Report to the AER: Analysis of Criticism of 2015 Determinations

Graham Partington

and

Steven Satchell

Report Dated: October 2015.

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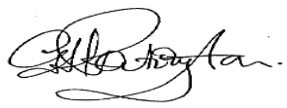
EXPERT WITNESS COMPLIANCE DECLARATION

We have read "Expert witnesses in proceedings in the Federal Court of Australia" and this report has been prepared in accordance with those guidelines. As required by the guidelines, we have made all the inquiries that we believe are desirable and appropriate and no matters of significance that we regard as relevant have, to our knowledge, been withheld from the Court.

Signed



Graham. H. Partington

Steven. E. Satchell

BACKGROUND

We have been requested by the AER to provide advice as detailed below:

Part A.

A. Having reviewed the relevant material, provide a report setting out an overall view with reasons, whether Satchell & Partington (the consultant) consider it necessary to change any of the findings in McKenzie & Partington, *Report to the AER – Advice on the Return on Equity, [Part A1 —A5]*, October 2014, Partington, *Report to the AER – Advice on the Return on Equity (Updated)*, April 2015 and Partington & Satchell, *Report to the AER: Return on equity and comment on submissions in relation to JGN*, May 2015.

The AER, without intending to directly or by implication provide a view of the relative importance of the expert reports and material (listed in attachment 1) wishes to highlight listed in items A1 to A7 below. While the authors of those reports have expressed numerous views, under A1 to A7, some of their specific views are noted. These issues must be specifically addressed in the consultant's report. This is not intended to restrict the consultant in any way or direct his review. In addition to these, the consultant should review and address all relevant issues that support his overall conclusion.

The consultant is also required to respond to any criticisms levelled against positions/findings in the consultant's previous advice to the AER.

A1. Frontier Economics, *Key issues in estimating the return on equity for the benchmark efficient firm* June 2015. In this report, Frontier Economics considers (among other things):

i. There is no proper basis for the AER's decision to apply the foundation model approach and not adopt empirical estimates from the Black CAPM and Fama French Three Factor Model (FFM).

ii. The possibility that the current low risk free rates could result in higher equity risk premiums provide a reasonable basis to uplift the allowed return on equity.

iii. The manner in which the AER had regard to evidence before it, in particular, international beta estimates, Wright approach, independent expert reports, and broker reports result in a return on equity estimate that is unreasonable.

A2. NERA, *The cost of equity: Response to the AER's final decisions for the NSW and ACT electricity distributors and JGN*, June 2015. In this report, NERA (among other things):

i. Responds to criticisms of its previous reports by McKenzie, Partington and Satchell.

A3. CEG, *Measuring risk free rates and expected inflation*, April 2015.

i. CEG's report includes analysis of beta estimates for CGS, which it shows are currently negative. CEG considers this (and other evidence) implies that the fall in CGS yields cannot be assumed to be associated with a fall in the cost of equity. Consequently, if CGS yields are used as a proxy for the risk free rate in the CAPM, then it requires an upward adjustment of around 1.0%, and if historical excess returns are used to estimate the MRP, these must be adjusted upwards by around 0.7%.

ii. At this stage, the AER does <u>not</u> require the consultant to respond to CEG's opinion on the approach that provides the best estimate of

forecast inflation for the purposes of population the AER's Post Tax Revenue Model (PTRM).

A4. NERA, *The relation between the MRP and the risk free rate: Evidence from independent expert reports*, April 2015. In this report, NERA (among other things):

i. Finds evidence of an inverse relationship between the MRP and the risk-free rate from independent expert reports. Consequently, it generates a current MRP estimate from independent expert reports that incorporates an (estimated) adjustment for an inverse relationship between the MRP and risk free rate.

A5. Frontier Economics, *Review of the AER's conceptual analysis of equity beta*, June 2015. In this report, Frontier considers (among other things):

i. The AER's statement in the recent decisions that risk arising from disruptive technologies cannot be reasonably classified as systematic risks is too strong a claim to make.

ii. The AER's statement that to the extent that these risks are systematic in nature they would be reflected in the AER's Australian empirical beta estimates is a very unlikely outcome.

A.6. Frontier Economic, *Cost of equity estimates over time, Report prepared for Ergon Energy*, June 2015

A.7. NERA, *Further assessment of the Historical MRP: Response to the AER's final decisions for the NSW and ACT electricity distributors*, June 2015

Part B

B. The AER's foundation model approach includes steps (4 and 5) that allow consideration of other information to inform its final estimate of the overall return on equity estimate. Under these steps, the information and the role the AER gives to such information (as applied in the recent decisions) are set out in the table below.

A number of service providers have criticised the AER's analysis in its recent regulatory decisions of the evidence arising from independent valuation reports, broker reports and the comparison with the debt risk premium. These service providers have submitted that such evidence does not support the AER's estimate of the equity risk premium (and therefore the return on equity). Further, proposals from the service providers have sought to characterise the AER's recent decisions on the return on equity as heading downwards when evidence on market sentiment and market practice is indicating that the premium for investing in equity is increasing. Essentially, the service providers are critical of the AER's equity risk premium estimate of 4.55 per cent as unreasonably low in current market conditions.

Table 1 Role assigned to relevant material in informing the overall return on equity estimate

Relevant material	Role	Reasons for role
Wright approach	Directional role to inform movements in overall return on equity	See discussion under equity models.
Return on debt relative to the return on equity	Directional role to inform movements in overall return on equity	Equity investors are residual claimants (after creditors) on a firm's assets in the event of default. But there is no consensus on the size or strength of any relationship between debt and equity returns. Directional evidence may be used with caution.
Return on equity estimates from independent valuation (expert) reports	Directional role to inform movements in overall return on equity	Issues of comparability, timeliness, and adjustments made to suit a different objective mean that point or range estimates are not directly comparable. Directional evidence may be used with caution.
Return on equity estimates from broker reports	Directional role to inform movements in overall return on equity	
Return on equity estimates from other regulators' decisions	Directional role to inform movements in overall return on equity	
Transaction multiples, trading multiples	No role	A transaction multiple may imply that the regulatory rate of return is different to that required by investors, but we cannot know by how much. Given the limited usefulness of this material, and other issues of comparability, we are not satisfied that the allowed rate of return objective is furthered by its use.
Return on equity estimates and profitability measures from financial statements	No role	The practical application of this material is the same as a transaction multiple.

The consultant is required to review the following criticisms of the AER's analysis of independent valuation reports, broker reports and the debt risk premiums. When reviewing the criticisms please have regard to the AER's decision for JGN on the return on equity against the following claims made by the service providers.[1]

B1. The AER's use of estimates from independent expert reports is flawed

i. Jemena, Attachment 9-2, Rate of return proposal, pp. 76-78

ii. ActewAGL, Appendix 8.02, Return on equity – detailed proposal, pp. 47-48

iii. AGN, Attachment 10.1, Rate of return, pp. 38-39.

B2. The AER has erred in concluding that its estimate of the return on equity is consistent with other market evidence

i. ActewAGL, Appendix 8.02, Return on equity – detailed proposal, p. 3

ii. AGN, Attachment 10.1, Rate of return, p. 39

[1] Note that the service providers' claims may be made with reference to decisions other than the JGN decision. However, as the JGN decision is the AER's most recent decision, it is appropriate to test all claims against the JGN decision as the content of this decision is either consistent with that in other decisions or reflects the AER's updated analysis and position. Note also that any documents referenced by the service providers can be provided on request.

iii. Energex, Revised regulatory proposal, p. 99-100.

B3. The imputation-adjusted estimate of the equity risk premium from independent valuation reports was higher than 5 per cent in all but two reports, and therefore this class of evidence does not support the AER's estimate of the equity risk premium (of 4.55 per cent)

i. ActewAGL, Appendix 8.02, Return on equity – detailed proposal, p. 47

ii. AGN, Attachment 10.1, Rate of return, pp. 38-39.

B4. There are flaws in the AER's assessment of the equity risk premium versus the debt risk premium

i. ActewAGL, Appendix 8.02, Return on equity – detailed proposal, p. 48.

B5. Broker reports are not sufficiently reliable and/or do not support the AER's conclusion once appropriate adjustments are made to their results

i. AGN, Attachment 10.1, Rate of return, p. 39

ii. Energex, Revised regulatory proposal, p. 100.

Part C

C A number of service providers have criticised the AER's analysis of independent expert reports. These service providers have submitted that AER should have greater regard to uplifts applied initial risk free rate and/or market risk premium estimates (as distinct from uplifts for specific company risk). In support for their proposals, these service providers refer to Incenta Economic Consulting (2015), NERA (2015b), and Grant Samuel (2015).

Incenta Economic Consulting (2015) states that it finds:

> "…almost 90 per cent [of independent expert reports] having adjusted the risk free rate and / or the market risk premium in response to changes in the risk free rate".

As an example, Grant Samuel and Associates' independent expert report for Hastings Diversified Utilities Fund in 2012 stated:[2]

> "global interest rates, including long term bond rates, are at very low levels by comparison with historical norms reflecting the very substantial amounts of liquidity being pumped into many advanced economies (particularly Western Europe and the United States) to stimulate economic activity. Effective real interest rates are now extremely low, if not negative in some cases (e.g. the United States). We do not believe this position is sustainable and, in our view, the risk is clearly towards a rise in bond yields. Conceptually, the interest rates used to calculate the discount rate should recognise this expectation (i.e. they should be forecast for each future period)

[2] Reproduced in NERA (2015b) at p. 9.

but for practical ease market practice is that a single average rate based on the long term bond rate is generally adopted for valuation purposes.

The passage above from Grant Samuel & Associates notes that a risk free rate estimate derived from Commonwealth Government securities with a 10-year term to maturity may differ from expectations of the risk free rate with a term longer than 10 years. Similar circumstances may also apply to the other CAPM parameters.

The passage above from Grant Samuel & Associates also notes that independent experts generally adopt a single average return on equity for valuation purposes. For practical reasons, independent experts typically estimate CAPM parameters with a ten-year term, while the actual investment horizon (of parties to the transaction subject to the expert report) may be longer.

In cases such as the one presented in the passage above from Grant Samuel & Associates, an independent expert may uplift a return on equity estimate to account for differences in CAPM parameter estimates with a ten-year term relative to CAPM parameter estimates with a longer term.

We also note that regulated service providers will have their allowed rate of return reset at the start of each regulatory control period (typically every five years).

The consultant is required to consider:

- the extent to which uplifts to initial return on equity estimates as described above are relevant to the AER's return on equity estimate; and

- the extent to which such uplifts contribute to the achievement of the allowed rate of return objective and reflect the prevailing conditions in the market for equity funds."

INTRODUCTION

There has been extensive criticism of the AER's determinations in the submissions that we have been asked to review. The volume and variety of this criticism is so extensive that it does not permit a convenient summary in this introduction. However, the interested reader, seeking a concise summary in relation to the key issues, should see the material under the heading "Summary Discussion" given for particular topics in the table of contents. The critical conclusion on reviewing and carefully considering this criticism of the AER's determinations is that we see no compelling reason to change any of the findings in McKenzie & Partington, *Report to the AER – Advice on the Return on Equity, [Part A1 —A5]*, October 2014, Partington, *Report to the AER – Advice on the Return on Equity (Updated)*, April 2015 and Partington & Satchell, *Report to the AER: Return on equity and comment on submissions in relation to JGN*, May 2015.

We note that the Queensland Council of Social Services (QCOSS, 2015) expressed a concern about the risk of cherry picking where multiple asset pricing models are used. In response to this expression of concern Partington (2015) makes the following statement:

Even with the best will in the world, there is a natural inclination to select the parameters that favour self-interest as being the truth, so there is a natural tendency towards cherry picking. As a test of this we propose the following hypothesis: Where a choice of parameters are available, the regulated businesses will tend to select the values resulting in a higher rate of return and those groups representing users will tend to select the values resulting in a lower rate of return. This hypothesis is well supported by the submissions that we have been asked to review.

As an on-going test we are carrying this hypothesis forward across our reports. In the current submissions that we have been asked to review the hypothesis continues to be well supported.

PART A

A Having reviewed the relevant material, provide a report setting out an overall view with reasons, whether Satchell & Partington (the consultant) consider it necessary to change any of the findings in McKenzie & Partington, *Report to the AER – Advice on the Return on Equity, [Part A1 —A5]*, October 2014, Partington, *Report to the AER – Advice on the Return on Equity (Updated)*, April 2015 and Partington & Satchell, *Report to the AER: Return on equity and comment on submissions in relation to JGN*, May 2015.

Having reviewed the relevant material we find no reason to make any substantive changes to the findings in the reports referenced above. We provide our reasoning in addressing the questions below and in the discussion of the reports referenced by those questions.

Part A1

A1. Frontier Economics, *Key issues in estimating the return on equity for the benchmark efficient firm* June 2015. In this report, Frontier Economics considers (among other things):

iv. There is no proper basis for the AER's decision to apply the foundation model approach and not adopt empirical estimates from the Black CAPM and Fama French Three Factor Model (FFM).

v. The possibility that the current low risk free rates could result in higher equity risk premiums provide a reasonable basis to uplift the allowed return on equity.

vi. The manner in which the AER had regard to evidence before it, in particular, international beta estimates, Wright approach, independent expert reports, and broker reports result in a return on equity estimate that is unreasonable.

Summary Discussion

In response to Frontier (2015, Key), our first observation is that the CAPM is ubiquitous in relation to the estimation of the cost of equity. The same cannot be said for the alternative models proposed by the regulated businesses. Whilst much of the criticism of the CAPM has some validity, the good points of the CAPM need repeating, it is parsimonious, it is widely used and understood, and, importantly, it is an equilibrium model. Equilibrium theories for the Fama and French models are much less well-founded and the model itself is in the process of revision by Fama and French. The zero-beta CAPM is an equilibrium model, but we have made the case, that was not refuted by the submission of the regulated businesses, that there are troublesome problems in estimating the zero beta return.

There is a possibility that current low interest rates could result in higher equity risk premiums, but we do not think this is likely and more importantly we have seen no convincing evidence that this is the case. We discuss the evidence from experts' reports in more detail under question A4 below where we review NERA (2015, R_f). The NERA report finds no evidence of a relation between the market risk premium used by experts and the risk free rate as measured by the return on government bonds. There is evidence that a subset of expert reports have increased the risk free rate above the government bond rate, but that this evidence is heavily influenced by reports from two expert firms. As we have discussed previously we give little weight to the Wright approach. Low bond yields tell us that the required return for low risk assets is low. We do not see a corollary that therefore the return required on risky assets rises relative to low risk assets. The Wright approach also runs counter to the widely accepted view that there is a negative relation between security prices and interest rates.

In terms of the role of international comparators in the estimation of beta we discuss these issues in more detail at A5 below. Here we note that the outcome depends very much on the comparator countries that you pick. We also make the point that betas for overseas comparators can be used to estimate the WACC without the problematic issue of relevering and we have previously shown how this can be done, see Partington (2015). In that analysis we used the relatively high US utility betas and showed that

the AER's allowed rate of return exceeded the WACC implied by the use of US utilities as comparators.

