Attachment 7.01

CEG, WACC estimates, a report for NSW DNSPs

May 2014

COMPETITION ECONOMISTS GROUP

WACC estimates

A REPORT FOR NSW DNSPs

May 2014

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1 Introduction

1. My name is Tom Hird. I have a Ph.D. in Economics and 20 years' experience as a professional economist. My curriculum vitae is provided separately. This report has been prepared for the NSW DNSPs (Ausgrid, Endeavour Energy and Essential Energy) to assess the reasonableness of the return on capital range contained in each respective transitional regulatory proposal.

2. This report examines the following subject areas:

   - CAPM estimates of the cost of equity;
   - non-CAPM estimates of the cost of equity;
   - estimates of the cost of debt; and
   - the value of imputation credits (gamma).

3. The remainder of this report is set out as follows:

   - section 2 provides estimates of the cost of equity for a benchmark regulated distribution network service provider (DNSP);
   - section 3 provides estimates of the cost of debt; and
   - section 4 addresses the best estimate of the value of imputation credits.

4. I acknowledge that I have read, understood and complied with the Federal Court of Australia's *Practice Note CM 7, Expert Witnesses in Proceedings in the Federal Court of Australia*.

5. I have been assisted in the preparation of this report by Daniel Young, Johanna Hansson and Annabel Wilton from CEG's Sydney office. However, the opinions set out in this report are my own.

Thomas Nicholas Hird

29 May 2014

2 Estimating the cost of equity

2.1 Summary

6. In arriving at an estimate of the cost of equity using the capital asset pricing model (CAPM) it is necessary to populate the below equation:

Equation 1

$$E[R_i] = E[R_{\beta=0}] + \beta_i \cdot (E[R_m] - E[R_{\beta=0}])$$

where $E[R_i]$ is the expected return on the benchmark firm, $E[R_{\beta=0}]$ is the expected return on zero beta equity (the 'risk free' rate of return), β_i is the beta for the asset and $E[R_m]$ is the expected return on the market portfolio.

2.1.1 Best estimate of equity beta

7. My first key conclusion is that the AER Guidelines range and point estimate for the equity beta is too low. The AER range of 0.4 to 0.7 only captures 3 out of 18 regression beta estimates provided by the AER's expert Olan Henry.[1] Moreover, it only captures 7 out of 56 beta estimates for US comparable companies (or 13%). None of the US comparable regression betas are below the AER range and the remainder (87%) are above the AER range. My best estimate of the benchmark regression beta is 0.82 having regard to both the Australian and US comparable companies.

2.1.1.1 Using alternatives to regression based betas to account for low beta bias

8. It is also well understood that, if the government bond rate is used as the proxy for $E[R_{\beta=0}]$, using regression estimates of beta that are below 1.0 will lead to a downward bias in the estimated cost of equity. In order to account for this my best estimate of beta is above 0.82 in any scenario where the government bond rate is being used as the proxy for $E[R_{\beta=0}]$. In this context, my best estimate is 0.94, which is based on work by SFG which, using the dividend growth model (DGM), demonstrates that regulated utilities historically have a risk premium that is 0.94 of the market risk premium.

[1] Using the ordinary least squares and the full data range.

2.1.1.2 Using regression betas in the 'Black CAPM' to account for low beta bias

9. An alternative methodology to account for low beta bias is to retain the use of regression based beta estimates, but to use an estimate of $E[R_{\beta=0}]$ that is above the government bond rate. This is sometimes referred to as implementing the Black CAPM', and I adopt this terminology.[2] In implementing the Black CAPM, I have had regard to the empirical finance literature and conclude that the best estimate of $E[R_{\beta=0}]$ is above the government bond rate by around half of the difference between the government bond rate and $E[R_m]$. That is:

Equation 2

$$E\left[R_{\beta=0}\right] = \text{Govt. bond rate} + 0.5 * (\,E[R_m] - \text{Govt. bond rate})$$

Substituting equation (2) into equation (1) gives:

Equation 3

$$E[R_i] = \text{Govt. bond rate} + 0.5 * (\,E[R_m] - \text{Govt. bond rate}) * (1 + \beta_i)$$

10. The effect of this, relative to simply setting $E\left[R_{\beta=0}\right]$ equal to the government bond rate in equation (1), is to reduce the weight given to β_i by increasing the risk free rate ($E\left[R_{\beta=0}\right]$) and reducing the MRP ($E[R_m] - E\left[R_{\beta=0}\right]$) by the same amount.

2.1.2 Best estimate of the return on the market portfolio ($E[R_m]$)

11. The second key conclusion is that the range for the required return on the market ($E[R_m]$) derived from internally consistent methodologies is between 11.2% and 11.6%. This contrasts with an estimate of 10.5% associated with application of the approach set out in the Guidelines, namely, adding 6.5% to the prevailing 10 year government bond rate (4.0% at the time of writing).

12. The internally consistent estimates of the required return on the market portfolio ($E[R_m]$) are summarised in Table 1.

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[2] However, it is, in reality, an implementation of the CAPM that simply has regard to the empirically undisputed fact that equity assets that have zero regression betas tend to earn a return that is well in excess of the government bond rate – suggesting that the correct risk free rate (return on a zero beta asset) to use in the CAPM when pricing equities is in excess of the Government bond rate.

Table 1: Internally consistent estimates of $E[R_m]$

Approach	E[Rm]
Wright approach – the historical average return on the market portfolio	11.6%
Historical average excess return on the market portfolio plus the historical average government bond rate	11.3%
Pure forward looking DGM estimates of prevailing required return on the market portfolio	
• SFG DGM market *	11.4%
• CEG DGM market	11.2% - 11.6%

** SFG's estimate is 10.32% before imputation credits which translates to 11.42% inclusive of the value of imputation credits.*

13. By contrast the Guidelines based estimate of 10.5% is derived in an internally inconsistent manner – estimating a historical average market return in excess of the (high) historical average government bond rates and adding to this (low) prevailing bond rates. This results in a downward biased estimate of $E[R_m]$ by around 0.8% (being the difference between historical average and prevailing real interest rates).

2.1.3 Best estimate of the benchmark CAPM cost of equity

14. Based on these two variations to the approach in the AER Guidelines I arrive at a lower bound and a best estimate of the cost of equity.

   - My lower bound estimate is 10.1% based on adopting a regression beta of 0.82 and correcting the internal inconsistency in the use of different values for $E[R_{\beta=0}]$ in the CAPM formula. This 10.1% estimate is derived using the 10 year government bond rate as the proxy for $E[R_{\beta=0}]$;
   - My best estimate is 10.9% which also adjusts for the low beta bias associated with using regression betas and setting $E[R_{\beta=0}]$ equal to the government bond rate.

15. These estimates are themselves averages of the approaches outlined in Table 1 above and are set out in Table 2 below.

Table 2: Estimates of the CAPM cost of equity

	$E[R_m]$	$E[R_{\beta=0}]$	Regression Beta	$E[R_i]$ no correction for low beta bias	Non-regression Beta	$E[R_i]$ low beta bias corrected
Wright approach	11.6%	4.0%	0.82	10.2%	0.94	11.1%
Historical average	11.3%	4.8%	0.82	10.1%	0.94	10.9%
Pure forward looking						
SFG DGM market	10.3%	4.1%	0.82	10.2%	0.94	11.0%
CEG DGM market	11.4%	4.0%	0.82	10.0%	0.94	10.9%
Black CAPM	11.4%	7.7%	0.82	NA	NA	10.7%
Average				**10.1%**		**10.9%**

Source: Grundy, AER, SFG, Bloomberg, CEG analysis.
** The SFG $E[R_m]$ estimate excludes the value of imputation credits which are added back in when estimating $E[R_i]$. This is why, despite having the lowest estimate of $E[R_m]$ SFG has an estimate of $E[R_i]$ that is consistent with the other non AER estimates.*

16. I note that a Guidelines based estimate of $8.5\% = (4\% + 0.7 * 6.5\%)$ is well below the lowest estimate in the above table.

2.1.4 Fama French estimates of the cost of equity

17. In addition to the use of the CAPM, it is commonplace for academics and market practitioners to estimate the cost of equity for a company/industry using the Fama French three factor model. The Fama French Model is well-accepted in the finance literature and the results of the model should be considered "relevant' information for the purposes of assessing the cost of equity under the NER.

18. SFG have estimated the cost of equity of the benchmark Australian benchmark firm using the Fama French model.[3] They estimated that the cost of equity under long term average market conditions was 11.5%. Using the same values for β_i, s, SML, h and HML but updating $E[R_{\beta=0}]$ to reflect prevailing government bond rates (4.0%) and $E[R_m]$ to reflect prevailing DGM based estimates of $E[R_m]$ (11.4%) results in an estimated cost of equity of 10.9%.

19. These estimates (10.9% and 11.5%) are the same as and materially above my best estimate based on the CAPM models (10.9%). They are both materially above the lower end of the reasonable range based on the CAPM models (10.1%).

3 SFG (2013), Regression-based estimates of risk parameters for the benchmark firm.

2.2 Defining the CAPM equation

20. The CAPM first set out by Sharpe (1964)[4] is a model of relative risk. The CAPM assumes that investors demand a return equal to the return on a zero beta equity ($E[R_{\beta=0}]$) plus a risk premium that is equal to the asset's "beta" (β_i) multiplied by the difference between the expected return on the market portfolio ($E[R_m]$) less $E[R_{\beta=0}]$,.[5] $E[R_m]$ is an input into the CAPM, not an output. The output of the models is an estimate of a particular asset's required return *relative to* $E[R_m]$. The required return on each asset is determined as:

Equation 1 (repeated)

$$E[R_i] = E[R_{\beta=0}] + \beta_i \cdot (E[R_m] - E[R_{\beta=0}])$$

21. The inputs into this model are $E[R_{\beta=0}]$, β_i and $E[R_m]$. The above equation could just as easily and correctly be written as:

Equivalent representation Equation 1

$$E[R_i] = \beta_i \cdot E[R_m] + E\left[R_{\beta=0}\right] \cdot (1 - \beta_i)$$

22. The expected market risk premium (E[MRP]) is not an input into this model – the E[MRP] is simply the difference between the value of $E[R_m]$ and $E[R_{\beta=0}]$.

2.3 Estimating beta

23. The equity beta reflects the systematic risk of the benchmark firm in relation to the average firm (which has an equity beta of 1.0). Consistent with recent work performed by CEG[6], SFG[7] I consider that the appropriate range for beta is between

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4 Sharpe, William F. (1964). *Capital asset prices: A theory of market equilibrium under conditions of risk*, Journal of Finance, 19 (3), 425-442.

5 Beta is defined as the ratio of the covariance of an asset's return with the return on the market portfolio to the variance of the market return. An asset has zero risk in the CAPM when beta is zero – hence the risk free rate is termed $E[R_{\beta=0}]$.

6 CEG, *Information on equity beta from US companies*, a report for the ENA, June 2013, CEG , *International comparators*, a report for the ENA, October 2013, *Precision of beta estimates*, a report for APIA, October 2013.

7 SFG, *Regression-based estimates of risk parameters for the benchmark firm*, a report for the ENA, June 2013, SFG, *The Vasicek adjustment to beta estimates in the CAPM*, a report for the ENA, June 2013, *Comparison of OLS and LAD regression techniques for estimating beta*, a report for the ENA, June 2013. *SFG, Alternative versions of the dividend discount model and the implied cost of equity*, May 2014.

0.82 (based on the results of regression estimates) and 0.94 (based on DGM estimates of relative risk).

2.3.1 Regression estimates of beta

24. In its Rate of Return Guideline, the AER proposed to use a value of 0.7 for the equity beta which was the top of its estimated range of 0.4 to 0.7. The AER describes the basis for this range as:

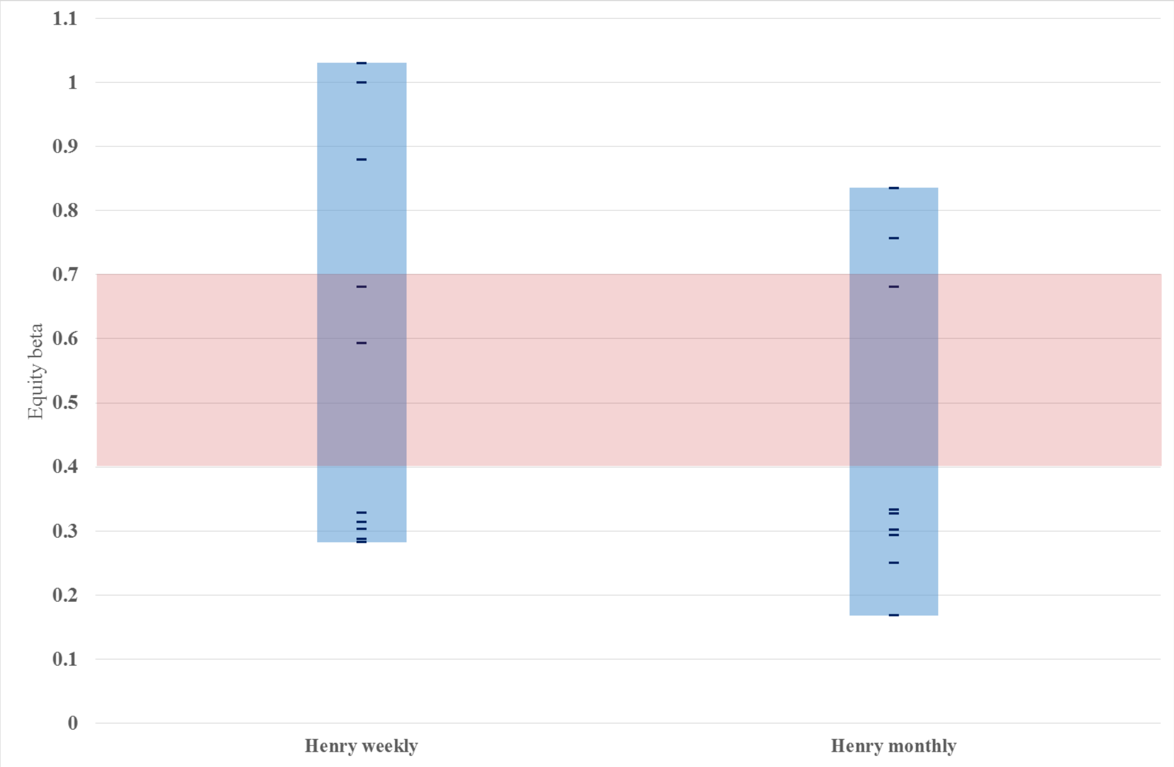
> *…we have based our 0.4 to 0.7 range on the equity beta point estimates for entities in our Australian comparator set of energy networks under different samples and sampling periods.*[8]

25. In my view, even if one only had regard to regression estimates of beta from Australia, it is unreasonable for the AER to arrive at such a narrow range. In a report provided to the AER after it finalised its Guideline,[9] Olan Henry has estimated, weekly and monthly ordinary least squares (OLS) betas for the AER's nine (9) proposed sample of Australian comparators. Focusing on the longest dataset available (Tables 2 and 5 in the Henry report) there are 18 beta estimates (one weekly and one monthly beta for each comparator). Of these 18 beta estimates, only three (3) are within the AER's proposed range. The other 15 beta estimates fall either above or below the AER's range. This is illustrated in Figure 1 below.

8 AER, *Explanatory Statement to the Rate of Return Guidelines*, Appendix C, p. 43.

9 Olan Henry, *Estimating β: An update*, April 2014.

Figure 1: AER regression betas



Source: Henry (2014), CEG analysis

26. Three important observations can be made about the Henry's estimates. First, there are a very small number of firms (only 9 with only 6 of these currently trading/owning regulated assets). Second, the range is very wide for such a small sample. Third, the distribution within the sample is polarised. That is, rather than having most observations falling close to the mean observation and fewer observations the further from the mean, the observations tend to cluster well above or well below the mean.

27. In contrast, US beta estimates for comparable firms[10] are centrally distributed around the mean estimate. This is illustrated in Figure 2 below which simply adds US comparable betas to the AER Australian betas presented in Figure 1.

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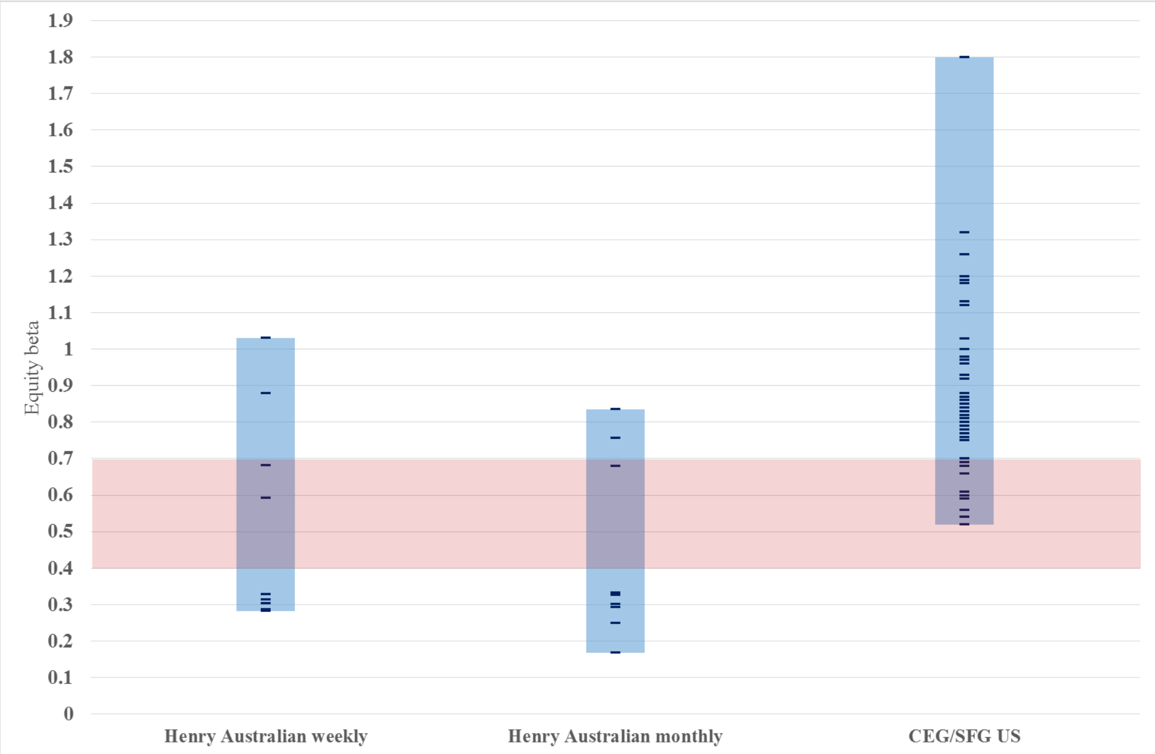
10 See SFG (2013), Regression-based estimates of risk parameters for the benchmark firm, Table 6 for the full list of companies and beta estimates.

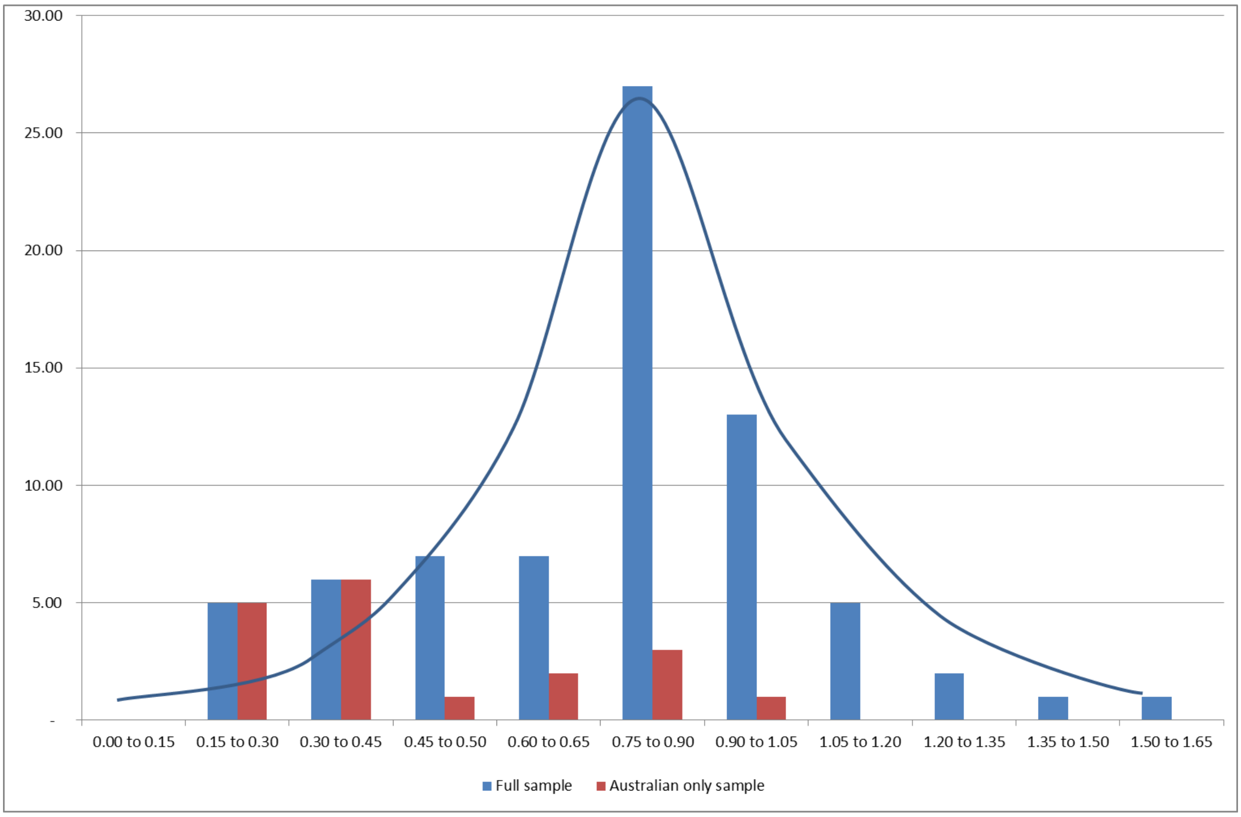
Figure 2: AER and international regression betas



Source: Henry, CEG/SFG, CEG analysis

28. Figure 3 below provides a different way of comparing the distribution of the AER Australian sample to the distribution of the combined sample of Australian and US comparable companies.

Figure 3: Frequency distribution of AER Australian vs combined Australian and US sample



Source: Henry and CEG analysis.
Note that the 18 Australian beta estimates include two observations (one weekly and one monthly both sourced from Henry) for each of the 9 Australian comparators. The US comparators only have one beta estimates per company.

29. It can be seen that the sample that is restricted purely to the Australian data is not symmetrically distributed around its mean. However, the full sample, which includes 56 US comparable firms, is symmetrically distributed around its mean.

30. In my view, the best estimate of beta based solely on regression based estimates of beta is 0.82. This is based on regression estimates of beta using historical stock market data. This estimate gives twice as much weight to beta estimates when they exist for the small number of Australian comparables but also gives weight to the much larger number US comparables.[11]

[11] Consistent with the analysis set out on page 16 of SFG, *Regression-based estimates of risk parameters for the benchmark firm*, June 2013.

2.3.2 Accounting for low beta bias

31. It is also well understood that, if the government bond rate is used as the proxy for $E[R_{\beta=0}]$, using regression estimates of beta that are below 1.0 will lead to a downward bias in the estimated cost of equity. There are two ways that this bias can be accounted for:

- estimate beta using a different methodology (i.e., not regression based estimates of beta); or
- use an estimate of $E[R_{\beta=0}]$ that exceeds the government bond rate (the "Black CAPM").

2.3.2.1 Establishing the existence of low beta bias

32. The CAPM formula (Equation 1) is derived under a number of strong assumptions. These include that:

- investors can borrow at $E[R_{\beta=0}]$ for the purpose of leveraged investment in the equities market;
- investors invest once, hold that portfolio unchanged for a given period, and then consume their entire wealth at the end of that period. In the terminology of finance theory the Sharpe-Lintner CAPM is a 'single period' model; and
- there are zero transaction costs (broadly defined to include taxes and costs of acquiring knowledge).

33. The first assumption is clearly violated if $E[R_{\beta=0}]$ is set equal to the Government bond rate. That is, investors cannot borrow at the government bond rate 'full stop', let alone do so for the purpose of investing in leveraged equities. Black (1972)[12] showed that this meant that $E[R_{\beta=0}]$ would be in excess of the government bond rate. Specifically, Black showed that once it is recognised that investors cannot borrow at the Government bond rate in order to leverage investment in equities, then $E[R_{\beta=0}]$ in Equation 1 must include a 'zero beta premium'.

34. In addition, the unique role of equity beta in the CAPM flows directly from the extreme simplifying assumption that investors only invest for a single period (the second dot point above). Of course, the reality is that investors invest over their entire life and are interested not just in the returns on their portfolio in the next week or month but returns on their portfolio over their entire life.

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

35. The Merton CAPM (1973),[13] developed by Nobel Prize winner Robert Merton, showed that in multiple period models of the CAPM factors other than β_e drive equity returns. In particular, investors also care about the correlation between returns in this period and the profitability of reinvesting those returns in the next period (reinvestment opportunities). Equity that pays off more when reinvestment opportunities are so attractive that investors would otherwise cut-back consumption in order to invest more will be more valuable (lower risk) than equity that pays off less when reinvestment opportunities are high. The 'technology bubble' and the 'commodity boom' could reasonably fit into these categories.

36. Unlike regression betas, covariance with reinvestment opportunities is very difficult to measure directly (as it is difficult to measure *ex-ante* perceived reinvestment opportunities). However, researchers have used the Merton CAPM (also known as the intertemporal CAPM) as the rationale for testing for proxies for this risk. Most famously, Fama and French (2004) have described their three factor model as a practical implementation of the Merton CAPM. The Fama and French three factor model is the model that best predicts the returns that are actually observed in capital markets.

