses data from Frank Russell to compute the factors, Fama and French (1998) use data from Morgan Stanley, while O’Brien, Brailsford and Gaunt (2008) use data from the ASX and company accounts.

Similarly different authors measure the return to the market portfolio in different ways. As Roll (1977) points out, there may be no ambiguity about how, *in theory*, to measure the return to the market portfolio but there is ambiguity about how, *in practice*, to measure the return.¹⁴⁶ As Stambaugh (1982) shows, though, a lack of consensus about how to measure the return to the market portfolio need not imply that different authors will measure the return required on

¹⁴⁶ Roll, Richard, *A critique of the asset pricing theory’s tests: Part I*, Journal of Financial Economics 4, 1977, pages 129-176.

an asset to be different.¹⁴⁷ Similarly, a lack of consensus about how to measure the Fama-French factors need not imply that different authors will measure the return required on an asset to be different. In other words, the use of an alternative set of factors need not imply that one will measure the return required on an asset differently.

To illustrate how ambiguity about how to measure the return to the market portfolio can create substantial variation across estimates of the mean real return to the market portfolio, we use data from Stambaugh. Table 5.2 provides estimates of the real return to the US market portfolio in percent per annum across four different time periods using the four measures of the market that Stambaugh employs. As the table makes clear, the estimates are sensitive to the way the market proxy is constructed. Nevertheless, Stambaugh finds that tests of the SL CAPM and Black CAPM are not sensitive to the use of a proxy. His tests *reject* the SL CAPM but find little evidence against the Black CAPM.

Table 5.2
Estimates of the mean real return to the market portfolio: US evidence from 1953 to 1976

Period	Market proxy			
	1	2	3	4
1953-1959	15.74	7.25	2.75	0.98
1959-1965	9.95	6.85	3.12	1.39
1965-1971	1.87	0.38	-0.02	-0.64
1971-1976	0.50	0.43	-0.11	-0.14
1953-1976	7.02	3.73	1.43	0.40

Note: Market proxy no. 1 is a value-weighted portfolio of NYSE common stocks; market proxy no. 2 is no. 1 plus corporate bonds and government bonds and Treasury bills; market proxy no. 3 is no. 2 plus real estate, housefurnishings and automobiles; market proxy no 4 is the same as no. 3 but with NYSE stocks given a 10 percent weight. All returns are in percent per annum.

Source: Stambaugh, R., On the exclusion of assets from tests of the two-parameter model: A sensitivity analysis, Journal of Financial Economics 10, pages 237-268.

To summarise, there are two reasons why estimates of the Fama-French factor premiums that various authors produce may vary. First, the estimates may be drawn from different periods. Second, different authors may compute the premiums using different sets of data. In *exactly* the same way estimates of the MRP drawn from different periods will differ. Also, in *exactly* the same way, estimates of the MRP are sensitive to what one defines to be the market portfolio. The fact that estimates of the MRP that various authors produce may differ does not imply that these authors will produce different estimates using the SL CAPM of the cost of equity – at least if they are consistent in their use of a proxy for the market portfolio. Similarly, the fact that estimates of the Fama-French factor premiums that various authors

¹⁴⁷ Stambaugh, R., *On the exclusion of assets from tests of the two-parameter model: A sensitivity analysis*, Journal of Financial Economics 10, pages 237-268.

produce may differ does not imply that these authors will produce different estimates of the cost of equity – if they are consistent in their use of the factors that they construct.

In its submission, we are careful to ensure that the Fama-French factor premiums that we compute and thus the estimate of the cost of equity that we produce reflect the value investors may place on imputation credits.

5.5. Imputation credits

The original version of the FFM does not allow for imputation credits on which investors may place a value. In the same way, the original version of the SL CAPM does not allow for credits on which investors place a value. Officer (1994) assumes that investors care about the total return to each asset where the total return includes a proportion of the imputation credits delivered. We make *exactly* the same assumption. We use the value of 6.5 percent per annum for the market risk premium that the AER endorses in its WACC Review and in the Draft Decision.¹⁴⁸ This value includes a proportion of the imputation credits that the Australian market portfolio is expected to deliver. In the same way we adjust the *HML* and *SMB* premiums by adding a proportion of the imputation credits that each factor delivers.

To determine the maximum quantity of franking credits that can be attached to the dividends that each portfolio pays out each year, we use the statutory corporate tax rates in effect at the time. To compute the quantity of franking credits distributed, we follow Handley and Maheswaran (2008) and assume that 75 percent of dividends are franked.¹⁴⁹ Finally, to compute the value the market places on these franking credits, JGN have directed us to assume that the market places a value of 20 cents on a dollar of franking credits created. To be conservative, we assume that all credits created are distributed so that the value the market places on a dollar of credits distributed is also 20 cents – not higher. The assumption we make is conservative because we find that the dividend yield of the high book-to-market portfolio exceeds the yield of the low book-to-market portfolio and the dividend yield of the portfolio of small firms exceeds the yield of the portfolio of big firms.

¹⁴⁸ AER, *Electricity transmission and distribution network service providers, Review of the weighted average cost of capital (WACC) parameters: Final Decision*, May 2009, page iii.

AER, *Jemena access arrangement proposal for the NSW gas networks: Draft Decision*, February 2010, page xvi.

¹⁴⁹ Handley J. and Maheswaran K., A Measure of the Efficacy of the Australian Imputation Tax System, *The Economic Record*, Vol 84 No 264, March 2008, page 91.

6. Conclusions

On August 2009 JGN submitted a revised access arrangement proposal for its distribution network for the period 2010-2014. An important element in determining its revenues during the access period is the allowed return on equity. JGN engaged NERA together with Jeff Balchin to estimate the current cost of equity for a gas distributor using the FFM.

The NGR provide a set of criteria that lay out how the cost of equity for a gas distributor must be determined. Rule 87(2)(b) states that an estimate of the cost of equity must be computed using a financial model that is ‘well accepted’. In this report we have provided evidence that the FFM is *well accepted* by both the academic community and practitioners.

The evidence that we provide that the model is well accepted by the academic community includes statements from papers introduced by the AER into the debate. The evidence we provide that the model is well accepted by practitioners includes evidence that the model is taught as part of the Chartered Financial Analyst program. We also provide evidence that the work of Fama and French has received substantive media attention.

Rule 74(2)(b) requires that an estimate of the cost of equity be the ‘best forecast or estimate possible in the circumstances’. The alternative to using the FFM to compute the cost of equity for a gas distributor is for the AER to continue to use the SL CAPM. Thus the choice to be made is between two models:

- § the FFM; and
- § the SL CAPM.

We provide evidence that the FFM provides *better* estimates of the cost of equity both in Australia and the US than does the SL CAPM. The evidence that we provide includes evidence drawn from papers introduced by the AER into the debate. We therefore show that our use of the FFM to compute the cost of equity for a gas distributor satisfies Rule 74(2)(b).

Rule 74(2)(a) requires that estimates of the cost of equity be ‘arrived at on a reasonable basis’. We emphasise that in every respect we use the FFM in a conventional way to estimate the cost of equity for a gas distributor. For example, we use:

- § the relevering mechanism that the AER endorses;
- § data on the same nine regulated Australian energy businesses that form the sample of companies that the AER employs;
- § the longest period available to estimate the factor premiums (necessary inputs for the FFM), consistent with advice provided by the AER on how one should estimate the market risk premium (a necessary input for both the SL CAPM and FFM); and
- § an alternative source for data to determine whether an estimate of the cost of equity is sensitive to the use of a different data source.

We therefore show that the estimate of the cost of equity for a gas distributor that we provide satisfies Rule 74(2)(a).

Rule 87(1) requires that ‘the rate of return on capital is to be commensurate with prevailing conditions in the market for funds and the risks involved in providing reference services’. We note that the estimate that we provide of the cost of equity for a gas distributor uses recent market data. For example,

- § consistent with AER advice, we use the arithmetic average of the annualised yields of 10-year Government bonds over a recent 20-day period as a measure of the risk-free rate¹⁵⁰; and
- § consistent with AER advice, weekly data from 1 January 2002 onwards on the sample of nine regulated energy businesses to compute measures of risk.

The estimate of the cost of equity that we produce is computed in a way that satisfies Rule 87(1).

Our estimates indicate strongly that the equity of a gas distributor behaves like a value stock. In other words, we find that the equity of a gas distributor has a positive and highly significant *HML* beta. This means that if the shareholders of JGN are to be rewarded for the risks that they bear, they should receive an additional return as compensation for bearing the risk associated with behaving like a value stock.

Our estimates of the parameters of the FFM appear in Table 6.1 below. Table 6.1 shows the beta estimates that we have produced using the Fama-French three-factor model and the weekly data supplied by Dimensional Fund Advisors Australia Ltd from 2002 to 2008. The table also shows the estimates of the risk premiums we have computed using monthly data from 1975 to 2008.¹⁵¹

¹⁵⁰ Note that the sample period we use to estimate the risk-free rate is only indicative and that a different sample period may result in a different return on equity. Our FFM estimate that we provide below indicates that the cost of equity for a gas distribution business is 6.46 percentage points above the risk-free rate.

¹⁵¹ The estimate of the market risk premium is from Table 5.7 of AER, *Jemena Access arrangement proposal for the NSW gas networks 1 July 2010 – 30 June 2014: Draft Decision (Public)*, February 2010. Table 5.7 of the AER’s draft decision uses estimates of the beta of a gas distributor and the market risk premium taken from AER, *Electricity transmission and distribution network service providers, Review of the weighted average cost of capital (WACC) parameters: Final Decision*, May 2009 that not have been updated. We, similarly, do not update our August 2009 estimates.

Table 6.1
FFM parameter estimates for a gas distributor

Factor	Beta	Risk premium
Market minus risk-free rate	0.59	6.50
HML	0.48	6.24
SMB	0.30	-1.23

Note: Risk premiums are in percent per annum. The beta estimates are computed using weekly data from 1 January 2002 to 29 May 2009. The HML risk premium is computed using monthly data from January 1975 to December 2008. The SMB risk premium is computed using monthly data from January 1980 to December 2008. The market risk premium is from Table 5.7 of AER, Jemena Access arrangement proposal for the NSW gas networks 1 July 2010 – 30 June 2014: Draft Decision (Public), February 2010.

The FFM states that the cost of equity for a gas distributor must be:

$$E(R_e) = R_f + b_e MRP + h_e HMLP + s_e SMBP \quad (5)$$

where

R_f is the risk-free rate,

b_e is the market beta;

h_e is HML beta;

s_e is SMB beta;

MRP is the market risk premium;

$HMLP$ is the HML risk premium; and

$SMBP$ is the SMB risk premium.

Using the parameter estimates that appear in Table 6.1 above and a risk-free rate which was 5.5813 percent for the 20 business days up to and including the 12 February 2010 produces a post-tax cost of equity for a gas distribution business of:¹⁵²

$$5.5813 + 0.59 \times 6.50 + 0.48 \times 6.24 + 0.30 \times -1.23 = 12.043 \text{ per cent}$$

¹⁵² Again, that the sample period used to estimate the risk-free rate is only indicative and that a different sample period may result in a different return on equity.

Appendix A. The FFM: A How-To Guide

In this appendix we provide an extract drawn from Reading 35 for the CFA's Level II exam of how to use the FFM.¹⁵³ This extract shows how to use the FFM and data drawn from Morningstar and Ken French's web site to estimate the return required on the equity of Microsoft.

A.1. Multifactor Models

A substantial amount of evidence has accumulated that the CAPM beta describes risk incompletely. In practice, coefficients of determination (*R*-squared) for individual stocks' beta regressions may range from 2 percent to 40 percent, with many under 10 percent. For many markets, evidence suggests that multiple factors drive returns. At the cost of greater complexity and expense, the analyst can consider a model for required return based on multiple factors. Greater complexity does not ensure greater explanatory power, however, and any selected multifactor model should be examined for the value it is adding.

Whereas the CAPM adds a single risk premium to the risk-free rate, arbitrage pricing theory (APT) models add a set of risk premia. APT models are based on a multifactor representation of the drivers of return. Formally, APT models express the required return on an asset as follows:

$$r = R_f = (\text{Risk premium})_1 + (\text{Risk premium})_2 + \dots + (\text{Risk premium})_K \quad (10)$$

where $(\text{Risk premium})_i = (\text{Factor sensitivity})_i \times (\text{Factor risk premium})_i$. **Factor sensitivity** or **factor beta** is the asset's sensitivity to a particular factor (holding all other factors constant). In general, the **factor risk premium** for factor *i* is the expected return in excess of the risk-free rate accruing to an asset with unit sensitivity to factor *i* and zero sensitivity to all other factors.¹⁵⁴

One of the best known models based on multiple factors expands upon the CAPM with two additional factors. That model, the Fama-French model, is discussed next.

A.1.1. The Fama-French Model

By the end of the 1980s, empirical evidence had accumulated that, at least over certain long time periods, in the U.S. and several other equity markets, investment strategies biased toward small-market capitalization securities and/or value might generate higher returns over the long-run than the CAPM predicts.¹⁵⁵

¹⁵³ CFA Program Curriculum – Volume 4, Level II 2010, page 130-134.

¹⁵⁴ In the case of the Fama-French model, however, the premiums of two factors are not stated as quantities in excess of the risk-free rate.

¹⁵⁵ For example, Fama and French (1993) and Strong and Xu (1997) documented size and book-to-market premiums for the United States and the United Kingdom, respectively. Capaul, Rowley, and Sharpe (1993) and Chen and Zhang (1998) documented a value premium in developed markets internationally.