Further discussion

Frontier (2015, Key) are critical of Partington (2015) and Partington and Satchell (2015) for not providing solutions to many of the problems identified in their reports and/or for not providing return estimates for alternative models to the CAPM.[3] There are good reasons for the lack of solutions and estimates. Our argument is that many of the problems we identify are virtually intractable and estimates, such as those of the zero beta return, are so problematic and unreliable as to render them virtually worthless. The foregoing are the reasons why McKenzie and Partington (2014) and Partington (2015), although suggesting that both the Fama and French and zero beta CAPM could have a role to play in determining the required rate of return, also suggest that it is not clear how, and in particular that we would not recommend using empirical estimates of the Fama and French model to determine the cost of capital in the Australian context.

Fama and French and zero beta models

We have explained the problems in the use of the Fama and French three factor model and the zero beta CAPM at some length in Partington (2015), Partington and Satchell (2015) and in earlier reports, so we will not repeat all that detail here. We will, however, add a couple of recent results from the literature. First the results from the latest work of Fama and French (2015), in which they conclude for the Asia Pacific region that their five factor model does a better job of explaining returns than their three factor model. They also find that there is a book to market effect in returns, but

[3] For example, Frontier (2015, Key, para 57), Para 59 criticise Partington (2015) for failing to conclude on whether book to price factor is likely to be a proxy for risk, but to our knowledge the finance profession has yet to satisfactorily answer this question, so it seems unreasonable to expect Partington to supply a definitive answer.

a substantial part of this effect is driven by small stocks with a weaker effect for large stocks. In particular, they observe that while there is a large value (HML) premium in average returns, the average value of HML owes a lot to small stocks. On this basis, claims of an HML bias in CAPM estimates of returns for large stocks are less compelling. How large such a bias is, or whether it applies at all to large stocks in Australia is an open question. We therefore reiterate our observation in Satchell and Partington (2015, p14) that:

With the original Fama and French model under revision by its originators, this does not seem to be an appropriate time for the AER to adopt the FF model and follow a path that other regulators have avoided.

Second, we note that the paper by Beaulieu, Dufour and Khalaf (2012), reinforces our most recent discussion of technical problems in the estimation of zero beta returns, see Partington and Satchell (2015). Using γ as the notation for the return on the zero beta portfolio Beaulieu, Dufour and Khalaf observe (p3):

Identification: as $\beta i \to 1$, γ becomes weakly identified. Weak identification (WI) strongly affects the distributions of estimators and test statistics, leading to unreliable inference even asymptotically. This should not be taken lightly: reported betas are often close to one (see e.g. Fama and MacBeth, 1973). Further, even if estimated betas are not close to one, irregularities associated with WI are not at all precluded [in view of (1) and (2) above].

Beaulieu, Dufour and Khalaf have been working on this problem for over a decade and have developed improved estimation procedures. Applying these procedures they conclude that the estimate of the zero beta return is unstable over time. Although these improved procedures are a valuable contribution to the research literature, they involve complex econometrics and are not yet widely accepted. Consequently, we would not currently recommend them for regulatory use.

The quote below by Frontier (2015, Key, p63) ignores the unreliable econometric nature of estimates of zero beta returns, but does raise the problem of bounding such estimates.

The recent paper by Partington and Satchell (2015) now goes further to contend that our estimate of the zero beta return is unreasonable as it exceeds the rate on BBB debt.[153] Neither the AER, nor Partington, nor Satchell, have ever made an estimate of the zero beta return that is appropriate to account for the shortcomings and empirical limitations of the Sharpe-Lintner CAPM that have been acknowledged by the AER. Yet an estimate of the zero beta premium (3.34%) formed with respect

to returns on all Australian listed stocks over 20 years is rejected because it is higher than the most recent estimate of the debt premium. There is no basis for the implication by Partington and Satchell that they know the proposed upper bound on the zero beta return without providing any estimate or method for estimating the zero beta return.

Even if we considered the process of zero beta return estimation a worthwhile exercise, we agree that we could not empirically determine the upper bound of the zero beta return. As we have pointed out before, given that an inefficient portfolio is used as the proxy for the market portfolio there is an infinite possible set of zero beta returns and even when you constrain the estimate by using a regression model, what you get is very much determined by what you do. Hence the wide range of estimates previously submitted by regulated business. In short, there is no unambiguous empirical basis for determining what an upper bound should be. However, it is possible to obtain some guidance from theory. Applying the Brennan model the zero beta return should lie between the risk free lending and borrowing rates. The 3.43% zero beta premium puts the zero beta return in the realm of speculative grade bonds, which is well beyond the bounds imposed by the Brennan model.

The quote above also reveals another problem with the zero beta estimate relative to the government bond rate, it is not current. The current government bond rate is readily observed, the zero beta return has to be estimated. In the case above it takes twenty years of data to do so.

Models and realised returns

There is considerable discussion in the Frontier (2015, Key) report about the fit of models to realised returns. However, what we require to know in testing an asset pricing model is how well it describes ex-ante expected returns when security prices are in equilibrium. Empirical work attempts to examine how well the asset pricing model explains ex-post realised returns, which may not be a particularly good test. Fisher Black, for example, suggested that such tests might be telling us more about the shocks to expected returns (volatility) rather than the equilibrium expected returns.

It is more than fifty years since the introduction of the CAPM, but as a consequence of the difficulties in testing asset pricing models, we are still debating what the results

of asset pricing model tests mean and how we should correctly interpret the statistics arising from such tests. In this context Lewellen, Nagel and Shanken (2010) title their paper "A sceptical appraisal of asset pricing tests" and find that none of the asset pricing models perform particularly well. Since the consultants to the regulated businesses make much, in relation to Lewellen, Nagel and Shanken's paper, about the superior performance of the other models relative to the CAPM, we reiterate Lewellen, Nagel and Shanken's statement (p.189)[4]:

"The third key result is that none of the models provides much improvement over the simple or consumption CAPM when performance is measured by the GLS R2 or q."

We also note their observation that the set of portfolios used to test asset pricing models should include portfolios other than those created by the usual process of ranking by size and book to market.

Test of time and use

We agree with Frontier (2015, Key) that the CAPM has not performed well in terms of empirical attempts to fit the model to realised returns, but the CAPM has passed an important test. That test is the test of time. While academics are still debating the merits of the different asset pricing models, how they should be tested and what the appropriate test statistics are, the users of models have made up their mind about which model to use when estimating the cost of capital. The CAPM has had several decades of widespread practical use in estimating the cost of capital. None of the other models have passed the same test.

Consider, for example, the expert reports which are reviewed in the work of NERA (2015, R_f). There are a substantial number of reports where the CAPM is used. However, we would be very surprised if more than a handful of cases, if any, could be found where there was explicit use of the Fama French three factor model, or the zero beta CAPM. We would be surprised for two reasons, first our own experience, which suggests that such models are not used to estimate the cost of capital and second, had

[4] Additional relevant results in Kan, Robotti and Shanken (2013) are discussed below under A2.

there been such evidence, we would expect the regulated businesses to have made much of it. We expect there will be a few cases where experts make reference to such models in order to justify adjustments to the CAPM return. We also expect that such adjustments will be matters of judgement and we doubt there will be much analysis of the sort that Frontier asks for from the AER.

Adjusting returns

We sympathise with Frontier's (2015, Key) argument that the AER should present some measure of the quality of its cost of equity estimate and provide a quantitative analysis of the adjustments it makes to the CAPM returns. This might be done relatively easily if the estimate involved was just the OLS estimator for a given set of data. However, when a value is chosen from a range of values and the overall process involves both judgement and estimation the exercise becomes very difficult to carry out. With well-defined priors on the part of the AER, perhaps a Bayesian approach could be adopted, but we expect this would just shift the debate to arguments about the priors. There is no straightforward solution to the demands by Frontier (2015, Key). However, the role of judgement by the AER in such exercises seems to us entirely warranted and indeed inescapable.

Frontier (2015, Key) go to some lengths in discussing the low beta bias. At paragraph 44, point c, they say:

Low beta bias. The literature shows that the Sharpe-Lintner CAPM systematically underestimates the return on equity for stocks with low beta estimates.

While at paragraph 52 it is stated that:

...the beta range has nothing to do with the limitations or empirical shortcomings of the Sharpe-Lintner model.

We find this puzzling; if the statement at paragraph 44 point c is true then moving the estimated beta to a higher point in the range will surely lead to a reduction in any underestimate? We accept, however, that it is an open question whether this adjustment is too high, or too low.

In relationship to criticisms made in Frontier (2015, Key) about our unwillingness to concede that adding extra models should improve the cost of capital estimates, we have previously discussed in Partington (2015) and Partington and Satchell (2015), the problems with the alternative models and the conditions under which a weighted average across models can result in a worse estimate than a single model, the risks of cherry picking and the problems in adding more models to the regulatory menu. Here we note that the cost of capital is a model-dependent construct and that mixing across different models needs some notion of what the "true" cost of capital actually is. Whilst it may be of some intellectual comfort to believe in a true cost of capital independent of any model we will inevitably need to think that one of our models is true to assess such concepts as bias in estimation. To clarify the above point we could use a DDM model, a CAPM approach and a FF approach and each would give us an answer. We might be persuaded if all these answers were very close to each other that we had discovered the true cost of capital but if there was variation in the answers we would need to assess the extent to which we thought the models were sensible to weight the outcomes. This might lead us to some notion of Bayesian model averaging. While this may be interesting as a research idea, it is some way off providing a solid basis for regulatory practice.

Part A2

A2. NERA, *The cost of equity: Response to the AER's final decisions for the NSW and ACT electricity distributors and JGN*, June 2015. In this report, NERA (among other things):

ii. Responds to criticisms of its previous reports by McKenzie, Partington and Satchell.

Empirical asset pricing

NERA (2015, Re) makes reference to Kan, Robotti and Shanken (2013) in support of the superiority of the three factor model over the CAPM. The results, however, depend upon the characteristics used in sorting stocks into portfolios. When portfolios are formed by ranking on size and CAPM beta, rather than size and book to market, the

superiority of the Fama and French three factor model disappears. In the words of Kan, Robotti and Shanken (p.2620):[5]

…we examine the sensitivity of our model comparison results using 25 portfolios formed by ranking stocks on size and CAPM beta. Interestingly, the conditional CCAPM and ICAPM are the best performers in this context, both dominating the three-factor model at the 5% level in the OLS case. Again, precision plays an important role here, as other models with lower R^2s than the three-factor model are not statistically dominated.

They conclude (p.2630):

Thus, model comparison can be very sensitive to the test assets employed. However, the comparatively strong performance of ICAPM is a fairly robust empirical finding for the test portfolios we examine.

They also find the zero beta estimates to be implausibly high (p.2620):

…most of the estimated zero-beta rates are far too high to be consistent with plausible spreads between borrowing and lending rates, as required by theory.

Additionally, when Kan, Robotti and Shanken (2013) test the explanatory power of the market to book factor in the Fama and French three factor model, they find that it makes no incremental contribution. As they state (p.2621)

Finally, an important related question is whether a particular factor in a multifactor model makes an incremental contribution to the model's overall explanatory power… With an unconstrained zero beta rate, the much heralded book-to-market factor is not statistically significant in terms of covariance risk, but the size factor is.

Thus they conclude (p.2636):

Thus, surprisingly, we cannot reject the hypothesis that the expected returns generated by a two-factor model consisting of the market and smb equal those based on FF3.

We note however, that this result reverses when the zero beta return is constrained to be equal to the T-Bill rate.

We are not suggesting that these results are an endorsement of the CAPM, but rather that they highlight the difficulties of all attempts to fit asset pricing models to realised

[5] The ICAPM is the intertemporal CAPM which is a multi-period model as opposed to the standard CAPM which is a single period model The CCAPM is the consumption CAPM where risk is measured relative to consumption, rather than wealth as in the standard CAPM.

returns, including the work of NERA. The work of Kan, Robotti and Shanken (2013) reinforces our concerns about the nature of estimates of zero beta returns. The new result is that they call into question the book to market effect. While we caution against reading too much into one empirical result, we also note that Shanken is highly respected for his work in empirical asset pricing models, so this result should not be taken lightly. Taken together the results above support the case that what you get in empirical asset pricing is substantially influenced by what you do. As the work of Kan, Robotti and Shanken (2013) shows, the optimal approach, if there is one, is still a subject of research.

The motive for our discussion of Da, Guo and Jagannathan (2012) and Levy and Roll (2102) in earlier reports was not to suggest that the AER's application of the CAPM followed the approaches in these papers. It was the motivation of the papers that attracted our attention. Part of the motivation of both papers was to help explain the continued widespread practical use of the CAPM to measure the cost of equity despite the academic evidence against it. In this respect they are a defence of the practical use of the CAPM. However, we agree that following the approach of either of these papers would require modification of the application of the CAPM as used by the AER. Such modifications may be worthy of consideration, but much work would be required before such approaches became serious contenders for standard regulatory practice.

Zero Beta CAPM

There appears to be general agreement that there is a solid theoretical base to the zero beta CAPM. The two contentious issues that have arisen in relation to submissions to the AER are the estimates of the zero beta return and a largely semantic issue about the labelling of the Black, Vasicek and Brennan version of the zero beta CAPM. With regard to the labelling, and which specific model is in contemplation, this is not the major issue. The major issue is determining the return on the zero beta portfolio. We use the term zero beta CAPM as a label covering the three models as this label reflects the essential nature of the models and the substantive issue currently under debate.

NERA's (2015, Re) discussion on the econometric issues associated with estimation of zero-beta expected return is interesting and NERA make a number of good points. Unfortunately the problems raised by us do not seem resolved by NERA's approach. Whilst we do not have enough detail to be absolutely certain that we could reproduce their calculations we note, (page 32, para 2), that NERA uses an estimate of the zero-beta premium following the work of Litzenburger and Ramaswamy (1979) and Shanken (1992). However, Shanken (page 23,ibid) offers words of caution about the use of such procedures and cites a number of papers where both the method used and a closely-related method based on maximum-likelihood estimation occasionally throw up very large values (see Banz (1981), Amsler and Schmidt (1985)). This is, again, evidence of non-existence of moments, reflecting the very real possibility that these procedures can be quite unreliable. The unreliable nature of estimates of the return on the zero beta portfolio is also highlighted by the work of Beaulieu, Dufour and Khalaf (2012) discussed under A1 and also Kan, Robotti and Shanken (2013) as noted above.

We thank NERA (2015, Re) for pointing out an error in Partington (2015); it is indeed mean standard deviation space that the discussion should refer to and in this space the efficient frontier is a segment of a hyperbola. The substantive points however are unchanged. First, the estimate of the return on the zero beta portfolio is sensitive to the choice of the portfolio used to represent the market and it can be very sensitive to this choice. Second the sensitivity depends on the curvature of the efficient frontier lying between alternative portfolios used to represent the market.

At a theoretical level the choice of portfolio to represent the market leads to a multiplicity of possible values for the zero beta return and what you get in empirical work depends very much on what you do. The very substantial variation in the estimates provided by the regulated businesses, and the theoretical and empirical work showing the unreliable nature of zero beta return estimates, clearly suggests that estimates of zero beta returns are not appropriate for use in determining regulated returns.

Part A3

A3. CEG, *Measuring risk free rates and expected inflation*, April 2015.

iii. CEG's report includes analysis of beta estimates for CGS, which it shows are currently negative. CEG considers this (and other evidence) implies that the fall in CGS yields cannot be assumed to be associated with a fall in the cost of equity. Consequently, if CGS yields are used as a proxy for the risk free rate in the CAPM, then it requires an upward adjustment of around 1.0%, and if historical excess returns are used to estimate the MRP, these must be adjusted upwards by around 0.7%.