37. Sharpe (1964) himself states in relation to the other assumptions:

> *Needless to say, these are highly restrictive and undoubtedly unrealistic assumptions.*

38. Given the unrealistic nature of the assumptions underpinning equation (1) (especially if implemented with the government bond rate as the proxy for $E[R_{\beta=0}]$) it is prudent to have regard to empirical evidence of its performance in explaining observed returns in asset markets. This has been done in different countries at different times and a near universal finding of these tests is that:

- $E[R_{\beta=0}]$ is set equal to the government bond rate; and
- regression estimates of beta are used; then
- the estimated cost of equity tends to under/over-estimate the actual returns for assets that have regression betas of less/more than 1.0.

39. This is depicted in the figure below from Fama and French (2004).[14] The figure shows clearly the difference between the actual relation between a stock's regression based beta and its return compared to the relation predicted by the Sharpe CAPM if the regression beta was truly equal to investors' perceived beta.

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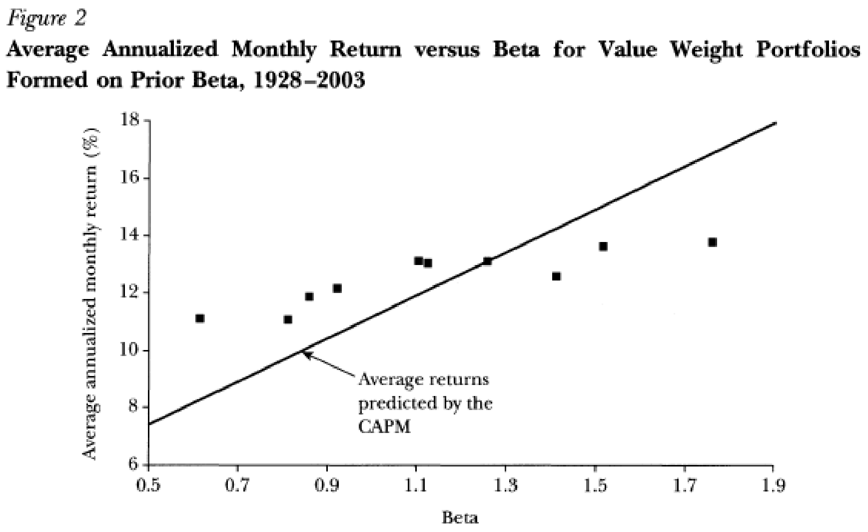
13 Merton, Robert C., 1973, *An intertemporal asset pricing model*, Econometrica 41, 867-887

14 Fama, Eugene F. and Kenneth R. French, 2004, "The capital asset pricing model: Theory and evidence," The Journal of Economic Perspectives 18, pp. 25-46.

Figure 4: Average annualised monthly return versus beta



Source: Fama and French (2004)

40. In Figure 4, the Government bond rate defines the intercept of the CAPM security market line (SML = the upward-sloping line) based on regression betas (i.e., this is the line that should exist if the government bond rate was the best proxy for $E[R_{\beta=0}]$). The slope of the line is defined by the market risk premium measured relative to the Government bond rate.

41. It is clear from Figure 4 that the actual relationship between beta and market returns is much flatter than that predicted by Equation 1 implemented using regression based betas as the proxy for investors' perceived beta and government bond rates as the proxy for $E[R_{\beta=0}]$.

42. Precisely the same relationship has been found in every study of this kind that I am aware of. The seminal studies of this kind were performed by Fama and Macbeth (1973)[15] and Black, Jensen and Scholes (1972)[16]. In relation to more recent tests Fama and French (2004) state:

> *Fama and French (1992) also confirm the evidence (Reinganum, 1981; Stambaugh, 1982; Lakonishok and Shapiro, 1986) that the relation between*

[15] Fama, Eugene F. and James D. MacBeth, (1973), "Risk, Return, and Equilibrium: Empirical Tests," Journal of Political Economy, 81 (3), 607–636.

[16] Black, Fischer, Michael C. Jensen and Myron Scholes, (1972), "The Capital Asset Pricing Model: Some Empirical Tests," in Studies in the Theory of Capital Markets, Michael C. Jensen, ed., New York: Praeger, 79-121.

average return and beta for common stocks is even flatter after the sample periods used in the early empirical work on the CAPM. [Note that in this quote the reference to 'beta' is a reference to beta estimated using regression techniques]

43. This is a general finding of the empirical tests of the CAPM as described by Fama and French (2004):

> *The Sharpe-Lintner CAPM predicts that the portfolios plot along a straight line, with an intercept equal to the risk-free rate, Rf, and a slope equal to the expected excess return on the market, E(RM)- Rf. We use the average one-month Treasury bill rate and the average excess CRSP market return for 1928-2003 to estimate the predicted line in Figure 2. Confirming earlier evidence, the relation between beta and average return for the ten portfolios is much flatter than the Sharpe-Lintner CAPM predicts. The returns on the low beta portfolios are too high, and the returns on the high beta portfolios are too low. For example, the predicted return on the portfolio with the lowest beta is 8.3 percent per year; the actual return is 11.1 percent. The predicted return on the portfolio with the highest beta is 16.8 percent per year; the actual is 13.7 percent.*

44. More recently, Campbell and Vuolteenaho (2004)[17] have estimated that the return on zero beta equity is above not only the government bond rate but also is above the market return. That is, lower equity betas are actually associated with higher returns rather than the opposite as predicted by the single period CAPM models (Sharpe-Lintner and Black).

45. In 2008, Bruce Grundy, Daniel Young and I replicated the Fama and Macbeth study using 44 years of monthly Australian return data from 1964 to 2007.[18] We found the same results as other researchers. Figure 5 below summarises the key empirical results of our study.

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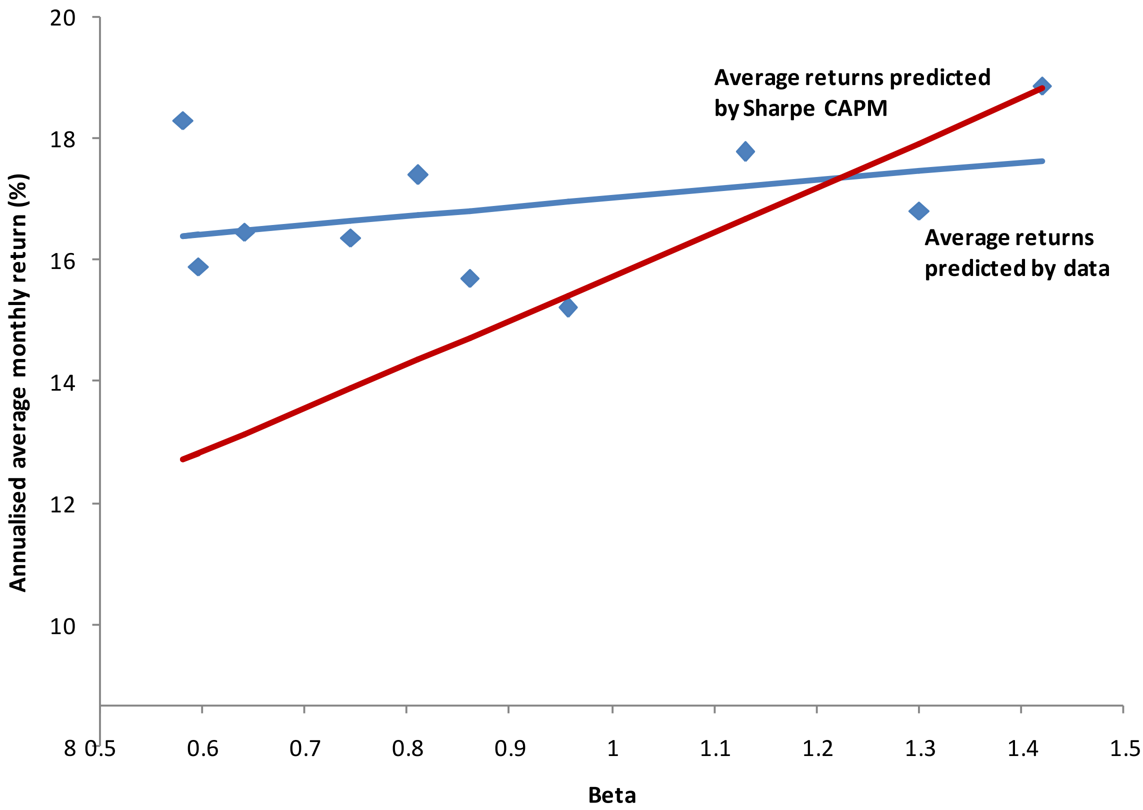
[17] Campbell, John Y. and Tuomo Vuolteenaho, 2004, "Bad beta, good beta," American Economic Review 94, pp. 1249-1275.

[18] Hird, Grundy, and Young, *Estimation of, and correction for, biases inherent in the Sharpe CAPM formula*, A report for the Energy Networks Association Grid Australia and APIA, 2008.

Figure 5: Reproduction of Figure 1 from CEG 2008: Sharpe-Lintner CAPM Predictions vs Actual Relationship in Australian Capital Markets



Source: CEG analysis

46. The flatter (blue) line in Figure 5 is the actual relationship between beta and stock returns in the Australian market. The steeper (red) line is the relationship predicted by the Sharpe-CAPM using the Government debt as the proxy for the risk free rate. The flatter actual relationship is consistent with the findings of other researchers in other markets, namely, that a model which estimates $E[R_{\beta=0}]$ as including a premium to the return on Government debt is more accurate than one which assumes that $E[R_{\beta=0}]$ is equal to the return on government debt.

47. This is a robust statistical result: The expected return on zero beta equity is statistically significantly greater than the rate on government bonds at the 99.7% confidence level[19].

[19] That is, based on the Australian data for the 300 largest firms we can be 99.7% certain that zero beta equity will earn more than the risk free rate. That is, we can be 99.7% confident that the Black CAPM is a better description of reality than the Sharpe CAPM implemented assuming $E[R_{\beta=0}]$ equals the government bond rate.

48. As described in the body of our 2008 report, these results are not sensitive to the use of only the 300 largest stocks in the data set. That is, no matter how one 'cuts the data' the same result is found – zero beta equity earn significantly more than the government bond rate. This result is a direct contravention of the Sharpe-Lintner CAPM formula when assuming the risk free rate is proxied by the government bond rate.

49. Professor Grundy has separately surveyed the finance literature (attached at Appendix C) and concludes[20]:

> *I know of no published study that has empirically tested the Sharpe CAPM and failed to reject the Sharpe CAPM.*

50. It, it is important to note that the context of this quote is that the implementation of the Sharpe CAPM using *regression betas* and the government bond rate as the proxy for $E[R_{\beta=0}]$ is rejected.

2.3.2.2 Correcting for low beta bias using the Black CAPM

51. In the same paper from which the above quote is taken, Professor Grundy surveys the empirical literature, including the full set of papers the AER[21] referred to in support of the use of the CAPM rather than the Fama French model. In addition to Fama and Macbeth (1973) and Black, Jensen and Scholes (1972) already referenced, the papers surveyed by Grundy (and relied on by the AER to reject the use of the Fama French model) are:

    i. Ferson, Sarkissian and Simin, 1999, "The alpha factor asset pricing model: A parable," Journal of Financial Markets 2, pp. 49-68

    ii. Lo, Andrew W. and A. Craig MacKinlay, 1990, "Data-snooping biases in tests of financial asset pricing models," Review of Financial Studies 3(3), pp. 431-467.

    iii. Roll, Richard, 1977, "A critique of the asset pricing theory's tests Part I: On past and potential testability of the theory," Journal of Financial Economics 4(2), pp. 129–176.

    iv. Roll, Richard and Stephen A. Ross, 1994, "On the cross-sectional relation between expected returns and betas," Journal of Finance 49(1), pp. 101-121.

20 Grundy, Calculation of the Cost of Capital - A Report for Envestra, February 2011.

21 AER, Jemena Gas Networks, Access arrangement proposal for the NSW gas networks 1 July 2010 to 30 June 2015, Draft and Final Decisions

v. Schrimpf, Andreas, Michael Schroder and Richard Stehle, 2007, "Cross-sectional tests of conditional asset pricing models: Evidence from the German stock market," European Financial Management 13(5), pp. 880–907.

vi. Ang, Andrew and Joseph Chen, 2007, "CAPM over the long run: 1926–2001," Journal of Empirical Finance 14, pp. 1–40.

vii. Grauer, Robert R. and Johannus A. Janmaat, 2010, "Cross-sectional tests of the CAPM and Fama–French three-factor model," Journal of Banking & Finance 34, pp. 457–470.

viii. Gregory, Alan and Maria Michou, 2009, "Industry cost of equity capital: UK evidence," Journal of Business Finance & Accounting 36(5) & (6), pp. 679–704.

ix. Black, Fischer, 1993, "Beta and return," Journal of Portfolio Management, 1993, 20(1), pp. 8–18.

x. Schwert,G. William, 2003, "Anomalies and market efficiency," in Handbook of the Economics of Finance, editors G. Constantinides, M. Harris and R. Stulz, Elsevier Science, ch. 15, pp. 937–972.

xi. Morana, Claudio, 2009, "Realized betas and the cross-section of expected returns," Applied Financial Economics, 19, pp. 1371-138.

xii. Daniel, Kent, Sheridan Titman and K.C. John Wei, 2001, "Explaining the cross-section of stock returns in Japan: factors or characteristics', Journal of Finance, 56(2), pp. 743–767

xiii. Da, Zhi, Re-Jin Guo and Ravi Jagannathan, 2009, "CAPM: Interpreting the evidence," NBER working paper 14889.

xiv. Kothari, S., Jay Shanken and Richard G. Sloan, 1995, "Another look at the cross-section of expected returns," Journal of Finance, 50(1), pp. 185–224;

52. Professor Grundy concludes that, all of these papers support the use of the "Black CAPM' and that the average estimate in the empirical literature is that the 'zero beta premium' is around half of $E[R_m]$ less the government bond rate. That is, the "MRP" measured relative to the required return on zero beta equity is around half the MRP measured relative government bond rates. Specifically, Professor Grundy's review of the finance literature suggests that, on average:

$$\frac{E[R_m] - E[R_{\beta=0}]}{E[R_m] - Govt. bond\ rate} = 0.511$$

53. More recently, other researchers have examined Australian stock market data and reached broadly similar conclusions. In particular, SFG (2014) estimated that

$\frac{E[R_m]-E[R_{\beta=0}]}{E[R_m]-Govt.bond\ rate} = 0.48$ – very similar to the average of Grundy's survey of the literature.[22]

54. On this basis, and consistent with Equation 2 at paragraph 9, I consider that the best estimate of the relationship between $E[R_{\beta=0}]$, the government bond rate and $E[R_m]$ is given by:

Equation 2

$$\frac{E[R_m] - E[R_{\beta=0}]}{E[R_m] - Govt.\,bond\ rate} = 0.5$$

55. Rearranging this equation so that $E\left[R_{\beta=0}\right]$ is on the left hand-side and $E\left[R_{\beta=0}\right]$ is expressed as a premium above the government bond rate gives:

Equation 2 (rearranged)

$$E\left[R_{\beta=0}\right] = \text{Govt. bond rate} + 0.5 * (E[R_m] - \text{Govt. bond rate})$$

56. This states that $E\left[R_{\beta=0}\right]$ is equal to the government bond rate plus half of the difference between $E[R_m]$ and the government bond rate. Substituting Equation 2 into Equation 1 (the CAPM formula)Equation gives the 'Black CAPM' equation (previously set out at paragraph 0):

Equation 3

$$E[R_i] = \text{Govt. bond rate} + 0.5 * (E[R_m] - \text{Govt. bond rate}) * (1 + \beta_i)$$

57. The effect of this, relative to simply setting $E\left[R_{\beta=0}\right]$ equal to the government bond rate in equation (1), is to reduce the weight given to β_i by increasing the risk free rate ($E\left[R_{\beta=0}\right]$) and reducing the MRP ($E[R_m] - E\left[R_{\beta=0}\right]$) by the same amount.

58. Based on an equity beta of 0.82, a risk free rate of 3.96% and DGM estimate of E[Rm] of 11.4% the "Black CAPM" estimate of the cost of equity is 10.7% given by:

$$10.7\% = 4.0\% + 0.5 * (11.4\% - 4.0\%) * (1 + 0.82)$$

22 SFG, Cost of equity in the Black Capital Asset Pricing Model, May 2014. See paragraph 102 for source of the numbers in the calculation = (12.40-9.36)/(12.40-6.02)=3.34%/6.38%=0.48.

2.3.2.3 *Correcting for low beta bias using DGM based estimates of beta*

59. SFG[23] has estimated the relative risk of the benchmark Australian utility using the DGM in the following manner. For all Australian-listed firms for which data is available there is an estimate of the required return on equity performed over every six month period from 2002 to 2014. Applying market capitalisation weights to these required return on equity estimates results in a market cost of equity estimate for every six month period. This is compared to the risk-free rate every six months to form an estimate of the implied market risk premium every six months.

60. SFG then subtracts the government bond rate from the cost of equity estimates for regulated utilities in order to derive an equity risk premium for these comparable firms. The risk premium associated with these individual firm estimates is compared to the market risk premium in the corresponding six month period to provide a set of risk premium ratios. The average ratio is 0.94, implying that the average listed network has an equity risk premium which is 94% of the market risk premium.

61. That is, on average since 2002, if we define risk premiums relative to 10 year government bond rates, investors have priced equity in regulated utilities consistent with them having a perceived beta of 0.94.

62. I note that setting $E[R_{\beta=0}]$ equal to the government bond rate and using a 0.94 beta in Equation 1) gives a very similar result to using a 0.82 beta in the Black CAPM Equation 1) This can be demonstrated by:

- setting $E[R_{\beta=0}]$ equal to the government bond rate in Equation 1);
- setting Equation 3) equal to Equation 1); and
- solving for the value of β_i in Equation 1) in terms of the (regression) beta used in Equation 3.

63. When this is done it can be shown that:

Equation 4

$$\beta_i \text{ from equation } 1 = 0.5 * \beta_{i\,regression} + 0.5$$

64. This is similar to commonly used adjustments to ‘raw’ regression betas. As noted by Damodaran:

[23] SFG, *Alternative versions of the dividend discount model and the implied cost of equity*, 2014, see Table 14.

"...most services adjust their regression betas towards one, using fairly simple techniques. To illustrate, Bloomberg estimates an adjusted beta by doing the following:

*Adjusted Beta = Regression Beta * (0.67) + 1.00 * (0.33)*

This effectively pushes all regression beta estimates closer to one."[24]

65. Substituting my best estimate of regression beta (0.82) into equation (4) results in an estimate of β_i of 0.91. This estimate of 0.91 is consistent with, although slightly lower than, the 0.94 estimated by SFG using DGM estimates of ex ante measurements of relative risk premiums. That these estimates are so similar, despite being derived from completely different data sources and methodologies, provides material support for the conclusions of both estimation techniques.

2.4 DGM estimates of E[Rm]

66. In order to arrive at a purely forward looking estimate of E[Rm] it is necessary to rely purely on prevailing market conditions. The DGM estimates E[Rm] by equating the present value of forecast future dividends on the market portfolio with the current cost of purchasing the market portfolio (current market capitalisation). The discount rate that makes these two things equal is an estimate of the implied discount rate being used by investors to value future dividends on the market portfolio (i.e., E[Rm]).

67. Professor Grundy and I have separately concluded that:

The academic state of the art in determining the E[MRP] is to use the current level of the market in conjunction with a dividend growth model to determine the implied discount rate used by investors. This implied level of the E[R_m], also known as the implied market cost of capital, reflects all the information available to investors, including the historical level of the MRP. The E[MRP] is then simply the implied E[R_m] less the current level of the required return on a zero beta asset (i.e., the risk free rate in the CAPM).[25]

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24 Damodaran, *Estimating Risk Parameters*, available here. Notwithstanding the fac t that Damodaran goes on to argue in favour of more bespoke adjustments to regression betas, the description of common practice is relevant.

25 S See the first paragraph of section 4 of Hird and Grundy, Estimating the return on the market, June 2013. Available at http://www.aer.gov.au/node/18859

2.4.1 SFG DGM estimates of E[Rm]

68. SFG has[26] applied the DGM to estimate the cost of equity for the market. In doing so, SFG apply a technique that attempts to jointly estimate the long term growth rate in dividends and the cost of equity from model of prices, earnings and dividends inputs to the DGM.[27]

69. SFG estimates that, using the most recently available data from 1 January to 14 February 2014, the market cost of equity is 10.32% - excluding any value applied to imputation credits. The 10 year Commonwealth Government Security (CGS) yield over the 20 days ending 14 February is estimated by SFG at 4.12% implying a value for $E[R_M - R_{\beta=0}]$ excluding the value of imputation credits of 6.20%.[28]

70. Implementing the CAPM equation (equation 1 above) with an estimate of the equity beta of 0.82 (see section 2.3above) results in an estimated cost of equity for a DNSP of 9.20%. However, this is the cost of equity not ascribing any value to imputation credits and the PTRM model used by the AER requires a cost of equity input that includes the value of imputation credits. SFG advises that, based on a value of gamma of 0.25 (see section 4) the without imputation credits return must be divided by 0.903.[29] This results in a cost of equity inclusive of the value of imputation credits of 10.19%.

2.4.2 DGM estimates of E[Rm] using the AER model

71. Following the AER methodology as set out in appendix E.2 of the December 2013 rate of return Guidelines, I have used the dividend growth model to estimate $E[R_m]$ and E[MRP] – where E[MRP] is estimated using the 10 year government bond rate as the proxy for $E[R_{\beta=0}]$. The analysis was performed using data for the 20 days ending 13 May 2014. I estimate that the 10 year CGS yield over this period was 3.96% such that E[MRP] reported in the tables below is simply $E[R_m]$ less 3.96%.

72. Each table shows results for an 8 year transition from short term analyst forecasts of dividend growth to long term forecasts of dividend growth based on long run projections of GDP growth.

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26 SFG, *Alternative versions of the dividend discount model and the implied cost of equity*, May 2014. SFG DGM 2014.

27 Using a process set out in Fitzgerald, T., S. Gray, J. Hall and R. Jeyaraj, 2013. "*Unconstrained estimates of the equity risk premium*," Review of Accounting Studies, 18, on-line release 8 May 2013

28 SFG DGM 2014, *Alternative versions of the dividend discount model and the implied cost of equity*., page 59.

29 Calculated as (1-0.3)/(1-0.3*(1-0.25)) – where 0.3 is the corporate tax rates and 0.25 is the value of gamma.

Table 3: DGM: estimates of E[Rm] – Lally long run GDP growth assumption

LR real dividend growth rate=3.00%	E[R_m]				E[MRP]*			
	d=0.0%	d= 0.5%	d= 1.0%	d = 1.5%	d=0.0%	d= 0.5%	d= 1.0%	d = 1.5%
AER estimate of theta (0.7)	11.95%	11.56%	11.17%	10.78%	7.99%	7.60%	7.21%	6.82%
CEG estimate of theta (0.35)	11.35%	10.95%	10.55%	10.16%	7.39%	6.99%	6.59%	6.19%

Source: Bloomberg, RBA, CEG analysis.
** Using the 10 year government bond rate as the proxy for* $E[R_{\beta=0}]$.

Table 4: DGM: estimates of E[R_m] – base case GDP growth of 3.75%

LR real dividend growth rate=3.75%	E[R_m]				E[MRP]*			
	d=0.0%	d= 0.5%	d= 1.0%	d = 1.5%	d=0.0%	d= 0.5%	d= 1.0%	d = 1.5%
AER estimate of theta (0.7)	12.56%	12.17%	11.77%	11.38%	8.60%	8.20%	7.81%	7.42%
CEG estimate of theta (0.35)	11.98%	11.57%	11.17%	10.77%	8.02%	7.61%	7.21%	6.81%

Source: Bloomberg, RBA, CEG analysis.
** Using the 10 year government bond rate as the proxy for* $E[R_{\beta=0}]$.

Table 5: DGM: estimates of E[R_m] – sensitivity GDP growth of 4.28%

LR real dividend growth rate=4.28%	E[R_m]				E[MRP]*			
	d=0.0%	d= 0.5%	d= 1.0%	d = 1.5%	d=0.0%	d= 0.5%	d= 1.0%	d = 1.5%
AER estimate of theta (0.7)	12.99%	12.60%	12.20%	11.80%	9.03%	8.64%	8.24%	7.84%
CEG estimate of theta (0.35)	12.42%	12.01%	11.61%	11.21%	8.46%	8.05%	7.65%	7.24%

Source: Bloomberg, RBA, CEG analysis.
** Using the 10 year government bond rate as the proxy for* $E[R_{\beta=0}]$.

73. Table 3, Table 4 and Table 5 show estimates of E[Rm] and E[MRP] assuming respectively that long run economic growth will be 3.00%, 3.75% or 4.28% p.a. in real terms. These figures are based on, respectively, estimates of historical real GDP

growth by Lally, historical real growth in gross domestic income since 1959 and the average of world and Australian growth rates in GDP for the longest period reported by the Madison project[30].

74. The first column of figures in each table applies the DGM assuming that long run nominal dividends will grow in line with nominal long run economic activity while subsequent columns assume that dividends will grow at a slower rate (nominal long run economic growth less "d"). It can be seen that, even with the most extreme assumption that dividends grow at 1.5% less than economic activity, the implied E[MRP] is above 6.5% in all but one scenario.

75. My methodology is based on the AER's description of its DGM methodology for estimating the whole market's return on equity and the MRP.[31] [32] Variations to this methodology are also described.

76. In my view a conservative estimate of the DGM $E[R_m]$ is 11.17% based on the "d=1%" scenario in Table 4. The assumption that "d=1%" is common to the AER's central estimate. However, I regard this as conservative because, as noted by SFG, the basis for concluding that earnings growth for listed equity (and, hence, the ability to pay dividends) tends to be below GDP growth is based on very long datasets that do not reflect more recent history. As noted by SFG:

> *For the time period since central banks in Australia and the U.S. began using monetary policy to constrain inflation, real earnings per share growth has matched or exceeded real GDP growth.* [33]

77. For this reason I use a range for my best estimate of the DGM $E[R_m]$ of 11.17% to 11.57%. This is consistent with the range of estimates in my base case (bottom row of Table 4) associated with values of d=0.5% and 1.0%. A 0.5% value for "d" is used in recognition of the fact that unless dividends of existing companies grow slower

30 See, http://www.ggdc.net/maddison/oriindex.htm

31 See, AER, *Explanatory Statement- Rate of Return Guideline,* December 2013, appendix E, pp. 116-119.

32 We calculated forecast dividend yields for the current and next two financial years by dividing the average of Bloomberg forecast dividends for the ASX200 for each of the current, next and following years into the future ("IDX_EST_DVD_CURR_YR", "IDX_EST_DVD_NXT_YR" and "EST_DVD_FY3_AGGTE") by the value of the ASX200 (sourced from Bloomberg). We calculated the 20 day prevailing average of each dividend yield and then adjusted for the effect of imputation credits by a factor of either 1.1125 (our method, consistent with a 0.35 theta) or 1.225 (AER method, consistent with a 0.7 theta). Uplift = 1+ theta x proportion of franked dividends (0.75) * tax rate/(1-tax rate) where theta is assumed to be 0.7 by the AER and 0.35 in our method, the proportion of franked dividends is 0.75 and the tax rate is 0.3.