In 1993, researchers Eugene Fama and Kenneth French addressed these perceived weaknesses of the CAPM in a model with three factors, known as the Fama-French model (FFM). The FFM is among the most widely known non-proprietary multifactor models. The factors are:

- § RMRF, standing for $R_M - R_F$, the return on a market value-weighted equity index in excess of the one-month T-bill rate – this is one way the equity risk premium can be represented and is the factor shared with the CAPM.
- § SMB (small minus big), a size (market capitalization) factor. SMB is the average return on three small-cap portfolios minus the average return on three large-cap portfolios. Thus SMB represents a small-cap return premium.
- § HML (high minus low), the average return on two high book-to-market portfolios minus the average return on two low book-to-market portfolios.¹⁵⁶ With high book-to-market (equivalently, low price-to-book) shares representing a value bias and low book-to-market representing a growth bias, in general, HML represents a value return premium.

Each of the factors can be viewed as the mean return to a zero-net investment, long-short portfolio. SMB represents the mean return to shorting large-cap shares and investing the proceeds in small-cap shares; HML is the mean return from shorting low book-to-market (high P/B) shares and investing the proceeds in high book-to-market shares. The FFM estimate of the required return is:

$$r_i = R_F + b_i^{mkt} RMRF + b_i^{size} SMB + b_i^{value} HML. \quad (11)$$

Historical data on the factors are publicly available for at least 24 countries.¹⁵⁷ The historical approach is frequently used in estimating the risk premia of this model. The definitions of RMRF, SMB and HML have a specificity that lends itself to such estimation. Nevertheless, the range of estimation approaches discussed earlier could also be applied to estimating the FFM factors. Note the definition of RMRF in terms of a short-term rate; available historical series are in terms of a premium over a short-term government debt rate. In using Equation 11, we would take a current short-term risk-free rate. Note as well that because other factors besides the market factor are included in Equation 11, the beta on the market in Equation 11 is generally not exactly the same value as the CAPM beta for a given stock.

We can illustrate the FFM using the case of the U.S. equity market. A current short-term interest rate is 4.1 percent. We take RMRF to be 5.5 percent based on Panel B of Exhibit 1. The historical size premium is 2.7 percent based on Fama-French data from 1926. However, over the last quarter century approximately (1980 to 2006) the realized SML premium has averaged about one-half of that. Therefore, the historical estimate is adjusted downward to 2.0 percent. The realized value premium has had wide swings, but absent the case for a

¹⁵⁶ See <http://mba.tuck.dartmouth.edu/pages/faculty/ken.french/> for more information on the Fama-French model and factor data information.

¹⁵⁷ The countries include Australia, Austria, Belgium, Canada, Denmark, Finland, France, Germany, Hong Kong, Ireland, Italy, Japan, Malaysia, Netherlands, New Zealand, Norway, Singapore, Spain, Sweden, Switzerland, the United Kingdom and the United States. See <http://mba.tuck.dartmouth.edu/pages/faculty/ken.french/> for more information on the Fama-French model and factor data information.

secular decline as for the size premium, we take the historical value of 4.3 percent based on Fama-French data. Thus, one estimate of the FFM for the U.S. market as of 2007 is:

$$r_i = 0.041 + b_i^{mkt} 0.055 + b_i^{size} 0.02 + b_i^{value} 0.043$$

Consider the case of a small-cap issue with value characteristics and above-average market risk – assume the FFM market beta is 1.20. If the issue's market capitalization is small we expect it to have a positive size beta; for example, $b_i^{size} = 0.5$. If the shares sell cheaply in relation to book equity (i.e., they have a high book-to-market ratio) the value beta is also expected to be positive; for example, $b_i^{value} = 0.8$. For both the size and value betas, zero is the neutral value, in contrast with the market beta, where the neutral value is 1. Thus, according to the FFM, the shares' required return is slightly over 15 percent:

$$r_i = 0.041 + 1.20(0.055) + 0.5(0.02) + 0.8(0.043) = 0.151$$

The FFM market beta of 1.2 could be above or below the CAPM beta, but for this comparison, suppose it is 1.20. The CAPM estimate would be $0.041 + 1.20(0.055) = 0.107$ or less by about 15.1 – 10.7 or 4.4 percentage points. In this case, positive size and value exposures help account for the different estimates in the two models.

Returning to the specification of the FFM to discuss its interpretation, note that the FFM factors are of two types:

- § an equity market factor, which is identified with systematic risk as in the CAPM; and
- § two factors related to company characteristics and valuation, size (SMB) and value (HML).

The FFM views the size and value factors as representing (“proxying for”) a set of underlying risk factors. For example, small market-cap companies may be subject to risk factors such as less ready access to private and public credit markets and competitive disadvantages. High book-to-market may represent shares with depressed prices because of exposure to financial distress. The FFM views the return premiums to small size and value as compensation for bearing types of systematic risk. Many practitioners and researchers believe however, that those return premiums arise from market inefficiencies rather than compensation for systematic risk.¹⁵⁸

¹⁵⁸ Lakonishok, Shleifer, and Vishny (1994) and La Porta, Lakonishok, Shleifer, and Vishny (1997).

Example 7

An Analyst Case Study (3): The Required Return on Microsoft Shares

Weeramantry's next task in researching Microsoft shares is to estimate a required return on equity (which is also a required return on total capital because Microsoft has no long-term debt). Weeramantry uses an equally weighted average of the CAPM and FFM estimates unless one method appears to be superior as judged by more than a five point difference in adjusted R^2 ; in that case only the estimate with superior explanatory power is used. Exhibit 7 shows the cost of equity information for Microsoft Corporation. All the beta estimates in Exhibit 7 are significant at the 5 percent level.

Exhibit 7: CAPM and FFM Required Return Estimates, Microsoft Corporation

	Model A	Model B
1) Current risk-free rate	4.7%	4.7%
2) Beta	1.04	1.14
3) Market (equity) risk premium	5.5%	5.5%
<i>Premium for stock: (2) x (3) =</i>	5.72%	6.27%
4) Size beta	-	-0.222
5) Size Premium (SMB)	-	2.7%
<i>Premium for stock: (4) x (5) =</i>	-	-0.60%
6) Value beta	-	-0.328
7) Value Premium	-	4.3%
<i>Premium for stock: (6) x (7) =</i>	-	-1.41%
R^2	0.34	0.35
<i>Adjusted R^2</i>	0.33	0.32

Sources: http://mba.tuck.dartmouth.edu/pages/faculty/ken.french/data_library.html for size and value historical premia data (1926-2006) and Morningstar Ibbotson, The Cost of Capital Resources (March 2007 report for Microsoft) for CAPM and FFM betas and R^2 .

Weeramantry's and Delacour's fund holds positions for 4 years on average.

Weeramantry and his colleague Delacour are apprised that their firm's economic unit expects that the marketplace will favour growth-orientated equities over the coming year. Reviewing all the information, Delacour makes the following statements:

§ “Microsoft’s cost of equity benefits from the company’s above average market capitalization which offsets the stock’s above average premium for market risk.”

§ “If our economic unit’s analysis is correct, growth-orientated portfolios are expected to outperform value-orientated portfolios over the next year. As a consequence, we should favour the CAPM required return estimate over the Fama-French model.”

Using only the above information, address the following:

1. Estimate Microsoft’s cost of equity using the:

A. CAPM.

B. Fama-French model.

2. Judge whether Delacour’s first statement, concerning Microsoft’s cost of equity is accurate.

3. Judge whether Delacour’s second statement, concerning the expected relative performance of growth-orientated portfolios and the use of the CAPM and FFM required return estimates, is correct.

Solution to 1:

A. The required return according to the CAPM is $4.7\% + 1.04(5.5\%) = 4.7\% + 5.72\% = 10.42\%$.

B. The required return according to the FFM is $4.7\% + 1.14(5.5\%) + (-0.222)(2.7\%) + (-0.328)(4.3\%) = 4.7\% + 6.27\% + (-0.60\%) + (-1.41\%) = 8.96\%$ percent.

Solution to 2: The statement is accurate. Because the SMB premium is positive and Microsoft has negative exposure to it (size beta is -0.222), the effect of size on Microsoft’s required return is to reduce it, offsetting the opposite effect on the required return of Microsoft’s above average market risk (Microsoft’s market beta is above 1.0).

Solution to 3: The statement is incorrect. It suggests that computing a required return using a positive value premium is questionable when the investor short-term forecast is for growth to outperform value. Required return estimates should reflect the expected or long-run compensation for risk. The positive value of the value premium in the FFM reflects expected compensation for bearing risk over the long run, consistent with the company’s cash flows extending out to the indefinite future. The economic unit’s prediction for a short-term time horizon does invalidate the use of a positive value premium for the Fama-French model.

The regression fit statistics for both the CAPM and the FFM in Example 7 were high. There is more to learn about the relative merits of the CAPM and FFM in practice, but the FFM appears to have the potential for being a practical addition to the analyst’s toolkit. One study contrasting the CAPM and FFM for U.S. markets found that whereas differences in the CAPM beta explained on average 3 percent of the cross-sectional differences in returns of the

stocks over the next year, the FFM betas explained on average 5 percent of the differences.¹⁵⁹ Neither performance appears to be impressive, but keep in mind that equity returns are subject to a very high degree of randomness over short horizons.

¹⁵⁹ Bartholdy and Peare (2004).

Appendix B. The FFM and SL CAPM

The AER states that:¹⁶⁰

‘The NERA report on the FFM outlines that the FFM is used because it is more accurate than the CAPM. The AER notes that any increase in accuracy arising from the use of three risk premiums (instead of one) arises only in the context of within sample explanatory power. This is a statistical artefact of the model as a consequence of including additional explanatory variables. Even variables that are not relevant to the estimation of the rate of return of capital will give this result—the greater explanatory power may even reach the threshold of statistical significance despite no true relationship between a randomly selected variable and the dependent variable.’

Thus the AER believes that adding the *HML* and *SMB* factors to the SL CAPM to produce the FFM is bound to provide the appearance of greater accuracy. This is untrue.

The accuracy of each model can be assessed by testing whether the alphas associated with the model differ significantly from zero. An alpha is the error with which a model measures the return required on an asset. The alphas for the SL CAPM and FFM are given by

$$a_j = E(R_j) - R_f - b_j[E(R_m) - R_f], \quad (6)$$

$$a_j = E(R_j) - R_f - b_j[E(R_m) - R_f] - h_j HMLP - s_j SMBP \quad (7)$$

An estimate of an asset’s alpha that is significantly different from zero provides evidence against a model and evidence that the model will produce inaccurate estimates of the return required to the asset both in sample and out of sample.

The AER believes, incorrectly, that we assess the performance of the SL CAPM and FFM by comparing the R-squareds from time series regressions of the return to an asset on the excess return to the market and on the three Fama-French factors. We do no such thing. Indeed we recognise that these R-squareds will *not* provide a guide as to whether the SL CAPM or FFM provide accurate estimates of the return required on the asset.¹⁶¹ Like Da, Guo and Jagannathan (2009) and Gharghori, Lee and Veeraraghavan (2009), we compare the performance of the SL CAPM and FFM by comparing estimates of the alphas associated with each model.^{162,163}

¹⁶⁰ AER, *Jemena access arrangement proposal for the NSW gas networks: Draft Decision*, February 2010, page 120.

¹⁶¹ In the absence of any pricing restrictions both the Fama-French and market return regressions will produce *identical* estimates of the return required on the asset in sample. This is because the in-sample estimate of the mean of the dependent variable in an unrestricted linear regression is the sample mean of the variable *regardless* of the number of regressors.

¹⁶² Da, Guo and Jagannathan, *CAPM for Estimating the Cost of Equity Capital: Interpreting the Empirical Evidence*, 2009, NBER Working Paper.

Gharghori, P., R. Lee and M. Veeraraghavan, *Anomalies and stock returns: Australian evidence*, Accounting and Finance 49, 2009, pages 555–576.

To make it absolutely clear that the FFM does not include the SL CAPM as a special case, Table B.1 provides a hypothetical example in which the SL CAPM is true but the FFM is false. If the FFM includes the SL CAPM as a special case, one should not be able to construct such an example.

Suppose that the return to the equity of a company ABC, in excess of the risk-free rate, and the three Fama-French factors are distributed in the following way:

Table B.1
The relation between the SL CAPM and FFM: An example

Variable	Mean vector	Covariance matrix			
$R_{ABC} - R_f$	5	1600	400	400	400
$R_m - R_f$	5	400	400	0	0
HML	5	400	0	400	0
SMB	5	400	0	0	400

From Table B.1, $b_{ABC} = h_{ABC} = s_{ABC} = 1$. It follows that the Sharpe-Lintner alpha of ABC is

$$a_{ABC} = E(R_{ABC}) - R_f - b_{ABC}[E(R_m) - R_f] = 5 - 1 \times 5 = 0, \quad (8)$$

while the Fama-French alpha of ABC is

$$\begin{aligned} a_{ABC} &= E(R_{ABC}) - R_f - b_{ABC}[E(R_m) - R_f] - h_{ABC}HMLP - s_{ABC}SMBP \\ &= 5 - 1 \times 5 - 1 \times 5 - 1 \times 5 = -10 \end{aligned} \quad (9)$$

¹⁶³ Both these papers are papers that the AER introduces into the debate. The AER introduces Da, Guo and Jagannathan (2009) into the debate on page 63 of AER, *ActewAGL Access arrangement proposal for the ACT, Queanbeyan and Palerang gas distribution network: 1 July 2010 – 30 June 2015*, 2009.

The AER introduces Gharghori, Lee and Veeraraghavan (2009) into the debate on page 114 of AER, *Jemena access arrangement proposal for the NSW gas networks: Draft Decision*, February 2010.

This hypothetical example makes clear that SL CAPM is *not* a special case of the FFM. Thus the AER's assertion that NERA's results are:¹⁶⁴

‘a statistical artefact of the model as a consequence of including additional explanatory variables.’

is *untrue*.

¹⁶⁴ AER, *Jemena access arrangement proposal for the NSW gas networks: Draft Decision*, February 2010, page 120.

