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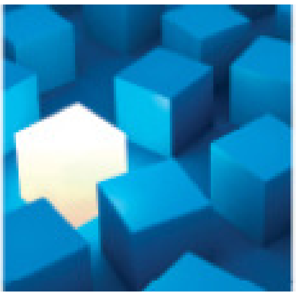

# The Market, Size and Value Premiums

## A report for the Energy Networks Association

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## Project Team

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# Executive Summary

This report has been prepared for the Energy Networks Association (ENA) by NERA Economic Consulting (NERA). The ENA has asked NERA to examine a number of issues arising from recent reports released by the Australian Energy Regulator (AER) and its advisors.

In particular, the ENA has asked NERA to assess a number of issues pertaining to the estimation of the *long-run* market risk premium (*MRP*):

1. The accuracy of the downward adjustments to Lamberton's (1961) dividend yield data that Brailsford, Handley and Maheswaran (2008, 2012) and the AER employ; [1]
2. The merits or otherwise of the Siegel-averaging method that Lally (2012) advocates and the Queensland Competition Authority (QCA) has adopted; [2]
3. Whether a long-run estimate of the *MRP* should be computed using an arithmetic mean, geometric mean, or some weighted average of the two; and
4. The impact of the choice of sample on estimates of the *MRP*.

The ENA is also seeking an analysis from NERA of the following issues, some of which will pertain to the estimation of the *currently prevailing MRP*:

5. The costs and benefits of using biased estimators for the *MRP*;
6. Whether the dividend growth model (DGM) will necessarily deliver an upwardly biased estimate of the *MRP* in current or recent circumstances, during which the risk-free rate has been low; and
7. Whether market practitioner estimates of the return required on the market are consistent with a constant *MRP* through time when measured against the prevailing yields on 10-year Commonwealth Government Securities (CGS), and whether the estimates are consistent with the proposition that the prevailing forward looking *MRP* in 2012 and 2013 was 6 per cent.

Finally, the ENA has also asked NERA:

8. To investigate suitable data sources for use in estimating the size and value premiums and to provide estimates of the premiums.

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1 Brailsford, T., J. Handley and K. Maheswaran, *Re-examination of the historical equity risk premium in Australia*, Accounting and Finance 48, 2008, pages 73-97.

Brailsford, T., J. Handley and K. Maheswaran, *The historical equity risk premium in Australia: Post-GFC and 128 years of data*, Accounting and Finance, 2012, pages 237-247.

Lamberton, D., *Ordinary share yields: A new statistical series*, Sydney Stock Exchange Official Gazette, 14 July 1961.

2 Lally, M., *The cost of equity and the market risk premium*, Victoria University of Wellington, 25 July 2012, pages 28-29.

## Downward adjustments to Lamberton's yield data

Dimson, Marsh and Staunton (2012) and Brailsford, Handley and Maheswaran (2012) provide two different estimates of the long-run mean return to a value-weighted portfolio of Australian stocks.[3] In their Credit Suisse Global Investment Returns Sourcebook 2012, Dimson, Marsh and Staunton report that the arithmetic mean of the annual return to a value-weighted portfolio of Australian stocks, exclusive of imputation credits, from 1900 to 2011, is 12.9 per cent. The arithmetic mean of the series of annual returns to a value-weighted portfolio of Australian stocks that Brailsford, Handley and Maheswaran supply, exclusive of imputation credits, from 1900 to 2011, is 11.9 per cent. Thus the arithmetic mean of the series of annual returns that Brailsford, Handley and Maheswaran supply is 100 basis points below the arithmetic mean of the series that Dimson, Marsh and Staunton use.

The difference between the two arithmetic means is primarily explained by differences in the way in which the dividends distributed by a value-weighted portfolio of stocks were determined by those who provided the data to the two sets of authors. Dimson, Marsh and Staunton (2012) use a series of dividend yields provided to them by Officer that is largely based on a series produced by Lamberton (1961).[4] Brailsford, Handley and Maheswaran (2012) use a series of yields provided to them by the Australian Stock Exchange that is also largely based on Lamberton's data.[5] The yields that Brailsford, Handley and Maheswaran use, however, have been adjusted downwards to take account of perceived deficiencies in the series that Lamberton provides.

We assess whether the adjustment to Lamberton's yield series in the data that Brailsford, Handley and Maheswaran employ is warranted and provide evidence that it is not. The evidence suggests that some adjustment should be made but that the adjustment should be *smaller* than the adjustment made in their data. An estimate of the downwards bias generated by inappropriately adjusting Lamberton's yield series is 18 basis points for the period that Dimson, Marsh and Staunton examine, 1900 to 2011, but 37 basis points for the longer period, 1883 to 2011, on which the AER focuses.

Our estimates of the downward bias rely on Lamberton's series, Brailsford, Handley and Maheswaran's analysis of yield data for February 1966, our analysis of yield data for December 1891, December 1901, December 1911, December 1921, December 1931, December 1941, December 1951 and interpolation.

An estimate of the *MRP* computed using the data that Brailsford, Handley and Maheswaran (2012) supply for the period 1883 to 2010 and that we update to 2011, assuming a value of 35

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3 Dimson, E., P. Marsh and M. Staunton, *Credit Suisse Global investment returns sourcebook 2012*, Credit Suisse, February 2012.

Brailsford, T., J. Handley and K. Maheswaran, *The historical equity risk premium in Australia: Post-GFC and 128 years of data*, Accounting and Finance, 2012, pages 237-247.

4 Dimson, E., P. Marsh and M. Staunton, *Credit Suisse Global investment returns sourcebook 2012*, Credit Suisse, February 2012.

Lamberton, D., *Ordinary share yields: A new statistical series*, Sydney Stock Exchange Official Gazette, 14 July 1961.

5 Brailsford, T., J. Handley and K. Maheswaran, *The historical equity risk premium in Australia: Post-GFC and 128 years of data*, Accounting and Finance, 2012, pages 237-247.

cents is assigned to each dollar of imputation credits distributed, adjusted for the bias that we identify, will be 6.47 per cent per annum.[6, 7]

## Siegel averaging

Lally (2012) argues, on the basis of evidence that Siegel (1992) provides, that the sample mean of a series of historical returns to the market portfolio in excess of the yield on a government bond can be an upwardly biased estimate of the long-run *MRP*. [8] Lally's argument is based on a view that investors have systematically underestimated inflation and that while the real returns to stocks are, in the long run, protected against unanticipated inflation, the real returns to bonds are not protected against unanticipated inflation.

Lally argues that while investors have in the past underestimated inflation, they will not do so in the future. As a result, he argues that while the real return to the market portfolio in the future will on average be similar to its real return in the past the real return to a government bond in the future will on average be higher than it has been in the past. So Lally argues that an unbiased estimate of the long-run *MRP* going forward will be lower than the sample mean, computed from past data, of a series of returns to the market portfolio in excess of the government bond yield.

We show here that Lally's argument makes little sense because the available evidence does not support the idea that investors *systematically* underestimate inflation. Using survey data, we identify periods over which investors have underestimated inflation but these are matched by periods over which investors have overestimated inflation. So it is difficult to see how the sample mean of a series of returns to the market portfolio in excess of the yield on a government bond can be viewed as an upwardly biased estimate of the long-run *MRP*.

We also note that the AER uses the yield on a *new* 10-year bond each year in estimating the long-run *MRP*. Moreover, the AER measures the yield at the *end* of each year. These two factors will limit the impact that unanticipated inflation can have in any one year on the excess return that the AER uses to estimate the long-run *MRP*.

## Arithmetic versus geometric averaging

In recent reports the AER states its belief that consideration should be given to estimates of the long-run *MRP* based on both arithmetic and geometric averages. Whether an arithmetic or geometric average is appropriate will depend on whether there is any compounding of estimates of the *MRP* in the regulatory process.

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6 Brailsford, T., J. Handley and K. Maheswaran, *The historical equity risk premium in Australia: Post-GFC and 128 years of data*, Accounting and Finance, 2012, pages 237-247.

7 This value is the value laid down by the ACT in a decision on the market value of a one-dollar credit distributed. See ACT, Application by Energex Limited (Gamma) (No 5) [2011] ACompT 9, May 2011.

8 Lally, M., *The cost of equity and the market risk premium*, Victoria University of Wellington, 25 July 2012, pages 28-29.

Siegel, J., *The equity premium: Stock and bond returns since 1802*, Financial Analysts Journal, pages 28-38+46.

- In the absence of compounding an arithmetic average should be used since the use of a geometric average will produce a downwardly biased estimate of the *WACC*.
- On the other hand, if regulatory returns are compounded, then some weight should placed on a geometric average since an arithmetic average used alone will produce an upwardly biased estimate of the *WACC*.

We show that, aside from some minor adjustments to the regulatory asset base (*RAB*) and to the evolution of prices over the regulatory period, the AER *never* compounds the *WACC* over more than one year. As a result, the use of an arithmetic average will produce an *unbiased* estimate of the revenue that the market requires in any one year on the *RAB*. In contrast, an estimate of the *WACC* that is in part based on a geometric average of the *MRP* will produce a *downwardly biased* estimate of the revenue that the market requires in any one year.

## Choice of sample

Recent evidence that the AER provides suggests that the *MRP* has declined through time. In particular, the AER provides estimates of the *MRP* over a number of sub-periods and it appears from these estimates that the *MRP* has been declining over the last century. We show that there is no significant evidence that the *MRP* has declined. Indeed, we show that the samples that the AER employs could have been chosen to provide the appearance that the *MRP* has risen.

We also emphasise that the way in which the AER chooses samples invites the reader to weight recent returns to the market portfolio in excess of the yield on a government bond more heavily than earlier observations. While this may sound an attractive strategy, placing a larger weight on more recent observations than on earlier observations can substantially lower the precision of the estimates that one produces. In addition, we note that the way in which the AER chooses samples invites the reader to place a higher weight on one particular recent period over which the return to the market portfolio in excess of the yield on a government bond was low and to place lower weights on periods over which the return was high.

## The Use of Biased Estimates

Lally (2012) suggests that better estimators for the *MRP* can be constructed by combining several different estimators for the *MRP*. In particular, he suggests that better estimators for the *MRP* can be constructed by combining an estimator for the *MRP* known to be unbiased with an estimator or estimators that may be biased.[9]

Lally's analysis, which assumes that the bias associated with a biased estimator is known, is deceptively attractive. He shows that if one knows the bias, the optimal estimator will use not only unbiased estimators but also biased estimators. While this is true, it is also true that if one were to know the bias associated with a biased estimator, one could construct an unbiased estimator from the biased estimator by subtracting the bias from the estimator. Thus there would be no reason to use a biased estimator.

[9] Lally, M., *The cost of equity and the market risk premium*, Victoria University of Wellington, 25 July 2012, page 30.

In practice, the bias associated with a biased estimator is rarely known. We demonstrate that if the bias is unknown, then it will be difficult to show that an estimator that places a significant weight on a biased estimator will be a better estimator than one that relies only on unbiased estimators.

## The DGM

A natural place to look for information on what the market thinks the *MRP* should be is in market prices. The DGM allows one, in principle, to use market prices together with forecasts of future dividends to be distributed by the market portfolio to compute the return that the market requires on the portfolio. The return that the DGM delivers, though, is the single internal rate of return that will discount back the market's expectations of the dividends that the market portfolio will pay in all future periods – not just over the next regulatory period – back to the current market value of the market portfolio. This internal rate of return will be a complicated average of the expected returns to the market portfolio over the next year and over all future years.

As we point out in our March 2012 report and as Lally points out in his July 2012 and March 2013 reports, the internal rate of return that the DGM delivers may lie above or below the current expected return to the market. [10] Nevertheless, we show that there are recently encountered circumstances where it would have been difficult to argue persuasively that the expected return over the next regulatory period sat below the return delivered by the DGM. In the particular circumstances, the risk-free rate was low relative to its history but, contrary to the arguments put forward by Lally, it would have been difficult to argue that the expected return to the market portfolio over the next regulatory period sat below the return delivered by the DGM.

## Market practitioner estimates

Independent expert reports potentially provide an alternative source of information on the value for the *MRP* used by market participants. The use of independent expert reports circumvents a number of the problems associated with other forms of market data such as survey evidence. In particular:

- independent expert reports are typically made public and so it is not necessary to seek a response from each expert;
- many transactions require an independent expert report be produced;
- independent experts face strong incentives to provide accurate responses;
- it is clear from independent expert reports how returns are measured, that is, whether returns are continuously compounded or not continuously compounded;
- independent experts generally state whether they place a value on imputation credits;

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[10] Lally, M., *The cost of equity and the market risk premium*, Victoria University of Wellington, 25 July 2012, page 3.

Lally, M., *The dividend growth model*, Victoria University of Wellington, 4 March 2013, pages 5-9.

NERA, *Prevailing conditions and the market risk premium: A report for APA Group, Envestra, Multinet & SP AusNet*, March 2012, page 42.

- independent experts generally state how they choose a value for the risk-free rate; and
- a time series of independent expert reports can be collected so that one can test propositions about the behaviour of expert assessments of the *MRP* through time.

We examine 142 independent expert reports conducted between 2008 and 2013 and find evidence of a significant negative relation between the 10-year CGS yield and the *MRP* experts choose relative to the yield. From this relation we estimate that the *MRP* relative to the 3.18 per cent per annum risk-free rate prevailing on 26 April 2013 should lie between 7.25 and 7.66 per cent per annum inclusive of a value assigned to imputation credits. Separately we estimate that the *MRP* relative to the 10-year CGS yield computed from the 20 independent expert reports published between 27 April 2012 and 26 April 2013 lies between 7.56 and 8.22 per cent per annum, inclusive of a value assigned to imputation credits.

Further, statistical tests that we conduct show that an *MRP* of 6 per cent is inconsistent with the *MRP* relative to the 10-year CGS yield contained in the 20 independent expert reports published between 27 April 2012 and 26 April 2013.

## The size and value premiums

The recently revised National Electricity Rules and National Gas Rules require the AER to consider all relevant financial models and therefore provide greater scope to look at cost of equity models beyond the traditionally adopted Sharpe-Lintner (SL) Capital Asset Pricing Model (CAPM). One of the financial models that the AER will consider is the Fama-French three-factor model.[11] The size and value premiums play an important role in this model.

Ken French, a co-originator of the Fama-French model, provides series of monthly returns to Australian value and growth portfolios from January 1975 to December 2012 that exhibit strong value and growth characteristics. MSCI and S&P, in contrast, provide series of monthly returns to Australian value and growth portfolios that exhibit weaker value and growth characteristics. MSCI provide data over the same period as French while S&P provide data over a shorter period.

SIRCA provides high-quality data that one can use to construct series of monthly returns to Australian small-cap and large-cap portfolios from January 1974 to December 2012. MSCI and S&P, in contrast, provide returns for small-cap and large-cap portfolios over shorter periods.

Since in using the Fama-French model, it is important to compute estimates of the value and size premiums that are as precise as possible, we believe that it is best to use the longest time series available to compute estimates of the premiums. We believe it is also important that estimates of the value premium be constructed from series of returns to value and growth portfolios that exhibit strong value and growth characteristics.

Thus we recommend that the AER use data from French's web site to estimate the value premium and data from SIRCA to estimate the size premium. Our estimates indicate that,

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[11] Fama, E., and K. French, *Common risk factors in the returns on stocks and bonds*, Journal of Financial Economics, 1993, pages 3–56.

using data from French's web site, the value premium is both economically and statistically significant. We estimate the value premium, inclusive of a value assigned to imputation credits, to be 7.68 per cent per annum.[12] On the other hand, our estimates indicate that, using data from SIRCA, the size premium, while economically significant, is not statistically significant. We estimate the size premium, inclusive of a value assigned to imputation credits, to be 3.05 per cent per annum.

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12 We assume that the market places a value of 35 cents on a one-dollar credit distributed consistent with the recent ACT decision on the market value of a one-dollar credit distributed. See

ACT, Application by Energex Limited (Gamma) (No 5) [2011] ACompT 9, May 2011.

# 1. Introduction

This report has been prepared for Multinet Gas (MG) and United Energy (UE) on behalf of the Energy Networks Association (ENA) by NERA Economic Consulting (NERA). The ENA has asked NERA to examine a number of issues arising from recent reports released by the Australian Energy Regulator (AER) and its advisors.

In particular, the ENA has asked NERA to assess a number of issues pertaining to the estimation of the *long-run* market risk premium (*MRP*):

1. The accuracy of the downward adjustments to Lamberton's (1961) dividend yield data that Brailsford, Handley and Maheswaran (2008, 2012) and the AER employ; [13]
2. The merits or otherwise of the Siegel-averaging method that Lally (2012) advocates and the Queensland Competition Authority (QCA) has adopted; [14]
3. Whether a long-run estimate of the *MRP* should be computed using an arithmetic mean, geometric mean, or some weighted average of the two; and
4. The impact of the choice of sample on estimates of the *MRP*.

The ENA is also seeking an analysis from NERA of the following issues, some of which will pertain to the estimation of the *currently prevailing MRP*:

5. The costs and benefits of using biased estimators for the *MRP*;
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7. Whether market practitioner estimates of the return required on the market are consistent with a constant *MRP* through time when measured against the prevailing yields on 10-year Commonwealth Government Securities (CGS), and whether the estimates are consistent with the proposition that the prevailing forward looking *MRP* in 2012 and 2013 was 6 per cent.

Finally, the ENA has also asked NERA:

8. To investigate suitable data sources for use in estimating the size and value premiums and to provide estimates of the premiums.

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[13] Brailsford, T., J. Handley and K. Maheswaran, *Re-examination of the historical equity risk premium in Australia*, Accounting and Finance 48, 2008, pages 73-97.

Brailsford, T., J. Handley and K. Maheswaran, *The historical equity risk premium in Australia: Post-GFC and 128 years of data*, Accounting and Finance, 2012, pages 237-247.

Lamberton, D., *Ordinary share yields: A new statistical series*, Sydney Stock Exchange Official Gazette, 14 July 1961.

[14] Lally, M., *The cost of equity and the market risk premium*, Victoria University of Wellington, 25 July 2012, pages 28-29.

The remainder of this report is structured as follows:

- section 2 examines the accuracy of the downward adjustments to Lamberton's yield data that Brailsford, Handley and Maheswaran and the AER employ;
- section 3 examines the merits or otherwise of the Siegel-averaging method that Lally advocates and the QCA has adopted;
- section 4 examines the arguments for using arithmetic means and against using geometric means;
- section 5 examines the impact of the choice of sample on estimates of the *MRP*;
- section 6 examines the difficulties that arise in assessing whether it is worth using biased estimators;
- section 7 provides estimates of the *MRP* that use the DGM and considers how to interpret the estimates;
- section 8 examines what value for the *MRP* relative to the current 10-year CGS yield market practitioners were using in 2012;
- section 9 investigates what are appropriate data sources for use in estimating the size and value premiums and provide estimates of the premiums; and
- section 10 provides conclusions.

In addition:

- Appendix A examines arguments made by McKenzie and Partington (2011) about whether one should use the sample mean, median or mode of a time series of returns to the market portfolio in excess of a government bond yield to estimate the long-run *MRP*. [15]
- Appendix B emphasises that the AER must be consistent in its use of evidence;
- Appendix C explains how we test in section 5 whether the *MRP* has declined over time;
- Appendix D provides the terms of reference for this report; and
- Appendix E provides the curricula vitae of the two authors of the report.

## 1.1. Statement of Credentials

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

**Simon Wheatley** is a Special Consultant with NERA, and was until 2008 a Professor of Finance at the University of Melbourne. Since 2008, Simon has applied his finance expertise in investment management and consulting outside the university sector. Simon's interests and expertise are in individual portfolio choice theory, testing asset-pricing models and

[15] McKenzie, M. and G. Partington, *Report to Corrs Chambers Westgarth: Equity market risk premium*, 21 December 2011.

determining the extent to which returns are predictable. Prior to joining the University of Melbourne, Simon taught finance at the Universities of British Columbia, Chicago, New South Wales, Rochester and Washington.

**Brendan Quach** is a Senior Consultant at NERA with eleven 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.

In preparing this report, the joint authors (herein after referred to as 'we' or 'our' or 'us') confirm that we have made all the inquiries that we believe are desirable and appropriate and that no matters of significance that we regard as relevant have, to our knowledge, been withheld from this report. We acknowledge that we have read, understood and complied with the Federal Court of Australia's *Practice Note CM 7, Expert Witnesses in Proceedings in the Federal Court of Australia*. We have been provided with a copy of the Federal Court of Australia's *Practice Note CM 7, Expert Witnesses in Proceedings in the Federal Court of Australia*, dated 1 August 2011, and our report has been prepared in accordance with those guidelines.

We have undertaken consultancy assignments for the Energy Networks Association in the past. However, we remain at arm's length, and as independent consultants.

# 2. Historical Data

Dimson, Marsh and Staunton (2012) and Brailsford, Handley and Maheswaran (2012) provide two different estimates of the long-run Australian market risk premium (*MRP*) based on two different but closely related series of returns to a value-weighted portfolio of Australian stocks.[16] In their *Credit Suisse Global Investment Returns Sourcebook 2012*, Dimson, Marsh and Staunton report that the arithmetic mean of the annual return to a value-weighted portfolio of Australian stocks, exclusive of imputation credits, from 1900 to 2011, is 12.9 per cent. The arithmetic mean of the series of annual returns to a value-weighted portfolio of Australian stocks that Brailsford, Handley and Maheswaran supply and that we update, exclusive of imputation credits, from 1900 to 2011, is 11.9 per cent. Thus the arithmetic mean of the series of annual returns that Brailsford, Handley and Maheswaran supply is a full percentage point below the arithmetic mean of the series that Dimson, Marsh and Staunton use.

The difference between the two arithmetic means is primarily explained by differences in the way in which the dividends distributed by a value-weighted portfolio of Australian stocks were determined by those who provided the data to the two sets of authors. Dimson, Marsh and Staunton (2012) use a series of dividend yields provided to them by Officer that is largely based on a series produced by Lamberton (1961).[17] Brailsford, Handley and Maheswaran (2012) use a series of yields provided to them by the Australian Stock Exchange that is also largely based on Lamberton's data.[18] The yields that Brailsford, Handley and Maheswaran use, however, have been adjusted downwards to take account of perceived deficiencies in the series that Lamberton provides.

In this section, we assess whether the adjustment to Lamberton's yield series in the data that Brailsford, Handley and Maheswaran employ is warranted and provide evidence that it is not entirely warranted. The evidence suggests that some adjustment should be made but that the adjustment should be smaller than the adjustment made to the data with which Brailsford, Handley and Maheswaran were provided. An estimate of the downwards bias generated by the inappropriate adjustment of Lamberton's yield series is only 18 basis points for the period that Dimson, Marsh and Staunton examine, 1900 to 2011, but is 37 basis points for the longer period, 1883 to 2011, on which the Australian Energy Regulator (AER) in large part relies.

Our estimates of the downward bias rely on Lamberton's series, Brailsford, Handley and Maheswaran's analysis of yield data for February 1966, our analysis of yield data for December 1891, December 1901, December 1911, December 1921, December 1931, December 1941, December 1951 and interpolation.

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16 Dimson, E., P. Marsh and M. Staunton, *Credit Suisse Global investment returns sourcebook 2012*, Credit Suisse, February 2012.

Brailsford, T., J. Handley and K. Maheswaran, *The historical equity risk premium in Australia: Post-GFC and 128 years of data*, Accounting and Finance, 2012, pages 237-247.

17 Dimson, E., P. Marsh and M. Staunton, *Credit Suisse Global investment returns sourcebook 2012*, Credit Suisse, February 2012.

Lamberton, D., *Ordinary share yields: A new statistical series*, Sydney Stock Exchange Official Gazette, 14 July 1961.

18 Brailsford, T., J. Handley and K. Maheswaran, *The historical equity risk premium in Australia: Post-GFC and 128 years of data*, Accounting and Finance, 2012, pages 237-247.

We begin by describing how each set of authors assembles their data.

## 2.1. Dimson, Marsh and Staunton Data

Dimson, Marsh and Staunton (2012) use data that Officer (1989) provides together with data for the Standard and Poors (S&P) All Ordinaries Accumulation Index to construct a series of with-dividend returns to a value-weighted portfolio of Australian stocks. [19] Officer's data consist of:

- the Commercial and Industrial price index assembled by Lamberton (1958) from 1882 to 1958; [20]
- the series of yields on ordinary shares provided by Lamberton (1958, 1961) from 1882 to 1958; [21]
- an accumulation index of 50 leading shares constructed by the Australian Graduate School of Management (AGSM) from 1958 to 1974; and
- the AGSM Value-Weighted Accumulation Index from 1975 to 1987. [22]

Dimson, Marsh and Staunton use these data from 1900 to 1979 but from 1980 onwards, they use:

- the S&P All Ordinaries Accumulation Index.

Dimson, Marsh and Staunton are aware of the data that Brailsford, Handley and Maheswaran (2008, 2012) assemble but state that because: [23]

> 'Brailsford, Handley and Maheswaran (2008) ... do not present alternative annual dividend estimates ... we continue to use Officer's dataset.'

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[19] Dimson, E., P. Marsh and M. Staunton, *Credit Suisse Global investment returns sourcebook 2012*, Credit Suisse, February 2012.

Officer, R., *Rates of return to shares, bond yields and inflation rates: An historical perspective*, in Ball, R., P. Brown, F. Finn and R. Officer (Eds), *Share markets and portfolio theory*, Second edition, University of Queensland Press, 1989.

[20] Lamberton, D., *Share price indices in Australia*, Sydney: Law Book Company, 1958.

Lamberton, D., *Some statistics of security prices and yields in the Sydney market, 1875-1955*, Economic Record, 1958, pages 253-259.

[21] Lamberton, D., *Security prices and yields*, Sydney Stock Exchange Official Gazette, 14 August 1958.

Lamberton, D., *Ordinary share yields: A new statistical series*, Sydney Stock Exchange Official Gazette, 14 July 1961.

[22] Officer constructs with-dividend returns from 1882 to 1958 using the price index and yield series that Lamberton provides and constructs with-dividend returns from 1958 to 1987 using the accumulation indices provided by the AGSM. Note that the percentage change in an accumulation index from one year to the next is the annual with-dividend return to the index.

[23] Brailsford, T., J. Handley and K. Maheswaran, *Re-examination of the historical equity risk premium in Australia*, Accounting and Finance 48, 2008, pages 73-97.

Brailsford, T., J. Handley and K. Maheswaran, *The historical equity risk premium in Australia: Post-GFC and 128 years of data*, Accounting and Finance, 2012, pages 237-247.

Dimson, E., P. Marsh and M. Staunton, *Credit Suisse Global investment returns sourcebook 2012*, Credit Suisse, February 2012, page 57.

## 2.2. Brailsford, Handley and Maheswaran Data

Brailsford, Handley and Maheswaran (2008, 2012) use data provided to them by the Australian Stock Exchange.[24] Surprisingly, when we asked the Australian Stock Exchange for the data and a description of how the data were constructed, we were told no reference to the data provided to Brailsford, Handley and Maheswaran could be found.[25] Brailsford, Handley and Maheswaran, however, state that their data are constructed from:[26]

- the Commercial and Industrial index assembled by Lamberton (1958) from 1882 to 1936;[27]
- the Sydney Stock Exchange (SSE) All Ordinary Shares price index from 1936 to 1979;
- the S&P All Ordinaries Accumulation Index from 1980 onwards;

and in a way that is not clearly specified:

- the Lamberton/SSE yield series from 1882 to 1979;[28]
- the Melbourne 50 Leaders weighted yield series from 1965 to 1979; and
- the Statex yield series from 1974 to 1979.

Although, the exact way in which these three yield series are used is not specified, Brailsford, Handley and Maheswaran (2008) indicate that an analysis of the data suggests that the yields provided by Lamberton and the SSE were lowered between 1882 and 1964 by multiplying

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24 Brailsford, T., J. Handley and K. Maheswaran, *Re-examination of the historical equity risk premium in Australia*, Accounting and Finance 48, 2008, pages 73-97.

Brailsford, T., J. Handley and K. Maheswaran, *The historical equity risk premium in Australia: Post-GFC and 128 years of data*, Accounting and Finance, 2012, pages 237-247.

25 To be precise, we sent an email to the ASX on 17 August 2011 stating that:

> '(we) would like to know from where the data Brailsford, Handley and Maheswaran are using came. They say the ASX but you tell (us) you know nothing about the data'

and were told by the ASX in an email dated 25 August 2011 that:

> 'the employee of the ASX who specialises in the field of Index Data is Brian Goodman ... he could not find any reference to the indices mentioned in your email dated August 15.'

This correspondence does not imply that Brailsford, Handley and Maheswaran did not correspond with the ASX. It implies only that the ASX either do not possess or cannot find the data provided to Brailsford, Handley and Maheswaran.

26 Brailsford, T., J. Handley and K. Maheswaran, *Re-examination of the historical equity risk premium in Australia*, Accounting and Finance 48, 2008, pages 78-79.

27 Lamberton, D., *Some statistics of security prices and yields in the Sydney market, 1875-1955*, Economic Record, pages 253-259.

28 Lamberton, D., *Share price indices in Australia*, Sydney: Law Book Company, 1958.

Lamberton, D., *Some statistics of security prices and yields in the Sydney market, 1875-1955*, Economic Record, pages 253-259.

them by 0.75.[29] Brailsford, Handley and Maheswaran suggest that Lamberton's series was adjusted downwards to take account of two perceived deficiencies in the series:

- Lamberton's series is an equally weighted rather than a value-weighted average of the yields on stocks and so places more weight on smaller, potentially higher yielding stocks; and
- the series is an average of only the yields on dividend-paying stocks and so places no weight on stocks that pay no dividends.

Brailsford, Handley and Maheswaran (2008) estimate the yield on a value-weighted index of 908 stocks for February 1966 and find it to be just 67 per cent of the yield on an equally weighted index of the 590 of the 908 stocks paying dividends. So they conclude that the adjustment made to the data with which they were supplied appears appropriate.

An analysis of the annual series that Brailsford, Handley and Maheswaran (2012) provide and Lamberton's series confirms that Lamberton's series was indeed multiplied by a factor of 0.75.[30] We are able to independently construct a series of annual with-dividend returns in per cent from 1883 to 1957 to a portfolio of Australian stocks that matches to one decimal place the series that Brailsford, Handley and Maheswaran provide in every year except one.[31] We provide evidence, though, that an adjustment that involves multiplying Lamberton's series by 0.75 has not always been warranted.

## 2.3. Lamberton Data

Around sixty years ago, Lamberton, who worked from 1949 to 1953 at the Sydney Stock Exchange before returning to academic life, started to assemble a database of stock prices and yields with the aim of creating a series of returns to an index of Australian stocks. To make the project manageable, Lamberton limited his attention to a representative sample of primarily larger stocks. The sample of stocks while small before 1900, however, grew thereafter. Lamberton describes the construction of his database in five reports:

> Lamberton, D., *Some statistics of security prices and yields in the Sydney market, 1875-1955*, Economic Record, pages 253-259.
>
> Lamberton, D., *Share price indices in Australia*, Sydney: Law Book Company, 1958.
>
> Lamberton, D., *Economic growth and stock prices: The Australian experience*, Journal of Business, 1958, pages 200-212.
>
> Lamberton, D., *Security prices and yields*, Sydney Stock Exchange Official Gazette, 14 July 1958, pages 257-258 and 14 August 1958, page 307.

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29 Brailsford, T., J. Handley and K. Maheswaran, *Re-examination of the historical equity risk premium in Australia*, Accounting and Finance 48, 2008, page 80.

30 Brailsford, T., J. Handley and K. Maheswaran, *The historical equity risk premium in Australia: Post-GFC and 128 years of data*, Accounting and Finance, 2012, pages 237-247.

31 The with-dividend return that Brailsford, Handley and Maheswaran report for 1921 is 19.9 per cent. We compute the return to be 19.8 per cent.

Lamberton, D., *Ordinary share yields: A new statistical series*, Sydney Stock Exchange Official Gazette, 14 July 1961.

Lamberton provides in the *Sydney Stock Exchange Official Gazette* monthly price series for three indices, an index of commercial and industrial stocks, an index of financial stocks and an index of mining stocks together with a list of the firms that he uses. The commercial and industrial series and financial series run from January 1875 to June 1936 while the mining series runs from January 1875 to December 1910. In addition, Lamberton provides in his book a number of monthly price series from July 1936 to December 1957 including a series for an index he labels All Ordinary Shares together with a list of the firms and issues that he uses. The series that Officer (1989) and Brailsford, Handley and Maheswaran (2008, 2012) construct use the index of commercial and industrial stocks from 1882 to 1936 and the All Ordinary Shares index from 1936 to 1957. [32]

Lamberton also provides in the *Sydney Stock Exchange Official Gazette* of 1958 a quarterly yield series that runs from the last quarter of 1882 to the last quarter of 1955. He subsequently provides in the *Sydney Stock Exchange Official Gazette* of 1961 a monthly yield series that runs from January 1956 to June 1961. The yield series that he produces uses all of the firms that he employs to construct price indices. In other words, Lamberton does not produce a yield series for each index that he constructs. Also, the yield series that he produces is not value-weighted. Our focus here is on this series and the extent to which it overstates the yield on a value-weighted index of stocks. In particular, we are interested in whether the adjustment made to the series that Brailsford, Handley and Maheswaran (2008, 2012) employ is appropriate over the entire length of the series. [33]

We focus on the period 1883 to 1957 because this is the period over which a high-quality alternative set of data – the AGSM data – are not available.

## 2.4. Adjustments

Brailsford, Handley and Maheswaran (2008) estimate the yield on a value-weighted index of 908 stocks for February 1966 and find it to be just 67 per cent of the yield on an equally weighted index of the 590 of the 908 stocks paying dividends. [34] So they conclude that the adjustment made to the data with which they were supplied appears appropriate. While neither Officer nor Dimson, Marsh and Staunton use the yield on an equally weighted index

32 Brailsford, T., J. Handley and K. Maheswaran, *Re-examination of the historical equity risk premium in Australia*, Accounting and Finance 48, 2008, pages 73-97.

Brailsford, T., J. Handley and K. Maheswaran, *The historical equity risk premium in Australia: Post-GFC and 128 years of data*, Accounting and Finance, 2012, pages 237-247.

Officer, R., *Rates of return to shares, bond yields and inflation rates: An historical perspective*, in Ball, R., P. Brown, F. Finn and R. Officer (Eds), *Share markets and portfolio theory*, Second edition, University of Queensland Press, 1989.

33 Brailsford, T., J. Handley and K. Maheswaran, *Re-examination of the historical equity risk premium in Australia*, Accounting and Finance 48, 2008, pages 73-97.

Brailsford, T., J. Handley and K. Maheswaran, *The historical equity risk premium in Australia: Post-GFC and 128 years of data*, Accounting and Finance, 2012, pages 237-247.

34 Brailsford, T., J. Handley and K. Maheswaran, *Re-examination of the historical equity risk premium in Australia*, Accounting and Finance 48, 2008, pages 73-97.

of stocks after 1958, and so in 1966, the observation that Brailsford, Handley and Maheswaran make suggests that an adjustment to Lamberton's series should be made. It is unclear, however, whether the same adjustment should be made to all yields from 1883 to 1958. To investigate whether the adjustment to be made should vary through time, we collect yield data for the years 1891, 1901, 1911, 1921, 1931, 1941 and 1951 for the stocks that Lamberton uses to construct a yield series.

Lamberton (1958) states that in constructing price series:

> 'data were taken from the following sources: *Sydney Morning Herald* financial pages, January 1875-September 1882; T. J. Thompson and Sons' monthly *Stock and Share Reports*, October 1882-December 1903; Sydney Stock Exchange official sales records, January 1904-June 1936. Details of the capitalization of companies were obtained from the *Sydney Morning Herald* financial pages, the *Australasian Insurance and Banking Record*, the *Australasian Joint Stock Companies' Year Books*, the monthly *Stock and Share Reports* of T. J. Thompson and Sons, *Jobson's Investment Digest*, and the *Investment Service* of the Research & Statistical Bureau of the Sydney Stock Exchange.'

On the other hand, Lamberton (1961) states about the yield series that he constructs that:

> 'the data, which relate to the end of the month except from 1914 to 1934 when mid-month values were used, were taken from the *Stock and Share Reports* of T. J. Thompson and Sons for the period 1882-1913, and from the *Sydney Stock Exchange Official Gazette* beginning with 1914.'

We use the some of the same sources that Lamberton employs. In particular, we use:

- data from the *Australasian Insurance and Banking Record* for 1891, 1901, 1911, 1921, 1931 and 1941;

- data from T. J. Thompson and Sons' monthly *Stock and Share Reports* for 1891, 1901 and 1911;

- data from the *Sydney Stock Exchange Official Gazette* for 1941 and 1951; and

- data from the *Sydney Morning Herald* for 1891, 1901, 1911, 1921, 1931, 1941 and 1951.

We also use:

- data from the *Australian Town and Country Journal* for 1891, data from the *Brisbane Courier* for 1901, data from the *Mercury* for 1921 and data from the *Argus* for 1941 to fill in some gaps.

We follow Lamberton and use end-of-month values for all years except 1921 and 1931, where we use mid-month values.

In general, we compute the dividend yield on the ordinary shares that a commercial, industrial or financial company has outstanding as:

$$\frac{RATE(t) \times PAID(t)}{PRICE(t)} \tag{1}$$

where

| | | |
|---|---|---|
| $RATE(t)$ | = | annual rate at which dividends were last paid in month *t*; |
| $PAID(t)$ | = | paid-up capital per share in month *t*; and |
| $PRICE(t)$ | = | average of bid and ask price per share in month *t* if both are available, the bid or ask if only one is available and the last sale if neither are available. |

As an example, as of the end of December 1891, bid and ask prices for the one issue of Tooth ordinary shares were 14/9 and 15/3, paid-up capital per share was £1, and dividends had been distributed at the last payment date at a rate of 8 per cent per annum.[35] So we compute the yield on a share of Tooth as of the end of December 1891 as:

$$\frac{8 \times 1}{((14+9/12)/20+(15+3/12)/20)/2} = 10.67 \text{ per cent} \tag{2}$$

In contrast, we typically compute the dividend yield on the ordinary shares that a mining company has outstanding as:

$$\frac{DIVIDENDS(t)}{PRICE(t)} \tag{3}$$

where

| | | |
|---|---|---|
| $DIVIDENDS(t)$ | = | the dividends paid out per share over the 12 months up to and including month *t*. |

We do so because the sources that we use do not indicate the annual rate at which mining companies pay dividends and because mining companies, at least in the earlier part of our data set, often do not pay dividends at regular intervals. As an example, as of the end of December 1891, bid and ask prices for Broken Hill Proprietary (BHP) ordinary shares were £7 3s. and £7 4s. and dividends of £1 4s. had been distributed over 1891.[36] So we compute the yield on a share of BHP as of the end of December 1891 as:

$$\frac{100 \times (1+4/20)}{(7+3/20+7+4/20)/2} = 16.72 \text{ per cent} \tag{4}$$

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[35] Recall that the notation X/Y means X shillings and Y pence. Recall also that prior to 1963 there were 12 pence to a shilling and 20 shillings to a pound.

[36] £X Ys. Means X pounds and Y shillings.

Table 2.1 provides various dividend yield estimates for the seven years that we select between 1883 and 1957 computed using all of the firms that Lamberton employs in constructing his yield series. The table shows that the number of firms and issues that Lamberton uses grows substantially through time. While Lamberton uses only 24 firms in 1891, he uses 166 firms in 1951. This largely reflects a growth in the number of firms listed on Australian exchanges. It may also, though, reflect an increase over time in the availability of data. The table also shows that firms may have more than one issue of ordinary shares outstanding. Where a firm has more than one issue of ordinary shares outstanding, we use all of the issues for which we can find data. The number of issues with missing data is small. There are 12 issues with missing data – they are predominantly mining companies in 1901 – while there are 532 issues without missing data. So less than 2½ per cent of the issues that Lamberton uses in constructing a series of yields are missing data.

Since Lamberton uses a variety of sources and we do not know precisely which sources he uses to compute the yield to each issue on each date, it is not surprising that our yield estimates differ from his. Our estimates, though, are strongly correlated with his estimates over time. The correlation between our estimate of the equally weighted average yield to dividend paying issues (firms) and his estimate is 0.93 (0.94) across the seven years we examine. Also, the means of our series come close to matching the mean of his estimates. The mean of our seven estimates of the equally weighted average yield to dividend paying issues (firms) is 7.19 (7.16) while the mean of his seven estimates is 7.09.

Table 2.1 shows that it is not always the case that an equally weighted average of the yields on stocks lies above a value-weighted average. In 1901, 1911, 1921, 1941 and 1951, an equally weighted average across issues or firms does lie above a value-weighted average but in 1891 and 1931, the reverse is true. Also, in only one of the seven years does the ratio of a value-weighted average to Lamberton's yield fall below the adjustment factor that Brailsford, Handley and Maheswaran (2008, 2012) use of 0.75.[37] The average ratio over the seven years is 0.85.