Summary Discussion

CEG (2015, β) suggest the use of a beta for government bonds that varies over time. While interesting this raises a number of issues. The first issue is that an extra beta estimate is required. Relatively, little is known about the properties of estimated betas for government debt and it has been commonly assumed, perhaps incorrectly, that the beta is zero.

The second issue is that the CEG approach involves an inconsistency. Resolving this inconsistency requires a new equilibrium model that is likely to result in a lower cost of equity than is obtained under the AER's current approach. Such a new equilibrium model may be worthy of consideration, but a considerable amount of research would be needed before we would recommend its adoption for the purposes of regulation. For example, CEG have provided an alternative approach to estimating a zero beta return, but is this appropriate?

Further Discussion

It has been common practice to assume that the beta of government debt is zero. Indeed, it is relatively common practice to assume that the beta of risky corporate debt is zero. Both the AER and consultants to the regulated businesses have made this assumption in the past in relation to the relevering formulas for equity betas. Our

view is that corporate debt betas are not likely to be zero, but they are likely to be small and the betas for government bonds are likely to be smaller still, if not zero. The ongoing debate about the magnitude of equity betas for the regulated businesses highlights the difficulties in obtaining precise estimates of beta. The difficulties of obtaining a precise estimate of beta are likely to be even greater when the beta to be estimated is of small magnitude. Since, the betas of government bonds have been little studied, little is known about their empirical properties. However, on the basis of what we know about varying estimates of equity betas, it would probably be unwise to rely exclusively on CEG's (2015, β) estimate. It seems plausible that government bond betas measured relative to the equity market may well have been negative in recent times, but how robust is the magnitude of the estimate? In any event, as we discuss below if the return on government bonds is treated as risky, the equity market is no longer the correct portfolio to estimate betas against.

A revised market portfolio

In CEG's (2015, β) approach government bonds are risky assets, so the market portfolio for risky assets includes both equities and government bonds. As we no longer have a riskless asset we also need to utilise a zero-beta CAPM. We show below, under reasonable assumptions, that the resulting cost of equity is likely to be lower than under the current application of the CAPM.

Let μ_i, μ_m be the expected arithmetic rates of return on asset i and the market m respectively. Let β_i, r_f be the population beta of asset i with respect to the market m and the riskless rate of return, respectively. The CAPM states:

$$\mu_i - r_f = \beta_i(\mu_m - r_f) \tag{1}$$

It follows that:

$$\mu_i = \beta_i \mu_m + (1 - \beta_i)\, r_f$$

We now address the question as to what happens if, as in CEG's analysis, the interest rate corresponding to the yield on Government bonds becomes stochastic.

The first point to note is that this will change the market portfolio, we now have a new portfolio of risky assets, which consists of the former market portfolio(with return r_{mt}) and the now risky bonds(with return r_{ft}) held in proportions ω and 1- ω respectively.

We denote the new market return by R_{mt}, which is given by;

$$R_{mt}= \omega r_{mt} +(1- \omega)r_{ft}. \quad (2)$$

As we no longer have a riskless asset, we have to resort to the zero-beta CAPM. This entails that

$$\mu_{0i} = \beta_{0i}\mu_{0m} + (1 - \beta_{0i})\, \mu_0$$

Where, μ_0 is the expected return on a zero-beta portfolio orthogonal to the market portfolio whose return is now given by R_{mt}, see equation (2), and with similar definitions for the other parameters with zero subscripts; for example, μ_{0i} is the expected rate of return on asset i, in a world with stochastic government debt and no riskless assets.

We note that a major point of the CEG report is to argue for an increase in the riskless rate by about 70 to 100 basis points, essentially by replacing r_f by an estimate of μ_0. However the notion that the expected rate of return on the benchmark-efficient business needs to be raised should be tempered by the realisation that the whole equilibrium model and hence all of the parameters will have changed. For example, μ_{0m} will almost certainly be less than μ_m as ω is likely to be between 70% to 80% and E(r_{ft}) will be less than μ_m.

The magnitude of β_{0i} relative to β_i is hard to determine but will be less under plausible circumstances. Overall, the assumption that government bonds are stochastic is quite likely to decrease the estimate of the expected rate of return on a benchmark-efficient business rather than increase it.

We can derive an expression for β_{0i} .

$$\beta_{0i} = \frac{\omega\sigma_{im} + (1-\omega)\sigma_{id}}{\omega^2\sigma_{mm} + (1-\omega)^2\sigma_{dd} + 2\omega(1-\omega)\sigma_{dm}}$$

Where σ_{im} is the covariance between asset i (e.g. the benchmark-efficient business) and the original market portfolio, m; σ_{mm} is the variance of the original market portfolio, σ_{dm} is the covariance between government 10 year bonds and the original market portfolio and σ_{id} and σ_{dd} are defined analogously. In comparison β_i is given by

$$\beta_i = \frac{\sigma_{im}}{\sigma_{mm}}$$

We assume, for simplicity, that the new mean-variance efficient set consists of m, the original market portfolio and d, the now risky debt. It is straightforward to show that the zero-beta portfolio will consist of holding the proportions a in m and (1-a) in d. The proportion, a, is given below;

$$\text{a} = \frac{(1-\omega)\sigma_{dd} + \omega\sigma_{dm}}{\sigma_{dd} - \sigma_{dm} - \omega(\sigma_{mm} + \sigma_{dd} - 2\sigma_{md})}$$

Inspection of the above formula suggests that a is now negative in most realistic cases, so that, in this framework, μ_0 will be less than E(r_{ft}). This follows from the higher expected returns on equity relative to debt, the higher volatility of equity relative to debt, the fact that in Australia , ω is circa 75%, and also that σ_{dm} is negative, a point established by CEG(2015, β). Taking all these points together, treating government debt as stochastic is very likely to reduce the estimate of the expected rate of return on the benchmark-efficient business.

Part A4

A4. NERA, *The relation between the MRP and the risk free rate: Evidence from independent expert reports*, April 2015. In this report, NERA (among other things):

Finds evidence of an inverse relationship between the MRP and the risk-free rate from independent expert reports. Consequently, it generates a current MRP estimate from independent expert reports that incorporates an (estimated) adjustment for an inverse relationship between the MRP and risk free rate.

Summary Discussion

As it turns out the results in NERA (2015, R_f) are driven more by the risk free rate that experts use, rather than their MRP. Some experts have substantively increased their estimate of risk free rate above the CGS yield post 2010, but some experts have not done so. The observed increase in the risk free rate is particularly influenced by two firms of experts. These two firms supply over 40% of the reports where there are substantial increases in the risk free rate.

It is the experts who increase the risk free rate that drive the results in the NERA (2015, R_f) report, rather than changes made to the market risk premium. The market risk premium that was used in the expert reports, about 6%, is unrelated to the magnitude of the risk free rate as measured by the yield on ten year government bonds (CGS) yield. Based on the results from the expert reports the case to increase the risk free rate is quite weak and there is no case to adjust the MRP. A more detailed discussion of NERA (2105, R_f) follows.

Further Discussion

As we have previously observed, we view expert reports as one form of survey evidence and we consider that survey evidence has a role to play in informing estimates of the market risk premium. However, we do not consider that the evidence from expert reports is so compelling as to over-ride other survey evidence, or the evidence of the history of returns.

While independent expert reports are intended to provide an arm's length assessment, we would not expect them to necessarily have the impartiality of say a judicial review. Independent experts may strive for an objective view but it seems unlikely that their

work will be entirely uninfluenced by their own commercial interests with respect to their current and potential future clients.

Our conclusion on experts' reports is that they supply relevant, but not definitive, information and considerable care needs to be taken in the analysis and interpretation of such reports. We have discussed problems in the analysis of such reports previously, McKenzie and Partington (2014). Here we comment on issues relevant to the NERA (2015, R_f) analysis.

We would like to take this opportunity to thank NERA for facilitating our analysis by supplying us with their data. In the course of providing this data NERA found some minor errors in their data and we have been supplied with corrected data. Similar problems were encountered by Incenta (2014 Addendum). While the data errors in NERA's work were not in general a substantive concern, they do suggest that experts' reports are somewhat difficult to deal with. Since the corrections involved no substantive changes to NERA's results and conclusions, our discussion is focused on NERA's main report. However, we do undertake some analysis of the corrected data.

In our prior advice on expert reports we recommended that the AER look to the components of the experts' cost of capital rather than their headline rate. We also commented on the potential for dependence in data drawn from experts' reports. Considering these issues leads to a rather different set of conclusions than those reached by NERA (2015, R_f).

Dependence in the experts' estimates

The experts are independent experts in the sense of being at arm's length from their clients. However, we previously advised that expert reports were likely to be dependent in a statistical sense. For example if ten reports are written by the same independent expert this does not provide ten independent observations of the market risk premium, indeed it may be the case that there is only one observation repeated ten times. NERA (2015, R_f) has accepted this point and makes a good job of explaining the resulting downward bias in the standard error of the estimate. Consequently, NERA attempts to correct the standard errors of their regression estimates. While there is an attempt to correct the standard errors, it is important to note there was no

attempt to adjust the magnitude of the estimates, perhaps because NERA believe that the dependence will not induce bias.

The problem of dependence in the magnitude of estimates can be illustrated as follows, suppose the true risk free rate is 4.5% and the true market risk premium is 7%. Further suppose that there are 100 reports supplied by two experts. Expert one writes seventy of the reports and expert two writes 30. Expert one adopts 5% and 8% for the risk free rate and the market risk premium respectively and expert 2 adopts 4% and 6%.

Treating the reports as representing 100 observations gives an estimate of the mean risk free rate as 4.7% and an estimate of the mean market risk premium as 7.4%. In forming these estimates the views of expert 1 get a 70% weight and the views of expert 2 get a 30% weight. However, if the two experts are equally good in their judgement the estimates should be equally weighted, in which case the estimate gives the true values of 4.5% for the risk free rate and 7% for the market risk premium. The problem in practice is that we don't know what weighting should be given to each expert firm and the reality, if we use each report as an observation, is that we weight each firm according to the number of reports they write. This turns out to be important in the current context, because two firms write more than 40% of the reports that use a substantially increased risk free rate.

Motivating the NERA report

NERA (2015, R_f, p iii) motivate their report as follows:

In a recent speech in New York that received widespread media attention, RBA Governor Glenn Stevens stated that:

'The possibility that, de facto, the risk premium being required by those who make decisions about real capital investment has risen by the same amount that the riskless rates affected by central banks have fallen may help to explain why we observe a pick-up in financial risk-taking, but considerably less effect, so far, on 'real economy' risk-taking.'

If, as RBA Governor Stevens conjectures, the MRP is inversely related to the risk free rate, then one should be able to find evidence of the relation in independent expert reports. Moreover, one should then be able to use an estimate of the relation to generate an estimate of the current MRP. In our 2013 report we did indeed find a relation. In this report we update the evidence and use an estimate of the relation to compute an estimate of the current MRP.

We make two observations with respect to this quote. First, as we explain more fully below, a key result of NERA's analysis is that there is no relation between the MRP that experts use and the risk free rate, measured as the return of Commonwealth Government Securities (CGS).

Second, Governor Stevens comment that there is a pick-up in financial risk taking suggests a reducing risk premium in financial markets, which is the risk premium relevant to the determination of the weighted average cost of capital. With regard to the risk premium that managers are requiring to undertake new projects this may have become disconnected from the risk premium in financial markets, but this does not change the market risk premium, or the return required by the suppliers of capital (the WACC). The alternative explanation, for the failure of reduced interest rates to stimulate investment, is pessimism on the part of managers about the returns that new investments are likely generate in a world where growth rates are not expected to be strong.

Managers' opinion on the risk premium

With respect to what managers think, the Duke CFO Global Business Outlook Survey, is a well-respected quarterly survey of mangers. According to the Second Quarter, June, 2015 survey, on average US mangers expect the return on the S&P 500 to be 6.81% over the next ten years with the 95% confidence interval running from 6.26% to 7.36% (see details below). The question in the Duke survey gives the ten year Treasury bond yield as 2.3% per annum. The implied risk premium is therefore 4.3%, so at least with respect to these managers it does not seem that there is a perception of a high market risk premium.

On May 18, 2015 the annual yield on 10-yr treasury bonds was 2.3%. Please complete the following:

	Mean	SD	95% CI	Median	Minimum	Maximum	Total
Over the next 10 years, I expect the average annual S&P 500 return will be: There is a 1-in-10 chance it will be less than:	0.62	8.03	-0.13 - 1.36	2	-50	60	443
Over the next 10 years, I expect the average annual S&P 500 return will be: Expected return:	6.81	5.96	6.26 - 7.36	6	-25	75	453
Over the next 10 years, I expect the average annual S&P 500 return will be: There is a 1-in-10 chance it will be greater than:	11.17	9.80	10.25 - 12.08	10	0	100	440

Source: US-Topline Duke Survey for June 2015.

Interpreting NERA's regressions

Tables 4.3, 4.4 and 4.6 of the NERA (2015, R_f) report present regressions involving adjusted and unadjusted estimates of the MRP using three alternative regression models per table. All tables lead to substantively similar results. For illustrative purposes we reproduce Table 4.3 below. The middle two columns of regression results show the estimated intercept and slope for the regression of the experts' market risk premium on the ten year commonwealth government bond yield (CGS yield). The slope coefficient in this table is not significantly different from zero. In other words, there is no significant relation between the experts' market risk premium and the yield on CGS.

The estimate of the experts' risk premium is given by the intercept at 6.162%. The alternative regressions in NERA's Tables 4.4 and 4.6 also fail to find any relation between the experts' MRP and the yield on CGS.