Appendix C. Testing Asset Pricing Models

Broadly speaking there are two kinds of asset pricing tests. There are time series tests and there are cross-sectional tests.

C.1. Time Series Tests

In time series tests of the SL CAPM and FFM, the return on an asset in excess of the risk-free rate is regressed on either the excess return on the market portfolio or the three Fama-French factors. The intercept in the regression is the alpha associated with the asset. Again, an asset's alpha is the error with which a pricing model measures the return required on the asset. A time series test of each pricing model is a test of whether the alpha on each asset is zero. Table 4.1 provides estimates of the alphas associated with 25 portfolios formed on the basis of size and book-to-market and two models: the SL CAPM and the FFM. Alphas that differ significantly from zero offer evidence against a model.

In conducting time series tests one must remember that since the returns to large diversified portfolios are often strongly correlated with one another (their returns tend to move together with one another), estimates of the alphas attached to the portfolios are not independent of one another. Thus counting the number of significant alphas may provide a misleading view of the evidence. Essentially, if the portfolio returns are correlated with one another, counting the number of significant alphas may involve double counting. Thus multivariate statistics have been developed to test whether a large number of alpha estimates simultaneously differ significantly from zero. The use of these statistics provides a more reliable guide as to whether a model is true or false than counting the number of significant alphas.

C.2. Cross Sectional Tests

The SL CAPM predicts that there should be an exact linear relation between the mean return to an asset and its beta computed relative to the market portfolio. In other words, it predicts that no variable other than beta should explain the cross-section of mean returns. Similarly, the FFM predicts that there should be an exact linear relation between the mean return to an asset and its betas computed relative to the three Fama-French factors. The two models also predict that the mean return to a zero-beta portfolio and the risk-free rate should be equal.

So another way to test the models is to regress excess returns on estimates of beta or on estimates of the three Fama-French betas across assets.¹⁶⁵ The intercept in a regression of this kind should be zero if the pricing model is true. In other words, a zero-beta portfolio should earn on average a zero excess return. If the SL CAPM is true, the slope coefficient should be the market risk premium in a regression of excess returns on beta. If the FFM is true, the slope coefficients in a regression of excess returns on the three factor betas should be the market risk premium, the *HML* risk premium and the *SMB* risk premium.

A second more demanding test is to find out whether variables other than beta or the three factor betas can explain the cross-section of average returns. If the SL CAPM is true, no

¹⁶⁵ An excess return is the return on an asset in excess of the risk-free rate.

variable other than beta should explain the cross-section of mean returns. One should not find, for example, that besides beta, size and book-to-market can explain the cross-section of returns.

Table 4.2 provides the results of cross-sectional tests. In these tests, Boudoukh, Michaely, Richardson and Roberts (2007) regress returns on beta, size, book-to-market and payout.¹⁶⁶ They find that, conditional on a portfolio's beta, there is a significant relation between returns and size, book-to-market and payout. Thus they are able to reject the SL CAPM.

Table 4.3 also provides the results of cross-sectional tests. In these tests, Da, Guo and Jagannathan (2009) regress excess returns on beta and on the three factor betas.¹⁶⁷ They find evidence against both the SL CAPM and FFM. The evidence that they find is that the expected return to a zero-beta portfolio is higher than the risk-free rate. Thus the evidence that they find is consistent with what Lewellen, Nagel and Shanken (2008) find.¹⁶⁸ This evidence indicates that both the SL CAPM and FFM will underestimate the returns to low-beta assets. Since the equity of an energy business is a low-beta asset, this evidence indicates that the FFM will *underestimate* the cost of equity for a gas distributor.

¹⁶⁶ Boudoukh, J., R. Michaely, M. Richardson and M. Roberts, *On the importance of measuring payout yield: Implications for empirical asset pricing*, Journal of Finance 62, 2007, pages 877–916.

¹⁶⁷ Da, Guo and Jagannathan, *CAPM for Estimating the Cost of Equity Capital: Interpreting the Empirical Evidence*, 2009, NBER Working Paper.

¹⁶⁸ Lewellen, J., S. Nagel and J. Shanken, *A skeptical appraisal of asset pricing tests*, Journal of Financial Economics, forthcoming.

Appendix D. Terms of Reference

D.1. Background

Jemena Gas Networks (JGN) is the major gas distribution service provider in New South Wales (NSW). JGN owns 24,000 kilometres of natural gas distribution system, delivering approximately 100 petajoules of natural gas to over one million homes, businesses and large industrial consumers across NSW. Jemena Asset Management (JAM) undertakes the majority of JGN's operating, maintenance, and capital works activity.

The relevant provisions relating to the economic regulation of natural gas distribution networks in NSW are set out in the National Gas Law and National Gas Rules, which are available at <http://www.aemc.gov.au/Gas/National-Gas-Rules/Current-Rules.html>.

JGN is currently engaged with the Australian Energy Regulator (AER) in the AER's review of its Access Arrangement (AA). JGN submitted a revised AA in August 2009 which, if approved, will cover the period 2010/11-2014/15 (July to June financial years).

Under the National Gas Rules, total revenue for a relevant service provider is determined for each regulatory year of the access arrangement using a "building blocks" methodology (Rule 76). The building blocks include, amongst others, a return on the projected capital base for the year (Subrule 76(a)).

Subrule 87(1) provides that the rate of return on capital is to be commensurate with prevailing conditions in the market for funds and the risks involved in providing reference services. Subrule 87(2) provides:

In determining a rate of return on capital:

- (a) it will be assumed that the service provider:
 - (i) meets benchmark levels of efficiency; and
 - (ii) uses a financing structure that meets benchmark standards as to gearing and other financial parameters for a going concern and reflects in other respects best practice; and
- (b) a well accepted approach that incorporates the cost of equity and debt, such as the Weighted Average Cost of Capital, is to be used; and a well accepted financial model, such as the Capital Asset Pricing Model, is to be used.

Rule 72(1)(g) provides that the access arrangement information for a full access arrangement proposal must include the proposed rate of return, the assumptions on which the rate of return is calculated and a demonstration of how it is calculated.

Under the National Gas Law (section 28), in making a decision on whether to approve Jemena's AA proposal, the AER must have regard to the National Gas Objective (in section 23 of the National Gas Law), which is:

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

The AER may also take into account the pricing principles in section 24(2) of the National Gas Law, and must do so when considering whether to approve a reference tariff:

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

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

It may also be relevant to note that Rule 74, which applies to forecasts and estimates, provides:

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

In its revised AA, JGN proposed using a domestic version of the Fama-French model as its cost of equity model based on an independent expert report by NERA.¹⁶⁹ The form of this model is (in nominal terms):

$$R_e = R_f + b_e MRP + h_e HMLP + s_e SMLP$$

Where: R_e is the post-tax cost of equity, R_f is the risk free rate, b_e is the market beta, MRP is the market risk premium, h_e is the high minus low (HML) beta, $HMLP$ is the HML risk premium, s_e is the small minus big (SMB) beta and $SMLP$ is the SMB risk premium.

On 10 February 2010 the AER published its draft decision on JGN’s AA revision proposal.¹⁷⁰ If JGN wishes to revise its proposal in response to the AER’s draft decision, it must submit the revised proposal to the AER by 19 March 2010. Submissions on the AER’s draft decision close on 28 April 2010, however Jemena is hopeful of submitting both any revised proposal as well as its response to the draft decision at the same time, by 19 March 2010.

In section of 5.5 of its draft decision, the AER considered that JGN’s proposed cost of equity model did not meet the requirements of rule 87. Further, in this section, the AER required JGN to amend its AA to use the Sharpe-Lintner CAPM to estimate the cost of equity.

¹⁶⁹ NERA, 12 August 2009, *Cost of equity: Fama-French three-factor model: Jemena Gas Networks (NSW)*. This report was submitted as part of JGN’s revised AA.

¹⁷⁰ Australian Energy Regulator, *Draft decision, Jemena, Access arrangement proposal for the NSW gas networks*, 1 July 2010 – 30 June 2015 (**draft decision**), February 2010, can be found at <http://www.aer.gov.au/content/index.phtml/itemId/730676>.

Accordingly, JGN is seeking the opinion of a recognised independent expert to support the specification of the cost of equity for a gas distributor that complies with the requirements of the National Gas Law and Rules in the revised access arrangement.

D.2. Scope of work

The independent expert will provide an opinion report detailing:

1. *Review of the AER's draft decision on the cost of equity*—an assessment of the AER's analysis and conclusions on the cost of equity in section 5, including whether the AER's cost of equity estimate is: (a) a return on capital that is commensurate with prevailing conditions in the market for funds and the risks involved in providing reference services; (b) estimated using a well accepted financial model; and (c) a forecast or estimate that is arrived at on a reasonable basis and represents the best forecast or estimate possible in the circumstances; and
2. *Propose a cost of equity*—propose a cost of equity estimate for an efficient gas network that is: (a) a return on capital that is commensurate with prevailing conditions in the market for funds and the risks involved in providing reference services; (b) estimated using a well accepted financial model; and (c) a forecast or estimate that is arrived at on a reasonable basis and represents the best forecast or estimate possible in the circumstances. This estimate should incorporate a gamma estimate of 0.2 and a risk free rate estimate of 5.5813 per cent for the 20 business days from 15 January 2010 to 12 February 2010.¹⁷¹

D.3. Information to be considered

JGN will make the following information available to the expert:

- § the public version of the AER's draft decision; and
- § the public version of JGN's revised AA, including the NERA report.

The expert is also expected to draw upon the following additional information:

- § the National Gas Law and the National Gas Rules in relation to the economic regulation of gas networks;
- § the National Electricity Law and National Electricity Rules in relation to the economic regulation of electricity networks;
- § the AER's Final "Electricity and Distribution Network Service Providers Statement of Revised WACC Parameters (transmission) Statement of regulatory intent on the revised WACC parameters (Distribution)" dated 1 May 2009;
- § the AER's recent regulatory decisions;
- § historic share data for the Australian market, including returns and other financial information;

¹⁷¹ Note: 26 January 2010 was a public holiday.

- § published econometric, statistical, economic, financial and other relevant literature; and
- § such information that, in expert's opinion, should be taken into account to address the questions outlined above.

D.4. Deliverables

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

- § is of a professional standard capable of being submitted to the AER;
- § is prepared in accordance with the Federal Court Guidelines for Expert Witnesses set out in Attachment 1 and acknowledges that the expert has read the guidelines;¹⁷²
- § summarises the expert's experience and qualifications and attaches relevant curriculum vitae;
- § identifies any person and their qualifications, who assists in the preparation of the report or in carrying out any research or test for the purposes of the report;
- § provides or makes available copies of all citations relied upon in the preparation of the report;
- § summarises JGN's instructions and attaches these term of reference; and
- § (without limiting the points above) carefully sets out the facts that the expert has assumed in putting together his or her report and the basis for those assumptions.

The expert report will include the findings for each of the two parts defined in the scope of works (Section 2).

¹⁷² Available at: http://www.fedcourt.gov.au/how/prac_direction.html.

D.5. Timetable

The independent expert will deliver the final report to JGN by **18 March 2010**. The full list of deliverables and their due dates are shown in the table below.

Deliverable	Due Date
Draft report	1 Mar 2010
JGN feedback on adherence to scope and factual accuracy of draft report	3 Mar 2010
Final report	18 Mar 2010

At the completion of this phase of work, the expert will provide an opinion report which:

- § provides a summary of their opinions;
- § sets out their findings for each of the parts defined in the scope of works (Section 2);
- § includes detailed reasons for these opinions;
- § fully documents the methodology used in detail and discusses the results obtained;
- § lists the facts, matters and assumptions on which their opinions are based and the source of those facts, matters and assumptions, and lists all reference material and information on which they have relied; and
- § list any limitations, incomplete matters or qualifications to the expert's opinion.

Appendix E. Curriculum Vitae

E.1. Gregory Houston

Director

NERA Economic Consulting
Darling Park Tower 3
201 Sussex Street
Sydney NSW 2000
Tel: +61 2 8864 6501
Fax: +61 2 8864 6549
E-mail: greg.houston@nera.com
Website: www.nera.com



Overview

Gregory Houston has twenty years experience in the economic analysis of markets and the provision of expert advice in litigation, business strategy, and policy contexts. His career as a consulting economist was preceded by periods working in a financial institution and for government.

Greg Houston has directed a wide range of competition, regulatory and financial economics assignments since joining NERA in 1989. His work in the Asia Pacific region principally revolves around the activities of the enforcement and regulatory agencies responsible for these areas, many of whom also number amongst his clients. Greg has advised clients on: merger clearance processes; competition enforcement proceedings involving allegations of anticompetitive conduct ranging from predatory pricing, anti-competitive agreements, anti-competitive bundling and price fixing; a wide range of infrastructure access regulation matters; intellectual property and damages valuation; and a number of shareholder class action proceedings. His industry experience spans the aviation, beverages, building products, e-commerce, electricity and gas, grains, medical waste, mining, payments networks, petroleum, ports, rail transport, retailing, scrap metal, securities markets, steel, telecommunications, waste processing and water sectors. Greg Houston has acted as expert witness in valuation, antitrust and regulatory proceedings before the courts, in various arbitration and mediation processes, and before regulatory and judicial bodies in Australia, Fiji, New Zealand, the Philippines, Singapore, the United Kingdom and the United States.

In December 2005, Greg was appointed by the Hon Ian Macfarlane, Minister for Industry, Tourism and Resources, to an Expert Panel to advise the Ministerial Council on Energy on achieving harmonisation of the approach to regulation of electricity and gas transmission and distribution infrastructure in Australia.

Greg serves on the Trade Practices Committee of the Law Council of Australia, the United States Board of Directors of National Economic Research Associates Inc as well as its Management Committee, and is head of NERA's Australian operations.