33 SFG, Alternative versions of the dividend discount model and the implied cost of equity, May 2014.

than GDP then eventually, taking into account the issue of new equity, dividends will eventually exceed aggregate GDP.

78. However, I do depart from the AER's central estimate of GDP growth. I consider that it is unreasonable because it is based an estimate of the long term historical growth in GDP (3.00%) provided by Lally which is deeply flawed (as discussed below). The actual historical level of GDP growth is much higher which is why my base case is associated with a 3.75% GDP growth forecast (Table 4). This forms my 'base case' and is based on the longest time series published by the ABS (3.75% real and 6.34% nominal).[34]

79. The AER's 3.00% estimate is based on observations by Lally.[35] The relevant paragraph of Lally states:

> *In respect of the long-run expected GDP growth rate, CEG (2012b, Appendix) favours an estimate of 3.9% based upon the average outcome over the period 1958-2010. However, the result over the considerably longer period from 1900-2000 is 3.3% (Bernstein and Arnott, 2003, Table 1), and the average over the 11 years since 2000 is 3.1% (The Treasury, 2012, Chart 2.2), yielding an average over the period 1900-2011 of 3.3%. This figure of 3.3% suggests that CEG's figure of 3.9% is too high. Furthermore, Bernstein and Arnott provide average real GDP growth rates over 16 countries, and the average over this set of 16 countries is 2.8%, suggesting that even the figure of 3.3% is too high. Furthermore, the Australian Federal Treasury (The Treasury, 2012, Chart 2.2) has forecasted the Australian real GDP growth rate at 3% over the next four years. Taking account of all of this, an estimate for long-run expected real GDP for Australia should be about 3%.*[36]

80. In my view this is an entirely unreasonable basis on which to alight on a long run real GDP forecast of 3.0%. In particular:

- The Bernstein and Arnott historical GDP figures are based on a data series developed by Madison and these have been updated.[37] The average GDP growth rate between 1900 and 2008 is actually 3.43% not 3.3%.

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34 Series A2304314X, which is published from December 1959 and from which the annual growth rate is 3.75% in real terms. This translates to 6.34% if we assume long run inflation of 2.5% (6.34%=(1+3.75%)*(1+2.5%)-1.

35 The relevant section of the AER December 2013 Final Explanatory Statement is page 117 of Appendix E where it is stated "Associate Professor Lally has recently estimated g using the long–term expected growth rate of real GDP, which he evaluates to be 3 per cent."

36 Lally, The Dividend Growth Model, 4 March 2013, p.17.

37 See, http://www.ggdc.net/maddison/oriindex.htm

- The time series extends back to 1820 (i.e., it does not start at 1900). The average real growth in Australian GDP over the entire period 1820 to 2008 reported by Madison is 4.58% simple average (4.36% compounding).
- Madison has yearly estimates of world GDP going back to 1950. The average world GDP growth rate between 1950 and 2008 is 3.98% simple average (3.97% compounding).[38]
- A Treasury forecast of 4 year GDP growth (as reported by Lally) is too short term to be of relevance to a long run forecast of GDP growth.

81. Properly analysed, the data referred to by Lally support, rather than undermine, the adoption of an estimate of long-term real GDP growth of around 3.9%. This is less than world GDP growth since 1950 (4.0%) and is less than Australia's long term GDP growth over the longest horizon reported in that data (4.6%).

82. Finally, my estimate of 3.9% real long run growth in dividends was not based on historical average GDP growth since 1959 but, rather, based on historical average real gross domestic income (GDI) growth.[39] Following updates and revisions by the ABS the currently published historical average economic growth figure is 3.75%.[40]

83. For this reason, I use 3.75% (average gross domestic income growth since 1959) as the base-case long run growth rate in Australian company dividends. I also include a sensitivity of 4.28% (the average of the longest time series available for world GDP and Australian GDP available from the Madison data source referenced by Lally).

84. Since the AER methodology moves from the short-term dividend forecast growth rate sourced from Bloomberg to an estimate of long-run dividend growth, I have modelled the linear transition in growth rates as occurring over 8 years (which I understand to be the AER's three-stage model). I do not present the results of

38 The 16 countries reported by Bernstein and Arnott and referred to by Lally are dominated by Western European countries and the selection of the period 1990 to 2000 is dominated by two "world wars" and a great depression that disproportionately affected Western Europe. The average growth rate for these 16 countries since 1950 has been 3.3% according to Madison

39 As set out in paragraph 189 of CEG, Internal Consistency of the Risk Free Rate and MRP in the CAPM, March 2012 (the precursor to the November 2012 report quoted by Lally – where the November 2012 report was a rebuttal of the AER analysis of the March 2012 report). The source provided there is the Australian Bureau of Statistics (ABS) economic growth figures for "growth in real domestic income of 3.9% (A2304314X of ABS Catalogue 5206.0) rather than nominal growth, since future expectations of inflation are not consistent with the high levels of inflation that were experienced at various times over this period."

40 I note that the equivalent figure for gross domestic product (ABS series A2298668K) is 3.55% which is slightly lower than 3.75%. I also note that gross domestic product and gross domestic income attempt to measure the same thing using different data sources. The difference between them is a statistical artefact. 3.75% is more consistent with the long run growth rates for Australia and world GDP from the Madison project.

moving immediately to the long run growth rate (0 year transition), in line with the AER's two-stage model. This is consistent with Lally's advice that *"a convergence period of at least 10 years is sensible"*.[41]

85. The expected market return on equity was calculated as the discount rate at which the net present value of the series of uplifted dividend yields equals 1. The uplift value depends on the assumed valuation of imputation credits at the time they are distributed to investors ("theta").[42] I consider a value for theta of 0.35 is appropriate (see section 4) while the AER guideline proposes a value of theta equal to 0.7 - which is why two different estimates are reported in each table.

2.5 The "Wright approach" estimate of $E[R_m]$

86. As already stated, Professor Grundy and I have separately advised that, if one believed that it is possible to estimate variations in $E[R_m]$, the DGM model is the best method for doing. However, in the same report we considered what the best approach would be if one were, for whatever reason, denied the ability to use the DGM and had, instead, to rely on historical averages.

87. We concluded that in this case the best estimate of $E[R_m]$ would be the historical average realised real value of R_m normalised to prevailing inflation rates.[43] We explained that this approach to estimating $E[R_m]$ is the best approach if you believe that it is not possible to accurately discern movements in $E[R_m]$ using forward looking models such as the DGM. The AER has termed this approach the "Wright approach".

88. According to NERA's update[44] to the Brailsford et al.[45] data, the average real realised R_m for the Australian market, inclusive of the value of imputation credits, from 1883 to 2011 is 8.84%. Adding currently expected inflation of around 2.50% to the historical average realised real R_m provides an estimate of the current nominal $E[R_m]$ of 11.56%. Given prevailing interest rates at the time of writing of 3.96%, the implied E[MRP] is 7.60%. These estimates are within the range of MRP estimates derived from the DGM analysis of the previous section and are presented in Table 6.

41 Lally, *The Dividend Growth Model*, 4 March 2013, p.20.

42 Uplift = 1+ theta x proportion of franked dividends (0.75) * tax rate/(1-tax rate) where theta is assumed to be 0.7 by the AER and 0.35 in our method, the proportion of franked dividends is 0.75 and the tax rate is 0.3.

43 See section 4 of Hird and Grundy, Estimating the return on the market, June 2013.

44 NERA, *The market, size and value premiums*, 2013.

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

Table 6: Historical average estimate of E[Rm] and implied E[MRP]

	Value
Historical average real realised Rm	8.84%
E[Rm] (historical real realised return with forward looking inflation of 2.5%)	11.56%
E[MRP] = E[Rm] – 3.96%	7.60%

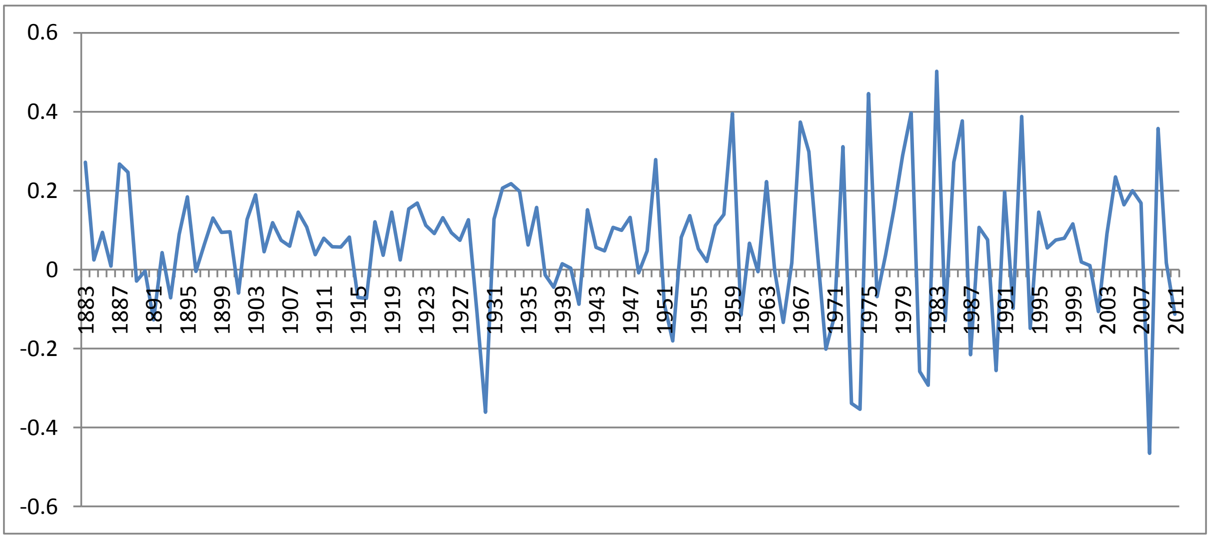
Source: NERA, RBA, CEG analysis.

2.6 Historical average for both R_m and the bond rate

89. An alternative approach is to estimate the value of $(E[R_m] - E[R_{\beta=0}])$ from Equation 1) based on the historical average realised R_m less the historical average yield of government bonds. However, if this approach is used then the same value for $E\left[R_{\beta=0}\right]$ should be used as the first term on the right hand side of Equation 1). That is, the same value for $E\left[R_{\beta=0}\right]$ should be used in the two places in which $E\left[R_{\beta=0}\right]$ enters Equation 1).

90. According to NERA's update[46] to the Brailsford et al.[47] data, the average realised excess return for the Australian market, inclusive of the value of imputation credits, from 1883 to 2011 is 6.5%. The pattern of excess returns is illustrated in

Figure 6: Excess returns on the Australian market



Source, BHM and NERA

46 NERA, *The market, size and value premiums*, 2013.

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

91. The historical average yield on the 10 year government debt over the same period and from the same source is 5.6% and the historical average inflation rate is 3.3%. This implies a historical average real bond yield of 2.22%[48] which, when combined with an inflation forecast of 2.5%, implies a nominal risk free rate of 4.78%. (This compares with the more recent historical average in the inflation targeting period[49] of 5.17%. At 2.5% inflation expectations, this would imply an average real expected return of 2.60%).

2.7 Estimating CAPM return on equity for the benchmark firm

92. As already noted, the CAPM equation is described by Equation 1).

$$E[R_i] = E[R_{\beta=0}] + \beta_i \cdot (E[R_m] - E[R_{\beta=0}])$$

93. It would be an internally inconsistent method of implementing Equation 1:

- Use the prevailing yield on CGS as the proxy for the first $E[R_{\beta=0}]$ term in equation 1); and
- When populating the terms inside the brackets use:
  - historical average returns on the equity market as the proxy for $E[R_m]$; and
  - historical average yields on CGS as the proxy for $E[R_{\beta=0}]$.

94. This clearly involves using two different proxies for $E[R_{\beta=0}]$ when the construction of Equation 1) requires that the same value for $E\left[R_{\beta=0}\right]$ is used in the two places it enters Equation 1).

95. In my view, discussed in more detail in the next section, the AER Guideline's involves precisely the internal inconsistency as set out above.

96. In contrast, there are three internally consistent ways in which this internal inconsistency can be avoided when using government bond yields (CGS) as the proxy for $E\left[R_{\beta=0}\right]$.

48 This is estimated by first averaging bond rates and inflation and then subtracting the average inflation rate from the average bond rate (using the Fisher equation). Alternatively, one could convert bond rates into real bond rates first (using the contemporaneous inflation rate in that year) and then average these over time. If this is done then the real bond rate is 0.1% higher. However, this is problematic in the sense that the yield in question for that year was a perceived 10 year yield but the observed inflation rate was only a one year inflation rate.

49 From 19 November 2003 to 18 November 2013. Over this period it is reasonable to assume that inflation expectations were centered around the RBA's target rate of 2.5%.

a. Use historical average CGS yields in both places that $E[R_{\beta=0}]$ enters equation 1). The "**historical average**" approach";

b. Use prevailing CGS yields in both places that $E[R_{\beta=0}]$ enters equation 1 while:

   i. Retaining the historical realised R_m as the proxy for $E[R_m]$. The "**Wright**" approach; or

   ii. Using the DGM to estimate the prevailing $E[R_m]$. The "**pure forward looking**" approach.

97. Consistent with the foregoing discussion, I have implemented each of these approaches as follows:

   i. The Wright approach – using a historical average value for $E[R_m]$ sourced from NERA[50] and a prevailing value for $E[R_{\beta=0}]$ based on the government bond rate;

   ii. The historical average approach uses a historical average value both $E[R_m]$ and $E[R_{\beta=0}]$ based on the prevailing government bond rate both also sourced from NERA;

   iii. A pure forward looking approach – uses DGM applied to the market to estimate $E[R_m]$ and $E[R_{\beta=0}]$ based on the prevailing government bond rate. I report results for this approach based on:

      a) SFG DGM estimates of $E[R_m]$ (10.3% excluding the value of imputation credits); and

      b) CEG DGM estimates of $E[R_m]$ following the AER's proposed DGM model but with my own best estimate of historical real GDP growth (11.4% inclusive of the value of imputation credits).

98. Each of these three approaches can be combined with a pure regression based beta or with a beta derived from observed relative risk premiums (as described in section 2.3.2). My best estimates of these for the benchmark firm are, respectively, 0.82 and 0.94. For this reason I report the results of applying each of the above methodologies with a beta of 0.82 and a beta of 0.94. This results in eight (8) different estimates of benchmark cost of equity.

99. In addition to the above approaches it is also possible to arrive at an internally consistent estimate of the CAPM cost of equity by using an estimate of $E[R_{\beta=0}]$ which includes a premium above the prevailing government bond rate (i.e., applying the Black CAPM). In my view, this is best done using equation 3 from section 2.1.1.

50 NERA, *The market, size and value premiums*, 2013. NERA, The Market Risk Premium : Analysis in Response to the AER's Draft Rate of Return Guidelines, October 2013

However, this approach should only be applied using a regression beta (0.82) because, by setting $E[R_{\beta=0}]$ above the government bond rate, the derivation of equation (3) already takes account of the information embodied in the 0.94 equity beta estimate. I implement this equation using the same estimate of $E[R_m]$ as set out in paragraph 97.iii.b) above. This adds one further estimate of the benchmark cost of equity.

100. The table below summarises the various estimates of the CAPM cost of equity found by combining the various parameter estimates set out above (where such combinations can be made in an internally consistent manner). The first row of this table also shows the cost of equity (8.5%) derived using the prevailing 10 year government bond rate (4.0%), the Guidelines point estimate of MRP (6.5%) and the Guidelines point estimate for the equity beta (0.7).

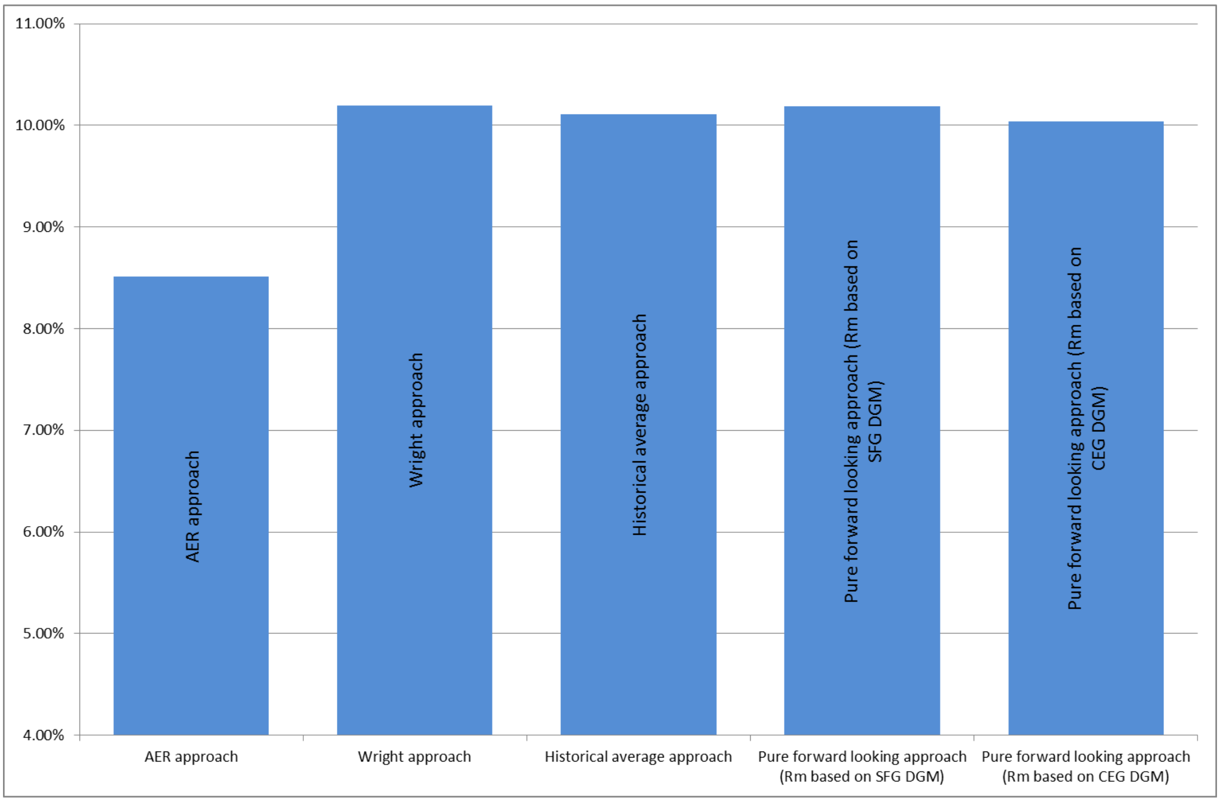
Table 7: Estimates of the CAPM cost of equity

	$E[R_m]$	$E[R_{\beta=0}]$	Regression Beta	$E[R_i]$ no correction for low beta bias	Non-regression Beta	$E[R_i]$ low beta bias corrected
AER CAPM (inconsistent $E[R_{\beta=0}]$)	10.5%	4.0%	0.70	8.5%%	NA	NA
Wright Approach	11.6%	4.0%	0.82	10.2%	0.94	11.1%
Historical average	11.3%	4.8%	0.82	10.1%	0.94	10.9%
Pure forward looking						
SFG DGM market	10.3%*	4.1%	0.82	10.2%*	0.94	11.0%*
CEG DGM market	11.4%	4.0%	0.82	10.0%	0.94	10.9%
Black CAPM	11.4%	7.7%	0.82	NA	NA	10.7%
Average (non-AER estimates)				**10.1%**		**10.9%**

*Source: Grundy, AER, SFG, Bloomberg, CEG analysis. *The SFG $E[R_m]$ estimate excludes the value of imputation credits which are added back in when estimating $E[R_i]$. This is why, despite having the lowest estimate of $E[R_m]$ SFG has an estimate of $E[R_i]$ that is consistent with the other non AER estimates.*

101. It can be seen that the high end of the AER range for beta (associated with the AER point estimate for beta of 0.7) is well below the estimates using the other methodologies – even with no correction for zero beta bias. This is also illustrated in Figure 7 below, which compares the AER estimate with the estimates that do not correct for low beta bias. (The vertical axis in the below figures start at 4.0% - the effect of which is that the comparison shows the difference in risk premiums relative to 10 year CGS yields which are around 4.0% in all estimation periods.)

Figure 7: Comparison of AER estimate to other CAPM estimates with no adjustment for low beta bias



Source: Grundy, AER, SFG, Bloomberg, CEG analysis

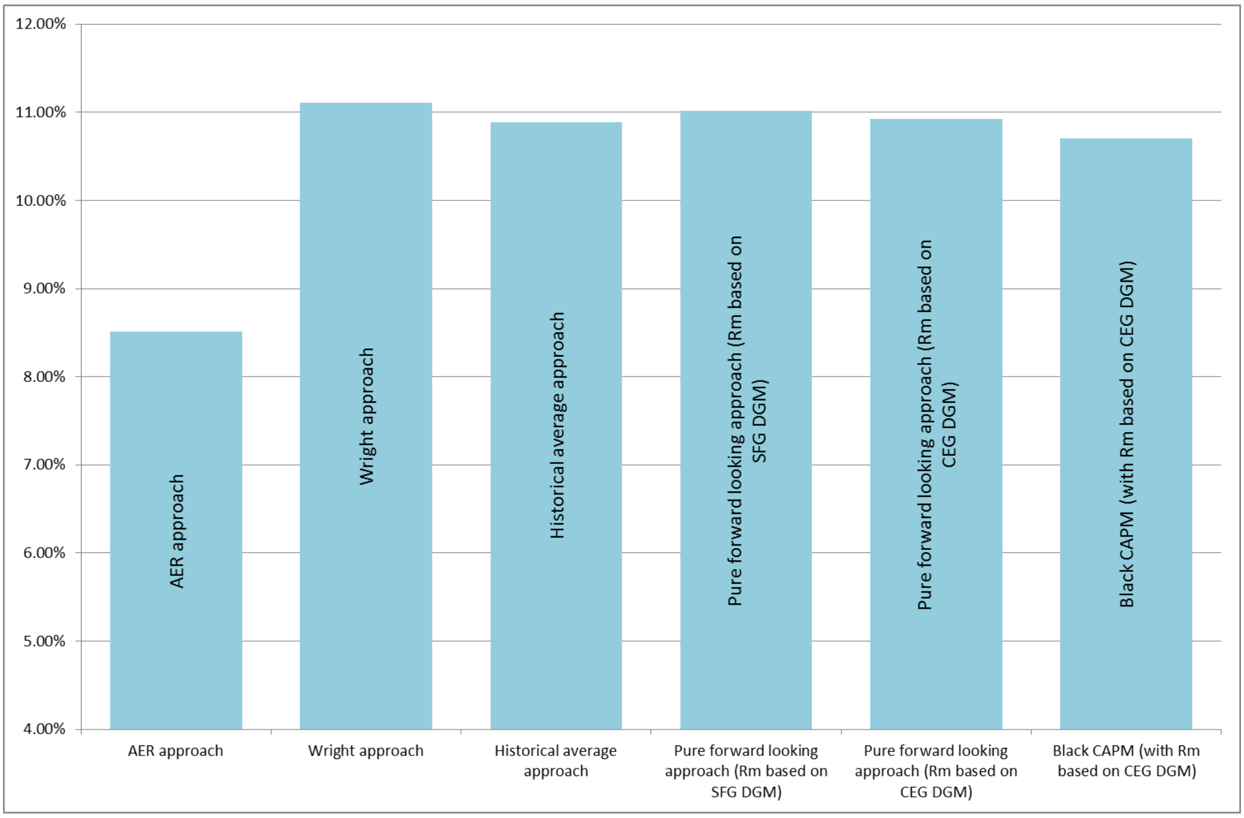
102. The AER estimate of 8.5% is 1.7% lower than the average of the other estimates (10.1%). There are two main reasons that the AER estimate is below the other estimates. The first is that the value of AER beta (0.7) is lower than the beta used in the other estimates (0.82). Using an equity beta of 0.82 would raise the AER estimate to 9.3% - still 0.8% below the average of the other estimates.

103. The remaining 0.9% difference is largely explained by the internal inconsistency in the values of $E[R_{\beta=0}]$ used by the AER. In order to arrive at a 6.5% estimate of "$E[R_m]$ less $E[R_{\beta=0}]$" the AER relies on historical average realised market returns in excess of 10 year government bond rates over the last century. However, the AER combines this with a prevailing estimate of the government bond rate.

104. To the extent that the prevailing estimate of government bond rate is lower than the historical average estimate this internal inconsistency biases down the AER's estimate. This is, indeed, the case with the prevailing 10 year CGS yield at 4.0% while the historical average 10 year CGS yield is 4.8%. This internal inconsistency results in a 0.8% downward bias – explaining almost all of the remaining difference to the other estimates.

105. The Black CAPM estimate and the other estimates associated with using a 0.94 beta are higher still because they also attempt to adjust for the empirically observed bias in the CAPM when government bond rates are used as the proxy for $E[R_{\beta=0}]$ and when regression based betas are used. Figure 8 below compares the AER estimate to the other estimates which take account of the low beta bias.

Figure 8: Comparison of AER high estimate to other estimates including adjustment for low beta bias



Source: Grundy, AER, SFG, Bloomberg, CEG analysis

106. The average of the non-AER estimates is 10.9% – 2.4% higher than the AER estimate of 8.5% and 0.8% higher than the same estimates that do not attempt to account for low beta bias.