The results in Table 2.1 are for a portfolio formed from the stocks that Lamberton uses to construct a yield series. This portfolio includes financial and mining companies. Neither Officer (1989) nor Brailsford, Handley and Maheswaran (2008, 2012), however, use financial or mining stocks over the period 1882 to 1936.[38] They use instead a portfolio that contains only commercial and industrial companies. For this reason, we also examine what the data

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[37] Brailsford, T., J. Handley and K. Maheswaran, *Re-examination of the historical equity risk premium in Australia*, Accounting and Finance 48, 2008, pages 73-97.

Brailsford, T., J. Handley and K. Maheswaran, *The historical equity risk premium in Australia: Post-GFC and 128 years of data*, Accounting and Finance, 2012, pages 237-247.

[38] Brailsford, T., J. Handley and K. Maheswaran, *Re-examination of the historical equity risk premium in Australia*, Accounting and Finance 48, 2008, pages 73-97.

Brailsford, T., J. Handley and K. Maheswaran, *The historical equity risk premium in Australia: Post-GFC and 128 years of data*, Accounting and Finance, 2012, pages 237-247.

Officer, R., *Rates of return to shares, bond yields and inflation rates: An historical perspective*, in Ball, R., P. Brown, F. Finn and R. Officer (Eds), *Share markets and portfolio theory*, Second edition, University of Queensland Press, 1989.

indicate the adjustment factor should be for the data that Officer, Brailsford, Handley and Maheswaran use. Table 2.2 provides the results of this exercise.

**Table 2.1**
**Dividend yield estimates for 1891 to 1951 computed using firms that Lamberton (1958) employs in constructing his yield series**

| | 1891 | 1901 | 1911 | 1921 | 1931 | 1941 | 1951 |
|---|---|---|---|---|---|---|---|
| Panel A: Equally weighted averages | | | | | | | |
| Issues | 28 | 36 | 33 | 47 | 59 | 128 | 201 |
| Average across issues | 7.72 | 6.42 | 5.58 | 7.47 | 3.97 | 5.98 | 4.56 |
| Issues paying dividends | 20 | 28 | 32 | 45 | 41 | 116 | 169 |
| Average across dividend paying issues | 10.81 | 8.25 | 5.76 | 7.80 | 5.71 | 6.60 | 5.42 |
| Firms | 24 | 31 | 31 | 42 | 54 | 115 | 166 |
| Average across firms | 8.08 | 6.31 | 5.52 | 7.52 | 3.70 | 6.12 | 5.03 |
| Firms paying dividends | 17 | 25 | 30 | 41 | 36 | 106 | 158 |
| Average across dividend paying firms | 11.40 | 7.83 | 5.71 | 7.70 | 5.54 | 6.64 | 5.28 |
| Panel B: Value-weighted averages | | | | | | | |
| Value-weighted average across all firms and issues | 11.28 | 6.00 | 5.10 | 6.69 | 4.64 | 5.30 | 4.27 |
| Lamberton yield | 9.40 | 7.01 | 5.76 | 8.21 | 6.11 | 7.03 | 6.14 |
| Ratio of value-weighted average to Lamberton yield | 1.20 | 0.86 | 0.89 | 0.82 | 0.76 | 0.75 | 0.70 |
| Missing issues | 0 | 8 | 0 | 2 | 1 | 1 | 0 |

*Sources: Various issues of the Argus , Australasian Insurance and Banking Record, Australian Town and Country Journal, Brisbane Courier, Mercury, Sydney Morning Herald, Sydney Stock Exchange Official Gazette, T. J. Thompson and Sons' monthly Stock and Share Reports,*

*Lamberton, D., Ordinary share yields: A new statistical series, Sydney Stock Exchange Official Gazette, 14 July 1961.*

Like Table 2.1, Table 2.2 indicates that an equally weighted average of the yields on stocks does not always lie above a value-weighted average. Also, in only two of the seven years does the ratio of a value-weighted average to Lamberton's yield fall below the adjustment factor that Brailsford, Handley and Maheswaran (2008, 2012) use of 0.75.[39] The average ratio over the seven years is 0.82 and, more importantly, the ratio tends to be high when yields are high.

**Table 2.2**
**Dividend yield estimates for 1891 to 1951 computed using firms that Brailsford, Handley and Maheswaran (2012) employ in constructing their price series**

| | 1891 | 1901 | 1911 | 1921 | 1931 | 1941 | 1951 |
|---|---|---|---|---|---|---|---|
| Panel A: Equally weighted averages | | | | | | | |
| Issues | 9 | 12 | 22 | 36 | 48 | 128 | 201 |
| Average across issues | 10.80 | 5.30 | 5.51 | 8.01 | 3.77 | 5.98 | 4.56 |
| Issues paying dividends | 9 | 10 | 21 | 35 | 30 | 116 | 169 |
| Average across dividend paying issues | 10.80 | 6.36 | 5.78 | 8.23 | 6.03 | 6.60 | 5.42 |
| Firms | 7 | 10 | 21 | 33 | 44 | 115 | 166 |
| Average across firms | 11.84 | 5.92 | 5.41 | 7.89 | 3.44 | 6.12 | 5.03 |
| Firms paying dividends | 7 | 9 | 20 | 32 | 26 | 106 | 158 |
| Average across dividend paying firms | 11.84 | 6.57 | 5.68 | 8.13 | 5.82 | 6.64 | 5.28 |
| Panel B: Value-weighted averages | | | | | | | |
| Value-weighted average across all firms and issues | 8.97 | 5.78 | 5.26 | 7.37 | 4.39 | 5.30 | 4.27 |
| Lamberton yield | 9.40 | 7.01 | 5.76 | 8.21 | 6.11 | 7.03 | 6.14 |
| Ratio of value-weighted average to Lamberton yield | 0.95 | 0.83 | 0.91 | 0.90 | 0.72 | 0.75 | 0.70 |
| Missing issues | 0 | 0 | 0 | 2 | 1 | 1 | 0 |

*Sources: Various issues of the Argus , Australasian Insurance and Banking Record, Australian Town and Country Journal, Brisbane Courier, Mercury, Sydney Morning Herald, Sydney Stock Exchange Official Gazette, T. J. Thompson and Sons' monthly Stock and Share Reports,*

*Lamberton, D., Ordinary share yields: A new statistical series, Sydney Stock Exchange Official Gazette, 14 July 1961.*

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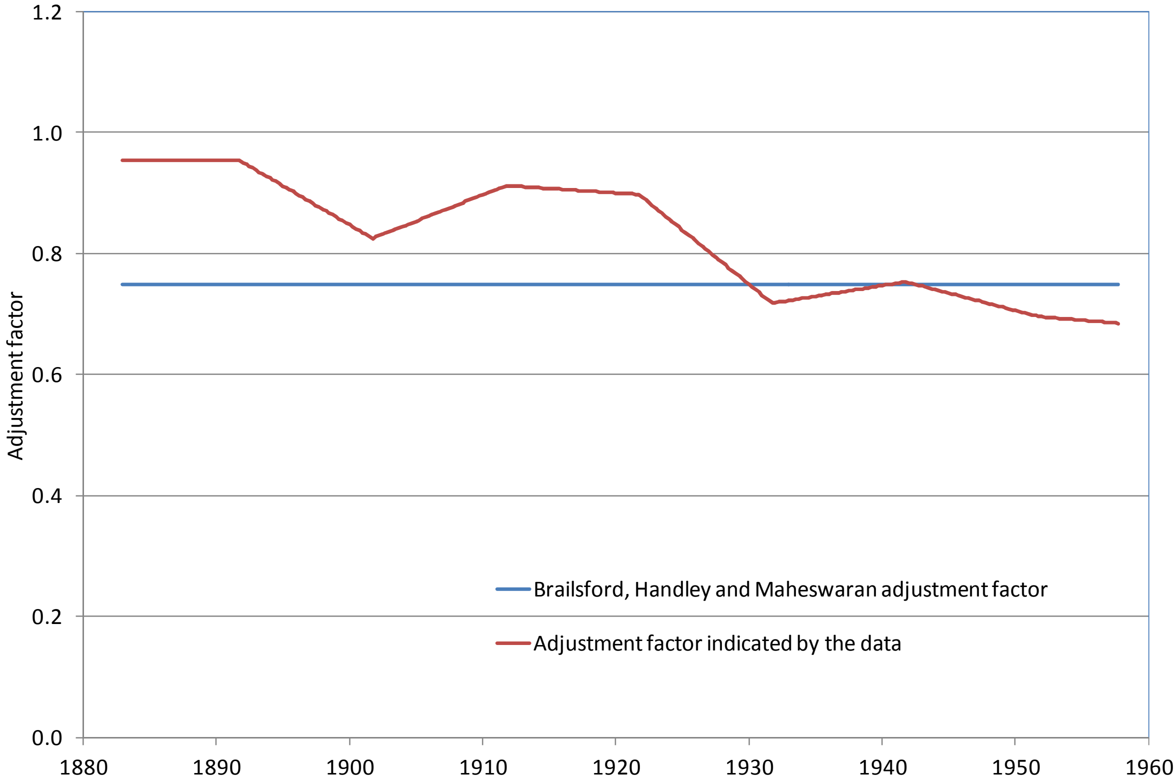
39 Brailsford, T., J. Handley and K. Maheswaran, *Re-examination of the historical equity risk premium in Australia*, Accounting and Finance 48, 2008, pages 73-97.

Brailsford, T., J. Handley and K. Maheswaran, *The historical equity risk premium in Australia: Post-GFC and 128 years of data*, Accounting and Finance, 2012, pages 237-247.

To produce an estimate of the adjustment that should be made to Lamberton's data each year to reflect our analysis and the analysis of Brailsford, Handley and Maheswaran (2008), we use linear interpolation. [40] Figure 2.1 plots the adjustment factors that we produce in this way against time. To be conservative, we do not use extrapolation to estimate the adjustment factor before 1891 but instead use the 1891 adjustment factor of 95.43 per cent.

**Figure 2.1**
**Adjustment factors**




*Sources: Various issues of the Argus , Australasian Insurance and Banking Record, Australian Town and Country Journal, Brisbane Courier, Mercury, Sydney Morning Herald, Sydney Stock Exchange Official Gazette, T. J. Thompson and Sons' monthly Stock and Share Reports,*

*Brailsford, T., J. Handley and K. Maheswaran, Re-examination of the historical equity risk premium in Australia, Accounting and Finance 48, 2008, pages 73-97.*

*Lamberton, D., Ordinary share yields: A new statistical series, Sydney Stock Exchange Official Gazette, 14 July 1961.*

Since the unadjusted Lamberton yield declines through time, the adjusted yield – the product of the unadjusted yield and the adjustment factor shown in Figure 2.1 – declines at an even faster pace. This feature of the data is illustrated in Figure 2.2. In addition, the impact on the arithmetic mean of the yields of adjusting the earlier yields by less is greater than the impact of adjusting the later yields by more. This is because the yields in the late 19th century were larger than the yields in the mid-20th century. Thus the impact of an upward adjustment to

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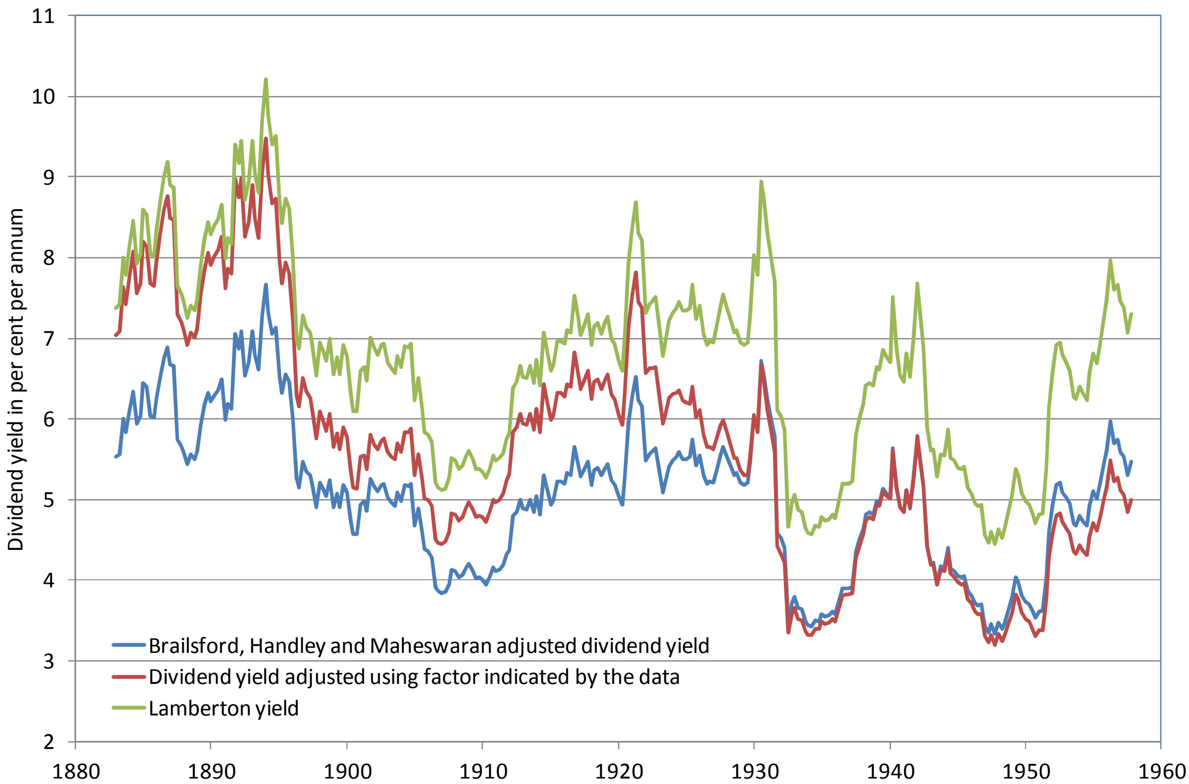
[40] Brailsford, T., J. Handley and K. Maheswaran, *Re-examination of the historical equity risk premium in Australia*, Accounting and Finance 48, 2008, pages 73-97.

the yields from the late 19th century is greater than the impact of a downward adjustment to the yields from the mid-20th century.

**Figure 2.2**
**Lamberton and adjusted dividend yields**




*Sources: Various issues of the Argus , Australasian Insurance and Banking Record, Australian Town and Country Journal, Brisbane Courier, Mercury, Sydney Morning Herald, Sydney Stock Exchange Official Gazette, T. J. Thompson and Sons' monthly Stock and Share Reports,*

*Brailsford, T., J. Handley and K. Maheswaran, Re-examination of the historical equity risk premium in Australia, Accounting and Finance 48, 2008, pages 73-97.*

*Lamberton, D., Ordinary share yields: A new statistical series, Sydney Stock Exchange Official Gazette, 14 July 1961.*

Dimson, Marsh and Staunton (2012), like Officer (1989), use high-quality data provided by the AGSM from 1958 onwards. [41] So in this report we focus on the impact of an adjustment to the yields that Lamberton (1961) provides from 1883 to 1957 on estimates of the market risk premium (*MRP*) that use the data that Dimson, Marsh and Staunton employ and on

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[41] Dimson, E., P. Marsh and M. Staunton, *Credit Suisse Global investment returns sourcebook 2012*, Credit Suisse, February 2012.

Officer, R., *Rates of return to shares, bond yields and inflation rates: An historical perspective*, in Ball, R., P. Brown, F. Finn and R. Officer (Eds), *Share markets and portfolio theory*, Second edition, University of Queensland Press, 1989.

estimates of the *MRP* that use the data that Brailsford, Handley and Maheswaran (2008, 2012) employ. [42]

To determine the impact, we recompute an estimate of the mean with-dividend return to the index that Lamberton (1958) provides using the factors that the data indicate that one should use to adjust Lamberton's (1961) yield series and compare this estimate to an estimate that uses an adjustment factor of 0.75. Table 2.3 provides the results of this exercise.

Table 2.3 indicates that the impact of multiplying Lamberton's yield series by 0.75 is to lower an estimate of the mean return to the market computed using data from 1883 to 1957 from 12.02 to 10.18, that is, by 184 basis points. The impact of adjusting the yield series by factors indicated by the data rather than by 0.75 is to raise an estimate of the mean from 10.18 to 10.81, that is, by 63 basis points.

Table 2.3 also indicates that the impact of multiplying Lamberton's yield series by 0.75 is to lower an estimate of the mean return to the market computed using data from 1900 to 1957 from 12.11 to 10.37, that is, by 174 basis points. The impact of adjusting the yield series by factors indicated by the data rather than by 0.75, on the other hand, is to raise an estimate of the mean from 10.37 to 10.73, that is, by 36 basis points.

**Table 2.3**
**Estimates of the return to the market portfolio**

| Adjustment factor | 1883-1957 | 1900-1957 |
|---|---|---|
| None | 12.02 | 12.11 |
| 0.75 | 10.18 | 10.37 |
| Indicated by the data | 10.81 | 10.73 |

*Sources: Various issues of the Argus , Australasian Insurance and Banking Record, Australian Town and Country Journal, Brisbane Courier, Mercury, Sydney Morning Herald, Sydney Stock Exchange Official Gazette, T. J. Thompson and Sons' monthly Stock and Share Reports,*

*Lamberton, D., Security prices and yields, Sydney Stock Exchange Official Gazette, 14 July 1958, pages 257-258.*

*Lamberton, D., Ordinary share yields: A new statistical series, Sydney Stock Exchange Official Gazette, 14 July 1961.*

It follows that the impact of adjusting the yield series by factors indicated by the data rather than by 0.75 on estimates of the *MRP* that use data from 1900 to 2011 is to raise an estimate of the mean return to the market and so the *MRP* by:

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[42] Brailsford, T., J. Handley and K. Maheswaran, *Re-examination of the historical equity risk premium in Australia*, Accounting and Finance 48, 2008, pages 73-97.

Brailsford, T., J. Handley and K. Maheswaran, *The historical equity risk premium in Australia: Post-GFC and 128 years of data*, Accounting and Finance, 2012, pages 237-247.

Lamberton, D., *Ordinary share yields: A new statistical series*, Sydney Stock Exchange Official Gazette, 14 July 1961.

$$36\times\left(\frac{1957-1899}{2011-1899}\right)=18\,\text{basis points} \tag{5}$$

The impact of adjusting the yield series by factors indicated by the data rather than by 0.75 on estimates of the *MRP* that use data over the period from 1883 to 2011 on which the AER largely relies is to raise an estimate of the mean return to the market and so the *MRP* by:

$$63\times\left(\frac{1957-1882}{2011-1882}\right)=37\,\text{basis points} \tag{6}$$

The larger impact on an estimate of the *MRP* computed using the longer series of data reflects the high yields on stocks in the late 19$^{th}$ century and the fact that the adjustment factor indicated by the data is considerably higher than 0.75 for the years prior to 1900.

Thus an estimate of the *MRP* computed using the data that Brailsford, Handley and Maheswaran (2012) supply for the period 1883 to 2010 and that we update to 2011, assuming a value of 35 cents is assigned to each dollar of imputation credits distributed, adjusted for the bias that we identify, will be 6.47 per cent per annum.[43, 44]

43 Brailsford, T., J. Handley and K. Maheswaran, *The historical equity risk premium in Australia: Post-GFC and 128 years of data*, Accounting and Finance, 2012, pages 237-247.

44 This value is the value laid down by the ACT in a decision on the market value of a one-dollar credit distributed. See ACT, Application by Energex Limited (Gamma) (No 5) [2011] ACompT 9, May 2011.

# 3. Siegel Averaging

In a recent report for the AER, Lally (2012) argues, on the basis of evidence that Siegel (1992) provides, that the sample mean of a series of historical returns to the market portfolio in excess of the yield on a government bond can be an upwardly biased estimate of the long-run *MRP*. [45] Lally's argument is based on a view that investors have systematically underestimated inflation and that while the real returns to stocks are, in the long run, protected against unanticipated inflation, the real returns to bonds are not protected against unanticipated inflation. Lally argues that while investors have in the past underestimated inflation, they will not do so in the future. As a result, he argues that while the real return to the market portfolio in the future will on average be similar to its real return in the past the real return to a government bond in the future will on average be higher than it has been in the past. So Lally argues that an unbiased estimate of the long-run *MRP* going forward will be lower than the sample mean, computed from past data, of a series of returns to the market portfolio in excess of the government bond yield.

We show here that Lally's argument makes little sense because the available evidence does not support the idea that those whose business it is to forecast inflation – that is, professional forecasters – systematically underestimate inflation. Indeed, the available evidence also shows that those who are not professional forecasters do not systematically underestimate inflation. We identify periods over which individuals have underestimated inflation but these are matched by periods over which individuals have overestimated inflation. So it is difficult to see how the sample mean of a series of returns to the market portfolio in excess of the yield on a government bond can be viewed as an upwardly biased estimate of the long-run *MRP*.

In addition, we note that while Siegel examines the holding-period returns to bonds, the AER uses the yield on a new 10-year bond each year in estimating the long-run *MRP*. Moreover, the AER measures the yield at the end of each year. These two factors will limit the impact that unanticipated inflation can have on the excess returns that the AER uses to estimate the long-run *MRP*.

## 3.1. Theory

Siegel (1992) examines the behaviour of US bill, bond and stock returns from 1802 to 1990 and finds that: [46]

> 'the real rate of return on equity held remarkably constant over this period, while the real return on fixed income assets declined dramatically.'

Table 3.1 below summarises his results. The real returns to bills and bonds are the real holding-period returns to the assets.

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[45] Lally, M., *The cost of equity and the market risk premium*, Victoria University of Wellington, 25 July 2012, pages 28-29.

[46] Siegel, J., *The equity premium: Stock and bond returns since 1802*, Financial Analysts Journal, January-February 1992, page 28.

Siegel considers that one explanation for the decline in the real returns provided by bonds might be that unanticipated inflation between 1926 and 1990 depressed real bond returns, because bonds are financial assets, but did not depress stock returns, because stocks are claims on real assets. For example, Siegel states that: [47]

> 'although the data demonstrate that returns on equities have compensated investors for increased inflation over the post-war period, the returns on fixed income securities have not. One possible explanation is that lenders did not anticipate inflation during much of the period.
>
> One could argue that a large part of the increase in the price level since World War II, especially since 1970, was unanticipated, hence bondholders did not have a chance to adjust their required returns. The progressive abandonment of the gold standard only slowly reduced investors' convictions about the stability of the long-run price level.
>
> Unanticipated inflation certainly lowered the real return on long-term bonds. Buyers of such instruments in the 1960s and early 1970s could scarcely have imagined the double-digit inflation that followed.'

**Table 3.1**
**Arithmetic average real returns to US bills, bonds and stocks: 1802-1990**

| Period | Bills | Bonds | Stocks |
|---|---|---|---|
| 1802-1870 | 5.4 | 5.2 | 6.9 |
| 1871-1925 | 3.3 | 4.0 | 7.9 |
| 1926-1990 | 0.6 | 1.8 | 8.6 |

*Note: Estimates are from Tables I and II of Siegel (1992). Arithmetic average real returns in per cent per annum are shown before tax. Siegel, J., The equity premium: Stock and bond returns since 1802, Financial Analysts Journal, January-February 1992, pages 28-36+48.*

Siegel notes, however, that the same argument cannot be used to explain the decline in the real returns to bills, evident in Table 3.1, because the exposure of short-term bonds like bills to unanticipated inflation is limited. For example, he states: [48]

> 'But unanticipated inflation is less important for short-term bonds. The inflationary process, although increasingly subject to long-term uncertainty, has been quite persistent and inertial in the short run. Short-term investors thus have a better opportunity to capture the inflation premium in the rate of interest as they roll over their investments. Short-term bonds should therefore provide better protection against unanticipated inflation than longer-term bonds.'

Siegel nevertheless states that: [49]

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[47] Siegel, J., *The equity premium: Stock and bond returns since 1802*, Financial Analysts Journal, January-February 1992, page 36.

[48] Siegel, J., *The equity premium: Stock and bond returns since 1802*, Financial Analysts Journal, January-February 1992, page 36.

> 'this protection is not perfect; unanticipated inflation may account for up to one percentage point of the decline in the real yield on short-term bonds over the sample period.
>
> This has been suggested to me by some preliminary work done by Charles Calomaris.'

Although Siegel is not clear about from where Calomaris produced an estimate of one percentage point, it is likely that the estimate was produced using the Livingston survey of business economists and data from the inception of the survey in 1946 until 1990. We show below that this estimate of average unanticipated inflation does not differ significantly from zero at conventional levels and, in addition, that an estimate that uses data from 1946 to 2012 is only half as large and also not significantly different from zero at conventional levels. Moreover, we show that an estimate of average unanticipated inflation computed using the ASA-NBER survey of professional forecasters is smaller still and is also not significantly different from zero.

## 3.2. Data

To examine whether market participants have in the past underestimated the level of inflation we use two surveys: the Livingston survey of business economists and the American Statistical Association (ASA) and the National Bureau of Economic Research (NBER) survey of professional forecasters.

### 3.2.1. Livingston survey

In 1946, Joseph A. Livingston, then a columnist for the *Philadelphia Record,* began asking business economists whom he knew to provide him with their forecasts for important economic variables – including the consumer price index. He conducted the survey every six months, in June and December, continuing the survey when he moved from the *Record* to the *Bulletin* in 1948 and to the *Philadelphia Inquirer* in 1972. On Livingston's death in 1989, the Philadelphia Federal Reserve took over the running of the survey.
For simplicity, we focus our analysis on forecasts made in December of each year. The December survey is mailed to participants in November of each year, immediately after the government's release of the consumer price index (CPI) for October and the Fed requests that the survey be returned before the release of the CPI for November. Each participant is asked to make forecasts at a number of horizons. We focus on forecasts made of the rate of change in the CPI – that is, inflation – on an annual basis from the end of June of the following year to the end of December of the following year. We do so because until 1992 participants were not asked in December to forecast the CPI for that month – which along with the CPI for November would not have been announced before participants returned their surveys.

Each year, we compare the medians of the inflation forecasts made by participants with the actual level of inflation computed on an annual basis from June to December. Prior to December 2004, participants were asked to provide forecasts that were not seasonally adjusted whereas from December 2004 onwards they were asked to provide seasonally

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[49] Siegel, J., *The equity premium: Stock and bond returns since 1802*, Financial Analysts Journal, page 36.

adjusted forecasts. We compare the forecasts with the corresponding series for the CPI All Urban Consumers All Items taken from the Bureau of Labor Statistics. [50]

### 3.2.2. ASA-NBER survey

The ASA-NBER survey has asked professional forecasters for predictions of a large number of economic variables four times each year since 1968. The Philadelphia Federal Reserve now also runs this survey. For simplicity, we focus on forecasts made in the last quarter of each year of the rate of change in the GDP price index – that is, inflation – between the second and fourth quarters of the following year. We do so because when participants return their surveys they do not know the value of the index in the fourth quarter – and participants during the fourth quarter are not asked to forecast the value of the index in the fourth quarter.

We compare the medians for each year of the inflation forecasts made by participants with the actual level of inflation computed on an annual basis from the second to the fourth quarter of each year. Prior to 1992, participants were asked to provide forecasts not of the GDP price index but instead of the GNP price deflator while from 1992 to 1995 they were asked to provide instead forecasts of the GDP implicit price deflator. We compare the forecasts participants make with the percentage change in the corresponding price variable taken from the Federal Reserve of St Louis web site. [51]

### 3.2.3. Bond data

Besides examining whether forecasts of inflation made by the Livingston and ASA-NBER survey participants are rational, we also test for a link between unanticipated inflation and bond holding-period returns and between unanticipated inflation and bond yields. We use monthly holding-period returns to a portfolio of long-term government bonds from the *Ibbotson SBBI 2012 Classic Yearbook* and we use the yields on 10-year government bonds from the Board of Governors of the Federal Reserve System web site. [52]

## 3.3. Evidence

### 3.3.1. Rationality

Figure 3.1 plots unanticipated inflation over the second half of each year computed using the two surveys. Unanticipated inflation is actual inflation less forecast inflation. It is clear that forecasts made by participants in the Livingston survey were very poor for the first few years. Survey participants forecast deflation in the four years from 1947 to 1950 but prices rose rapidly in both 1947 and 1950 – falling only in 1949. [53] It is also evident that both the Livingston and ASA-NBER forecasts tend to underestimate inflation up until the

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[50] The not seasonally adjusted series is CUUR0000SA0 while the seasonally adjusted series is CUSR0000SA0.

[51] The GNP implicit price deflator series is GNPDEF, the GDP implicit price deflator series is GDPDEF while the GDP price index series is GDPCTPI.

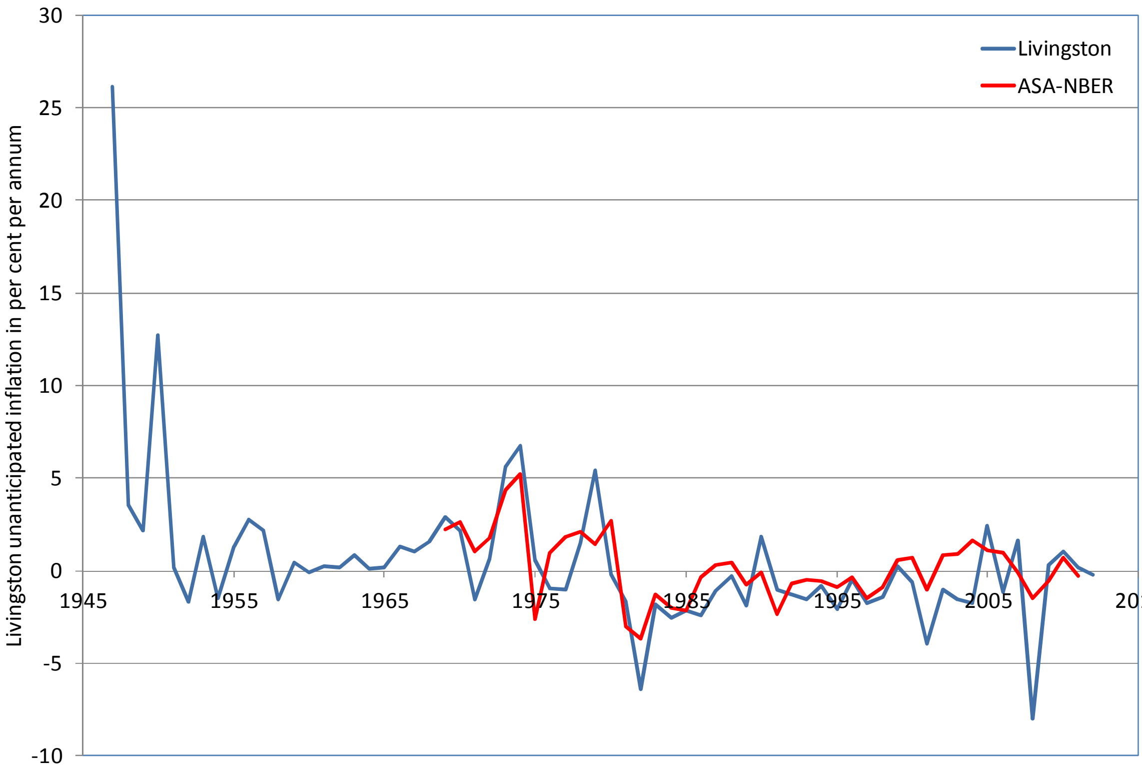
[52] The 10-year bond yield series is H15_TCMNOM_Y10_MONTHLY.

[53] Aizenman and Marion argue that the large public debt accumulated by the U.S. by the end of World War II and the longer maturities attached to the debt provided an incentive for the Federal Reserve to inflate away some of the burden.

Aizenman, J. and N. Marion, *Using inflation to erode the U.S. public debt*, NBER, 2009.

appointment of Paul Volcker as Chairman of the Federal Reserve and overestimate inflation thereafter. Paul Volcker was appointed Chairman of the Federal Reserve in July 1979 and is generally credited with bringing inflation in the U.S. under control.[54] On average over time, however, it appears that neither survey systematically underestimates or overestimates inflation.

**Figure 3.1**
**ASA-NBER and Livingston measures of unanticipated inflation**




These inferences are confirmed by tests, the results for which appear in Table 3.2. There is no evidence that in the long run either the Livingston or ASA-NBER participants systematically underestimate inflation.

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[54] See, for example, Poole (2005).

Poole, W., *Volcker's handling of the great inflation taught us much*, The Regional Economist, St Louis Federal Reserve, 2005.

**Table 3.2**
**Rationality of Livingston and ASA-NBER inflation forecasts**

| Survey | Sample mean of unanticipated inflation in per cent per annum | | | |
|---|---|---|---|---|
| | 1947-1990 | 1947-2012 | 1947-1979 | 1980-2012 |
| Livingston | 1.298 | 0.517 | 2.294* | -1.260* |
| | (0.733) | (0.526) | (0.894) | (0.355) |
| | 1969-1990 | 1969-2011 | 1969-1979 | 1980-2011 |
| ASA-NBER | 0.499 | 0.165 | 1.908* | -0.434 |
| | (0.502) | (0.280) | (0.603) | (0.240) |

*Note: Data are from the Bureau of Labor Statistics, the Federal Reserve of Philadelphia and the Federal Reserve of St Louis. Sample means are outside of parentheses while standard errors are in parentheses. * indicates significantly different from zero at the 5 per cent level.*

### 3.3.2. Bond returns, bond yields and unanticipated inflation

If inflation is persistent, then unanticipated inflation can raise expectations of future inflation. It follows that if bond yields reflect the market's expectation of future inflation, holding-period returns on bonds will be negatively related to unanticipated inflation while changes in bond yields will be positively related to unanticipated inflation. The holding-period return to a bond from time *t* to time *t*-1 is defined to be:

$$\frac{P(t)+C(t)-P(t-1)}{P(t-1)} \tag{7}$$

where

$P(t)$ = the price of the bond at time *t* ;

$C(t)$ = the coupon the bond pays at time *t*.

Table 3.3 below shows that this expectation is borne out. Moreover, the results in the table demonstrate that, consistent with expectations, bond returns are more sensitive to unanticipated inflation than bond yields. In other words, the slope coefficient estimates in the bond return column are larger than the slope coefficient estimates in the yield change column. The reason for this difference is that an increase in the yield on a long-term bond of one per cent will be associated with a decline of far more than one per cent in its price.

While Siegel examines the holding-period returns to bonds, the AER uses the yield on a new 10-year bond each year in estimating the long-run *MRP*. In addition, the AER measures the yield at the end of each year. Table 3.3 suggests that these two factors will limit the impact that unanticipated inflation can have on the excess returns that the AER uses to estimate the long-run *MRP*. First, the impact of unanticipated inflation on bond returns is much larger than on bond yields. Second, the AER measures the yield on a bond at the end of each year at which time the impact of unanticipated inflation over the year will have been incorporated into the yield.

**Table 3.3**
**Bond returns, bond yields and unanticipated inflation**

| Survey | Bond returns | Bond yield changes |
|---|---|---|
| Livingston (1953 – 2012) | -1.617* | 0.168* |
| | (0.553) | (0.061) |
| ASA-NBER (1969 – 2011) | -2.133* | 0.255* |
| | (0.854) | (0.110) |

*Note: Data are from the Bureau of Labor Statistics, the Board of Governors of the Federal Reserve, the Federal Reserve of Philadelphia and the Federal Reserve of St Louis. Slope coefficients from regressions of bond returns or bond yield changes on unanticipated inflation are outside of parentheses while heteroscedasticity and autocorrelation consistent standard errors are in parentheses. * indicates significantly different from zero at the 5 per cent level.*

## 3.4. QCA Estimates

The Queensland Competition Authority (QCA) (2012) uses Lally's suggestion and computes an estimate of the long-run *MRP* for Australia of 4.32 per cent per annum.[55] The QCA should arrive at this figure by subtracting the difference between what it deems to be the long-run real yield, 4 per cent, and the average real holding-period return from 1900 to 2000 of 1.9 per cent that Dimson, Marsh and Staunton (2002) report, from an estimate of the with-imputation-credit *MRP* taken from Brailsford, Handley and Maheswaran (2012) of 6.21 per cent per annum.[56, 57] That is, the figure that the QCA should have produced should have been:

$$6.21 - (4.00 - 1.90) = 4.11 \text{ per cent per annum} \tag{8}$$

Clearly, however, the QCA has made an arithmetical error and has instead subtracted the long-run real yield of 1.9 per cent from the with-imputation-credit *MRP* of 6.21 per cent per annum. Regardless of how the QCA arrived at the figure, though, the QCA assumes that investors have underestimated inflation by around two per cent each year over the 128-year period from 1883 to 2010. The evidence that we provide suggests that this assumption is not credible.

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55 QCA, The risk-free rate and the market risk premium, November 2012, page 11.

56 We ignore here the concerns that we raise about Brailsford, Handley and Maheswaran's data in Section 2.

57 Brailsford, T., J. Handley and K. Maheswaran, *The historical equity risk premium in Australia: Post-GFC and 128 years of data*, Accounting and Finance, 2012, pages 237-247.

Dimson, E., P. Marsh, and M. Staunton, *Triumph of the Optimists*, Princeton University Press: Princeton, New Jersey, United States, 2002.

# 4. Arithmetic versus Geometric Means

We emphasise in our March 2012 on behalf of the APA Group, Envestra, Multinet and SP AusNet ("our March 2012 report") that an estimate of the long-run *WACC* that is based on the arithmetic mean of a sample of annual excess returns to the market portfolio will – so long as the other components of the *WACC* have been correctly computed and ignoring minor adjustments to the regulated asset base (*RAB*) and to the evolution of prices – produce an unbiased estimate of the revenue that the market requires in any one year on the *RAB*.[58] We also emphasise that, in contrast, an estimate of the *WACC* that is in part based on an estimate of the *MRP* that places a positive weight on the geometric mean of a sample of annual excess returns to the market portfolio will produce a downwardly biased estimate of the revenue that the market requires in any one year.

We show in our March 2012 report that the downward bias associated with an estimate of the long-run *MRP* that uses the geometric mean can be substantial.[59] We provide estimates of the bias using simulations that employ data designed to have the same characteristics as the data that Brailsford, Handley and Maheswaran (2012) provide and that we update.[60] These simulations indicate that the downward bias associated with an estimate of the *MRP* over any single year that uses the geometric mean and data from 1883 through 2011 (1958 through 2011) is 134 (251) basis points.

While an estimate of the *WACC* compounded over more than one year, based on the arithmetic mean of a sample of annual excess returns to the market portfolio, will be biased, the AER, aside from some minor adjustments to the *RAB* and to the evolution of prices over the regulatory period, never compounds the *WACC* over more than one year.

In independent advice provided at the AER's request, Lally (2012) reaches the same conclusion.[61] He states that:[62]

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

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58 NERA, *Prevailing conditions and the market risk premium: A report for APA Group, Envestra, Multinet & SP AusNet*, March 2012, pages 3-16.

59 NERA, *Prevailing conditions and the market risk premium: A report for APA Group, Envestra, Multinet & SP AusNet*, March 2012, pages 3-16.

60 Brailsford, T., J. Handley and K. Maheswaran, *The historical equity risk premium in Australia: Post-GFC and 128 years of data*, Accounting and Finance, 2012, pages 237-247.

61 Lally, M., *The cost of equity and the market risk premium*, Victoria University of Wellington, 25 July 2012.

62 Lally, M., *The cost of equity and the market risk premium*, Victoria University of Wellington, 25 July 2012, pages 31-32.

In their December 2011 report, McKenzie and Partington recognise that an estimate of the *WACC* compounded over more than one year, based on the arithmetic mean of a sample of annual excess returns to the market portfolio, will be biased. [63] They state, for example that:[64]

> 'The problem with the use of annual arithmetic averages, is that compounding an arithmetic average will lead to a bias.'

There is no sign in their December 2011 report, however, that McKenzie and Partington know whether or not the AER ever compounds an arithmetic average. In other words, while McKenzie and Partington recognise in their report that, in principle, compounding an arithmetic average can generate bias, they do not appear to know whether, in practice, the AER ever compounds an arithmetic average. They conclude their December 2011 analysis with the statement: [65]

> 'we recommend using the arithmetic average. This recommendation, however, is subject to the caveat that due recognition be given to the likely overestimation bias inherent in the use of the arithmetic average.'

Two months later in their February 2012 report, on the other hand, McKenzie and Partington (2012) state that:[66]

> 'We make it clear that the unbiased estimator of the MRP lies between the arithmetic average and the geometric average.'
>
> 'The evidence solidly supports the AER's position that over the ten year regulatory period the unbiased MRP lies somewhere between the arithmetic average and the geometric average of annual returns.'

The regulatory period is, of course, five years and not ten years. More importantly, the AER, as we stress in our March 2012 report and Lally (2012) makes clear, never – ignoring minor adjustments to the *RAB* and to the evolution of prices – compounds an arithmetic average. Thus an unbiased estimate of the *MRP* should place no weight on a geometric average.

The AER, though, argues in its Multinet Draft Decision that it does compound arithmetic averages. It states that: [67]

> 'the building block model is a tool to achieve an outcome whereby the present value of expected revenue equals the present value of expected expenditure over the life of the regulated assets. From this perspective, the AER considers an appropriate discount rate requires the evaluation of an expected multi-period cost of equity.'