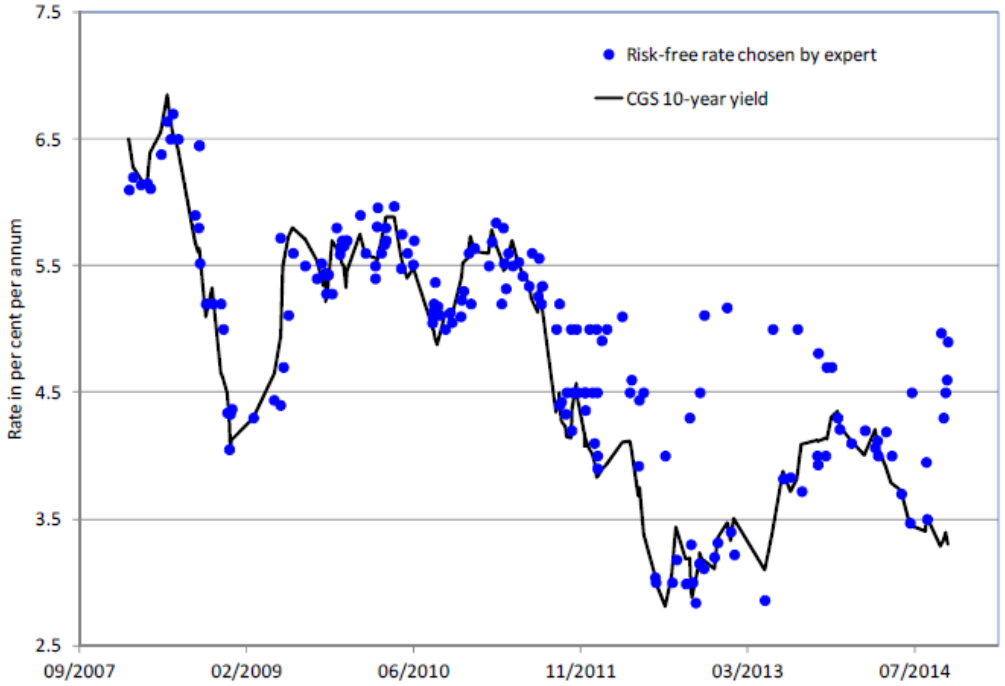
Table 4.3
Unadjusted expert assessments of the *MRP* and the risk-free rate

	Dependent variable: $MRP_{IER} + RFR_{IER} - RFR_{CGS}$		Dependent variable: MRP_{IER}		Dependent variable: $RFR_{IER} - RFR_{CGS}$	
	Intercept	Slope	Intercept	Slope	Intercept	Slope
OLS	**7.376**	**-0.194**	**6.162**	0.022	**1.215**	**-0.216**
	(0.182)	(0.038)	(0.156)	(0.033)	(0.155)	(0.032)
RE	**7.376**	**-0.194**	**6.162**	0.022	**1.215**	**-0.216**
	(0.305)	(0.064)	(0.372)	(0.078)	(0.283)	(0.059)
GMM	**7.376**	**-0.194**	**6.162**	0.022	**1.215**	**-0.216**
	(0.205)	(0.042)	(0.167)	(0.036)	(0.198)	(0.038)

Note: Data are from the Connect-4 database, the ASX and the RBA. MRP_{IER} is the MRP chosen by the independent expert, RFR_{IER} is the risk-free rate chosen by the independent expert and RFR_{CGS} is the 10-year yield interpolated from the RBA files f16.xls, f16hist.xls and f16hist2013.xls. The results are generated by regressing each dependent variable on RFR_{CGS}. OLS denotes ordinary least squares, RE, random effects and GMM the generalised method of moments. Standard errors are in parentheses. An estimate in bold differs significantly from zero at the 5 per cent level when inference uses the standard error that sits directly below the estimate.

Tables 4.3, 4.4 and 4.6 show that if you compute the difference between the risk free rate that experts use and the interest rate on CGS there is a significant negative relation between this difference and the CGS yield (see the last two columns of regression results in Table 4.3). It is this relation that drives the results of the regression given in results columns 1 and 2 of Table 4.3. The apparent inference from these regression results is that as CGS yields have fallen experts have used a higher risk free rate than the CGS rate, which would lead to a higher cost of capital if applied in the CAPM. However NERA's (2015, R_f) Figure 4.1, reproduced below, casts a somewhat different light on this inference.

Figure 4.1
Plot of risk-free rates chosen by experts and 10-year CGS yield against time



From Figure 4.1 in it is clear that there is a change in behaviour from late 2011 onwards. Prior to this the expert reports tended to use a risk free rate that was close to the CGS yield. From late 2011, however, some expert reports adopted estimates of the risk free rate that appear to be substantially above the CGS yield, while others continued to use estimates of the risk free rate closely approximating the CGS yield. The plot in Figure 4.1 suggests that it is the subset of expert reports adopting the substantially higher yield that drive the negative relation between experts' adjustment of the risk free rate and the CGS yield.

Using the data supplied to us by NERA we compute the average risk free rate used in each expert report and compare it with the CGS yield. We then filter the data to identify which of the expert reports have a risk free rate that diverges substantially from the CGS yield. The criterion that we use as a filter is that the report has a risk free rate at least 0.5% higher than the CGS yield post 2010. There are 28 such observations and 43% of these reports were provided by two firms. Other filters would give qualitatively similar results. For example if the filter was set to post 2010

observations 0.25% higher than the CGS rate, there would be 40 observations and 43% of them would come from two firms. Thus the subset of the reports driving the regression relation have a heavy weighting from a small number of firms.

In the light of the foregoing analysis an appropriate interpretation of the data is that on average the expert reports examined have a risk free rate about 20 basis points above the CGS yield. However, this result is largely driven by a subset of the post 2010 reports, where some reports contained a risk free rate that was at a substantial premium to the CGS rate. In turn the subset with the premium had a heavy weighting of dependent observations since they were provided by a small number of firms. Some of the experts clearly have a view that the risk free rate is substantially above the CGS rate, but on the basis of evidence it cannot be said that this is a consensus view. We find that the evidence of a need to lift the risk free rate for use in the CAPM is quite weak and we see no case to lift the market risk premium.

Part A5

A5. Frontier Economics, *Review of the AER's conceptual analysis of equity beta*, June 2015. In this report, Frontier considers (among other things):

iii. The AER's statement in the recent decisions that risk arising from disruptive technologies cannot be reasonably classified as systematic risks is too strong a claim to make.

iv. The AER's statement that to the extent that these risks are systematic in nature they would be reflected in the AER's Australian empirical beta estimates is a very unlikely outcome.

Summary Discussion

In addition to discussing the impact of disruptive technology Frontier (2015, β) also revisits the unlevering/relevering debate. With respect to disruptive technology, it is clearly not a systematic risk as it can be diversified away. With respect to unlevering and relevering this is both problematic and unnecessary.

Further Discussion

Systematic risk

A systematic risk is one that investors cannot diversify away. The impact of disruptive technology on the returns to the regulated businesses can clearly be seen to be diversifiable. A simple diversification strategy would be for investors to invest in disruptive technology firms and/or the physical assets, and more generally invest in stocks that have a positive covariance of returns with respect to the returns of disruptive technology investments.

Since we do not consider the impact of disruptive technology to be a systematic risk we do not consider that it would be captured by estimates of beta, however recent they are. We agree with the AER, that any adjustment for the impact of disruptive technology should be made by adjustment to the cash flows, for example by increasing the depreciation allowance. We suggest that this could be done if and when there is some more substantive evidence of the impact, such as companies making announcements to shareholders about asset value impairment, writing down asset values and seeking to minimise new capital expenditures.

Utility Betas

We agree with Frontier (2015, β) that utilities tend to be low risk assets and so have low asset betas. We also agree that the addition of leverage increases the equity beta above the asset beta and that this is due to the increased volatility of the cash flow to equity, rather than increases in bankruptcy risk. However we do not agree that it is a useful exercise to take the equity betas of overseas utilities and relever them. Not only is this process subject to uncertainty and debate about the appropriate formula to use, particularly where tax systems differ, more importantly as we show below, it is unnecessary.

There is also the fundamental question of how close the underlying business risks are and, how similar is the impact of leverage, between the domestic and overseas utilities. For example, if they really are similar why do American utilities have lower leverage ratios than Australian utilities, when it is generally considered that the

American tax system is more favourable to leverage?[6] In Partington (2015) we urge care in making such international comparisons and we also show that when such comparisons are made it is unnecessary to go through the unlevering/relevering process. Since that material is instructive we reproduce it in full below:

With respect to the use of betas estimated for overseas utilities, we consider that attempts to re-lever them to some assumed level of leverage in Australia are likely to be unreliable. This is because the problems of re-levering that we refer to above are compounded by institutional differences across countries. For example, evidence from Vietnam suggests that utility betas are very low. However, given the difference in institutional, political and taxation regimes, we would not consider it appropriate to re-lever such estimates and apply them in Australia. Damodaran estimates the utility betas for developing counties at 0.14, but we would not suggest Australian utility betas were that low. Care also needs to be taken in utilising betas from the USA, which has different conditions to Australia (notably with respect to the tax regime). Consequently, we do not consider a re-levering exercise for overseas utilities to be particularly useful. Furthermore, we would caution against the substantial weight that SFG applies to beta estimates from the USA in determining appropriate betas for Australian regulated businesses. The conclusion to be drawn from beta estimates for utilities in other markets is that they generally have relatively low betas. The appropriate conclusion from such evidence is that betas for utilities are generally lower than for average risk companies and a beta of less than one is appropriate for the Australian regulated businesses.

Given that the AER makes use of a plain vanilla WACC and thus makes the adjustment for taxes in the cash flow rather than the discount rate, the re-levering exercise is unnecessary. The theories of capital structure that underpin the re-levering exercise are either that changes of capital structure have no effect on the overall cost of capital, or that any effect is on the after tax cost of capital via the interest tax shield. Given that the AER allows for the tax shield benefit of debt in the cash flow the latter theory does not apply. Under the former theory the WACC is a constant independent of leverage. In other words, the plain vanilla WACC is a constant.

Once the WACC is calculated at any particular level of leverage, that cost of capital applies at all levels of leverage. Of course the cost of equity varies across different levels of leverage, but it is the overall cost of capital (WACC), not the cost of equity, that is the objective of the AER's determinations.

These principles can be illustrated using beta data from the USA, thus demonstrating why we do not need to re-lever such estimates. We take the data from Damodaran as cited in footnote 34 of SFG (2015b). Damodaran gives the utility industry beta as 0.59 at a debt to value leverage ratio of 38% and an unlevered equity beta (zero leverage) as 0.42. If, as SFG advocate, we can use the beta of US utilities as indicative of the risk of Australian utilities, then we can use the raw beta value to estimate the cost of equity. That cost of equity can then be used in the plain vanilla WACC calculated at the same leverage level as for the US utility. If re-levering is considered acceptable,

[6] We suspect the answer may be that American utilities have higher operating risks and so use less leverage, but there could be other explanations.

then we can also use the unlevered beta to directly estimate the cost of equity and hence the WACC at 100% equity financing.[7]

For these purposes we utilise the AER's parameters for risk free rate of 3.55% and the market risk premium of 6.5% as per the Transgrid (2014) draft determination. Using the unlevered beta is easiest as plugging the unlevered beta into the CAPM gives the WACC at 100% equity:

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

$$= 3.55\% + 0.42(6.5\%)$$

$$= 6.28\%$$

This comes in below the AER's allowed rate of return of 7.24%.

Alternatively we can compute the cost of equity using the raw beta at 38% leverage. This cost of equity is given by:

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

$$= 3.55\% + 0.59(6.5\%)$$

$$= 7.39\%$$

In order to calculate the WACC, we need the cost of debt. However, the cost of debt as assumed by the AER in the Transgrid determination is too high, as it reflects a higher level of leverage than 38%. We consider two alternatives for the cost of debt. First we take the debt to be AA grade since this is utility debt, which has generally been rated as having excellent characteristics with respect to business risk. With a 38% level of leverage, the debt would probably be rated as having modest to intermediate financial risk. Thus, the debt would likely be rated AA or A by Standard and Poors. According to Bloomberg data, AA Australian denominated corporate debt is currently yielding 3.79% for a ten year maturity.

The WACC is then given by:

$$WACC = \frac{D}{V} \times r_d + \frac{E}{V} \times r_e$$

$$= 38\% \times 3.79\% + 62\% \times 7.39\%$$

$$= 6.02\%$$

This is reasonably close to the 6.28% WACC calculated for 100% equity above (as it should be) and the two calculations would be approximately equal if we increased the cost of debt by 70 basis points to 4.49%. This latter cost is close to the current yield that Bloomberg reports for BBB debt

[7] The unlevered equity beta is also equal to the asset beta.

with a seven year maturity. However, 4.49% is substantially below the AER's trailing cost of debt of 6.67%. Substituting the AER's trailing cost of debt into the WACC formula gives:

$$WACC = \frac{D}{V} \times r_d + \frac{E}{V} \times r_e$$

$$= 38\% \times 6.79\% + 62\% \times 7.39\%$$

$$= 7.16\%$$

This result is again below the AER's allowed return of 7.24%. On the basis of these calculations we find no evidence that the USA data suggests that the AER's allowed return is too low. We also note that Damodaran calculates the WACC for USA utilities at a low 4.07%, driven in part by current very low interest rates in the USA. While these calculations do give some comfort to the AER, we reiterate our earlier caution that too much weight should not be given to inter-country comparisons and overseas betas.

Part A6

A.6. Frontier Economic, *Cost of equity estimates over time, Report prepared for Ergon Energy*, June 2015

Summary Discussion

A key point of Frontier (2015, Time) is that changes in the government bond rate have a bigger role to play than changes in the market risk premium in the AER's estimate of required returns. There is a good reason for this, it has been traditional to assume that the market risk premium is relatively constant and that the best estimate is the long run average of the realised market risk premium. The current government bond rate is what it is and is easily measured.

Frontier's (2015, Time) complaint is that not enough weight is being given to the "market cost of equity implied by share prices" or the "market signal". These are labels for the application of some form of the dividend growth model (DGM) over a two month period to derive an implied market risk premium. Accurately tracking changes in the market risk premium using the DGM and two months of data is a fanciful notion. To suggest that this is the market signal is a very long stretch indeed.

Further Discussion

In computing an estimate of the market risk premium from historical returns NERA (2015, History) argues for the longest period possible (many decades) in order to reduce the standard error of the estimate. Of course the nature of standard errors differs for estimates from the DGM, but we have no reason to believe the method is so accurate that a two month estimation period suffices, our belief is quite the contrary. With the historic MRP, we just have measurement error to deal with. In dealing with the DGM we add the problems of model error, biased inputs to the model, assumptions about the long term growth rate and the problem of sticky dividends.

There are several possible variants of the DGM model that can be used and several ways such models may be implemented. This can make a substantial difference, as can be seen in Frontier (2015, Time) by comparing the estimates reported for the AER in Figure 2 and the Bloomberg model in Figure 4. It is also well established that the inputs used in the implementation of DGM models, which are analysts' forecasts of earnings, dividends and target prices, are upward biased. Furthermore it is clear that there has been extensive debate about what the appropriate long term growth rate should be. See, for example, McKenzie and Partington (2013, DGM) Table 2, where alternative forecasts of the long term growth rate vary from 0.31% to 6.5%. Neither is this value necessarily a constant.

As we have also pointed out, rather than providing a good tracker of required returns as prices change, the DGM is an unreliable tracker because of sticky dividends. In this respect we conclude Partington (2015, p.50)

Thus, in times of sharply moving prices, the dividend growth model is at its most unreliable. When there has been a sharp rise in dividend yields resulting in historically high dividend yields, there is a particular risk that overestimates of the cost of equity will result and the reverse when there has been a sharp fall in dividend yields resulting in historically low dividend yields.

Given the problems with the DGM we concluded in Partington (2015, p.51):

Indeed, we would caution against relying on month by month, or even year by year, estimates from the DGM. Averaging measurement error over several periods is likely to reduce the error and therefore, we would recommend taking the mean over several years. In this way the DGM could be used to get a ball park - although likely upward biased figure - for the cost of equity.

Our conclusion in this respect has not changed. In determining the market risk premium, it takes an extremely hopeful view about the properties of the DGM estimate to contemplate weighting it, as Frontier does, at 50%.

Part A7

A.7. NERA, *Further assessment of the Historical MRP: Response to the AER's final decisions for the NSW and ACT electricity distributors*, June 2015

Arithmetic and geometric returns

NERA (2015, History) makes a repeated case that if we are estimating the mean for one period using data over a number of past periods (denoted by T) then they are unaware of any work that suggests the superiority of geometric returns or combinations of geometric or arithmetic returns in situations when the data are iid or correlated. We see no compelling reason why the situation described above is the only one that the AER should consider. For the sake of argument, however, we consider this restricted case below and demonstrate that geometric returns can be a superior estimator.