107. In my view, the best estimate of the cost of equity for the benchmark firm based on application of the CAPM is 10.9%, which is the average of the internally consistent and low beta-bias adjusted estimates represented in Figure 8 above. In my view, the lowest reasonable estimate of the cost of equity for the benchmark firm is 10.1% based on the average of the internally consistent estimates represented in Figure 7 above.

2.8 Fama French estimates of the cost of equity

108. In addition to the use of the CAPM, it is commonplace for academics and market practitioners to estimate the cost of equity for a company/industry using the Fama French three factor model. The Fama-French model predicts the required return on equity for the benchmark firm using the following equation:

Equation 4

$$E[R_{\mathrm{i}}] = E[R_{\beta=0}] + \beta_i \times \left(E[R_m] - E[R_{\beta=0}]\right) + s \times SMB + h \times HML$$

where $E[R_{\mathrm{i}}]$ is the required return on equity for the benchmark firm, $E\left[R_{\beta=0}\right]$ is the expected return on a zero beta asset, $E[R_m]$ is the required return on the market portfolio and β_e (beta) is an estimate of systematic/market risk of equity in the benchmark firm, SMB is the expected return to a portfolio of small market capitalisation stocks minus the expected return to a portfolio of large market capitalisation stocks, HML is the expected return to a portfolio of high book-to-market stocks minus the expected return to a portfolio of low book-to-market stocks, and s and h represent the sensitivities of expected returns to the SMB and HML factors.

109. In my view, the Fama French Model is well-accepted in economic literature and the results of the model should be considered "relevant" information for the purposes of assessing the cost of equity under the NER. In support of this contention I note that Eugene Fama, after whom the Fama French Model is named, was awarded the 2013 Nobel Prize in Economics in part for the development and empirical testing of this asset pricing model.[51]

110. SFG have estimated the cost of equity of the benchmark Australian regulated utility using the Fama French model.[52] They estimated that the cost of equity under long term average market conditions was 11.5%. Using the same values for β_i, s, SML, h and HML but updating $E[R_{\beta=0}]$ to reflect prevailing government bond rates (4.0%) and $E[R_m]$ to reflect prevailing DGM based estimates of $E[R_m]$ (11.4%) results in an estimated cost of equity of 10.9%.

These estimates (10.9% and 11.5%) are the same as and materially above my best estimate based on the CAPM models (10.9%). They are both materially above the lower end of the reasonable range based on the CAPM models (10.1%).

51 http://www.nobelprize.org/nobel_prizes/economic-sciences/laureates/2013/advanced-economicsciences2013.pdf

52 SFG (2013), Regression-based estimates of risk parameters for the benchmark firm.

2.9 Specification of an averaging period for the risk free rate

111. As already noted, the CAPM equation is as per equation 1.

$$E[R_i] = E[R_{\beta=0}] + \beta_i \cdot (E[R_m] - E[R_{\beta=0}])$$

112. The Guideline state that:

> *On the risk free rate averaging period, the AER proposes to adopt a period that:*
>
> - *is short—specifically, 20 consecutive business days in length*
> - *is as close as practicably possible to the commencement of the regulatory control period.*

113. The Guideline makes clear that it is only the first $E[R_{\beta=0}]$ in Equation 1) that is being set in this averaging period. The value of the MRP ($E[R_m] - E[R_{\beta=0}]$) is set independently of this averaging period for the risk free rate and based, primarily, on the historical average of R_m and $R_{\beta=0}$.

114. In my view this is a serious flaw in the Guideline. The assumption is that the value of ($E[R_m] - E[R_{\beta=0}]$) can be determined independently of, and prior to, the observation of the value of $E[R_{\beta=0}]$. This is simply not possible - $E[R_{\beta=0}]$ is a constituent element of ($E[R_m] - E[R_{\beta=0}]$) and the latter cannot be determined prior to the observation of one of its two constituent element. Attempting to do so creates the potential for serious error – as exemplified in the RBP averaging period discussed in Appendix A.

115. This potential for error is underscored by the fact that the AER has written to Essential Energy stating that, absent an alternative designation from Essential Energy, it intends to apply the Guideline by setting the risk free rate based on observation over 20 consecutive business days ending after the final date for submission of responses to the AER draft decision.

116. This means that the AER will not have time to invite, receive and properly digest any submissions on the value of $E[R_m]$ prevailing over the same 20 day period. The Guideline appears to anticipate that the AER's sole task will be to observe the average 10 year CGS yields in that period and simply, and mechanically, set the first $E[R_{\beta=0}]$ term in equation 1) equal to this value along with predetermined values for the MRP ($E[R_m] - E[R_{\beta=0}]$) and β_i.

117. Separately, there is a question of whether it is appropriate to attempt to estimate $E[R_{\beta=0}]$ over a short averaging period of 20 days. I do not consider that doing so

will serve to promote Rule 6.5.2 (c) of NER which defines the allowed rate of return objective (ARORO) as:

> *The allowed rate of return objective is that the rate of return for a Distribution Network Service Provider is to be commensurate with the efficient financing costs of a benchmark efficient entity with a similar degree of risk as that which applies to the Distribution Network Service Provider in respect of the provision of standard control services (the allowed rate of return objective).*

118. A benchmark efficient entity does not finance its equity over a 20 day period. The Guideline adopted a 10 year trailing average for the cost of debt but persists with the notion that equity costs should be estimated 'as if' 100% of equity is being raised over a 20 day period. This is not the case and, consequently, there is no benefit in terms of promoting the ARORO from attempting to estimate the cost of equity financing 'as if' it was the case.

119. Moreover, it actively does not serve the ARORO to specify a very narrow averaging period for $E\left[R_{\beta=0}\right]$ when this creates difficulty in estimating $E[R_m]$ in a manner that is accurate and consistent with the value of $E\left[R_{\beta=0}\right]$. For this reason, I consider that:

- If a short term averaging period is to be used then this should end in advance of the AER draft decision to ensure that robust analysis and submissions on market conditions (affecting both $E[R_m]$ and $E\left[R_{\beta=0}\right]$) can be undertaken prior to the AER final decision; or
- If historical average realised R_m/CGS yields are being used to proxy $E[R_m]$ and/or $E\left[R_{\beta=0}\right]$ then the averaging period:
  - Should be as long as possible in order to ensure a robust mean estimate is derived. This applies to the Wright approach and the historical average approach;
  - Should be the same for both estimates of $E\left[R_{\beta=0}\right]$ that enter into equation 1). The Wright approach (both $E\left[R_{\beta=0}\right]$ estimates are prevailing) and the historical average approach (both $E\left[R_{\beta=0}\right]$ estimates are historic averages) satisfy this criterion. However, estimating $(E[R_m]-E\left[R_{\beta=0}\right])$ based on historical averages but the first $E\left[R_{\beta=0}\right]$ term in Equation 1) based on prevailing rates does not satisfy this criterion.

2.9.1 AER response

120. The AER has addressed my criticism of internal inconsistency in its explanatory statement. It states:

CEG's suggestion may also have stemmed from its consideration that prevailing equity prices can provide a reliable estimate of the prevailing MRP—using DGM models for example.[499] If this were the case, it would be appropriate to use these estimates ahead of others. Equity market prices likely reflect market conditions in the same manner as the market for CGS.[500]

However, we do not agree with CEG's view. As discussed above, we do not consider DGM estimates robust enough to place sole reliance on, or even primary reliance. As a result, we estimate a prevailing MRP based on a number of different methods, including historical averages.

CEG also stated:

> *The AER also, unsurprisingly given the inconsistency in definitions, adopts inconsistent supporting logic for its definitions. The AER decision employs logic:*
>
> - *in support of why short run fluctuations in the spot rate for the 10 year CGS must be fully reflected in the risk free rate estimate in the form of recourse to the 'present value principle'; but does not apply the same logic to the determination of the MRP;*
> - *in support of why short term fluctuations in equity market conditions should not be reflected in its long-term cost of equity estimate; but does not apply the same logic to the determination of the risk free rate.*

We consider the approach in this decision is consistent with the CAPM. The 'short run fluctuations' that are reflected in the prevailing risk free rate reflect changes in market conditions and market prices. If a perfectly reliable estimate of the MRP could be generated from market prices it would be reasonable to use this estimate. However, no such estimate exists.50

2.9.2 Inappropriate framing of the task as estimating 'MRP'

121. I do not accept this as a justification for the AER rejecting my criticism. The key problem with this response is that it continues to express the problem in term of arriving at an estimate of the "MRP" as if this estimate can be divorced from the value of $E[R_{\beta=0}]$. This is, of course, not the case. When the AER refers to the "MRP" this is actually just short-hand for (as per Equation 1):

Definition of "MRP": $E[R_m] - E[R_{\beta=0}]$

122. When this is understood, the AER's position is untenable. The AER's position is that:

- $(E[R_m] - E[R_{\beta=0}])$ cannot be reliably estimated based on prevailing market conditions over the same period that $E[R_{\beta=0}]$ is estimated; and
- therefore, the AER relies on historical averages to determine $(E[R_m] - E[R_{\beta=0}])$.

123. But, purely as a matter of logic, it cannot be claimed that it is impossible to reliably measure both constituents of $(E[R_m] - E[R_{\beta=0}])$ over the averaging period – given that the averaging period is intended to measure $E[R_{\beta=0}]$. This means that the AER is actually saying that the prevailing $E[R_m]$ cannot be measured accurately over the averaging period and that recourse must be had to historical average estimates.

124. However, if this is the case then the relevant historical average is the historical average for R_m not the historical average for $(R_m - R_{\beta=0})$. If the historical average for R_m is adopted then one ends up at the (internally consistent) Wright approach to implementing equation 1).

125. Making the same point in another way, recall that the CAPM equation (Equation 1) can be expressed as follows

$$E[R_i] = \beta_i \cdot E[R_m] + E[R_{\beta=0}] \cdot (1 - \beta_i)$$

126. Expressed in this way it is clear that there is only one (unique) $E[R_{\beta=0}]$ that enters into this equation.

2.9.3 Incorrect interpretation of the finance literature on predictability of returns

127. In section D.6.5 of the Explanatory Statement the AER refers to what it describes as apparent disagreement in the finance literature as to whether returns are predictable or not. It concludes that:

> *In summary, we consider the debate about return predictability is not settled. There are reasons to be sceptical about the ability of conditioning variables or valuation models to predict excess returns. At the same time, there is support for predictability in the academic literature. The uncertainty suggests we should be hesitant about predicting excess returns.*[53]

128. This conclusion is the foundation of the AER's justification for adopting a more or less fixed estimate of $E[R_m] - E[R_{\beta=0}]$. The logic in the Explanatory Statement is that:

53 AER, Explanatory Statement, December 2013, p. 113.

- There is disagreement about whether $E[R_m]-E[R_{\beta=0}]$ can be accurately predicted/measured at a given point in time; and
- Therefore, the AER will adopt a stance that strongly anchors an estimate of $E[R_m]-E[R_{\beta=0}]$ to fixed historical averages – because adopting any other stance would involve 'predicting' $E[R_m]-E[R_{\beta=0}]$ which, as per the first dot point, (elements) of the literature suggests is not possible.

129. In reality, the overwhelming evidence in the literature is that the first dot point is not correct.[54] That is, it is possible to identify variations in the level of $E[R_m]$ which also implies that (if $R_{\beta=0}$ is proxied by observable government bond yields) it is also possible to predict variations in $(E[R_m]-E[R_{\beta=0}])$.

130. However, even if we put that fact aside and interpret the literature as strongly suggesting that it is not possible to predict $(E[R_m]-E[R_{\beta=0}])$, the second dot point simply does not follow. If the first dot point is true then the reason it is true must be because $E[R_m]$ cannot be predicted. That is, given $R_{\beta=0}$ is known/observable,[55] the only reason that $(E[R_m]-E[R_{\beta=0}])$ could not be predicted would be because $E[R_m]$ could not be predicted.

131. Therefore, the first dot point, suggests, if anything, that the AER should be hesitant about attempting to predict variations in $E[R_m]$ (at least, no less hesitant that trying to predict $(E[R_m]-E[R_{\beta=0}])$. However, by adopting a more or less fixed value for $(E[R_m]-E[R_{\beta=0}])$ the AER is doing precisely this. Specifically, the AER is predicting that $E[R_m]$ will vary one for one with $E[R_{\beta=0}]$. The AER is adopting a methodology that predicts variation in $E[R_m]$ and is justifying doing so on the basis that elements of the literature suggests that it is not possible to predict $E[R_m]$.

132. As previously noted in Hird and Grundy (2013):

> *If one is relying on the literature that says E[MRP] and E[Rm] are not sufficiently predictable to justify adopting an invariant estimate there is simply no basis to make that invariant estimate E[MRP] and not E[Rm].*[56]

133. Put simply, the predictability literature, even if read in the way the AER does, provides no basis to support its position in the Guidelines.

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54 Hird and Grundy, CEG, Estimating the return on the market, a report for the ENA, June 2013.

55 Assuming government bond yields are used as the proxy for $R_{\beta=0}$.

56 Hird and Grundy, CEG, Estimating the return on the market, a report for the ENA, June 2013. P.25

3 Estimates of the cost of debt

134. I have separately provided advice to the effect that immediate adoption of a trailing average cost of debt is appropriate for firms that already finance themselves consistent with this benchmark.[57] In this section I propose an estimate of the 10 year trailing average cost of debt ending in December 2013.

3.1 Choice of third party estimate

135. There are currently two sources of potential third party fair value estimates of the cost of debt for BBB rated corporates that also go back historically in the order of 10 years. These are yield curves published by Bloomberg and the RBA. Bloomberg publishes a BBB fair value (BFV) yield curve going back 10 years but not always at the 10 year maturity. The RBA publishes a yield for a 'target maturity' of 10 years going back 9 years from December 2013. Bloomberg has recently introduced an alternative methodology for estimating BBB yields (its BVAL yield curves) but these have only been backdated to mid-2010. Bloomberg has, in May 2014, also ceased to publish its BFV curve in favour of its BVAL curve.

136. Historically there also exists the potential to have regard to fair value curves published by CBASpectrum. The CBASpectrum curve is not currently available, having been discontinued in mid-2010. However, CBASpectrum estimates are a useful reference point against which to compare the behaviour of the other curves.

137. Figure 9 below shows a time series for each of these curves.[58]

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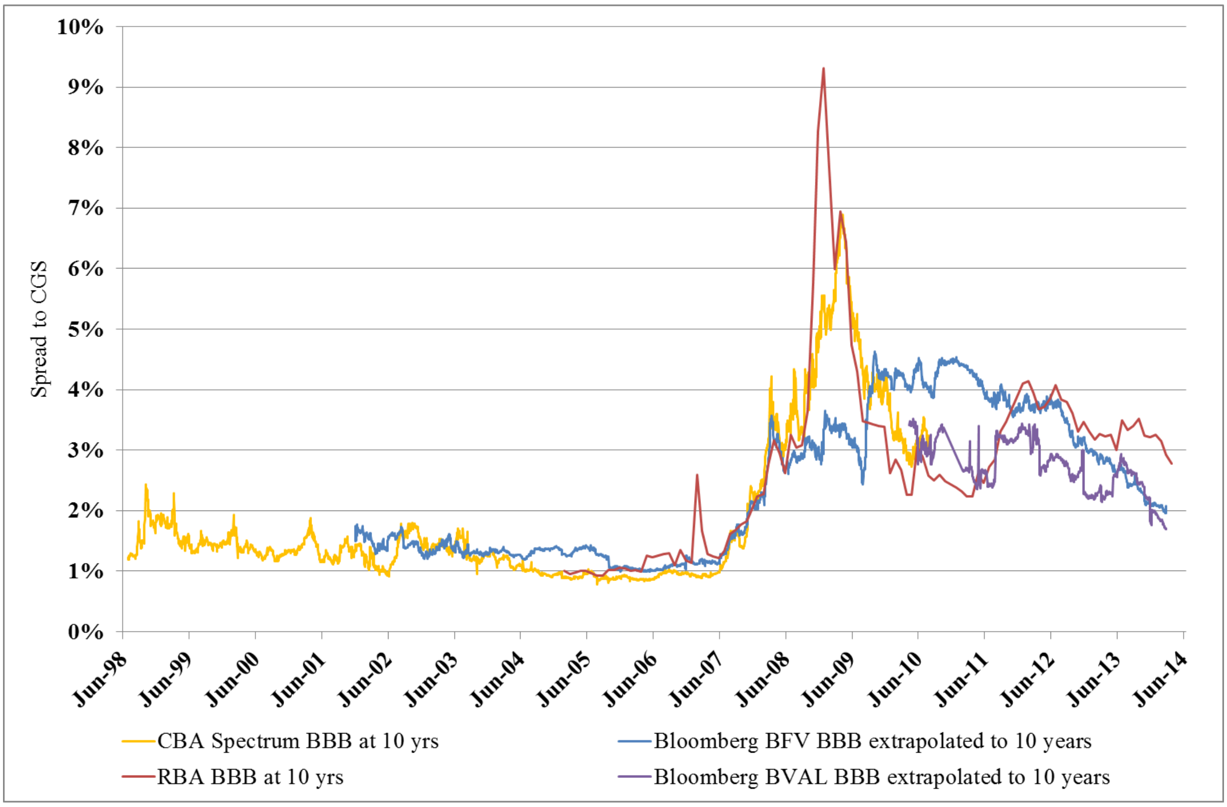
57 Hird, *Debt transition consistent with the NER and NEL*, May 2014

58 The Bloomberg BBB fair value estimate shown in the chart is, where necessary, extrapolated to 10 years as follows: until 22 June 2010, the BBB curve is extrapolated to 10 years based on the slope of the fair value curve closest to BBB in rating (ie, A, AA and AAA in order of preference); between 23 June 2010 and 31 October 2013, the BBB curve is extrapolated from 7 years to 10 years assuming an increase in DRP calculated as the average increase in DRP between 7 and 10 years for the Bloomberg AAA fair value curve over the 20 days to 22 June 2010; and since 1 November 2013, the BBB curve is extrapolated from 7 years to 10 years assuming no increase in DRP.

Figure 9: RBA, CBASpectrum and Bloomberg



Source: RBA, Bloomberg, CBASpectrum and CEG analysis

138. It is possible to make some observations about the performance of each of these curves by asking whether it has behaved:

- as one would expect over the last decade; and
- in a manner consistent with the other estimates of the cost of BBB debt.

139. Over the last decade we have had two periods of what can reasonably be referred to a 'financial crisis' the first relates to the period of late 2008 and early 2009 the intensity of which was at its peak following the bankruptcy of Lehman Brothers in September 2008 and the subsequent nadir of global stock markets in March 2009. The second distinct period of financial crisis relates to the period of heightened perceived risk of European sovereign government default and potential exit from the Euro currency area. This period dates from late 2011 to late 2012 and had its epicentre in June/July of 2012 – a period described by the RBA Governor Glen Stevens as follows:

> *But, as we said at the last hearing, sorting out the problems in the euro area is likely to be a long, slow process, with occasional setbacks and periodic bouts of heightened anxiety. We saw one such bout of anxiety in the middle of this year, when financial markets displayed increasing nervousness about*

> *the finances of the Spanish banking system and the Spanish sovereign. The general increase in risk aversion saw yields on bonds issued by some European sovereigns spike higher, while those for Germany, the UK and the US declined to record lows. This 'flight to safety' also saw market yields on Australian government debt decline to the lowest levels since Federation.*[59]

140. The RBA BBB curve has responded to each of these crises in the manner expected – increasing substantially. In doing so it has followed more or less the pattern of the CBASpectrum fair value estimate where both were published concurrently (although the RBA series peaked in December 2008 earlier and higher than the CBASpectrum series).

141. The RBA curve also behaved in a manner consistent with that of the Bloomberg and CBASpectrum curves prior to late 2008.[60] Subsequent to the financial crisis of 2008/09 the RBA and CBASpectrum estimates fall as expected. The CBASpectrum curve was discontinued in mid-2010, but the RBA curve does respond to the European sovereign debt crisis in the expected manner – rising materially in late 2011 and the first half of 2012 before falling again.

142. By contrast, the spread implied by the Bloomberg fair value (BFV) curve, having failed to rise in the 2008/09 crisis, finally does rise when that crisis is past its worst and when the other curves are falling. The BFV spread reaches levels of around 4.5% in late 2010 and then falls modestly during the lead up to the European debt crisis but fails to rise at all in response to that crisis.

143. The Bloomberg BVAL curve was only introduced in 2013 and has since been extended backwards in time by Bloomberg to mid-2010. As such, it does not extend include the 2008/09 crisis. The BVAL curve is the most erratic of the three curves published over the same time period – with large single day changes in estimated yields. For example, from 1 August 2011 to 3 August 2011 the extrapolated[61] BVAL spread rose from 2.47% to 3.18%.

144. The extrapolated BVAL curve reached a peak of 3.44% in December 2011 and then fell materially to an average of 2.98% in June/July 2012. This is the same period RBA Governor Glen Stevens refers to in the above quote and the period I examine in

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59 Reserve Bank of Australia (RBA) Governor (Glenn Stevens) statement to the House of Representatives Standing Committee on Economics (24thof August 2012).

60 In January 2007 the RBA spread to CGS rose dramatically (to around 2.5%) then fell dramatically the following month and this was not consistent with the Bloomberg or the CBASpectrum curve. It appears likely that this was the result of the temporary existence of a high yielding 8+ year maturity bond in the RBA dataset in that month. The 7 and 10 year spreads show the same magnitude jump but not the 5 year or 3 year spread. The number of bonds in the 8-12 maturity range jumps from 1 to 3 in January 2007 and then drops to 2 in February 2007. There is only 1 bond in the 6 to 8 year maturity in January 2007.

61 I have extrapolated the BVAL curve from 7 to 10 years in the same manner as the BFV curve.

more detail in Appendix – demonstrating heightened risk premiums in that month by reference to a number of other indicators. The behaviour of the BVAL curve is inconsistent with expectations of how the risk premium on BBB debt would have behaved over 2012. Specifically, I would have expected any measured BBB risk premium to rise from December 2011 to June/July 2012 – not fall.[62]

145. The RBA makes similar observations:

> *The Bloomberg Australian dollar fair value curve appears to be overly smooth between early 2009 and late 2010. These measures did not increase as much as could be expected in early 2009, given that the global financial crisis was at its most severe at that time, and as was observed in other measures of Australian and foreign corporate bond spreads. Moreover, the Bloomberg spread measures remained elevated for an extended period of time between early 2009 and 2010, while credit spreads globally declined sharply following the introduction of extraordinary policy measures; this was especially true of BBB-rated bond spreads.*[63]

146. The RBA also compares its BBB estimates with the Bloomberg US BBB BFV curve and find that the US Bloomberg curve is more similar to the Australian RBA curve than to the Australian Bloomberg curve.

147. On the above basis I consider that the RBA fair value curve is the best third party source that can be relied on to estimate a cost of 10 year BBB debt over the 10 years to December 2013.

148. Finally, it is worth noting that even though the RBA and BFV estimates differ materially through much of 2008 to 2013 these differences tend to cancel each other out – with the RBA estimates being higher in some periods and the Bloomberg estimates higher in other periods. The net difference over the period January 2005 to December 2013 is only 8 basis points (0.08%). (I note that the same comparison is not available for the BVAL curve because of its limited history.)

[62] It is unclear to what extent Bloomberg regards its backdating of this curve should be relied on (i.e., whether backdated yields are as reliable as yields published on dates after the first date the BVAL curve was regularly published).

[63] RBA, New Measures Of Australian Corporate Credit Spreads, p.24

3.2 Methodology

149. The RBA methodology is well documented and transparent, and the results are publicly available online.[64] The RBA publishes yield estimates for BBB and A rated debt at maturities of 3, 5, 7 and 10 years at the end of each month.

150. The RBA's methodology estimates a yield at a particular maturity based on a weighted average of yields on a sample of bonds. The yield of each bond is weighted by the product of:

- the face value of the bond, such that larger bond issues receive greater weight in the assessment of the benchmark spread or yield; and
- the relative closeness of the bond to the target maturity. This second weighting is achieved by estimating a 'Gaussian kernel', or essentially a normal probability density function, centred on the target maturity. The weight given to each bond is a positive function of the height of the density function at that bond's maturity.

151. In order to be included in the RBA's sample of bonds used to estimate yields on BBB debt, bonds need to:[65]

- be rated BBB-, BBB or BBB+ (a "broad" BBB credit rating) by Standard & Poor's, or if unrated have an issuer credit rating with Standard & Poor's in that band;
- be a fixed rate bond;
- be issued in Australia by an Australian company in either Australian dollars, United States dollars or in Euros (with foreign currency bonds converted into equivalent Australian dollar yields);
- have raised more than $A100 million or its equivalent in foreign currency terms at the time of issue;
- have a residual term to maturity of at least one year; and
- not have any duplicate bond issues in the sample.

152. By contrast, the Bloomberg AUD BBB corporate curve relies solely on bonds issued in Australian dollars. Bloomberg's estimates are proprietary and, consequently, its sample selection criteria and methodology is not transparent. Bloomberg states that its fair value curves are constructed using a proprietary optimisation model.