Qualifications

1982 **UNIVERSITY OF CANTERBURY, NEW ZEALAND**
B.Sc.(First Class Honours) in Economics

Prizes and Scholarships

1980 University Junior Scholarship, New Zealand

Career Details

1987-89 **HAMBROS BANK, TREASURY AND CAPITAL MARKETS**
Financial Economist, London, United Kingdom

1983-86 **THE TREASURY, FINANCE SECTOR POLICY**
Investigating Officer, Wellington, New Zealand

Project Experience

Competition Policy and Mergers

2009-10 **Arnold + Porter/Visa Inc, Mastercard Inc and others**
Payment card markets
Expert report and deposition testimony on behalf of defendants in *Re Payment Cadr Interchange Fee and Merchant Discount Antitrust Litigation* on the effects of regulatory interventions in the Australian payment cards sector.

2009-10 **Australian Government Solicitor/ACCC**
Misuse of market power
Expert report prepared in the context of Federal Court proceedings brought by the ACCC against Cement Australia in relation to conduct alleged to breach sections 45, 46 and 47 of the Trade Practices Act.

2008-10 **Gilbert & Tobin/Confidential**
Merger assessment
Retained to advise on the competitive implications of the then proposed merger and then subsequently the proposed iron ore production joint venture between BHP Billiton and Rio Tinto.

2009 **State Solicitor's Office/Forest Products Commission**
Alleged breach of s46

Expert advice in the context of Federal Court proceedings alleging breaches of the misuse of market power provisions (s46) of the Trade Practices Act.

- 2009** **Clayton Utz/Confidential Client**
Joint venture arrangement
Reviewed the competitive implications under s50 of the Trade Practices Act of a proposed joint venture transaction in the rail industry.
- 2008-09, 05-06** **Phillips Fox/Fortescue Metals Group**
Access to bottleneck facilities
Expert report and testimony in the Federal Court proceedings concerning whether or not access to the BHP Billiton and Rio Tinto rail lines, serving iron ore export markets in the Pilbara, amounted to use of a production process. Subsequently, prepared expert reports on matters arising in interpreting the criteria for declaration under Part IIIA, and testified before the Competition Tribunal in late 2009.
- 2009** **Clayton Utz/Confidential Client**
Competitive implications of agreement
Advised on the competitive effects of a joint venture arrangement in the context of Federal Court proceedings brought by the ACCC under section 45 of the Trade Practices Act.
- 2009** **Australian Competition and Consumer Commission**
Competitive effects of buy-sell agreements
Advice to the ACCC on the extent to which buy-sell arrangements between the four major refiner-marketers of petroleum products in Australia may be inhibiting competition in a relevant market.
- 2008-09** **Watson Mangioni/ICS Global**
Alleged breach of s46
Prepared an expert report in the context of Federal Court proceedings alleging breaches of the misuse of market power provisions (s46) of the Trade Practices Act.
- 2008-09** **Australian Competition and Consumer Commission**
Competitive effects of various agreements
Expert advice on potential theories of competitive harm arising from various agreements in two separate industry sectors.
- 2008** **Johnson Winter Slattery/Pepsico**
Merger analysis
Retained to advise on the competitive implications certain potential transactions in the soft drinks sector.

- 2008** **Deacons/eBay**
Exclusive dealing notification
Expert report submitted to the ACCC analysing the competitive effects of eBay's proposal that users of its online marketplace be required to settle transactions using eBay's associated entity, PayPal.
- 2008** **Allens Arthur Robinson/Confidential**
Cartel damages assessment
Expert advice on the approach to and quantification of damages arising from alleged cartel conduct.
- 2008** **BG plc**
Market analysis
Retained to advise on economic aspects of the operation of the east Australian wholesale gas market.
- 2007-08** **Australian Energy Market Commission**
Wholesale gas and electricity markets, and implications for retail competition
Retained to provide an overview of the operation and structure of the wholesale gas and electricity markets within the National Electricity Market (NEM) jurisdictions and to identify the issues that the AEMC should consider when assessing the influence of the wholesale markets on competition within the retail gas market in each jurisdiction.
- 2007** **Meerkin & Apel/SteriCorp**
Damages assessment
Expert report and testimony in the context of an international arbitration on commercial damages arising from alleged non-performance of a medical waste processing plant.
- 2006-07** **Middletons/Confidential Client**
Damages assessment
Retained to provide an expert report on the methodological framework for assessing alleged damages arising from contractual non-performance and associated forecast for demand and supply conditions and prices for natural gas and ethane prices and over a ten year period.
- 2006-07** **Essential Services Commission of South Australia**
Competition assessment
Directed the preparation of a comprehensive report analysing the effectiveness of competition in retail electricity and gas markets in South Australia.

- 2006-07** **Allens Arthur Robinson/Confidential Client**
Merger clearance
Retained to provide advice on competition issues arising in the context of s50 clearance of a proposed merger in the board packaging industry.
- 2006-07** **Johnson Winter & Slattery/Confidential Client**
Damages assessment
Advice on the quantification of damages arising from alleged cartel conduct.
- 2006** **Minter Ellison/Confidential Client**
Misuse of market power
Expert economic advice in relation to market definition, market power and taking advantage in the context of an alleged price squeeze between wholesale and retail prices for fixed line telecommunications services, for proceedings brought under section 46 of the Trade Practices Act. The proceedings were withdrawn following regulatory amendments by the ACCC.
- 2006** **DLA Phillips Fox/Donhad**
Merger clearance
Preparation of an expert report on competition issues arising in the context of s50 clearance for the proposed Smorgon/One Steel merger.
- 2006** **Johnson Winter & Slattery/Qantas Airways**
Competition effects of proposed price fixing agreement
Assessed the competition effects of the proposed trans-Tasman networks agreement between Air New Zealand and Qantas Airways.
- 2006** **Phillips Fox/ACCC**
Vertical foreclosure
Retained by the ACCC as economic expert in the context of proceedings before the Federal Court concerning the acquisition of Patrick Corporation by Toll Holdings. The proceedings were subsequently withdrawn following a S87B undertaking made by Toll.
- 2006** **Gilbert + Tobin/AWB**
Access to bottleneck facilities
Expert report and testimony in a private arbitration concerning the imposition of throughput fees for grain received at port and so bypassing the grain storage, handling and rail transport network in South Australia.

- 2006** **Qantas Airways, Australia/Singapore**
Assessment of single economic entity
Advice in the context of Qantas' Application for Decision to the Competition Commission of Singapore that the agreement between it and Orangestar did not fall within the ambit of the price-fixing and market sharing provisions of the Singapore Competition Act.
- 2005-06** **Qantas Airways, Australia/Singapore**
Competition effects of price fixing agreement
Expert report submitted to the Competition Commission of Singapore evaluating the net economic benefits of a price fixing/market sharing agreement, in relation to an application for exemption from the section 34 prohibition in the Competition Act of Singapore.
- 2005-06** **Australian Competition Consumer Commission**
Electricity generation market competition
Advice on the competition effects under S50 of the Trade Practices Act of three separate proposed transactions involving the merger of generation plant operating in the national electricity market.
- 2005** **Gilbert + Tobin/Hong Kong Government, Hong Kong**
Petrol market competition
Directed a NERA team working with Gilbert + Tobin that investigated the extent of competition in the auto-fuel retailing market in Hong Kong.
- 2005** **Phillips Fox/National Competition Council**
Access and competition in gas production and retail markets
Retained as expert witness in the appeal before the WA Gas Review Board of the decision to revoke coverage under the gas code of the Goldfields pipeline. Proceedings brought by the pipeline operator were subsequently withdrawn.
- 2004-05** **Gilbert + Tobin/APCA**
Competition and access to Eftpos system
Economic advisor to the Australian Payments Clearing Association in connection with the development of an access regime for the debit card/Eftpos system, so as to address a range of competition concerns expressed by the Reserve Bank of Australia and the ACCC. This involved the provision of an expert report examining barriers to entry to Eftpos and the extent to which these can be overcome by an access regime.

- 2003-05** **Phillips Fox/Austrac**
Misuse of market power
Retained to assist with all economic aspects of a potential Federal Court action under s46 of the Trade Practices Act alleging misuse of market power in the rail freight market.
- 2004** **Clayton Utz/Sydney Water Corporation**
Competition in sewage treatment
Retained to assist with Sydney Water's response to the application to have Sydney's waste water reticulation network declared under Part IIIa of the Trade Practices Act.
- 2004** **Blake Dawson Waldron/Boral**
Competition analysis of cement market
Directed a NERA team advising on Boral's proposed acquisition of Adelaide Brighton Ltd, a cement industry merger opposed in Federal Court proceedings by the ACCC. Boral subsequently decided not to proceed with the transaction.
- 2004** **Minter Ellison/Singapore Power**
Merger clearance
Advice on competition issues arising from the proposed acquisition of TXU's Australian energy sector assets by Singapore Power. This included the submission of an expert report to the ACCC.
- 2004** **Mallesons/Orica**
Competition in gas production and retail markets
Retained as expert witness in the appeal by Orica against the Minister's decision to revoke coverage under the gas code of the substantial part of the Moomba to Sydney gas pipeline. The case was subsequently settled.
- 2004** **Courts, Fiji**
Merger clearance, abuse of market power
Prepared a report for submission to the Fijian Commerce Commission on the competition implications of the Courts' acquisition of the former Burns Philip retailing business, and related allegations of abuse of market power. The Commission subsequently cleared Courts of all competition concerns.
- 2003-04** **Mallesons/Sydney Airport Corporation**
Competition in air travel market
Retained as principal expert witness in connection with proceedings before the Australian Competition Tribunal on economic aspects of the application by Virgin Blue for declaration of airside facilities at Sydney Airport under Part IIIa of the Trade Practices Act.

- 2003-04** **Bartier Perry/ DM Faulkner**
Alleged collusive conduct
Submitted an expert report to the Federal Court in connection with allegations under s45 of the Trade Practices Act of collusive conduct leading to the substantial lessening of competition in the market for scrap metal. The ‘substantial lessening of competition’ element of this case was subsequently withdrawn.
- 2002-04** **Essential Services Commission**
Effectiveness of competition
Advisor on six separate reviews of the effectiveness of competition and the impact of existing or proposed measures designed to enhance competition in the markets for wholesale gas supply, port channel access services, liquid petroleum gas, retail electricity and gas supplies, and port services.
- 2003** **Gilbert + Tobin/AGL**
Vertical integration in electricity markets
Prepared a report on the international experience of vertical integration of electricity generation and retailing markets, in connection with proceedings brought by AGL against the ACCC. This report examined the principles applied by competition authorities in assessing such developments, and evidence of the subsequent impact on competition.
- 2002-03** **National Competition Council**
Gas market competition
Expert report in connection with the application by East Australian Pipeline Limited for revocation of coverage under the Gas Code of the Moomba to Sydney Pipeline System. The report addressed both the design of a test for whether market power was being exercised through pipeline transportation prices substantially in excess of long-run economic cost, and the assessment of existing prices by reference to this principle.
- 2001-03** **Blake Dawson Waldron/Qantas Airways**
Alleged predatory conduct
Directed a NERA team advising on all economic aspects of an alleged misuse of market power (section 46 of the Trade Practices Act) in Federal Court proceedings brought against Qantas by the ACCC. The proceedings were withdrawn soon after responding expert statements were filed.
- 2002** **Phillips Fox/AWB Limited**
Access and competition in bulk freight transportation
Retained to provide an expert report and testimony on the pricing arrangements for third party access to the Victorian rail network and

their impact on competition in the related bulk freight transportation services market, preparation for the appeal before the Australian Competition Tribunal of the Minister's decision not to declare the Victorian intra-state rail network, pursuant to Part IIIA of the Trade Practices Act. The case settled prior to the Tribunal hearings.

2002

**Australian Competition and Consumer Commission
Anti-competitive bundling or tying strategies**

Provided two (published) reports setting out an economic framework for evaluating whether the sale of bundled or tied products may be anti-competitive. These reports define the pre-conditions for such strategies to be anti-competitive, and discuss the potential role and pitfalls of imputation tests for anti-competitive product bundling.

2002

**Minter Ellison/SPI PowerNet
Merger clearance**

Advice in connection with the acquisition of energy sector assets in Victoria on merger clearance under section 50 of the Trade Practices Act.

2001

**Gilbert + Tobin/AGL
Gas market competition**

Advised counsel for AGL in connection with the application by Duke Energy to the Australian Competition Tribunal for review of the decision by the National Competition Council to recommend that the eastern gas pipeline should be subject to price regulation under the national gas code.

2000

**One.Tel
Competitive aspects of Mobile Number Portability**

Advised on the competitive aspects of proposed procedures for Mobile Number Portability and whether these arrangements breached the Trade Practices Act in relation to substantial lessening of competition.

2000

**Baker & McKenzie/Scottish Power
Impact of consolidation on competition**

Expert report submitted to the ACCC on the extent to which the acquisition of the Victorian electricity distribution and retail business, Powercor by an entity with interests in the national electricity market may lead to a 'substantial lessening of competition' in a relevant market.