NERA (2015, History) makes the point that the AER does not compound its estimate of the rate of return and thus should only consider a single period return. However, the point of setting the regulatory return is to select a rate at which new investment is a zero NPV activity. Underlying the rate setting, therefore, is the concept that the return is compounded.

However, we shall temporarily accept that the above is the valid context to consider the rival merits of arithmetic versus geometric returns. It is true that arithmetic means will be unbiased in these circumstances, but as Jacquier, Kane and Marcus (2005) point out, it is a noisy estimator. Indeed, if we were to think of the true geometric rate of return per annum being μ, then the quantity that interests us, and, presumably NERA in the constrained context that they have defined, is $\exp(\mu) - 1$, the implied arithmetic rate of return per annum. Now, suppose that the data are iid log-normal in the sense of following a log-normal random walk with drift. So if prices

P_t are log-normal iid (μ, σ^2) then $P_{t+1} = P_t \exp(\mu + \sigma z_{t+1})$, where z_{t+1} is assumed normally distributed iid mean 0 and variance 1. We stress that these assumptions are not necessary for our conclusions but are introduced to spare the reader too much wading in mathematics.

Now, following the NERA approach, an arithmetic mean based on T observations will have an expected value of $\exp(\mu + .5\sigma^2) - 1$. Thus, even if we used a very large amount of data (large T), we would always overestimate $\exp(\mu) - 1$. Suppose now we decide to use the geometric mean based estimator of the arithmetic mean, namely,

$G_T = \prod_{t=1}^{T} P_t^{\frac{1}{T}}$-1. A straight-forward calculation shows that $E(G_T) = \exp(\mu + \frac{\sigma^2}{2T}) - 1$.

We see immediately that as T becomes large, our estimator becomes an asymptotically unbiased estimator of $\exp(\mu) - 1$. Thus, depending on the circumstances, there is a good case for using geometric returns and the above argument will extend to more complex cases.

Other issues

NERA (2015, History) p.28 advocate the use of the longest possible series to minimise standard error of the estimate and use the following quote from Goetzmann and Ibbotson (2007)

One of the major issues with statistical estimation of the realized equity risk premium is that a very long time series of stationary returns is required to achieve a high degree of confidence in the estimate. The longer the data series, the more accurate the equity risk premium calculation, as long as the fundamental expectations have remained the same

We agree that using long data series are desirable subject to stationarity and no change in fundamental expectations. We also accept that there is a trade-off between getting a long data series and risking the effects of structural breaks. However, there are important issues to do with changes in market circumstances, taxation rules, currency regimes and so on, which makes it highly likely that the stochastic process generating returns is such that there will be potentially more information gleaned from some sort of conditioning. We note, however, concerns that we have previously expressed about the risk of an ad-hoc approach, and also cherry picking, when

restricting the analysis to particular sub-periods of the data. Bearing this caution in mind, the idea of looking at sub-periods seems to us to be warranted.

While we are in favour of using as much data as possible, it should be recognised that it is not all of the same quality. Estimates of returns from the 1800's based on handful of stocks with prices averaged between high and low prices on a monthly basis are rather different to current return measurements for indices such as the ASX 200. This provides another reason for considering sub-periods and for more heavily weighting data from more recent observations, but we agree with NERA that the use of overlapping data reduces the precision of the estimates, and we also agree with NERA that the presentation of standard errors is desirable. NERA also states

We recommend that the AER remove the column of geometric means from its table of results.

The notion that there is no information in geometric returns and that they should be discarded seems somewhat draconian. We refer readers to the section above.

PART B

We were asked to review the criticisms (labelled B1 to B5 below) of the AER's cross check analysis against independent valuation reports, broker reports, other regulators decisions and debt risk premiums. The regulated business position is summarised by AGN (2015, Attachment 10.1) as follows, p39:

When correctly interpreted none of the AER's cross check evidence actually supports its return on equity estimate and the AER's estimate lies below or at the low end of each of its cross checks undertaken in step 4.

In our opinion this criticism is overstated. The AER can take some comfort from its cross checks, but these crosschecks are at best in the nature of ballpark checks and in several cases the ballparks are relatively big. Consequently, limited weight should be given to this evidence.

We note the AER's statement regarding how expert reports, brokers reports and regulatory decisions should be used as a cross check.

Issues of comparability, timeliness, and adjustments made to suit a different objective mean that point or range estimates are not directly comparable. Directional evidence may be used with caution.

(See *Table 2 Role assigned to relevant material in informing the overall return on equity estimate*, in the section headed Background above)

The AER are similarly cautious with respect to the cross check of the return on debt relative to the return on equity, stating: *Directional evidence may be used with caution*.

Such caution in the use of this evidence is warranted.

B1. The AER's use of estimates from independent expert reports is flawed

In the material that we were asked to review there was considerable debate about what Grant Samuel did, or did not say/mean. It would seem, in this case, that the best people to explain the Grant Samuel report would be the firm Grant Samuel. That said, Grant Samuel might well have objectives in forming its estimates that diverge from the appropriate objectives in determining a regulatory cost of capital. There also

appears to be some ambiguity in the role played by adjustments to the risk free rate in determining the uplift to the initial CAPM estimate. More importantly, we consider that one data point (report) in the available evidence should receive relatively little weight. Since this is analogous to survey evidence with only one response, the extent of debate on the Grant Samuel report seems excessive relative to the weight it should receive. The AER (2015, JGN) considers a somewhat larger sample but observes (p.3-474) that:

Only 12 reports included a discounted cash flow analysis with information on a return on equity estimate. These 12 reports were provided by only three independent valuation firms, with 9 of the 12 reports being provided by Grant Samuel & Associates.

Thus even in this larger sample the number of observations is small. The number of independent observations is smaller again and heavily weighted to the views of Grant Samuel. The range of reported values is quite wide and with a small sample of dependent observations we expect a large standard error. This standard error is probably so large as to encompass both the AER's estimate and estimates from the regulated businesses. So while the AER could take some comfort from their analysis of the expert report sample we would not place much weight on it.

It would be better to consider a larger sample, this however requires extending the sample beyond reports on utilities and hence would be relevant to the market wide, rather than firm specific, risk premium. One such analysis has been undertaken by NERA (2015, R_f). As discussed in Part A above, NERA's estimate of the market risk premium used by experts is 6.16%. NERA does present evidence that some experts have increased their estimate of the risk free rate. However, as discussed in Part A this evidence is not compelling. Our conclusion on expert reports is that the case to increase the risk free rate is quite weak and there is no case to increase the MRP.

B2. The AER has erred in concluding that its estimate of the return on equity is consistent with other market evidence

The material that we have been asked to review here focussed on the AER's use of expert reports, the Wright approach, broker's reports, and comparison with the decisions of other regulators. We have dealt with the issue of expert reports in B1 above. In previous reports and Part A above we have recommended against giving

weight to the Wright approach. In our opinion, therefore, there is little point in either the AER's analysis, or the analysis of the regulated businesses, as it relates to the Wright approach.

AGN's claim (Attachment 10.1, p39) that brokers' reports are an unreliable source of evidence sits uneasily with the regulated business's advocacy of the DGM, which relies on the forecasts of brokers' analysts. The AER's estimate the risk premium (4.55%) is very close to the midpoint of the reported range (4.5%) for the imputation adjusted risk premium. However, as with the expert reports, there is the problem of a small sample size. The standard error of the estimate is likely to be substantial and so would likely admit a substantial range of values as being consistent with this data.

Criticism, in relation to the AER's cross check against the decisions of other regulators, is summarised by AGN (2015, Attachment 10.1) p39:

In relation to reliance on other regulators' decisions, such decisions cannot be used as direct evidence or as a cross check to support the AER's estimates in circumstances where that process is entirely circular. Past decisions will also not have regard to forward looking prevailing market conditions relevant to AGN's access arrangement review.

It seems to us that criticism of the AER's comparison of its decision with other regulators is unwarranted. If, for example, the AER's decision resulted in a risk premium that was very substantially different to that of other regulators that would be a cause for further investigation. Indeed we anticipate that if the AER's risk premium was noticeably below that of other regulators the regulated businesses would be raising this as a matter of substantial concern. However, as with independent expert reports, the risk premium estimates across different regulators are likely to have some dependence.

With regard to the currency of the regulatory comparisons, their forward looking nature and relevance to prevailing market conditions, the AER restricted its analysis to recent regulatory decisions and in particular presented evidence from other regulators' decisions made in 2015. We consider this appropriate.

B3. The imputation-adjusted estimate of the equity risk premium from independent valuation reports was higher than 5 per cent in all but two reports, and therefore this class of evidence does not support the AER's estimate of the equity risk premium (of 4.55 per cent)

As discussed in part B2 above, the sample is small and heavily weighted to the opinions of one firm. Since the observations are not independent of each other counting reports with a particular value for the risk premium is likely to be a misleading exercise. Also see our discussion, at A4 above, of how bias can arise in estimates from expert's reports when expert's opinions are weighted by the number of reports that they have written.

B4. There are flaws in the AER's assessment of the equity risk premium versus the debt risk premium

As we have observed in previous reports comparisons between the returns on debt and equity can be misleading. This is because the return on debt is calculated as a promised return and the return on equity is calculated as an expected return. The difference between them therefore reflects differences in expectations and the default risk on the debt. If the default risk is high enough the promised return on debt can exceed the expected return on equity. However, the usual state of affairs is relatively low default risk, such that the promised return on debt is reasonably close to the expected return on the debt. Consequently, it is usual for the return on equity to exceed the promised return on debt. It is reassuring, therefore, that the AER's cost of equity exceeds the cost of debt. The premium over the cost of BBB rated debt of 260 basis points is of a healthy magnitude, but it is difficult to judge whether this is the appropriate magnitude. So while this evidence provides some comfort to the AER, it is not compelling.

B5. Broker reports are not sufficiently reliable and/or do not support the AER's conclusion once appropriate adjustments are made to their results

See our discussion of brokers' reports at B2.

Part C

Brief from the AER

C A number of service providers have criticised the AER's analysis of independent expert reports. These service providers have submitted that AER should have greater regard to uplifts applied initial risk free rate and/or market risk premium estimates (as distinct from uplifts for specific company risk). In support for their proposals, these service providers refer to Incenta Economic Consulting (2015), NERA (2015b), and Grant Samuel (2015).

Incenta Economic Consulting (2015) states that it finds:

> "…almost 90 per cent [of independent expert reports] having adjusted the risk free rate and / or the market risk premium in response to changes in the risk free rate".

As an example, Grant Samuel and Associates' independent expert report for Hastings Diversified Utilities Fund in 2012 stated:[8]

> "global interest rates, including long term bond rates, are at very low levels by comparison with historical norms reflecting the very substantial amounts of liquidity being pumped into many advanced economies (particularly Western Europe and the United States) to stimulate economic activity. Effective real interest rates are now extremely low, if not negative in some cases (e.g. the United States). We do not believe this position is sustainable and, in our view, the risk is clearly towards a rise in bond yields. Conceptually, the interest rates used to calculate the discount rate should recognise this expectation (i.e. they should be forecast for each future period) but for practical ease market practice is that a single average rate based on the long term bond rate is generally adopted for valuation purposes.

The passage above from Grant Samuel & Associates notes that a risk free rate estimate derived from Commonwealth Government securities with a 10-year term

8 Reproduced in NERA (2015b) at p. 9.

to maturity may differ from expectations of the risk free rate with a term longer than 10 years. Similar circumstances may also apply to the other CAPM parameters.

The passage above from Grant Samuel & Associates also notes that independent experts generally adopt a single average return on equity for valuation purposes. For practical reasons, independent experts typically estimate CAPM parameters with a ten-year term, while the actual investment horizon (of parties to the transaction subject to the expert report) may be longer.

In cases such as the one presented in the passage above from Grant Samuel & Associates, an independent expert may uplift a return on equity estimate to account for differences in CAPM parameter estimates with a ten-year term relative to CAPM parameter estimates with a longer term.

We also note that regulated service providers will have their allowed rate of return reset at the start of each regulatory control period (typically every five years).

The consultant is required to consider:

- the extent to which uplifts to initial return on equity estimates as described above are relevant to the AER's return on equity estimate; and
- the extent to which such uplifts contribute to the achievement of the allowed rate of return objective and reflect the prevailing conditions in the market for equity funds."

Subsequent to the initial brief, the AER supplied us with the following information regarding KPMG's increasing the risk free rate above the ten year Government Bond rate by using a blended rate.

In Australia, the spot yield to maturity of 10 year Government Bonds has traditionally been accepted as a proxy for the risk free rate in determining a cost of equity under the CAPM. Further, the market in 10 year Government Bonds is liquid such that, in our view, the current yield on Government Bonds represents the best indicator of the risk free opportunity cost of the assets for the forthcoming 10 year period at any particular point in time. In our view, it is appropriate to take into account both the current yield on 10 year Australian Government Bonds, as well as the longer term expected yield in order to calculate a blended risk free rate over a time horizon appropriate to the underlying business operations of Prima. In this regard, we note that long term estimates of the yield on 10 year Australian Government Bonds approximated 5.5%. Adopting the spot yield of 2.64% for a period of 10 years, followed by 5.5% from year 11 onwards results in a blended risk free rate estimate of 4.3%.[KPMG, Independent Expert Report for Prima Biomed, 22 June 2015, p. 60]

Changing the risk free rate when extending the time horizon.

Below we address the issue of increasing the risk free rate and in particular explicit (KPMG), or implicit (Grant Samuel), use of blended rates to replace the 10 Government bond rate. The argument's underlying such an action are based on two features;

- That the yield curve is not flat.
- That some investors have different time horizons than 10 years

Below we present some current estimates of Australian Government Bond yields from Bloomberg; these clearly show an increase in yields as maturities increase, which supports the first point. This will imply that the cost of capital will increase over time. The beta should change as well. We return to a discussion on beta later.

Current Australian Government Bond Yields

	YIELD
Australia Bond 2 Year Yield	1.79%
Australia Bond 5 Year Yield	1.96%
Australia Bond 10 Year Yield	2.58%
Australia Bond 15 Year Yield	2.90%

The second point is to do with investor time horizons. Turning to the quoted KPMG text above; they proceed by taking the geometric average of the 10 year and the 20 year rate. Whilst this has the benefit of simplicity, it has very little basis in economics.

To assess how rates should be blended requires a model and different models will lead to different answers opening the door to procedures that will favour non-objective advisory practises.

The essential features of such a model can be described succinctly. Consider two groups of investors who differ in their wealth and risk aversion. Group 1 only holds 10 year bonds; group 2 only holds 20 year bonds; this is the preferred habitat model for bond markets which has a long history in finance. Suppose that both groups have exponential utility and returns are normal; then the cost of capital in equilibrium becomes

$$\mu_i = \omega r_{10} + (1-\omega) r_{20} + \beta_i(\mu_m - (\omega r_{10} + (1-\omega) r_{20}))$$

Where μ_i is the cost of capital , μ_m is the expected rate of return of the market portfolio , r_{10} is the 10 year rate, r_{20} is the 20 year rate and ω is the blending proportion, in this model, ω is calculated as the risk tolerance of 10 year bond holders divided by the sum of the risk tolerances of the two groups. This is a positive number which lies between 0 and 1. In the special case where both groups have the same risk tolerance the blended rate would be the arithmetic average which in the above example would be 4.07%pa.