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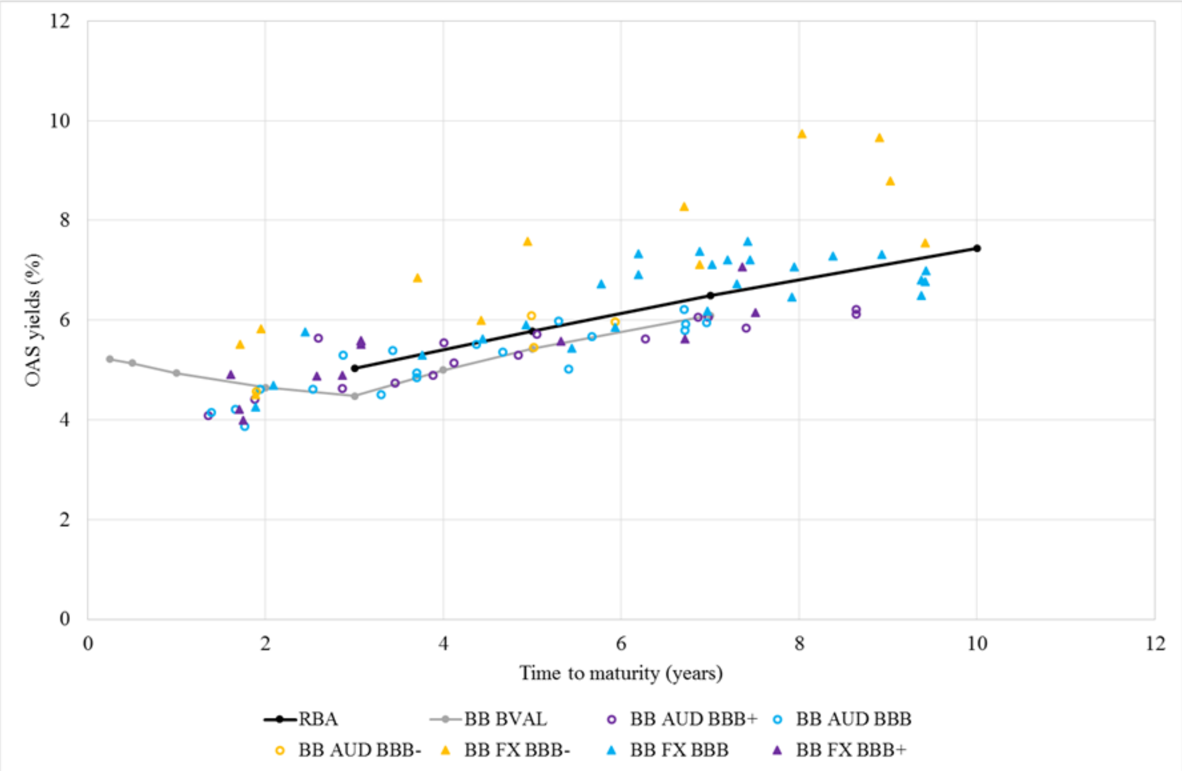
64 See New Measures of Australian Corporate Credit Spreads, RBA Bulletin, December 2013, available at http://www.rba.gov.au/publications/bulletin/2013/dec/pdf/bu-1213-3.pdf for a description of the RBA's methodology and http://www.rba.gov.au/statistics/tables/xls/f03hist.xls for its results.

65 RBA, *New Measures of Australian Corporate Credit Spreads*, December 2013.

Bloomberg publishes its yield estimates at 3 months, 6 months, 1 to 5 years and 7 years on a continuous basis.

153. Figure 10 shows the bonds which meet the RBA selection criteria over the 20 day period from 22 October to 18 November 2013, together with the RBA curve and the Bloomberg BVAL curve. It is clear from this figure that the Bloomberg BVAL curve tends to pass below most of the long dated observations during the relevant 20 day averaging period.

Figure 10: RBA and Bloomberg methodology



Source: Bloomberg, RBA, CEG analysis. RBA values are interpolated.

3.3 Credit rating

154. The AER guidelines sets a BBB+ benchmark credit rating based on the median credit rating for a sample of regulated utilities over the period 2002 to 2012.[66] The AER does not provide the basis for its calculation. However, I have replicated it and arrive at the same result for 2002 to 2012 (first estimating the median credit rating in each year and then taking the median of these annual median credit ratings). However, there has been a sustained drop in median credit ratings for the AER

66 See page 156 of the Explanatory Statement

sample from A- in 2002 to BBB since 2009. This is illustrated in the below table (see Appendix B for more detail).

Table 8: Median credit rating for AER sample by year

2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
A-	BBB+	BBB+	BBB+	BBB+	BBB+	BBB+/A-	BBB	BBB	BBB	BBB	BBB

Source: Bloomberg, CEG analysis

155. I note that the median credit rating over all observations covering the 10 year period from 2004 (i.e., 10 years prior to 2013) is BBB not BBB+ (as described in Appendix B).

156. In order to provide an illustration of the impact of choosing different benchmark credit ratings at different times in the past over the last 10 years I have estimated a time series of the cost of debt for each credit rating using different weightings to the RBA BBB and A fair value estimates.

157. In order to do this I have assumed a linear relationship between yields and credit ratings – such that a benchmark BBB rated bond has a yield that is above the benchmark A rated bond by three times as much as an A- bond and 1.5 times as much as the BBB+ rated bond. This allows A- and BBB+ credit ratings to be derived from the A and BBB published yield estimates as follows in Table 9.

Table 9: Median credit rating for AER sample by year

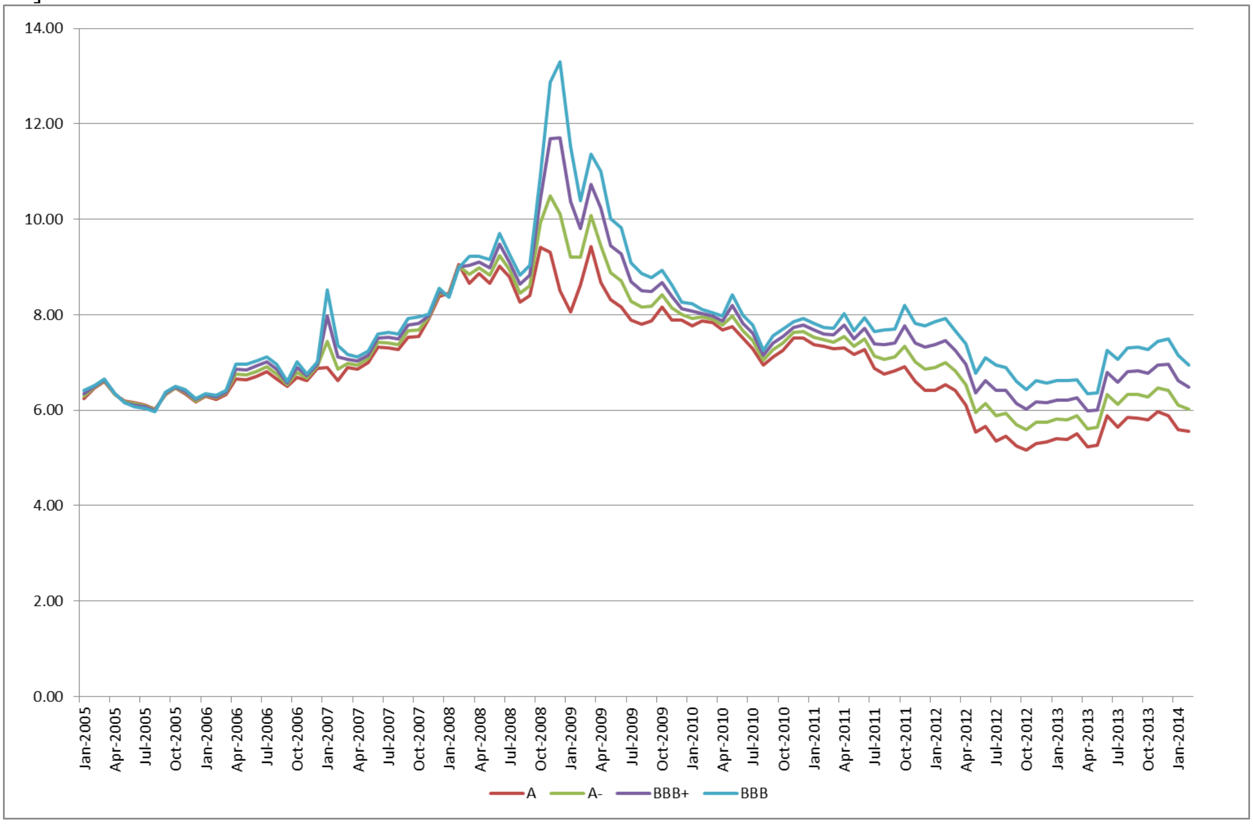
Target credit rating	Weight to A curve	Weight to BBB curve
A	1.00	0.00
A-	0.67	0.33
BBB+	0.33	0.67
BBB	0.00	1.00

Source: Bloomberg, CEG analysis

158. When the weighting scheme in Table 9 is applied the time series in Figure 11 is derived.

Figure 11: Time series of RBA cost of debt by credit rating

N]



Source: RBA, CEG analysis

159. It can be seen that varying the benchmark credit rating in the years 2008 and earlier will not have a material impact on estimated average yield. It is only really in 2009 and 2011 onwards that there is a significant departure between the different credit ratings. Cross comparison to Table 8 shows that over this entire period the median credit rating is BBB. Consequently, adopting a single benchmark credit rating of BBB throughout the period will give a similar estimate to adopting a BBB+ benchmark prior to 2009 and a BBB benchmark from 2009 onwards. This is illustrated in Table 10 below.

Table 10: Impact of credit rating on 10 year trailing average cost of debt at December 2013

Credit rating assumptions	Cost of debt
BBB throughout the entire period	8.06%
BBB+ up to 2008, BBB thereafter	7.98%

Source: RBA, Bloomberg, CEG analysis

3.4 Sourcing an estimate for 2004

160. The RBA only publishes estimates of the cost of A and BBB rated debt from January 2005 onwards. This means that, if the most recent averaging period was to end in December 2013 and sole reliance was to be placed on the RBA data it would be necessary to arrive at a 10 year trailing average estimate based on data from only 9 years. This could conceivably be achieved in a number of ways.[67] However, each of these approaches requires some arbitrary weighting of the existing data. The only way to avoid this is to extend the cost of debt estimate back to 2004 and give each calendar year 10% weight.

161. Including 2004 data requires a choice between adopting CBASpectrum or Bloomberg fair value curves in this period. In May 2005, using data from 2003/04, Professor Grundy and I published a report which examined the relative accuracy and Bloomberg and AER fair value curves.[68] We concluded that the the CBASpectrum estimation technique had a built in downward 'bias' that was especially strong for long-dated maturities of around 10 years.[69] This advice was subsequently accepted by regulators, including the ACCC/AER, and Bloomberg fair value curves were used in regulatory decisions in preference to CBASpectrum fair value curves.[70]

162. In light of this analysis and precedent, I have sourced the estimates for 2004 from Bloomberg and have calculated a BBB+ figure from the BBB and A fair value curves applying the same weighting scheme as described above. I note that 2004 is the least important year in the trailing average because it drops out of the trailing average after the first year and, in that year, is only given a 10% weight. This means that it only has a 2.0% weight over the 5 year regulatory period.

163. Throughout 2004 Bloomberg published a 10 year cost of debt for the A credit rating. Bloomberg also published a 10 year BBB cost of debt on 80% of the trading days in 2004 and a 9 year BBB cost of debt for the BBB cost of debt on the remaining days. On the small number of dates that 10 year estimates were not available I have used 9 year estimates.

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67 For example, by dividing the nine existing years of data into 10 periods of approximately 11 months each or be specifying, say, the most recent 8 calendar years as 8 different averaging periods and specifying the first and second half of calendar 2005 as averaging periods.

68 Hird and Grundy, *Critique of available estimates of the credit spread on corporate bonds*, 2005.

69 Ibid, Hird and Grundy 2005, page 5.

70 See, for example, Economic Regulation Authority, Proposed Revisions to the Access Arrangement for the Mid-West and South-West Gas Distribution Systems, Final Decision, 12 July 2005; Australian Energy Regulator, Directlink Joint Venturers' Application for Conversion and Revenue Cap, Decision, 3 March 2006; Australian Energy Regulator. Powerlink Queensland transmission network revenue cap 2007-08 to 201 1-12, Decision, 8 December 2006.

3.5 Extrapolating to 10 years

164. The RBA BBB 10 year spread to swap is estimated by taking a weighted average of the spreads on its full sample of BBB bonds. However, the weights used are highest for bonds close to 10 years and lower for bonds with maturities further away from 10 years. The weighting methodology employed by the RBA is a 'Gaussian kernel' where the weights applied to each bond essentially fall in line with a 'normal' probability density function centred on 10 years.

165. However, the weighted average maturity of the resulting estimate will not be equal to 10 years unless there are as many bonds in the RBA sample above 10 years as there are below 10 years. In practice, this is generally not the case because the passage of time means all bonds, even if issued with a maturity of more than 10 years, eventually have a maturity that is less than 10 years but the opposite is not true (bonds issued with maturity of less than 10 years never have a remaining maturity of more than 10 years).

166. Presumably in order to allow researchers to take account of this fact, the RBA publishes both the 'target tenor' and the 'effective tenor' of each of its estimates. The 'target tenor' is the maturity at which the Gaussian kernel is centred and the 'effective tenor' is the resulting weighted average maturity of the bonds in the sample using the weights derived from the Gaussian kernel.

167. The average effective maturity of the 10 year 'target tenor' estimates from 2005 to 2013 is 8.7 years for the BBB estimates (and 8.9 years for A estimates). This means that, on average, the 10 year 'target tenor' estimate published by the RBA reflects the yield on bonds with an average maturity of slightly under 10 years.

168. I have adjusted for this by re-expressing the RBA curve based on effective tenor (rather than target tenor) and then extrapolating out to 10 years using the slope of the reported curve. This has a relatively minor impact on the trailing average (raising it around 18 – 21 bp).

169. The extrapolation process is relatively simple and can be mechanically implemented. The process used is illustrated below

- Let the published yield for a target tenor of 10/7 years be A%/B%;
- Let the associated effective tenors be "a" and "b" years.
- The implied slope of the yield curve is (A%-B%)/(a yrs-b yrs).
- Consequently, the extrapolated cost of debt to an effective tenor of 10 years = A%+(A%-B%)/(a yrs-b yrs)*(10yrs- a yrs).

170. For example, if A=9% and B=8% and a=9 years and b=6 years then the extrapolated cost of debt to 10 years effective tenor would be 9.33%=9+(9-1)/(9-6)*(10-9).

Table 11: Extrapolated vs not extrapolated 10 year trailing average to December 2013.

Credit rating assumptions	Cost of debt (not extrapolated)	Cost of debt (extrapolated)
BBB throughout the entire period	7.85%	8.06%
BBB+ up to 2008, BBB thereafter	7.80%	7.98%

Source: RBA, Bloomberg, CEG analysis.

171. The average slope of extrapolation is 13.3 bppa for the BBB curve throughout the period, and 11.9 bppa if the BBB+ benchmark is used up to 2008. This is broadly consistent with regulatory precedent. In its most recent final decision, for SP AusNet, the AER extrapolated the Bloomberg fair value curve from 7 year to 10 years with an increase in spreads to CGS of 34.6 basis points. This is 11.5 basis points per annum –close to the average RBA extrapolation described above.

172. The RBA fair value curve is calculated as the weighted average of a relatively small number of bonds, particularly at long maturities. This means that variance in the composition of these bonds over time is likely to cause variation in the slope of the RBA's fair value curve over time (and hence extrapolation using the method I have used). However, there is no basis to expect that the slope of the RBA fair value curve is deterministically biased upward or downward – such that averaged over 10 years these are likely to be relatively stable and accurate.

4 Gamma

173. The AER Guideline has proposed a value of imputation credits (gamma) parameter of 0.5 based on a payout ratio of 0.7 and a value of distributed imputation credits (theta) of 0.7. By contrast, in our view the best estimate of the value of gamma is 0.25 based on a payout ratio 0.7 (consistent with the AER Guideline) and a theta value of 0.35 (half the AER Guideline estimate).

174. The point of difference between our estimate and that of the AER relates to the estimate of theta. This difference arises fundamentally because the AER believes that the value of imputation credits distributed can be estimated using accounting techniques – in essence asking what proportion of imputation credits are 'used' in Australian resident tax returns to offset personal income tax assessments. By contrast, we consider that the value of imputation credits must be estimated using economic techniques – in essence asking what value (price) does the market as a whole place on imputation credits when they are distributed.

175. In our view, the market value of imputation credits is the only valuation that is consistent with arriving at an estimate of efficient financing costs. This follows from the fact that businesses must compete in the market for equity funding. The way they do this is by promising investors a combination of cash dividends and imputation credits in return for the investors providing equity funding.

176. The level of cash dividends that must be provided depends on the market value of imputation credits. If the market places a low value on imputation credits then, other things equal, higher cash dividends must be promised in order to attract equity funding. Similarly, if the market places a high value on imputation credits, then other things equal, lower cash dividends must be promised in order to attract equity funding. This is true irrespective of the rate at which resident taxpayers "use" imputation credits (noting that resident taxpayers are only a fraction of the total market providing equity funding to Australian businesses).

177. Once it is accepted that businesses must pay the market rate for equity funding it follows inexorably that the correct value to place on imputation credits when estimating the cost of equity funding is the market value. Any other basis for arriving at value for imputation credits would not be consistent with estimating the efficient financing costs of a benchmark efficient entity as required under the National Electricity Rules allowed rate of return objective. Similarly, it would risk not providing a reasonable opportunity for a regulated business to recover at least its efficient costs as required under the revenue and pricing principles of the National Electricity Law.

COMPETITION ECONOMISTS GROUP

178. The question of the market value of imputation credits has been the subject of Australian Competition Tribunal review.[71] In that case the value of imputation credits was set at 0.35 based on dividend drop off studies. As noted by the ENA the basis for this finding remains unchanged[72]:

Dividend drop-off analysis can be used to estimate the value of distributed credits by observing the stock price change around the ex-dividend date, when the dividend and associated imputation credit separate from the share.

In the Gamma Case, the Tribunal directed that SFG should be retained to perform a "state of the art" dividend drop-off study. That study ultimately concluded that the appropriate estimate of theta was 0.35, paired with an estimate of the value of cash dividends of 0.85 to 0.90.

The Tribunal strongly endorsed the estimates from the SFG state-of-the-art study:

> *In respect of the model specification and estimation procedure, the Tribunal is persuaded by SFG's reasoning in reaching its conclusions. Indeed, the careful scrutiny to which SFG's report has been subjected, and SFG's comprehensive response, gives the Tribunal confidence in those conclusions.* [73]

The Tribunal went on to conclude that:

> *The Tribunal is satisfied that SFG's March 2011 report is the best dividend drop-off study currently available for the purpose of estimating gamma in terms of the Rules.* [74]

and

> *The Tribunal finds itself in a position where it has one estimate of theta before it (the SFG's March 2011 report value of 0.35) in which it has confidence, given the dividend drop-off methodology. No other dividend drop-off study estimate has any claims to be given weight vis-à-vis the SFG report value.* [75]

71 Application by Energex Limited (Gamma) (No 5) [2011] ACompT 9 (12 May 2011)

72 ENA, Response to the AER Consultation Paper, June 2013, pp 86-87.

73 Application by Energex Limited (Gamma) (No 5) [2011] ACompT 9 (12 May 2011), Paragraph 22.

74 Ibid, Paragraph 29.

75 Ibid, Paragraph 38.

> *The ENA has retained SFG to update the dividend drop-off study that was prepared for the Tribunal. SFG (2013a)*[76] *uses the same econometric specifications, estimation methods and data sources as in the study prepared for the Tribunal. The updated study also includes a wide range of sensitivity analyses, robustness checks and stability analyses. SFG concludes that:*
>
> > *In our view, the conclusions from our earlier study remain valid when tested against the updated data set.*[77]

179. SFG has since provided a separate report that reaches the same conclusions as I have noted above regarding the conceptual definition of 'theta'. SFG also note that this interpretation is shared by other experts including the AER's own advisers.[78]

180. I consider, based on the above, that the best estimate of the value of gamma is 0.25.

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76 SFG Consulting, 2013, Updated dividend drop-off estimate of theta, Report prepared for the Energy Networks Association, 7 June.

77 SFG (2013a), p. 27.

78 SFG, An appropriate regulatory estimate of gamma, May 2014.

Appendix A Case study of internal inconsistency

181. Market conditions influencing spot Australian government bond (Commonwealth government securities or CGS) yields at any given time will also be influencing spot E[Rm] and, therefore, the spot E[MRP] estimate (which is simply the difference between these two if CGS yields are used as the proxy for the zero beta rate in the CAPM). Moreover, there will be times when market conditions are such that very low spot CGS yields are associated with a normal (or even a heightened) spot expected return on the market E[MRP] – such that the spot E[MRP] estimate is heightened relative to average conditions.

182. In this appendix I address a specific set of market circumstances that provides a near perfect illustration of the problems with the AER's current methodology for setting the cost of equity. On the 24th of August 2012 the RBA Governor (Glenn Stevens) made a statement to the House of Representatives Standing Committee on Economics that included the following statement:

> *But, as we said at the last hearing, sorting out the problems in the euro area is likely to be a long, slow process, with occasional setbacks and* ***periodic bouts of heightened anxiety****. We saw* ***one such bout of anxiety*** *in the middle of this year, when financial markets displayed increasing nervousness about the finances of the Spanish banking system and the Spanish sovereign. The* ***general increase in risk aversion*** *saw yields on bonds issued by some European sovereigns spike higher, while those for Germany, the UK and the US* ***declined to record lows****. This* ***'flight to safety'*** *also saw market yields on Australian government debt decline to the* ***lowest levels since Federation****.* [Emphasis added]

183. As it happens, the Roma to Brisbane Pipeline (RBP), regulated by the AER, had its averaging period during the period described by RBA Governor Glenn Stevens as a 'flight to quality'. The RBP averaging period started on the 25 June 2012 and ended on 20 July 2012. The RBP decision's averaging period occurred over the particular time interval to which Governor Stevens was referring in his remarks:

> *This 'flight to safety' also saw market yields on Australian government debt decline to the lowest levels since Federation.*

184. Notwithstanding that the fall in CGS yields was a direct corollary of "*heightened anxiety*", an "*increase in risk aversion*", and a "*flight to safety*", the AER passed the full amount of this fall in CGS into an assumed lower cost of equity for RBP.

185. This is not the first time that I have written a report drawing the AER's attention to the averaging period and have attempted to explain why it is an exemplar of the

problems I have identified. In a report for the Victorian gas businesses[79] I made precisely the above observations.

186. I also drew the AER's attention to other contemporaneous market evidence suggesting that risk premiums during the RBP averaging period were unusually high.

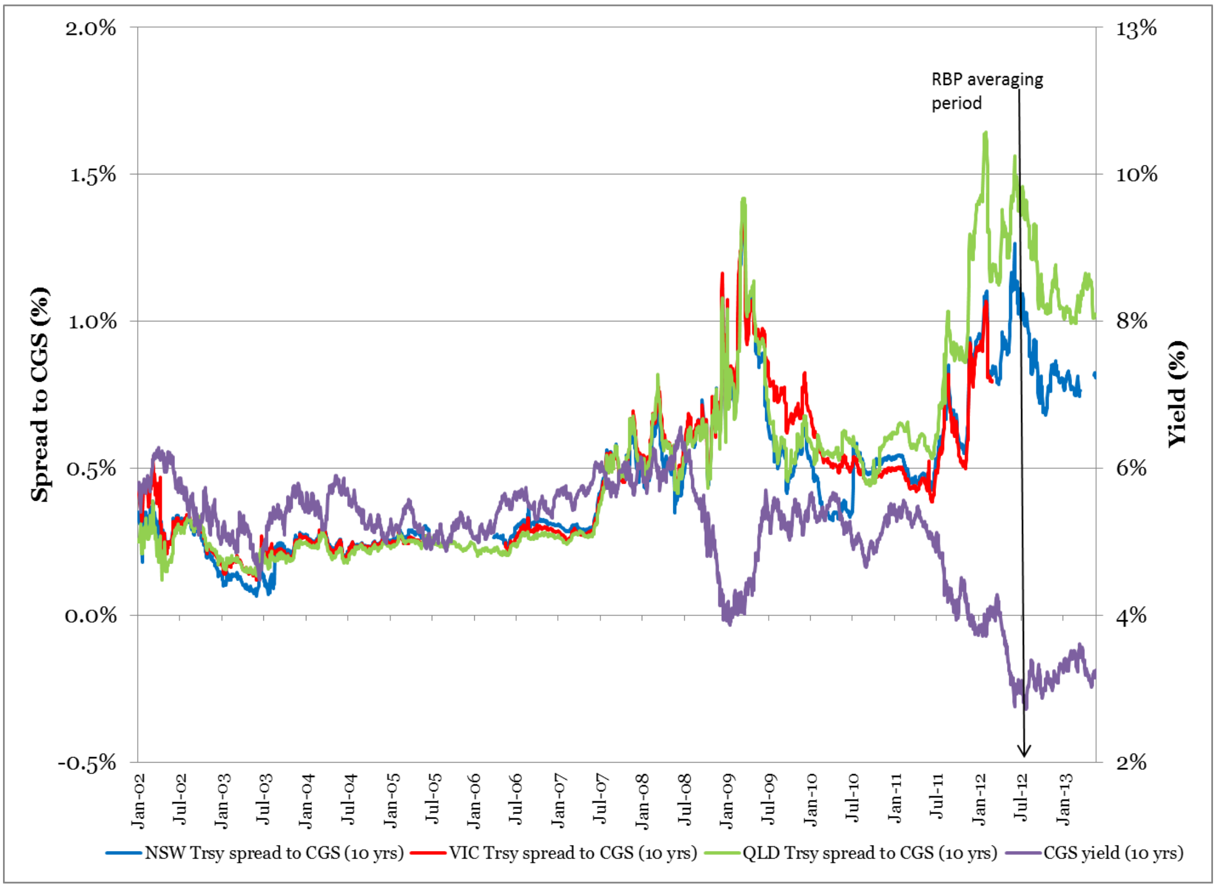
A.1 Required returns on low risk assets and the RBP averaging period

187. The following three figures illustrate spreads between CGS yields and the yields on other very low risk assets. These figures show that required returns on these very safe assets *did not* fall one-for-one with CGS yields during the RBP averaging period. This finding is in contrast to the AER's assumption that required returns on equity in regulated business *did* fall one-for-one with falls in CGS yields.

188. Figure 12 shows that the required return on state government debt (rated AAA for NSW and Victoria and rated AA+ for Queensland) has increased materially relative to the required return on CGS since mid-2011. As a result, the difference in these returns (the "spread") has increased materially. Moreover, this spread was at levels not seen since the midst of the 2008/09 financial crisis during the RBP averaging period. This figure provides ample evidence to the effect that required returns on low risk assets have not fallen in line with required returns on CGS.

79 Response to AER Vic gas draft decisions, Internal Consistency of MRP and Risk-Free Rate, prepared by Competition Economists Group, November 2012.

Figure 12: Spread between 10 year state government debt and 10 year CGS



Source: Bloomberg, CEG analysis.