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63 McKenzie, M. and G. Partington, *Report to Corrs Chambers Westgarth: Equity market risk premium*, 21 December 2011.

64 McKenzie, M. and G. Partington, *Report to Corrs Chambers Westgarth: Equity market risk premium*, 21 December 2011, page 11.

65 McKenzie, M. and G. Partington, *Report to Corrs Chambers Westgarth: Equity market risk premium*, 21 December 2011, page 12.

66 McKenzie, M. and G. Partington, *Report to the AER: Supplementary report on the equity market risk premium*, SIRCA Limited, 22 February 2012, pages 5-7.

67 AER, *Draft decision | Multinet 2013–17 | Draft decision appendices*, September 2012, page 30.

For this reason, the AER dismisses the concerns that we raise in our March 2012 report. For example, the AER states in its Roma to Brisbane Draft Decision that: [68]

> 'while the issues are technical and complex, the AER considers NERA's concerns are no longer valid. To determine a profile of revenues in which the NPV=0 outcome holds, an appropriate discount rate must be used, which requires the evaluation of an expected multi-period cost of equity.'

Given its own views and the conflicting advice provided by McKenzie and Partington (2011, 2012) and Lally (2012), the AER concludes that: [69]

> 'the consultants have different views, which need assessing to determine a reasonable approach. In view of the conflicting evidence, the AER considers it should review both arithmetic and geometric averages when considering the historical estimates of the MRP. It is aware of potential deficiencies with both averages, so does not exclusively rely on one or the other.'

We show here that use of the revenue equation, the asset-base roll-forward equation and an estimate of the *MRP* based on the arithmetic mean of a time series of excess returns to the market portfolio imply that, on average, the present value principle will be satisfied. We also show that use of the revenue equation, the asset-base roll-forward equation and an estimate of the *MRP* that places a positive weight on the geometric mean of a time series of excess returns to the market portfolio imply that, on average, the present value principle will be violated. Finally, we emphasise, as we make clear in our March 2012 report and Lally (2012) makes clear, that the AER never – ignoring minor adjustments to the *RAB* and to the evolution of prices – compounds an estimate of the *MRP*.

## 4.1. The Bias Produced by Compounding

While the arithmetic mean of a sample of returns will provide an unbiased estimate of the unconditional expected return to an asset over a single period (so long as the expectation exists), the use of arithmetic means and the use of geometric means can provide biased estimates of unconditional expected multi-period returns. [70, 71] To see why the use of arithmetic means can provide biased estimates of expected multi-period returns, it will be

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68 AER, *APT Petroleum Pipeline Pty Ltd Access arrangement draft decision Roma to Brisbane Pipeline 2012–13 to 2016–17*, April 2012, page 294.

69 AER, *Draft decision | Multinet 2013–17 | Draft decision appendices*, September 2012, page 30.

Lally, M., *The cost of equity and the market risk premium*, Victoria University of Wellington, 25 July 2012.

McKenzie, M. and G. Partington, *Report to Corrs Chambers Westgarth: Equity market risk premium*, 21 December 2011.

McKenzie, M. and G. Partington, *Report to the AER: Supplementary report on the equity market risk premium*, SIRCA Limited, 22 February 2012.

70 There are random variables which have no means. The mathematical expectation of a Cauchy random variable, for example, does not exist. We assume from henceforth that the expected values to which we refer exist.

71 The unconditional expectation of a random variable is the mean of its marginal probability distribution. The conditional expectation of a random variable, on the other hand, is the mean of the probability distribution of a random variable conditional on some other variable or variables. Our focus in this section of the report is on unconditional expectations.

useful to consider a simple example. Define $A$ to be the arithmetic mean of a sample of gross annual returns, that is, define:

$$A = \sum_{t=1}^{T} \frac{R(t)}{T}, \tag{9}$$

where

| | | |
|---|---|---|
| $R(t)$ | = | one plus the rate of return to some asset from $t$-1 to $t$; and |
| $T$ | = | the number of observations. |

If the return to the asset is serially uncorrelated, that is, if past returns are not useful for forecasting future returns, then the expected value of an estimate of the expected return to the asset over two years that uses the arithmetic mean will be:

$$\mathrm{E}(A^2) = [\mathrm{E}(A)]^2 + \mathrm{Var}(A) = \mathrm{E}(R(t)^2) + \mathrm{Var}(A) > \mathrm{E}(R(t)^2). \tag{10}$$

The bias associated with estimates of expected multi-period returns that use the arithmetic mean arises from the fact that the expectation of a function of a random variable will not in general equal the same function of the expectation of the variable. So in this simple example, the expectation of the square of the random variable does not equal, but exceeds the square of the expectation.[72] The key point that we wish to make, however, is that the AER, aside from some minor adjustments to the *RAB* and to the evolution of prices over the regulatory period, never uses the arithmetic mean of a sample of annual returns to estimate the expected value of a return over more than one year.

## 4.2. The AER Never Compounds

To see that the AER never compounds an estimate of the *MRP*, it will be helpful to understand how by use of the revenue condition the AER can ensure that the present value principle is, on average, satisfied.

The present value principle requires that:

72 To see that the arithmetic mean of a sample of returns will provide an *unbiased* estimate of the unconditional expected return to an asset over a single period, note that:

$$\mathrm{E}(A) = \mathrm{E}\left(\sum_{t=1}^{T} \frac{R(t)}{T}\right) = \sum_{t=1}^{T} \frac{\mathrm{E}(R(t))}{T} = \frac{T\,\mathrm{E}(R(t))}{T} = \mathrm{E}(R(t)).$$

$$RAB(t) = \sum_{s=1}^{5} \frac{E(REV(t+s)) - E(CAPEX(t+s)) - E(OPEX(t+s)) - E(TAX(t+s))}{(1+WACC)^s} + \frac{E(RAB(t+5))}{(1+WACC)^5}, \qquad (11)$$

where

| | | |
|---|---|---|
| $RAB(t)$ | = | the regulated asset base of the utility at the end of year $t$; |
| $REV(t)$ | = | the utility's revenue in year $t$; |
| $CAPEX(t)$ | = | capital expenditure in year $t$; |
| $OPEX(t)$ | = | operating expenditure in year $t$; |
| $TAX(t)$ | = | company tax paid in year $t$; and |
| $WACC$ | = | the utility's $WACC$ – a parameter unknown to the regulator. |

Equation (11) states that the discounted value of the revenues that the *RAB* is expected to generate over the five years of the regulatory period plus the discounted value of the *RAB* five years from now must match the *RAB* today. Note that while the utility's true *WACC* is compounded, the *WACC* is a parameter and not an estimate. In other words, the true *WACC* is not a random variable. The expected value of the revenue that the AER allows a regulated utility each year is determined by the revenue equation:

$$E(REV(t+s)) = AERK \times E(RAB(t+s-1)) + E(DEP(t+s)) + E(OPEX(t+s)) + E(TAX(t+s)), \qquad (12)$$

where

| | | |
|---|---|---|
| $AERK$ | = | the value that the regulator chooses for the $WACC$; and |
| $DEP(t)$ | = | depreciation in year $t$. |

Unlike the true *WACC*, *AERK* is not a parameter but is instead an estimator. In other words, *AERK* is a random variable. Substitution of the revenue equation (12) into the present value condition (11) yields:

$$RAB(t) = \sum_{s=1}^{5} \frac{AERK \times E(RAB(t+s-1)) - E(CAPEX(t+s)) + E(\mathrm{DEP}(t+s))}{(1+WACC)^s} \qquad \frac{E(RAB(t+5))}{(1+WACC)^5}, \qquad (13)$$

The asset-base roll-forward equation, however, states that:

$$RAB(t+s) = RAB(t+s-1) + CAPEX\,(t+s) - DEP(t+s) \tag{14}$$

Substitution of the asset-base roll-forward equation (14) into the present value condition (13) yields the condition:

$$(AERK - WACC)\sum_{s=1}^{5} \frac{\mathrm{E}(RAB(t+s-1))}{(1+WACC)^{s}} = 0 \tag{15}$$

This condition will be satisfied only if the value for the *WACC* that the regulator chooses, *AERK*, matches the firm's *WACC*. The condition will be satisfied on average only if the value for the *WACC* that the regulator chooses, *AERK*, matches the firm's *WACC* on average, that is, only if:

$$\mathrm{E}(AERK) = WACC \tag{16}$$

This condition states that the value for the one-period *WACC* that the regulator chooses, *AERK*, must be an unbiased predictor of the firm's true one-period *WACC*. An estimate of the *WACC* that is based, in part, on the arithmetic mean of a sample of annual excess returns to the market portfolio will produce an unbiased estimate of the true *WACC* and so will lead the present value principle to be on average satisfied. In contrast, an estimate of the *WACC* that is in part based on an estimate of the *MRP* that places a positive weight on the geometric mean of a sample of annual excess returns to the market portfolio will produce a downwardly biased estimate of the true *WACC* and will lead the present value principle to be on average violated.

# 5. Choice of Sample

Recent evidence that the AER provides suggests that the *MRP* has declined through time. We emphasise here that there is no significant evidence that the *MRP* has declined. Indeed, the samples that the AER employs could have been chosen to provide the appearance that the *MRP* has risen.

## 5.1. Appearance

On page 94 of its recent draft decision: *Access arrangement draft decision Multinet Gas (DB No. 1) Pty Ltd Multinet Gas (DB No. 2) Pty Ltd 2013-17* (the *Draft Decision*)), the AER provides a table with a number of estimates of the *MRP* computed from historical data from 1883 to 2011. We reproduce this table, Table 4.3, below.

**Table 4.3 Historical excess return estimates—, assuming a use rate of distributed imputation credits of 0.35 (per cent)**

| Sampling period | Arithmetic mean | Geometric mean |
|---|---|---|
| 1883–2011 | 6.1[a] | 4.7 |
| 1937–2011 | 5.7[a] | 3.7 |
| 1958–2011 | 6.1[a] | 3.5 |
| 1980–2011 | 5.7 | 3.1 |
| 1988–2011 | 4.9 | 3.0 |

a Indicates estimates are statistically significant at the 5 per cent level using a two tailed test.
Source: Handley.[286]

There are plausible arguments for choosing each of the sample periods that the AER uses:

- 1883 is the first full year of ordinary share yields that Lamberton (1961) provides and so marks the start of the annual series of data on which most authors rely; [73]
- 1937 is the first full year of ordinary share price index data that Lamberton (1958) provides in his landmark study; [74]
- 1958 is the year in which Lamberton published a number of his studies of past stock price behaviour – so his samples typically end at the end of 1957. [75] It is also the first

[73] Lamberton, D., *Ordinary share yields: A new statistical series*, Sydney Stock Exchange Official Gazette, 14 July 1961.

[74] Lamberton provides a monthly All Ordinary Shares price series from July 1936 to December 1957. This series also forms part of the longer Sydney All Ordinaries Index published by Stock Exchange Research in 1986.

Lamberton, D., *Share price indices in Australia*, Sydney: Law Book Company, 1958.

Stock Exchange Research Pty Ltd, *Stock exchange indices and statistics,* Stock Exchange Research, Sydney, NSW, 1986.

[75] Lamberton, D., *Share price indices in Australia*, Sydney: Law Book Company, 1958.

year for which the Share Price and Price Relative database, constructed by the Australian Graduate School of Management and now maintained by SIRCA, provide data – although the AER, unlike Officer (1989) and Dimson, Marsh and Staunton (2012), do not use these data; [76]

- 1980 is the first full year for which data on the S&P (Australian Stock Exchange) ASX All Ordinaries Price and Accumulation Indices are available; and

- 1988 is the first full year in the modern era in which an imputation system operated.

Table 4.3 from the AER's *Draft Decision* provides the appearance that the *MRP* has fallen over the last 129 years. Although the table provides this appearance, however, formal tests of the hypothesis provide no evidence to indicate that the *MRP* has changed over the last 129 years. Table 5.1 below shows that there are no significant differences between the *MRP* estimates over the periods 1883-1936, 1883-1957, 1883-1979 and 1883-1987 and the corresponding estimates over the periods 1937-2011, 1958-2011, 1980-2011 and 1988-2011 regardless of whether one uses the yield series that Brailsford, Handley and Maheswaran (2012) provide or one adjusts the yield series in the way that we describe in section 2. [77] The table also shows that a Wald test indicates that there are no significant differences between *MRP* estimates computed over the five sub-periods 1883-1936, 1937-1957, 1958-1979, 1980-1987 and 1988-2011 when the estimates are considered jointly and no significant evidence that the *MRP* has trended down. Panels A and B provide tests that use the unadjusted data that Brailsford, Handley and Maheswaran provide while panels C and D provide tests that use the adjusted data that we construct. Appendix C describes in detail how the statistics in Table 5.1 are constructed.

It is important to note that while the evidence provided by Table 5.1 is consistent with the hypothesis that the unconditional *MRP* is a constant through time, the evidence does not imply that the *MRP* conditional on information available at each point in time does not vary through time as the information changes. Thus the evidence provided by Table 5.1 does *not* imply that the current *MRP* matches its long-run average.

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Lamberton, D., *Some statistics of security prices and yields in the Sydney market, 1875-1955*, Economic Record, 1958, pages 253-259.

Lamberton, D., *Economic growth and stock prices: The Australian experience*, Journal of Business, 1958, pages 200-212.

Lamberton, D., *Security prices and yields*, Sydney Stock Exchange Official Gazette, 14 August 1958.

[76] Dimson, E., P. Marsh and M. Staunton, *Credit Suisse Global investment returns sourcebook 2012*, Credit Suisse, February 2012.

Officer, R., *Rates of return to shares, bond yields and inflation rates: An historical perspective*, in Ball, R., P. Brown, F. Finn and R. Officer (Eds), *Share markets and portfolio theory*, Second edition, University of Queensland Press, 1989.

[77] Brailsford, T., J. Handley and K. Maheswaran, *The historical equity risk premium in Australia: Post-GFC and 128 years of data*, Accounting and Finance, 2012, pages 237-247.

**Table 5.1**
**Tests for variation in the *MRP* across time**

| Period | *MRP* estimate | Period | *MRP* estimate | Difference | Standard error |
|---|---|---|---|---|---|
| **Panel A: Sub-period stability, unadjusted data** | | | | | |
| 1883-1936 | 6.72 | 1937-2011 | 5.66 | 1.06 | 2.57 |
| 1883-1957 | 6.07 | 1958-2011 | 6.12 | 0.05 | 2.96 |
| 1883-1979 | 6.24 | 1980-2011 | 5.68 | 0.56 | 3.39 |
| 1883-1987 | 6.38 | 1988-2011 | 4.87 | 1.51 | 3.27 |
| Wald statistic for test of sub-period stability = 0.83 with a p-value of 0.93. | | | | | |

Panel B: Tests for a trend, unadjusted data

| *MRP* in 1882 | Trend in per cent per decade since 1882 |
|---|---|
| 6.62 | -0.08 |
| (2.06) | (0.35) |

Panel C: Sub-period stability, adjusted data

| Period | *MRP* estimate | Period | *MRP* estimate | Difference | Standard error |
|---|---|---|---|---|---|
| 1883-1936 | 7.67 | 1937-2011 | 5.60 | 2.06 | 2.57 |
| 1883-1957 | 6.76 | 1958-2011 | 6.07 | 0.69 | 2.96 |
| 1883-1979 | 6.73 | 1980-2011 | 5.68 | 1.05 | 3.39 |
| 1883-1987 | 6.83 | 1988-2011 | 4.87 | 1.96 | 3.27 |
| Wald statistic for test of sub-period stability = 1.78 with a p-value of 0.78. | | | | | |

Panel D: Tests for a trend, adjusted data

| *MRP* in 1882 | Trend in per cent per decade since 1882 |
|---|---|
| 7.85 | -0.21 |
| (2.06) | (0.35) |

*Notes: Panels A and C report the differences between pairs of MRP estimates and the standard errors of the differences. None of the differences differ significantly from zero. Panels A and C also report the result of Wald tests of the hypothesis that there are no differences in the MRP across the five sub-periods 1883-1936, 1937-1957, 1958-1979, 1980-1987 and 1988-2011. Panels B and D report estimates of the MRP in 1882 and the trend per decade since – together with the standard errors of the estimates in parentheses. Estimates of the trend do not differ significantly from zero. All standard errors in the table are heteroscedasticity and autocorrelation consistent.*

While there are plausible reasons for choosing the sample periods that the AER uses, there are many other sample periods that could also have been chosen. To determine whether there are other periods that could have been chosen to provide the appearance that the *MRP* has risen over the last 129 years, we examine estimates of the *MRP* that use at least 20 years and increasing amounts of data starting in 2011 and working backwards. We plot the results of this exercise in Figure 5.1 below. This figure and the remaining figures and tables in this section use the data that Brailsford, Handley and Maheswaran (2012) supply because these are the data that the AER employs in constructing Table 4.3 in its recent *Draft Decision*. Using the adjusted data that we construct, though, does not affect the inferences that we draw in any way.

**Figure 5.1**
**Estimates of the *MRP* computed using data that end in 2011: Sample size ≥ 20 years**

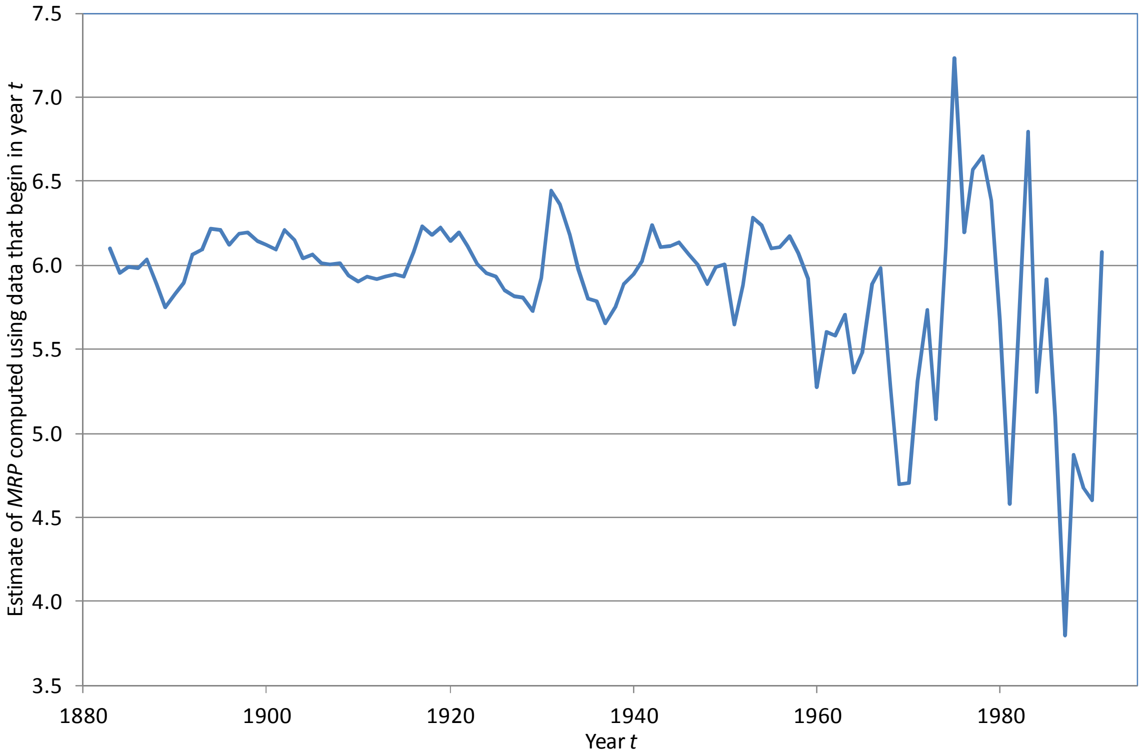
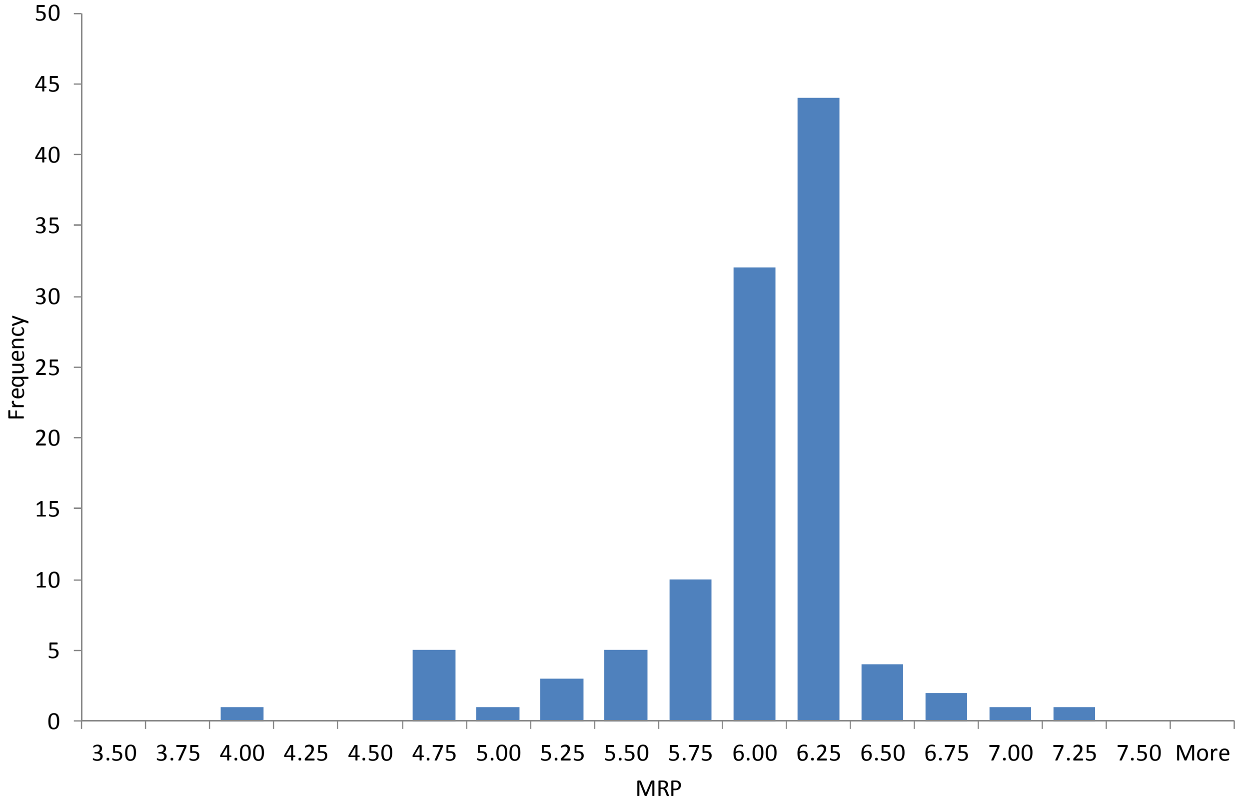



Figure 5.1 shows that there are sample periods that could have been chosen that would have provided the appearance that the *MRP* has risen over the last 129 years. As an example, sample periods starting in 1883, 1919, 1953, 1977 and 1983 would provide this appearance. Figure 5.1 also shows that there were few other samples of at least 20 years that ended in 2011 that would have produced an estimate of the *MRP* as low as 4.9 per cent – the estimate that the AER provides for the period 1988 to 2011. Figure 5.2 shows this in a different way by plotting the estimates from Figure 5.1 in a histogram. An estimate as low as 4.9 per cent

may reflect a low *MRP* over the period 1988 to 2011 or it may reflect a low realised return to the market portfolio over this period – there is no way of knowing. [78]

**Figure 5.2**
**Distribution of estimates of the *MRP* computed using data that end in 2011: Sample size ≥ 20 years**




The appearance of the data will change marginally with the addition of data from 2012. A back-of-the-envelope calculation – data on imputation credits distributed are not yet available – indicates that an estimate of the *MRP* over the period 1988 to 2012 will be around 5.1 per cent per annum, that is, 20 basis points higher than the estimate of 4.9 over the period from 1988 to 2011.

Figure 5.3 examines estimates of the *MRP* in the same way that use at least 50 years and increasing amounts of data starting in 2011 and working backwards.

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78 The standard error attached to the estimate, which the AER does not provide in Table 4.3, is 3.84 per cent per annum. Thus, under the assumption that the data are drawn from a series that is normally distributed, a 95 per cent confidence interval for the *MRP* over the period 1988 to 2011 will be $4.9 \pm 3.84 \times t_{0.025,23}$ per cent. Since $t_{0.025,23} = 2.069$, a 95 per cent confidence interval will lie from -3.04 to 12.84 per cent per annum. So it is very difficult to draw any conclusion from the data about the value of the *MRP* from 1988 to 2011.

**Figure 5.3**
**Estimates of the *MRP* computed using data that end in 2011:**
**Sample size ≥ 50 years**

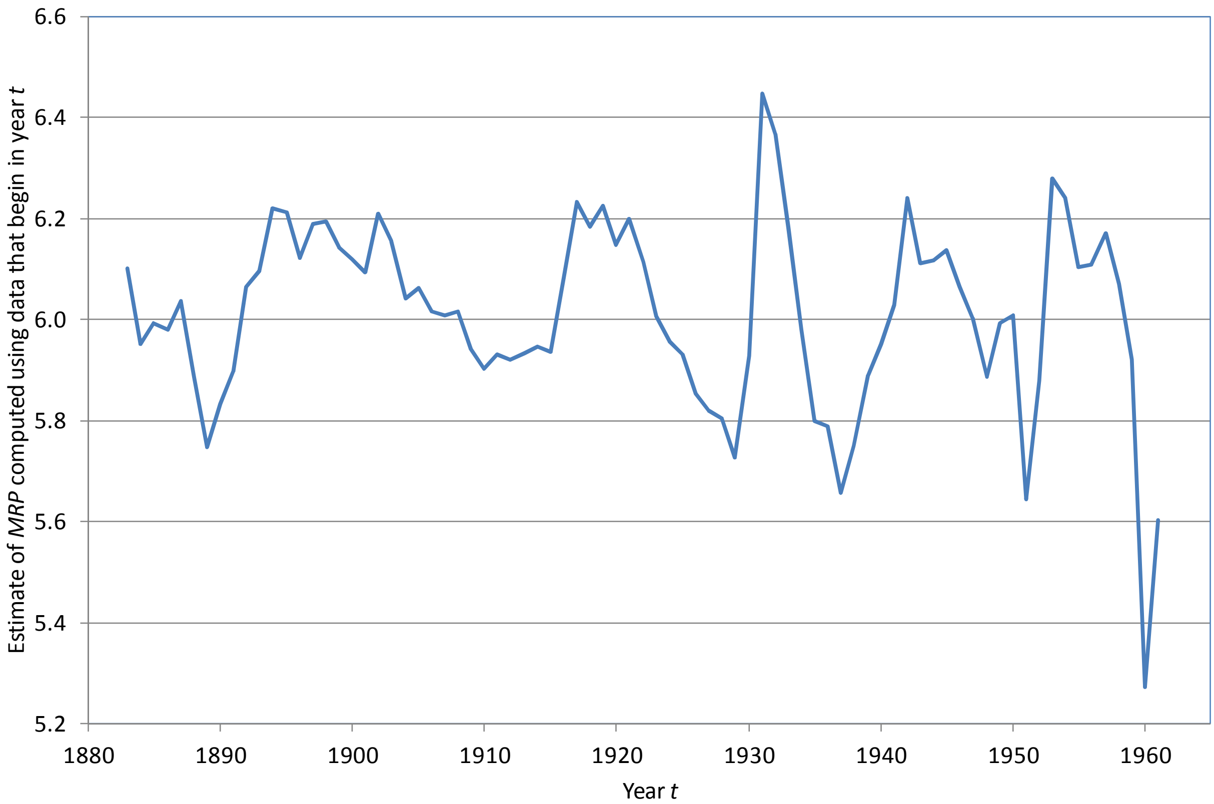
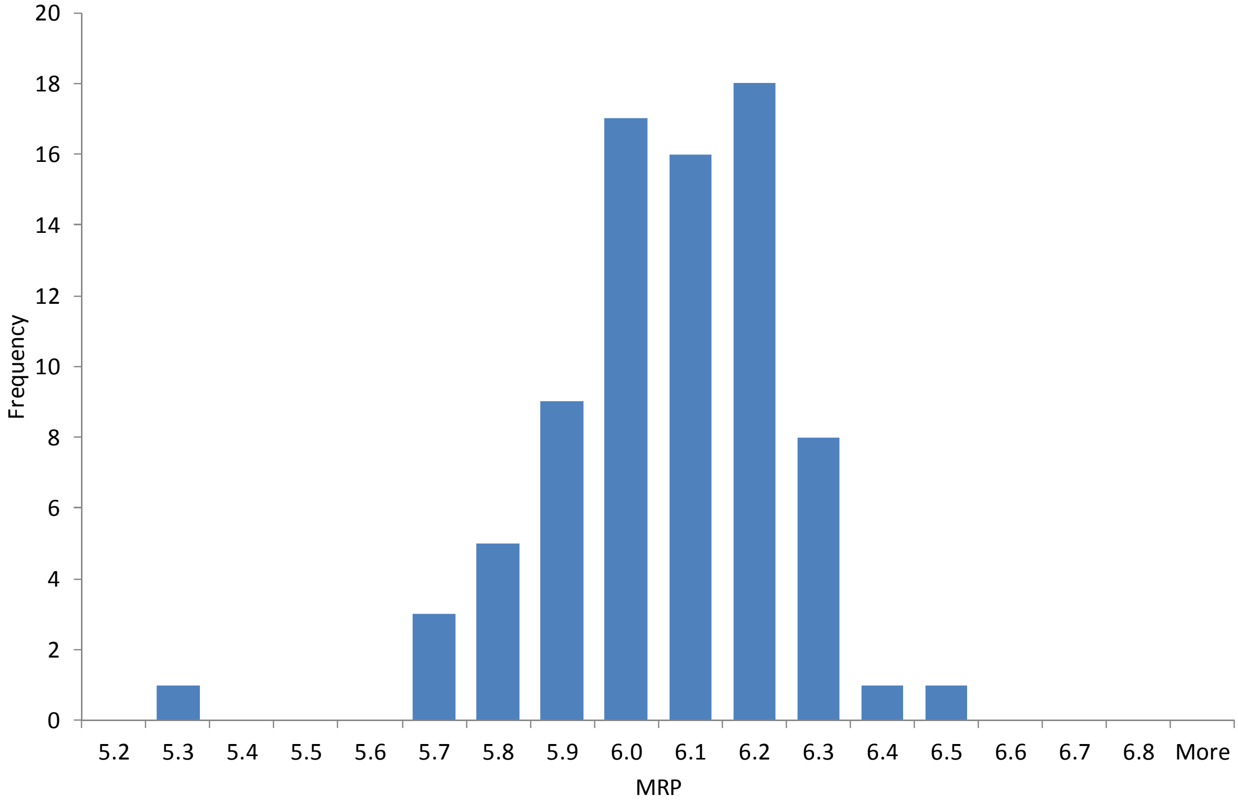



Figure 5.3 shows that there were many other samples of at least 50 years that ended in 2011 that would have produced an estimate of the *MRP* of less than 6.1 per cent – the estimate that the AER provides for the period 1958 to 2011 – but there were also samples that would have produced an estimate of the *MRP* of more than 6.1 per cent. Figure 5.4 shows this by plotting the estimates from Figure 5.3 in a histogram.

**Figure 5.4**
**Distribution of estimates of the *MRP* computed using data that end in 2011: Sample size ≥ 50 years**




## 5.2. Precision

It is important to note that data from the 24-year period 1988 to 2011 contributes to all five pairs of *MRP* estimates that the AER uses while data from the 22-year period 1958 to 1979 contributes to three pairs of estimates and data from the 54-year period 1883 to 1936 contributes to only one pair. So by displaying estimates of the *MRP* from the five sample periods that the AER uses, the regulator is inviting the reader to weight recent returns to the market portfolio in excess of the yield on a government bond more heavily than earlier observations. While this may sound an attractive strategy, placing a larger weight on more recent observations than on earlier observations can substantially lower the precision of the estimates that one produces.[79]

Consider, for example, the two estimators:

$$\hat{\mu}_1 = \frac{1}{T}\sum_{t=1}^{T} X_t \qquad \text{and} \qquad \hat{\mu}_2 = \frac{1}{\sum_{t=1}^{T}(T-t+1)}\sum_{t=1}^{T}(T-t+1)\,X_t\,, \tag{17}$$

[79] The precision of a random variable is the reciprocal of its variance. See Davidson, R. and J.G. MacKinnon, *Estimation and inference in econometrics*, Oxford University Press, 1993, page 144.

where $X_t$ is the return to the market portfolio in excess of the yield on a government bond and $T$ is the sample size. The first estimator is the sample mean while the second estimator places a larger weight on more recent observations than on earlier observations. If, for example, $T = 100$, then the second estimator places a weight on the most recent observation that is 100 times larger than the weight it places on the first observation and twice as large as the weight it places on the 50th observation. While the second estimator may appear an attractive alternative, the standard errors of the two estimators are:

$$\sigma_1 = \frac{\sigma}{\sqrt{T}} \qquad \text{and} \qquad \sigma_2 = \sigma\sqrt{\frac{2(2T+1)}{T(T+1)}} = \sigma_1\sqrt{\frac{2(2T+1)}{(T+1)}}\,, \tag{18}$$

where $\sigma$ is the standard deviation of the excess return to the market portfolio. Thus in large samples the standard error of the second estimator, which places a larger weight on more recent observations than on earlier observations, is around twice the standard error of the plain vanilla sample mean.

Table 4.3 from the *Draft Decision* indicates that an estimate based on the period 1988 to 2011 and the arithmetic mean is 4.9 per cent per annum while some simple calculations indicate that estimates based on the periods 1883 to 1936 and 1958 to 1979 are 6.7 and 6.6 per cent. Thus Table 4.3 invites the reader to place a higher weight on a period over which the return to the market portfolio in excess of the yield on a government bond was low and lower weights on periods over which the return was high. This is not obvious from the table because estimates of the *MRP* over the periods 1883 to 1936 and 1958 to 1979 are blended with estimates of the *MRP* over other periods – including the period 1988 to 2011.

# 6. Using Biased Estimates

Lally (2012) suggests that better estimators for the *MRP* can be constructed by combining several different estimators for the *MRP*. In particular, he suggests that better estimators for the *MRP* can be constructed by combining an estimator for the *MRP* known to be unbiased with an estimator or estimators that may be biased.[80]

## 6.1. Lally's Example

Lally (2012) considers an example in which two estimators – one for the Australian *MRP* and the other for the US *MRP* – are combined to form an alternative estimator for the Australian *MRP*.[81] Lally assumes that the estimator for the Australian *MRP* is an unbiased estimator for the Australian *MRP* while the estimator for the US *MRP* is a biased estimator for the Australian *MRP*. He assumes, for simplicity, that the two estimators have the same standard deviation and that they are uncorrelated with one another. I will relax the assumption that the two estimators are uncorrelated with one another but I assume that the two estimators are normally distributed. I assume that the estimators are normally distributed so that I can more easily examine problems associated with inference.

With these assumptions, we can write that:

$$\begin{pmatrix} \hat{\mu}_{\text{AUS}} \\ \hat{\mu}_{\text{USA}} \end{pmatrix} \sim \text{N}\left( \begin{pmatrix} \mu_{\text{AUS}} \\ \mu_{\text{USA}} \end{pmatrix}, \sigma^2 \begin{pmatrix} 1 & \rho \\ \rho & 1 \end{pmatrix} \right), \tag{19}$$

where $\mu_{\text{AUS}}$ is the Australian *MRP*, $\mu_{\text{USA}}$ is the US *MRP*, a hat denotes an estimator, $\sigma$ is the common standard deviation of the two estimators and $\rho$ is the correlation coefficient between the estimators.

Consider using a combination of the two estimators that places a weight of $w$ on the estimator for the Australian *MRP* and a weight of $(1 - w)$ on the estimator for the US *MRP* to estimate the Australian *MRP*. That is, consider a combination:

$$w\hat{\mu}_{\text{AUS}} + (1-w)\hat{\mu}_{\text{USA}} \tag{20}$$

The mean squared error (MSE) of the combination will be the square of the bias associated with the combination plus its variance:

$$(1-w)^2(\mu_{\text{AUS}} - \mu_{\text{USA}})^2 + (w^2 + 2\rho w(1-w) + (1-w)^2)\,\sigma^2 \tag{21}$$

## 6.2. Bias Known

Minimising (21) with respect to $w$ yields:

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[80] Lally, M., *The cost of equity and the market risk premium*, Victoria University of Wellington, 25 July 2012, page 30.

[81] Lally, M., *The cost of equity and the market risk premium*, Victoria University of Wellington, 25 July 2012, page 30.

$$w = \frac{(1-\rho)\sigma^2 + (\mu_{\text{AUS}} - \mu_{\text{USA}})^2}{2(1-\rho)\sigma^2 + (\mu_{\text{AUS}} - \mu_{\text{USA}})^2} \tag{22}$$

For the moment, we will assume, like Lally, that the bias associated with the combination (20), $(1 - w)\ (\mu_{AUS} - \mu_{USA})$ is known so that one can identify the weight that will minimise the MSE of the combination. Lally (2012) considers an example where $\rho = 0$, $\mu_{\text{AUS}} - \mu_{\text{USA}} = 0.01$ and $\sigma = 0.02$. From (22), with these values the weight $w$ that will produce a minimum MSE estimator will be 0.44. The MSE of an estimator that places a weight of 0.44 on the estimator for the Australian *MRP* and a weight of 0.56 on the estimator for the US *MRP* will be, with the values for the parameters that Lally chooses, $2.33 \times 10^{-4} < 4 \times 10^{-4}$, the MSE of the estimator for the Australian *MRP* alone.

Computation of the optimal weight requires one know the difference between the Australian *MRP* and the US *MRP*. If one knows this quantity, however, one can also compute the bias adjusted combination:

$$w\hat{\mu}_{\text{AUS}} + (1-w)(\hat{\mu}_{\text{USA}} + \mu_{\text{AUS}} - \mu_{\text{USA}}) \tag{23}$$

The value for $w$ that minimises the MSE of the bias adjusted combination will be 0.5, regardless of the values of the other parameters, and the MSE will be, with the values for the parameters that Lally chooses, $2.00 \times 10^{-4} < 2.33 \times 10^{-4}$, the MSE of the combination (20) that uses (22).

## 6.3. Bias Unknown

In practice, one does not know the difference between the Australian *MRP* and the US *MRP*, one can only estimate the difference. In what follows, we assume that the difference between the Australian *MRP* and the US *MRP* is unknown but, for simplicity, that the common standard deviation of the estimator for the Australian *MRP* and the estimator for the US *MRP* is known. [82]

The difference between the MSE of the estimator for the Australian *MRP* and the MSE of the combination (20) is:

$$\sigma^2 - \left( (1-w)^2(\mu_{\text{AUS}} - \mu_{\text{USA}})^2 + (w^2 + 2\rho w(1-w) + (1-w)^2)\,\sigma^2 \right) \tag{24}$$

This difference will be positive and so one will better off using the combination (20) if:

$$(\mu_{\text{AUS}} - \mu_{\text{USA}})^2 < 2(1-\rho)\sigma^2\left(\frac{w}{1-w}\right) \tag{25}$$

Condition (25) says that if little weight is attached to the estimator for the US *MRP* – that is, if the weight $w$ on the estimator for the Australian *MRP* is close to one – then the difference

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[82] In practice a relatively precise estimate of the standard deviation can be produced by using high frequency data. The use of high frequency data, on the other hand, will not assist one in constructing a precise estimate of the difference between the Australian *MRP* and the US *MRP*.

between the Australian *MRP* and the US *MRP* can be quite large and the use of the combination will still generate a marginally lower MSE. If, however, a substantial weight is to be placed on the estimator for the US *MRP*, then a tighter restriction must be placed on the bias that can be associated with the estimator for the combination (20) to generate a lower MSE. If, for example, the weight to be placed on each estimator is one half, then for the combination to deliver a lower MSE, it must be the case that:

$$(\mu_{\text{AUS}} - \mu_{\text{USA}})^2 < 2(1-\rho)\sigma^2 \tag{26}$$

Providing evidence that condition (26) is satisfied will be difficult. To see why, note that with the assumptions made the difference between the estimator for the Australian *MRP* and the estimator for the US *MRP* will be distributed in the following way:

$$\hat{\mu}_{\text{AUS}} - \hat{\mu}_{\text{USA}} \sim \text{N}(\mu_{\text{AUS}} - \mu_{\text{USA}}, 2(1-\rho)\sigma^2) \tag{27}$$

So condition (26) says that the square of the bias associated with the US estimator for the *MRP* must be less than the variance of an estimator for the bias. Showing that this condition is satisfied will be difficult.