However, it is worth pausing at this stage of the argument and asking exactly which groups should be represented in such a model. The model generalises to an arbitrary number of different groups. Thus, it should reflect all groups in the market. In which case, the growing prevalence of high frequency trading and the overall reduction in holding times for equity positions suggest that other groups should be considered, namely those whose habitat is short duration debt and whose risk tolerance is very high. This would then create a blended rate lower than the 10 year rate and the cost of capital would actually fall.

Changing beta when extending the time horizon

We now turn our attention to changes in beta if we change the holding period. Again results here are typically model dependent and there is a literature on this issue., see Levhari and Levy(1977) who assume independently identically distributed returns

and Hong and Satchell (2014) who assume correlated returns; other authors have also addressed this problem. Levhari and Levy (op cit) prove that as the horizon increases, the beta of defensive stocks(those with beta less than one) decreases so that, even in the case of an upward sloping yield curve it is possible that the cost of capital may fall as we increase the length of the holding period.

Taking these arguments together, it is clear that questions of the impact of interest rate blending and investment horizon on the cost of capital are interesting and should be monitored by AER, but the arguments are sufficiently complex and the outcomes so ambiguous that a move away from the 10 year government bond rate seems completely unwarranted based on existing evidence.

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CURRICULUM VITAE

PERSONAL

Name: Graham Harold Partington

Address: Economics and Business Building (H69),

Finance Discipline, School of Business,

University of Sydney

NSW 2006

Australia

Telephone: +61 (0)2 9036-9429

Email: Graham.Partington@sydney.edu.au

HIGHER EDUCATION AND EMPLOYMENT

Academic Qualifications: B.Sc. (Hons) Economics/Forestry, University of Wales, 1971

MEc. (Hons) by thesis, Macquarie University, 1983.

My current position is Associate Professor of Finance in the Finance Discipline at the University of Sydney. I have been chair of the Finance Discipline and was also head of the postgraduate research program in finance. Concurrent with my position at the University of Sydney I was also the Education Director for the Capital

Markets Co-operative Research Centre PhD program. In a career stretching back more than thirty years I have held Associate Professorships in finance at The University of Technology Sydney and The University of British Columbia. I have also held academic positions at Macquarie University and the University of Bangor I have had extensive teaching and research responsibilities in finance and accounting as well as being head, or deputy head, of University Departments and Schools. I have been very influential in the design of several undergraduate and masters degrees in finance and also PhD programs.

I have written in excess of thirty consulting and expert witness reports covering topics such as valuation, the cost of capital, the value of imputation tax credits, and the market risk premium.

Awards and Major Research Grants

Awards

2013 Best paper prize for accounting, banking economics and finance, Global Business Research Conference.

2012 Bangor University: Honorary Visiting Senior Research Fellow title extended for the period 2013-2016.

2010 The GARP (Global Association of Risk Professionals) Prize for Quantitative Finance/Risk Management/Derivative Instruments, Finance and Corporate Governance Conference.

2009 The CFA (Chartered Financial Analyst) Prize Asian Investments, Asian Finance Association Conference

2009 Bangor University: Honorary Visiting Senior Research Fellow for the period 2009-2012.

2008: PhD students name their rock group after me "The Partingtons"

2001: Manuscript award for the best paper: Education Notes, *Accounting Research Journal,* 2000.

2000: Peter Brownell Manuscript Award. Awarded by the Accounting Association of Australia and New Zealand for the best paper in *Accounting and Finance*, 1999

1985: Butterworths Travelling Fellowship

Major Research Grants

2014-2016 Centre for International Financial Regulation (CIFR), *Measuring Market Quality: Current Limitations and New Metrics*, $170,000.

2007-2014: National Co-operative Research Centre Scheme, grant for the Capital Markets Cooperative Research Centre (CMCRC) $98 million ($49 million in cash and matching in kind contributions.) About $21 million cash over the term of the grant was under my management to run the scholarship and education program.

2000-2003: Australian Research Council, industry linked grant, *Intangibles, Valuation and Dividend Imputation* ($667,000).

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E. Lai, A. Ainsworth, M. McKenzie, and G. Partington, 2014, *The Value of Dividends: Evidence from Short-Sales*, Proceedings of the European Financial Management Association 2014 Annual Meetings, Rome, June.

G. Partington, and M. Kim, 2014 *The Dynamic Prediction of Company Failure: The Influence of Time Non-linearity and the Economy*, 2014 China Meeting of the Econometric Society, Xiamen, China, 25 - 27 June.

S. Foley, G. Partington, J. Svec and N. Pritcha, 2014 *The Effects of Underwriting Dividend Reinvestment Plans*, CFA-JCF-Schulich Conference on Financial Market Misconduct, Toronto, April.

R. Philip, P. Buchen and G. Partington, 2013, *Returns and Doubling Times,* Global Business Research Conference, Kathmandu. (Best paper prize for accounting, banking economics and finance.)

R. Philip, P. Buchen and G. Partington, 2013, *The transformation of returns to the time domain as doubling times*, 6th MEAFA Workshop, Sydney

M. McKenzie and G. Partington, 2012, *Selectivity and Sample Bias in Dividend Drop-off Studies*, 10th INFINITI Conference on International Finance, Dublin.

L. Hodgkinson and G. Partington, 2011 *Capital Gains Tax Managed Funds and the Value of Dividends*, Accounting and Finance Association of Australia and New ZealandConference, Darwin.

A. Jun and G. Partington 2011, *Taxes International Clienteles and the Value of ADR Dividends*, 9th INFINITI Conference on International Finance, Dublin.

A. Ainsworth, K. Fong, D. Gallagher, and G. Partington, 2010, *Taxes, Price Pressure and Order Imbalance around the Ex-Dividend Day*, Financial Management Association (FMA) Asian Conference, Singapore

H. Dang and G. Partington, 2010, *The Dynamic Estimation of Rating Migration Hazard*, Finance and Corporate Governance Conference, Melbourne, (Awarded the GARP prize in Quantitative finance/Risk Management/Derivatives).

Partington G and Xu Y 2010, *Rights issue announcements motives and price response,* 8th INFINITI Conference on International Finance - International Credit and Financial Market Integration: After the Storm?, Dublin.

A. Ainsworth, K. Fong, D. Gallagher, and G. Partington, 2009, *Institutional Trading Around the Ex-Dividend Day*, Asian Finance Association Conference, Brisbane. Awarded the CFA best paper prize (Asian Investments.)

H. Dang and G. Partington, 2009, *Rating Migrations: The Effect of History and Time*, Financial Management Association (FMA) European Conference, Turin.

H. Dang and G. Partington, 2008, *Rating History and the Rating Dynamics of Fallen Angels, Rising Stars, and Big Rating Jumpers*, Risk Management Conference: Credit and Financial Risk Management 40 Years after the Altman Z-score Model, Florence.

G. Partington, M. Stevenson, and J. Yao, 2008, *Predicting the Directional Change in Consumer Sentiment*, The 28th Annual Symposium on Forecasting, Nice.

M. Kim and G. Partington, 2008, *The Dynamic Prediction of Corporate Failure*, Australasian Finance and Banking Conference.

M. Dempsey and G. Partington, 2007, *Cost of Capital and Valuation Equations that Work for Any Tax System: Their Application under the Australian Imputation Tax System*, Multinational Finance Society Conference, Thessalonica.

H. Dang and G. Partington, 2007, *Modeling Rating Migrations*, Poster Session, CREDIT Conference, Venice

G. Truong and G. Partington, 2007, *Alternative Estimates of the Cost of Equity Capital for Australian Firms*, 20th Australasian Finance and Banking Conference, Sydney,

G. Partington, 2006, *Dividend Imputation Credits and Valuation*, Business Tax Reform Meet the Critics, Australian Tax Research Foundation Conference, Sydney.

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A. McAdam, and G. Partington, 2005, *Does the Choice of Share Price Matter when Examining Takeovers?* Accounting and Finance Association of Australia and New Zealand Conference, Melbourne.

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V. Alaganar, G. Partington and M. Stevenson, 2000, *Do Ex-dividend Drop-offs Differ Across Markets? Evidence From Internationally Traded* (*ADR*) *Stocks*, Accounting Association of Australia and New Zealand Conference, Hamilton Island.

G. Partington and S. Walker, 2000, *A Theory of Ex-Dividend Equilibrium Under Imputation and Some Empirical Results*, Accounting Association of Australia and New Zealand Conference, Hamilton Island,.

G Partington and S. Walker, 1999, *The 45-Day Rule: The Pricing of Dividends and the Crackdown on Trading in Imputation Credits*, Accounting Association of Australia and New Zealand Conference, Cairns.

S. Walker and G. Partington, 1999, *Optus: A Market Valuation Pre-listing*, Accounting Association of Australia and New Zealand Conference, Cairns.

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G. Hobbes, G. Partington and M. Stevenson, 1995, *Earnings Dividends and Returns: A Theoretical Model,* Asia-Pacific Finance Association Conference, Hong Kong.

G. Partington and E. Hutson, 1994, *Share Prices, Takeover Outcomes and the Expected Value Hypothesis*, invited paper at the University of Wales Finance & Accounting Colloquium, Gegynog.

G. Partington and E. Hutson, 1994, *Share Prices, Takeover Outcome sand the Volume of Trades*, Australasian Finance and Banking Conference, Sydney.

G. Partington, M. Peat and M. Stevenson, 1992, *The Probability and Timing of Corporate Financial Distress: Preliminary Results for Australia,* Australasian Finance and Banking Conference, Sydney.

G. Partington, M. Peat and M. Stevenson, 1991, *Estimating the Probability and Timing of Financial Distress,* Australian Institute of Bankers Conference, Melbourne.

P. Eddey, G. Partington and M. Stevenson, 1989, *Predicting the Probability and Timing of Takeover Success,* Australasian Finance and Banking Conference, Sydney.

G. Partington and T. Valentine 1984, *Finance for Australian Industry*, Metal Trades Industry Conference, Sydney.

G. Partington, 1983, *Why Firms Use Payout Targets: A Comparative Study of Dividend Policy,* Accounting Association of Australia and New Zealand Conference, Brisbane.

Unpublished Working Papers

H. Chu and G. Partington, 2001, *The Market Valuation of Cash Paid into Australian Companies: Evidence from Ex-Rights Day Share Price Behaviour,*.

G. Partington, 1993, *Miller Modigliani and Ohlson: A Note on Old Models in New Clothes,*.

Submissions to Government Inquiries and the Accounting Research Foundation

A. Ainsworth, A. Lee, G. Partington and T. Walter, 2013, *Analysis of ASX Cum Dividend Trading in the Ex Dividend Period 2003-2013: Submission to the Treasury on "Preventing Dividend Washing",* submission to Treasury Inquiry: Protecting the Corporate Tax base from Erosion and Loopholes - Preventing 'Dividend Washing'

G. Partington, 1991, *Pricing and Capital Adequacy: Are the Banks Getting it Wrong*? a submission to The Australian Banking Inquiry.

G. Partington, 1989, *Accounting in Higher Education*, a submission to The Review of The Accounting Discipline in Higher Education.

J. McKinnon and G. Partington, 1980, *Statement of Sources and Applications of Funds - A Comment on the Exposure Draft,* a submission to the Australian Accounting Research Foundation.

C. Le Gras and G. Partington, 1979, *Commission Rates - Sheep and Cattle Sales,* a submission to the Prices Justification Tribunal.

R. Chenhall and G. Partington, 1979, *Financial Effects of Corporate Taxation,* an invited submission, Australian Financial System Inquiry.

R. Chenhall and G. Partington, 1979, *Submission on Corporate Sector Finance,* a submission to the Australian Financial System Inquiry.

Miscellaneous

G. Partington, 1989, Careers in Finance, *Focus on Careers*; *National Graduate Careers Magazine*. (Updated 1993, at the request of the Department of Education Employment and Training, Careers Reference Centre.)

D. Leece, G. Partington and R. Skellington, 1975, *Not All Over the Audience*, Bangor Arts Festival, Bangor.

D. Leece, G. Partington, D. Power and R. Skellington, 1974, *A Spring Revue,* Bangor Arts Festival, Bangor.

MEMBERSHIPS

Accounting and Finance Association of Australia and New Zealand (Current))

American Finance Association (Current))

American Accounting Association (1978–1992)

European Accounting Association (1984–1987)

Australian Institute of Bankers (1993–1997)

Royal Forestry Society (1978-1984)

CURRICULUM VITAE

NAME Stephen Ellwood SATCHELL

CURRENT POSITION College Teaching Fellow

COLLEGE Trinity College, Cambridge University

DATE OF BIRTH 22nd February 1949

CAREER 1971-73- School Teacher

1973-74 - Computer Executive

1974-76 - Research Officer

1977-78 - Economic Advisor 10 Downing Street, (part-time)

1978-79 - Lecturer (Statistics Department) at LSE

1979-80 - Lecturer (Economics Department) at LSE

1980-86 - Lecturer, University of Essex

1986-2014 - Fellow(Title C), Trinity College

1986-89 - Assistant Lecturer, University of Cambridge

1989-2000 - University Lecturer at the University of Cambridge

1991-93 - Reader, Birkbeck College

2000-2009 - The Reader of Financial Econometrics, Cambridge University.

2010-2012 - Visiting Professor, Sydney University.

2011 - The Emeritus Reader of Financial Econometrics, Cambridge University.

2012- 2014 -Visiting Lecturer ,RHUL, London University

2013 -Professor, Sydney University

2014 - Fellow(Title E), Trinity College

CURRENT RESEARCH

I am working on a number of topics in the broad areas of econometrics, finance, risk measurement and utility theory. I have an interest in both theoretical and empirical problems. Many of my research problems are motivated by practical investment issues. My current research looks at alternative methods of portfolio construction and risk management, as well as work on non-linear dynamic models. I am active in researching the UK mortgage and housing markets.

I have strong links with Inquire (Institute for Quantitative Investment Research). This is a city-based organization that finances academic research on quantitative investment. I am also on the management committee of LQG (London Quant Group).

JOURNAL AFFILIATIONS

I am the Founding Editor of *Journal of Asset Management* (Palgrave Macmillan publishers) first issue, July 2000

I am the Series Editor of a book series, *Quantitative Finance* (Academic Press/Elsevier publishers).

I am the Editor of *Journal of Derivatives and Hedge Funds* (Palgrave Macmillan publishers). I am on the Editorial Board of *Applied Financial Economics*, *Journal of Financial Services Marketing*, *Journal of Bond Trading and Management. QASS, Journal of Financial Policy* and *European Journal of Finance* and senior associate editor of *Journal of Mathematical Finance.*

I am the Founding Editor of a journal for Incisive-Media Ltd, *Journal of Risk Model Validation.* and was editor for another of their journals, *Journal of Financial Forecasting.*

SUBMITTED PUBLICATIONS

Estimating Consumption Plans for Endowments with Recursive Utility by Maximum Entropy Methods, (with S. Thorp and O. Williams), submitted to *Applied Mathematical Finance*

Aligned with the stars: the Morningstar rating system and the cross-section of risk aversion (with S. Thorp and R. Louth)

"Individual capability and effort in retirement benefit choice" (with H. Bateman, S. Thorp, , J. Louviere, C. Eckert) submitted to *Journal of Risk and Insurance*

("Default and Naive Diversification Heuristics in Annuity Choice",(with H. Bateman, S. Thorp, , J. Louviere, C. Eckert) submitted to *Journal of Behavioural Finance*

Selfish Banks and Central Price Setting :The LIBOR price setting mechanism(with O. Ross and M. Tehranchi) submitted to OR

."Investigating a Fund Return Distribution when the Value of the Fund under Management is Irregularly Observed", with John Knight and Jimmy Hong, submitted to the *Journal of the Royal Statistical Society: Series A*.