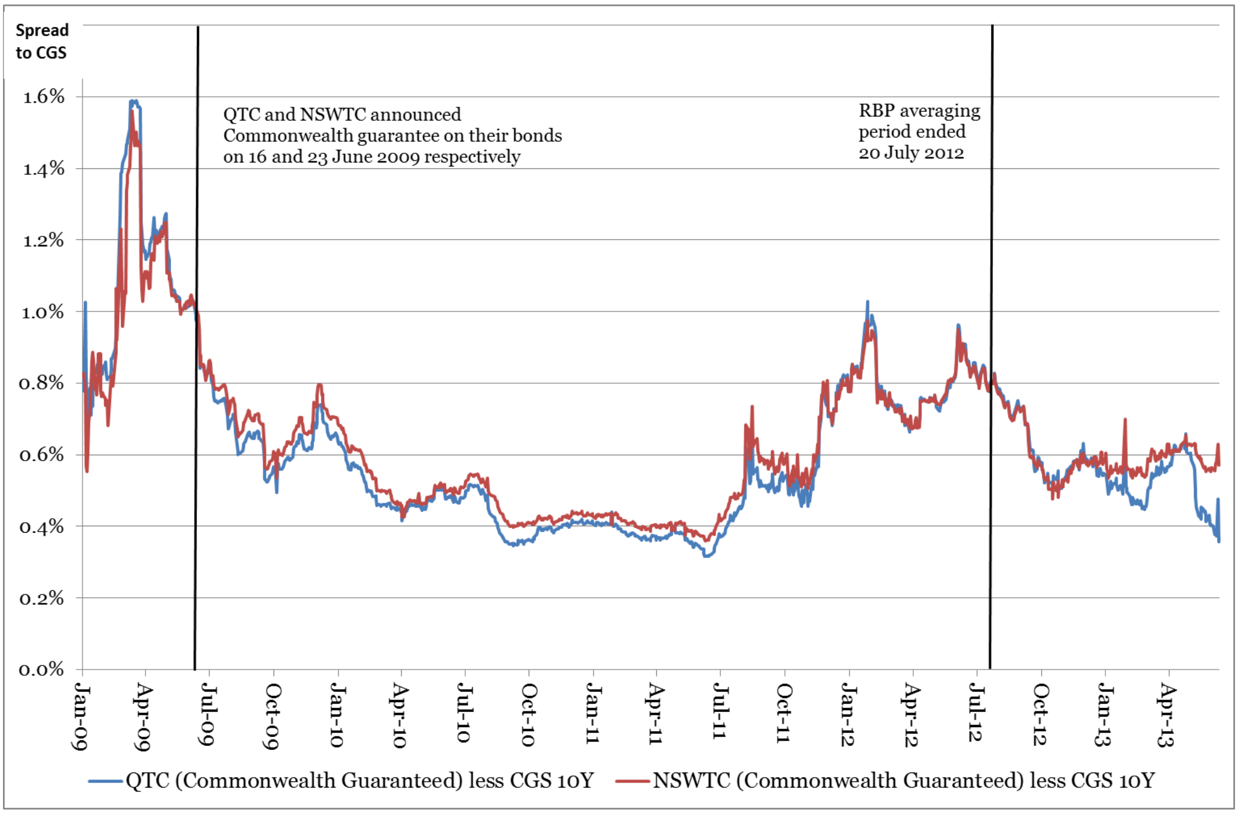
189. This is strong evidence that the forces driving down required yields on CGS are not driving down required yields on all other asset classes to the same extent. Put simply, if heightened demand for safe/liquid assets is causing risk premiums relative to CGS for the next most safe/liquid assets to rise by 70 bp (and in so doing trebling in magnitude), then risk premiums relative to CGS for the much riskier and much less liquid equity market must be rising by many multiples of this.

190. As a further illustration of this, I note that there are a number of state government bonds that are directly guaranteed by the Commonwealth Government.[80] Thus, they have an identical default risk to CGS. Despite this, even these bonds have traded at a heightened spread to CGS – presumably because they are perceived as less liquid than CGS or because international investors (who now account for nearly

80 These bonds include a Queensland Government bond maturing in 2021, and a NSW Government bond maturing 01/05/2023. These are the longest dated Commonwealth Guaranteed state government debt on issue.

80% of all CGS holdings, and for whom the share of overall holdings has increased steadily from around 30% in 2000)[81] have mandates that prevent them from owning debt other than that of a sovereign government. These spreads to CGS were at very high levels in the RBP averaging period. In other words, even the yields on Commonwealth Government guaranteed state government bonds did not fall one-for-one with CGS during the market circumstances surrounding the RBP averaging period. It is therefore preposterous to argue that the best estimate is that required returns on the equity market ($E[R_m]$) did so.

Figure 13: QTC and T-Corp Commonwealth guaranteed bonds



Source: Bloomberg, CEG analysis. QTC bond matures on 06/14/2021, NSWTC bond matures on 05/01/2023.

191. Another very low risk financial asset is an interest rate swap. Before 2008, these traded at a spread of around 40 bp or so – see Figure 14 below. The spread spiked in 2008/09 and then returned to levels above, but much closer to, pre GFC levels. Then, over 2011 and the first half of 2012, spreads to CGS rose to a new post 2008/09 spike – with its peak just before the RBP averaging period. This

81 See graph 4.3 from the RBA November 2012 Statement on Monetary Policy.

demonstrates, once more, that required returns on swap contracts did not fall one-for-one with the falls in CGS yields in the lead up to the RBP averaging period.

Figure 14: Spread between 10 year swaps and CGS

Source: Bloomberg and CEG analysis

A.2 Required returns on higher risk assets and the RBP averaging period

192. The dividend yield on listed equities can also be used to arrive at a direct estimate of the prevailing cost of equity using a simple dividend growth model. In what follows I use the method used by AMP Capital Investors. Prior to the GFC, this methodology was relied on by the AER in support of a position that the then MRP of 6.0% was generous:[82]

[82] AER, Explanatory Statement, *Electricity transmission and distribution network service providers Review of the weighted average cost of capital (WACC) parameters,* December 2008, p. 173

> *A more recent estimate is from AMP Capital Investors (2006), who base the growth rate on the expected long-run GDP growth rate, similar to Davis (1998). AMP Capital Investors (2006) estimate the forward looking Australian MRP for the next 5-10 years to be 'around 3.5 per cent' (specifically 3.8 per cent), 1.9 per cent for the US and 2.4 per cent for the 'world'. AMP Capital Investors (2006) considers an extra 1 to 1.5 per cent could be added for imputation credits resulting in a 'grossed-up' Australian MRP of around 4.5 to 5.0 per cent.*

193. The AMP methodology involves approximating a cost of equity by adding the long term average real growth in GDP (as a proxy for long term average nominal growth in dividends) to the prevailing dividend yield for the market as a whole. This gives a 'cash' cost of equity. To convert this into a cost of equity including the value of imputation credits, the cost of equity needs to be scaled up by the relevant factor. In Figure 15 below I have used 3.9% per annum as the long run growth path for real GDP[83] and a scaling factor of 1.1125 to capture the value of imputation credits.[84] These assumptions are important for the level but not for the variation in the cost of equity estimate. I compare the cost of equity estimated in this manner with the real yield on CPI indexed CGS. When I do this I derive Figure 15.

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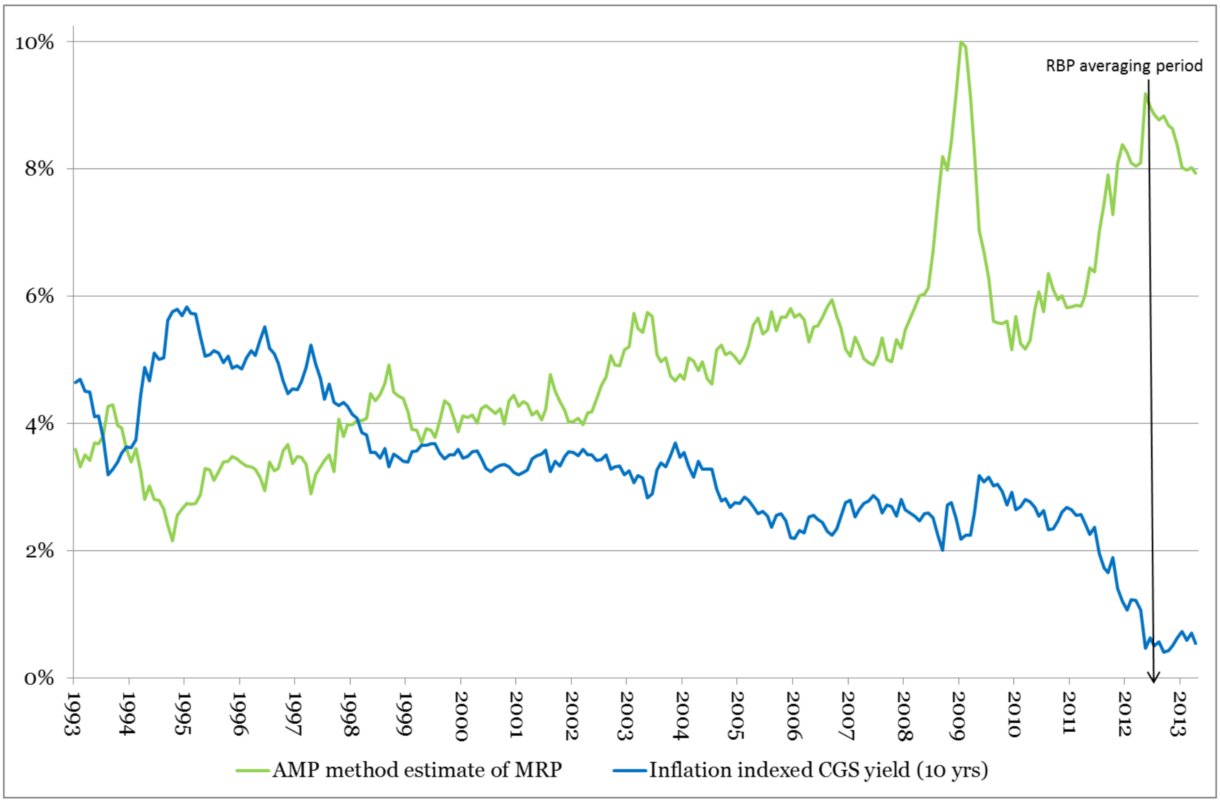
83 The Australian Bureau of Statistics (ABS) publishes economic growth figures on its website starting in 1959. Here I use growth in real domestic income of 3.9% (A2304314X of ABS Catalogue 5206.0) rather than nominal growth, since future expectations of inflation are not consistent with the high levels of inflation that were experienced at various times over this period. The average annual rate of growth in real gross domestic income between the December quarter 1959 and June quarter 2012 was 3.9%.

By way of comparison, equivalent real growth in the US since 1929, starting immediately prior to the great depression, was 3.3%. If the data series begins instead at 1933 the real average growth rate is 4.0%. (The longest published series by the Bureau of Economic Analysis at the US Department of Commerce http://www.bea.gov/national/index.htm#gdp.)

84 This is based on the assumption of a corporate tax rate of 30%; and, that the value of imputation credits distributed (theta) is 35% of their face value, consistent with Australian Competition Tribunal precedent; and that the proportion of dividends that are franked is 75% (consistent with Brailsford, T., J. Handley and K. Maheswaran, Re-examination of the historical equity risk premium in Australia, Accounting and Finance 48, 2008, page 85). The value of 1.1125 is calculated as 1+.30*.35*.75/(1-.3).

Figure 15: AMP method estimate of the E[MRP] relative to 10 year indexed CGS yields



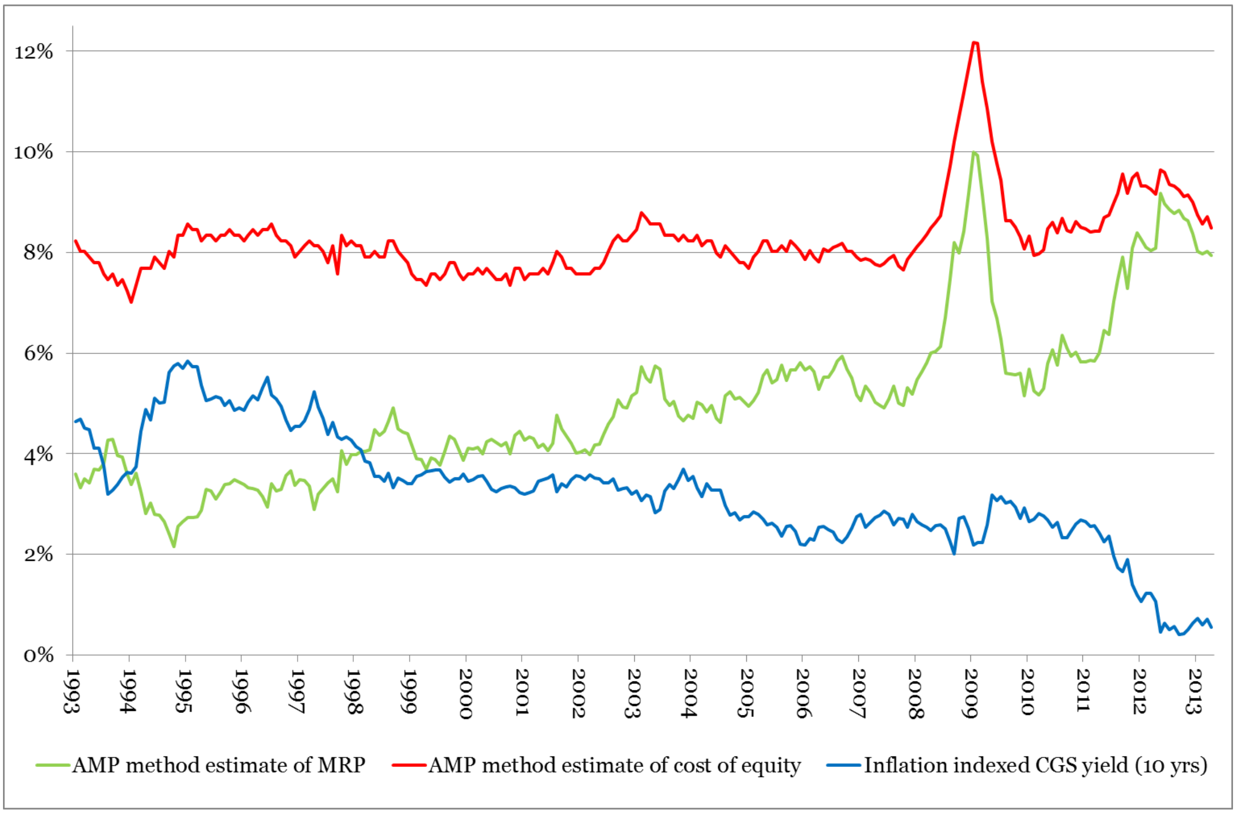
Source: RBA, CEG analysis

194. Notably, the fall in CGS yields in the lead up to the RBP averaging period has been associated with a more than offsetting rise in E[MRP] measured relative to CGS yields – such that the estimate of E[Rm] has risen materially since mid-2011. I note that the path of these parameters over time is similar to those recently estimated and presented by Capital Research.[85]

195. The estimate of E[Rm], being the sum of the CGS and MRP time series is much more stable than either of these two time series – as shown below in Figure 16.

[85] Capital Research, *Forward Estimate of the Market Risk Premium: Update*, A report prepared for the Victorian gas transmission and distribution businesses: APA Group, Envestra, Multinet Gas and SP AusNet, March 2012; Figure 11, Implied MRP from Constant Dividend Growth model, net theta = 0.2625.

Figure 16: AMP method estimate of real E[Rm] and E[MRP] relative to 10 year indexed CGS yields



Source: RBA and CEG analysis

A.3 AER statements on RBP period in the Victorian gas draft decision

196. In the following extended quote from the AER Victorian gas draft decision it is not obvious that the AER realised that the period in question covered the RBP averaging period. In this quote, the AER concedes that the spot CGS yield might be depressed by factors that do not depress required equity returns (such that E[MRP] measured relative to the spot CGS yield is heightened). However, the AER fails to acknowledge the implications for its choice of E[MRP] in the RBP averaging period.[86]

> *A definition of a flight to quality may include:*

[86] AER, *Access Arrangement draft decision SPI Networks (Gas) Pty Ltd 2013–17: Part 3*, September 2012, p. 7.

> Flight to quality episodes involve a combination of extreme risk- or uncertainty-aversion, weaknesses in the balance sheets of key financial intermediaries, and strategic or speculative behavior, that increases credit spreads on all but the safest and most liquid assets.[87]

There have been periods since the onset of the GFC that could be described as being flight to quality periods. However, the AER does not consider there has been a sustained flight to quality since the onset of the GFC. Glenn Stevens recently made the following comment:

> We saw one such bout of anxiety in the middle of this year when financial markets displayed increasing nervousness about the finances of the Spanish banking system and the Spanish sovereign.
>
> The general increase in risk aversion saw yields on bonds issued by some European sovereigns spike higher; while those for Germany, the US and the UK declined to record lows. This flight to safety also saw market yields on Australian government debt decline to the lowest levels since Federation. Meanwhile many European economies saw a further contraction of economic activity and share markets decline sharply.[88]

A flight to quality would not provide justification to depart from a prevailing estimate of the risk free rate. Demand for highly liquid assets is likely to increase in a flight to quality period.[89] This would, all else the same, push the yield on risk free assets down. These actions reflect changes in investor expectations and perceptions of the relative value of a risk free asset and would not undermine the risk free nature of that asset.[90]

Shortly before RBA Governor Glenn Stevens made the comments above, the RBA provided the following advice:

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87 Caballero, R. and Kurlat, P., *MIT Department of Economics Working Paper No. 08-21, Flight to Quality and Bailouts: Policy Remarks and a Literature Review*, 9 October 2008, p. 1.

88 Glenn Stevens, *Opening Statement to the House of Representatives - 24 August 2012 - Hansard script*, p. 2.

89 Caballero, R. and Kurlat, P., *MIT Department of Economics Working Paper No. 08-21: Flight to Quality and Bailouts: Policy Remarks and a Literature Review*, 9 October 2008, p. 2.

90 Discussed further in section 4.3.2.

> I therefore remain of the view that CGS yields are the most appropriate measure of a risk-free rate in Australia.[91]

> *This suggests that the RBA does not consider a flight to quality period makes CGS an inappropriate proxy for the risk free rate*. [The italicised text above represents AER drafting while the indented small text represents quotes from third parties which the AER reproduced.]

197. The AER's response involves an implicit assumption that the RBA is that it was not appropriate to adopt the 'Black CAPM'. It is not at all obvious that this is the case.

198. In any event, even if it were, the AER's conclusion in the last paragraph of this quote is beside the point. The point of concern is not whether CGS yields are the best estimate of the risk free rate. The question is how must the E[Rm] and, therefore, the E[MRP] be estimated relative to the CGS yield.

199. Moreover, the AER's focus on the need to establish a 'sustained flight to quality since the onset of the GFC' is misguided. There may, or may not, be a sustained flight to quality but the point, amply demonstrated in the above discussion, is that even if a very brief flight to quality occurs during a business's averaging period, then CGS yields will be pushed down even though the cost of equity not be similarly pushed down.

200. Failing to address the impact of a flight to quality on the E[MRP] in the RBP averaging period 'cordons off' discussion of the E[MRP] from E[Rm] and the required return on a zero beta asset. In effect, these are estimated over different time periods and gives rise to outcomes that diverge substantially over time and are far from commensurate with prevailing costs of equity for firms with the same degree of risk.

91 Reserve Bank of Australia, *Letter to the ACCC: The Commonwealth Government Securities Market*, 16 July 2012, p. 1 (RBA, *Letter regarding the CGS market*, July 2012).

Appendix B Benchmark credit rating

201. The AER has conducted analysis on a sample of regulated utilities (gas and electricity) over the period 2002 to 2013[92].

- APT Pipelines Ltd
- ATCO Gas Australian LP
- DBNGP Trust
- DUET Group
- ElectraNet Pty Ltd
- Energy Partnership (Gas) Pty Ltd
- Envestra Ltd
- ETSA Utilities
- Powercor Australia LLC
- SP AusNet Group
- SPI (Australia) Assets Pty Ltd
- The CitiPower Trust
- United Energy Distribution Pty Ltd

202. The AER does not provide the basis for its calculation, but concludes that the median credit rating over the periods 2002 – 2012 and 2002 - 2013 is BBB+, whereas the median credit rating in June 2013 is BBB. The AER's results are summarised in Table 12 below. The AER concludes that adopting BBB+ as a benchmark credit rating is consistent with recent determinations and the 2009 WACC review.

Table 12: Median credit rating of AER's sample

Measure	Energy Networks
Median credit rating (2002 – 2012)	BBB+
Median credit rating (2002 – 2013)	BBB+, negative watch
Median credit rating (June 2013)	BBB

Source: AER (Dec 2013 p. 156)

[92] AER (2013) *Explanatory Statement, Draft rate of Return Guideline,* p. 111 - 112

203. I have replicated the AER's analysis by collecting historical S&P credit ratings for the stated benchmark sample from 2002-2013 in order to calculate a median credit rating in each year. Specifically, I have used the S&P long-term local issuer credit rating. The credit rating for each company in each year is summarised in the following table.

Table 13: Credit ratings 2002 – 2013

Credit ratings	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
APT Pipelines	N/A	N/A	N/A	N/A	N/A	N/A	N/A	BBB	BBB	BBB	BBB	BBB
ATCO Gas Australian LP	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	BBB	BBB	BBB
DBNGP Trust	N/A	N/A	BBB	BBB	BBB	BBB	BBB	BBB-	BBB-	BBB-	BBB-	BBB-
DUET Group	N/A	BBB-	BBB-	BBB-	BBB-	BBB-	BBB-	BBB-	BBB-	BBB-	BBB-	BBB-
ElectraNet Pty Ltd	BBB+	BBB+	BBB+	BBB+	BBB+	BBB+	BBB+	BBB	BBB	BBB	BBB	BBB
Energy Partnership (Gas)	N/A	BBB	BBB	BBB	BBB	BBB	BBB-	BBB-	BBB-	BBB-	BBB-	BBB-
Envestra Ltd	BBB	BBB	BBB	BBB	BBB-	BBB-	BBB-	BBB-	BBB-	BBB-	BBB-	BBB
ETSA Utilities	A-	A-	A-	A-	A-	A-	A-	A-	A-	A-	A-	A-
Powercor Utilities	A-	A-	A-	A-	A-	A-	A-	A-	A-	A-	A-	A-
SP AusNet Group	A	A	A	A	A	A	A-	A-	A-	A-	A-	BBB+
SPI (Australia) Assets	N/A	N/A	N/A	N/A	N/A	N/A	A-	A-	A-	A-	A-	BBB
The CitiPower Trust	A-	A-	A-	A-	A-	A-	A-	A-	A-	A-	A-	A-
United Energy Dist.	A-	BBB	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Source: Bloomberg

204. I have used a conversion table to assign each credit rating a value, starting with 1 for BBB- and ending with 12 for AAA+. The values corresponding to the credit ratings in Table 13 are summarised in Table 14. In the bottom row of the table I calculate the median credit rating across the sample.

Table 14: Credit rating values 2002 – 2013

Credit ratings	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
APT Pipelines	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2	2	2	2	2
ATCO Gas Australian LP	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2	2	2
DBNGP Trust	N/A	N/A	2	2	2	2	2	1	1	1	1	1
DUET Group	N/A	1	1	1	1	1	1	1	1	1	1	1
ElectraNet Pty Ltd	3	3	3	3	3	3	3	2	2	2	2	2
Energy Partnership (Gas)	N/A	2	2	2	2	2	1	1	1	1	1	1
Envestra Ltd	2	2	2	2	1	1	1	1	1	1	1	2
ETSA Utilities	4	4	4	4	4	4	4	4	4	4	4	4
Powercor Utilities	4	4	4	4	4	4	4	4	4	4	4	4
SP AusNet Group	5	5	5	5	5	5	4	4	4	4	4	3
SPI (Australia) Assets	N/A	N/A	N/A	N/A	N/A	N/A	4	4	4	4	4	2
The CitiPower Trust	4	4	4	4	4	4	4	4	4	4	4	4
United Energy Dist.	4	2	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
MEDIAN	**4**	**3**	**3**	**3**	**3**	**3**	**3.5**	**2**	**2**	**2**	**2**	**2**

Source: Bloomberg

205. I note that the median across all credit rating observations from 2004 (i.e. 10 years prior to 2013) is BBB, not "BBB+, negative watch" as per the AER's estimate in Table 12.

206. The AER's estimate appears to be based on taking the median of each year's median which is 2.5 (or exactly half way between BBB and BBB+). It is not clear why this value should be described as "BBB+, negative watch" rather than "BBB, positive watch". However, to the extent this measure (a median of annual median observations) is 'on a knife edge' the fact that the median of all observations is clearly BBB suggests BBB is a preferred estimate.

207. I also note that the two most highly rated issuers SPI (Australia) Assets (SPIAA) and SP AusNet Group both had significant credit rating support as a result of ownership by the Singapore Government. When this was diluted in 2013 credit rating agencies put SP AusNet and SPI on negative watch citing this dilution.

> *The likely downgrade of SP AusNet's rating to A3 would reflect our view that the high likelihood of parental support from SP -- and which has been incorporated in the rating through a 2-notch uplift -- would no longer hold following the divestment to a minority interest.*[93]

[93] Moody's Investors Service, Moody's maintains review for possible downgrade of SP AusNet and SPIAA's ratings, 01 Aug 2013. Available at: https://www.moodys.com/research/Moodys-maintains-review-for-possible-downgrade-of-SP-AusNet-and--PR_279138

208. Removing SP AusNet and SPIAA from the sample (or reducing their credit ratings by two notches) results in the median of annual median observations also falling closer to BBB than BBB+. Moreover, I note that Citipower, Powercor and ETSA are all part of the same corporate group and arguably should consistute only one observation in the above table. These are the 3 most highly rated entities in the table and condensing these 3 observations into a single observation would further reduce the median credit rating.

209. As such, if a single credit rating is to be applied over the entire 10 years this analysis suggests that a credit rating of BBB for energy (electricity and gas) network businesses is appropriate. Alternatively, if credit annual median credit ratings from the below table could be used.