Securities and Finance

- 2009-10** **William Roberts/Confidential Client**
Shareholder damages assessment
Preparation of expert report for submission in representative proceedings before the Federal Court alleging misstatement and/or breach of the continuous disclosure obligations of an ASX-listed entity.
- 2009** **Minter Ellison/Confidential Client**
Misleading and deceptive conduct
Prepared an expert report in light of investor claims and pending litigation following the freezing of withdrawals from a fixed interest investment trust that primarily held US-denominated collateralised debt obligations (CDOs), as offered by a major Australian financial institution. Analysis undertaken included the extent to which the investment risks were adequately described in the fund documents, and the quantum of any potential damages arising.
- 2009** **Jemena Limited**
Cost of equity estimation
Co-authored an expert report on the application of a domestic Fama-French three-factor model to estimate the cost of equity for regulated gas distribution businesses.
- 2008-09** **Clayton Utz/Fortescue Metals Group**
Materiality of share price response
Preparation of expert report and testimony before the WA division of the Federal Court addressing alleged breaches of the ASX continuous disclosure obligations and the associated effect on the price of FMG securities arising from statements made by it in 2004.
- 2008-09** **Energy Trade Associations – APIA, ENA and Grid Australia**
Value of tax imputation credits
Preparation of expert report on the value to investors in Australian equities of tax imputation credits, for submission to the Australian Energy Regulator.
- 2008-09** **Freehills/Confidential**
Shareholder damages assessment
Assistance in the estimation of potential damages arising from anticipated representative proceedings concerning accounting misstatements and/or breach of the continuous disclosure obligations of an ASX-listed entity.

- 2008** **Slater & Gordon/Confidential**
Shareholder damages assessment
Preparation of an expert report for submission to a mediation on the damages arising in representative proceedings before the Federal Court alleging accounting misstatements and/or breach of the continuous disclosure obligations of an ASX-listed entity.
- 2007-08** **Slater & Gordon/Watson (AWB)**
Shareholder damages assessment
Preparation of a report estimating the damages arising in representative proceedings before the Federal Court alleging accounting misstatements and/or breach of the continuous disclosure obligation by the ASX-listed entity, AWB Limited.
- 2007** **Freehills/Telstra Corporation**
Shareholder damages assessment
Advice and assistance in the preparation of the expert report of Dr Fred Dunbar submitted to the Federal Court in the context of proceedings alleging breaches of the continuous disclosure obligations by Telstra. The principal subject of this work was the assessment of the extent to which of material alleged not to have been disclosed was already known and incorporated in Telstra's stock price.
- 2007** **Maurice Blackburn/Confidential**
Shareholder damages assessment
Advice and assistance on the appropriate methodology for assessment of damages in representative proceedings before the Federal Court alleging fraud and breach of the continuous disclosure obligation by an ASX listed entity.
- 2006-07** **Maurice Blackburn/Dorajay (Aristocrat)**
Shareholder damages assessment
Advice and assistance in the preparation of the expert report of Dr Fred Dunbar submitted to the Federal Court in the context of proceedings between Dorajay and Aristocrat Leisure. The principal subject of this work was the assessment of the extent and duration of share price inflation arising from various accounting misstatements and alleged breaches of the continuous disclosure obligations.
- 1999-2001** **Australian Competition and Consumer Commission**
Cost of capital
Various assignments in relation the cost of debt and equity capital for regulated businesses. These included: an analysis of the approach taken by regulators overseas in relation to the treatment of taxation in estimating the WACC, and the use of pre-tax versus post-tax WACC formulations in regulation; and, a survey of regulatory decisions in

relation to the cost of capital across a range of international jurisdictions. Two reports have been published by the ACCC.

Regulatory Analysis

- 2009-10** **New Zealand Electricity Industry Working Group, New Zealand Transmission pricing project**
Advice to a working group comprising representatives from lines companies, generators, major users and Transpower on potential improvements to the efficiency of New Zealand's electricity transmission pricing arrangements.
- 2002-10** **Orion New Zealand Ltd, New Zealand Electricity lines regulation**
Advisor on all regulatory and economic aspects of the implementation by the Commerce Commission of the evolving regimes for the regulation of New Zealand electricity lines businesses. This role has included assistance with the drafting submissions, the provision of expert reports, and the giving of expert evidence before the Commerce Commission.
- 2009** **CitiPower/Powercor Efficiency carryover mechanisms**
Expert report submitted to the AER on the consistency of carrying-forward accrued negative amounts arising from the application of the ESC's efficiency carryover mechanism with the National Electricity Law and the National Electricity Rules.
- 2008-09** **Minter Ellison/Confidential client Treatment of past capital contributions**
Expert report and oral evidence prepared for arbitration proceedings on the extent to which a discount should apply under a long term water supply contract, in recognition of a capital contribution made at the outset of the agreement.
- 2007-09** **GDSE, Macau Electricity tariff reform**
Advice to the regulatory of electricity tariffs in Macau on a series of potential reforms to the structure of electricity supply tariffs.
- 2007-09** **Powercor/CitiPower Regulatory advice**
Wide ranging advice on matters arising under the national electricity law and rules, such as the framework for reviewing electricity

distribution price caps, the treatment of related party outsourcing arrangements, the potential application of total factor productivity measures in CPI-X regulation, and arrangements for the state-wide roll out of advanced metering infrastructure.

- 2001-09** **Auckland International Airport Limited, New Zealand**
Aeronautical price regulation
Provision of advice and various expert reports in relation to: the review by the Commerce Commission of the case for introducing price control at Auckland airport; a fundamental review of airport charges implemented in 2007; and the modified provisions of Part IV of the Commerce Act concerning the economic regulation of airports and other infrastructure service providers.
- 2008** **Clayton Utz/Confidential client**
Regulatory implications of outsourcing
Expert report on the regulatory implications of a proposed outsourcing arrangement in the context of the National Gas Law and Rules.
- 2008** **Western Power**
Optimal treatment and application of capital contributions
Advice to Western Power the optimal regulatory treatment of capital contributions.
- 2000-08** **TransGrid**
National electricity market and revenue cap reset
Regulatory advisor to TransGrid on a range of issues arising in the context of the national electricity market (NEM), including: the economics of transmission pricing and investment and its integration with the wholesale energy market, regulatory asset valuation, the cost of capital and TransGrid's 2004 revenue cap reset by the ACCC.
- 2007** **Johnson Winter & Slattery/Multinet**
Review of outsourced asset management contracts
Expert report developing a framework for assessing the prudence of outsourcing contracts in the context of the Gas Code, and evaluating the arrangements between Multinet and Alinta Asset Management by reference to that framework.
- 2007** **Ministerial Council on Energy**
Review of Chapter 5 of the National Electricity Rules
Advice on the development of a national framework for connection applications and capital contributions in the context of the National Electricity Rules.

- 2006-07** **Ministerial Council on Energy**
Demand side response and distributed generation incentives
Conducted a review of the MCE's proposed initial national electricity distribution network revenue and pricing rules to identify the implications for the efficient use of demand side response and distributed generation by electricity network owners and customers.
- 2006** **Ministerial Council on Energy**
Electricity network pricing rules
Advice on the framework for the development of the initial national electricity distribution network pricing rules, in the context of the transition to a single, national economic regulator.
- 2005-06** **Australian Energy Markets Commission**
Transmission pricing regime
Advice to the AEMC on its review of the transmission revenue and pricing rules as required by the new National Electricity Law.
- 1998-2006** **Essential Services Commission of Victoria**
Price cap reviews
Wide ranging advice to the Essential Services Commission (formerly the Office of the Regulator-General), on regulatory, financial and strategic issues arising in the context of five separate reviews of price controls/access arrangements applying in the electricity, gas distribution, rail and water sectors in Victoria. This work has encompassed advice on the development of the Commission's work program and public consultation strategy for each review, direct assistance with the drafting of papers for public consultation, the provision of internal papers and analysis on specific aspects of the review, drafting of decision documents, and acting as expert witness in hearings before the Appeal Panel and Victorian Supreme Court.
- 2004-05** **Ministerial Council of Energy**
Reform of the National Electricity Law
Retained for two separate advisory roles in relation to the reform of the institutions and legal framework underpinning the national energy markets. These roles include the appropriate specification of the objectives and rule making test for the national electricity market, and the development of a harmonised framework for distribution and retail regulation.
- 2004-05** **Johnson Winter Slattery, ETSA Utilities**
Price determination
Advice on a wide range of economic and financial issues in the context of ETSA Utilities' application for review of ESCOSA's determination of a five year electricity distribution price cap.

- 2004** **Deacons/ACCC**
Implementation of DORC valuation
Prepared a report on the implementation of a cost-based DORC valuation, for submission to the Australian Competition Tribunal in connection with proceedings on the appropriate gas transportation tariffs for the Moomba to Sydney gas pipeline.
- 2003-04** **Natural Gas Corporation, New Zealand**
Gas pipeline regulation
Advisor in relation to the inquiry by the Commerce Commission into the case for formal economic regulation of gas pipelines. This role includes assistance with the drafting of submissions, the provision of expert reports, and the giving of evidence before the Commerce Commission.
- 2001-03** **Rail Infrastructure Corporation**
Preparation of access undertaking
Advised on all economic aspects arising in the preparation of an access undertaking for the New South Wales rail network. Issues arising include: pricing principles under a 'negotiate and arbitrate' framework, asset valuation, efficient costs, capacity allocation and trading, and cost of capital.
- 2002** **Clayton Utz/TransGrid**
National Electricity Tribunal hearing
Retained as the principal expert witness in the appeal brought by Murraylink Transmission Company of NEMMCO's decision that TransGrid's proposed South Australia to New South Wales Electricity Interconnector was justified under the national electricity code's 'regulatory test'.
- 2001-02** **SPI PowerNet**
Revenue cap reset
Advisor on all regulatory and economic aspects of SPI PowerNet's application to the ACCC for review of its revenue cap applying from January 2003. This included assistance on regulatory strategy, asset valuation in the context of the transitional provisions of the national electricity code, drafting and editorial support for the application document, and the conduct of a 'devil's advocate' review.
- 1999-2002** **Sydney Airports Corporation**
Aeronautical pricing notification
Directed all aspects of NERA's advice to Sydney Airports Corporation in relation to its notification to the ACCC of proposed aeronautical charges at Sydney Airport. This work involved the analysis and presentation of pricing and revenue determination principles and their

detailed application, through to participation in discussion of such matters at SACL's board, with the ACCC, and in a public consultation forum.

- 2002** **Corrs Chambers Westgarth/Ofgar**
Economic interpretation of the gas code
Provision of expert report and sworn testimony in the matter of *Epic Energy v Office of the Independent Gas Access Regulator*, before the Supreme Court of Western Australia, on the economic interpretation of certain phrases in the natural gas pipelines access code.
- 2001** **ACCC**
Determination of local call resale prices
Advised the ACCC regarding the determination of local call resale prices from Telstra's fixed line network. This included providing advice on how the cost of community service obligations should be allocated to competitors with wholesale access to local calls.
- 2000** **Gilbert + Tobin/AGL**
Vesting contract terms
Advised AGL SA in connection with its application to the ACCC for revocation and substitution of both vesting contract terms and network pricing provisions for the retail supply of electricity in South Australia.
- 2000** **Commonwealth Bank of Australia**
Access arrangements
Advised on the legislative framework for access to essential facilities in Australia in comparison to the frameworks used in the United States, United Kingdom and European Union. This included an assessment of the pricing policies regulators use when setting access tariffs, and relevant case studies from the electricity, telecommunications and transportation industries.
- 1998, 2000** **Rail Access Corporation**
Regulatory and pricing strategy
Advisor on regulatory and financial issues arising in the context of the 1998/99 IPART review of the NSW rail access regime. Subsequently, prepared two board papers on, first, the principles for commercially sustainable pricing in the context of the NSW access regime and, second, on issues and options for addressing the growing imbalance between costs and revenues, including the probable need to finance a significant increase in capital expenditure.

1998-99

MWSS Regulatory Office, Philippines

Regulation by concession

Advised the MWSS Regulatory Office on its response to applications for “extraordinary price adjustments” under the terms of the two, twenty five-year, water and wastewater concession agreements. This involved an assessment of the grounds for the applications, the associated financial impact, and the appropriate rate of return to be applied in determining the consequent price adjustment. Subsequently, provided expert testimony in the arbitration of one applicant’s appeal of the Regulatory Office’s decision.

Valuation and Damages Analysis

2009

Freehills/Santos

Gas supply agreement arbitration

Analysis and advice on factors influencing the market price of gas in eastern Australia, as to be determined in a potential arbitration concerning the terms of a substantial long term gas supply agreement.

2008-09

Clayton Utz/Origin Energy

Gas supply agreement arbitration

Retained to provide expert reports and testimony in an arbitration concerning to the market price of gas, which was to be determined and applied in a substantial long term gas supply agreement.

2008

Freehills/Tenix Toll

Logistics contract arbitration

Advice on the appropriate methodology for adjusting prices under a long term logistics contract in light of changing fuel costs.

2008

Gilbert + Tobin/Waste Services NSW

Damages estimation

Damages assessment in the context of Federal Court proceedings alleging misleading and deceptive conduct relating to the extent of environmental compliance in the provision of waste services.

2006

Confidential Client/Australia

Valuation of digital copyright

Advice in relation to the negotiation for a licence for digital copyright. This included the discussion of the matters that should be considered in determining fees for a digital copyright licence, including the extent to which digital material should be valued differently from print material and whether the charging mechanism for print is appropriate for digital copyright.

- 2006** **Minter Ellison/Australian Hotels Association**
Valuation of copyright material
Expert report in the context of proceedings before the Copyright Tribunal concerning the appropriate valuation of the rights to play recorded music in nightclubs and other late night venues.
- 2005-06** **Minter Ellison and Freehills/Santos**
Gas supply agreement arbitrations
Principal economic expert in two separate arbitrations of the price to apply following review of two substantial gas supply agreements between the South West Queensland gas producers and, respectively, a large industrial customer and major gas retailer.
- 2002-03** **ActewAGL**
Consumer willingness to pay
Directed a one year study of consumers' willingness to pay for a range of attributes for electricity, gas and water services in the ACT. This study involved the use of focus groups, the development of a pilot survey and then the implementation of a stated preference choice modelling survey of household and commercial customer segments for each utility service.
- 2002-03** **National Electricity Market Management Co**
Participant fee determination
Advice to NEMMCO in the context of its 2003 Determination of the structure of Participant Fees, for the recovery of NEMMCO and NECA's costs from participants in the national electricity market.
- 2001-03** **Minter Ellison/Optus Networks**
Arbitration of market lease fee
Retained as expert witness in the mediation and then arbitration between Optus Networks and United Energy on the appropriate annual market fee for leasing electricity pole space for the attachment of HFC coaxial cable.
- 2002** **Screenrights**
Non-market valuation methods
Advice on the range and suitability of revealed preference and stated preference survey methodologies for valuing the retransmission of free to air television broadcasts for the purposes of determining the 'equitable remuneration' to be paid for retransmission of copyright material contained in free-to-air television broadcasts.