Biased estimates of beta in the CAPM(with R.Philip and H. Malloch) submitted to *Applied Economics*

An Equilibrium Modelof Bayesian Learning(with O.Ross and M.Tehranchi) submitted to

Econometrica.

FORTHCOMING PUBLICATIONS

Time Series Momentum, Trading Strategy and Autocorrelation Amplification", (with J. Hong) in *Quantitative Finance. A*

Theoretical Decomposition of the Cross-Sectional Dispersion of Stock Returns(with A.Grant) forthcoming in *Quantitative Finance. A*

Evaluating the Impact of Inequality Constraints and Parameter Uncertainty on Optimal Portfolio Choice with A.Hall and P. Spence, forthcoming in *Applied Economics*

2015 Publications

On the Difficulty of Measuring Forecasting Skills in Financial Markets, (with O. Williams), in *Journal of Forecasting A* http://onlinelibrary.wiley.com/journal/10.1002/%28ISSN%291099-131X

2014 Publications

'Modelling Style Rotation: Switching and Re-Switching',(with Golosov, E.) in

Journal of Time Series Econometrics,(A) vol.6, no. 2, pp.103-28. Citation Information: Journal of Time Series Econometrics. Volume 0, Issue 0, Pages 1–26, ISSN (Online) 1941-1928, ISSN (Print) 2194-6507, DOI: 10.1515/jtse-2012-0028, April 2013

Steady State Distributions for Models of Locally Explosive Regimes: Existence and Econometric Implications (with J.Knight and N. Srivastava) in *Economic Modelling*. (A) Volume 41, August 2014, Pages 281-288, ISSN 0264-9993, http://dx.doi.org/10.1016/j.econmod.2014.03.015. (http://www.sciencedirect.com/science/article/pii/S0264999314001114)

A General Theory of Smoothing and Anti-Smoothing (with M.Mackenzie and W.Wongwachara) in *Journal of Empirical Finance, vol 28, pp 215-219.(A)*

Risk Presentation and Portfolio Choice (with H.Bateman, S. Thorp, J. Geweke, J. Louviere, C. Eckert) in *Review of Finance*. ((A+) 12/2010; DOI: 10.2139/ssrn.1776525, Source: OAI

'Financial Competence, Risk Presentation andRetirement Portfolio Preferences', (with - Bateman, H., Eckert, C., Geweke, J., Louviere, J., Satchell, S. and Thorp, S. *) in Journal of Pension Economics and Finance*, vol. 13, no. 1, pp. 27-61

Is Rating associated with better Retail Funds' Performance in Bull or Bear Markets? (with R.Louth and W.Wongwachara)in *Bankers, Markets and Investors*. In Vol 132,sep-oct 2014, 4,25

Testing linear factor models on individual stocks using the average F-test', (with S.Hwang,) in *European Journal of Finance*, vol. 20, no. 5, pp. 463-98. DOI:10.1080/1351847X.2012.717097; Version of record first published: 10 Sep 2012

'The sensitivity of beta to the time horizon when log prices follow an Ornstein-Uhlenbeck process', (with - Hong, K.H.) in *European Journal of Finance*, vol. 20, no. 3, pp. 264-90 DOI:10.1080/1351847X.2012.698992;Version of record first published: 24 Jul 2012

What factors drive the US labour market?(with S.Ahmed and P.Burchardt

Efund research.com 07/10/2014; http://ch.e-fundresearch.com/newscenter/120-lombard-odier/artikel/23090-what-factors-drive-the-us-labour-market

Art as a Luxury Good, with N. Srivastava in"*Risk and Uncertainty in the Art World*", edited by A. Dempster, ;Chapter 9, Bloomsbury Publishing, London; 2014.

Quantitative Approaches to High Net Worth Investment (with A. Rudd,) 2014, (London, Risk Books,2014).

High Net Worth Consumption: The Role of Luxury Goods" (with N. Srivastava,)in *Quantitative Approaches to High Net Worth Investment*, edited by Steve Satchell and Andrew Rudd, 183–212. London: Risk Books,2014.

Modelling Sustainable Spending Plans for Family Offices, Foundations and Trusts (with S. Thorp) in *Quantitative Approaches to High Net Worth Investment*, edited by Steve Satchell and Andrew Rudd, 213–251. London: Risk Books, 2014.

2013 PUBLICATIONS

How Much does an Illegal Insider Trade? (with A. Frino and H. Zheng) in *The International Review of Finance* Article first published online: 4 FEB 2013 | DOI: 10.1111/irfi.12006

Sequential Variable Selection as Bayesian Pragmatism in Linear Factor Models

(with John Knight, Jessica Qi Zhang) in *Journal of Mathematical Finance*

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Portfolio Skewness and Kurtosis (with A.D. Hall) in *Journal of Asset Management* 14, 228–235. doi:10.1057/jam.2013.18

2012 PUBLICATIONS

Financial Competence and Expectations Formation: Evidence from Australia, (with H. Bateman, C. Eckert, J. Louviere, and S. Thorp), *Economic Record*, Vol. 88, Issue 280, pp. 39-63, March 2012.

Unsmoothing Real Estate Returns: A Regime-Switching Approach"(with C. Lizieri and W. Wongwachara) in *Real Estate Economics*. 40(4).2012.

Why All Equity Portfolios Still Remain the Exception, (with R. Lewin and M. J. Sardy), in *Academy of Economics and Finance Journal*.3,73-83.

An Assessment of the Social Desirability of High Frequency Trading; in

JASSA; Finsia Journal of Applied Finance,vol 3,7-11.

Retirement investor risk tolerance in tranquil and crisis periods: experimental survey evidence (with H.Bateman, S. Thorp, J. Geweke, J. Louviere, C. Ebling.), in *Journal of Behavioural Finance. Vol 12,No 4.*

Some Exact Results for an Asset Pricing Test Based on the Average *F* Distribution

(with S.Huang)in *Theoretical Economic Letters. Vol 2,No5,435-437.*

Defining Single Asset Price Momentum in terms of a Stochastic Process

(with K.Hong); in *Theoretical Economic Letters.Vol 2,No 3,274-277.*

Nonlinearity and smoothing in venture capital performance data ,(with Michael McKenzie, ,Warapong Wongwachara), in *Journal of Empirical Finance.* DOI:10.10.10/jempfin.2012.08.004 Version of record first published: 4 Aug 2012

Discussion on "Log-optimal economic evaluation of probability forecasts" by David Johnstone. ;*Journal of the Royal Statistical SocietyA* (*2012)*

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2011 PUBLICATIONS

Large deviations theorems for Optimal Investment problems with large portfolios, (with B. Chu and J. Knight), *European Journal of Operations Research*, Vol. 211, No. 3 (June 2011), pp. 533-555..

Some New Results for Threshold AR(1) Models, (with J. Knight); in *the Journal of Time Series Econometrics*. Vol. 3: Issue 2, Article 1. DOI: 10.2202/1941-1928.1085

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The Optimal Mortgage Loan Portfolio in UK Regional Residential Real Estate (with Y. Cho and S. Huang) in *Journal of Real Estate Finance and Economics*, pp. 1-33-33., doi:10.1007/s11146-010-9269-9, (25 September 2010).

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Optimal Investment and Asymmetric Risk: A Large Deviations Approach, (with J. Knight), *Optimization: A Journal of Mathematical Programming and Operations Research*, vol. 59, no. 1, pp. 3–27, (January 2010).

Modelling Conditional Heteroscedasticity and Skewness using the Skew-Normal Distribution (with R. Corns), in *Metron,* vol 68, no. 3, (December 2010).

Using Approximate Results for Validating VaR, (with J. Hong, J. Knight and B. Scherer),

in *Journal of Risk Model Validation,* vol. 4, no 3 (June 2010).

2009 PUBLICATIONS

Fairness in Trading-a Microeconomic Interpretation (with B. Scherer); in *Journal of Trading,* , pp. 1-8, *(*Winter 2009).

On the Valuation of Warrants and Executive Stock Options: Pricing Formulae for Firms with Multiple Warrants/Executive Options, (with T. Darsinos), in *QASS*. vol. 3 (2), pp. 69-114.

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Collecting and High Net Worth Investment, (Elsevier, 2009).

Optimizing the Optimizers, (Elsevier, 2009).

B) PAPERS (PAST)

Are Stock Prices Driven by the Volume of Trade? Empirical Analysis of the FT30, FT100 and Certain British Shares over 1988-1990, (with Y. Yoon), 1991.

Variance Bounds Tests Using Options Data, (M. Ncube and P. Seabright), 1992.

The Use of High-Low Volatility Estimators in Option Pricing, (with A. Timmermann), 1992.

Misspecification in Measurement of the Correlation Dimension, (with Y. Yoon), 1992.

Can We Hedge the FT30? (with C. Rogers and Y. Yoon), 1992.

Estimation of Stationary Stochastic Processes via the Empirical Characteristic Function, (with J. Knight), 1993.

Modelling U.K. Mortgage Defaults Using a Hazard Approach Based on American Options, (with M. Ncube), 1994.

Elliptical Distributions and Models of Garch Volatility, 1994.

Estimating the Mean-Generalized - Gini CAPM, 1995.

The Distribution of the Maximum Drawdown for a Continuous Time Random Walk (with E. Acar and J. Knight), 1995.

Analytical Properties of Rebalancing Strategies in TAA Models, (with M. Leigh), 1995.

The Effects of Serial Correlation on Normality Tests, (with Y. Yoon), 1996.

Index Futures Pricing with Stochastic Interest Rates: Empirical Evidence from FT-SE 100 Index Futures, (with Y. Yoon), 1996.

Forecasting the Single and Multiple Hazard. The Use of the Weibull Distribution with Application to Arrears Mortgages Facing Repossession Risk, (with Y. Shin), 1996.

Tactical Style Allocation: Applications of the Markov Switching Model to Value-Growth Investment and Tactical Asset Allocation, (with Y. Yoon), 1997.

Modelling Mortgage Population Dynamics, (with R.L. Kosowski), 1997.

Evolving Systems of Financial Asset Returns: AutoRegressive Conditional Beta , Working Paper. (With G. Christoulakis) 2000

Bayesian Analysis of the Black-Scholes Option Price. DAE Working Paper No. 0102, University of Cambridge. (With T. Darsinos) 2001.

Bayesian Forecasting of Options Prices: A Natural Framework for Pooling Historical and Implied Volatility Information, DAE Working Paper No. 0116, University of Cambridge. (With T. Darsinos) 2001.

The Implied Distribution for Stocks of Companies with Warrants and/or Executive Stock Options, DAE Working Paper No. 0217, University of Cambridge. (With T. Darsinos) 2002.

On the Valuation of Warrants and Executive Stock Options: Pricing Formulae for Firms with Multiple Warrants/Executive Options, DAE Working Paper No. 0218, University of Cambridge. (With T. Darsinos) 2002.

Reconciling Grinblatt and Titman's Positive Period Weighting Performance Measure with Loss Aversion: An application to UK active managers, Mimeo, University of Cambridge. (With N. Farah) 2002.

The Asset Allocation Decision in a Loss Aversion World, Financial Econometric Research Centre working paper WP01-7, Cass Business School. (With S. Hwang) 2001.

Returns to Moving Average Trading Rules: Interpreting Realized Returns as Conventional Rates of Return (with G. Kuo).

On the Use of Revenues to Assess Organizational Risk (with R. Lewin).

Improving the Estimates of the Risk Premia – Application in the UK Financial Market, DAE Working Paper No. 0109, University of Cambridge. (With M. Pitsillis) 2001

Ex-Ante versus Ex-Post Excess Returns, mimeo. (with D. Robertson) 2001.

The Impact of Technical Analysis of Asset Price Dynamics, DAE Working Paper No. 0219, University of Cambridge. (With J-H Yang) 2002.

A Bayesian Confidence Interval for Value-at-Risk. Submitted to theDAE Working Paper Series. (with Contreras, P.). 2003

PAPERS (CURRENT)

"Using the Large Deviation Technique to Estimate Asymmetric Financial Risk", Institute for Financial Research, Birkbeck College, IFR 1/2003 (with Ba Chu and Knight, J.). 2003

A Bayesian Confidence Interval for Value-at-Risk. Submitted to theDAE Working Paper Series. (with Contreras, P.). 2003

The Impact of Background Risks on Expected Utility Maximisation (with V. Merella).

Valuation of Options in a Setting With Happiness-Augmented Preferences (with V. Merella) (QFRC discussion paper, Number 182), (2006).

Information Ratios, Sharpe Ratios and the Trade-off Between Skill And Risk (with P. Spence and A.D. Hall)

The Impacts of Constraints on the Moments of an Active Portfolio (with P. Spence and A.D. Hall)

Exact Properties of Optimal Investment for Institutional Investors (with J. Knight), Birkbeck College WP, 0513, 2005.

Distribution of Constrained Portfolio Weights and Returns, (with J. Knight,).

Improved Testing for the Validity of Asset Pricing Theories in Linear Factor Models, Financial Econometric Research Centre working paper WP99-20, Cass Business School. (With S. Hwang) 2001.

Optimal Portfolio for Skew Symmetric Distributions, (with R. Corn).

Scenario Analysis with Recursive Utility: Dynamic Consumption Paths for Charitable Endowments, (with S. Thorp), working paper, UTS.

Incorporating Gain-Loss and Mean-Variance in a Single Framework, (with S. Cavaglia, and K. Scherer).

'Heuristic Portfolio Optimisation: Bayesian Updating with the Johnson Family of Distributions', Callanish Capital Partners Technical Paper (with R. J. Louth)

'The Impact of Ratings on the Assets Under Management of Retail Funds', S&P Internal Report, (with R. J. Louth).

'The Impact of Ratings on the Performance of Retail Funds', S&P Internal Report (with R. J. Louth)

Are There Bubbles in the Art Market? (with N. Srivastava)

EDUCATION

1965-9 - BA in Economics, Mathematics, Statistics and Politics, University of New South Wales.

1971 - Diploma in Education, Balmain Teachers' College

1972 - Teachers Certificate, Department of Education, NSW

1972-73 - MA in Mathematics, University of Sydney

1974-75 - M. Commerce in Economics, University of New South Wales

1976-80 - Ph.D. in Economics, University of London (The Ph.D. was supervised by Professor J.D. Sargan), examined by P. Phillips and D. Sargan.

1990 - MA (Cambridge).

1995 - Ph.D (Cambridge), examined by P. Robinson and P. Schmidt.