Table 15: Median credit rating 2002 – 2013 for AER sample

Year	Median value	Median credit rating	Median credit rating – SPN and SPIAA adj.*
2002	4	A-	A-
2003	3	BBB+	BBB+
2004	3	BBB+	BBB+
2005	3	BBB+	BBB+
2006	3	BBB+	BBB+
2007	3	BBB+	BBB+
2008	4	BBB+/A-	BBB
2009	2	BBB	BBB
2010	2	BBB	BBB
2011	2	BBB	BBB
2012	2	BBB	BBB
2013	2	BBB	BBB

*Source: CEG analysis. *Two notch downward adjustment to SP AusNet and SPIAA prior to 2013 to account for implicit support from Singapore Government.*

210. Moreover, I note that Citipower, Powercor and ETSA are all part of the same corporate group and arguably should consistute only one observation in the above table. These are the 3 most highly rated entities in the table and condensing these 3 observations into a single observation would further reduce the median credit rating. Indeed, it would be BBB in all years but 2002.

Appendix C Grundy report

The Calculation of the Cost of Capital

A Report for Envestra

Bruce D. Grundy

Date of this report: 17 February, 2011

1. My full name is Bruce David Grundy. I am a Professor of Finance in the Department of Finance at the University of Melbourne. I received my PhD in Finance from the University of Chicago and before joining Melbourne I was a faculty member at Stanford and Wharton and a visiting Professor at Chicago, Goethe-Universität Frankfurt am Main and Singapore Management University. I have taught subjects in *Corporate Finance*, *Derivatives*, *Real Options*, *Corporate Governance* and *Financial Management for Executives* at the undergraduate, masters and doctoral levels as well as executive education classes. I have served as Managing Editor of the *International Review of Finance* and Associate Editor of the *Journal of Finance, Review of Financial Studies, Journal of Financial and Quantitative Analysis, Journal of Financial Research* and *Accounting and Finance*. I have published extensively on the convertible bond market, dividend policy, corporate governance, option pricing, momentum trading strategies, and rational expectations models. I have consulted for investment banks, corporations, mutual funds and regulators in both the US and Australia. I am a Fellow of the Australian Society of Certified Practicing Accountants, a founding member of the Financial Integrity Research Group, a member of the Australian Centre for Financial Studies and convener of the Melbourne Derivatives Research Group. My curriculum vitae appears in Schedule 1 to this Statement.

2. I have been provided with and have read and complied with the Federal Court of Australian Practice Note CM7.

Issues addressed in this Report

3. The calculation of the cost of capital involves numerous steps. The issues addressed in this report are:

3.1 The theoretical limitations of the Sharpe CAPM as a measure of the cost of equity.

3.2 The empirical limitations of the Sharpe CAPM as a measure of the cost of equity.

3.3 An estimate of the cost of equity that is consistent with the empirical evidence.

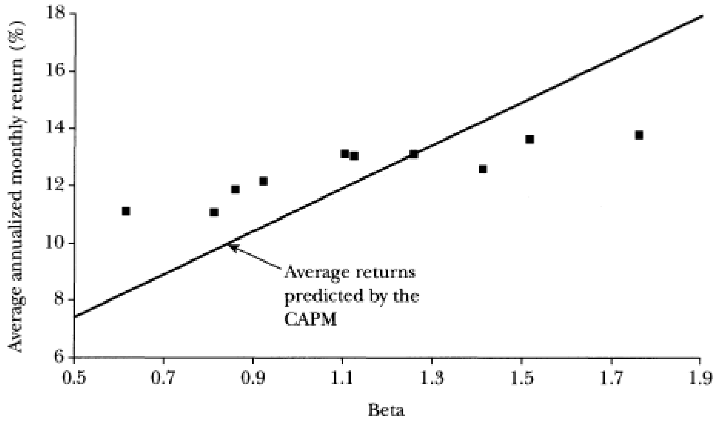
3.4 The relation between the cost of equity and the cost of debt.

THEORETICAL LIMITATIONS OF THE SHARPE CAPM

4. Whether a model gives useful predictions is an empirical question. The fact that the Sharpe-Lintner CAPM relies on a number of simplifying assumptions does not in itself invalidate the model. But when a model does not accurately describe the data it is intended to explain it can be useful to examine the model's assumptions. The key empirical finding of the asset pricing literature is summarised in the figure reproduced below from Fama and French (2004)[94] which demonstrates graphically that low beta stock earn more than predicted by the Sharpe CAPM (and vice versa for high beta stock). The upward sloping line in the figure immediately below depicts the relation between average returns and betas as predicted by the Sharpe CAPM. The actual relation is depicted by the boxes.

[94] Fama, Eugene F. and Kenneth R. French, 2004, "The capital asset pricing model: Theory and evidence," *Journal of Economic Perspectives* 18, pp. 25-46.

Figure 2
Average Annualized Monthly Return versus Beta for Value Weight Portfolios Formed on Prior Beta, 1928–2003



5. It can be seen that the lower the beta estimate used in the Sharpe CAPM, the more that model underestimates actual returns. According to the Sharpe CAPM the cost of equity, Re, is predicted to be

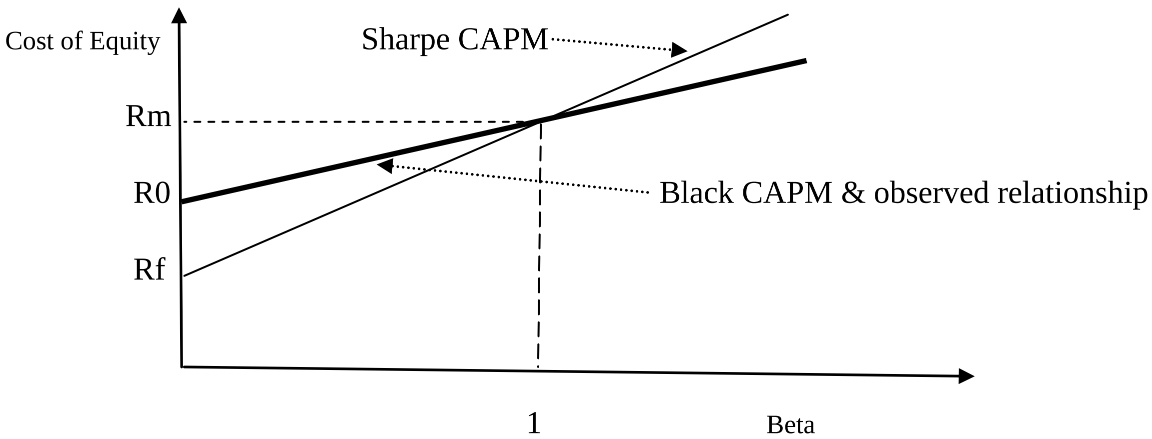
$$Re = Rf + \beta(Rm - Rf), \quad (1)$$

where β is the beta of equity, Rm is the expected on the market as a whole, and Rf is the risk-free rate. Beta is a measure of relative risk. If a stock has a beta of 2 it means that a 1% more (less) than expected return on the market as a whole will tend to be associated by a 2% more (less) than expected return on that stock. In practice average returns on stocks are better described by the relation

$$Re = R0 + \beta(Rm - R0), \quad (2)$$

where R0 is the return on a zero beta stock.

FIGURE 1: The Sharpe CAPM (depicted by the more-steep thin upward sloping line) and the Black CAPM & the empirical relation between the cost of equity and beta (depicted by the less-steep thick upward sloping line).



Black (1972) [95] was the first to relax the assumptions of the Sharpe CAPM and the model he developed, the Black CAPM, provides a better fit to the data. The Black CAPM predicts that the cost of equity for a zero beta stock will exceed the risk-free rate. In contrast, the Sharpe CAPM predicts that the cost of equity for a zero beta stock is equal to the risk-free rate.

Sharpe CAPM Assumption: Borrowing & lending rates are equal

6. Black's insight was to examine the implication of the fact that investors must pay higher rates to borrow than they could earn by lending to the government. The Sharpe CAPM assumes that investors can borrow on the same terms as the government. Black's insight was to see the implication of higher borrowing rates then lending rates, namely that:

The cost of equity for zero beta stock will exceed the risk-free rate and the cost of equity for all stock with betas less than (greater than) one will exceed (be less than) the cost predicted by the Sharpe CAPM.

[95] Black, F., 1972, "Capital market equilibrium with restricted borrowing," Journal of Business, 1972 (45), pp. 444-454.

Sharpe CAPM Assumption: Transactions costs are zero

7. The Sharpe CAPM assumes that there are no brokerage costs, bid-ask spreads or information differences between traders; in short markets are perfectly liquid and traders can buy and sell shares costlessly. In practice, different securities involve different costs to trade them and lower trading cost, more liquid securities are more valuable all else equal. This can be seen most clearly in the higher price of more liquid, lower transaction cost "on-the-run" bonds versus less liquid bonds backed by the same issuer. This phenomenon has been well-documented in many countries. (See, for example, Boudoukh and Whitelaw (1993).[96]) The yield on the higher-priced, more-liquid bond issues is lower than the yield on less-liquid, otherwise equivalent bonds. Differences in liquidity have also been shown to similarly affect average returns on equities—see, for example, Lubos and Stambaugh (2003).[97]

8. The implication for the cost of equity is that investors in zero beta equity will demand a higher return than the risk-free rate paid on liquid government securities.; i.e., R0 > Rf. Trading equities involves higher transaction costs than trading governments bonds. The equity market is less liquid than the government bond market. Note that Rm naturally reflects the effect of the liquidity of the typical stock. The market risk premium measured as the difference between the return on the market and the return on zero beta equity (i.e., measured as Rm – R0) will be smaller than the market risk premium measured as Rm – Rf.

9. The implication of recognizing the effect of transactions cost on the cost of equity is that:

The cost of equity for zero beta stock will exceed the risk-free rate and the cost of equity for all stock with betas less than (greater than) one will exceed (be less

[96] Boudoukh, J., and R. Whitelaw, 1993, "Liquidity as a choice variable: A lesson from Japanese government bond market" *Review of Financial Studies* 6, pp. 265-292.

[97] Pastor, L., and R. F. Stambaugh, 2003. "Liquidity Risk and Expected Stock Returns," Journal of Political Economy, 111(3), pp. 642-685.

than) the cost predicted by the Sharpe CAPM.

<u>Sharpe CAPM Assumption: The market contains all equities, bonds and real estate</u>

10. Most empirical investigations of the CAPM treat the stock market as if it were the entire portfolio of all assets in the economy held by investors. The market portfolio in the Sharpe CAPM is in fact the portfolio of all equities, bonds and real estate in the economy. Implementations that use as a proxy for the entire portfolio of all assets only the equity component of those assets are vulnerable to what has become known as the Roll critique (Roll (1977)).[98]

11. Roll (1977) shows that for any efficient portfolio it is a mathematical truism that the cost of equity for any given stock is given by

$$Re = R0^E + \beta^E(R^E - R0^E), \tag{3}$$

where $R0^E$ is the average return on any stock that has zero beta with respect to the return on that efficient portfolio (i.e., does not covary with that efficient portfolio), β^E is the beta of the given stock measured with respect to the return on that efficient portfolio, and R^E is the average return on that efficient portfolio. A portfolio is an efficient portfolio if it is the portfolio with the minimum volatility within the set of all portfolios with a given level of expected return.

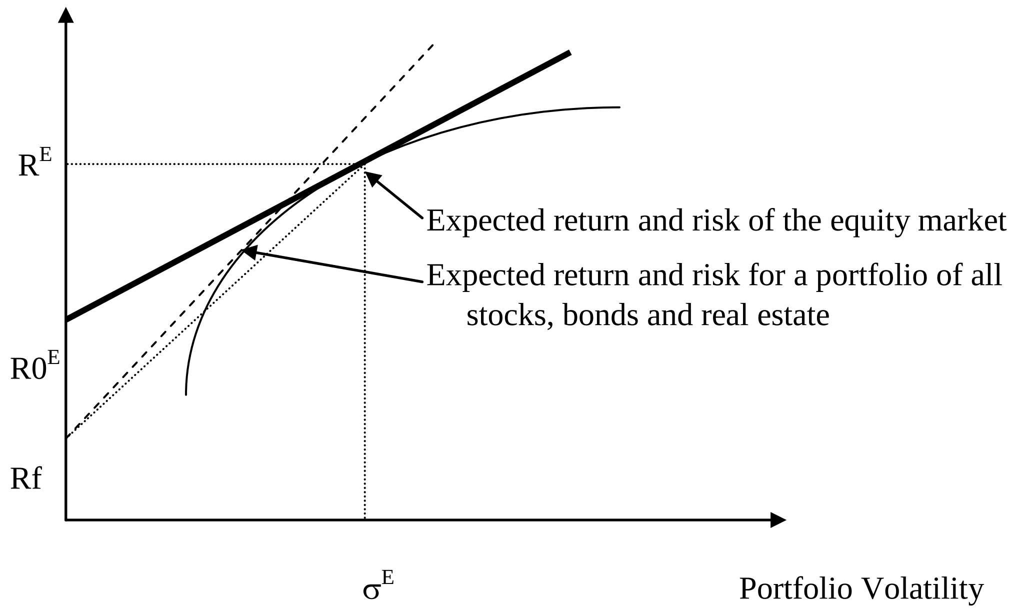
12. The relation set out in the preceding paragraph takes the same form as the Sharpe CAPM. The import of the Sharpe CAPM is that, under its assumptions, the true market is an efficient portfolio and the expected return on all stock with a zero beta measured with respect to the true market is equal to the risk-free rate.

13. The figure below depicts a set of efficient portfolio and one particular efficient

[98] R Roll, R., 1977, "A critique of the asset pricing theory's tests Part I: On past and potential testability of the theory," *Journal of Financial Economics* 4(2), pp. 129–176.

portfolio. The well-diversified portfolio of all equities is likely to be a close to efficient portfolio. It will though be more volatile than the volatility of the true market, and its expected return will be greater than the expected return on the true market.

FIGURE 2: The Set of Efficient Portfolios and the Expected Return and Volatility of the Well-Diversified Equity Market as a Proxy for an Efficient Portfolio



14. If the well-diversified portfolio of all stocks is a good proxy for an efficient portfolio then equation (3) can be rewritten as

$$Re = R0 + \beta(Rm - R0),$$

where Rm is the average return on the equity market rather than the true market portfolio; i.e., equation (3) can be rewritten in the form of the Black CAPM. Note that the average return on the equity market will exceed the average return on the true market and in turn the average return on stocks that have zero beta with respect to the equity market will exceed the risk-free rate; i.e, R0 > Rf.

15. The implication of recognizing that the market in the Sharpe CAPM is the portfolio of all assets in the economy, not just the equities in the economy is that:

The cost of equity for zero beta stock when the equity market is used as a proxy for the entire market will exceed the risk-free rate and the cost of equity for all stock with betas with respect to that proxy less than (greater than) one will exceed (be less than) the cost predicted by the Sharpe CAPM.

Sharpe CAPM Assumption: Investors live for one period only

16. The Sharpe CAPM assumes that investors consume their entire wealth at the end of the single investment period. Investors are assumed to allocate their investments across assets and borrow or lend in order to maximize the expected utility from consuming their entire wealth at the end of the period. High beta stock tend to payoff more when the market has done well and hence high beta stock will typically make their biggest contribution to end-of-period consumption when the investor's consumption from the remainder of his/her assets is already high. (The investor consumes everything at the end of the period).

17. The intuition underlying single-period asset pricing models is straightforward. High beta stocks give their best payoffs in states of the world where an extra unit of consumption has relatively little marginal value. In contrast, low beta stock will not have as strong a tendency to achieve their best just when additional consumption has relatively little marginal value. Thus for the same level of expected end-of-period payoff, investors will be willing to pay more at the beginning of the period for low-beta stock than they will pay for high-beta stock. Equivalently, investors require a lower return from low-beta stock than they will require from high-beta stock.

18. In practice, investors consume and invest throughout their lifetimes. At the end of each period, they allocate their wealth between current consumption and continued investment for future consumption and allocate the reinvested amount across different stocks and they also borrow or lend. Recognition of the inherently multi-period nature

of investment decisions underlies the Consumption CAPM of Breeden (1979).[99] The Consumption CAPM describing expected returns over any one period takes the form

$$\mathrm{Re} = \mathrm{Rf} + \frac{\mathrm{cov}(\mathrm{Re},\ \%\ \text{change in consumption})}{\mathrm{cov}\ (\mathrm{Rm},\ \%\ \text{change in consumption})}(\mathrm{Rm} - \mathrm{Rf})\ .$$

Note that the correct risk measure when investors live for more than one period is not given by the beta risk measure of the Sharpe CAPM, β.

$$\frac{\mathrm{cov}(\mathrm{Re},\ \%\ \text{change in consumption})}{\mathrm{cov}\ (\mathrm{Rm},\ \%\ \text{change in consumption})} \neq \beta \equiv \frac{\mathrm{cov}(\mathrm{Re},\ \mathrm{Rm})}{\mathrm{cov}\ (\mathrm{Rm},\ \mathrm{Rm})} = \frac{\mathrm{cov}(\mathrm{Re},\ \mathrm{Rm})}{\sigma^2(\mathrm{Rm})}.$$

Only in a single period setting will the two risk measures be the same: In a single period setting consumption at the end of the period is equal to wealth at the end of the period which in turn is equal to the value of the market portfolio of the period

19. An equivalent way of thinking about the multi-period consumption investment problem is to recognize that an investor is interested not only in whether a particular stock tends to payoff when the market as a whole is doing well, but also in whether there is tendency for the stock to have higher or lower payoffs when reinvestment opportunities are good. Not only will co-movement with the return on the market be important, but co-movement with changes in future interest rates, changes in future market risk premiums and changes in future market volatility, and other changes in the investment opportunity set will be important. Thus a stock's risk will have many dimensions beyond the simple beta risk measure of co-movement with the return on the market. This way of viewing the multi-period consumption-investment problem is the basis for the Intertemporal CAPM first developed in Merton (1973).[100]

20. While the Fama-French (2004) model has been criticised as lacking a strong theoretical

[99] Breeden, D.T., 1979 "An intertemporal asset pricing model with stochastic consumption and investment opportunities," *Journal of Financial Economics* 7, pp. 265-296.

[100] Merton, R.C., 1973, "An intertemporal capital asset pricing model," *Econometrica* 41(5), pp. 867-887.

basis, it can be interpreted as an empirical determination of measures of co-movement with changes in the investment opportunity set that affect investors' required returns. The observation that in practice R0 (the average return on zero beta stock) exceeds Rf can be interpreted as consistent with zero beta stock having sensitivities to changes in the investment opportunity set that add to their required return.

21. The implication of recognizing the multi-period nature of consumption and investment decisions in practice is that if investors recognize the possibility of changes in future investment opportunities when choosing their optimal portfolios then:

The cost of equity for **zero beta stock can exceed the risk-free rate and the cost of equity for all stock with betas less than (greater than) one can exceed (be less than) the cost predicted by the Sharpe CAPM.**

EMPIRICAL LIMITATIONS OF THE SHARPE CAPM

22. I know of no published study that has empirically tested the Sharpe CAPM and failed to reject the Sharpe CAPM. Table 1 sets out a number of studies cited by the AER in rejecting the use of the Fama-French 3 factor model (FFM) to determine required returns on stocks.[101] The FFM links the expected return on stock to three factors: the beta of the stock, the equity value of stock (the size of the stock) and the book-to-market ratio of the stock.

23. Some of the papers cited by the AER are pure theory papers, while others are empirical studies of the relation between risk and return. Part A of Table 1 sets out the implications of the pure theory studies for the question of whether required returns are better-described by the Sharpe CAPM or the Black CAPM.

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[101] The FFM is discussed in

Fama, Eugene F., and Kenneth R. French, 2004, "The capital asset pricing model: Theory and evidence," *Journal of Economic Perspectives* 18(3), pp. 25-46.

TABLE 1
Part A: Pure theory papers cited by the AER in rejecting the FFM

<table>
<tr><td colspan="2">Paper cited by AER</td></tr>
<tr><td>Ferson, Sarkissian and Simin (1999)</td><td>Theoretical result:
The genesis for the theoretical examination in this paper is that the FFM provides a better empirical fit to the data than is provided by the Sharpe CAPM.

Suppose that:
i) Average returns are related to a stock’s beta, size and book-to-market ratio (i.e., to the 3 factors of the FFM), and
ii) Average returns are related to a stock’s sensitivity to the market and to proxies for a ‘size factor’ and ‘book-to-market factor’ and hence can be given a risk-reward interpretation.

Despite i) and ii) being true, it may be that the higher average returns empirically observed on small stocks and on stocks with high book-to-market ratios are the result of a behavioural bias of investors rather than a reward for risk.

Empirical implication for the Black CAPM:
The Black CAPM will be a better predictor of stock returns than is the Sharpe CAPM provided low beta stocks tend to be smaller stocks and/or tend to have higher book-to market ratios.</td></tr>
<tr><td>Lo and MacKinlay (1990)</td><td>Theoretical result:
If properties of the data are known to those developing theories and if the resultant model is then tested on data that consciously or otherwise provided the genesis for the model, it can appear to be a better model than it subsequently proves to be.

Empirical implication:
The relative ranking of the FFM, Sharpe CAPM and Black CAPM when explaining past returns may not be their relative ranking in the future.

There is no implication that the Sharpe CAPM will provide a better model of required returns than the FFM or the Black CAPM.</td></tr>
<tr><td>Roll (1977)</td><td>Theoretical result:
i) For any efficient portfolio $Re = R0^E + \beta^E(R^E – R0^E)$, where $R0^E$ is the average return on any stock that has zero beta with respect to the return on that efficient portfolio, β^E is the beta of the stock measured with respect to the return on that efficient portfolio, and R^E is the average return on that efficient portfolio. A portfolio is an efficient portfolio if it is the portfolio with the minimum</td></tr>
</table>

24. None of the four theoretical papers cited by the AER in rejecting the FFM provides any basis for a claim that the Sharpe CAPM theoretically dominates the FFM. Consider Ferson, Sarkissian and Simin (1999). That paper's theoretical explanation for the empirical superiority of the FFM over the Sharpe CAPM as potentially due to a behavioural bias by investors rather than a reward for risk does not challenge the empirical observation that gave rise to the paper—namely that the FFM provides a better empirical description of stock returns than the Sharpe CAPM does. Note also that all four theoretical papers cited by the AER in rejecting the FFM are consistent with the Black CAPM providing a better descriptor of average stock return than the Sharpe CAPM; in fact, the Roll and Ross (1994) analysis is motivated by exactly this empirical observation.

25. Part B of Table 1 sets out the results reported in those studies cited by the AER in rejecting the FFM that undertake an empirical examination of the link between risk and return. Part B of Table 1 also sets out the results in two classic tests of the Sharpe CAPM: Fama and Macbeth (1973) and Black, Jensen and Scholes (1972). Column 1 contains the author names and the year of publication of the study. Column 2 contains the sample period examined. Column 3 sets out the likelihood that the Sharpe CAPM is true given the data examined by the authors. Where it is possible to determine the ratio $\frac{Rm - R0}{Rm - Rf}$ from the results reported in the paper, column 4 reports the estimated value of this ratio. The notation n.a. denotes that this ratio could not be calculated from the results reported in the paper.

TABLE 1
Part B: Empirical papers cited by the AER in rejecting the FFM
plus 2 classic tests of the Sharpe CAPM

paper	Sample Period		$\frac{Rm-R0}{Rm-Rf}$
Empirical papers cited by the AER			
Schrimpf, Schröder and Stehle (2007)	1969 - 2002	Estimate of $Rm-R0 = 0.2\%$ per month. Note than an annual MRP of 6.5% implies a monthly MRP of 0.54% per month.	n.a.
Ang and Chen (2007)	1926 - 1963:06	Cannot reject the Sharpe CAPM	n.a.
	1963:07 - 2001	Likelihood the Sharpe CAPM true is < 1%	n.a.
Gruaer and Janmaat (2010)	1963 - 2005	For 7 of the 14 methods for grouping stocks to form portfolios that are examined in the paper, the likelihood of the Sharpe CAPM being true is < 5%	n.a.
Gregory and Michou (2009)	1975 - 2005	Examines 35 industries. For only 3 industries would one reject the Sharpe CAPM at the 5% level. For the *Gas, Water and Multi-utility Industry* returns are statistically significantly higher at the 5% level than predicted by the Sharpe CAPM	n.a.
Black (1993)	1926 - 1965	likelihood Sharpe CAPM true < 1%	n.a.
Schwert (2003)	1926 - 2001	likelihood Sharpe CAPM true < 0.0001%	n.a.
Morana (2009)	1965 - 2001	likelihood Sharpe CAPM true < 1%	n.a.
Daniel, Titman and Wei (2001)	1975 - 1997	likelihood Sharpe CAPM true < 0.34%	n.a.
Da, Guo and Jagannathan (2009)	1932 - 2007	likelihood Sharpe CAPM true < 0.002%	0.232
Kothari, Shanken and Sloan (1995)	1927 - 1990	likelihood Sharpe CAPM true < 0.058%	0.415
Classic tests of the Sharpe CAPM			
Fama and Macbeth (1973)	1935 - 1968	likelihood Sharpe CAPM true < 0.55%	0.639
Black, Jensen and Scholes (1972)	1931 - 1965	likelihood Sharpe CAPM true < 0.0001%	0.761
			Average = 0.511

25. Schrimpf, Schröder and Stehle (2007) do not test whether the Sharpe CAPM fits the data. Rather they conclude only that FFM does not fit the data better than the Sharpe CAPM does. For the first half of the sample period examined by Ang and Chen (2007) the authors do not reject the Sharpe CAPM. The authors do reject the Sharpe CAPM using data after 1963.

26. Although Gregory and Michou (2009) do not reject the Sharpe CAPM for most industries, the nature of their test bears discussion. Gregory and Michou regress the monthly return on an industry portfolio on the monthly return on the market. Most industries have betas near one and both the Sharpe CAPM and the Black CAPM make the same prediction for stock with a beta of one; the expected return on a beta one stock equals the expected return on the market. Gregory and Michou do not reject this prediction. Interestingly, for the portfolio whose beta is furthest from one, namely the *Gas, Water and Multi-utility Industry*, stock returns are significantly higher (at the 5% level) than predicted by the Sharpe CAPM. This is consistent with the true relation between expected returns and betas being flatter than the relation predicted by the Sharpe CAPM.