- 2001** **Gilbert & Tobin/One.Tel**
Arbitration on the local loop service
Advice on the pricing of Telstra's unconditioned local loop service (ULLS) for use in arbitration.
- 2001** **Department of Natural Resources and Environment**
Efficient pricing of water services
Prepared a report setting out the principles for efficient pricing of urban water services, an evaluation of the structure of existing wholesale and retail water tariffs in metropolitan Melbourne, and recommended reforms.
- 1998-2000** **TransGrid and EnergyAustralia**
Cost effectiveness study of transmission capacity augmentation
Directed a NERA team that conducted a cost effectiveness analysis of alternative options for augmenting transmission capacity to the Sydney CBD area. This included identification and evaluation of alternative transmission, generation and demand side management options, and application of the 'regulatory test', as defined in the national electricity code.
- Other*
- 2009** **Blake Dawson Waldron/ Airservices**
Effect of potential industrial action by Air Traffic Controllers
Prepared an expert report in the context of a potential application to the Australian Industrial Relations Commission for termination or suspension of a bargaining period addressing the economic effect that certain forms of industrial action by Air Traffic Controllers would be likely to have on passengers, businesses, and the Australian economy.

Institutional and Regulatory Reform

- 2008-09** **Department of Sustainability and Environment**
Management of bulk water supply
Retained to advise on the concept and merits of establishing a 'water grid manager' to operate the bulk water supply system in metropolitan Melbourne and, potentially, throughout the state of Victoria.
- 2008** **Department of Treasury and Finance**
Access regime for water networks
Prepared a report on the principles that should be applied in developing a state-wide third party access regime for water supply networks.

- 2007** **Economic Regulatory Authority**
Options for competitive supply bulk water
Prepared a report on institutional and structural reforms necessary to encourage the development of options for the procurement of alternative water supplies from third parties.
- 2006** **Bulk Entitlement Management Committee**
Development of urban water market
Prepared a report for the four Melbourne water businesses on options for devolution of the management of water entitlements from collective to individual responsibility, including the development of associated arrangements for oversight and co-ordination of the decentralised management and trading of water rights.
- 2003-05** **Goldman Sachs/Airport Authority, Hong Kong**
Framework for economic regulation
Lead a team advising on the options and detailed design of the economic regulatory arrangements needed to support the forthcoming privatisation of Hong Kong Airport.
- 2003-04** **Ministry of Finance, Thailand**
Framework for economic regulation
Lead a team advising on the detailed design and implementation of a framework for the economic regulation of the Thai water sector in order to support the proposed corporatisation and then privatisation of the Metropolitan Water Authority of Bangkok.
- 2003** **Metrowater and Auckland City, New Zealand**
Water industry reform options
Provided a report on alternative business models for the Auckland City water services supplier, Metrowater, in the context of proposals for structural reform elsewhere in the industry. This report examined the long term drivers of water industry efficiency and the costs and benefits of alternative structural reform options.
- 2001** **Independent Pricing and Regulatory Tribunal**
Review of energy licensing regime
Directed a program of work for in the context of IPART's year-long review of the energy licensing regime in NSW. This review included the identification - by reference to experience in other state and international jurisdictions - of the most effective regulatory model for the licensing of both network and retail functions in the electricity and gas sector, the development of a compliance monitoring and reporting framework, and an assessment of the need for and nature of minimum service standards.

Sworn Testimony, Transcribed Evidence

- 2010** **Expert evidence on behalf of Orion NZ, at the Commerce Commission’s Conference on its Input Methodologies Emerging View Paper**
Transcribed evidence, public hearings, Wellington, 24 February 2010
- Deposition Testimony in *Re Payment Card Interchange and Merchant Discount Antitrust Litigation*, in the United States District Court for the Eastern District of New York**
Deposition Testimony, District of Columbia, 18 February 2010
- 2009** **Expert evidence before the Australian Competition Tribunal on behalf of Fortescue Metals Group Ltd, in the matter of Application for Review of Decision in Relation to Declaration of Services Provided by the Robe, Hamersley, Mt Newman and Goldsworthy Railways**
Expert report, sworn evidence, Melbourne, 12-13 October and 5-6 November 2009
- Expert evidence on behalf of Orion NZ, at the Commerce Commission’s Conference on its Input Methodologies Discussion Paper**
Transcribed evidence, public hearings, Wellington, 16 September 2009
- Expert evidence before the Federal Court on behalf of Fortescue Metals Group Ltd, in the matter of ASIC v Fortescue Metals Group and Andrew Forrest**
Expert report, sworn evidence, Perth, 29 April–1 May 2009
- Expert report and evidence in arbitration proceedings before Hon Michael McHugh, AC QC, and Roger Gyles, QC, between Origin Energy and AGL**
Expert report, sworn evidence, Sydney, 19-24 March 2009
- 2008** **Expert evidence on behalf of Orion NZ, at the Commerce Commission’s Conference on its Draft Decision on Authorisation for the Control of Natural Gas Pipeline Services**
Transcribed evidence, public hearings, Wellington, 21 February 2008
- 2007** **Expert report and evidence in arbitration proceedings before Sir Daryl Dawson between SteriCorp and Stericycle Inc.**
Expert report, sworn evidence, 11 July 2007

- 2006**
- Expert report and evidence in arbitration proceedings before Sir Daryl Dawson and David Jackson, QC, between Santos and others, and AGL**
Expert report, sworn evidence, November 2006
- Expert report and evidence before the Federal Court on behalf of Fortescue Metals Group in the matter of BHP Billiton v National Competition Council and Others**
Expert report, sworn evidence, November 2006
- Expert report and evidence in arbitration proceedings before Sir Daryl Dawson and David Jackson, QC, between Santos and Others, and Xstrata Queensland**
Expert report, sworn evidence, September 2006
- Expert report and evidence before the Copyright Tribunal on behalf of the Australian Hotels Association and others in the matter of PPCA v AHA and Others**
Expert report, sworn evidence, May 2006
- Expert report and evidence in arbitration proceedings before Hon Michael McHugh, AC QC, on the matter of AWB Limited v ABB GrainLimited**
Expert report, sworn evidence, 24 May 2006
- Expert report and evidence to Victorian Appeal Panel, in the matter of the appeal by United Energy Distribution of the Electricity Price Determination of the Essential Services Commission**
Expert report, sworn evidence, 10 February 2006
- 2005**
- Expert evidence on behalf of Orion NZ, at the Commerce Commission's Conference on its Notice of Intention to Declare Control of Unison Networks**
Transcribed evidence, public hearings, Wellington, 17 November 2005
- Expert evidence on behalf of Orion NZ, at the Commerce Commission's Conference on Asset Valuation choice and the electricity industry disclosure regime**
Transcribed evidence, public hearings, Wellington, 11 April 2005

- 2004**
- Expert report and evidence to the Australian Competition Tribunal, in the matter of Virgin Blue Airlines v Sydney Airport Corporation**
Expert reports, sworn evidence, 19-20 October 2004
- Expert evidence on behalf of Orion NZ, at a Commerce Commission's Conference on the ODV Handbook for electricity lines businesses**
Transcribed evidence, public hearings, Wellington, 26 April 2004
- 2003**
- Expert evidence on behalf of Orion NZ, in response to the Commerce Commission's draft decision on re-setting the price path threshold for electricity lines businesses**
Transcribed evidence, public hearings, Wellington, 5 November 2003
- Expert evidence on behalf of NGC Holdings, in response to the Commerce Commission's draft framework paper for the gas control inquiry.**
Transcribed evidence, public hearings, 3 September 2003
- Affidavit submitted to the Federal Court, in the matter of ACCC v DM Faulkner and Others**
Expert report, Federal Court of Australia, May 2003
- Expert evidence on behalf of Orion NZ, in response to the Commerce Commission's draft decision on a targeted control regime for electricity lines businesses**
Transcribed evidence, public hearings, Wellington, 25 March 2003
- 2002**
- Expert evidence on behalf of Orion NZ, in the Commerce Commission's review of asset valuation methodologies for electricity lines businesses**
Transcribed evidence, public hearings, Wellington, 25 November 2002
- Expert report and evidence on behalf of Optus Networks and Optus Vision Ltd, in the matter of an arbitration with United Energy Ltd**
Expert report, prior to settlement, 18 October 2002
- Expert statement submitted to the National Electricity Tribunal, in the matter of Murraylink Transmission Company v NEMMCO, TransGrid, and others**
Sworn Testimony, National Electricity Tribunal, Melbourne, 26 August 2002

- Expert evidence on behalf of Orion NZ, in the Commerce Commission's review of control regimes for electricity lines businesses**
Transcribed evidence, public hearings, Wellington, 21 August 2002
- Affidavit and testimony before the Supreme Court of Western Australia, in the matter of Epic Energy v Dr Ken Michael – Independent Gas Access Regulator**
Sworn testimony, Supreme Court of Western Australia, November 2002
- 2001**
- Expert evidence on behalf of Auckland International Airport, in the Commerce Commission's review of airfield price control**
Transcribed evidence, public hearings, Wellington, 4-5 September 2001
- Expert evidence on behalf of Optus Networks, in the matter of Optus Networks v United Energy**
Mediation before Trevor Morling QC, Sydney, August and September 2001
- Expert evidence on behalf of Sydney Airports Corporation in the Productivity Commission's review of airport regulation**
Transcribed evidence, public hearings, Melbourne, 3 April 2001
- Affidavit submitted to Supreme Court of Victoria, in the matter of TXU v Office of the Regulator-General**
Sworn testimony, Supreme Court of Victoria, 23-26 March 2001
- 2000**
- Evidence on behalf of Sydney Airports Corporation in the aeronautical pricing determination by the ACCC**
Transcribed evidence, public forum, Melbourne, 13 December 2000
- Expert Statement on Rural Risk and the Weighted Average Cost of Capital, in the matter of an appeal by Powercor Australia Ltd of the Office of the Regulator-General's Electricity Price Determination 2001-05**
Sworn testimony before the Appeal Panel, Melbourne, 13 October 2000
- 1999**
- Affidavit submitted in arbitration proceedings between the MWSS Regulatory Office and Manila Water Company on the cost of capital for the Manila water concession agreements**
Sworn testimony, Manila, 20 August 1999

- 1998** **Expert evidence on behalf of Great Southern Networks in the gas access determination by IPART**
Transcribed evidence, Sydney, 12 November 1998
- 1996** **Expert evidence before the Monopolies and Mergers Commission inquiry into the proposed merger of Wessex Water plc and South West Water plc**
Transcribed evidence, London, August 1996
- 1995** **Expert evidence before the Monopolies and Mergers Commission inquiry into the proposed acquisition of Northumbrian Water plc by Lyonnaise des Faux**
Transcribed evidence, London, March 1995

Speeches and Publications

- 2009** **ACCC Regulatory Conference**
Substitutes and Complements for Traditional Regulation
Speech, Gold Coast, 30 July 2009
- Minter Ellison Shareholder Class Action Seminar**
Investor Class Actions – Economic Evidence
Speech, Sydney, 18 March 2009
- Competition Law and Regulation Conference**
Commerce Amendment Act: Impact on Electricity Lines Businesses
Speech, Wellington, 27 February 2009
- 2008** **Non-Executive Directors**
Shareholder Class Actions in Australia
Speech, Sydney, 28 July 2008
- Mergers & Acquisitions: Strategies 2008**
Competition Law Implications for Mergers & Acquisitions
Speech, Sydney, 27 May 2008
- Institute for Study of Competition and Regulation**
Role of Merits Review under Part 4 and Part 4A of the Commerce Act
Speech, Wellington, 20 February 2008
- 2007** **Trade Practices Workshop**
Hypothetical breach of s46
Economic expert in mock trial, 20 October 2007

Assessing the Merits of Early Termination Fees, *Economics of Antitrust: Complex Issues in a Dynamic Economy*, Wu, Lawrence (Ed)
NERA Economic Consulting 2007

Assessing the Impact of Competition Policy Reforms on Infrastructure Performance
ACCC Regulation Conference
Speech, Gold Coast, 27 July 2007

2006 **Trade Practices Workshop**
Access to Monopoly Infrastructure Under the Trade Practices Act: Current Issues with Part IIIa and Section 46
Conference Paper Co-Author, Canberra, 22 July 2006

2005 **Federal Court Judges' Conference**
Use of Quantitative Methods in Competition Analysis
Paper and speech, Sydney, 20 March 2005

2004 **ACCC Regulation Conference**
Market Power in Utility Industries
Speech, Gold Coast, 29 July 2004

Australian Water Summit
Integrating Regional and Urban Water Management Strategies
Speech, Melbourne, 25 February 2004

2003 **Assessing the Competitive Effects of Bundling: the Australian Experience, *Economics of Antitrust, New Issues, Questions and Insights*, Wu, Lawrence (Ed)**
NERA Economic Consulting, 2004

Water Infrastructure Conference
Pricing to promote reuse and recycling – Why Pay More for Less?
Speech, Melbourne, 28 July 2003

ACCC Incentive Regulation and Implementation Seminar
To Index or Not to Index – Is that the Right Question?
Speech, Melbourne, 8 May 2003

Australian Water Summit
Establishing Water Markets Why? How? What Next?
Speech, Sydney, 27 February 2003