2001 - FIA (Institute of Actuaries) Honorary

SUPERVISION

1987-2007 Have supervised students from all colleges in Paper 12, now Paper 11. Have supervised papers 1, 2, 5, 6 of Prelim and papers 7, 11, and 12 of Part 2 (now 6, 10, and 11).

TEACHING

1973 - Taught for two years in high school, was inspected and received Teacher's Certificate.

1975 - Taught again at NCR, learnt and taught various computing languages.

1976-78 - Taught Introductory Econometrics in a September Mathematics Course to MA in Economics students at the LSE.

1977 - Whilst Lecturer in Statistics, taught:

(i) post-graduate course in Causal Analysis

(ii) post-graduate course in Advanced Time-Series

1978 - Shared courses in Econometric Theory

1979-86 - At Essex: Taught courses in Econometric Theory

(i) Statistics

(ii) Econometrics

(iii) Computing

(iv) Mathematical Economics

(v) Finance

1987-90 - Finance, Econometrics (Cambridge Papers 12, 25, 31)

1990-91 - Taught Advanced Econometrics at Birkbeck.

1991-92 - Taught Introduction to Mathematical Economics.
Advanced Econometrics.

BASE (Birkbeck Advanced Studies in Economics) course on Finance

1992-93 - Taught September course Mathematics, taught Theory of Finance (M.Sc.), Financial Econometrics (M.Sc.), Financial Econometrics (B.Sc.).

1993-2004 - Taught Papers 7, 12, 31 201, 231, 301 and 321 (not all simultaneously).

2005-2007 Taught Papers 7, 11, and 403, also taught Risk Management in Msc, Financial Engineering, Birkbeck , and Corporate Finance, University of Sydney.

CONSULTING EXPERIENCE

My consulting experience is very extensive, particularly in the areas of asset management and investment technology. I have supervised the building and maintenance of portfolio risk models. I have organised conferences for risk managers, investment professionals, and academics. I have carried out risk analysis on investment strategies and investment products. I can provide specific details on any of these areas if requested. I have worked with large numbers of international financial institutions and can provide testimonies as to my value – added if required.

I also work in mortgages, house prices, and real estate generally; recently, I designed with G. Christodoulakis the FT House Price Index for Acadametrics. I have also built mortgage default and loss models for Acadametrics. In conjunction with Acadametrics, I have been involved in the validation of risk models for lending institutions; this has been part of Basle II work in the recent past.

GENERAL CONTRIBUTION

I received colours from the LSE for cross-country running in 1977 and 1978 . I was also Secretary of London University Cross-Country Club 1978. I represented Trinity College at cross-country running 1987-1988, completed the London Marathon on 5 occasions, best 3.04.41 (1987). I was reserve for Cambridge University Marathon Team (1990). In recent years, I ran 10 km in 44.32, Oct 2000, 44.05 in Mar, 2001; 44.48 in Jan, 2003, 44.52 in March 2005 , 42.53 in Feb, 2006, 44.24 in April 2007. I have won a number of medals in Veteran's road running.

CAMBRIDGE FACULTY ADMINISTRATION

At various stages I have been on:

Management Board for Management Studies Tripos

Statistics Committee (Chair)

Graduate Admissions Committee, was acting Admissions Officer 1989

Organised Seminar Series in Finance

Organising Seminar Series in Econometrics

Future Needs and Lecture List Committee

Faculty Board

Appointments Committee

College Administration

Director of Studies (1987- 2011) and Director of Admissions in Economics (1987-1994)

Trinity College

Finance Committee (1991-2003) ,2008 to 2011 and Treasurer of Trinity in Camberwell (charity) (1989-1992) plus other minor committees. Inspector of Accounts 1994-5 and 1996-97.

Wine Committee from 2005 to 2012.

Birkbeck Administration 1991-92

Department Seminar Organiser

Chairman Finance Examinations

Appointments Committee

Ph.D. Admissions

M.Sc. Finance Admissions

Jointly responsible for the creation of the new M.Sc. Finance (currently 70 students) which has now run successfully for 15 years.

Cambridge Administration 1993 to present

Appointments Committee

M.Sc. Finance Admissions

Chairman Finance Exams

M.Sc. Finance Co-ordinator

1993-94 Coordinator Papers 12, 31, 201, 231.

MSc Finance Admissions

1994-95 Coordinator Papers 12 and 231.

1995-96 Coordinator Papers 12, 201,231. Chairman ETE Exams.

1996-1999 Coordinator Papers 7 and 12.

1999-2000 Acting Graduate Chairman

2000-2001 Coordinator Paper 301.

2002-2006 Coordinator Papers 6 and 11. Head of Part 1 Examiners (2004).

PROFESSIONAL CONTRIBUTIONS

Refereeing

I have refereed articles for the *Journal of Econometrics*, *Econometrica, IER*, *Mathematical Social Sciences*, *Journal of Public Economics*, *Review of Economic Studies*, *Econometric Theory*, and *Journal of Applied Econometrics* plus many other journals.

Visiting and Seminars

I have given seminars at many British and Australian Universities and have been a visitor at Monash University (1985), (1987) and the University of New South Wales (1986) and Australian National University (1986), (1987). I have visited the University at Western Ontario (1988) and been a Visiting Fellow to University College, London. In 1989, I visited Complutense, Madrid. I am currently 4 times a Visiting Professor at Birkbeck College, London (1994 -). I recently visited University of Technology, Sydney (1998-2006). I have been appointed Visiting Professor at CASS/CUBS (2000-2006) and Visiting Professor at Birkbeck College (2000-2006) and Visiting Lecturer in Applied Mathematics at Oxford University (2002-2004). I am currently an Adjunct Professor at UTS (Sydney), and have had an association since 1997.

Supervision and Examination

I have supervised numerous post-graduate students and have successfully supervised the Ph.D.'s of A. Nasim at Essex and of M. Ncube and Y. Yoon, B. Eftekhari and S Hwang, G. Kuo, C. Pedersen, M. Sokalska, S. Bond, L. Middleton(Judge), M. Pitsillis, T. Darsinos, A. Sancetta, S. Yang, R. Lewin(Judge), G. Davies, W. Cheung , R. Corns, O. Williams and P. Contreras ,J.Zhang, R. Louth, Jimmy Hong, Nandini Srivastava,

Omri Ross(Maths) at Cambridge, plus other Cambridge students on a joint supervision basis including A. Timmermann and L. Shi. Other successful PhD students supervised at Birkbeck include Y. Hatgioniddes, R. Daccó, M. Karanassou, G. Christodoulakis , B. Chu , Wei Jin, Wei Xia , Riko Miura and John Wylie from Sydney University.

My current students consist of four Cambridge Ph.D. students in Economics and three Birkbeck students. Plus one from Sydney University I have been an Examiner every year that I have taught at University. I have been external examiner at Queen Mary College and London School of Economics (Econometrics), and at London School of Economics (Economics), Imperial College, and Essex University. I have also examined over forrty doctoral dissertations in Econometrics, Finance and Land Economy at universities in Great Britain, Europe, Canada, and Australia.

Awards and Prizes

My research project was awarded a prize (the Inquire Prize for the best presentation at the annual Inquire Conference, Bournemouth, 1991 value £3,000).

Received Econometric Theory Multa Scripsit Award (1997).

My paper The Pricing of Market-to-Market Contingent Claims in a No-Arbitrage Economy was runner-up 1997 E. Yetton Award for the best paper published in AJM (1997).

Received Honorary Membership of the Institute of Actuaries (2001), received F.I.A.

Fund Raising

I have raised well in excess of £1,000,000 since 1991, I give details below:

I raised £105,000 for a financial econometrics project, the research was done at the Department of Applied Economics (Cambridge). This was funded by Inquire and the Newton Trust. The research project brought Professor W. Perraudin to Cambridge and employed Y. Yoon.

I have received £9,000 from the Newton Trust for 1993-94; and have had 2 research grants from ESRC joint with W. Perraudin, total value about £60,000. I have received £17,500 from Inquire for 93-94. I have received a further £20,000 from the Newton Trust (1993).

I started a new research project on the Econometrics of Emerging Markets. I received £30,000 from the Newton Trust (1994) and £10,000 from Inquire (1995) and £30,000 from Kleinwort Benson Investment Management (1995) plus a further £28,000 from Alpha Strategies (1998). This project has employed R. Daccó, and S. Huang.

I received £26,000 from the DSS to work on Pension Funds (joint with C. Pratten). I received £10,000 from Inquire (1996). I received a further £10,000 from Inquire (1997). In 1998, I received £7,500 for research on trading rules from a private donor and a further £25,000 from the Newton Trust. I received £4,500 research donation from Alpha Strategies and £2,500 from General-Re to speak at their annual conference (joint with C. Pratten), plus £6,500 from Inquire (1998) and £9,000 from Inquire (2000), £8,000 from Inquire (2003) and a grant of £6,000 from Acadametrics to employ J. Zhang.

I have received an ESRC grant of £80,000, which employed A. Sancetta for two years (2003-2004).

In 2005 I received with S. Hwang and B. Chu £45,000 from the ESRC to research on risk-management and non-linear correlation.

I have also received two grants of 3000 pounds each from Reading University(2005-2006) to work on real estate finance and a grant of (approx.) 20.000 pounds in 2006,joint with S.Bond and S.Hwang to work on asset allocation issues, the grant being from IRF.

Summary of Discovery Project Proposal for Funding to Commence in 2010

DP1093842 A/Prof HJ Bateman; Prof JJ Louviere; Dr SJ Thorp; Dr C Ebling; A/Prof T Islam; Prof S Satchell; Prof JF Geweke

Approved The paradox of choice: Unravelling complex superannuation decisions

Approximately A$960,0000

CIFR Grant Graham Partington, Steve Satchell, Richard Philip, Amy Kwan Measuring market quality: current limitations and new metrics $140,000 total

CIFR Grant: Identifying Asset Price Bubbles in Australian Listed Securities

$122,000 total

<u>Popular Articles</u>

Making Money Out of Chaos, Investors Chronicle, 10th July 1992. (Interview)

Articles in the *International Broker*, (with Allan Timmermann), (15 pieces), listed next.

Weekly columns on Investment Techniques:

Equity switch programme (Vol. 6, page 7)
Making money out of chaos (Vol. 7, page 6)
Where random walks trips up (Vol. 8, page 7)
Ignorance can be profitable (Vol. 9, page 7)
Making money from market volatility (Vol. 10, page 7)
High-low prices in options trading (Vol. 11, page 7)
Can heavy trading be profitable? (Vol. 12, page 7)
Economic variables show stock returns (Vol. 13, page 7)
No mean return on shares (Vol. 14, page 9)
Do option prices augur a crash? (Vol. 15, page 9)
Puzzles in closed-end fund prices (Vol. 16, page 9)
Capital asset pricing model challenged (Vol. 17, page 9)
How dividends affect share prices (Vol. 18, page 9)
The relationship between price and volume (Vol. 19, page 9)
How persistent are financial market shocks? (Vol. 22, page 9)

Research work written up by International Management (April 1993).

Article in the *Professional Investor* (May 1995), Short-termism (with D.C. Damant), (pages 21-27).

Article in the *Professional Investor* (July 1995), Accounting for Derivatives (with D.C. Damant).

Book Review on Ethnic Minorities and Higher Education in *Higher Education Review*, 1996, 28:2, 96.

Article in the *Professional Investor* (June 1996), Downside Risk (with D.C. Damant).

Contribution to discussion British *Actuarial Journal*, Volume 3, Part I, pages 10-11, 1997

Contribution to discussion British *Actuarial Journal*, 1998.

Article on Lloyd's Syndicate Valuations Methodology, (*ALM News*), 1998.

Research discussed in Observer (26th April 1998, page 11).

Research discussed in Inside Monthly (April 1998, pages 12-14).

Interviewed on Bloomberg TV (27th February 1998)

Pension Scheme Investment Policies, DSS Research Report No. 82 (with C. Pratten), 1998.

Designed the FT Acadametrics House Price Index, 2003. This Index appears monthly in the FT and is
usually discussed by journalists and market pundits.

Contribution to discussion, British *Actuarial Journal,* 2006.

The Impact of Utility on Endowment Strategy, *Professional Investor, April 2007.*

Interviewed on ABC re financial crisis(October 2008)

<u>Research Affiliations (past and present)</u>

Head of Research,Bita-Risk.

Academic Advisor, Alpha Strategies

Advisory Panel, IFC (Subsidiary of the IMF)

Academic Advisor, Kleinwort Benson Asset Management

Academic Advisor Kiln Colesworth Stewart (Member's Agents, Lloyds)

Academic Panel, Panagora Asset Management (1992-1998)

U.K. Representative, Pension Research Institute (State University of California)

Fellow, Pensions Institute (Birkbeck College)

Academic Adviser, Quantec

Academic Panel, State Street Global Advisors

Research Advisor, Thesys Forecasting, currently Acadametrics.

Visiting Professor, Cass Business School, City University,

Visiting Professor University of Technology, Sydney.

Visiting Professor, Birkbeck College.

Honorary Visiting Professor University of Sydney

Academic Advisor, Style Research Associates

Visiting Lecturer, University of Oxford, applied mathematical finance diploma.

Academic Adviser, Northern Trust.

Academic Advisory Board, Old Mutual Asset Management.

Expert Witness between fund Manager and Pension Fund., 2003.

Expert Witness between fund Manager and Pension Fund, 2004-2006.

Expert Witness between Insurance Company and Lettuce Grower.

Adviser in Risk Management to the Governor of the Bank of Greece.

Head of Research, BITA Risk..

Member, Advisory Board, Quantitative Finance Research Centre, UTS.

Member, Steering Committee, CIMF, Cambridge University.

Area Coordinator, Fundamentals of Economic Analysis, Libros de Economia y Empresa, Real Academia de Ciencias Morales Y Politicas.

Consultant, JP Morgan AM,Behavioural Equity Team.

Academic Advisor, Lombard-Odier Asset Management.

Program Committees

European Meeting of the Econometric Society (1997)

Forecasting FX Conference organized by Imperial College and B.N.P. (1996 to 2007)

Inquire UK (2006, 2007)

Program Committee, UK Inquire.

Prize Committee, European Inquire.

Conferences and Seminars

NZ Econometric conference, feb,2011.

Conferences and Seminars (2009)

Presented seminars at:
Sydney University (April 3rd);
Macquarie Bank (April 7th),
CRMC Sydney (April 8th);
Sydney Q group, April 15th.

Conferences (2008)

Finance Conference, London, October, key-note speaker.

Chair, LQ conference (Cambridge, September), presented.

Prize Committee, Inquire Europe(Bordeaux, October).

Conferences (2007)

Finance Conference, Imperial College, March 2007, Discussant.

Finance Conference, Zurich, March 2007. Invited Key Note Speaker.

Alpha Strategies Finance Conference, April 2007, Duke University, chaired conference.

UKSIP Lecture on Endowments, April 2007.

Alpha Strategies Finance Conference, September 2007, Oxford University, chaired conference.

Conferences (2006)

Alpha Strategies Finance Conference, April 2006, Duke University, chaired conference.

Risk Management Conference, June 2006, Bank of Greece, Athens. Gave paper, helped organize programme.

Asset Allocation Summit, July 2006, London, presented paper.

New Zealand Econometrics Conference Dunedin August 2006, chaired session, gave paper, was on prize committee.

Alpha Strategies Finance Conference, September 2006, Cambridge University, chaired conference.