To see this, it will, perhaps, be easiest to return to Lally's example. Recall that Lally assumes that $\rho = 0$ and $\sigma = 0.02$. With these assumptions, for the combination to deliver a lower MSE, (26) says that the absolute value of the bias must not exceed:

$$\sqrt{2(1-\rho)\sigma^2} = \sqrt{2 \times (1-0) \times 0.02^2} = 0.0283 \tag{28}$$

Lally also assumes that $\mu_{\text{AUS}} - \mu_{\text{USA}} = 0.01$, so that in his example use of the combination will deliver a lower MSE. Suppose, though, that one does not know that the bias associated with the US estimator for the *MRP* is 0.01. Assume instead that 0.01 is just an estimate of the bias. From (27), a 95 per cent confidence interval for the bias will then be:

$$0.01 \pm 1.96 \times 0.0283 = 0.01 \pm 0.0555 \tag{29}$$

In other words, the confidence interval will be so wide that it will include values for the bias that will render the combination not worth using and values for the bias that will render the combination worth using. So while one would conclude that there is no significant evidence to indicate that one would be worse off using a simple average of the estimate of the Australian *MRP* and the estimate of the US *MRP* to estimate the Australian *MRP*, one would also conclude that there is no significant evidence that one would be better off.

It may be that one views a difference between the Australian *MRP* and US *MRP* of 2.83 per cent per annum as large. A value for $\rho$ of zero, however, is low. A larger value for $\rho$ will produce an upper bound for the bias in (28) that is lower. For example, if $\rho = 0.75$, then the upper bound generated by (19) will be 1.41 per cent. A lower value for the common standard deviation of the two estimators will also produce an upper bound that is lower.

## 6.4. Tests

With the assumptions made, a statistic can be constructed that can be used to test the hypothesis that one will be neither better off nor worse off in using the combination (20).[83] For example, under the null that one will be neither better off nor worse off in using the combination (20) with a weight of one half on each estimator for the *MRP*,

$$(\mu_{\text{AUS}} - \mu_{\text{USA}})^2 = 2(1-\rho)\sigma^2 \tag{30}$$

and

$$\frac{(\hat{\mu}_{\text{AUS}} - \hat{\mu}_{\text{USA}})^2}{2(1-\rho)\sigma^2} \sim \chi^2_{1,1}\ , \tag{31}$$

where $\chi^2_{1,1}$ denotes a chi-square with one degree of freedom and a non-centrality parameter of one.

Thus a test of the null that one will be neither better off nor worse off in using the combination (20) with a weight of one half on each estimator can be carried out by comparing the left-hand side of (31) with tabulated values of a chi-square with one degree of freedom and a non-centrality parameter of one. The power of the test, though, against the alternative that one will be better off using the combination will be very, very low. The distribution of the statistic when the bias associated with the estimator for the US *MRP* is zero will be central chi-square with one degree of freedom – that is, not so very different from its distribution under the null that one is neither better off nor worse off in using the combination. Judge and Bock (1983) provide a more detailed analysis of the problems associated with determining whether one will be better off or worse off in using biased estimators.[84]

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[83] For a discussion of tests like these, see:

Toro-Vizcorrondo, C. and T.D. Wallace, *A test of the mean square error criterion for restrictions in linear regression*, Journal of the American Statistical Association, 1968, pages 558-572.

[84] Judge, G.G. and M. E. Bock, *Biased estimation*, Handbook of Econometrics Volume 1, Editors Z. Griliches and M. D. Intriligator, Elsevier North Holland, 1983, Chapter 10.

# 7. The Dividend Growth Model

## 7.1. Theory

A natural place to look for information on what the market thinks the *MRP* should be is in market prices. The DGM allows one, in principle, to use market prices together with forecasts of future dividends to compute the return that the market requires on an asset or portfolio. While one can observe market prices and forecasts of dividends over horizons of one or two years, few analysts forecast dividends at longer horizons. Thus as a practical matter, the use of the DGM requires that one make an assumption about the long-term growth of dividends.

Suppose that we assume, consistent with the analysis of Lally (2013), that consensus forecasts are available over two years and that expectations of dividends to be delivered more than two years hence are governed by the relation[85]

$$\mathrm{E}(D(t+s)) = \mathrm{E}(D(t+2))(1+g)^{s-2}, \qquad s > 2. \tag{32}$$

where

| | | |
|---|---|---|
| $D(t+s)$ | = | the dividend the market portfolio pays at $t+s$. |
| $g$ | = | long-run dividend growth. |

With this assumption, we show in our March 2012 report that [86]

$$P(t) = \frac{\mathrm{E}(D(t+1))}{1+\mathrm{E}(R)} + \frac{\mathrm{E}(D(t+2))}{1+\mathrm{E}(R)}\left(\frac{1}{\mathrm{E}(R)-g}\right). \tag{33}$$

where

| | | |
|---|---|---|
| $P(t)$ | = | the price of a share in the market portfolio at $t$; and |
| $\mathrm{E}(R)$ | = | the internal rate of return that discounts back the expected future dividends that the market portfolio will pay back to the current price of a share in the market portfolio. |

This expression can be solved for E($R$). Note that E($R$) is the internal rate of return that will discount back the market's expectations of the dividends that the market portfolio will pay in all future periods – not just over the next regulatory period – back to the current market value of the market portfolio. This internal rate of return will be a complicated average of the expected returns to the market portfolio over the next year and over all future years. As we point out in our March 2012 report and as Lally points out in his July 2012 and March 2013 reports, the internal rate of return E($R$) may lie above or below the current expected return to

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85 Lally, M., *The dividend growth model*, Victoria University of Wellington, 4 March 2013, pages 16-20.

86 NERA, *Prevailing conditions and the market risk premium: A report for APA Group, Envestra, Multinet & SP AusNet*, March 2012, page 42.

the market. [87] We show, however, that it would have been difficult to argue persuasively that the current expected return sat below the return delivered by the DGM at around the time that Lally (2012) provided his critique. [88] At this time the risk-free rate was low relative to its history but, contrary to the arguments put forward by Lally, it would have been difficult to argue that the current expected return sat below the return delivered by the DGM.

As a practical matter, we also note that while the term structure of mean real returns to the market may not be flat, the incorporation of a term structure that is not flat into the DGM is not standard practice.

## 7.2. DGM Estimates

Our example uses data from September 2012. Thus we do not pretend to supply an estimate of the currently prevailing return required on the market portfolio of stocks as of June 2013. Our intention instead is to illustrate that the evidence provided by the DGM can place restrictions on what a reasonable choice for the return required on the market might be. We show that the evidence provided by the DGM in September 2012 would have ruled out an *MRP* of 6 per cent per annum.

To be conservative, in the example we use consensus forecasts made in September 2012 to predict dividends per share (DPS) one and two years from that date and an estimate of real DPS growth over the past to predict DPS three or more years from September 2012. These predictions are conservative in that they use as a forecast of long-run nominal DPS growth a number, 5.65 per cent per annum, based on past real DPS growth and the RBA's target for inflation, lying below the forecast for long-run DPS growth that the AER uses in its *Aurora Draft Decision*, 6 per cent per annum. [89]

The AER bases its forecast of long-run DPS growth on GDP growth. Bernstein and Arnott (2002) note, though, that GDP growth is likely on average to exceed DPS growth. [90] They point out that: [91]

> 'per share earnings and dividends keep up with GDP only if no new shares are created. Entrepreneurial capitalism … creates a "dilution effect" through new enterprises and new stock in existing enterprises. So, per share earnings and dividends grow considerably slower than the economy.'

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87 Lally, M., *The cost of equity and the market risk premium*, Victoria University of Wellington, 25 July 2012, page 3.

Lally, M., *The dividend growth model*, Victoria University of Wellington, 4 March 2013, pages 5-9.

NERA, *Prevailing conditions and the market risk premium: A report for APA Group, Envestra, Multinet & SP AusNet*, March 2012, page 42.

88 Lally, M., *The cost of equity and the market risk premium*, Victoria University of Wellington, 25 July 2012, page 3.

Lally, M., *The dividend growth model*, Victoria University of Wellington, 4 March 2013, pages 5-9.

NERA, *Prevailing conditions and the market risk premium: A report for APA Group, Envestra, Multinet & SP AusNet*, March 2012, page 42.

89 AER, *Draft Distribution Determination Aurora Energy Pty Ltd 2012–13 to 2016–17*, November 2011, page 234.

90 Bernstein, W.J. and R.D. Arnott, *Earnings growth: The two percent dilution*, Financial Analysts Journal, 2003, pages 47-55.

91 Bernstein, W.J. and R.D. Arnott, *Earnings growth: The two percent dilution*, Financial Analysts Journal, 2003, page 48.

We, however, do not base our forecast of long-run DPS growth on GDP growth in this report, and nor do we do so in our March 2012 report. [92] In this report and in our March 2012 report we base our forecast simply on past real DPS growth and the RBA's target for inflation. A new issue of shares in an existing company or the replacement of an existing member of the All Ordinaries with another company will in general alter the market capitalisation of the All Ordinaries but will not alter the level of the All Ordinaries, that is, the value of a hypothetical share of the All Ordinaries. Thus, our use of past real DPS growth to forecast future DPS growth is entirely consistent with the way in which the DGM is developed from an identity that links the return on a single share over a single period to the price of the share at the start and end of the period and the dividends that the share pays at the end of the period.

We compute an estimate of the *MRP* using the DGM averaged across the 20 working days of September 2012. The DGM estimates of the return that the market required on the market portfolio that use Bloomberg consensus forecasts and our conservative estimate of long-run DPS growth indicate that, with an average 10-year bond yield of 3.13 per cent per annum in September 2012, an estimate of the *MRP* relative to the yield would have been be 8.03 per cent per annum. [93]

We note that this estimate lies below an estimate constructed using the assumption that the AER makes in its *Aurora Draft Decision* about the growth in dividends. [94] Using the AER's assumption, the *MRP* relative to a 10-year bond yield of 3.13 per cent per annum would have been 8.52 per cent per annum.

As we have emphasised, an estimate of the return that the market requires on an asset or portfolio that uses the DGM depends crucially on estimates of the long-run growth in dividends. One place to look for estimates of what the growth in dividends might be in the long-run is in the past behaviour of dividends.

Table 7.1 provides summary statistics for the real growth in DPS for the All Ordinaries from 1981 to 2011. We use data over this period because daily price and accumulation indices are available from 1980 onwards that allow one to accurately compute a DPS series for the index. We use the inflation data that Brailsford, Handley and Maheswaran (2012) provide and update their series using, like they do, the December year-end value of the CPI: All Groups Weighted Average of Eight Capital Cities series from the Australian Bureau of Statistics (ABS). [95]

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92 In our March 2012 report we do examine the relation between real DPS growth and real GDP growth and find that the two are related. We do not base our forecast of long-run DPS growth, though, on past real GDP growth.

93 A risk-free rate of 3.135 per cent per annum is obtained by applying the AER's method of interpolation to compute the yield on a 10-year Commonwealth Government Security (CGS) over the 20-day averaging period from 3 September 2012 to 28 September 2012. The AER's method of interpolation is consistent with clause 6.5.2(d) of the National Electricity Rules.

94 AER, *Draft Distribution Determination Aurora Energy Pty Ltd 2012–13 to 2016–17*, November 2011, page 234.

95 Brailsford, T., J. Handley and K. Maheswaran, The historical equity risk premium in Australia: Post-GFC and 128 years of data, Accounting and Finance, 2012, pages 237-247.

Table 7.1 shows that the mean growth in real DPS has been around 3 per cent per annum over the period 1981 to 2011. The growth in real DPS has been volatile. As a result, a 95 per cent confidence interval for mean real DPS growth is from -1.30 to 7.44 per cent per annum.[96]

**Table 7.1**
**Summary statistics for real DPS growth from 1981 to 2011**

| Variable | Mean | Standard deviation |
|---|---|---|
| Real DPS growth | 3.07 | 12.41 |
| | (2.23) | |

*Note: Data are from the ABS and Bloomberg. The standard error of the sample mean is parentheses.*

Figure 7.1 plots real DPS against time and consensus forecasts of DPS that Bloomberg provided in September 2012.[97] Consensus forecasts made on average during the 20 days from 3 September 2012 to 28 September 2012 appear in The ACT in its recent decision found that the AER should place a value of 35 cents on each one dollar of imputation credits distributed. Brailsford, Handley and Maheswaran (2008) indicate that on average 75 per cent of dividends distributed are franked and the corporate tax rate is currently 30 per cent. So to take into account the value of credits distributed, we multiply each DPS forecast by

$$1 + 0.35 \times 0.75 \times \left( \frac{0.30}{1 - 0.30} \right) = 1.1125 \qquad (36)$$

Table 7.2. The DPS forecasts are for the All Ordinaries and correspond to values of the All Ordinaries Price Index. The ACT in its recent decision found that the AER should place a value of 35 cents on each one dollar of imputation credits distributed. Brailsford, Handley and Maheswaran (2008) indicate that on average 75 per cent of dividends distributed are franked and the corporate tax rate is currently 30 per cent. So to take into account the value of credits distributed, we multiply each DPS forecast by

$$1 + 0.35 \times 0.75 \times \left( \frac{0.30}{1 - 0.30} \right) = 1.1125 \qquad (36)$$

Table 7.2 shows that the consensus in September 2012 was that dividends were expected to grow over the next two years by around 7 per cent per annum.

Using interpolation and the Bloomberg consensus forecasts that appear in The ACT in its recent decision found that the AER should place a value of 35 cents on each one dollar of

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96 A tighter, but not dramatically tighter, 95 per cent confidence interval for mean real DPS growth can be constructed using the annual data that Brailsford, Handley and Maheswaran (2012) provide and that we adjust and update in section 2. Using these data we find that a 95 per cent confidence interval for mean real DPS growth lies from -0.11 to 5.08 per cent.

97 The consensus forecasts are extracted using the Bloomberg function EEO. Forecasts are made for the constituents of an index and the forecast for the index is a weighted average of the forecasts for each index member.

Bloomberg, *Getting started*, 2007.

imputation credits distributed. Brailsford, Handley and Maheswaran (2008) indicate that on average 75 per cent of dividends distributed are franked and the corporate tax rate is currently 30 per cent. So to take into account the value of credits distributed, we multiply each DPS forecast by

(36)

Table 7.2 below, an estimate of the DPS for the All Ordinaries for the month of September 2013 would have been [98]

$$(288 \times 210.691 + 77 \times 226.276) \div 365 = 213.979 \tag{34}$$

and for the month of September 2014,

$$(288 \times 226.276 + 77 \times 243.265) \div 365 = 229.860 . \tag{35}$$

The ACT in its recent decision found that the AER should place a value of 35 cents on each one dollar of imputation credits distributed. [99] Brailsford, Handley and Maheswaran (2008) indicate that on average 75 per cent of dividends distributed are franked and the corporate tax rate is currently 30 per cent. [100] So to take into account the value of credits distributed, we multiply each DPS forecast by [101]

$$1 + 0.35 \times 0.75 \times \left( \frac{0.30}{1 - 0.30} \right) = 1.1125 \tag{36}$$

**Table 7.2**
**Bloomberg consensus forecasts of DPS**

| June 2013 | June 2014 | June 2015 |
|---|---|---|
| 210.691 | 226.276 | 243.265 |

*Note: Data are from Bloomberg. The DPS forecasts are for the All Ordinaries and correspond to values of the All Ordinaries Price Index.*

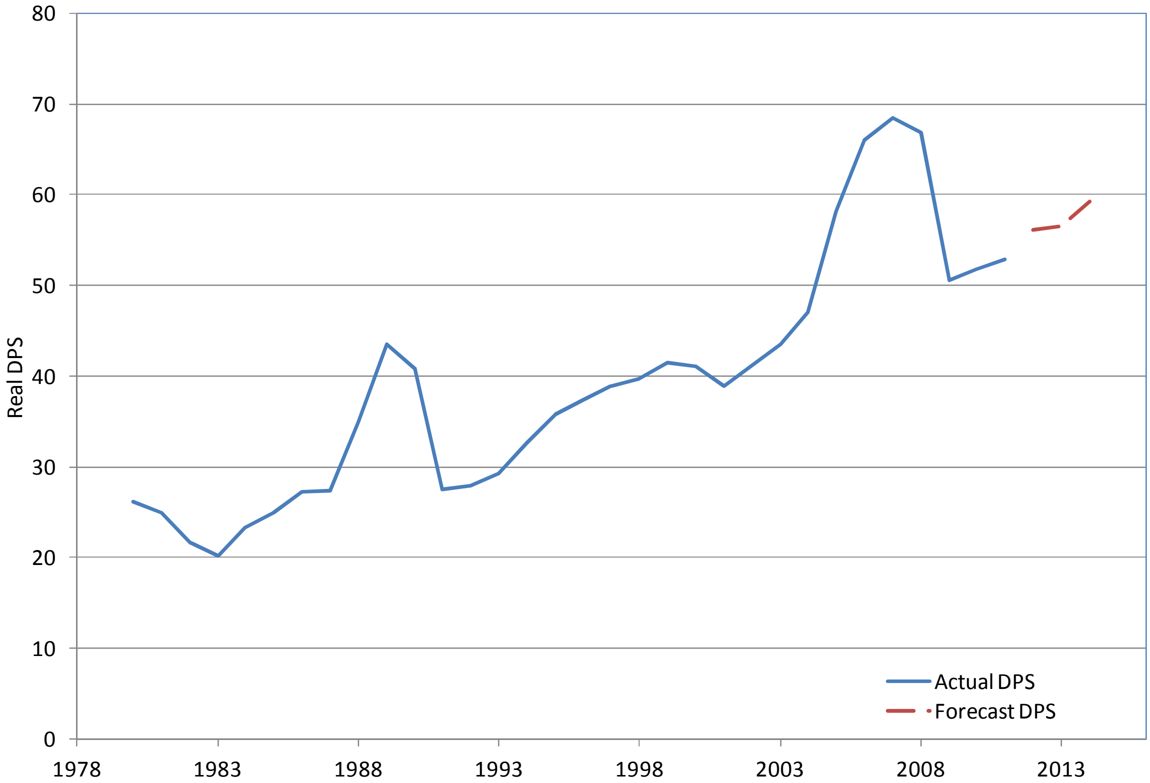
98 There are 31 days in July, 31 days in August and 15 days in the first half of September and so there are 77 days from the end of June until the middle of September..

99 This value is the value laid down by the ACT in a decision on the market value of a one-dollar credit distributed. See ACT, Application by Energex Limited (Gamma) (No 5) [2011] ACompT 9, May 2011.

100 Brailsford, T., J. Handley and K. Maheswaran, *Re-examination of the historical equity risk premium in Australia*, Accounting and Finance 48, 2008, page 85.

101 With a corporate tax rate of 28 per cent, which the government hopes to introduce at some stage in the future, the adjustment factor would be 1.1021. Using this lower corporate tax rate lowers the expected return to the market portfolio by around 5 basis points.

**Figure 7.1**
**Real dividends on the All Ordinaries**




*Note: Data are from the ABS and Bloomberg.*

It is difficult to forecast the long-run growth in dividends. We fit a regime-switching model, in which there is a high-growth state and a low-growth state, to real DPS growth and find that the rate at which the model tends to move from one state to another is sufficiently fast that there is little point in using short-term consensus forecasts and estimates of past real DPS growth together to forecast long-run DPS growth.[102] So instead we assume that the expected long-run growth in real DPS equals the past growth in real DPS over the period 1981 to 2011 of 3.07 per cent per annum, although, as we have pointed out, the past growth is sufficiently volatile that it is difficult to determine with any degree of precision what is the mean growth in real DPS. We also assume that expected inflation lies at the middle of the RBA target range of 2 to 3 per cent, that is, it equals 2.5 per cent.[103] With these assumptions the expected long-run growth in dividends will be

$$100 \times ((1 + 0.0307) \times (1 + 0.0250) - 1) = 5.65 \text{ per cent.} \tag{37}$$

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[102] We fit a regime-switching model to real DPS growth because Hamilton (1989) finds that:

'The business cycle is better characterized by a recurrent pattern of [discrete] shifts between a recessionary state and a growth state than by positive coefficients at low lags in an autoregressive model.'

Hamilton, James D., *A new approach to the economic analysis of nonstationary time series and the business cycle*, Econometrica, 1989, pages 357-384.

[103] http://www.rba.gov.au/monetary-policy/about.html

Thus the assumption that we make about the long-run growth in dividends is conservative in the sense that we assume that it lies below the forecast for long-run DPS growth that the AER uses in its *Aurora Draft Decision*, 6 per cent per annum. [104]

The average level of the All Ordinaries Price Index over the 20 days from 3 September 2012 to 28 September 2012 was 4,382.068. So from (33), it follows that if we use the Bloomberg DPS forecasts, the expected return to the market portfolio as of September 2012, E($R$), must satisfy

$$4{,}382.068 = \frac{213.979 \times 1.1125}{1+\mathrm{E}(R)} + \frac{229.860 \times 1.1125}{1+\mathrm{E}(R)}\left(\frac{1}{\mathrm{E}(R) - 0.0565}\right). \tag{38}$$

The value of E($R$) that satisfies (38) is 11.17 per cent per annum. Note that the value of E($R$) that satisfies (38) is not the sum of a forecast of the one-year-ahead dividend yield and the long-term growth in dividends because (38) uses two forecasts of dividends rather than a single forecast.

A risk-free rate of 3.13 per cent per annum on an annual effective basis is obtained by applying the AER's method of interpolation to compute the yield on a 10-year CGS bond over the 20-day averaging period from 3 September 2012 to 28 September 2012. The DGM estimates of the return that the market would have required on the market portfolio that use the Bloomberg consensus forecasts indicate that with a 10-year bond yield of 3.13 per cent per annum an estimate of the *MRP*, relative to the yield, would have been 8.03 per cent per annum – rounded to two decimal places.

## 7.3. AER's DGM Estimates

The AER in its *Aurora Draft Decision* produces DGM estimates of the *MRP*. [105] The AER states that it bases these estimates on:

- a market value for a one-dollar imputation credit distributed of 35 cents;
- an assumed dividend growth rate of 6 per cent; and
- a dividend yield drawn from the RBA table f07.pdf.[106]

Imposing the assumption that

$$\mathrm{E}(D(t+s)) = \mathrm{E}(D(t))(1+g)^s, \qquad s > 0 \tag{39}$$

yields the familiar form of the DGM:

[104] AER, *Draft Distribution Determination Aurora Energy Pty Ltd 2012–13 to 2016–17*, November 2011, page 234.

[105] AER, *Draft Distribution Determination Aurora Energy Pty Ltd 2012–13 to 2016–17*, November 2011, page 234.

[106] http://www.rba.gov.au/statistics/tables/pdf/f07.pdf

$$\mathrm{E}(R) = \frac{D(t+1)}{P(t)} + g = \frac{(1+g)D(t)}{P(t)} + g. \tag{40}$$

Plugging in the numbers that the AER states that it uses and a yield for September 2012 of 4.8 per cent per annum from the RBA document f07.pdf and grossing up the yield for the assumed value of imputation credits distributed using (36) produces an estimate of the return to the market of [107]

$$\mathrm{E}(R) = 100 \times ((1+0.06) \times 1.1125 \times 0.048 + 0.06) = 11.66 \text{ per cent} \tag{41}$$

This estimate is 49 basis points higher than the estimate that we construct over a reference period in September 2012 using Bloomberg consensus forecasts. Part of the difference can be attributed to our use of a lower and so more conservative forecast of long-run dividend growth. Part of the difference can be attributed to a higher forecast of the dividend on the All Ordinaries one year from now, relative to the current value of the All Ordinaries, generated using the AER's assumptions and the data that the AER uses from the RBA than generated using Bloomberg consensus forecasts.

## 7.4. Interpreting DGM Estimates of the Expected Return to the Market

As we point out in our March 2012 report and Lally points out in his July 2012 and March 2013 reports, the DGM delivers the single internal rate of return that discounts forecasts of the future dividends that the market portfolio will pay back to the current value of the market portfolio. This internal rate of return will be a complicated average of the expected returns to the market portfolio over the next year and over all future years and may lie above or below the short-term expected return to the market.

As a practical matter, we note that while it is theoretically possible that the term structure of expected returns to the market may not be flat, the incorporation of a term structure that is not flat into the DGM is not standard practice. Rather, the standard implementation of the DGM is to determine a single required return that is applied to all future expected cash flows – a single return that equates the present value of all future cash flows to the current market price.

Besides this important practical issue, however, it would have been difficult to argue persuasively that the current expected return sat below the return delivered by the DGM at around the time that Lally (2012) provided his critique. [108] At this time the risk-free rate was low relative to its history but, contrary to the arguments put forward by Lally, it would have been difficult to argue that the current expected return sat below the return delivered by the DGM. That is, not only does Lally (2012) advocate an approach that differs from the standard practice, the implementation of his proposed approach at the time he was advocating it does *not* support the conclusion that he reaches. In what follows we illustrate this point.

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107 http://www.rba.gov.au/statistics/tables/pdf/f07.pdf

108 Lally, M., *The cost of equity and the market risk premium*, Victoria University of Wellington, 25 July 2012, page 3.

Lally, M., *The dividend growth model*, Victoria University of Wellington, 4 March 2013, pages 5-9.

NERA, *Prevailing conditions and the market risk premium: A report for APA Group, Envestra, Multinet & SP AusNet*, March 2012, page 42.

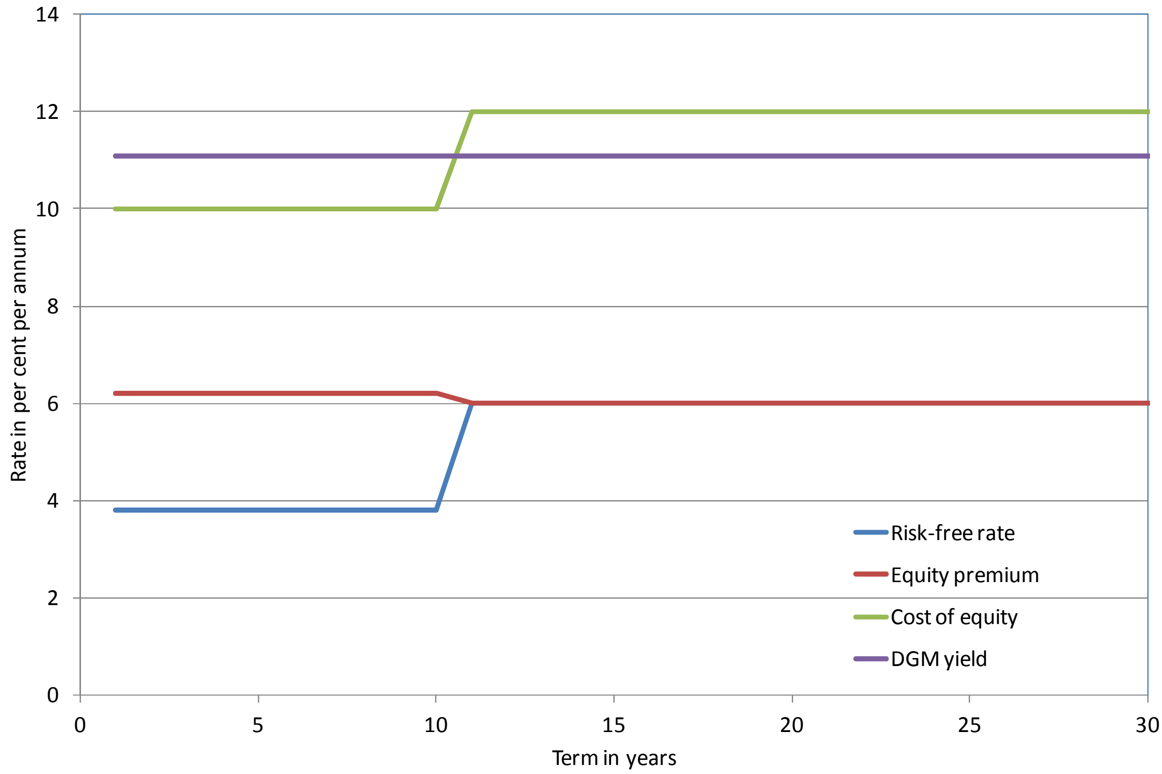
To illustrate the problems that one may face in interpreting the single internal rate of return that the DGM delivers, Lally (2012) provides an example in which one may be misled by the DGM into overestimating the short-term cost of equity and *MRP*.[109] Lally assumes that the one-year risk-free rate, the annual equity premium and the annual cost of equity follow the paths shown in Figure 7.2. Lally assumes in the example that the one-year risk-free rate is currently low, 3.8 per cent per annum, but will be expected to rise to its long-run value of 6 per cent per annum after 10 years. He assumes, on the other hand, that the equity premium is currently 6.2 per cent per annum, marginally above its long-run value of 6 per cent per annum to which it is expected to fall after 10 years. These figures imply that the annual market cost of equity is currently 10 per cent and will be expected to rise to its long-run value of 12 per cent after 10 years.

Lally assumes that the dividends delivered by a share will grow at a rate of 5 per cent per annum in perpetuity. Discounting the market's expectations of the stream of future dividends that a share will generate using the term structure of required returns on equity will allow one to compute the current share price. Lally computes this price and then using the price shows that the single internal rate of return that the DGM will deliver will be 11.1 per cent per annum. Combining this value with the assumed current risk-free rate of 3.8 per cent could lead one to believe, incorrectly, that the equity premium is currently 11.1 – 3.8 = 7.3 per cent – well above its long-run mean – when it is really 6.2 per cent – above its long-run mean, but only marginally so.

While Lally's example shows that one can, in principle, be misled in relying on estimates of the current *MRP* generated by the DGM, it does not follow that one will necessarily be misled – even if the risk-free rate is substantially below its long-run mean..

[109] Lally, M., *The cost of equity and the market risk premium*, Victoria University of Wellington, 25 July 2012, pages 15-16.

**Figure 7.2**
**Lally's (2012) example**




Our estimate of the mean return to the market portfolio based on consensus forecasts of dividend growth for the two years from September 2012 and a conservative estimate of dividend growth thereafter is 11.17 per cent per annum inclusive of credits. If expected inflation as of September 2012 lay at the middle of the RBA target range of 2 to 3 per cent, that is, at 2.5 per cent, then this estimate corresponds approximately to an estimate of the mean real return to the market portfolio in per cent per annum of:[110]

$$100 \times \left( \left( \frac{1+0.1117}{1+0.0250} \right) - 1 \right) = 8.46 \tag{42}$$

An estimate of the mean return to the market portfolio based on the AER's assumptions is 11.66 per cent per annum inclusive of credits.[111] If expected inflation as of September 2012 lay at the middle of the RBA target range of 2 to 3 per cent, an estimate that uses the AER's assumptions corresponds approximately to an estimate of the mean real return to the market portfolio in per cent per annum of:[112]

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110 http://www.rba.gov.au/monetary-policy/about.html

111 AER, *Draft Distribution Determination Aurora Energy Pty Ltd 2012–13 to 2016–17*, November 2011, page 234.

112 http://www.rba.gov.au/monetary-policy/about.html

$$100 \times \left( \left( \frac{1 + 0.1166}{1 + 0.0250} \right) - 1 \right) = 8.94 \tag{43}$$

An estimate of the long-run mean real return to the market portfolio over the period 1883 to 2011, computed from the annual data that Brailsford, Handley and Maheswaran (2012) provide and that we adjust using the method we describe in section 2, is 8.84 per cent per annum, inclusive of credits.[113, 114] Thus an estimate of the mean real return to the market portfolio as of September 2012 generated by the DGM is similar to an estimate of the long-run mean of the real return. This, as we will show, implies that it would have been difficult to generate a reasonable empirical argument corresponding to the theoretical argument that Lally (2012) provides to justify a low *MRP* for the five years from September 2012.[115]

Using the AER's assumption that the *MRP* is 6 per cent per annum, a 10-year CGS yield of 3.13 per cent for the period 3 September to 28 September 2012 and an assumption that expected inflation as of September 2012 lay at the middle of the RBA target range of 2 to 3 per cent produces an estimate of the mean real return to the market in per cent per annum of:[116]

$$100 \times \left( \left( \frac{1 + 0.0913}{1 + 0.0250} \right) - 1 \right) = 6.47 \tag{44}$$

To determine whether there are term structures for the mean real return to the market portfolio as of September 2012 that would have simultaneously satisfied the following conditions:

(i) a five-year mean real return to the market of 6.47 per cent per annum – consistent with the AER's assumption of an *MRP* of 6 per cent per annum;

(ii) a with-credit yield for September 2012 of 1.1125 × 4.8 = 5.34 per cent – drawn from the same source that the AER uses;[117]

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113 We ignore here the concerns that we raise about Brailsford, Handley and Maheswaran's data in Section 2.

114 The ACT in its recent decision found that the AER should place a value of 35 cents on each one dollar of imputation credits distributed and so we assume that each dollar of credits distributed is worth 35 cents.

ACT, Application by Energex Limited (Gamma) (No 5) [2011] ACompT 9, May 2011.

Brailsford, T., J. Handley and K. Maheswaran, *The historical equity risk premium in Australia: Post-GFC and 128 years of data*, Accounting and Finance, 2012, pages 237-247.

115 Lally, M., *The cost of equity and the market risk premium*, Victoria University of Wellington, 25 July 2012, pages 15-16.

116 AER, *Draft Distribution Determination Aurora Energy Pty Ltd 2012–13 to 2016–17*, November 2011, page 39.

http://www.rba.gov.au/monetary-policy/about.html

117 The without-credit dividend yield of 4.8 per cent, measured as the ratio of the dividends paid over a year to the end-of-year price, is taken from the RBA's document f07.pdf.

http://www.rba.gov.au/statistics/tables/pdf/f07.pdf

(iii) an expected growth in real dividends of 3.41 per cent – consistent with the AER's assumption about the future growth in dividends; [118] and

(iv) a long-run mean real return to the market portfolio of 8.84 per cent per annum – estimated from the annual data, adjusted for deficiencies, on which the AER in large part relies, [119]

we search across term structures that belong to the Nelson-Siegel family of curves: [120]

$$R(t) = a + b\exp(-t/\tau) + c\,(t/\tau)\exp(-t/\tau)\ , \tag{45}$$

where $R(t)$ is the mean real return to the market portfolio from year $t$-1 to year $t$ and $a$, $b$, $c$ and $\tau$ are parameters. We use this family of curves instead of the step function that Lally employs because empirically the Nelson-Siegel family of curves has been found to contain many of the term structures that one encounters in practice and one rarely encounters in practice a term structure that is a step function.

To search for term structures for the mean real return to the market portfolio that would satisfy (i) to (iv) we start by assuming that $a$ = 0.0884, $b$ = $c$ =0 and $\tau$ = 25. These parameter values imply that the term structure is flat and the mean real return to the market is 8.84 per cent per annum. Thus condition (iv) will be satisfied. We assume that the dividend paid in year 1 is $1.0341. It follows that if dividend growth is 3.41 per cent per annum, consistent with condition (iii), the dollar price of a share in the market will be

$$\frac{1+0.0341}{0.0884-0.0341} = 20.396 \tag{46}$$

Condition (ii), however, states that the dollar price of a share in the market must be

$$\frac{1}{0.0534} = 18.727 \tag{47}$$

Thus the term structure that we have selected will violate condition (ii). It is straightforward to see that it will also violate condition (i). The five-year mean real return to the market associated with the term structure is 8.84 per cent rather than the 6.47 per cent that condition (i) dictates that it should be. Since conditions (i) and (ii) are violated we use Solver in Excel to search for values for $a$, $b$, $c$ and $\tau$ that will satisfy these conditions as well as conditions (iii) and (iv).

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118 The expected growth in real dividends corresponding to an expected nominal growth of 6 per cent per annum will be 100 × ((1.060/1.025) – 1) = 3.41 per cent per annum where we assume that expected inflation sits in the middle of the RBA's target range.

AER, *Draft Distribution Determination Aurora Energy Pty Ltd 2012–13 to 2016–17*, November 2011, page 234.

http://www.rba.gov.au/monetary-policy/about.html

119 AER, *Draft decision Multinet Gas (DB No. 1) Pty Ltd Multinet Gas (DB No. 2) Pty Ltd 2013–17 Part 1*, September 2012, page 94.

120 Equation (45) corresponds to equation (1) on page 475 of

Nelson, C.R. and A.F. Siegel, *Parsimonious modelling of yield curves*, Journal of Business, 1987, 473-489

Figure 7.3 provides an example of a term structure, labelled Example 1 in the figure, which would simultaneously satisfy conditions (i) to (iv). The mean real returns are mean one-year real returns – like the mean one-year real returns in Figure 7.2. Consistent with what intuition would indicate would need to be true, the term structure is hump-shaped, first rising and then falling. Condition (iv) that the future long-run mean real return to the market portfolio must match an estimate that uses past data pins down long-term expectations. Condition (i) that dictates that the short-term mean real return to the market portfolio must be below the long-run mean restricts short-term expectations to be below their long-term counterparts. Lastly, conditions (ii) and (iii) together imply that the single internal rate of return delivered by the DGM must come close to matching the long-run mean real return to the market. Thus together these conditions imply that, between the short term and the long term, expectations of the real return to the market portfolio must lie above their long-term counterparts.

Figure 7.3 also provides an example of a term structure, labelled Example 2 in the figure, which relaxes the restriction that the long-run mean real return to the market portfolio must match an estimate produced from the annual data on which the AER in part relies. Relaxing this assumption implies that the term structure no longer need be hump-shaped. For the term structure not to be hump-shaped, however, while simultaneously delivering conditions (i) to (iii), requires that the long-run mean real return to the market portfolio lie above the estimate of the mean of 8.84 per cent per annum produced using the annual data on which the AER in large part relies.[121] In Example 2, the long-run mean real return is 13 per cent per annum – substantially above the estimate of 8.84 per cent per annum produced using past data.

The standard implementation of the DGM is to determine a single required return that is applied to all future expected cash flows – a single return that equates the present value of all future cash flows to the current market price. Our analysis suggests a fundamental problem with deviating from this standard implementation by estimating one required return for the next regulatory period on the basis that there will be a different required return in the long run. A party that was pre-disposed to low regulatory returns could always choose a very high estimate of the long-run mean real return to the market and then argue that the DGM delivers a mean real return below this figure, implying that the short-run mean real return to the market is below the level implied by the DGM. Such an argument could be made in a succession of regulatory determinations, with the result being low allowed returns – on the basis of higher long-run real returns being promised in every determination but never delivered.

We do not pretend that the two examples that we provide are the only examples that would generate a low mean real return over the five years from September 2012, but common sense dictates that other examples would have to share the same sort of characteristics.

To justify a low mean real short-term return to the market portfolio when the DGM delivers a mean real return that comes close to matching an estimate of the long-run mean real return produced from past data would require that either:

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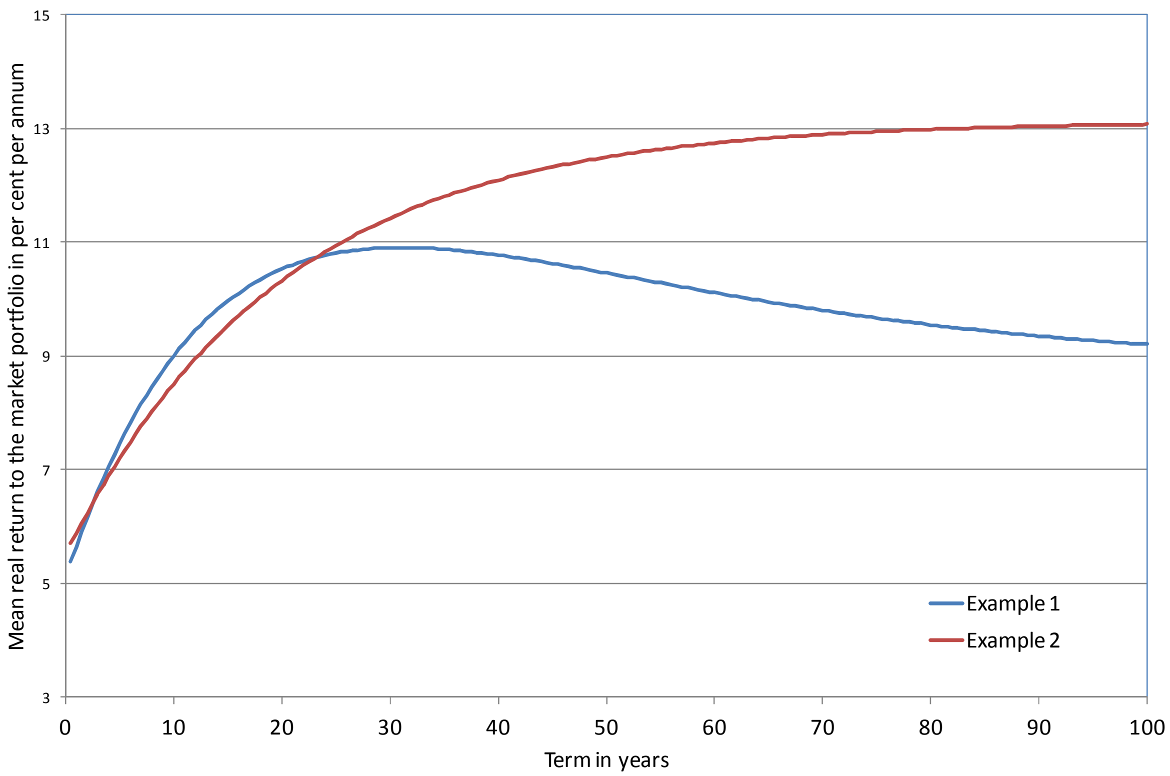
121 AER, *Draft decision Multinet Gas (DB No. 1) Pty Ltd Multinet Gas (DB No. 2) Pty Ltd 2013–17 Part 1*, September 2012, page 94.