- 2002**
- Australian Energy Users Association Conference**
Emerging Themes in Energy Sector Reform – Global and Local
Speech, Melbourne, 15 October 2002
- Australian Conference of Economists**
Efficient Transmission: Where to from here?
Conference Paper, Adelaide, 3 October 2002
- ACCC Regulatory Conference**
Foundation Contracts and Greenfields Pipeline Development – an Economic Perspective
Speech, Melbourne 26 July 2002
- 2001**
- IPART Conference, Incentive Regulation at the Crossroads**
Incentive Regulation: at the Cross Roads or Back to the Future?
Speech, Sydney, 5 July 2001
- World Bank Conference on Private Participation in Infrastructure**
A Regulatory Perspective
Speech, Beijing, 15 November 2001
- Airports Council International (ACI) World Conference**
Role of prices in managing airport congestion
Presentation of paper, Montreal, 11 September 2001
- NSW Power Conference**
Electricity transmission pricing and investment
Presentation of paper, Sydney, 30 August 2001
- ACCC Regulation and Investment Conference**
International Comparison of Regulated Rates of Return
Speech and presentation of paper, Sydney 26 March 2001

Publicly Available Reports

- 2009**
- Treatment of Accrued Carryovers in the 2011-2015 Regulatory Period**
A report for DLA Phillips Fox/CitiPower-Powercor
December 2009
- Initial Value of Regulatory Assets – the Australian Experience**
A report for Orion and Powerco
December 2009

Asset Values in Workably Competitive Markets

A report for Orion
October 2009

Cost of Equity – Fama-French Three-Factor Model

A report for Jemena Gas Networks
August 2009

2008

The Value of Imputation Credits

A report for the ENA, Grid Australia and APIA
August 2008

Economic Interpretation of Clauses 6.5.6 and 6.5.7 of the National Electricity Rules

A report for Energy/Australia
May 2008

The Gas Supply Chain in Eastern Australia

A report for the Australian Energy Market Commission
March 2008

The Wholesale Electricity Market in Australia

A report for the Australian Energy Market Commission
March 2008

2007

Treatment of Outsourcing Contracts

A report for the Multinet Gas Distribution partnership
December 2007

Review of Commerce Commission’s Draft Gas Distribution Services Paper

A report for Orion New Zealand Limited
November 2007

Equity Beta for Gas Distribution

A report for the APIA, ENA and ETNOF
October 2007

Assessing the Impact of Competition Policy Reforms on Australia’s Infrastructure Performance

A report for the Australian Competition and Consumer Commission
July 2007

**Review of the Effectiveness of Energy Retail Market Competition
in South Australia**

A report for the Essential Services Commission of South Australia,
June 2007

**Remuneration for the Use of Copyright Material – Comment on
the ACCC’s Guidelines**

A report for Minter Ellison, January 2007

2006

**Consistency of the Transmission Rules with the Competition
Principles Agreement**

A report for the Australian Energy Market Commission,
December 2006

Study of the Hong Kong Auto-fuel Retail Market

A report for the Economic Development and Labour Bureau, Hong
Kong, April 2006

Expert Panel on Energy Access Pricing

A report to the Ministerial Council on Energy, April 2006

2005

Intention to Declare Control

A report for Orion, October 2005

Efficient Investment in Transmission and its Alternatives

A report for Mighty River Power, July 2005

Wealth Transfers in Cost Benefit Analysis

A report for Auckland International Airport, January 2005

2003

Asset Valuation for the Gas Control Inquiry

A report for NGC Holdings, August 2003

**Estimating the Rate of Economic Profit for Electricity Lines
Businesses**

A report for Orion, November 2003

Inclusion of Competition Benefits in the Regulatory Test

A report for TransGrid, April 2003

Imputation Tests for Bundled Services

A Report for the ACCC, January 2003

- Anticompetitive Bundling Strategies**
A Report for the ACCC, January 2003
- 2002**
- The Hypothetical New Entrant Test in the Context of Assessing the Moomba to Sydney Pipeline Prices**
A Report for the ACCC, September 2002
- A Comment on the Commerce Commission's Report: Regulation of Electricity Lines Businesses**
A Report for Orion, May 2002
- Review of Energy Licensing Regimes in NSW: Compliance Monitoring and Reporting Framework**
A Report for IPART, March 2002
- Review of Energy Licensing Regimes in NSW: Minimum Service Standards**
A Report for IPART, January 2002
- 2001**
- Review of Energy Licensing Regimes in NSW: Most Effective Regulatory Model**
A Report for IPART, November 2001
- A Review of Melbourne's Water Tariffs**
Report for the Department of Natural Resources and Environment
- A Critique of Price Control Study of Airfield Activities**
A Report for Auckland International Airport Limited, August 2001
- International Comparison of Utilities' Regulated Post Tax Rates of Return in North America, the United Kingdom and Australia**
A Report for the Australian Competition and Consumer Commission (ACCC), March 2001
- A Critique of Crew and Kleindorfer's Paper Comparing Single and Multi-till Pricing Methodologies**
A Report for Sydney Airports Corporation, February 2001

E.2. Brendan Quach

Senior Consultant

NERA Economic Consulting
Darling Park Tower 3
201 Sussex Street
Sydney NSW 2000
Tel: +61 2 8864 6502
Fax: +61 2 8864 6549
E-mail: brendan.quach@nera.com
Website: www.nera.com



Overview

Brendan Quach has nine years experience as an economist, specialising in network economics, and competition policy in Australia, New Zealand and Asia Pacific. Since joining NERA in 2001, Brendan has advised clients on the application of competition policy in Australia, in such industries as aviation, airports, electricity, rail and natural gas. Brendan specialises in regulatory and financial modelling and the cost of capital for network businesses. Prior to joining NERA, Brendan worked at the Australian Chamber of Commerce and Industry, advising on a number of business issues including tax policy, national wage claims and small business reforms.

Qualifications

1991-1995 **AUSTRALIAN NATIONAL UNIVERSITY**
Bachelor of Economics.
(High Second Class Honours)

1991-1997 **AUSTRALIAN NATIONAL UNIVERSITY**
Bachelor of Laws.

Career Details

2001 - **NERA ECONOMIC CONSULTING**
Economist, Sydney

1998-1999 **AUSTRALIAN CHAMBER OF COMMERCE AND INDUSTRY**
Economist, Canberra

1996 **AUSTRALIAN BUREAU OF STATISTICS**
Research Officer, Canberra

Project Experience

Industry Analysis

- 2009** **EnergyAustralia – NSW Electricity Distribution
Review of Public Lighting Services**
Brendan provided advice to EnergyAustralia during its electricity distribution price review on the provision of public lighting services. Our work provided strategic and regulatory advice to EnergyAustralia and their legal during the appeal of the AER’s revenue determination for the 2009-2014 period.
- 2008-09** **MSAR Office for the Development of the Energy Sector
Review of Electricity Cost and Tariff Structures**
Review of current and projected costs of electricity provision in Macau, including modelling and analysis of marginal costs and sunk cost attribution to various consumer classes. Our work for the Macau Government has incorporated the development of potential tariff structures (specifically rising block tariff structures) and scenarios, including modelling revenue recovery and cross subsidies.
- 2008** **Singaporean Ministry for Trade and Industry
Electricity Industry Review**
NERA was retained by the Singaporean Ministry for Trade and Industry (MTI) to provide a comprehensive review of the Singaporean electricity market. Brendan was involved in the analysis of the costs and benefits arising from the restructuring and reform of the Singaporean electricity industry since the mid 1990’s, the estimated costs and benefits of future security of supply and energy diversification approaches. The project required NERA to undertake quantitative dispatch modelling of the Singaporean electricity market.
- 2008** **Ministerial Council Energy
Retailer of Last Resort**
Assisted in the development of a joint expert report with Allens Arthur Robinson (AAR) that: reviewed the existing jurisdictional retailer of last resort (RoLR) frameworks; advised the MCE on the development of an appropriate national policy framework for RoLR and developed a suggested base set of proposals for a national RoLR scheme.

- 2005-06** **Freehills/South Australian Gas Producers, NSW and South Australia**
Gas supply agreement arbitration
Assisted in the development of an economic expert report in the arbitration of the price to apply following review of a major gas supply agreement between the South Australian gas producers and a large retailer in NSW and South Australia.
- 2005-2006** **Australian Energy Market Commission (AEMC), Australia**
Advised the AEMC on its review of the Electricity Rules relating to transmission revenue determination and pricing, which included providing briefing papers to the Commission on specific issues raised by the review.
- 2005-2006** **Minter Ellison/ South West Queensland Gas Producers, Queensland**
Gas supply agreement arbitration
Advised Minter Ellison and the Producers in an arbitration of the price to apply following review of a major gas supply agreement between the South West Queensland gas producers and a large industrial customer.
- 2005** **International Utility, Queensland**
Generator sale, due diligence
Part of the due diligence team acting on behalf of a large international utility in the purchase of two coal fired generators in Queensland, Australia. Provided advice on the features of the Australian electricity market and regulatory environment.
- 2003** **Auckland City Council, New Zealand**
Rationalisation Options Study
Conducting a rationalisation options study to examine alternative business models for Metrowater. Our report assessed different vertical and horizontal integration options for Metrowater.
- 2003** **Metrowater, New Zealand**
Institutional Restructuring
Prepared advice for the board of the Auckland City Water and wastewater service provider, Metrowater on options for institutional and regulatory reform of the entire Auckland regional water sector.

- 2002 - 2003** **Rail Infrastructure Corporation, Australia**
Research to RIC on their proposed access undertaking.
Provided research and advice into various components of RICs proposed access undertaking with the ACCC including the cost of capital, asset valuation and pricing principles.
- 2002** **Argus Telecommunications, Australia**
Critique of CIE's bandwidth pricing principles.
Provided a critique of a CIE report on bandwidth pricing principles for the fibre optic networked run owned by Argus Telecommunications.
- 2001** **Screenrights, Australia**
Advice on valuing retransmission of local TV
A review and analysis of different methodologies in valuing retransmission of local television on pay TV services.

Regulatory and Financial Analysis

- 2009** **Jemena - Gas Distribution**
Cost of Equity
Co-authored a report on the application of a domestic Fama-French three-factor model to estimate the cost of equity for regulated gas distribution businesses. The report examined whether the Fama-French three-factor model met the dual requirements of the National Gas Code to provide an accurate estimate of the cost of equity and be a well accepted financial model. The using Australian financial data the report also provided a current estimate of the cost of equity for Jemena.
- 2009** **WA Gas Networks - Gas Distribution**
Cost of Equity
Co-authored a report that examined a range of financial models that could be used to estimate the cost of equity for a gas distribution business. The report of estimating the cost of equity of a gas distribution business using the Sharpe Lintner CAPM, Black CAPM, Fama-French three-factor model and Fama-French two-factor model. The report examined both the domestic and international data.
- 2009** **CitiPower and Powercor – Victorian Electricity Distribution**
Network Reliability Incentive Mechanism (S-factor)
Brendan provided advice to CitiPower and Powercor on the proposed changes to the operation of the reliability incentive mechanism. The advice considered the effects of the proposed changes to the operation of the two distribution network service providers. Specifically, how the 'S-factors' would be changed and implications this has to the revenue

streams of the two businesses. A comparison was also made with the current ESC arrangements to highlight the changes to the mechanism.

- 2009** **Jemena and ActewAGL - Gas Distribution**
Cost of Equity
Co-authored a report on alternative financial models for estimating the cost of equity. The report examined the implication of estimating the cost of equity of a gas distribution business using the Sharpe Lintner CAPM, Black CAPM and Fama-French models. The report examined both the domestic and international data.
- 2008** **Joint Industry Associations - APIA, ENA and Grid Australia**
Weighted Average Cost of Capital
Assisted in the drafting of the Joint Industry Associations submission to the Australian Energy Regulator's weighted average cost of capital review. The submission examined the current market evidence of the cost of capital for Australian regulated electricity transmission and distribution businesses.
- 2008** **Joint Industry Associations - APIA, ENA and Grid Australia**
Weighted Average Cost of Capital
Expert report for the Joint Industry Associations on the value of imputation credits. The expert report was attached to their submission to the Australian Energy Regulator's weighted average cost of capital review. The report examined the current evidence of the market value of imputation credits (gamma) created by Australian regulated electricity transmission and distribution businesses.
- 2007-2008** **Smart Meter Working Group, Ministerial Council on Energy –**
Assessment of the costs and benefits of a national mandated rollout of smart metering and direct load control
Part of a project team that considered the costs and benefits of a national mandated rollout of electricity smart meters. Brendan was primarily responsible for the collection of data and the modelling of the overall costs and benefits of smart metering functions and scenarios. The analysis also considering the likely costs and benefits associated with the likely demand responses from consumers and impacts on vulnerable customers.
- 2007** **Victorian Electricity Distribution Business**
Review of Smart Meter model
Reviewed the smart meter model developed by a Victorian distributor and submitted to the Victorian Essential Service Commission (ESC). The smart meter model supported the business' regulatory proposal that quantified the revenue required to meet the mandated roll out of smart meters in Victoria. The smart meter model the quantified the

expected, meter, installation, communications, IT and project management costs associated with the introduction of smart meters. Further, the estimated the expected change in the business' meter reading and other ongoing costs attributed with the introduction of smart meter infrastructure.

2007

**Energy Trade Associations - APIA, ENA and Grid Australia
Weighted Average Cost of Capital**

Expert reports submitted to the Victorian Essential Services Commission evaluating its draft decision to set the equity beta at 0.7, and its methodology for determining the appropriate real risk free rate of interest, for the purpose of determining the allowed rate of return for gas distribution businesses.