27. Every other study listed in Table 1B rejects the Sharpe CAPM and does so because the estimated return on a zero beta stock, R0, exceeds the risk-free rate, Rf. Equivalently, in every case the estimated difference in the return on the market and the return on zero beta stock is significantly less than Rm – Rf. Thus every other study documents that the thick line of Figure 1 is flatter than the thin line of Figure 1; i.e., that the empirical relation between the cost of equity and beta is flatter than is predicted by the Sharpe CAPM.

28. Where the paper's reported results make it possible to calculate the average values of (Rm – R0) and (Rm – Rf) over the sample period, the ratio of the two average differences is reported in column 4. Averaging over the four papers where this possible, the difference between the return on the market and the return on zero beta stock is only 0.511 of the difference predicted by the Sharpe CAPM.

29. The full citations for the set of papers in Table 1 are given below in the order the papers are listed in the table:

Ferson, Sarkissian and Simin, 1999, “The alpha factor asset pricing model: A parable,” Journal of Financial Markets 2, pp. 49-68

Lo, Andrew W. and A. Craig MacKinlay, 1990, “Data-snooping biases in tests of financial asset pricing models,” *Review of Financial Studies* 3(3), pp. 431-467.

Roll, Richard, 1977, “A critique of the asset pricing theory's tests Part I: On past and potential testability of the theory,” *Journal of Financial Economics* 4(2), pp. 129–176.

Roll, Richard and Stephen A. Ross, 1994, “On the cross-sectional relation between expected returns and betas,” *Journal of Finance* 49(1), pp. 101-121.

Schrimpf, Andreas, Michael Schröder and Richard Stehle, 2007, “Cross-sectional tests of conditional asset pricing models: Evidence from the German stock market,” *European Financial Management* 13(5), pp. 880–907.

Ang, Andrew and Joseph Chen, 2007, “CAPM over the long run: 1926–2001,” *Journal of Empirical Finance* 14, pp. 1–40.

Grauer, Robert R. and Johannus A. Janmaat, 2010, “Cross-sectional tests of the CAPM and Fama–French three-factor model,” *Journal of Banking & Finance* 34, pp. 457–470.

Gregory, Alan and Maria Michou, 2009, “Industry cost of equity capital: UK evidence,” *Journal of Business Finance & Accounting* 36(5) & (6), pp. 679–704.

Black, Fischer, 1993, “Beta and return,” *Journal of Portfolio Management*, 1993, 20(1), pp. 8–18.

Schwert,G. William, 2003, “Anomalies and market efficiency,” in *Handbook of the Economics of Finance*, editors G. Constantinides, M. Harris and R. Stulz, Elsevier Science, ch. 15, pp. 937–972.

Morana, Claudio, 2009, “Realized betas and the cross-section of expected returns,” *Applied Financial Economics*, 19, pp. 1371-138.

Daniel, Kent, Sheridan Titman and K.C. John Wei, 2001, “Explaining the cross-section of stock returns in Japan: factors or characteristics’, *Journal of Finance*, 56(2), pp. 743–767

Da, Zhi, Re-Jin Guo and Ravi Jagannathan, 2009, “CAPM: Interpreting the evidence,” NBER working paper 14889.

Kothari, S., Jay Shanken and Richard G. Sloan, 1995, “Another look at the cross-section of expected returns," *Journal of Finance*, 50(1), pp. 185–224;

Fama., Eugene F. and James D. Macbeth, 1973, "Risk, return, and equilibrium: Empirical tests," *Journal of Political Economy*, 81(3), pp. 607-636.

Black, Fischer, Michael C. Jensen and Myron S. Scholes, 1972 "The capital asset pricing model: Some empirical tests," in Studies in the Theory of capital Markets, Michael C. Jensen editor, (Praeger Publishers Inc.).

CONSISTENT ESTIMATION OF THE COST OF EQUITY GIVEN THE EMPIRICAL EVIDENCE

30. The empirical evidence that the Black CAPM provides a better fit to the data than the Sharpe CAPM is clear. What then is the bias in the Sharpe CAPM? The downward bias in the estimated cost of equity for low beta stocks will be greater the lower that beta is.

31. Consider a stock with a beta of 0.55. Assume that Rf is 5.3% and the MRP is 6.5%. The return on the market, Rm, is then Rf + MRP = 5.3% + 6.5% = 11.8%. The Sharpe CAPM would imply a cost of equity for our stock of

$$Rf + \beta(Rm - Rf) = 5.3\% + 0.55 \times 6.5\% = 8.875\%.$$

32. The Black CAPM provides a better fit to the data and the difference Rm – R0 can be approximated as 0.511×(Rm – Rf) based on the average of the estimates of $\frac{Rm - R0}{Rm - Rf}$ in column 4 of Table 1B, and as 0.232 using the most recent estimate of $\frac{Rm - R0}{Rm - Rf}$ in Table 1B, namely that of Da, Guo and Jagannathan (2009).

33. Based on the average estimate of $\frac{Rm - R0}{Rm - Rf}$ in Table 1B, the empirically-based estimate of the cost of equity for a zero beta stock follows as

$R0 = Rm - 0.511\,(Rm - Rf) = 11.8\% - 0.511(11.8\% - 5.3\%) = 8.478\%.$

The empirically-based estimate of the cost of equity for a stock with a beta of 0.55 is then

$R0 + \beta \times (Rm - R0) = 8.4785\% + 0.55 \times (11.8\% - 8.478\%) = 10.305\%.$

34. Based on the Da, Guo and Jagannathan estimate of $\frac{\text{Rm}-\text{R0}}{\text{Rm}-\text{Rf}}$, the empirically-based estimate of the cost of equity for a zero beta stock is

R0 = Rm – 0.232 (Rm – Rf) = 11.8% – 0.232(11.8% - 5.3%) = 10.292%.

The empirically-based estimate of the cost of equity for a stock with a beta of 0.55 is then

R0 + β × (Rm – R0) = 10.292% + 0.55 × (11.8% – 10.292%) = 11.121%.

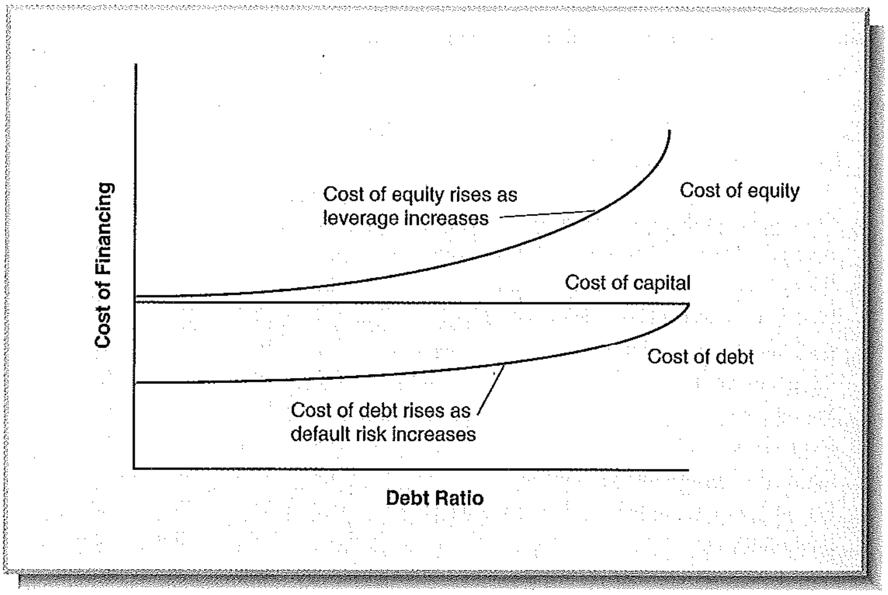
35. Thus the downward bias in a Sharpe CAPM-based estimate of the cost of equity for a stock with a beta of 0.55 given the average estimate of $\frac{\text{Rm}-\text{R0}}{\text{Rm}-\text{Rf}}$ is then 10.3053% – 8.875% = 1.430%. The downward bias in a Sharpe CAPM-based estimate of the cost of equity for a stock with a beta of 0.55 given the Da, Guo and Jagannathan estimate of $\frac{\text{Rm}-\text{R0}}{\text{Rm}-\text{Rf}}$ is 11.121% – 8.875% = 2.246%.

THE RELATION BETWEEN THE COST OF EQUITY AND THE COST OF DEBT

36. The relation between the cost of debt and a firm's leverage as measured by the the value of the firm's debt relative to value of the firm's assets, *D*/*V*, is convex. The Figure below (taken from the Damodaran (2001)[102] textbook) shows that the cost of debt initially increases very little as *D*/*V* grows from a very low level. But as the firm becomes increasingly debt-financed, the cost of debt becomes equal to the firm's cost of capital as the debtholders' claim on the firm comes increasingly closer to the right to 100% of the firm's cash-flows.

[102] Damodaran, Aswath, 2001, *Corporate Finance: Theory and Practice*, 2nd ed, (John Wiley and Sons, Inc., NJ).

Figure 18.5 Cost of Capital in the Miller-Modigliani World



37. The convexity implies a lower bound on the Equity Risk Premium for a firm given the Debt Risk Premium. This follows from Miller-Modiglian proposition II which states that

$$\text{Firm Risk Premium} = \frac{D}{V}\text{Debt Risk Premium} + \frac{E}{V}\text{Equity Risk Premium} \quad . \qquad (4)$$

The convex relation between the Debt Risk Premium and D/V depicted in the Figure below implies immediately that the Debt Risk Premium must be less than D/V × Firm Risk premium. Substituting this inequality into (4) gives

$$\frac{D}{V}\text{Debt Risk Premium} + \frac{E}{V}\text{Equity Risk Premium} = \text{Firm Risk Premium} > \frac{V}{D}\text{Debt Risk Premium.}$$

38. For D/V = 0.6 this inequality is:

$$0.6 \times \text{Debt Risk Premium} + 0.4 \times \text{Equity Risk Premium} > \frac{1}{0.6}\text{Debt Risk Premium.}$$ rearranging

this inequality gives the result that the Equity Risk Premium must be at least 2.66 times as large as the Debt Risk Premium. This relation provides a consistency check between the observed Debt Risk Premium for a firm and the minimum possible value for the Equity Risk Premium for that same firm if it finances with 60% debt.

39. A lower bound on the Equity Risk Premium also provides a lower bound on the cost of equity and hence a consistency check between the observed cost of debt and the cost of equity derived from an asset pricing model. If the firm has 60% debt financing and the asset pricing model does not imply an Equity Risk Premium at least 2.66 the observed Debt Risk Premium, then the asset pricing model is underestimating the true cost of equity for the firm

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Curriculum Vita

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Education

PhD, Finance, Graduate School of Business, University of Chicago. 1992. Specialisations:

Finance and Economics. Beta Gamma Sigma. Dissertation: "Preferreds and Taxes."

Committee: Merton Miller (Chairman), George Constantinides, Douglas Diamond.

B. Com. Honours (1st Class), University of Queensland. 1977.

Academic Positions

Professor of Finance, University of Melbourne 2005-.

Ian Potter Professor, Melbourne Business School, 2000-2005.

Professor of Finance, University of Melbourne, 1998-1999.

Andrew Heyer Associate Professor of Finance, Wharton School, University of Pennsylvania, 1991-1998.

Assistant Professor of Finance, GSB, Stanford University, 1985-1990.

Visiting Positions:
Visiting Professor, Wharton School, University of Pennsylvania, 2005-2007.

Visiting Professor, Singapore Management University, Fall 2005.
Visiting Professor, University of Chicago, 2003

Metzler Bank Professor, Johann Wolfgang Goethe-Universität Frankfurt am Main 1998.
Visiting Professor, Macquarie University, 1994.

Publications

"Investor sentiment, executive compensation, and corporate investment," 2010, *Journal of Banking & Finance* 34, pp.2439-2449. Co-author: Michael Li

"Combining skill and capital: Alternate mechanisms for achieving an optimal fund size," forthcoming *Pacific Basin Finance Journal.*

"The analysis of VaR, deltas, and state prices: A new approach," forthcoming *Review of Finance*. Co-author: Zvi Wiener.

"Disclosure, hidden charges and indexed pensions," 2005, *Agenda: A Journal of Policy Analysis and Reform,* 12(1), pp. 33-46. Co-authors: Diana Beal and Sarath Delpachitra.

"Stock market volatility in a heterogeneous information economy," 2002, *Journal of Financial and Quantitative Analysis* 37(1), pp. 1-27. Co-author: Youngsoo Kim.

"Momentum: Fact or factor? Momentum investing when returns have a factor structure," 2001*, Review of Financial Studies* 14(1), pp. 29-78. Co-author: Spencer Martin.

"Merton H. Miller: His contribution to financial economics," 2001, *Journal of Finance* 56(4), pp. 1183-1206.

"Generalized properties of option prices," 1996, *Journal of Finance* 51(5), pp. 1573-1610. Co-authors: Yaacov Bergman and Zvi Wiener.

"Option prices and the underlying asset's return distribution," 1991, *Journal of Finance* 46(3), pp. 1045-1070.

"Changing risk, changing risk premiums, and dividend yield effects," 1990, *Journal of Business* 63(1), pp. 51-70. Co-authors: Nai-fu Chen and Robert F. Stambaugh.

"Optimal investment with stock repurchase and financing as signals," 1989, *Review of Financial Studies* 2(4), pp. 445-465. Co-author: George Constantinides.

"Trade and the revelation of information through prices and direct disclosure," 1989, *Review of Financial Studies* 2(4), pp. 495-526. Co-author: Maureen McNichols.

"Call and conversation of convertible corporate bonds: theory and evidence," 1986*,* *The Analysis of Security Prices* 31, pp. 35-70. Co-author: George Constaninides.

"The behavior of stock prices around ex-dividend dates," 1983, *The Analysis of Security Prices* 28, pp. 83-114.

Edited Volumes

Selected Works of Merton Miller: A Celebration of Markets. Vol I Finance, 2002 (University of Chicago Press, Chicago, Ill.

Selected Works of Merton Miller: A Celebration of Markets. Vol II Economics, 2002 (University of Chicago Press, Chicago, Ill).

Other Publications

"Stock return predictability in rational markets," 2007, *Insights: Melbourne Economics & Commerce* Volume 1 April.

"Real options analysis and investment appraisal: the opportunities and challenges," 2006, *Insights: Melbourne Economics & Commerce* Volume 4 November.

"Book Review: *Pricing and hedging of derivative securities* by Lars Tyge Nielsen," 2000, *Journal of Financial Research* 23, pp. 391-394.

Research papers:

"Optimal exercise and valuation of real options: The effects of uncertainty and asymmetric information," 2009, Co-author: Johannes Raaballe.

"Financing Strategies for Non-profit Organizations: Matching Grants or Seed Money," 2010, Co-author: Ning Gong.

"Do option markets undo restrictions on short sales? Evidence from the 2008 short-sale ban," 2010, Co-authors: Bryan Lim and Patrick Verwijmeren

"Convertibles and hedge funds as distributors of equity exposure," 2010, Co-authors Stephen J. Brown, Craig M. Lewis and Patrick Verwijmeren

"Coordinating Donations by Socially Conscious Employees: Employee Matching Grant Schemes vs. Lump-sum Donations," 2010, Co-author: Ning Gong.

Work-in-progress

"Expected returns and momentum for firms with low profitability and high investment," 2009, Co-authors: Gil Aharoni and Qi Zeng.

"Information and the term structure of expected future oil prices," 2009, Co-author: Richard Heaney.

"Differential information and derivatives pricing," 2009, Co-author: Qi-Zeng.

"Option prices, implied abnormal returns and momentum," Co-authors: Greg Clinch, John Lyon and Gary Twite.

"Valuing complex compensation packages," Co-author: Steve Usher

"A rational model of momentum and contrarian return behaviour," Co-authors Wei Li and Joe Zhang

"Characterizing multiplicative risk prudence in the presence of background risks," Co-author: George Wong.

"When can factor exposure 'explain' arbitrage profits," Co-author: Spencer Martin

"Corporate Social Responsibility and Corporate Donations," Co-author: Ning Gong

Awards

2010 Quantitative Finance/Risk Management/Derivative Instruments Finance, Corporate Governance Conference Prize

1998 Geewax-Terker Prize

1994-95 Batterymarch Fellowship

2008 FEC Teaching Award

2006 FEC Teaching Award

1994 Hauck Teaching Prize

1993 Outstanding Teaching Award (Wharton)

Grants

Australian Research Grants Council Discovery Grant, "Three Decades of Financial Distress and Corporate Restructuring in Australia" 2008-10, joint with Paul Kofman and Howard Chan. $104,537

Australian Research Grants Council Discovery Grant, "Storage and the Hotelling Valuation Principle: Understanding the Dynamics of the Oil Industry" 2007-09, joint with Richard Heaney. $345,000

National Science Foundation Grant, "Call and conversion of convertible bonds" 1985-1987, joint with George Constantinides, US$300,000

Professional Society Activities

Director: Asian Finance Association

Founding Member: Australian Financial Integrity Research Network

Fellow: Australian Society of Certified Practicing Accountants.

Member: Asian Finance Association, American Economics Association, American Finance Association, American Mathematical Society, European Finance Association, Western Finance Association.

Doctoral Colloquium Fellow: AFAANZ 2003 Colloquium, 2005 Colloquium.

Doctoral Consortium Fellow: AFAANZ 2004 Consortium

Doctorial Consortium Fellow: Asian Finance Association 2005

Doctorial Consortium Fellow: FMA Asia 2010

Australian Society of CPA's 1999 Research Lecture

FIRN Doctoral Tutorial Discussant: 2005-07.

FIRN Local Convener: 2006-present.

Managing Editor:

International Review of Finance, 2004-2008

Associate Editor:

Journal of Finance, 2000-2003

Journal of Financial Research, 1999-2006

Accounting and Finance, 1999-2002.

Journal of Financial and Quantitative Analysis, 1992-1996.

Review of Financial Studies, 1988-1994.

International Review of Finance, 2008-present

Editorial Board:

Accounting and Finance, 2002-present

Business Research, 2007-present

Insights: The Faculty of Economics & Commerce, 2007-present

Ad Hoc Referee:

Agenda
American Economic Review
Australian Journal of Management
Accounting and Finance
European Economic Review
European Journal of Finance
Financial Management
Financial Review
Journal of Accounting Research
Journal of Business
Journal of Business and Economic Statistics
Journal of Empirical Finance
Journal of Finance
Journal of Financial Economics
Journal of Financial Intermediation
Journal of Financial Services Research
Journal of Political Economy
Journal of Public Economics
Management Science
Mathematical Finance
Review of Accounting Studies
Review of Quantitative Finance and Accounting
Review of Financial Studies
Quarterly Journal of Economics

Program Committee:

Australasian Banking & Finance Conference: 2010.
American Economics Association Meetings: 1998.
American Finance Association Meetings: 2001.
Asian Finance Association Meetings: 2004, 2005, 2006, 2009.
Asian FMA Meetings, 2009, 2010

Finance Down Under Conference: 2009, 2010
European Finance Association Meetings: 2000, 2001, 2002, 2005, 2010.
European Financial Management Association Meetings: 1999.
Indiana University Symposium on Design of Securities and Markets: 1993.
Journal of Accounting Research Annual Conference: 2002-03.
Western Finance Association Meetings: 1990-91, 1994-95, 1997-98, 2004, 2007-10.
Review of Accounting Studies Annual Conference: 2004, 2005.
Singapore International Conference on Finance: 2008, 2009, 2010.
Society for Financial Econometrics: 2010

Reviewer:

Chair External Review Committee, ANU School of Business Department of Finance, Applied Statistics & Actuarial Science: 2010
Research Grants Council of Hong Kong: 1997, 2000, 2004, 2005, 2008, 2009.
National Science Foundation Proposals: 1990, 1991, 1994 and 1997.
Australian Research Council: 1994, 1995 and 2007.
Social Sciences and Humanities Research Council of Canada: 1993 and 1994.
Australian Accounting Research Foundation Exposure Draft on Director and Executive Disclosures.
Singapore Management University Quantitative Finance Programmes
External Reviewer, Accounting & Finance Department, Monash University: 2002

Discussant:

Accounting & Finance Association of Australia and New Zealand Meetings: 2006, 2007
American Finance Association Meetings: 1986-900, 1994-95, 2006.
Annual Conference on Financial Economics and Accounting: 1992 and 1996.
ANU Summer Camp: 2008, 2009.
Asia-Pacific Finance Association Meetings: 1999.
Asian Finance Association Meetings: 2004, 2005, 2006, 2009.
Asian FMA Meetings: 2010.
European Finance Association Meetings: 1995, 2002, 2005, 2010.
Fifth Annual Texas Finance Festival: 2003.
FIRN Research Day: 2010
Paul Woolley Centre on Capital Market Dysfunctionality Conference: 2008, 2009
Simulation Based & Finite Sample Inference in Finance Conference: 2003.
Singapore International Conference on Finance: 2008, 2009
Western Finance Association Meetings: 1993 and 1997.

Session Chair:

Accounting & Finance Association of Australia and New Zealand Meetings: 2003-05.

Asian Finance Association Meetings: 2004, 2005, 2006, 2009.

Asian FMA Meetings: 2010.

Australasian Finance & Banking Conference: 2003.

American Finance Association Meetings: 2001.

European Finance Association Meetings: 2002, 2005, 2010.

Western Finance Association Meetings: 1995.

Keynote Speaker:

Accounting & Finance Association of Australia and New Zealand Meetings: 2003.

Australasian Banking & Finance Conference: 2002.

Asian FMA Meetings: 2010.

Organizer:

The Dollars and Sense of Bank Consolidation: MBS Conference 2002.

Risk Management and Pricing for Financial Institutions: Lessons from the Closed-End Fund Industry: Wharton Financial Institutions Centre Conference 1995.

Finance Down Under Conference: 2007, 2008, 2010.

Conference Presentations:

Australian Conference of Economists: 2006.

Asian Finance Association Meetings: 2004, 2005 and 2006.

Asian FMA Meetings: 2010.

Australasian Q-group: 1999, 2004.

HKUST Annual Finance Symposium: 2004.

Third National Symposium on Financial Mathematics: 2004.

AGSM Finance and Accounting Camp: 1996, 1997 and 1999.

American Finance Association Meetings: 1986, 1989, 1990, 1996, 1997 and 1998.

NBER Summer Institute: 1998.

Annual Conference in Financial Economics and Accounting: 1995 and 1996.

American Mathematical Society Meetings: 1996.

European Finance Association Meetings: 1995, 2002, 2005, 2010.

NBER Financial Risk Assessment and Management Conference: 1995.

N.J.C.R.F.S. Conference in Security Design and Innovations in Financing: 1993.

Western Finance Association Meetings: 1984, 1989, 1993, 2010.

Sixth Annual Conference MSMESB: 1991.

Australasian Banking and Finance Conference: 1989 and 2007.

ZEW Centre for European Economic Research, Mannheim: Conference on the Economics of Charitable Fundraising: 2009

Seminar Presentations:

Australian Graduate School of Management
Australian National University
Bond University
Boston College
Carnegie-Mellon University
Central Queensland University
Chinese University of Hong Kong
Columbia University
Commodity Futures Trading Commission
Cornell University
Dartmouth College
Duke University
Fields Institute for Research in Mathematical Sciences
Hong Kong University of Science and Technology
Humboldt University
Indian School of Business
Insead
London Business School
London School of Economics
Macquarie University
Massey University
Melbourne Business School
MIT
Monash University
National University of Singapore
New York University
Northwestern University
NUS Risk Management Institute
Odense University
Ohio State University
Queen's University
Queensland University of Technology
Singapore Management University
Stanford University

The State University of New Jersey, Rutgers
University of Aarhus
University of Adelaide
University of Alberta
University of British Columbia
University of California Berkley
University of California Irvine
University of California Los Angeles
University of Chicago
University of Frankfurt am Main
University of Houston
University of Illinois Champaign,
University of Oregon
University of Maryland
University of Melbourne
University of Michigan
University of Minnesota
University of New South Wales
University of North Carolina Chapel Hill
University of Queensland
University of Sydney
University of Technology Sydney
University of Vienna
University of Western Australia
University of Washington in St Louis
Vanderbilt University
Victoria University Wellington
Washington University
Yale University

Manuscript Reviewer:
University of Chicago Press
Cambridge University Press
Academic Press.

Teaching Experience

Derivatives-related courses: Honours, Masters and PhD courses on options, futures, swaps, mortgage-backed securities and exotics.

Corporate Finance-related courses: Honours, Masters and PhD courses on capital budgeting, mergers and acquisitions, corporate taxation, agency problems, information asymmetries, and security design.

Corporate Governance: MBA course

Real Options and Resource Projects: Undergraduate and MBA courses

Financial Management: Executive MBA course

Executive Education:

ABN Amro, Australian Graduate School of Management, KPMG, Liechtenstein Global Trust, Melbourne Business School, PaperLinx, PWC, Susquehanna Investment Group, Telstra Risk Management and Assurance, Turkish Capital Markets Board, Wharton School Pension Funds and Money Management Program

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Administrative Positions

University of Melbourne

Cost Containment Committee: 2007.

Business@Melbourne Coordinating Committee: 2007-2008.

Melbourne Business School Committee: 2006-present

Academic Structures Working Group: 2008-2009.

University of Melbourne, Faculty of Business & Economics:

Deputy Dean: 2006-2007.

FEC Advisory Board: 2007-2008.

Convener Melbourne Derivatives Research Group: 2006-present.

Finance Seminar Convener: 2007-2009.

FIRN Local Coordinator: 2006-present.
PhD Coordinator, Department of Finance: 2007, 2009-present.
Accounting and Finance Department Committee: 1999.
Research and Research Training Committee: 1999, 2007, 2009-present.
International Committee: 2009.
SSPL Committee: 2009.
Academic Promotions Committee: 2009-present.
Head, Department of Finance: 2010-present.

University of Melbourne, Melbourne Business School:
Director Ian Potter Centre for Financial Studies: 2000-2005
Academic Planning and Development Committee: 2002-2005.
Curriculum Committee: 2002-2005.
Seminar Convener: 2000-2005.

The Wharton School:
Convenor Corporate Finance Workshop: 1995-1997.
Wharton Fellows Fund Oversight Committee: 1993-1997.
Recruiting Committee: 1995-1996.
Finance Seminar Convener: 1992-1994.

Stanford Graduate School of Business:
Finance Seminar Convener: 1988-1990.
Deans Advisory Committee: 1986-1988.