- the term structure of mean real returns to the market portfolio be hump-shaped, with returns first rising then falling; or
- the long-run mean real return to the market portfolio lie above the estimate of the mean of 8.84 per cent per annum produced using the annual data on which the AER in large part relies;[122] or
- a significantly lower rate of growth in dividends.

We know of no data available as of September 2012 to suggest that any of these conditions were satisfied.

**Figure 7.3**
**Examples of term structures that would support the AER's view**




Evidence on the market's expectations of future CGS rates as of September 2012 is, on the other hand, available. Figure 7.4 plots CGS zero-coupon rates and six-month forward rates against term to maturity using data from the RBA for September 2012. The figure plots RBA zero-coupon rates for bonds with maturities of up to 10 years, zero-coupon rates that we have independently derived from yields provided by the RBA in the workbook f16.xls, a zero-coupon curve fitted to our zero-coupon rates belonging to the Nelson-Siegel family:[123, 124]

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[122] AER, *Draft decision Multinet Gas (DB No. 1) Pty Ltd Multinet Gas (DB No. 2) Pty Ltd 2013–17 Part 1*, September 2012, page 94.

[123] www.rba.gov.au/statistics/tables/xls/zcr-analytical-series.xls

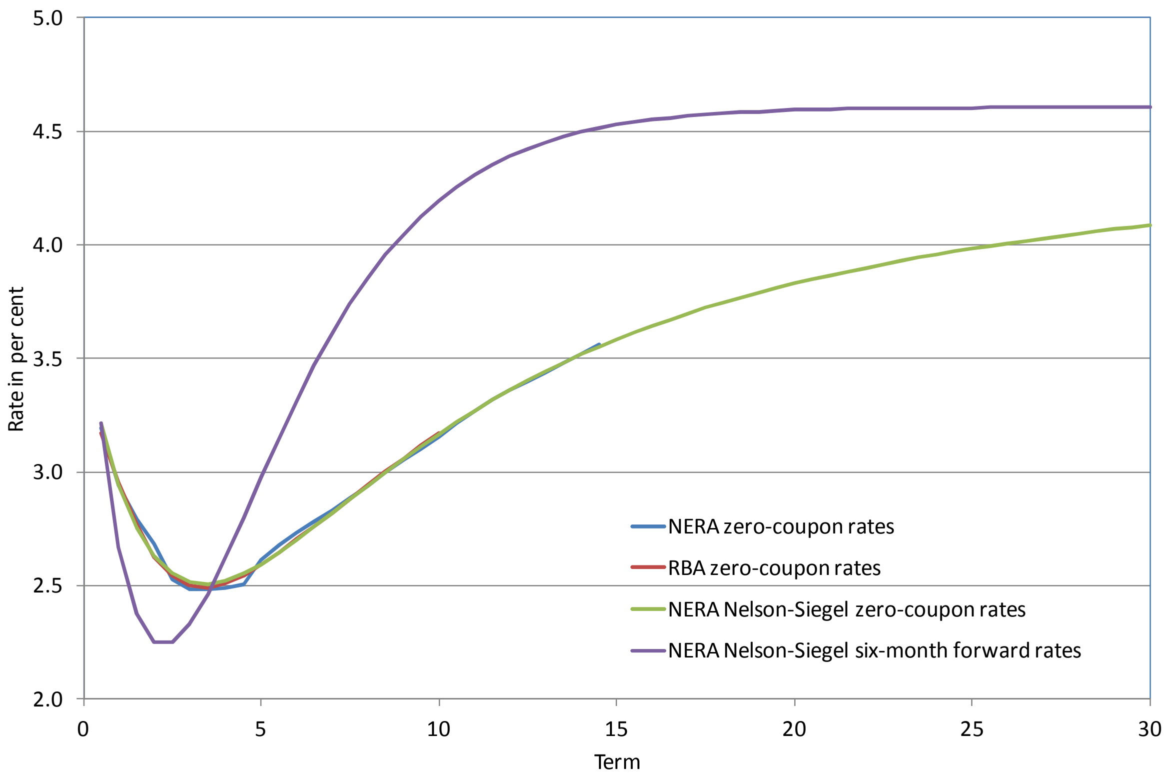
$$S(t) = a + b[1 - \exp(-t/\tau)]/(t/\tau) + c\exp(-t/\tau)\ , \quad (48)$$

where $S(t)$ is the $t$-year zero-coupon rate and six-month forward rates, computed as annual effective rates, derived from the curve.

While in the past forward rates have provided a poor guide to the market's expectation of future spot rates, Wright (2011) finds that the gap between forward rates and expectations of future spot rates has narrowed.[125] He shows that term premiums in Australia, among other countries, constructed using survey data on expectations of future spot rates have declined from around four per cent per annum to around one per cent. Thus while forward rates may not match the market's expectations of future spot rates, they can provide a guide.

Using the six-month forward rates as a guide, one must conclude that Figure 7.4 provides no evidence of the hump, characterised by rates first rising and then falling, that would have supported a low mean real short-term return to the market portfolio consistent with the AER's views of the market.

**Figure 7.4**
**Term structure of forward and spot rates on average during September 2012**




124 Equation (48) corresponds to equation (2) on page 475 of

Nelson, C.R. and A.F. Siegel, Parsimonious modelling of yield curves, Journal of Business, 1987, 473-489.

125 Wright, Julian, Term premia and inflation uncertainty: Empirical evidence from an international panel dataset, American Economic Review, 2011, pages 1514-1534.

## 7.5. Summary

To summarise, an estimate of the mean real return to the market portfolio generated by the DGM as of September 2012 is similar to an estimate of the long-run mean of the real return. This implies that it would have been difficult to generate a reasonable empirical argument corresponding to the theoretical argument that Lally (2012) provides to justify a low *MRP* for the five years from September 2012. [126]

We show that for one to have extracted from the DGM in September 2012 an estimate of the mean real return to the market that would have matched an estimate of the long-run mean of the real return constructed from past data and for one to have simultaneously observed:

(i) a five-year mean real return to the market of 6.47 per cent per annum – consistent with the AER's assumption of an *MRP* of 6 per cent per annum;

(ii) a with-credit yield of 1.1125 × 4.8 = 5.34 per cent – drawn from the same source that the AER uses; [127]

(iii) an expected growth in real dividends of 3.41 per cent – consistent with the AER's assumption about the future growth in dividends; [128] and

(iv) a long-run mean real return to the market portfolio of 8.84 per cent per annum – estimated from the annual data, adjusted for deficiencies, on which the AER in large part relies, [129]

would have required either that:

- the term structure of mean real returns to the market portfolio to have been hump-shaped, with returns first rising and then falling; or
- the long-run mean real return to the market portfolio to have sat above the estimate of the mean of 8.84 per cent per annum produced using the annual data, adjusted for deficiencies, on which the AER in large part relies; [130] or

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126 Lally, M., *The cost of equity and the market risk premium*, Victoria University of Wellington, 25 July 2012, pages 15-16.

127 The without-credit dividend yield of 4.8 per cent, measured as the ratio of the dividends paid over a year to the end-of-year price, is taken from the RBA's document f07.pdf.

http://www.rba.gov.au/statistics/tables/pdf/f07.pdf

128 The expected growth in real dividends corresponding to an expected nominal growth of 6 per cent per annum will be 100 × ((1.060/1.025) – 1) = 3.41 per cent per annum where we assume that expected inflation sits in the middle of the RBA's target range.

AER, *Draft Distribution Determination Aurora Energy Pty Ltd 2012–13 to 2016–17*, November 2011, page 234.

http://www.rba.gov.au/monetary-policy/about.html

129 AER, *Draft decision Multinet Gas (DB No. 1) Pty Ltd Multinet Gas (DB No. 2) Pty Ltd 2013–17 Part 1*, September 2012, page 94.

- a significantly lower rate of growth in dividends.

We know of no data available as of September 2012 to suggest that any of these conditions were satisfied.

[130] AER, *Draft decision Multinet Gas (DB No. 1) Pty Ltd Multinet Gas (DB No. 2) Pty Ltd 2013–17 Part 1*, September 2012, page 94.

# 8. Survey Results and Practitioner Behaviour

## 8.1. Surveys

In choosing a value for the currently prevailing *MRP* the AER has in the past generally placed some weight on survey evidence. For example, the AER states in its *Consultation Paper*: [131]

> 'We previously considered surveys of market practitioners and academics to be relevant as they reflect the forward looking MRP applied in practice.'

We emphasise in our March 2012 report, however, that there are a number of problems with the surveys that the AER cites: [132]

- the surveys that the AER cites typically do not explain how those surveyed were chosen;
- a majority of those surveyed in the surveys that the AER cites did not respond;
- it is unclear what incentives were provided to individuals contacted by the surveys that the AER cites to ensure that respondents would provide accurate responses;
- it is often unclear whether respondents are supplying estimates of the *MRP* that use continuously compounded returns or not continuously compounded returns;
- it is often unclear what value respondents place on imputation credits;
- it often unclear what risk-free rate respondents use; and importantly
- it is unclear how relevant some of the surveys that the AER cites are because of changes in market conditions since the time at which the surveys were conducted.

The Australian Competition Tribunal (ACT) also urges the AER to treat the results of surveys with caution. For example, the ACT states that: [133]

> 'Surveys must be treated with great caution … consideration must be given at least to … the number of respondents, the number of non-respondents and the timing of the survey.'
>
> 'When presented with survey evidence that contains a high number of non-respondents as well as a small number of respondents in the desired categories of expertise, it is dangerous for the AER to place any determinative weight on the results.'

The AER states in its *Consultation Paper*, on the other hand, that: [134]

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131 AER, *Consultation paper: Rate of return guidelines*, May 2013, page 81.

132 NERA, *Prevailing conditions and the market risk premium: A report for APA Group, Envestra, Multinet & SP AusNet*, March 2012, page 43.

133 Australian Competition Tribunal, *Application by Envestra Limited (No 2) [2012] ACompT 3*, 11 January 2012, paragraphs 165–166.

> 'Survey based estimates may be subjective, because market practitioners may look at a range of different time horizons and they are likely to have differing views on the market risk. This concern may be mitigated as the sample size increases.'

This statement assumes that the error with which surveys estimate the *MRP* can be diversified away across surveys. This need not be true. For example, if most of the surveys were conducted at a time when the *MRP* was low, then they will tend to underestimate the *MRP* and the error that they make in estimating the current *MRP* will not be diversified away.

Surveys can provide useful information, however, if properly executed. Such surveys will be ones:

- in which it is clear how those surveyed were chosen;
- in which a majority of those surveyed responded;
- in which respondents have an incentive to provide accurate answers;
- in which the questions asked are unambiguous; and
- where the responses are of relevance to current market conditions.

An example of a survey that satisfies these criteria is the survey that Bloomberg conducts to construct consensus forecasts. We use these forecasts in section 7 because we believe the surveys that Bloomberg conducts satisfy the criteria listed above.

Another example of a survey that satisfies the criteria is the survey that Incenta (2013) conduct in which they investigate the behaviour of independent experts who have valued regulated energy infrastructure and analysts who cover energy distribution businesses listed on the ASX. [135]

An example of a survey that does not satisfy the criteria listed above is the survey conducted by Asher (2011) to which the AER refers. [136] We note in this survey that:

- only 45 of 2,000 surveyed responded; and that
- the survey was conducted in February 2011 when bond yields were around 200 basis points higher than in May 2013. [137]

Asher did not reveal in his report the number of questionnaires he had sent out but he responded to an enquiry we made about the number. His response indicates that 97.75 per cent of those canvassed did not respond. The very low number of responses in his survey raises the possibility that the sample of respondents is not representative of the population.

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[134] AER, *Consultation paper: Rate of return guidelines*, May 2013, page 81.

[135] Incenta, *Term of the risk free rate for the cost of equity: Report for the Energy Networks Association*, 2013, pages 23-28.

[136] AER, *Consultation paper: Rate of return guidelines*, May 2013, page 82.

Asher, *Equity Risk Premium Survey – results and comments*, Actuary Australia 2011 Issue 161, July 2011, pages. 13-15.

[137] The RBA reports that the 10-year bond yield on 31 May 2013 was 3.42 per cent per annum while it was 5.47 per cent per annum on 28 February 2011. See

www.rba.gov.au/statistics/tables/xls/f02dhist.xls

The timing of the survey suggests that the results of the survey are, in any case, of little relevance to constructing a value for the *MRP* that reflects currently prevailing conditions.

Asher has, however, updated his 2011 survey using 49 responses collected in March 2012.[138] Again his report does not reveal the number of questionnaires he sent out to prospective respondents but in a response to an enquiry we made about the number he revealed that 4,000 members of the Actuaries Institute were canvassed. His response indicates that 98.78 per cent of those canvassed in March 2012 did not respond.

A second example of a survey that does not satisfy the criteria listed above is the survey conducted by Fernandez, Aguirreamalloa and Corres (2013) to which the AER refers.[139] We note that the questionnaire which the authors sent out to 21,500 email addresses worldwide is ambiguous. Figure 8.1 shows the questionnaire. It is evident that the questionnaire does not state whether:

- respondents should supply estimates of the *MRP* that use continuously compounded or not continuously compounded returns;
- what risk-free rate respondents should use; and importantly
- what value respondents should place on imputation credits.

An estimate of the *MRP* that uses continuously compounded returns can sit 200 basis points below an estimate that uses not continuously compounded returns. To see this note that the difference between the mean not continuously compounded return to an asset and the mean continuously compounded return is approximately half the variance and that the standard deviation of the return to a value-weighted portfolio of stocks (the square root of the variance) is around 20 per cent per annum.[140, 141]

Similarly, an estimate of the *MRP* based on the geometric mean of a series of returns to the market portfolio can sit 200 basis points below an estimate that is based on the arithmetic

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138 Asher, *Equity Risk Premium Survey 2012 – results and comments*, Actuary Australia 2012 Issue 171, July 2012, pages. 28-29.

139 AER, *Consultation paper: Rate of return guidelines*, May 2013, page 82.

Fernandez, P., J. Aguirreamalloa and L. Corres, *Market risk premium used in 82 countries in 2012: A survey with 7,192 answers*, University of Navarra, Madrid, Spain, May 2013.

140 The continuously compounded return to a portfolio can be written ln(1+*R*), where *R* is the not continuously compounded return to the portfolio. A second order Taylor series expansion for ln(1+*R*) around zero is:

$$\ln(1+R) = R - R^2/2$$

It follows, therefore, by re-arranging that, approximately,

$$\mathrm{E}(R) = \mathrm{E}\left[\ln(1+R)\right] + \mathrm{Var}(R)/2$$

See,

Chiang, A. C., *Fundamental methods of mathematical economics*, McGraw Hill, 1974, pages 268-271.

141 An estimate of the standard deviation of the return to the All Ordinaries from 1958 to 2011 using the annual data that Brailsford, Handley and Maheswaran (2012) supply and that we update is 22.7 per cent per annum.

Brailsford, T., J. Handley and K. Maheswaran, *The historical equity risk premium in Australia: Post-GFC and 128 years of data*, Accounting and Finance, 2012, pages 237-247.

mean.[142] We show in section 4 that an estimate of the *WACC* that is based, in part, on the arithmetic mean of a sample of annual returns to the market portfolio will produce an unbiased estimate of the true *WACC* and so will lead the present value principle to be on average satisfied. In contrast, an estimate of the *WACC* that is in part based on an estimate of the *MRP* that places a positive weight on the geometric mean of a sample of annual returns to the market portfolio will produce a downwardly biased estimate of the true *WACC* and will lead the present value principle to be on average violated. If survey respondents supply estimates of the *MRP* that are based on the geometric mean of a sample of annual returns to the market portfolio, then the use of the survey responses will lead the present value principle to be on average violated.[143]

**Figure 8.1**
**Questionnaire sent by Fernandez, Aguirreamalloa and Corres (2013)**

**EXHIBIT 1. Mail sent on May and June 2012**

We are doing a survey about the **Market Risk Premium** (MRP) or Equity Premium that companies, analysts and professors use to calculate the required return to equity in different countries.

We will be very grateful to you if you kindly reply to the following 2 questions.

1. The Market Risk Premium that I am using in 2012

   for USA is: _______%
   for __________ is: _______ %
   for __________ is: _______ %
   for __________ is: _______ %

2. Books or articles that I use to support this number:

Comments:

Of course, no companies, individuals or universities will be identified, and only aggregate data will be made public.
Best regards and thanks,
Pablo Fernandez
Professor of Finance, IESE Business School, Spain

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*Source: Fernandez, P., J. Aguirreamalloa and L. Corres, Market risk premium used in 82 countries in 2012: A survey with 7,192 answers, University of Navarra, Madrid, Spain, May 2013, page 14.*

What value for the risk-free rate survey respondents choose can have an important impact on the value that they supply for the *MRP*. The spread between short-term bank accepted bill

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[142] See, for example,

Dimson, E., P. Marsh and M. Staunton, *Credit Suisse Global investment returns sourcebook 2012*, Credit Suisse, February 2012.

[143] Note that Dimson, Marsh and Staunton place as much emphasis on geometric means as on arithmetic means and so it is quite possible that some survey respondents will supply what they know to be geometric means computed from past data.

Dimson, E., P. Marsh and M. Staunton, *Credit Suisse Global investment returns sourcebook 2012*, Credit Suisse, February 2012.

rates and long-term government bond rates, for example, can be significant. Data from the RBA show that at the end of May 2012, when Fernandez, Aguirreamalloa and Corres (2013) conducted their survey, the 30-day bank accepted bill rate was 3.63 per cent while the 10-year CGS yield was 71 basis points lower at 2.92 per cent. [144, 145]

Finally, imputation credits can add around 50 basis points to the value of the *MRP* as we will show later in this section.

It follows from this discussion of the problems that surround interpreting the results of surveys that it is difficult to know how to assess the results of the survey that Fernandez, Aguirreamalloa and Corres (2013) conduct. [146]

As an example of the problems that can arise with interpreting surveys, we note that the AER in its *Consultation Paper* misrepresents the results of Ernst and Young (2012) who examine reports written by independent experts over the period 2008 to 2012. [147, 148] The AER reports statistics intended to summarise the assessments made by independent experts in 2012. These statistics, though, are:

- not based on values for the *MRP* assessed by experts relative to the 10-year CGS yield at the time each report was produced, but are instead based on values for the *MRP* assessed by experts relative to the view of the experts of what risk-free rate should be employed in valuing risky assets at that time; and are
- not adjusted for the provision of imputation credits.

We show below that a failure to incorporate these adjustments leads the AER to understate by 98 basis points the average value for the *MRP* relative to the 10-year CGS yield assessed by the 17 experts whose 2012 reports Ernst and Young examine.

The assessments contained in independent expert reports, however, if properly evaluated, contain valuable insights about the value that practitioners currently place on the *MRP*. The assessments contained in independent expert reports also avoid many of the problems that are associated with survey responses.

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144 Fernandez, P., J. Aguirreamalloa and L. Corres, *Market risk premium used in 82 countries in 2012: A survey with 7,192 answers*, University of Navarra, Madrid, Spain, May 2013.

145 The RBA reports that the 30-day bank accepted bill rate on 31 May 2012 was 10-year bond yield on 31 May 2013 was 3.42 per cent per annum while it was 5.47 per cent per annum on 28 February 2011. See

www.rba.gov.au/statistics/tables/xls/f02dhist.xls

146 Fernandez, P., J. Aguirreamalloa and L. Corres, *Market risk premium used in 82 countries in 2012: A survey with 7,192 answers*, University of Navarra, Madrid, Spain, May 2013.

147 AER, *Consultation paper: Rate of return guidelines*, May 2013, page 82.

148 Ernst and Young, *Market evidence on the cost of equity Victorian Gas Access Arrangement Review 2013-2017*, 8 November 2012

## 8.2. Independent Expert Reports

The use of independent expert reports circumvents a number of the problems associated with survey evidence. In particular:

- independent expert reports are typically made public and so it is not necessary to seek a response from each expert;
- many transactions require an independent expert report be produced;
- independent experts face strong incentives to provide accurate responses;
- it is clear from independent expert reports how returns are measured, that is, whether returns are continuously compounded or not continuously compounded;
- independent experts generally state whether they place a value on imputation credits;
- independent experts generally state how they choose a value for the risk-free rate; and
- a time series of independent expert reports can be collected so that one can test propositions about the behaviour of expert assessments of the *MRP* through time.

In addition, the AER, in its September 2012 *Draft decision | Multinet 2013–17 | Draft decision appendices* (the AER's "September 2012 Draft decision") states that: [149]

- 'expert valuers … apply the MRP, so the AER considers (they) can make informed judgments about the MRP. McKenzie and Partington supported this view in their February 2012 MRP report.'

Thus the AER and at least two of its advisors believe that independent expert reports can provide information that is useful in determining the currently prevailing *MRP*.

Independent experts estimate the cost of equity so as to value certain transactions. The cost of equity is typically estimated and then blended with a cost of debt to establish a *WACC* which is then used to discount future cash flows expected if a transaction were to proceed. The present value of the transaction may be compared with the present values of alternatives to the transaction, including the alternative of not proceeding with the transaction.

The Corporations Act and the ASX Listing Rules specify the circumstances under which an expert report must be issued to shareholders who may be affected by certain types of transactions. Even where there is no requirement for an expert report under the Corporations Act or the ASX Listing Rules, the directors of a company may still voluntarily commission an expert report to assist security holders to make informed decisions in relation to certain proposals.

Independent expert reports are prepared by accredited independent experts, working within an explicit regime of regulation, comprising both formal statutory rules and less formal guidelines, which require that the experts be accountable for the results of their work.

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[149] AER, *Draft decision | Multinet 2013–17 | Draft decision appendices*, September 2012, page 32.

McKenzie, M. and G. Partington, *Supplementary report on the MRP*, SIRCA Limited, February 2012, page 17.

Experts preparing independent expert reports which express an opinion as required by the Corporations Act or ASX Listing Rules should be experts in their field. Section 9 of the Corporations Act defines an expert as: [150]

> 'a person whose profession or reputation gives authority to a statement made by him or her.'

ASIC requires that experts who prepare independent expert reports:

a. cannot be associated with certain parties who have interests in the transaction for which the independent expert report is prepared;

b. must disclose certain relevant interests and relationships when preparing reports required by the Corporations Act; and

c. must hold an Australian financial services licence which imposes obligations to manage potential conflicts of interest.

In paragraph 111.128 of Regulatory Guide 111 ASIC advises that it will consider regulatory action if it considers there are material issues about the adequacy and completeness of an independent expert's analysis, or if it has concerns about the expert's independence. Regulatory action may include revocation or suspension of the independent expert's licence.

## 8.3. The Connect 4 Data

We use data collected from the Connect 4 database by Ernst and Young who employ the data in their November submission to the AER on behalf of the APA Group, Envestra, Multinet and SP AusNet. [151] We also use data collected from the Connect 4 database by SFG who update the data that Ernst and Young collect to 26 April 2013. [152] The two sets of data together cover all 1,136 independent expert reports issued between 1 January 2008 and 26 April 2013 that are published in the Connect 4 Expert Reports database. Connect 4 is a web-based system, operated and maintained by the Thomson Reuters company, which provides information on companies listed on the ASX.

Like Ernst and Young, we examine only reports that:

- include a valuation of a transaction and employ a discounted cash flow valuation method;
- use the Sharpe-Lintner (SL) Capital Asset Pricing Model (CAPM) to derive a cost of equity;
- provide sufficient information on how the cost of equity is estimated; and

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150 Commonwealth Government, Corporations Act, 2001.

151 Ernst and Young, *Market evidence on the cost of equity Victorian Gas Access Arrangement Review 2013-2017*, 8 November 2012

152 SFG, *Evidence on the required return on equity from independent expert reports: Report for the Energy Networks Association*, June 2013.

- use the yield on a 10-year domestic government bond as a measure of the risk-free rate.

Using these criteria, of the 1,136 independent expert reports, 142 reports qualify for a more detailed analysis of the assessments that independent experts make of the *MRP*.

## 8.4. Independent Expert Assessments of the *MRP*

Each independent expert report that uses the CAPM specifies three parameters:

- a risk-free rate or a range for the risk-free rate;
- an equity beta or a range for the equity beta; and
- an *MRP* or a range for the *MRP*.

In addition, our own examination of the data reveals that in 66 of the 142 expert reports a firm-specific premium is added to the cost of equity. The CAPM predicts that the premium that an asset will earn over and above the risk-free rate will be determined solely by the contribution of the asset to the risk of the market portfolio, measured by its beta, and the price of risk, measured by the *MRP*. Thus an expert who adds a firm-specific risk premium to the cost of equity is not relying solely on the CAPM.

It is important to note that the focus of independent expert reports is on what constitutes an appropriate overall *WACC* and not on what appropriate choices are for the individual parameters used to compute the *WACC*. For example, as we show, expert reports have in the recent past made upward adjustments to the risk-free rate so as to lift the *WACC* that they compute. Consequently, in computing an estimate of the *MRP* that experts actually employ it is important to first determine what cost of equity they would use for the average firm, that is, for the market. To determine what cost of equity an expert would use for the market, we add the risk-free rate that the expert uses to his or her choice of an *MRP*.

There are, however, adjustments that the experts make that are difficult to interpret. Because there is more than one reasonable way in which to interpret how these adjustments might affect the choice of an expert of a cost of equity for the market, we examine a number of different ways of incorporating the adjustments that the experts make. We also examine the impact on inference of simply dropping the reports where adjustments made are difficult to interpret. We find that the inferences that we draw are unaffected by how we deal with these adjustments.

The conclusion from our analysis is that whatever approach we use, there is clear evidence that the practice of independent experts over the last year has been to use an (implied) *MRP* that sits far above the value of 6 per cent per annum, inclusive of a value assigned to imputation credits, that the AER has in the recent past employed.

### 8.4.1. Extracting expert assessments of the *MRP*

The extent to which each independent expert discusses how values for the parameters of the CAPM are chosen varies both across experts and through time. For example, BDO's discussion of the value that it chooses for the *MRP* in its November 2009 valuation of Excela consists of four sentences. BDO states that: [153]

> 'The market risk premium is the difference between the expected return on the market and the risk free rate. It represents the "undiversifiable risk" attached to all equity investments.
>
> According to empirical evidence the market risk premium is historically between 6% and 8%. We adopted a market risk premium of 6.50% in our valuation of Excela.'

In contrast, Grant Samuel's discussion of the value that it chooses for the *MRP* in its August 2012 valuation for Hastings Diversified Utilities Fund covers more than one page. Grant Samuel states initially that: [154]

> 'Grant Samuel has consistently adopted a market risk premium of 6% and believes that, particularly in view of the general uncertainty, this continues to be a reasonable estimate. It:
>
> - is not statistically significantly different to the premium suggested by long term historical data;
> - is similar to that used by a wide variety of analysts and practitioners (typically in the range 5-7%); and
> - makes no explicit allowance for the impact of Australia's dividend imputation system.'

This initial statement, however, is followed by a more detailed analysis that states that: [155]

> 'Grant Samuel's view is that the selected cost of capital should incorporate a margin over the calculated WACC range to reflect:
>
> - alternative approaches for estimating the cost of equity such as the Gordon Growth Model suggest higher rates than the 7.5-8.1% implied by the CAPM. Analysis of the entities most comparable to Epic Energy (i.e. APA Group, DUET Group and Envestra) using the Gordon Growth Model suggests costs of capital in the range 9.5-12% (yields mostly around 7.5% and growth of 2.0-3.0%) with a median of around 10.5%. The Gordon Growth Model is an alternative approach to estimating the cost of equity under which it is calculated as the current forecast yield plus the expected long term growth rate. This approach is particularly useful when valuing assets which generate long term stable growth cash flows such as energy infrastructure assets. However, caution is warranted in considering this analysis because of the difficulties of putting the yields of the energy infrastructure entities on a comparable basis because of differing tax treatments;
> - anecdotal information suggests that equity investors have substantially repriced risk since the global financial crisis (notwithstanding the uplift in equity markets since March 2009) and that acquirers are pricing offers on the basis of hurdle rates well above those implied by theoretical models. This can be evidenced

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[153] BDO, *Independent expert report: Fox Invest Limited*, 25 November 2009, page 41.

[154] Grant Samuel, *Independent expert's report: Pipeline Partners Offer*, 3 August 2012, page 6.

[155] Grant Samuel, *Independent expert's report: Pipeline Partners Offer*, 3 August 2012, pages 8-9.

through the decline in listed company earnings multiples (relative to the peak in 2007) although it has yet to be translated into the measures of market risk premium (at least those based on longer term historical data). Another way of looking at this is to note that while long term interest rates have fallen by approximately 150-200 basis points over the past 12 months there has been no corresponding lift in earnings multiples, suggesting investors have offset this reduction with an increase in their risk premium and/or a reduction in long term earnings growth rates. In this regard, an increase in the market risk premium of 1% (i.e. from 6% to 7%) would increase the calculated WACC range to 6.6-7.2%;

- global interest rates, including long term bond rates, are at very low levels by comparison with historical norms reflecting the very substantial amounts of liquidity being pumped into many advanced economies (particularly Western Europe and the United States) to stimulate economic activity. Effective real interest rates are now extremely low, if not negative in some cases (e.g. the United States). We do not believe this position is sustainable and, in our view, the risk is clearly towards a rise in bond yields. Conceptually, the interest rates used to calculate the discount rate should recognise this expectation (i.e. they should be forecast for each future period) but for practical ease market practice is that a single average rate based on the long term bond rate is generally adopted for valuation purposes. Some academics/valuation practitioners consider it to be inappropriate to add a "normal" market risk premium (e.g. 6%) to a temporarily depressed bond yield and therefore a "normalised" risk free rate should be used. On this basis, an increase in the risk free rate to (say) 5% would increase the calculated WACC range to 7.2-7.9%; and
- analysis of research reports on Australian entities involved in gas transmission operations (i.e. HDUF, APA Group, DUET Group and Envestra) indicates that brokers are currently adopting costs of equity capital in the range 9.1-12.0%, with a median of 10.6% and WACC in the range 7.3-8.8%, with a median of 7.8%.

Having regard to these matters and the calculations set out above, Grant Samuel has selected a discount rate range of 8.0-8.5% for application in the discounted cash flow analysis.'

In the 15 instances where an independent expert sets a value for the *MRP*, calculates a value for the cost of equity and then subsequently produces a revised value either for the cost of equity or the *WACC* that exceeds 25 basis points per annum, we record two values for the *MRP*. First, we record the initial value for the *MRP* that the expert chooses. We label this value the unadjusted value of the *MRP*. Second, we compute an adjusted value under the assumption that any difference between the final choice for a cost of equity or *WACC* and the initial value for a cost of equity or *WACC* is due solely to an adjustment to the *MRP*. We make this assumption because the 15 reports that make a final adjustment to the cost of equity or *WACC* do not specify what portion of the adjustment is due to an adjustment made to the *MRP*. We view the adjusted and unadjusted values of the *MRP* as providing upper and lower bounds for the parameter.

We also examine the independent expert reports to assess whether any further adjustments to the cost of debt have been made. In particular, we look for evidence as to whether any final revisions to the *WACC* (or to the discount rate) can be attributed to amendments to the cost of debt. In almost every instance, there is no commentary to suggest that a change to the cost of debt is responsible for any adjustment to the *WACC* (or to the discount rate).

To understand how we compute an adjusted value of the *MRP*, it will help to consider an example. The example we choose is the Grant Samuel August 2012 valuation for Hastings Diversified Utilities Fund. The adjusted value of the *MRP* is computed under the assumption that:

$$WACC(\text{final}) - WACC(\text{initial}) = \left(1 - \frac{D}{V}\right)\beta(MRP(\text{final}) - MRP(\text{initial})), \tag{49}$$

where $D/V$ is the fraction of the firm's value made up of debt outstanding and $\beta$ is the firm's equity beta. It follows that

$$MRP(\text{final}) = MRP(\text{initial}) + \frac{(WACC(\text{final}) - WACC(\text{initial}))}{\left(1 - \frac{D}{V}\right)\beta} \tag{50}$$

For the Grant Samuel August 2012 valuation for Hastings Diversified Utilities Fund: [156]

- the initial range for the *WACC* is 6.3 – 6.8 per cent per annum;
- the final range for the *WACC* is 8.0 – 8.5 per cent per annum;
- the range for the debt-to-value ratio is 45 – 55 per cent; and
- the range for the equity beta is 0.75 – 0.85.

Using the midpoints of each range produces an adjusted *MRP* in per cent per annum of:

$$6 + \frac{2 \times \left((8.0 + 8.5) - (6.3 + 6.8)\right)}{(0.45 + 0.55)(0.75 + 0.85)} = 10.25 \tag{51}$$

For the Grant Samuel August 2012 valuation for Hastings Diversified Utilities Fund, the unadjusted value of the *MRP* is 6 per cent per annum. [157]

From the discussion that we reproduce above from the Grant Samuel August 2012 report for Hastings Diversified Utilities Fund it is evident that the view of Grant Samuel is that the *MRP* lies above 6 per cent per annum. It is also evident from the discussion that Grant Samuel views estimates of the cost of equity generated by the CAPM as too low. Thus one cannot attribute all of the final adjustment that Grant Samuel makes to the *WACC* to an adjustment to the *MRP*. Part of the final adjustment appears to reflect Grant Samuel's belief that the CAPM omits factors that are important in pricing the equity of a regulated utility. Thus a reasonable interpretation is that the adjusted value of 10.25 per cent per annum represents an upper bound on the value that Grant Samuel believes the *MRP* should take and that the unadjusted value of 6 per cent per annum represents a lower bound.

Ernst and Young (2012) compute instead an adjusted value of the *MRP* under the implicit assumption that any difference between the final choice of a *WACC* and the initial value for

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[156] Grant Samuel, *Independent expert's report: Pipeline Partners Offer*, 3 August 2012, page 8.

[157] Grant Samuel, *Independent expert's report: Pipeline Partners Offer*, 3 August 2012, page 7.

the *WACC* is due solely to an adjustment to the risk-free rate.[158] We report evidence below that over the last two years some experts set the risk-free rate above the 10-year CGS yield. Thus the assumption that Ernst and Young make is a reasonable alternative to the assumption that we make about how experts make a final adjustment to the *WACC*.

Finally, we note before proceeding to the results of our empirical analysis that Ernst and Young report and our own analysis indicates that the values of the *MRP* that the 142 independent experts use are not adjusted for the value that imputation credits provide to some investors.[159] Grant Samuel, for example, state in their August 2012 valuation for Hastings Diversified Utilities Fund that:[160]

> 'the evidence gathered to date as to the value the market attributes to franking credits is insufficient to rely on for valuation purposes. More importantly, Grant Samuel does not believe that such adjustments are widely used by acquirers of assets at present.'
>
> 'it is Grant Samuel's opinion, that it is not appropriate to make any adjustment.'

### 8.4.2. Regression analysis of independent expert assessments of the *MRP*

The AER follows a policy of setting the *MRP* to be approximately a constant, 6 per cent per annum, through time that is independent of the risk-free rate.[161] We use the 142 independent expert assessments of the *MRP* to test whether this policy is consistent with market practice. To do so, we examine the behaviour of:

(i) an estimate, taken from an independent expert report, of the return required on the market portfolio in excess of the 10-year CGS yield, $MRP_{\mathrm{IER}} + RFR_{\mathrm{IER}} - RFR_{CGS}$;[162]

(ii) an estimate taken from an independent expert report of the return required on the market portfolio in excess of the risk-free rate that the expert uses, $MRP_{\mathrm{IER}}$; and

(iii) the difference between a value for the risk-free rate taken from an independent expert report and the 10-year CGS yield, $RFR_{\mathrm{IER}} - RFR_{CGS}$,

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158 Ernst and Young, *Advice on aspects of the cost of equity, Victorian Gas Access Arrangement Review 2013-2017: A report for the APA Group, Envestra, Multinet and SP AusNet*, November 2012, page 23.

159 Ernst and Young, *Advice on aspects of the cost of equity, Victorian Gas Access Arrangement Review 2013-2017: A report for the APA Group, Envestra, Multinet and SP AusNet*, November 2012, page 15.

160 Grant Samuel, *Independent expert's report: Pipeline Partners Offer*, 3 August 2012, page 10.

161 The AER raised the *MRP* in May 2009, in the face of the global financial crisis, to 6.5 per cent per annum but brought it back down again to 6 per cent in February 2011 after it judged the crisis had past.

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

AER, *Draft decision: Envestra Ltd Access arrangement proposal for the SA gas network 1 July 2011 – 30 June 2016*, February 2011.

162 We compute the CGS yield by applying each day the AER's method of interpolation to compute the annual effective yield on a 10-year Commonwealth Government Security. The AER's method of interpolation is consistent with clause 6.5.2(d) of the National Electricity Rules.

where the notation $MRP_{IER}$ denotes a value for the *MRP* taken from an independent expert report, $RFR_{IER}$, a value for the risk-free rate taken from an independent expert report and $RFR_{CGS}$, the 10-year CGS yield. In particular, we examine whether the quantities (i) to (iii) are related to the 10-year CGS yield by regressing each quantity on the 10-year CGS yield. Table 8.1 provides the results of these regressions. Panel A provides results that use the unadjusted data while Panel B provides results that use the adjusted data.

**Table 8.1**
**Analysis of independent expert assessments of the *MRP***

| Dependent variable | Intercept | Slope |
|---|---|---|
| | Panel A: Data unadjusted | |
| $MRP_{\mathrm{IER}} + RFR_{\mathrm{IER}} - RFR_{CGS}$ | 7.392* | -0.195* |
| | (0.222) | (0.045) |
| $MRP_{\mathrm{IER}}$ | 6.283* | -0.000 |
| | (0.205) | (0.042) |
| $RFR_{\mathrm{IER}} - RFR_{CGS}$ | 1.109* | -0.194* |
| | (0.210) | (0.039) |
| | Panel B: Data adjusted | |
| $MRP_{\mathrm{IER}} + RFR_{\mathrm{IER}} - RFR_{CGS}$ | 8.344* | -0.367* |
| | (0.491) | (0.093) |
| $MRP_{\mathrm{IER}}$ | 7.235* | -0.173 |
| | (0.537) | (0.102) |
| $RFR_{\mathrm{IER}} - RFR_{CGS}$ | 1.109* | -0.194* |
| | (0.210) | (0.039) |

*Note: Data are from the Connect-4 database and the RBA. $MRP_{\mathrm{IER}}$ is the MRP chosen by the independent expert, $RFR_{\mathrm{IER}}$ is the risk-free rate chosen by the independent expert and $RFR_{\mathrm{CGS}}$ is the 10-year yield interpolated from the RBA files f16.xls and f16hist.xls. The results are generated by regressing each dependent variable on $RFR_{\mathrm{CGS}}$. Standard errors are in parentheses and are heteroscedasticity and autocorrelation consistent. * indicates significantly different from zero at the 5 per cent level.*

Panel A indicates that one can reject the proposition that an estimate of the return required on the market portfolio taken from an independent expert report in excess of the 10-year CGS yield is independent of the yield. An estimate of the return required on the market portfolio taken from an independent expert report in excess of the 10-year CGS yield is an estimate of the *MRP* that independent experts use measured in exactly the same way that the AER measures the *MRP* – that is, relative to the 10-year CGS yield.