2007-

**Babcock and Brown Infrastructure, Qld
Review of Regulatory Modelling**

Providing advice to Babcock and Brown Infrastructure on the regulatory modelling of revenues and asset values of the Dalrymple Bay Coal Terminal (DBCT). DBCT has undertaken a substantial capital investment to increase the capacity of the port. Brendan's role has been to advise DBCT on variety of issues including the calculation of interest during construction, appropriate finance charges, cost of capital and regulatory revenues which were submitted to the Queensland Competition Authority (QCA).

2007-

**ActewAGL, ACT
Transition to National Electricity Regulation**

Providing on-going advice to ActewAGL, the ACT electricity distribution network service provider, on its move to the national energy regulation. The advice covers the revenue and asset modelling, the new incentives for efficient operating and capital expenditure and processes for compliance, monitoring and reporting of its regulatory activities.

2007 - 2008

**Smart Meter Working Group, Ministerial Council on Energy –
Assessment of the costs and benefits of a national mandated rollout
of smart metering and direct load control**

Brendan was a member of NERA team that investigated the costs and benefits of a national mandated rollout of electricity smart meters. Brendan's prime responsibility was to undertake the modelling of the costs and benefits of smart metering. NERA's assignment required an assessment of smart metering functions and scenarios, and also considering the likely demand responses from consumers and impacts on vulnerable customers.

- 2005-** **TransGrid, NSW**
Review of Regulatory Systems
Providing strategic advice to TransGrid, the NSW electricity transmission network service provider, on its current regulatory processes. The advice covers TransGrid's internal systems and processes for compliance, monitoring and reporting of its regulatory activities.
- 2006** **Grid Australia, National**
Submission to application by Stanwell to change the national Electricity Rules (Replacement and Reconfiguration investments)
Developed and drafted a submission to the AEMC on the appropriateness of the draft Rule change that extended the application of the regulatory test to replacement and reconfiguration investments.
- 2006** **Grid Australia, National**
Submission to application by MCE to change the national Electricity Rules (Regulatory Test)
Developed and drafted a submission to the AEMC on the appropriateness of the draft Rule change which changed the Regulatory Test as it applies to investments made under the market benefits limb.
- 2006** **Office of the Tasmanian Energy Regulator**
Implications of the pre-tax or post-tax WACC
Provided a report to OTTER on the potential implications of changing from a pre-tax to a post-tax regulatory framework.
- 2006** **Babcock Brown Infrastructure**
Regulatory Modelling of Dalrymple Bay Coal Terminal
Developed the economic model used to determine revenues at Dalrymple Bay Coal Terminal. This included updating the model for capital expenditure to upgrade capacity at the terminal, account for intra-year cash flows, and the proper formulation of the weighted average cost of capital and inflation.
- 2006** **Queensland Competition Authority, Queensland**
Review of Regulatory Revenue Models
Advised the QCA on the financial and economic logic of its revenue building block model that projects the required revenue for the Queensland gas distribution businesses and tariffs for the next 5 years.

- 2006** **Envestra, South Australia**
Review of RAB Roll Forward Approach
Assisted Envestra in responding to the Essential Services Commission of South Australia’s consultation paper on Envestra’s 2006/07 to 2010/11 gas access proposal. This involved reviewing Envestra’s RAB roll forward modelling and the Allen Consulting Group’s critique thereof.
- 2006** **Transpower, New Zealand**
Review of Regulatory Systems
Provided assistance to Transpower, the sole electricity company in New Zealand, in responding to the New Zealand Commerce Commission’s announcement of its intention to declare control of Transpower. This involved developing an expert report commenting on the Commission’s methodology for analysing whether Transpower’s has earned excess profits in the context of New Zealand’s “threshold and control” regime.
- 2006** **Pacific National**
Rail industry structure and efficiency
Assisted with the development of a report which examined options for addressing issues arising in vertically-separated rail industries. This involved examining a number of case study countries including the UK, US and Canada.
- 2005** **Australian Energy Markets Commission, Australia**
Transmission pricing regime
Advisor to the AEMC’s review of the transmission revenue and pricing rules as required by the new National Electricity Law.
- 2005** **Queensland Rail, Australia**
Weighted Average Cost of Capital
Provided a report for Queensland Rail on the appropriate weighted average cost of capital for its regulated below rail activities.
- 2004-2005** **ETSA Utilities**
Review of Regulatory Modelling
Advised ETSA Utilities on the financial and economic logic of ESCOSA’s regulatory models used to determine the regulatory asset base, the weighted average cost of capital, regulatory revenues and distribution prices.

- 2003- 2005** **TransGrid, NSW**
Review of Regulatory Revenues
Assisted TransGrid in relation to its application to the ACCC for the forthcoming regulatory review which focused on asset valuation and roll forward, cost of capital and financial/regulatory modelling.
- 2004** **Prime Infrastructure, Australia**
Weighted Average Cost of Capital
Provided a report for Prime Infrastructure on the appropriate weighted average cost of capital for its regulated activities (coal shipping terminal).
- 2004** **PowerGas, Singapore**
Review of Transmission Tariff Model
Advised the Singaporean gas transmission network owner on the financial and economic logic of its revenue building block model that projects PowerGas' revenue requirements and tariffs for the next 5 years.
- 2003** **ActewAGL, ACT**
Review of Regulatory Revenues
Provided strategic advice to ActewAGL in developing cost of capital principles, asset valuation and incentive mechanisms as part of their current pricing reviews for their electricity and water businesses.
- 2003** **Orion Energy, New Zealand**
Threshold and Control Regime in the Electricity Sector
Provided advice and assistance in preparing submissions by Orion to the Commerce Commission, in relation to the Commission's proposed changes to the regulatory regime for electricity lines businesses. Issues addressed included asset valuation, and the form of regulatory control.
- 2003** **EnergyAustralia, NSW**
Pricing Strategy Under a Price Cap
Advised EnergyAustralia on IPART's financial modelling of both regulated revenues and the weighted average price cap.
- 2002-03** **TransGrid, NSW,**
Advice in Relation to the Regulatory Test
Modelled the net present value of a range of investment options aimed at addressing a potential reliability issue in the Western Area of New South Wales. This work was undertaken in the context of the application of the ACCC's "regulatory test" which is intended to ensure only *efficient* investment projects are included in the regulatory asset base.

- 2002** **Rail Infrastructure Corporation (RIC), Australia**
Review of the Cost of Capital Model
Provided advice to RIC and assisted in drafting RIC's submission to the Australian Competition and Consumer Commission (ACCC) on the appropriate cost of capital. This included building a post-tax revenue model of RIC's revenues in the regulatory period.
- 2002** **PowerGrid, Singapore**
Review of Transmission Tariff Model
Advised the Singaporean electricity transmission network owner on the financial and economic logic of its revenue building block model that projects PowerGrid's revenue requirements and tariffs for the next 10 years.
- 2002** **EnergyAustralia, Australia**
Review of IPART's Distribution Tariff Model
Advised EnergyAustralia, a NSW distribution service provider, on the economic logic of the revenue model that projects EnergyAustralia's revenue requirements and tariffs for the 2004-2009 regulatory period.
- 2002** **Essential Services Commission of South Australia**
Review Model to Estimating Energy Costs
Reviewed and critiqued a model for estimating retail electricity costs for retail customers in South Australia for 2002-2003.
- 2002** **National Competition Council (NCC), Australia**
Exploitation of Market Power by a Gas Pipeline
Provided a report to the NCC in which we developed a number of tests for whether current transmission prices were evidence of the exploitation of market power by a gas transmission pipeline. Also provided a separate report that applied each of the tests developed. This analysis was relied on by the NCC in determining whether to recommend the pipeline in question be subject to regulation under the Australian Gas Code.
- 2002** **Australian Gas and Lighting, Australia**
Report on South Australian Retail Tariffs
An independent assessment on the cost components of regulated retail tariffs in South Australia that will be used by AGL in the next review.
- 2002** **New Zealand Telecom, New Zealand**
Report on the application of wholesale benchmarks in NZ
A report on the application of international benchmarks of wholesale discounts to New Zealand Telecom.

- 2002** **ENEL, Italy**
Survey of Retailer of Last Resort in NSW
Provided research into the retailer of last resort provisions in the NSW gas sector of an international review for the Italian incumbent utility.
- 2002** **ENEL, Italy**
Survey of Quality of Service provisions in Victoria and South Australia
Provided research into quality of service regulation for electricity distribution businesses in Victoria and South Australia of an international review for the Italian incumbent utility.
- 2002** **Integral Energy, Australia**
Provided Advice on the Cost of Capital for the 2004 – 2008 Distribution Network Review
Provided analysis and strategic advice to Integral Energy on the possible methodologies that IPART may use to calculate the cost of capital in the next regulatory period.
- 2001** **IPART, Australia**
Minimum Standards in Regulation of Gas and Electricity Distribution
Advised the NSW regulator on the appropriate role of minimum standards in regulatory regimes and how this could be practically implemented in NSW.
- 2001** **TransGrid, Australia**
Advice on ACCC's Powerlink WACC decision
Provided a report critically appraising the ACCC's decision regarding Powerlink's weighted average cost of capital (WACC).

Competition Policy

- 2005** **Confidential, Australia**
Merger Analysis
Provided expert opinion as well as strategic guidance to the merging firms on the competitive implications of that merger.
- 2004** **Mallesons Stephen Jaques / Sydney Airports Corporation, Australia**
Appeal to declare under Part IIIA
Provided strategic and economic advice on aspects of Virgin Blue's appeal for the declaration of airside facilities at Sydney Airport under

Part IIIA of the Trade Practices Act. This culminated in the production of an expert witness statement by Gregory Houston.

- 2003** **Sydney Airports Corporation, Australia**
Application to declare under Part IIIA
Expert report to the National Competition Council in connection with the application by Virgin Blue to declare airside facilities at Sydney Airport under Part IIIA of the Trade Practices Act, and the potential impact on competition in the market for air travel to and from Sydney.
- 2002 - 2003** **Blake Dawson Waldron/ Qantas Airways, Australia**
Alleged predatory conduct
NERA was commissioned to provide advice in relation to potential allegations of anticompetitive behaviour. Developed a paper examining the economic theory behind predation and the way courts in various jurisdictions determine whether a firm has breached competition law.
- 2002** **Phillips Fox and AWB Limited**
Declaration of the Victorian Intra-State Rail Network
Advised law firm Phillips Fox (and AWB Limited) in its preparation for an appeal (in the Australian Competition Tribunal) of the Minister's decision not to declare the Victorian intra-state rail network, pursuant to Part IIIA of the Trade Practices Act. This included assisting in the preparation of testimony relating to pricing arrangements for third party access to the rail network and their likely impact on competition in related markets, including the bulk freight transportation services market.
- 2002** **Singapore Power International (SPI)**
Impact of acquisition of a Victorian distributor on competition
Provided analysis to a company interested in acquiring CitiPower (a Victorian electricity distribution/retail business). Including an assessment of the extent to which the acquisition of CitiPower would lead to a 'substantial lessening of competition' in a relevant energy markets, given the company's existing Australian electricity sector assets. The NERA report was submitted to the ACCC as part of the pre-bid acquisition clearance process.
- Other**
- 1999-2000** **Australian Chamber of Commerce and Industry, Australia**
Alienation of Personal Service Income
Involved in analysing the effects of the proposed business tax reform package had on a number of industries which advocated a number of

recommendations to the Federal Government. The package also included the provisions to change the definition of personal service income.

1998-2000

**Australian Chamber of Commerce and Industry, Australia
Various economic policy issues**

Provided analysis on economic trends and Government policies to business groups. This covered issues such as industrial relations reform, taxation changes, business initiatives, and fiscal and monetary settings. Also compiled ACCI surveys on business conditions and expectations.

1996

**Australian Bureau of Statistics, Australia
Productivity Measures in the Public Health Sector**

Involved in a team that reported on the current methods used to measure output in the public health sector and analysed alternative methods used internationally. This was in response to the ABS investigating the inclusion of productivity changes in the public health sector.

Publicly Available NERA Reports

September 2002

**Hypothetical New Entrant Test in the Context of Assessing the
Moomba to Sydney Pipeline Prices**

A report for the Australian Competition and Consumer Commission which applied the hypothetical new entrant (HNE) test to the Moomba to Sydney Pipeline. The report also compared HNE prices with those actually charged for use of the MSP.

March 2002

Minimum Service Standards

Report for IPART which assessed the need for minimum performance standards for energy sector licensees and advised on the appropriate process and practical implementation issues associated with introducing any such standards.

E.3. Simon Wheatley

Special Consultant

NERA Economic Consulting
33 Exhibition Street
Melbourne VIC 3000
Tel: +61 3 9623 6800
Fax: +61 3 9623 0800
E-mail: simon.wheatley@nera.com
Website: www.nera.com

Overview

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

Employment

- § Special Consultant, NERA Economic Consulting, 2009-present
- § 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
- § Visiting Fellow, Australian Graduate School of Management, 1981
- § Aviation Insurance Adjuster, American International Group, London, 1977-1978

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

Publications

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, Gregory 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.

Imputation credits and equity returns (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.

Work in progress

Risks for the long run: A potential resolution of asset pricing puzzles?

Debt policy, growth, and the value of the tax shield (with Robert Neal)

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

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

Ph. D. dissertations supervised

En Te Chen, University of Melbourne (2006), To Invest or not to Invest? Theory and Evidence on Stock Holdings over the Life-Cycle. Current position: Lecturer, Queensland University of Technology, Queensland

Kogulakrishnan Maheswaran, University of Melbourne (2005), Some international evidence on the impact of liquidity constraints on consumption smoothing. Current position: Manager, Quantitative Research, KBC Financial Products, New York

Piruna Polsiri, University of Melbourne (2004), The effects of concentrated ownership on firm restructurings: evidence from Thailand. Current position: Director of DBA/MBA Programs, Dhurakij Pundit University, Thailand

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NERA

Economic Consulting

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