An estimate of the *MRP* relative to the 10-year CGS yield of 3.181 per cent for 26 April 2013 based on the first regression in Panel A of Table 8.1 is, in per cent per annum,

$$7.392 - 0.195 \times 3.181 = 6.772 \tag{52}$$

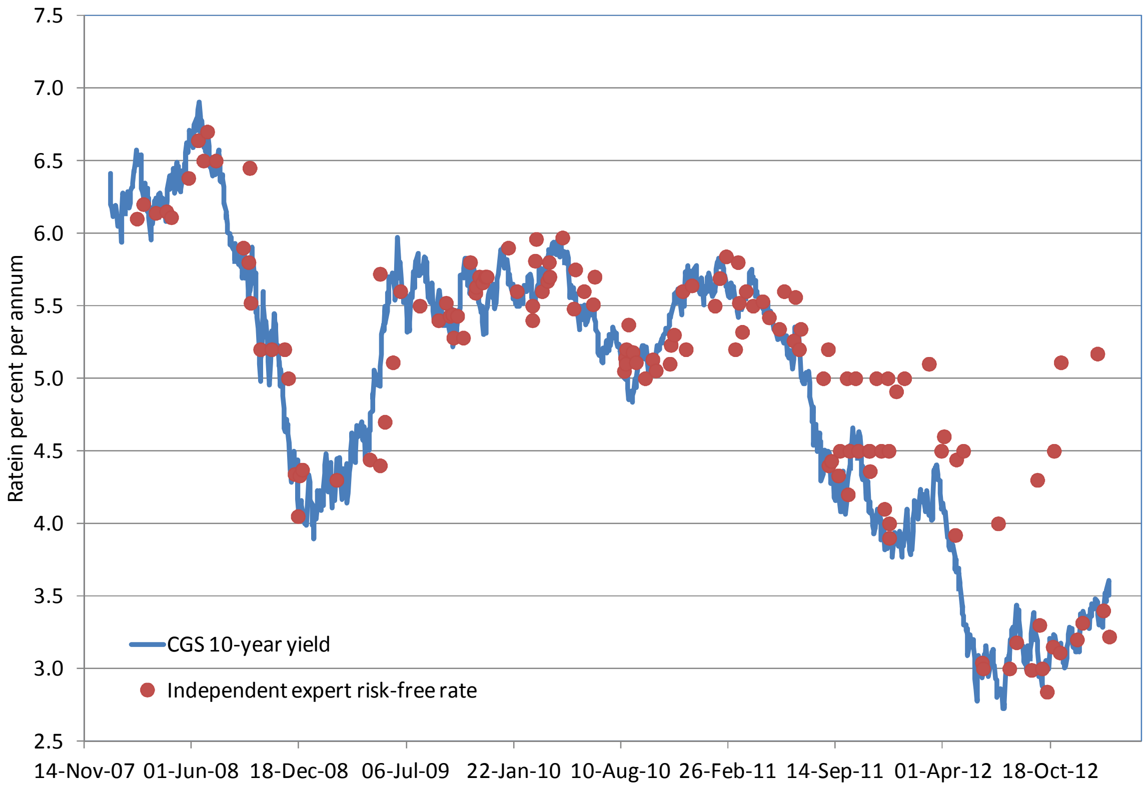
This figure is exclusive of a value assigned to imputation credits.

Panel A of Table 8.1 also shows, interestingly, that the negative relation between an estimate of the return required on the market portfolio taken from an independent expert report in excess of the 10-year CGS yield and the yield arises not because of a relation between the value for the *MRP* that experts provide and the yield. Instead the relation arises from a tendency for independent experts to substitute a higher value for the risk-free rate than the 10-year CGS yield when yields fall. This can be inferred from the negative slope coefficient that results from regressing the difference between the risk-free rates chosen by independent experts and the 10-year CGS yield on the CGS yield. Figure 8.2 illustrates this tendency and demonstrates that it is a relatively recent phenomenon. In the 20 reports from 27 April 2012 to 26 April 2013, independent experts set the risk-free rate on average 39 basis points above the 10-year CGS yield. In the 122 reports from 2 January 2008 to 26 April 2012 independent experts set the risk-free rate on average 12 basis points above the 10-year CGS yield. [163]

Panel B of Table 8.1 provides results that use the adjusted data. The panel indicates that, as with the unadjusted data, one can reject the proposition that an estimate of the return required on the market portfolio taken from an independent expert report in excess of the 10-year CGS yield is independent of the yield. The point estimate of the slope coefficient from a regression of an estimate of the return required on the market portfolio taken from an independent expert report in excess of the 10-year CGS yield on the CGS yield, though, is almost twice as large as its counterpart in Panel A. This reflects the size and timing of some of the adjustments made by the independent experts. Large upward adjustments, for example, were made to the initial estimates of the *MRP* provided in the Grant Samuel August 2012 report for Hastings Diversified Utilities Fund and the Grant Samuel October 2012 report for DUET at a time when GGS yields were low.

[163] We compute these values directly from the data. We do not infer the values from the regression results of Table 8.1.

## Figure 8.2
## Relation between independent expert and RBA measures of the risk-free rate




An estimate of the *MRP*, exclusive of a value assigned to imputation credits, relative to the 10-year CGS yield of 3.181 per cent for 26 April 2013 based on the first regression in Panel B of Table 8.1 is, in per cent per annum,

$$8.344 - 0.367 \times 3.181 = 7.177 \quad (53)$$

To summarise, regression analysis of the 142 independent expert reports suggests that an estimate of the *MRP* relative to the 10-year CGS yield for 26 April 2013 should lie between 6.77 and 7.18 per cent per annum exclusive of any value assigned to imputation credits.

The ACT in its recent decision found that the AER should place a value of 35 cents on each one dollar of imputation credits distributed.[164] Brailsford, Handley and Maheswaran (2008) indicate that on average 75 per cent of dividends distributed are franked and the corporate tax rate is currently 30 per cent.[165] So to take into account the value of credits distributed, we

[164] This value is the value laid down by the ACT in its recent decision on the market value of a one-dollar credit distributed. See

ACT, Application by Energex Limited (Gamma) (No 5) [2011] ACompT 9, May 2011.

[165] Brailsford, T., J. Handley and K. Maheswaran, *Re-examination of the historical equity risk premium in Australia*, Accounting and Finance 48, 2008, page 85.

multiply a forecast of the dividend yield, measured as the ratio of dividends paid to start-of-year price, on the All Ordinaries by [166]

$$0.35 \times 0.75 \times \left( \frac{0.30}{1-0.30} \right) = 0.1125 \tag{54}$$

The average dividend yield, measured as the ratio of dividends paid to start-of-year price, over the period 1883 to 2011, computed from the annual data that Brailsford, Handley and Maheswaran (2012) provide and that we adjust and update in section 2, is 5.48 per cent. [167] Thus an estimate of the value arising from the distribution of imputation credits based on this average yield in per cent per annum is

$$0.1125 \times 5.48 = 0.62 \tag{55}$$

The dividend yield, measured as the ratio of dividends paid to end-of-year price, for the S&P All Ordinaries on 26 April 2013 is 4.00 per cent. [168] Using the AER assumption about the annual growth in dividends, this yield implies a value for the dividend yield, measured as the ratio of dividends paid to start-of-year price, of 4.00 × 1.06 = 4.24 per cent. [169] Thus an estimate of the value arising from the distribution of imputation credits based on this yield in per cent per annum is [170]

$$0.1125 \times 4.24 = 0.48 \tag{56}$$

Using the lower of the two values in equations (55) and (56), to be conservative, we conclude that regression analysis of the 142 independent expert reports suggests that an estimate of the *MRP* relative to the 10-year CGS yield for 26 April 2013 should lie between 7.25 and 7.66 per cent per annum inclusive of a value assigned to imputation credits.

### 8.4.3. Behaviour of independent expert assessments of the *MRP* over last year

Figure 8.2 indicates that the views of independent experts have recently changed. A sensible alternative in the face of this recent change in behaviour is to estimate the *MRP* relative to the 10-year CGS yield not from a regression but as an average across reports using solely data from the last 12 months. SFG collect from the Connect 4 database up until 26 April 2013 and

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[166] With a corporate tax rate of 28 per cent, which the government hopes to introduce at some stage in the future, the adjustment factor would be 1.1021. Using this lower corporate tax rate lowers the expected return to the market portfolio by around 5 basis points.

[167] Brailsford, T., J. Handley and K. Maheswaran, *The historical equity risk premium in Australia: Post-GFC and 128 years of data*, Accounting and Finance, 2012, pages 237-247.

[168] http://www.rba.gov.au/statistics/tables/pdf/f07.pdf

[169] AER, *Draft Distribution Determination Aurora Energy Pty Ltd 2012–13 to 2016–17*, November 2011, page 234.

[170] Brailsford, T., J. Handley and K. Maheswaran, *The historical equity risk premium in Australia: Post-GFC and 128 years of data*, Accounting and Finance, 2012, pages 237-247.

so we choose to examine the period from 27 April 2012 to 26 April 2013.[171] We again compute the *MRP* relative to the 10-year CGS yield as $MRP_{\mathrm{IER}} + RFR_{\mathrm{IER}} - RFR_{CGS}$.

The CGS yield averaged across the 20 days on which independent expert reports were released between 27 April 2012 and 26 April 2013 is 3.17 per cent per annum while the risk-free rate chosen by the experts across these days was on average 3.57 per cent per annum. The *MRP* relative to the 10-year CGS yield averaged across the 20 independent expert reports published over the period lies between 6.79 and 7.39 per cent per annum exclusive of any value assigned to imputation credits. The lower bound is provided by the series of unadjusted values of the *MRP* while the upper bound is provided by the series of adjusted values.

These results are not only economically but also statistically significant. Panel A of Table 8.2 below provides:

- unadjusted estimates of the *MRP* – labelled 'unadjusted' – assessed by independent experts relative to the 10-year CGS yield over the periods 1 January 2008 to 26 April 2012 and 27 April 2012 to 26 April 2013 exclusive of the value of imputation credits; and

- estimates that we adjust using the method we describe earlier in this section – labelled 'NERA adjusted' – that are also exclusive of imputation credits.

Both these sets of estimates are computed as averages across either the 122 reports released between 1 January 2008 and 26 April 2012 or the 20 reports released between 27 April 2012 and 26 April 2013. Panel B of Table 8.2 shows that tests of the null that there is no difference between the *MRP* relative to the 10-year CGS yield over the period 1 January 2008 and 26 April 2012, and the *MRP* relative to the 10-year CGS yield over the period from 27 April 2012 to 26 April 2013, easily reject the hypothesis. Panel B of the table also shows that tests of the null that the *MRP* relative to the 10-year CGS yield over the period 27 April 2012 to 26 April 2013 is 6 per cent, as the AER asserts is true of the *MRP inclusive* of credits, also overwhelmingly reject the hypothesis despite the fact that the experts measure the *MRP exclusive* of credits.

Panel A of Table 8.2 also provides:

- estimates – labelled 'omitted' – of the *MRP* assessed by independent experts relative to the 10-year CGS yield on average over the period 1 January 2008 and 26 April 2012 and over the period 27 April 2012 to 26 April 2013, exclusive of the value of imputation credits, that omit observations for which experts make adjustments; and

- estimates that we adjust using the method that Ernst and Young (2012) describe – labelled 'E & Y adjusted' – that are also exclusive of imputation credits.[172] Ernst and Young compute an adjusted value of the *MRP* under the implicit assumption that

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171 SFG, *Evidence on the required return on equity from independent expert reports: Report for the Energy Networks Association*, June 2013.

172 Ernst and Young, *Advice on aspects of the cost of equity, Victorian Gas Access Arrangement Review 2013-2017: A report for the APA Group, Envestra, Multinet and SP AusNet*, November 2012, page 23.

any difference between the final choice of a *WACC* and the initial value for the *WACC* is due solely to an adjustment to the risk-free rate.

The 'E & Y adjusted' estimates are computed as averages across either the 122 reports released between 1 January 2008 and 26 April 2012 or the 20 reports released between 27 April 2012 and 26 April 2013. The 'omitted' estimates are computed as averages across either the 114 reports from 1 January 2008 until 26 April 2012 or the 13 reports released between 27 April 2012 and 26 April 2013 that do not make a significant adjustment. Panel A of Table 8.2 shows that these two sets of estimates are also well above 6 per cent – even though they, like the other estimates, are *exclusive* of a value assigned to imputation credits. Panel B of the table also shows that tests of the null that the *MRP* relative to the 10-year CGS yield over the period 27 April 2012 to 26 April 2013 is 6 per cent, that use the two sets of estimates, also overwhelmingly reject the hypothesis – again, despite the fact that the experts measure the *MRP exclusive* of credits.

Thus the results that are produced:

- do not depend on whether the estimates of the *MRP* are adjusted or unadjusted;
- do not depend on how the adjustments are made; and
- do not depend on whether the observations that are adjusted are included or excluded from the analysis.

Again, from (56), a conservative estimate of the value arising from the distribution of imputation credits is 48 basis points. It follows that a conservative estimate of the *MRP* relative to the 10-year CGS yield *inclusive* of a value assigned to imputation credits computed from the 20 independent expert reports released between 27 April 2012 and 26 April 2013 lies between 7.56 and 8.22 per cent per annum. Recall that our regression-based estimates of the *MRP* relative to the 10-year CGS yield *inclusive* of a value assigned to imputation credits lie between 7.25 and 7.66 per cent per annum. Thus it is also clear that the results that we produce are not particularly sensitive to whether we use regression analysis or we use simple means computed from recent data.

## Table 8.2
## Analysis of independent expert assessments of the *MRP* relative to the 10-year CGS yield exclusive of imputation credits over time

| Period or null hypothesis | Reports | Unadjusted | Omitted | NERA adjusted | E & Y adjusted |
|---|---|---|---|---|---|
| | | Panel A: Estimates | | | |
| 1 Jan 2008 – 26 Apr 2012 | 122 | 6.386 | 6.387 | 6.416 | 6.435 |
| | | (0.040) | (0.042) | (0.043) | (0.048) |
| 27 Apr 2012 – 26 Apr 2013 | 20 | 6.795 | 6.979 | 7.390 | 7.170 |
| | | (0.119) | (0.137) | (0.318) | (0.221) |
| | | Panel B: Tests | | | |
| MRP(1 Jan 2008 – 26 Apr 2012) | | 3.262 | 4.117 | 3.032 | 3.250 |
| = MRP(27 Apr 2012 – 26 Apr 2013) | | (0.003) | (0.001) | (0.007) | (0.004) |
| MRP(27 Apr 2012 – 26 Apr 2013) = 6 | | 6.705 | 7.129 | 4.365 | 5.297 |
| | | (0.000) | (0.000) | (0.000) | (0.000) |

*Note: Data are from the Connect-4 database and the RBA. Unadjusted indicates that the observations that experts adjust are unadjusted. Omitted indicates that the observations that experts adjust are omitted. In Panel A, estimates are outside of parentheses while standard errors are in parentheses. In Panel B, test statistics are outside of parentheses while p-values are in parentheses. To test the null that MRP(1 Jan 2008 – 26 Apr 2012) = MRP(27 Apr 2012 – 26 Apr 2013), we use the Smith-Satterthwaite test described by Miller and Freund (1965).*[173]

*Miller, I. and Freund, J.E., Probability and statistics for engineers, Prentice-Hall, Englewood Cliffs, NJ, 1965.*

[173] The Smith-Satterthwaite statistic for a test of the null hypothesis that the mean of a normally distributed series $x$ matches the mean of an independently normally distributed series $y$ is:

$$\left(\frac{s_x^2}{n_x}+\frac{s_y^2}{n_y}\right)^{-1/2}(\bar{x}-\bar{y}),$$

where $\bar{x}$ and $s_x$ are the sample mean and sample standard deviation of a sample of $n_x$ observations on $x$ and where $\bar{y}$ and $s_y$ are the sample mean and sample standard deviation of a sample of $n_y$ observations on $y$. Under the null, the statistic will be approximately $t$-distributed with

$$\left\lfloor\left(\frac{s_x^4}{n_x^2(n_x-1)}+\frac{s_y^4}{n_y^2(n_y-1)}\right)^{-1}\left(\frac{s_x^2}{n_x}+\frac{s_y^2}{n_y}\right)^2\right\rfloor$$

degrees of freedom, where $\lfloor . \rfloor$ is the floor function.

### 8.4.4. The AER's assessment of the expert reports

In its Consultation Paper the AER states that the average *MRP* assessed by the 17 experts who produced reports between 1 January 2012 and 10 October 2012 was 6.26 per cent. This figure is the average *MRP* assessed by the 17 experts relative to the risk-free rate that they employ and is *exclusive* of imputation credits. On average the 17 experts choose a risk-free rate that lies 49 basis points above the 10-year CGS yield. Thus the average *MRP* assessed by the 17 experts relative to the 10-year CGS yield, *exclusive* of imputation credits, is 6.75 per cent.

From (56) an estimate of the contribution of imputation credits to the *MRP*, inclusive of credits, is 48 basis points. It follows that the average *MRP* assessed by the 17 experts relative to the 10-year CGS yield, *inclusive* of imputation credits, is 7.23 per cent. In other words, the average *MRP* assessed in exactly the same way that the AER computes an estimate of the *MRP* from historical data is 98 basis points higher than the figure that the AER reports.

### 8.4.5. The cost of equity for the market in 2012 and 2013

In section 8.4.3 we test hypotheses about the *MRP* in 2012 and 2013 relative to earlier years and relative to the AER's views on the parameter. We find that independent experts have set a higher *MRP* on average between 27 April 2012 and 26 April 2013 than they did over the four or so years from 2008 to 2012. We also find that experts have set a higher *MRP* on average between 27 April 2012 and 26 April 2013 than the AER deems appropriate.

These results can be recast in terms of the cost of equity for the market, that is, the return required on the market. The cost of equity for the market is the sum of the 10-year CGS yield and the *MRP* relative to the 10-year CGS yield.

*Exclusive* of imputation credits, we find that the 'unadjusted' average cost of equity for the market that experts use between 27 April 2012 and 26 April 2013 is 9.97 per cent per annum. Recall that our unadjusted estimate ignores the adjustments that seven experts make to their initial choice of parameters in 2012.

There were seven independent expert reports for which we adjusted the *MRP* using the methods described in section 8.4.1. Again, one rationale provided by experts for adjusting the *MRP* in 2012 and 2013 was that risk premiums are at elevated levels. The 'NERA adjusted' average cost of equity for the market that experts use between 27 April 2012 and 26 April 2013, *exclusive* of imputation credits, is 10.56 per cent per annum.

Ernst and Young (2012) use a different method of adjusting the *MRP*. They assume that any adjustment that experts make reflects an adjustment to the risk-free rate that experts use.[174] We provide evidence that the experts use a risk-free rate in 2012 and 2013 that exceeds on average the 10-year CGS yield. So the course of action that Ernst and Young pursue is a reasonable alternative to the course we pursue. The 'E & Y adjusted' average cost of equity for the market that experts use between 27 April 2012 and 26 April 2013, *exclusive* of imputation credits, is 10.34 per cent per annum.

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174 Ernst and Young, *Advice on aspects of the cost of equity, Victorian Gas Access Arrangement Review 2013-2017: A report for the APA Group, Envestra, Multinet and SP AusNet*, November 2012, page 23.

Finally, if the seven reports for 2012 in which experts adjust their initial choice of parameters are omitted we produce a similar estimate. The 'omitted' average cost of equity for the market that experts use between 27 April 2012 and 26 April 2013, *exclusive* of imputation credits, is 10.19 per cent per annum.

The AER has since 2011 used a value for the *MRP* of 6 per cent per annum, *inclusive* of imputation credits.[175] Using this value for the *MRP* delivers a cost of equity for the market, *inclusive* of imputation credits, between 27 April 2012 and 26 April 2013 of 9.17 per cent per annum. We compute this figure using the 10-year CGS yields on the 20 days on which expert reports in the Ernst & Young – SFG database were released. Hence, the conclusion to be drawn is that on any view of the data, during 2012 and 2013, independent experts have been adopting a cost of equity for the market that is materially higher than that which is produced by applying the AER's method.

[175] AER, *Final Decision, Envestra Limited, Access arrangement proposal for the SA gas network, 1st July 2011 to 30th June 2016*, June 2011; page 50.

# 9. Estimating the Size and Value Premiums

This section outlines what we believe to be appropriate data sources for use in estimating size and value premiums and provides estimates of the premiums.

Under the previous National Electricity Rules (NER), the AER was required to estimate the cost of equity for electricity network businesses using the SL CAPM. Although the previous National Gas Rules (NGR) did not mandate the use of the SL CAPM, in practice, the AER also applied this approach in gas network decisions. The recently revised NER and NGR now require the AER to consider all relevant financial models and therefore provide greater scope to look at cost of equity models beyond the traditionally adopted SL CAPM. One of the financial models that the AER will consider is the Fama-French three-factor model.[176]

## 9.1. Theory

Fama and French (1992) show that, contrary to the predictions of both the SL CAPM and Black CAPM, the market value of a firm's equity and the ratio of the book value of the equity to its market value are better predictors of the equity's return than is an estimate of the equity's beta.[177, 178] If there are factors besides the return to the market portfolio of stocks that are pervasive, then the Arbitrage Pricing Theory (APT) of Ross (1976) predicts that the additional risks associated with the factors should be priced.[179] The intuition behind the APT is that investors will be rewarded for risks that are pervasive and that they cannot diversify away but will not be rewarded for risks that are idiosyncratic and which cannot be diversified away. If investors were not rewarded for bearing pervasive risks, then arbitrage opportunities would arise. Fama and French (1993) argue that if assets are priced rationally, then variables that can explain the cross-section of mean returns must be proxies for risks that cannot be diversified away.[180]

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176 Fama, E., and K. French, *Common risk factors in the returns on stocks and bonds*, Journal of Financial Economics, 1993, pages 3–56.

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

178 Kothari, Shanken, and Sloan (1995) suggest that the evidence that Fama and French provide may reflect survivorship bias. In particular, they suggest that selective backfilling by Compustat may provide the appearance of a stronger value effect than actually exists. Chan, Jegadeesh and Lakonishok (1995), however, show that selection bias contributes negligibly to the value effect in Compustat data and Davis (1994) shows that a value effect exists in pre-Compustat data that are free from any survivorship bias.

Chan, Louis K. C., Narasimhan Jegadeesh, and Josef Lakonishok, *Evaluating the performance of value versus glamour stocks: The impact of selection bias*, Journal of Financial Economics, 1995, pages 269–296.

Davis, James L., *The cross-section of realized stock returns: The pre-Compustat evidence*, Journal of Finance, 1994, pages 1579–1593.

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

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

180 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 and French (1993) suggest that there are three pervasive sources of risk or factors: [181]

(i) the excess return to the market portfolio;

(ii) the difference between the return to a portfolio of high book-to-market stocks and the return to a portfolio of low book-to-market stocks (*HML*); and

(iii) the difference between the return to a portfolio of small-cap stocks and the return to a portfolio of large-cap stocks (*SMB*).

If these three factors are the only pervasive sources of risk and a risk-free asset exists, then it must be true that:

$$\mathrm{E}(z_j) = b_j \mathrm{E}(z_m) + h_j \mathrm{E}(HML) + s_j \mathrm{E}(SMB), \tag{57}$$

where

$z_j$ and $z_m$ are, respectively, the returns to stock *j* and the market portfolio in excess of the risk-free rate;

$b_j$, $h_j$ and $s_j$ are the slope coefficients from a multivariate regression of the dependent variable $z_j$ on the regressors $z_m$, *HML* and *SMB;* and

E(*HML*) and E(*SMB*) are the *HML* and *SMB* premiums.

Whereas the SL CAPM and Black CAPM underestimate the returns to small-cap stocks and value stocks, the Fama-French model is designed to explain the returns to small-cap stocks and value stocks correctly.

The $R^2$ values attached to the time series regressions of the returns to the 25 US portfolios on the three factors that Fama and French (1993) report are all close to one. [182, 183] This means that one could almost replicate the returns to the 25 portfolios using the three Fama-French factors. Thus, as Cochrane (2001) points out, the three-factor model must be approximately true to avoid near-arbitrage opportunities. He states that: [184]

> ‘one can ... regard the (Fama-French three-factor) model as an arbitrage pricing theory. If the returns of the 25 size and book/market portfolios could be perfectly replicated by the returns to the three-factor portfolios – if the $R^2$ in the time series regressions were 100% - then the multifactor model would have to hold exactly in order to preclude arbitrage opportunities. In fact the R2 of Fama and French’s time-series regressions are all in the 90-95% range, so ... there would be near-arbitrage opportunities if value and small stocks did not move together in the way described by the Fama-French model.’

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

182 The coefficient of determination $R^2$ measures the fraction of the variation in a regressand explained by variation in a set of regressors.

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

184 Cochrane, John H., *Asset pricing*, Princeton University Press, 2001, page 442.

The idea that prices should be set so as to rule out arbitrage opportunities is one of the oldest and most basic in Finance. Rubinstein notes that Fisher used a no-arbitrage argument as early as 1907.[185]

## 9.2. Data

There are several data sources that one might use to construct *HML* and *SMB* factors. Similarly, as Roll (1977) and Stambaugh (1982) emphasise, there are several ways of constructing a proxy for the market portfolio. [186]

### 9.2.1. French and SIRCA

A natural source for data is the web site of Ken French, one of the creators of the Fama-French model. [187] French provides a series of monthly returns to Australian value and growth portfolios from January 1975 to December 2012. These returns can be used to construct a series of monthly observations on an Australian *HML* factor. French does not provide daily or weekly data on Australian value and growth portfolios. In addition, French does not provide data – daily, weekly or monthly – that can be used to construct an Australian *SMB* factor.

French forms value and growth portfolios at the end of December each year by sorting stocks according to the ratio of their quoted book value to their market value. Value-weighted returns are then computed for the following 12 months. The value (high book-to-market) portfolio contains firms in the top 30 per cent and the growth (low book-to-market) portfolio contains firms in the bottom 30 per cent. Thus French discards the 40 per cent of firms that lie between the top 30 per cent and the bottom 30 per cent. The methodology that French uses to construct Australian value and growth portfolios follows the methodology in Fama and French (1998) rather than in Fama and French (1993).[188] Fama and French (1993) form a value portfolio from a portfolio of large value stocks and a portfolio of small value stocks and, similarly, they form a growth portfolio from a portfolio of large growth stocks and a portfolio of small growth stocks. Fama and French (1998), who use data for primarily large stocks from Bloomberg, do not sort stocks on the basis of size.

A high-quality database that one can use to construct an *SMB* time series to match the *HML* series that French provides is the SIRCA Share Price and Price Relative (SPPR) database. [189] The SPPR database provides the monthly market capitalisations of and returns to all stocks listed on the ASX from January 1974 to December 2012. Lajbcygier and Wheatley (2012)

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185 Rubinstein, M., *A history of the theory of investments*, Wiley, 2006, page 7.

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

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.

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

188 Fama, E., and K. French, *Common risk factors in the returns on stocks and bonds*, Journal of Financial Economics, 1993, pages 3–56.

Fama, E., and K. French, *Value versus growth: The international evidence*, Journal of Finance, 1998, pages 1975–1999.

189 http://www.sirca.org.au/2011/05/sirca-share-price-price-relative-database/

use the database and the 500 largest stocks listed on the ASX to construct an *SMB* time series in exactly the same way that Fama and French (1998) construct an *HML* series.[190]

### 9.2.2. S&P

In work for Jemena in 2009, NERA used, at the suggestion of Dimensional Fund Advisors (DFA), data from French and Standard and Poors (S&P).[191] DFA suggested that NERA combine data from these two sources because French at that time had not recently updated the Australian *HML* series that he has since published on his web site. The S&P data that DFA suggested that NERA should use to construct a series of observations on an *HML* factor were:

- the S&P Australia BMI (Broad Market Index) Value Index;[192] and
- the S&P Australia BMI (Broad Market Index) Growth Index.[193]

These data are available on a monthly basis from July 1989 to December 2012 and on a daily basis from 3 July 1989 to 31 December 2012. S&P constructs these portfolios in the following way:

Each stock is given a value score and a growth score based on four value variables and three growth variables. Stocks are then allocated to four groups on the basis of these scores. Stocks that have above (below) average value scores and below (above) average growth scores are assigned to the value (growth) portfolio. The remaining stocks are allocated partially to both portfolios.[194]

Since, unlike Fama and French, S&P do not discard stocks that do not exhibit marked value or growth characteristics, one can expect the S&P *HML* premium to lie below the Fama and French *HML* premium.

The S&P data which DFA suggested that NERA should use to construct a series of observations on an *SMB* factor were:

- the S&P ASX Small Ordinaries Index;[195]
- the S&P ASX 50 Leaders Index;[196] and
- the S&P ASX 100 Index.[197]

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[190] Fama, E., and K. French, *Value versus growth: The international evidence*, Journal of Finance, 1998, pages 1975–1999. Lajbcygier, P. and S.M. Wheatley, *Imputation credits and equity returns*, Economic Record, 2012, pages 476-494.

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

[192] The tickers for the indices are SBVBCAUL (price) and STVBCAUL (accumulation).

[193] The tickers for the indices are SBGBCAUL (price) and STGBCAUL (accumulation).

[194] A more detailed description of how S&P constructs the portfolios appears at: https://www.sp-indexdata.com/idpfiles/citigroup/prc/active/whitepapers/methodology-sp-global-bmi-sp-ifci-indices.pdf

[195] The tickers for the indices are AS38 (price) and ASA38 (accumulation).

[196] The tickers for the indices are AS31 (price) and ASA31 (accumulation).

Returns to the Small Ordinaries (50 and 100 indices) are available from Bloomberg on a monthly basis from January 1991 (June 1992) to December 2012 and on a daily basis from 4 January 1994 (1 June 1992) to 31 December 2012. The S&P ASX Small Ordinaries Index is comprised of companies included in the S&P/ASX 300, but not in the S&P/ASX 100. The index currently covers approximately 7 per cent of the Australian equity market by capitalisation. The S&P/ASX 50 (100) is comprised of 50 (100) of the largest and most liquid index-eligible stocks listed on the ASX by float-adjusted market capitalisation. The S&P/ASX 50 (100) represents approximately 63 (74) per cent of the Australian equity market by capitalisation. [198]

DFA also provided NERA with:

- a monthly series of returns to an ASX ex-50 Leaders Simulated Index sourced from John Nolan and Associates (now JANA) running from January 1980 to December 1990;
- a monthly series of returns to the ASX 50 Leaders Index running from January 1980 to December 1990; and
- a monthly series of returns to the ASX 100 Index running from January 1991 to May 1992.

Combining these S&P and related series enabled NERA to form a monthly SMB series running from January 1980 to December 2012.

### 9.2.3. MSCI

In work for Jemena in 2009, NERA also used data from MSCI. In that work, NERA computed the *HML* factor as the difference between the returns to: [199]

- the MSCI Australia Standard Value Index; and
- the MSCI Australia Standard Growth Index.

Data on the returns to these two portfolios are available on a monthly basis from January 1975 to December 2012 and on a daily basis from 2 January 2001 to 31 December 2012. MSCI uses eight historical and forward looking variables to assess the style of each security. MSCI then places each security into either a value or growth portfolio based on this assessment or allocates the security partially to both portfolios. In this way the two portfolios together contain all securities deemed eligible by MSCI. [200]

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197 The tickers for the indices are AS25 (price) and ASA25 (accumulation).

198 A more detailed description of how the three indices are constructed appears under methodology at: http://au.spindices.com/indices/equity/sp-asx-50

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

200 A more detailed description of how MSCI forms value and growth indices appears at: http://www.msci.com/products/indices/style/

Since, unlike Fama and French, MSCI do not discard stocks that do not exhibit markedly value or growth characteristics, one can also expect the MSCI *HML* premium to lie below the Fama and French *HML* premium.

In its work for Jemena, NERA computed the *SMB* factor as the difference between the returns to

- the MSCI Australian Small Core Index; and
- the MSCI Australian Large Core Index.

Data on the returns to these two portfolios are available on a monthly basis from January 2001 (small) and June 1994 (large) to December 2012, and on a daily basis from 2 January 2001 (small) and 1 June 1994 (large) to 31 December 2012.

## 9.3. Estimates

In what follows, we examine estimates of the *HML* and *SMB* long-run premiums computed using the various series described above. All of the estimates use annual data and for now we ignore any value that investors might place on imputation credits distributed.

**Table 9.1**
**Summary statistics for the returns to style portfolios**

| Source | Period | Return to value portfolio | Return to growth portfolio | Difference (*HML*) |
|---|---|---|---|---|
| Fama & French | 1975-2012 | **20.04** | **12.52** | **7.53** |
| | | (27.08) | (23.87) | (19.85) |
| | | [4.39] | [3.87] | [3.22] |
| MSCI | 1975-2012 | **17.65** | **13.73** | 3.92 |
| | | (24.18) | (24.26) | (16.17) |
| | | [3.92] | [3.94] | [2.62] |
| S&P | 1990-2012 | **12.56** | **10.40** | 2.16 |
| | | (20.50) | (18.38) | (7.22) |
| | | [4.27] | [3.83] | [1.51] |

*Note: All returns are in per cent per annum. Sample means are outside of parentheses, sample standard deviations are in parentheses and the standard errors of the sample means are in brackets. Sample means that differ significantly from zero at the 5 per cent level are in bold.*

Table 9.1 provides estimates of the mean returns to value (high book-to-market) and growth (low book-to-market) portfolios and the difference between the two, the *HML* premium. As expected, the Fama-French estimate of the premium is larger than the two alternative estimates. The allocation by MSCI and S&P of stocks to value and growth portfolios that do not exhibit markedly value or growth characteristics leads, on the other hand, to a lower sample standard deviation of the *HML* series and so lower standard errors attached to the sample means of the two estimates. This is particularly noticeable with the S&P series.

Because of the similarity between the value and growth portfolios, the short position in a growth portfolio provides a partial hedge for the long position in a value portfolio. Despite these lower standard errors, however, the MSCI and S&P premiums do not differ significantly from zero at conventional levels. In contrast, the Fama-French premium does differ significantly from zero.

Table 9.2 provides estimates of the mean returns to low market-capitalisation (small firm) and high market-capitalisation (big firm) portfolios and the difference between the two, the *SMB* premium. As others have found, an estimate of the Australian *SMB* premium does not differ significantly from zero using data over the last 30 or 40 years or so.

**Table 9.2**
**Summary statistics for the returns to size portfolios**

| Source | Period | Return to small-cap portfolio | Return to large-cap portfolio | Difference (*SMB*) |
|---|---|---|---|---|
| SIRCA | 1974-2012 | **17.92** | **14.75** | 3.17 |
| | | (34.25) | (23.52) | (19.91) |
| | | [5.48] | [3.77] | [3.19] |
| MSCI | 2001-2012 | 12.59 | 9.19 | 3.40 |
| | | (28.30) | (21.20) | (12.09) |
| | | [8.17] | [6.12] | [3.49] |
| S&P | 1980-2012 | **13.09** | **13.96** | -0.88 |
| | | (27.23) | (23.18) | (12.74) |
| | | [4.74] | [4.03] | [2.22] |

*Note: All returns are in per cent per annum. Sample means are outside of parentheses, sample standard deviations are in parentheses and the standard errors of the sample means are in brackets. Sample means that differ significantly from zero at the 5 per cent level are in bold.*

## 9.4. Imputation Credits

The estimates that we report in Table 9.1 and Table 9.2 are exclusive of imputation credits. We also compute estimates of the *HML* and *SMB* premiums inclusive of imputation credits under the assumption that the market places a value of 35 cents on a one-dollar credit distributed.[201] Including a value for imputation credits distributed has little impact on the results. Table 9.3 provides estimates that use data from French's web site and SIRCA's SPPR. An estimate of the *HML* premium is 15 basis points higher than its counterpart in Table 9.1 because value stocks have higher credit yields than growth stocks. A stock's credit yield is the ratio of the credits that it distributes over a year divided by its end-of-year price. An estimate of the *SMB* premium is 12 basis points lower than its counterpart in Table 9.2 because small-cap stocks have lower credit yields than large-cap stocks.

[201] This value is the value laid down by the ACT in a decision on the market value of a one-dollar credit distributed. See ACT, Application by Energex Limited (Gamma) (No 5) [2011] ACompT 9, May 2011.

**Table 9.3**
**Summary statistics for the returns to size and style portfolios inclusive of a value assigned to imputation credits**

| Return to value portfolio | Return to growth portfolio | Difference (*HML*) | Return to small-cap portfolio | Return to large-cap portfolio | Difference (*SMB*) |
|---|---|---|---|---|---|
| **20.53** | **12.86** | **7.68** | **18.20** | **15.15** | 3.05 |
| (27.04) | (23.86) | (19.88) | (34.24) | (23.50) | (19.96) |
| [4.39] | [3.87] | [3.22] | [5.48] | [3.76] | [3.20] |

*Note: All returns are in per cent per annum. Estimates are computed under the assumption that the market places a value of 35 cents on a one-dollar credit distributed and use data provided by French and SIRCA. Sample means are outside of parentheses, sample standard deviations are in parentheses and the standard errors of the sample means are in brackets. Sample means that differ significantly from zero at the 5 per cent level are in bold.*

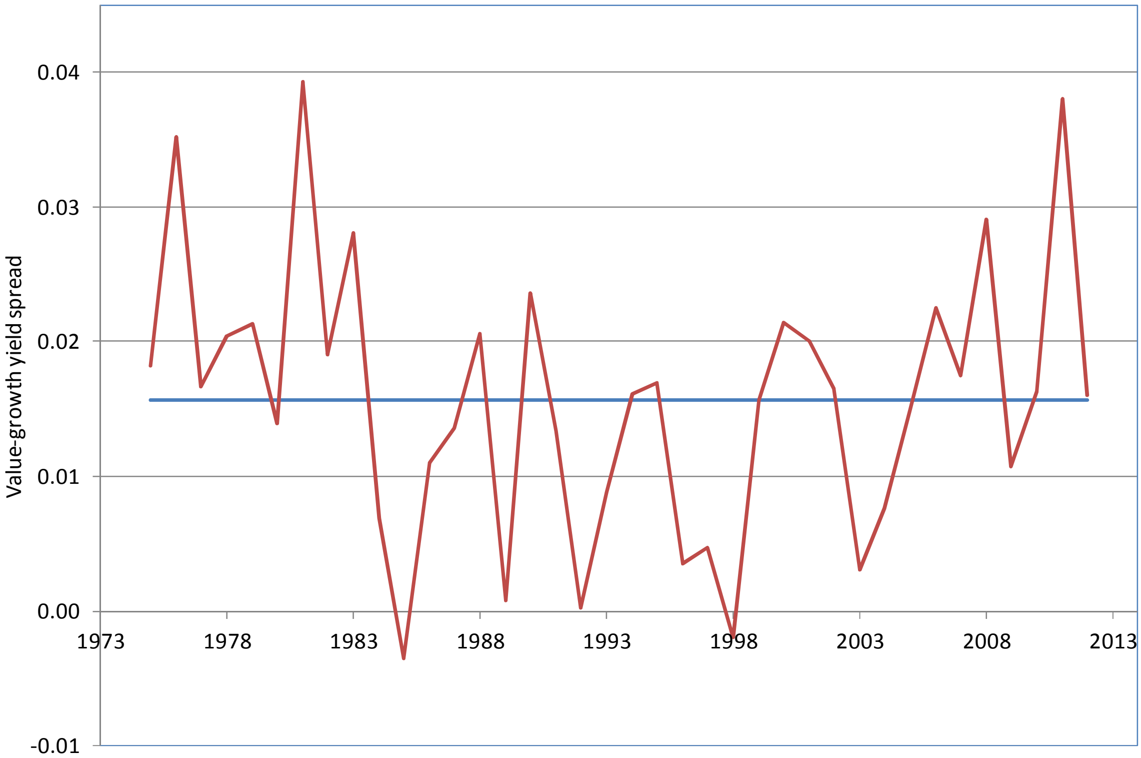
## 9.5. Currently Prevailing *HML* and *SMB* Premiums

One can use the DGM to construct estimates of the currently prevailing *HML* and *SMB* premiums.

We use French's data to examine the time series of differences between the growth in dividends flowing to a value portfolio and the growth in dividends flowing to a growth portfolio and find only weak evidence of negative serial dependence. We also use SIRCA's data to examine the time series of differences between the growth in dividends flowing to a small-cap portfolio and the growth in dividends flowing to a large-cap portfolio and find no evidence of serial dependence. Since forecasting the difference between the growth in dividends flowing to a value portfolio and the growth in dividends flowing to a growth portfolio is difficult, whether an estimate of the currently prevailing *HML* premium will sit above or below its long-run value will largely depend on the spread between the dividend yields on value and growth portfolios. Similarly, whether an estimate of the currently prevailing *SMB* premium will sit above or below its long-run value will largely depend on the spread between the yields on small-cap and large-cap portfolios.

Figure 9.1 uses French's data to plot the current spread between the yields on value and growth portfolios. The red line shows the spread while the blue line shows the long-run average spread. The figure shows that the current spread between the yields on value and growth portfolios sits at around its long-run average. This and the evidence that it is difficult to predict the the difference between the growth in dividends flowing to a value portfolio and the growth in dividends flowing to a growth portfolio suggests that there is little evidence that the currently prevailing *HML* premium differs from its long-run average.

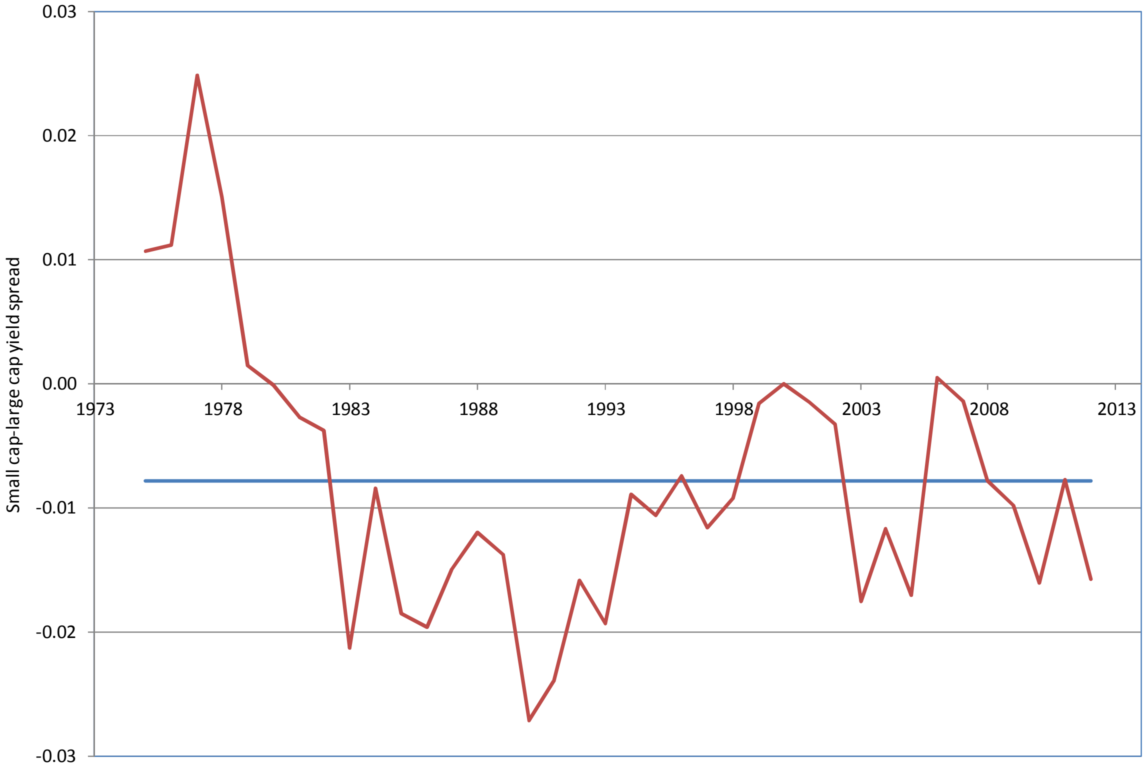
**Figure 9.1**
**Spread between the yields on value and growth portfolios**




*Notes: The red line shows the spread while the blue line shows the long-run average spread.*

Figure 9.2 uses SIRCA's data to plot the current spread between the dividend yields on small-cap and large-cap portfolios. The red line shows the spread while the blue line shows the long-run average spread. The figure shows that the current spread between the yields on small-cap and large-cap portfolios sits at around its long-run average. This and the evidence that it is difficult to predict the the difference between the growth in dividends flowing to a small-cap portfolio and the growth in dividends flowing to a large-cap portfolio suggests that there is little evidence that the currently prevailing *SMB* premium differs from its long-run average.

**Figure 9.2**
**Spread between the yields on small-cap and large-cap portfolios**




*Notes: The red line shows the spread while the blue line shows the long-run average spread.*

## 9.6. Sensitivity of the Premiums to the Data

It is important to note that the sensitivity of estimates of the premiums attached to the Fama-French factors to how one constructs the data does not set the model apart from other pricing models. Estimates of the MRP can also be sensitive to how one constructs the data.

To illustrate how ambiguity about how to measure the return to the market portfolio can create substantial variation across estimates of the mean return to the market portfolio, we use data from Stambaugh (1982).

Table 9.4 provides estimates of the mean real return to the US market portfolio in per cent 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 in which the market proxy is constructed. Stambaugh finds, on the other hand, that tests of the CAPM are not sensitive to the choice of a proxy for the market portfolio. His tests reject the SL CAPM in favour of the Black CAPM.

**Table 9.4**
**Estimates of the mean real return to the market portfolio:**
**US evidence from 1953 to 1976**

| | Market proxy | | | |
|---|---|---|---|---|
| Period | 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, house furnishings and automobiles; market proxy no 4 is the same as no. 3 but with NYSE stocks given a 10 per cent weight. All returns are in per cent 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.*

## 9.7. Summary

Ken French, a co-originator of the Fama-French model, provides series of monthly returns to Australian value and growth portfolios from January 1975 to December 2012 that exhibit strong value and growth characteristics. MSCI and S&P, in contrast, provide series of monthly returns to Australian value and growth portfolios that exhibit weaker value and growth characteristics. MSCI provide data over the same period as French while S&P provide data over a shorter period.

SIRCA provides data that one can use to construct series of monthly returns to Australian small-cap and large-cap portfolios from January 1974 to December 2012. MSCI and S&P, in contrast, provide returns for small-cap and large-cap portfolios over shorter periods.

Since in using the Fama-French model, it is important to compute estimates of the value and size premiums that are as precise as possible, we believe that it is best to use the longest time series available to compute estimates of the premiums. We believe it is also important that estimates of the value premium be constructed from series of returns to value and growth portfolios that exhibit strong value and growth characteristics.

Thus we recommend that the AER use data from French's web site to estimate the value premium and data from SIRCA to estimate the size premium. Our estimates indicate that, using data from French's web site, the value premium is both economically and statistically significant. On the other hand, our estimates indicate that, using data from SIRCA, the size premium, while economically significant, is not statistically significant.

# 10. Conclusions

This report has been prepared for the Energy Networks Association (ENA) by NERA Economic Consulting (NERA). The ENA has asked NERA to examine a number of issues arising from recent reports released by the Australian Energy Regulator (AER) and its advisors.

In particular, the ENA has asked NERA to assess a number of issues pertaining to the estimation of the *long-run* market risk premium (*MRP*):

1. The accuracy of the downward adjustments to Lamberton's (1961) dividend yield data that Brailsford, Handley and Maheswaran (2008, 2012) and the AER employ; [202]
2. The merits or otherwise of the Siegel-averaging method that Lally (2012) advocates and the Queensland Competition Authority (QCA) has adopted; [203]
3. Whether a long-run estimate of the *MRP* should be computed using an arithmetic mean, geometric mean, or some weighted average of the two; and
4. The impact of the choice of sample on estimates of the *MRP*.

The ENA is also seeking an analysis from NERA of the following issues, some of which will pertain to the estimation of the *currently prevailing MRP*:

5. The costs and benefits of using biased estimators for the *MRP*;
6. Whether the dividend growth model (DGM) will necessarily deliver an upwardly biased estimate of the *MRP* in current or recent circumstances, during which the risk-free rate has been low; and
7. Whether market practitioner estimates of the return required on the market are consistent with a constant *MRP* through time when measured against the prevailing yields on 10-year Commonwealth Government Securities (CGS), and whether the estimates are consistent with the proposition that the prevailing forward looking *MRP* in 2012 and 2013 was 6 per cent.

Finally, the ENA has also asked NERA:

8. To investigate suitable data sources for use in estimating the size and value premiums and to provide estimates of the premiums.

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[202] Brailsford, T., J. Handley and K. Maheswaran, *Re-examination of the historical equity risk premium in Australia*, Accounting and Finance 48, 2008, pages 73-97.

Brailsford, T., J. Handley and K. Maheswaran, *The historical equity risk premium in Australia: Post-GFC and 128 years of data*, Accounting and Finance, 2012, pages 237-247.

Lamberton, D., *Ordinary share yields: A new statistical series*, Sydney Stock Exchange Official Gazette, 14 July 1961.

[203] Lally, M., *The cost of equity and the market risk premium*, Victoria University of Wellington, 25 July 2012, pages 28-29.

### Downward adjustments to Lamberton's yield data

Dimson, Marsh and Staunton (2012) and Brailsford, Handley and Maheswaran (2012) provide two different estimates of the long-run mean return to a value-weighted portfolio of Australian stocks.[204] In their Credit Suisse Global Investment Returns Sourcebook 2012, Dimson, Marsh and Staunton report that the arithmetic mean of the annual return to a value-weighted portfolio of Australian stocks, exclusive of imputation credits, from 1900 to 2011, is 12.9 per cent. The arithmetic mean of the series of annual returns to a value-weighted portfolio of Australian stocks that Brailsford, Handley and Maheswaran supply, exclusive of imputation credits, from 1900 to 2011, is 11.9 per cent. Thus the arithmetic mean of the series of annual returns that Brailsford, Handley and Maheswaran supply is 100 basis points below the arithmetic mean of the series that Dimson, Marsh and Staunton use.

The difference between the two arithmetic means is primarily explained by differences in the way in which the dividends distributed by a value-weighted portfolio of stocks were determined by those who provided the data to the two sets of authors. Dimson, Marsh and Staunton (2012) use a series of dividend yields provided to them by Officer that is largely based on a series produced by Lamberton (1961).[205] Brailsford, Handley and Maheswaran (2012) use a series of yields provided to them by the Australian Stock Exchange that is also largely based on Lamberton's data.[206] The yields that Brailsford, Handley and Maheswaran use, however, have been adjusted downwards to take account of perceived deficiencies in the series that Lamberton provides.

We assess whether the adjustment to Lamberton's yield series in the data that Brailsford, Handley and Maheswaran employ is warranted and provide evidence that it is not. The evidence suggests that some adjustment should be made but that the adjustment should be *smaller* than the adjustment made in their data. An estimate of the downwards bias generated by inappropriately adjusting Lamberton's yield series is 18 basis points for the period that Dimson, Marsh and Staunton examine, 1900 to 2011, but 37 basis points for the longer period, 1883 to 2011, on which the AER focuses.

Our estimates of the downward bias rely on Lamberton's series, Brailsford, Handley and Maheswaran's analysis of yield data for February 1966, our analysis of yield data for December 1891, December 1901, December 1911, December 1921, December 1931, December 1941, December 1951 and interpolation.

An estimate of the *MRP* computed using the data that Brailsford, Handley and Maheswaran (2012) supply for the period 1883 to 2010 and that we update to 2011, assuming a value of 35

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[204] Dimson, E., P. Marsh and M. Staunton, *Credit Suisse Global investment returns sourcebook 2012*, Credit Suisse, February 2012.

Brailsford, T., J. Handley and K. Maheswaran, *The historical equity risk premium in Australia: Post-GFC and 128 years of data*, Accounting and Finance, 2012, pages 237-247.

[205] Dimson, E., P. Marsh and M. Staunton, *Credit Suisse Global investment returns sourcebook 2012*, Credit Suisse, February 2012.

Lamberton, D., *Ordinary share yields: A new statistical series*, Sydney Stock Exchange Official Gazette, 14 July 1961.

[206] Brailsford, T., J. Handley and K. Maheswaran, *The historical equity risk premium in Australia: Post-GFC and 128 years of data*, Accounting and Finance, 2012, pages 237-247.

cents is assigned to each dollar of imputation credits distributed, adjusted for the bias that we identify, will be 6.47 per cent per annum.[207, 208]

## Siegel averaging

Lally (2012) argues, on the basis of evidence that Siegel (1992) provides, that the sample mean of a series of historical returns to the market portfolio in excess of the yield on a government bond can be an upwardly biased estimate of the long-run *MRP*. [209] Lally's argument is based on a view that investors have systematically underestimated inflation and that while the real returns to stocks are, in the long run, protected against unanticipated inflation, the real returns to bonds are not protected against unanticipated inflation.

Lally argues that while investors have in the past underestimated inflation, they will not do so in the future. As a result, he argues that while the real return to the market portfolio in the future will on average be similar to its real return in the past the real return to a government bond in the future will on average be higher than it has been in the past. So Lally argues that an unbiased estimate of the long-run *MRP* going forward will be lower than the sample mean, computed from past data, of a series of returns to the market portfolio in excess of the government bond yield.

We show here that Lally's argument makes little sense because the available evidence does not support the idea that investors *systematically* underestimate inflation. Using survey data, we identify periods over which investors have underestimated inflation but these are matched by periods over which investors have overestimated inflation. So it is difficult to see how the sample mean of a series of returns to the market portfolio in excess of the yield on a government bond can be viewed as an upwardly biased estimate of the long-run *MRP*.

We also note that the AER uses the yield on a *new* 10-year bond each year in estimating the long-run *MRP*. Moreover, the AER measures the yield at the *end* of each year. These two factors will limit the impact that unanticipated inflation can have in any one year on the excess return that the AER uses to estimate the long-run *MRP*.

## Arithmetic versus geometric averaging

In recent reports the AER states its belief that consideration should be given to estimates of the long-run *MRP* based on both arithmetic and geometric averages. Whether an arithmetic or geometric average is appropriate will depend on whether there is any compounding of estimates of the *MRP* in the regulatory process.

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207 Brailsford, T., J. Handley and K. Maheswaran, *The historical equity risk premium in Australia: Post-GFC and 128 years of data*, Accounting and Finance, 2012, pages 237-247.

208 This value is the value laid down by the ACT in a decision on the market value of a one-dollar credit distributed. See ACT, Application by Energex Limited (Gamma) (No 5) [2011] ACompT 9, May 2011.

209 Lally, M., *The cost of equity and the market risk premium*, Victoria University of Wellington, 25 July 2012, pages 28-29.

Siegel, J., *The equity premium: Stock and bond returns since 1802*, Financial Analysts Journal, pages 28-38+46.

- In the absence of compounding an arithmetic average should be used since the use of a geometric average will produce a downwardly biased estimate of the *WACC*.
- On the other hand, if regulatory returns are compounded, then some weight should placed on a geometric average since an arithmetic average used alone will produce an upwardly biased estimate of the *WACC*.

We show that, aside from some minor adjustments to the regulatory asset base (*RAB*) and to the evolution of prices over the regulatory period, the AER *never* compounds the *WACC* over more than one year. As a result, the use of an arithmetic average will produce an *unbiased* estimate of the revenue that the market requires in any one year on the *RAB*. In contrast, an estimate of the *WACC* that is in part based on a geometric average of the *MRP* will produce a *downwardly biased* estimate of the revenue that the market requires in any one year.

### Choice of sample

Recent evidence that the AER provides suggests that the *MRP* has declined through time. In particular, the AER provides estimates of the *MRP* over a number of sub-periods and it appears from these estimates that the *MRP* has been declining over the last century. We show that there is no significant evidence that the *MRP* has declined. Indeed, we show that the samples that the AER employs could have been chosen to provide the appearance that the *MRP* has risen.

We also emphasise that the way in which the AER chooses samples invites the reader to weight recent returns to the market portfolio in excess of the yield on a government bond more heavily than earlier observations. While this may sound an attractive strategy, placing a larger weight on more recent observations than on earlier observations can substantially lower the precision of the estimates that one produces. In addition, we note that the way in which the AER chooses samples invites the reader to place a higher weight on one particular recent period over which the return to the market portfolio in excess of the yield on a government bond was low and to place lower weights on periods over which the return was high.

### The Use of Biased Estimates

Lally (2012) suggests that better estimators for the *MRP* can be constructed by combining several different estimators for the *MRP*. In particular, he suggests that better estimators for the *MRP* can be constructed by combining an estimator for the *MRP* known to be unbiased with an estimator or estimators that may be biased.[210]

Lally's analysis, which assumes that the bias associated with a biased estimator is known, is deceptively attractive. He shows that if one knows the bias, the optimal estimator will use not only unbiased estimators but also biased estimators. While this is true, it is also true that if one were to know the bias associated with a biased estimator, one could construct an unbiased estimator from the biased estimator by subtracting the bias from the estimator. Thus there would be no reason to use a biased estimator.

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[210] Lally, M., *The cost of equity and the market risk premium*, Victoria University of Wellington, 25 July 2012, page 30.

In practice, the bias associated with a biased estimator is rarely known. We demonstrate that if the bias is unknown, then it will be difficult to show that an estimator that places a significant weight on a biased estimator will be a better estimator than one that relies only on unbiased estimators.

### The DGM

A natural place to look for information on what the market thinks the *MRP* should be is in market prices. The DGM allows one, in principle, to use market prices together with forecasts of future dividends to be distributed by the market portfolio to compute the return that the market requires on the portfolio. The return that the DGM delivers, though, is the single internal rate of return that will discount back the market's expectations of the dividends that the market portfolio will pay in all future periods – not just over the next regulatory period – back to the current market value of the market portfolio. This internal rate of return will be a complicated average of the expected returns to the market portfolio over the next year and over all future years.

As we point out in our March 2012 report and as Lally points out in his July 2012 and March 2013 reports, the internal rate of return that the DGM delivers may lie above or below the current expected return to the market. [211] Nevertheless, we show that there are recently encountered circumstances where it would have been difficult to argue persuasively that the expected return over the next regulatory period sat below the return delivered by the DGM. In the particular circumstances, the risk-free rate was low relative to its history but, contrary to the arguments put forward by Lally, it would have been difficult to argue that the expected return to the market portfolio over the next regulatory period sat below the return delivered by the DGM.

### Market practitioner estimates

Independent expert reports potentially provide an alternative source of information on the value for the *MRP* used by market participants. The use of independent expert reports circumvents a number of the problems associated with other forms of market data such as survey evidence. In particular:

- independent expert reports are typically made public and so it is not necessary to seek a response from each expert;
- many transactions require an independent expert report be produced;
- independent experts face strong incentives to provide accurate responses;
- it is clear from independent expert reports how returns are measured, that is, whether returns are continuously compounded or not continuously compounded;
- independent experts generally state whether they place a value on imputation credits;

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[211] Lally, M., *The cost of equity and the market risk premium*, Victoria University of Wellington, 25 July 2012, page 3.

Lally, M., *The dividend growth model*, Victoria University of Wellington, 4 March 2013, pages 5-9.

NERA, *Prevailing conditions and the market risk premium: A report for APA Group, Envestra, Multinet & SP AusNet*, March 2012, page 42.

- independent experts generally state how they choose a value for the risk-free rate; and
- a time series of independent expert reports can be collected so that one can test propositions about the behaviour of expert assessments of the *MRP* through time.

We examine 142 independent expert reports conducted between 2008 and 2013 and find evidence of a significant negative relation between the 10-year CGS yield and the *MRP* experts choose relative to the yield. From this relation we estimate that the *MRP* relative to the 3.18 per cent per annum risk-free rate prevailing on 26 April 2013 should lie between 7.25 and 7.66 per cent per annum inclusive of a value assigned to imputation credits. Separately we estimate that the *MRP* relative to the 10-year CGS yield computed from the 20 independent expert reports published between 27 April 2012 and 26 April 2013 lies between 7.56 and 8.22 per cent per annum, inclusive of a value assigned to imputation credits.

Further, statistical tests that we conduct show that an *MRP* of 6 per cent is inconsistent with the *MRP* relative to the 10-year CGS yield contained in the 20 independent expert reports published between 27 April 2012 and 26 April 2013.

## The size and value premiums

The recently revised National Electricity Rules and National Gas Rules require the AER to consider all relevant financial models and therefore provide greater scope to look at cost of equity models beyond the traditionally adopted Sharpe-Lintner (SL) Capital Asset Pricing Model (CAPM). One of the financial models that the AER will consider is the Fama-French three-factor model.[212] The size and value premiums play an important role in this model.

Ken French, a co-originator of the Fama-French model, provides series of monthly returns to Australian value and growth portfolios from January 1975 to December 2012 that exhibit strong value and growth characteristics. MSCI and S&P, in contrast, provide series of monthly returns to Australian value and growth portfolios that exhibit weaker value and growth characteristics. MSCI provide data over the same period as French while S&P provide data over a shorter period.

SIRCA provides high-quality data that one can use to construct series of monthly returns to Australian small-cap and large-cap portfolios from January 1974 to December 2012. MSCI and S&P, in contrast, provide returns for small-cap and large-cap portfolios over shorter periods.

Since in using the Fama-French model, it is important to compute estimates of the value and size premiums that are as precise as possible, we believe that it is best to use the longest time series available to compute estimates of the premiums. We believe it is also important that estimates of the value premium be constructed from series of returns to value and growth portfolios that exhibit strong value and growth characteristics.

Thus we recommend that the AER use data from French's web site to estimate the value premium and data from SIRCA to estimate the size premium. Our estimates indicate that,

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[212] Fama, E., and K. French, *Common risk factors in the returns on stocks and bonds*, Journal of Financial Economics, 1993, pages 3–56.

using data from French's web site, the value premium is both economically and statistically significant. We estimate the value premium, inclusive of a value assigned to imputation credits, to be 7.68 per cent per annum.[213] On the other hand, our estimates indicate that, using data from SIRCA, the size premium, while economically significant, is not statistically significant. We estimate the size premium, inclusive of a value assigned to imputation credits, to be 3.05 per cent per annum.

[213] We assume that the market places a value of 35 cents on a one-dollar credit distributed consistent with the recent ACT decision on the market value of a one-dollar credit distributed. See

ACT, Application by Energex Limited (Gamma) (No 5) [2011] ACompT 9, May 2011.

# Appendix A. Means, Medians and Modes

McKenzie and Partington (2011), in work commissioned by the AER, consider the very basic question of what statistic one should use to estimate the *MRP*.[214] McKenzie and Partington state that:[215]

> 'Empirical estimation of the market risk premium commonly results in a distribution of possible risk premiums, or returns. So a natural question is which measure of the central tendency of the distribution should be used - the mean, median, or mode. There is no compelling reason to assert the superiority of one measure over another. Common practice has been to use the mean, in part because it is the most mathematically tractable measure. As a consequence, where the returns are skewed, the MRP estimate will be biased relative to the other two possible measures. This can be a particular problem in small samples where the mean can be strongly influenced by one or two extreme observations. Where large samples are used, we anticipate that differences between the three measures of central tendency be small.'

There are a number of problems with this statement. First, the statement that 'there is no compelling reason to assert the superiority of one measure over another' is incorrect. The SL CAPM and other pricing models such as the Fama-French three-factor model define the *MRP* to be the difference between the expected return to the market portfolio and the risk-free rate. This suggests that a desirable characteristic of an estimator for the *MRP* is that it be an unbiased estimator for the difference between the expected return to the market portfolio and the risk-free rate. The sample mean of a series of returns to the market portfolio in excess of the risk-free rate will provide an unbiased estimator for the difference, so long as the *MRP* exists, but, as we will show below, the median need not provide an unbiased estimator.[216]

Second, the statement that 'where the returns are skewed the [sample mean] will be biased' is also incorrect as we will also show below.

Third, the statement that in 'large samples … differences between the three measures of central tendency [will] be small' is incorrect too as we will also indeed show.

The simplest way to demonstrate that the assertions that McKenzie and Partington make are incorrect is through a numerical example. Let the gross return to the market portfolio be lognormally distributed and let the risk-free rate be a constant through time. Then the distribution of returns to the market portfolio will be positively skewed and the distribution of returns to the market portfolio in excess of the risk-free rate will also be positively skewed. Since we assume that the risk-free rate is a constant, we can in what follows ignore the risk-free rate and focus solely on the problem of estimating the mean return to the market portfolio.

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[214] McKenzie, M. and G. Partington, *Report to Corrs Chambers Westgarth: Equity market risk premium*, 21 December 2011.

[215] McKenzie, M. and G. Partington, *Report to Corrs Chambers Westgarth: Equity market risk premium*, 21 December 2011, page 5.

[216] There are random variables which have no means. The mathematical expectation of a Cauchy random variable, for example, does not exist.

We assume that the continuously compounded annual return to the market portfolio is normally distributed with mean 8 per cent and standard deviation 20 per cent. This implies that the not continuously compounded gross return is lognormal with mean 1.10517 and standard deviation 0.22326.[217] The median of the distribution of not continuously compounded gross returns will be exp(0.08) = 1.08329.[218] To examine the behaviour of the sample mean and sample median of samples of the simple returns corresponding to these gross returns, we conduct simulations. Each simulation uses 100,000 replications and we conduct separate simulations for each of four different sample sizes. The results of the simulations appear in Table A.1 below. The table shows that:

- even though the distribution of simple returns is skewed to the right, the mean of a sample of simple returns is an unbiased estimator for the population mean;
- the median need not provide an unbiased estimator for the population mean; and
- differences between the expected values of the sample mean and sample median do not disappear as the sample size increases.

**Table A.1**
**The mean and median of a sample drawn from a lognormal distribution**

| Sample Size | 25 | 50 | 100 | 200 |
|---|---|---|---|---|
| Mean | 10.507 | 10.522 | 10.524 | 10.516 |
| Median | 8.450 | 8.397 | 8.382 | 8.359 |

*Note: The table shows the average sample mean and sample median simple rate of return in per cent across 100,000 replications. The underlying distribution of the gross simple return is lognormal with mean 1.10517 and standard deviation 0.22326.*

217 Note that if $x \sim N(\mu, \sigma^2)$, then $E(\exp(x) - 1) = \exp(\mu + 0.5\sigma^2) - 1$ and $\mathrm{Var}(\exp(x) - 1) = \exp(2\mu)\,(\exp(2\sigma^2) - \exp(\sigma^2))$, where Var(.) denotes the variance operator. See, for example,

http://mathworld.wolfram.com/LogNormalDistribution.html

218 Note that if $x \sim N(\mu, \sigma^2)$, then the median of $x$ will be $\mu$. It follows that the median of $\exp(x)$ will be $\exp(\mu)$.

# Appendix B. The Consistent Use of Evidence

In this appendix we emphasise that the AER must be consistent in its use of evidence and any prior beliefs that it holds. We also point out that the empirical work of McKenzie and Partington (2012) contains a number errors.[219]

## B.1. The Use of Evidence

We note in our March 2012 report that the evidence provided by CEG (2008) and Lajbcygier and Wheatley (2012) indicates that there is no relation in Australian data between the mean return to a stock and an estimate of its beta.[220] Figure B.1 below, drawn from CEG's report, illustrates this empirical regularity. The figure plots the sample mean returns to 10 value-weighted portfolios, formed on the basis of past estimates of beta, against estimates of their betas using data from 1974 to 2007. CEG computes estimates of beta using – as does the AER's advisor Henry (2008, 2009) – a value-weighted portfolio of stocks as a proxy for the market portfolio.[221] Figure B.1 shows that there is a substantial variation in estimates of beta across portfolios but no relation between the mean return to a portfolio and an estimate of its beta.[222] This evidence does not appear to be consistent with the Sharpe-Lintner (SL) Capital Asset Pricing Model (CAPM) which predicts that there should be a positive relation between mean return and beta.

It is important to note that Roll (1977) emphasises that the SL CAPM predicts that the market portfolio of *all* assets must be mean-variance efficient.[223] The SL CAPM does not predict that the market portfolio of stocks *alone* must be mean-variance efficient. Thus tests of the SL CAPM that use a proxy for the market portfolio can reject the model, even when the

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219 McKenzie, M. and G. Partington, *Review of regime switching framework and critique of survey evidence*, SIRCA Limited, 7 September 2012.

220 This evidence is consistent with what others have found in US data. Lewellen, Nagel and Shanken (2010), for example, find no significant relation between the mean return to a portfolio of stocks in excess of the bill rate and its beta using 25 value-weighted portfolios formed on the basis of book to market and size, 30 value-weighted industry portfolios and data from 1963 to 2004.

CEG, *Estimation of, and correction for, biases inherent in the Sharpe CAPM formula: A report for the Energy Networks Association Grid Australia and APIA*, September 2008.

Lajbcygier, P. and S. M. Wheatley, *An evaluation of some alternative models for pricing Australian stocks,* Monash University, March 2012.

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

221 Henry, Olan T., *Econometric advice and beta estimation*, Attachment C to the AER's *Explanatory Statement: Electricity transmission and distribution network service provider, review of the weighted average cost of capital (WACC) parameters*, 2008.

Henry, Olan T., *Estimating beta*, Attachment C to the AER's *Final Decision: Electricity transmission and distribution network service providers, review of the weighted average cost of capital (WACC) parameters*, 2009.

222 We provide a similar figure using data from 1974 to 2012 in our analysis of the empirical relation between estimates of beta and the returns to stocks. See

NERA, *Estimates of the zero-beta premium: A report for the Energy Networks Association*, 2013.

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

model is true, because the proxy is poor. The issue that concerns Roll is whether evidence based on proxies for the market portfolio can be used to infer whether the SL CAPM itself is true or false. Discovering whether the model itself is really true, though, is not an issue that concerns us. The issue that concerns us is whether the empirical version of the SL CAPM that the AER uses produces accurate estimates of required returns. The empirical version of the SL CAPM that the AER uses employs a value-weighted portfolio of Australian stocks as a proxy for the market portfolio of all assets. In what follows, all references to the empirical evidence on the SL CAPM are to the empirical version of the model that the AER uses – unless we specify otherwise.

The SL CAPM presumes that an investor cares only about the mean and variance of the return to the portfolio that he or she holds and predicts that the only portfolio of risky assets that the investor will hold will be the market portfolio of risky assets. Investors in the model are assumed to be risk averse and so they will be willing to accept additional risk only if they receive an additional return. Beta measures the contribution of an asset to the risk of the market portfolio, measured by standard deviation of return, and so beta, in the SL CAPM, measures the risk of an individual asset. Assets that have higher betas must, in the SL CAPM, have higher mean returns.

In an intertemporal version of the SL CAPM there will also be a positive relation, through time, between the *MRP* and the variance of the return to the market portfolio.[224] Thus in an intertemporal version of the SL CAPM an investor will seek compensation for bearing additional risk at each point in time and will also seek compensation for bearing additional risk through time. In other words, at each point in time an investor will seek an additional return for investing in an asset with a high beta – because of the impact that investing in a high-beta stock will have on the risk of the investor's overall portfolio – that is, the market portfolio. Also, through time, an investor will seek an additional return for investing in the market portfolio when the risk of the market portfolio is high and will accept a lower return for investing in the market portfolio when the risk of the market portfolio is low.

In our March 2012 report we estimate the current *MRP* using an intertemporal version of the SL CAPM, a regime-switching model and the data that Brailsford, Handley and Maheswaran (2012) provide updated.[225] Since the risk of the market portfolio appears to have been far lower in the first 75 years or so of these data than currently, the use of an intertemporal version of the SL CAPM provides a higher estimate of the current *MRP* than simply averaging the past returns to the market portfolio in excess of the risk-free rate.

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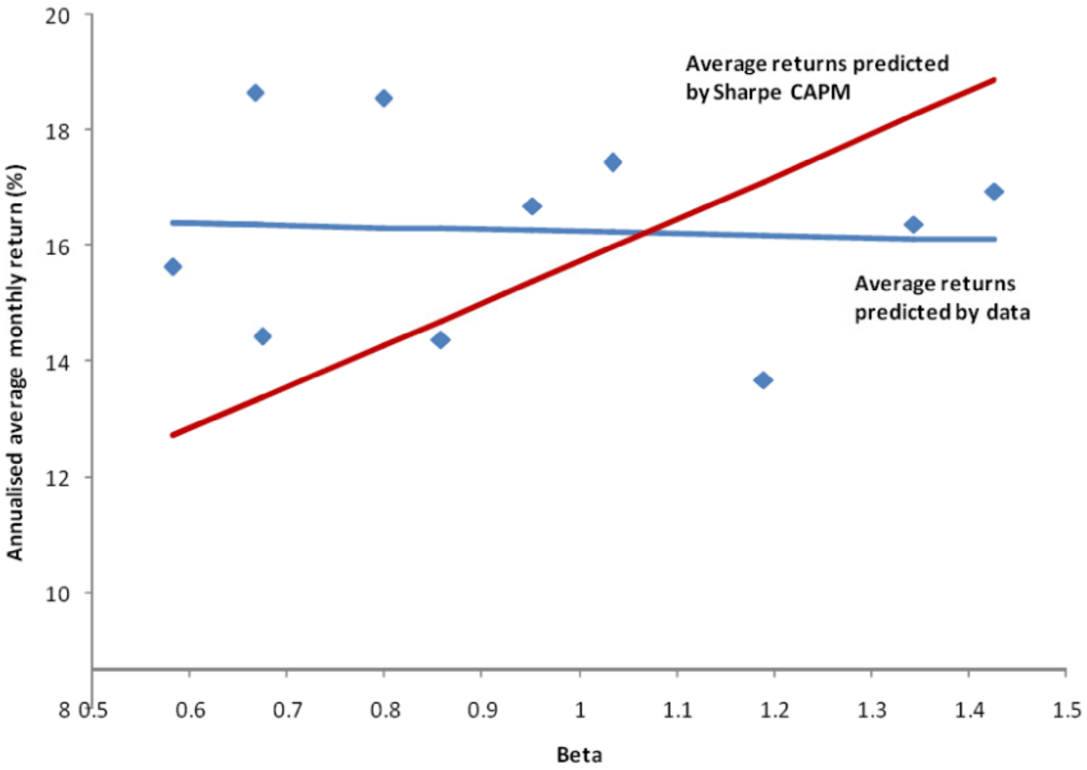
[224] Merton, Robert C., *An intertemporal capital asset pricing model*, Econometrica, 1973, pages 867-887.

[225] Brailsford, T., J. Handley and K. Maheswaran, *The historical equity risk premium in Australia: Post-GFC and 128 years of data*, Accounting and Finance, 2012, pages 237-247.

NERA, *Prevailing conditions and the market risk premium: A report for APA Group, Envestra, Multinet & SP AusNet*, March 2012.

**Figure B.1**
**Mean return against beta for 10 portfolios sorted on beta**




*Source: CEG, Estimation of, and correction for, biases inherent in the Sharpe CAPM formula: A report for the Energy Networks Association Grid Australia and APIA, September 2008, Figure 2.*

McKenzie and Partington (2012), however, provide evidence against an intertemporal version of the SL CAPM.[226] They show that the mean excess return to the market portfolio is lower, albeit insignificantly so, when market volatility is high than when market volatility is low. Figure B.2 illustrates their results. The figure plots their estimates of the mean excess return to the market portfolio from Table 2 of their report against their estimates of the variance of the excess returns taken from the same table. The figure also plots their estimate of the relation that would hold between the mean excess return to the market portfolio and the variance of the excess return to the portfolio were the intertemporal version of the SL CAPM to be true, taken from their Table 4.

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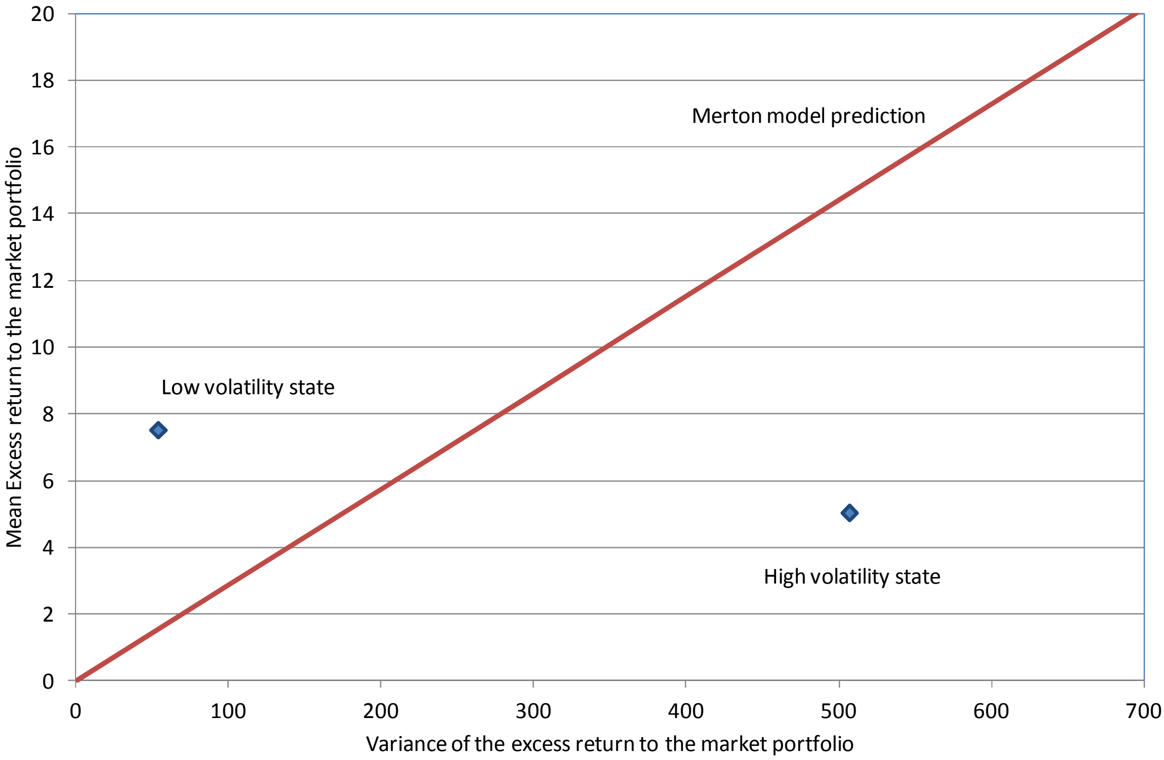
[226] McKenzie, M. and G. Partington, *Review of regime switching framework and critique of survey evidence*, SIRCA Limited, 7 September 2012.

**Figure B.2**
**Mean excess return against variance of excess return for the market portfolio**




*Source: McKenzie, M. and G. Partington, Review of regime switching framework and critique of survey evidence, SIRCA Limited, 7 September 2012.*

Thus CEG (2008), Lajbcygier and Wheatley (2012) and NERA (2013) show that there is evidence against the predictions of the SL CAPM for the cross section of mean returns to stocks while McKenzie and Partington (2012) show that there is evidence against the predictions of an intertemporal version of the SL CAPM on the *MRP*.[227] CEG, Lajbcygier and Wheatley and NERA show that there is no relation between mean return and beta across stocks while McKenzie and Partington show that there is no relation between the *MRP* and the risk of the market portfolio through time.

Consistency, we believe, requires the AER to follow one of two paths. The first path is to set a cost of equity based on the empirical evidence that Figure B.1 and Figure B.2 summarise, that is:

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

Lajbcygier, P. and S. M. Wheatley, *An evaluation of some alternative models for pricing Australian stocks,* Monash University, March 2012.

McKenzie, M. and G. Partington, *Review of regime switching framework and critique of survey evidence*, SIRCA Limited, 7 September 2012.

NERA, *Estimates of the zero-beta premium: A report for the Energy Networks Association*, 2013.

- set the cost of equity equal to the return required on the market portfolio or equivalently set beta to one; and
- ignore the link that an intertemporal version of the SL CAPM implies should exist between the *MRP* and the volatility of the market portfolio.

The second path is to ignore the empirical evidence that Figure B.1 and Figure B.2 summarise and:

- use the SL CAPM to set the cost of equity; and
- use the link that an intertemporal version of the SL CAPM implies should exist between the *MRP* and the volatility of the market portfolio to estimate the *MRP*.

We do not have prior beliefs about whether the SL CAPM is true and so our strong preference is to use the empirical evidence that CEG (2008), Lajbcygier and Wheatley (2012), NERA (2013) and McKenzie and Partington (2012) provide and follow the first path.[228] The AER has in the past indicated that it has a strong prior belief that the SL CAPM is true and so may wish to ignore the evidence that CEG, Lajbcygier and Wheatley, NERA and McKenzie and Partington provide and follow the second path.[229]

To be consistent, though, the AER must either use all of the evidence before it or use none of it – employing instead its prior beliefs. It can make no sense to argue that:

- at each point in time an investor will seek an additional return for investing in an asset with a high beta – because of the impact that investing in a high-beta stock will have on the risk of the investor's overall portfolio – that is, the market portfolio; but
- an investor will not seek an additional return for investing in the market portfolio when the risk of the market portfolio is high and will not accept a lower return for investing in the market portfolio when the risk of the market portfolio is low.

Again, beta measures the contribution of an asset to the risk of the market portfolio, measured by standard deviation of return. So it is difficult to see how one can simultaneously argue that:

- beta is the only measure of the risk of an individual asset about which investors care; but

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

Lajbcygier, P. and S. M. Wheatley, *An evaluation of some alternative models for pricing Australian stocks,* Monash University, March 2012.

McKenzie, M. and G. Partington, *Review of regime switching framework and critique of survey evidence*, SIRCA Limited, 7 September 2012.

[229] AER, *Final decision: Jemena Gas Networks Access arrangement proposal for the NSW gas networks 1 July 2010 – 30 June 2015*, June 2010, page 158.

- investors do not care about the risk of the market portfolio, measured by the standard deviation of the return to the portfolio.

If the AER is to use the SL CAPM to set the cost of equity, the AER the must assume that investors care about the risk of the market portfolio.

It is an error for the AER to use only some of the evidence before it on the SL CAPM. It is an error, for example, for the AER to:

- ignore the evidence against the restrictions that the SL CAPM imposes on the cross-section of mean returns; but
- use the evidence against the restrictions that an intertemporal version of the SL CAPM imposes on the behaviour of the *MRP* through time.

Put another way, it is an error for the AER to use only some of the theoretical restrictions imposed by the SL CAPM. It is an error, for example, for the AER to:

- use the SL CAPM to compute a cost of equity; but
- ignore the restrictions that an intertemporal version of the SL CAPM imposes on the behaviour of the *MRP* through time in computing an *MRP*.

## B.2. Time Series Variation in Volatility

McKenzie and Partington (2012) provide evidence against an intertemporal version of the SL CAPM.[230] They show in Table 2 of their paper that the mean excess return to the market portfolio is lower, albeit insignificantly so, when market volatility is high than when market volatility is low. We do not dispute these results. While there is evidence of a positive relation between the mean excess return to the market portfolio and market volatility in US data, McKenzie and Partington show that evidence of a similar relation in Australian data appears to be absent.[231] The results of McKenzie and Partington, however, are consistent with the results of CEG (2008), Lajbcygier and Wheatley (2012) and NERA (2013).[232]

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230 McKenzie, M. and G. Partington, *Review of regime switching framework and critique of survey evidence*, SIRCA Limited, 7 September 2012, pages 9-13.

231 For example, employing almost two centuries' worth of US data, Lundblad documents a positive and significant relation between risk and return using a variety of models for volatility.

Lundblad, C., *The risk return tradeoff in the long run: 1836-2003*, Journal of Financial Economics, 2007, pages 123-150.

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

Lajbcygier, P. and S. M. Wheatley, *An evaluation of some alternative models for pricing Australian stocks,* Monash University, March 2012.

NERA, *Estimates of the zero-beta premium: A report for the Energy Networks Association*, 2013.

CEG (2008), Lajbcygier and Wheatley (2012) and NERA (2013) show that there is evidence against the predictions of the SL CAPM for the cross section of mean returns to stocks while McKenzie and Partington (2012) show that there is evidence against the predictions of an intertemporal version of the SL CAPM on the *MRP*.[233] CEG, Lajbcygier and Wheatley and NERA show that there is no relation between mean return and beta across stocks while McKenzie and Partington show that there is no relation between the *MRP* and the risk of the market portfolio through time.

While we do not dispute the evidence that McKenzie and Partington (2012) find against an intertemporal version of the SL CAPM, we do dispute the assertion that McKenzie and Partington make that an:[234]

> 'EGARCH model (provides) volatility estimates (that) are more consistent with events in the equity markets.'

### B.2.1. Analysis

The exponential generalised auto-regressive conditional heteroscedasticity (EGARCH) model of Nelson (1991) allows for an asymmetric relation between future volatility and current returns and guarantees that forecasts of volatility are nonnegative.[235] Positive unexpected returns in the model can have a different impact on volatility than otherwise identical negative unexpected returns.

Before explaining why we dispute the assertion that McKenzie and Partington (2012) make, we note that it is obvious that Table 5 and Figure 7 in their report are incorrect.[236] McKenzie and Partington use the annual data that Brailsford, Handley and Maheswaran (2012) and Handley (2012) provide updated until the end of 2011.[237] So in this appendix we use the same data.[238] These data do not include the adjustments that we make to the series in section 2 of this report.

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

Lajbcygier, P. and S. M. Wheatley, *An evaluation of some alternative models for pricing Australian stocks,* Monash University, March 2012.

McKenzie, M. and G. Partington, *Review of regime switching framework and critique of survey evidence*, SIRCA Limited, 7 September 2012.

NERA, *Estimates of the zero-beta premium: A report for the Energy Networks Association*, 2013.

234 McKenzie, M. and G. Partington, *Review of regime switching framework and critique of survey evidence*, SIRCA Limited, 7 September 2012, page 5.

235 Nelson, D., *Conditional heteroskedasticity in asset returns: A new approach*, Econometrica, 1991, pages 347-370.

236 McKenzie, M. and G. Partington, *Review of regime switching framework and critique of survey evidence*, SIRCA Limited, 7 September 2012.

237 Brailsford, T., J. Handley and K. Maheswaran, *The historical equity risk premium in Australia: Post-GFC and 128 years of data*, Accounting and Finance, 2012, pages 237-247.

Handley, J., *An estimate of the historical equity risk premium for the period 1883 to 2011*, University of Melbourne, April 2012.

238 Since we use annual data, and an intertemporal version of the SL CAPM places restrictions on the *MRP* relative to a short-term risk-free rate, we use, like McKenzie and Partington, the annual returns to a strategy of rolling over three-month bills as a measure of the risk-free rate rather than the yield to a 10-year bond.

First, the estimates from Table 5 of McKenzie and Partington (2012) imply that the unconditional standard deviation of the return to the market portfolio in excess of the return to a bill is unreasonably high.[239] We use the EGARCH parameter estimates of McKenzie and Partington's Table 5 to simulate a series of one million excess returns and find the standard deviation of the returns to be 42.65 per cent per annum.[240] The sample standard deviation of the return to the market portfolio in excess of the return to a bill computed from the annual data that Brailsford, Handley and Maheswaran (2012) and Handley (2012) provide and that we update is, in contrast, 17.04 per cent per annum. Second, it is obvious that McKenzie and Partington's Figure 7 could not have been produced using the parameter estimates in McKenzie and Partington's Table 5. Third, estimates over recent years of the conditional standard deviation in McKenzie and Partington's Figure 7 are unreasonably low.

Since the EGARCH evidence that McKenzie and Partington provide is unreliable, we use PROC AUTOREG of SAS to estimate the same EGARCH model that McKenzie and Partington claim to use.[241] Again, we use the annual return to the market portfolio in excess of the return to a bill using data from 1883 to 2011 that Brailsford, Handley and Maheswaran (2012) and Handley (2012) provide and that we update.[242] Our estimates of an EGARCH model for the conditional standard deviation of the return to the market portfolio in excess of the return to a bill are:

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Brailsford, Handley and Maheswaran (2012) provide series of market returns, with and without dividends, and series of bill returns and bond yields from 1883 to 2010. Handley (2012) provides series of market returns, with and without dividends, and a series of bond yields from 1883 to 2011. We compute a bill return for 2011 and credit yields for 1987 to 2011 in the same way that Brailsford, Handley and Maheswaran (2008, 2012) describe. We adjust returns for the provision of imputation credits under the assumption that the value of a one-dollar credit distributed has a market value of 35 cents. This value is the value laid down by the ACT in its recent decision on the market value of a one-dollar credit distributed.

ACT, *Application by Energex Limited (Gamma) (No 5) [2011] ACompT 9*, May 2011.

Brailsford, T., J. Handley and K. Maheswaran, *Re-examination of the historical equity risk premium in Australia*, Accounting and Finance 48, 2008, pages 73-97.

Brailsford, T., J. Handley and K. Maheswaran, *The historical equity risk premium in Australia: Post-GFC and 128 years of data*, Accounting and Finance, 2012, pages 237-247.

Handley, J., *An estimate of the historical equity risk premium for the period 1883 to 2011*, University of Melbourne, April 2012.

239 McKenzie, M. and G. Partington, *Review of regime switching framework and critique of survey evidence*, SIRCA Limited, 7 September 2012.

240 The model that McKenzie and Partington believe best fits the data is

$$r_t = 0.0667 + h_t^{1/2} z_t, \qquad z_t \sim \text{NID}(0,1), \qquad \log(h_t) = -0.8231 + 0.5702\log(h_{t-1}) + 0.0947\left| z_{t\text{-}1} \right| + 0.2018\, z_{t\text{-}1},$$

where $r_t$ denotes the annual return to the market portfolio in excess of the return to a bill. We set $\log(h_0)$ and $z_0$ to their unconditional means and then simulate 1,000,000 excess returns. The standard deviation of the simulated series is 42.65 per cent.

241 http://support.sas.com/documentation/cdl/en/etsug/60372/HTML/default/viewer.htm#etsug_autoreg_sect022.htm

242 Brailsford, T., J. Handley and K. Maheswaran, The historical equity risk premium in Australia: Post-GFC and 128 years of data, Accounting and Finance, 2012, pages 237-247.

Handley, J., *An estimate of the historical equity risk premium for the period 1883 to 2011*, University of Melbourne, April 2012.

$$r_t = 0.0660 + h_t^{1/2} z_t, \qquad z_t \sim \text{NID}(0,1),$$
$$\log(h_t) = -1.3543 + 0.7707\log(h_{t-1}) + 0.6501\left|z_{t\text{-}1}\right| + 0.0391\, z_{t\text{-}1}, \qquad \text{(B.1)}$$

The variable $h_t$ is the conditional standard deviation, $z_t$ is the ratio of the unexpected return to the conditional standard deviation and NID means normally and independently distributed. We use these estimates to simulate a series of one million excess returns and find the standard deviation of the returns to be a more reasonable 18.01 per cent per annum. Our EGARCH estimates of the conditional standard deviation of the excess return to the market portfolio in excess of the return to a bill appear in Figure B.3 below.

In our March 2012 report we indicate that the sample standard deviation of the return to the market portfolio from 1958 through 2011 is more than twice the sample standard deviation of the return from 1883 through 1957.[243] Figure B.3 appears to suggest that the difference is smaller. An analysis of the standardised residuals generated by the EGARCH model shows why Figure B.3 appears to suggest that the difference is smaller. A standardised residual is a residual divided by the conditional standard deviation of the residual. In other words, it is an estimate of the variable $z_t$ in (B.1). The average squared standardised residual before 1958 is 0.66 while the average squared standardised residual from 1958 onwards is 1.46 and the difference between the two is significant at conventional levels. If the EGARCH model were to correctly describe the evolution of the excess return to the market portfolio, the expected squared standardised residual each year would be one. So one would expect the average squared standardised residual to be around one both before and after 1958.

The low average squared standardised residual before 1958 and high average squared standardised residual from 1958 thereafter suggest that the EGARCH model may be misspecified. To illustrate why the model may be misspecified, we provide the results of additional simulations. The purpose of the simulations is to examine how an EGARCH model performs when there is a regime shift. In these simulations we assume that there is a single regime shift that occurs in 1958 when the standard deviation of the excess return to the market portfolio shifts from 10 per cent to 20 per cent per annum. We make this assumption because the data suggest that there was a shift in the standard deviation of the excess return at around that time and because the AER uses 1958 as a date at which to split the data into sub-periods.[244, 245] Also, because we wish to focus solely on the ability of an EGARCH model to detect a regime shift in volatility, we do not use the restriction that the model of Merton (1973) imposes on the *MRP* in constructing series of excess returns.[246] In other words, because our focus is on the ability of an EGARCH model to detect a shift in volatility, we

243 NERA, *Prevailing conditions and the market risk premium: A report for APA Group, Envestra, Multinet & SP AusNet*, March 2012, page 63.

244 The data also suggest that there were short periods when the standard deviation was high before 1958 and low after 1958. The purpose of our simulations, though, is solely to examine whether an EGARCH model can successfully track regime shifts in the standard deviation of excess returns that last for many years.

245 AER, *Access arrangement draft decision Multinet Gas (DB No. 1) Pty Ltd Multinet Gas (DB No. 2) Pty Ltd 2013–17 Part 1*, September 2012, page 94.

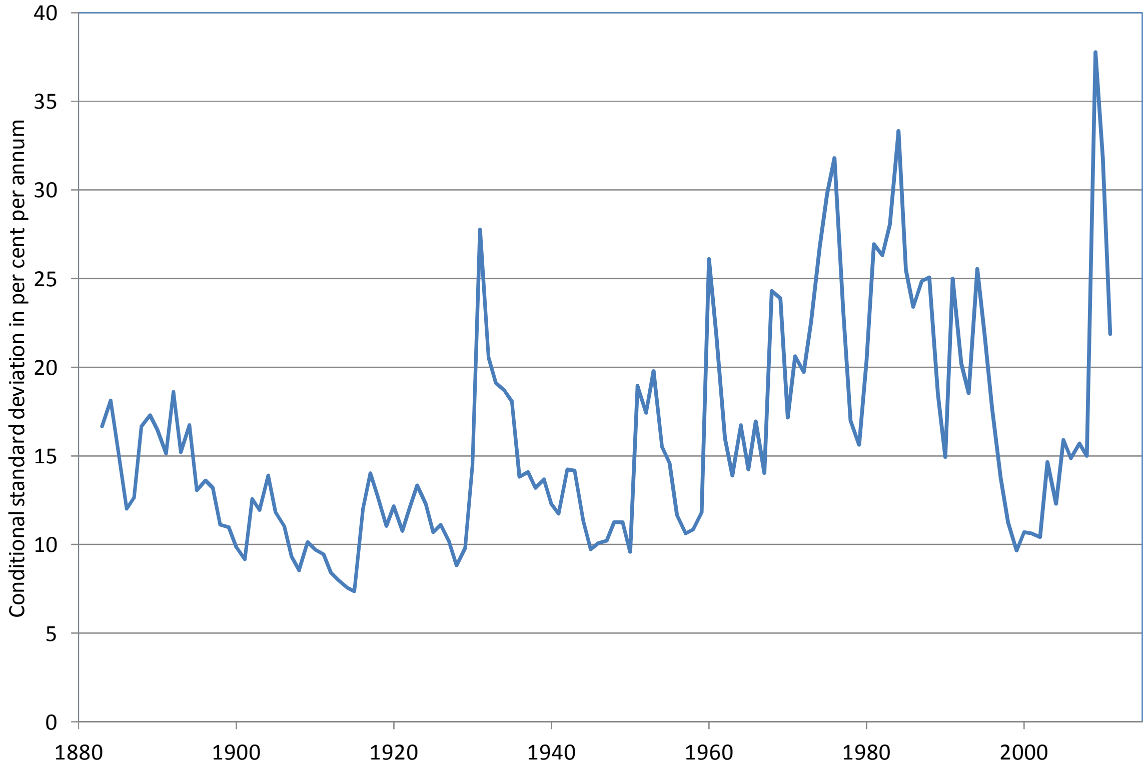
Brailsford, T., J. Handley and K. Maheswaran, *Re-examination of the historical equity risk premium in Australia*, Accounting and Finance 48, 2008, pages 73-97.

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

assume that the *MRP* is a constant through time. We generate 10,000 series of excess returns for the period 1883 to 2011 under the assumption that a single regime shift occurs in 1958 when the standard deviation of the excess return to the market portfolio shifts from 10 per cent to 20 per cent per annum. In particular, we generate series that satisfy

$$r_t = 0.0600 + h_t^{1/2} z_t , \qquad z_t \sim \text{NID}(0,1) ,$$
$$h_t = 0.10 , \quad t < 1958 , \qquad h_t = 0.20 , \quad t \geq 1958 \tag{B.2}$$

**Figure B.3**
**EGARCH estimates**




We then use the unrestricted regime-switching model and EGARCH model that McKenzie and Partington (2012) employ to estimate the conditional standard deviation of the return each year.[247] The unrestricted regime-switching model does not impose the restriction implied by Merton's model on the *MRP*.

Figure B.4 plots the conditional standard deviation in per cent per annum for each year averaged across the 10,000 series for each model. It is clear that the EGARCH model has more difficulty in identifying the regime shift than the regime-switching model. The EGARCH model overestimates the conditional standard deviation in the low-volatility state and underestimates the conditional standard deviation in the high-volatility state. In the simulations the standard deviation of the excess return to the market is 10 per cent higher

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247 McKenzie, M. and G. Partington, *Review of regime switching framework and critique of survey evidence*, SIRCA Limited, 7 September 2012.

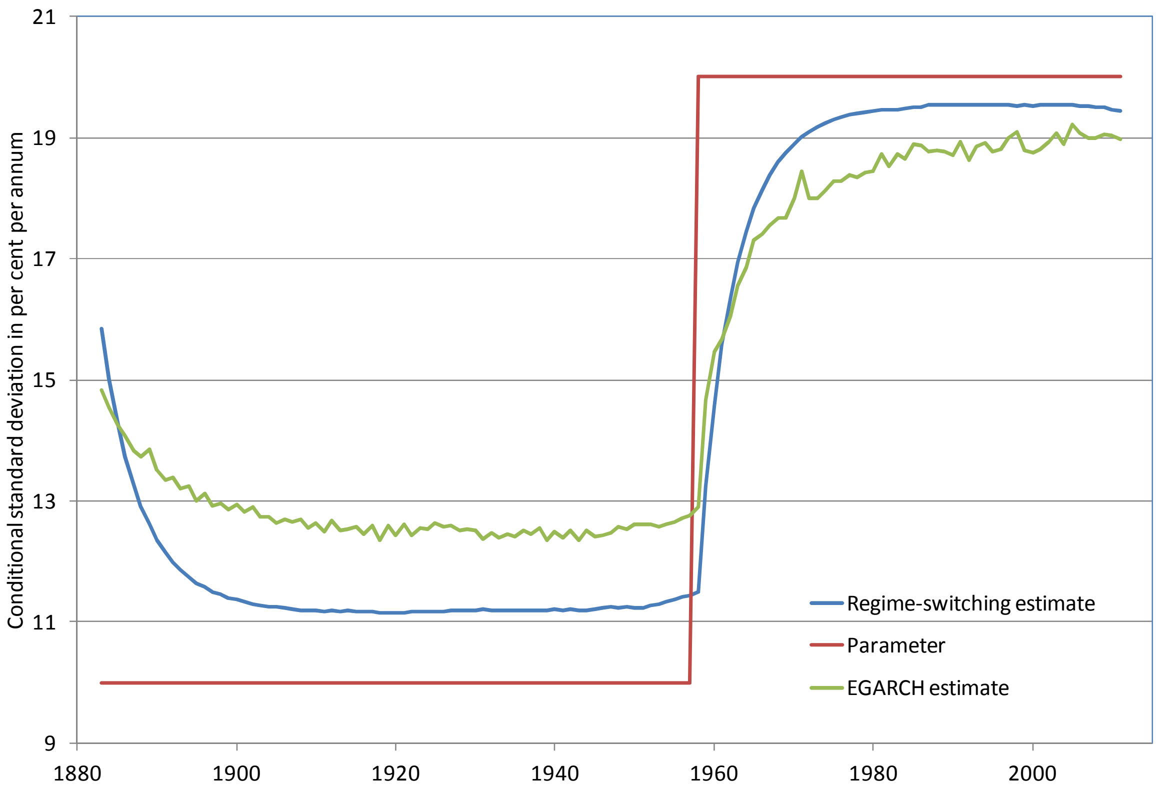
after 1958 than before 1958. The regime-switching model on average detects a difference of 7.23 per cent while the EGARCH model detects on average a difference of just 5.38 per cent.

These results and the evidence that the average squared standardised residual before 1958 is significantly lower than the average squared standardised residual from 1958 onwards suggest that it is *unclear* that the assertion that McKenzie and Partington (2012) make that an:

> 'EGARCH model (provides) volatility estimates (that) are more consistent with events in the equity markets.'

is correct. [248]

**Figure B.4**
**Simulation evidence on the behaviour of EGARCH and regime-switching estimates of the volatility of the return to the market portfolio**




## B.2.2. Summary

To summarise, we show that there is evidence that the EGARCH model that McKenzie and Partington (2012) introduce is misspecified. [249] Using the annual data from 1883 to 2011 that

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[248] McKenzie, M. and G. Partington, *Review of regime switching framework and critique of survey evidence*, SIRCA Limited, 7 September 2012, page 5.

[249] McKenzie, M. and G. Partington, *Review of regime switching framework and critique of survey evidence*, SIRCA Limited, 7 September 2012.

the AER employs and that we update, we provide statistically significant evidence that the model tends to overestimate the volatility of the return to the market portfolio when the volatility is low and tends to underestimate the volatility of the return to the market portfolio when the volatility is high.[250] Simulations that we conduct show that this is the result that one would expect to see if volatility underwent a regime shift. We recommend that the AER not use an EGARCH model with these data.

[250] AER, *Access arrangement draft decision Multinet Gas (DB No. 1) Pty Ltd Multinet Gas (DB No. 2) Pty Ltd 2013–17 Part 1*, September 2012, page 94.

# Appendix C. Tests for Variation in the *MRP*

This appendix describes how the statistics reported in Table 5.1 were computed.

Define

$$D_{1t} = \begin{cases} 1 & \text{if } t < 1937 \\ 0 & \text{otherwise} \end{cases}, \quad D_{2t} = \begin{cases} 1 & \text{if } t < 1958 \\ 0 & \text{otherwise} \end{cases},$$

$$D_{3t} = \begin{cases} 1 & \text{if } t < 1980 \\ 0 & \text{otherwise} \end{cases}, \quad D_{4t} = \begin{cases} 1 & \text{if } t < 1988 \\ 0 & \text{otherwise} \end{cases} \qquad \text{(C.1)}$$

In Panel A of Table 5.1, we estimate the *MRP* over the period 1937-2011 and the difference between the *MRP* over the period 1883-1936 and the *MRP* over the period 1937-2011 using the regression:

$$r_t = \alpha_1 + \beta_1 D_{1t} + \varepsilon_{1t}, \qquad \text{(C.2)}$$

where $r_t$ is the year-*t* return to the market portfolio in excess of the government 10-year bond yield, $\alpha_1$ is the *MRP* over the period 1937-2011, $\beta_1$ is the difference between the *MRP* over the period 1883-1936 and the *MRP* over the period 1937-2011 and $\varepsilon_{1t}$ is a regression disturbance. We produce the other estimates in Panel A of Table 5.1 in similar fashion.

We compute a Wald statistic for a test of the hypothesis that the *MRP* over the sub-periods 1883-1936, 1937-1957, 1958-1979, 1980-1987 and 1988-2011 is a constant using the regression:

$$r_t = \gamma_1 D_{1t} + \gamma_2 (D_{2t} - D_{1t}) + \gamma_3 (D_{3t} - D_{2t}) + \gamma_4 (D_{4t} - D_{3t}) + \gamma_5 (1 - D_{4t}) + \eta_t, \qquad \text{(C.3)}$$

where $\gamma_1$ is the *MRP* over the period 1883-1936, $\gamma_2$ is the *MRP* over the period 1937-1957, $\gamma_3$ is the *MRP* over the period 1958-1979, $\gamma_4$ is the *MRP* over the period 1980-1987, $\gamma_5$ is the *MRP* over the period 1988-2011and $\eta_t$ is a regression disturbance. The heteroscedasticity and autocorrelation-consistent Wald statistic that we report in Table 5.1 is for a test of the null that $\gamma_1 = \gamma_2 = \gamma_3 = \gamma_4 = \gamma_5$ and in large samples will be distributed chi-square with four degrees of freedom under the hypothesis.

In Panel B of Table 5.1, we estimate the trend in the *MRP* over time using the regression:

$$r_t = \delta + \lambda \left( \frac{t - 1882}{10} \right) + \zeta_t, \qquad \text{(C.4)}$$

where $\delta$ is the *MRP* in 1882, $\lambda$ is the change in the *MRP* per decade over the period 1883-2011 and $\zeta_t$ is a regression disturbance.

# Appendix D. Terms of Reference

**TERMS OF REFERENCE – MARKET RISK PREMIUM (NERA)**

## Background

The Australian Energy Regulator (AER) is developing a rate of return guideline that will form the basis of the regulated rate of return applied in energy network decisions. The AER published an issues paper in late December 2012 and a formal consultation paper in early May 2013 under the recently revised National Electricity Rules (NER) and National Gas Rules (NGR).

The new NER and NGR require the AER, when determining the long run market risk premium, to consider (amongst other things):

> "Relevant estimation methods, financial models, market data and other evidence for determining the rate of return".

As further detailed below, the ENA requests your opinion on the market risk premium to be used in equity models used in establishing the allowed rate of return in accordance with the following objective set out in the rules:

> "[t]he rate of return for a [Service Provider] is to be commensurate with the efficient financing costs of a benchmark efficient entity with a similar degree of risk as that which applied to the [Service Provider] in respect of the provision of [services]"

## Scope of work

Please consider:

- The accuracy of the downward adjustments to Lamberton's (1961) dividend yield data that Brailsford, Handley and Maheswaran (2008, 2012) and the AER employ;
- The merits or otherwise of the Siegel-averaging method that Lally (2012) advocates and that the Queensland Competition Authority (QCA) has adopted;
- Whether a long-run estimate of the MRP should be computed using an arithmetic mean, geometric mean, or some weighted average of the two;
- The impact of the choice of sample on estimates of the MRP; and
- The ENA is also seeking an analysis from NERA of the following issues, some of which will pertain to the estimation of the currently prevailing MRP:
- The costs and benefits of using biased estimators for the MRP.

- Whether the dividend growth model (DGM) will necessarily deliver an upwardly biased estimate of the MRP in current or recent circumstances, during which the risk-free rate has been low; and

- Whether market practitioner estimates of the return required on the market are consistent with a constant MRP through time when measured against the prevailing yields on 10-year Commonwealth Government Securities (CGS), and whether the estimates are consistent with the proposition that the prevailing forward looking MRP in 2012 and 2013 was 6 per cent.

- To investigate suitable data sources for use in estimating the size and value premiums and to provide estimates of the premiums.

The ENA requests the consultant to provide a report which must:

- Attach these terms of reference and the qualifications (in the form of CV(s) of the person(s) preparing the report;
- Identify any current or potential future conflicts of interest;
- Comprehensively set out the bases for any conclusions made;
- Only rely on information or data that is fully referenced and could be made reasonably available to the AER or others;
- Document the methods, data, adjustments, equations, statistical package specifications/printouts and assumptions used in preparing your opinion;[5]
- Include specified wording at the beginning of the report stating that "[the person(s)] acknowledge(s) that [the person(s)] has read, understood and complied with the Federal Court of Australia's Practice Note CM 7, Expert Witnesses in Proceedings in the Federal Court of Australia" as if your brief was in the context of litigation;
- Include specified wording at the end of the report to declare that "[the person(s)] has made all the inquiries that [the person(s)] believes are desirable and appropriate and that no matters of significance that [the person(s)] regards as relevant have, to [the person(s)] knowledge, been withheld"; and
- State that the person(s) have been provided with a copy of the Federal Court of Australia's "Guidelines for Expert Witnesses in Proceeding in the Federal Court of Australia" and that the Report has been prepared in accordance with those Guidelines, refer to Annexure A to these Terms of Reference or alternatively online at <*http://www.federalcourt.gov.au/law-and-practice/practice-documents/practice-notes/cm7*>.

## Timeframe

The consultant is to provide a final report at the end of the third week in June 2013.

[5] Note: this requires you to reveal information that you might otherwise regard as proprietary or confidential and if this causes you commercial concern, please consult us on a legal framework which can be put in place to protect your proprietary material while enabling your work to be adequately transparent and replicable.

## Contacts

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

**Nick Taylor (Jones Day)**

Email: njtaylor@jonesday.com

Phone: 02 8272 0500

# Annexure A

## FEDERAL COURT OF AUSTRALIA

## *Practice Note CM 7*

## EXPERT WITNESSES IN PROCEEDINGS IN THE FEDERAL COURT OF AUSTRALIA

1. Rule 23.12 of the Federal Court Rules 2011 requires a party to give a copy of the following guidelines to any witness they propose to retain for the purpose of preparing a report or giving evidence in a proceeding as to an opinion held by the witness that is wholly or substantially based on the specialised knowledge of the witness (see **Part 3.3 - Opinion** of the *Evidence Act 1995* (Cth)).

2. The guidelines are not intended to address all aspects of an expert witness's duties, but are intended to facilitate the admission of opinion evidence[251], and to assist experts to understand in general terms what the Court expects of them. Additionally, it is hoped that the guidelines will assist individual expert witnesses to avoid the criticism that is sometimes made (whether rightly or wrongly) that expert witnesses lack objectivity, or have coloured their evidence in favour of the party calling them.

<u>**Guidelines**</u>

**1. General Duty to the Court**[252]

1.1 An expert witness has an overriding duty to assist the Court on matters relevant to the expert's area of expertise.

1.2 An expert witness is not an advocate for a party even when giving testimony that is necessarily evaluative rather than inferential.

1.3 An expert witness's paramount duty is to the Court and not to the person retaining the expert.

**2. The Form of the Expert's Report**[253]

2.1 An expert's written report must comply with Rule 23.13 and therefore must

(a) be signed by the expert who prepared the report; and

(b) contain an acknowledgement at the beginning of the report that the expert has read, understood and complied with the Practice Note; and

(c) contain particulars of the training, study or experience by which the expert has acquired specialised knowledge; and

(d) identify the questions that the expert was asked to address; and

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

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

[253] Rule 23.13.

(e) set out separately each of the factual findings or assumptions on which the expert's opinion is based; and

(f) set out separately from the factual findings or assumptions each of the expert's opinions; and

(g) set out the reasons for each of the expert's opinions; and

(h) comply with the Practice Note.

2.2 The expert must also state that each of the expert's opinions is wholly or substantially based upon the expert's specialised knowledge[254].

2.3 At the end of the report the expert should declare that "[the expert] has *made all the inquiries that* [the expert] *believes are desirable and appropriate and that no matters of significance that* [the expert] *regards as relevant have, to* [the expert's] *knowledge, been withheld from the Court*."

2.4 There should be included in or attached to the report the documents and other materials that the expert has been instructed to consider.

2.5 If, after exchange of reports or at any other stage, an expert witness changes the expert's opinion, having read another expert's report or for any other reason, the change should be communicated as soon as practicable (through the party's lawyers) to each party to whom the expert witness's report has been provided and, when appropriate, to the Court[255].

2.6 If an expert's opinion is not fully researched because the expert considers that insufficient data are available, or for any other reason, this must be stated with an indication that the opinion is no more than a provisional one. Where an expert witness who has prepared a report believes that it may be incomplete or inaccurate without some qualification, that qualification must be stated in the report.

2.7 The expert should make it clear if a particular question or issue falls outside the relevant field of expertise.

2.8 Where an expert's report refers to photographs, plans, calculations, analyses, measurements, survey reports or other extrinsic matter, these must be provided to the opposite party at the same time as the exchange of reports[256].

## 3. Experts' Conference

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

PA KEANE
Chief Justice
1 August 2011

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[254] *Dasreef Pty Limited v Nawaf Hawchar* [2011] HCA 21.

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

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

# Appendix E. Curricula Vitae

## Simon M. Wheatley

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

### Overview

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

### Personal

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

### Employment

- Special Consultant, NERA Economic Consulting, 2009-present
- External Consultant, NERA Economic Consulting, 2008-2009
- Quantitative Analyst, Victorian Funds Management Corporation, 2008-2009
- Adjunct, Melbourne Business School, 2008
- Professor, Department of Finance, University of Melbourne, 2001-2008
- Associate Professor, Department of Finance, University of Melbourne, 1999-2001
- Associate Professor, Australian Graduate School of Management, 1994-1999
- Visiting Assistant Professor, Graduate School of Business, University of Chicago, 1993-1994

- Visiting Assistant Professor, Faculty of Commerce, University of British Columbia, 1986
- Assistant Professor, Graduate School of Business, University of Washington, 1984-1993

## Education

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

## Publicly Available Reports

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

## Consulting Experience

NERA, 2008-present

Lumina Foundation, Indianapolis, 2009

Industry Funds Management, 2010

## Academic Publications

Imputation credits and equity returns, (with Paul Lajbcygier), 2012, *Economic Record*, forthcoming.

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

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

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

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

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

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

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

## Working Papers

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

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

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

Evaluating asset pricing models, 1998.

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

Testing asset pricing models with infrequently measured factors, 1989.

## Refereeing Experience

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

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

## Teaching Experience

International Finance, Melbourne Business School, 2008

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

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

Investments, University of Chicago, 1993-1994

Investments, University of British Columbia, 1986

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

Investments, Macroeconomics, Statistics, University of Rochester, 1982

Accounting, 1981, Australian Graduate School of Management, 1981

## Teaching Awards

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

## Computing Skills

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

## Board Membership

Anglican Funds Committee, Melbourne, 2008-2011

## Honours

Elected a member of Beta Gamma Sigma, June 1986.

## Fellowships

Earhart Foundation Award, 1982-1983

University of Rochester Fellowship, 1979-1984

Simon Fraser University Fellowship, 1979

Inner London Education Authority Award, 1973-1977

# Brendan Quach

Senior Consultant

NERA Economic Consulting
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Sydney NSW 2000
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Fax: +61 2 8864 6549
E-mail: brendan.quach@nera.com
Website: www.nera.com

## Overview

Brendan Quach has eleven 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

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| **1991-1995** | **AUSTRALIAN NATIONAL UNIVERSITY**<br>Bachelor of Economics.<br>(High Second Class Honours) |
| **1991-1997** | **AUSTRALIAN NATIONAL UNIVERSITY**<br>Bachelor of Laws. |

## Career Details

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| **2001 -** | **NERA ECONOMIC CONSULTING**<br>Economist, Sydney |
| **1998-1999** | **AUSTRALIAN CHAMBER OF COMMERCE AND INDUSTRY**<br>Economist, Canberra |
| **1996** | **AUSTRALIAN BUREAU OF STATISTICS**<br>Research Officer, Canberra |

## Project Experience

### *Industry Analysis*

**2011** **Energy Networks Association**
**Review of the regulatory frameworks for energy networks**
Brendan is currently advising the ENA on the Australian Energy Regulator's (AER's) potential Rule change proposal. Advice currently focuses on a range of issues including the propose-respond framework, expenditure incentives, the cost of capital and the potential role of judicial reviews.

**2011** **MSAR Office for the Development of the Energy Sector**
**Development of a New Tariff Structure**
Brendan is currently leading a team reviewing Macau's current electricity tariffs. This requires NERA to model and analyse long- and short-run marginal costs, sunk costs and generation dispatch. Our work for the Macau Government will be incorporated into the potential development of new tariffs for residential, commercial and casino customers.

**2010** **Industry Funds Management/Queensland Investment Corporation**
**Due diligence, Port of Brisbane**
Brendan was retained to advise on various regulatory and competition matters likely to affect the future financial and business performance of the Port of Brisbane, in the context of its sale by the Queensland government.

**2010-2011** **Minter Ellison /UNELCO**
**Review of regulatory decision by the Vanuatu regulator**
Assisted in the development of an expert report on a range of matters arising from the Vanuatu regulator's decision to reset electricity prices under four concession contracts held by UNELCO. The matters considered included the methodology employed to calculate the new base price, the appropriateness of the rate of return, the decision by the regulator to reset future prices having regard to past gains/losses.

**2010** **Gilbert + Tobin/Confidential – Telecommunications**
**Incentive Arrangements for Regulated Telecommunications Services**
Brendan provided strategic advice to Gilbert + Tobin on possible regulatory arrangements that allow for the efficient delivery of fixed line telecommunications services in the context of the government mandated roll out the National Broadband Network.

**2009-10** **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 during the appeal of the AER's revenue determination for the 2009-2014 period.

**2009** **CitiPower/Powercor**
**Efficiency carryover mechanisms**
Assisted in the development of an 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.

**2009** **Prime Infrastructure**
**Sale of Dalrymple Bay Coal Terminal (DBCT)**
Brendan provided regulatory advice to a number of potential bidders for the assets of DBCT. Advice included an assessment of the rate of return parameters, depreciation, regulatory modelling and the regulatory arrangements in Queensland.

**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.

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| **2008** | **Ministerial Council Energy**<br>**Retailer of Last Resort**<br>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**<br>**Gas supply agreement arbitration**<br>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**<br>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**<br>**Gas supply agreement arbitration**<br>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**<br>**Generator sale, due diligence**<br>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**<br>**Rationalisation Options Study**<br>Conducting a rationalisation options study to examine alternative business models for Metrowater. Our report assessed different vertical and horizontal integration options for Metrowater. |

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| **2003** | **Metrowater, New Zealand**<br>**Institutional Restructuring**<br>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**<br>**Research to RIC on their proposed access undertaking.**<br>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**<br>**Critique of CIE's bandwidth pricing principles.**<br>Provided a critique of a CIE report on bandwidth pricing principles for the fibre optic networked run owned by Argus Telecommunications. |
| **2001** | **Screenrights, Australia**<br>**Advice on valuing retransmission of local TV**<br>A review and analysis of different methodologies in valuing retransmission of local television on pay TV services. |

### *Regulatory and Financial Analysis*

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| **2012** | **Queensland Competition Authority**<br>**Review of the retail water regulatory models**<br>Brendan undertook an independent quality assurance assessment of the financial models relied on by the QCA to set the regulated revenues of SunWater. The review considered: SunWater's Financial model, a model used by SunWater to calculate future electricity prices, an renewals annuity model, as well as the QCA's regulatory model. These models established a set of recommended prices for each of the 30 irrigation schemes operated by SunWater for the period 2014 to 2019. |
| **2011** | **Queensland Competition Authority**<br>**Review of the retail water regulatory models**<br>Undertook an independent quality assurance assessment of the models used to calculate regulated revenues for Queensland Urban Utilities, Allconnex Water, and Unitywater. The review considered: the formulation of the WACC; the intra year timing of cashflows; and the structural, computational and economic integrity of the models. |
| **2011** | **Queensland Competition Authority**<br>**Review of the wholesale water regulatory models**<br>Undertook an independent quality assurance assessment of the models used to calculate regulated revenues for LinkWater, Seqwater; and |

WaterSecure. The review considered: the formulation of the WACC; the intra year timing of cashflows; and the structural, computational and economic integrity of the models.

**2011** **Multinet Gas and SP AusNet - Gas Distribution**
**Report on the market risk premium**
Co-authored a report that examined a number of issues arising from the draft decision on Envestra's access proposal for the SA gas network. The report considered whether: the historical evidence supported the use of a long term average of 6 per cent; there is any evidence to warrant a MRP at it long term average; and the evidence relied on by the AER to justify its return to a MRP of 6 per cent.

**2011** **Dampier to Bunbury Natural Gas Pipeline - Gas Transmission**
**Cost of Equity**
Co-authored two reports that updated the cost of equity for a gas transmission business and responded to issues raised by the regulator in its draft decision. The report re-estimated the cost of equity of a gas distribution business using the Sharpe Lintner CAPM, Black CAPM, Fama-French three-factor model and a zero beta version of the Fama-French three-factor model.

**2010-2011** **Queensland Competition Authority**
**Weighted Average Cost of Capital (WACC) for SunWater**
Retained to provide two expert reports on the WACC for SunWater a Queensland rural infrastructure business. The first report considered issues pertaining to whether a single or multiple rates of return can be applied across SunWater's network segments. The second report focuses market evidence on the appropriate rate of return for SunWater.

**2011** **Mallesons Stephens Jaques, on behalf of ActewAGL Distribution**
**Determining the averaging period**
Assisted in the development of an expert report that considered the economic and financial matters arising from the Australian Energy Regulator's decision to reject ActewAGL's proposed risk free rate averaging period.

**2010** **Orion Energy, New Zealand**
**Information disclosure regime**
Provided advice and assistance in preparing submissions by Orion to the New Zealand Commerce Commission, in relation to the Commission's proposed weighted average cost of capital for an electricity lines businesses. Issues addressed included the financial model used to calculate the required return on equity, the appropriate term for the risk free rate and the WACC parameter values proposed by the Commission.

**2010** **Ministerial Council on Energy, Smart Meter Working Group, The costs and benefits of electricity smart metering infrastructure in rural and remote communities**

This report extends NERA's earlier analysis of the costs and benefits of a mandatory roll out of smart meters, by consider the implications of a roll out in rural and remote communities in the Northern Territory, Western Australia and Queensland. The project has focused on eight case study communities and has examined the implications of prepayment metering and remoteness on the overall costs and benefits of a roll out.

**2010** **Grid Australia, Submission to the AER on the proposed amendments to the transmission revenue and asset value models**

Developed and drafted a submission to the AER on the proposed amendments to the AER's post-tax revenue model (PTRM) and roll forward model (RFM). The proposal focused on a number of suggestions to simplify and increase the usability of the existing models.

**2010** **Dampier to Bunbury Natural Gas Pipeline (DBNGP) - Gas Transmission**

**Cost of Equity**

Co-authored a report that examined four well accepted financial models to estimate the cost of equity for a gas transmission 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 a zero beta version of the Fama-French three-factor model.

**2009-10** **Jemena - Gas Distribution**

**Cost of Equity**

Co-authored two reports on the use of the Fama-French three-factor model to estimate the cost of equity for regulated gas distribution business. 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. 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** **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 new arrangements on the business case for undertaking a series of reliability projects. Specifically, the project estimated the net benefit to the businesses of three reliability programs.

**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.

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| **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**<br>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** | **Electricity Transmission Network Owners Forum (ETNOF), Submission to the AER on the proposed transmission revenue and asset value models**<br>Developed and drafted a submission to the AER on the proposed post-tax revenue model (PTRM) and roll forward model (RFM) that would apply to all electricity transmission network service providers (TNSPs). The proposal focused ensuring that the regulatory models gave effect to the AER's regulatory decisions and insures that TNSPs have a reasonable opportunity to recover their efficient costs. |
| **2007** | **Victorian Electricity Distribution Business**<br>**Review of Smart Meter model**<br>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**<br>**Weighted Average Cost of Capital**<br>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**<br>**Review of Regulatory Modelling**<br>Provided 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 was 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 development of a tax asset base, 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.

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| **2006** | **Office of the Tasmanian Energy Regulator**<br>**Implications of the pre-tax or post-tax WACC**<br>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**<br>**Regulatory Modelling of Dalrymple Bay Coal Terminal**<br>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**<br>**Review of Regulatory Revenue Models**<br>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**<br>**Review of RAB Roll Forward Approach**<br>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**<br>**Review of Regulatory Systems**<br>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**<br>**Rail industry structure and efficiency**<br>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. |

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| **2005** | **Australian Energy Markets Commission, Australia**<br>**Transmission pricing regime**<br>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**<br>**Weighted Average Cost of Capital**<br>Provided a report for Queensland Rail on the appropriate weighted average cost of capital for its regulated below rail activities. |
| **2004-2005** | **ETSA Utilities**<br>**Review of Regulatory Modelling**<br>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**<br>**Review of Regulatory Revenues**<br>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**<br>**Weighted Average Cost of Capital**<br>Provided a report for Prime Infrastructure on the appropriate weighted average cost of capital for its regulated activities (coal shipping terminal). |
| **2004** | **PowerGas, Singapore**<br>**Review of Transmission Tariff Model**<br>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**<br>**Review of Regulatory Revenues**<br>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**<br>**Threshold and Control Regime in the Electricity Sector**<br>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 cumulated 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.

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