REPORT TO THE AER:

DISCUSSION OF ESTIMATES

OF THE RETURN ON EQUITY

By Graham Partington and Stephen Satchell

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Authors' Credentials

This report has been prepared by Associate Professor Graham Partington and Professor Stephen Satchell. We are senior finance academics who have published many books and many research papers in finance and we have extensive consulting experience, particularly with respect to the cost of capital and valuation. Our *curricula vitae* can be found in Appendix 2.

We have read the "Federal Court of Australia: Expert Evidence Practice Note" which is attached as Appendix 3. This report has been prepared in accordance with the guidance provided by the practice note. An expert witness compliance declaration can be found following the reference list at the end of our report.

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The context of the report

The AER has approached us with a request for advice in relation to the cost of equity when determining the cost of capital for regulatory purposes. The terms of reference are attached as Appendix 1. The main requirements were to present our views with respect to the following questions. So that readers can readily locate the answers to these question, we use the questions as headings in our report.

Part A.

A. Having reviewed the relevant material, provide a report setting out an overall view, with reasons, whether any matters in the relevant material would cause the consultant to:

- advise the AER to change the manner in which it estimates return on equity from that applied in its recent decisions, and/or
- alter, or add to, any of the findings in the reports set out in Table 1 (in the Relevant Material section below)

for the purpose of estimating the forward-looking return on equity of a regulated 'pure-play' Australian energy[1] network[2] business, which is the return that is just sufficient to induce investors to invest in the business.[3]

A1. CEG, *Replication and extension of Henry's beta analysis*, September 2016. In this report, CEG (among other things):

i. Considered that the equity beta is time varying.

ii. Considered that an extension of Henry's analysis shows that the average re-levered equity beta has increase materially since the 2013 Guideline due to increase/decrease in the raw equity betas/gearing ratios of the remaining listed stocks and an increase in the weighting of high-beta stocks in the value-weighted portfolios.

iii. In updating Henry's portfolio beta estimates, considered that it is appropriate to estimate a beta for a portfolio of companies where some constituents are no longer listed (and thus the number of observations different materially between constituents).

1 Being a gas or electricity business.

2 Being a transmission or distribution network.

3 Given a 60:40 debt to equity ratio.

A2. Frontier Economics, *The market risk premium*, September 2016. In this report, Frontier Economics (among other things):

i. Considered that the decline in government bond yields since the AER's December 2013 Rate of Return Guideline has not caused a commensurate reduction in the required return on equity, which has remained relatively stable.

ii. Considered that investors' required return on equity is relatively stable since the AER's 2013 Rate of Return Guideline based on evidence from DGM estimates, expert reports, bank statements and other regulators' decisions

iii. Considered the prevailing market conditions are currently materially dissimilar to the average historical conditions. Considered that a technique that estimates the MRP by subtracting the average government bond yield from the average market return would not produce a reasonable estimate of the prevailing MRP in current conditions.

iv. Considered that more weight should be given to DGM-based estimates of the MRP because it produces a forward looking MRP that is commensurate with the prevailing conditions in the market for equity funds.

v. Recommended estimating the risk premium by effectively applying equal weighting to the DGM and historical excess returns evidence, and cross checking using the Wright approach estimates of market risk premium, expert report estimates, conditioning variables, market participants and other regulators' decisions.

vi. Considered that it is difficult to draw conclusions from conditioning variables in the absence of formal econometric mapping to a point estimate of the MRP. However, the one conclusion is that it does not support is that the required return on equity falling 25 per cent since the 2013 Guideline.

vii. Considered that the DGM should be implemented without a downward adjustment to the long-run DGP growth rate because it is based on out-dated US evidence.

viii. Considered that issues with the DGM estimates of the MRP (noted by the AER) are overstated and have not intensified since the Guideline.

ix. Considered that the AER's consultants also noted that the allowed return on equity falls one for one with falls in the government bond yields

x. Considered that the AER's consultants recognise that the AER sets a nearly constant MRP

A3. APTPPL, *RBP Access Arrangement submission*, September 2016. In this report, APTPPL (among other things):

i. Considered that the MRP should be estimated as the difference between the expected return on market and the prevailing risk free rate. It should not be estimated using historical excess returns.

ii. Considered that a long term average of past returns on the market portfolio may be used as an estimate of the expected return on the market.

iii. Considered that it does not apply the Wright approach.

iv. Considered that the ERA found that the market return on equity series was stationary, with the implication that a long span of data could provide an estimate of the expected return on the market portfolio.

v. Stated that its estimation of the return on equity (including the use of the expected return on the market portfolio and the prevailing risk free rate to estimate the MRP) is the correct implementation of the Sharpe-Lintner CAPM.

Introduction

The questions that we have been asked to address cover a wide range of issues across submissions/reports by CEG, Frontier and APTPPL. The key issue in relation to the report presented by CEG is whether the magnitude of beta has increased since the AER 2013 guidelines. The results presented by CEG provide no statistical tests to determine whether observed changes represent anything more than sampling variation. In respect to the evidence presented we conclude as follows:

With the caveat, that we would like to see the results of the Chow test from the CEG data, our first pass conclusions are as follows:

With respect to re-levered betas:

1. Overall some weak evidence of increased beta at the portfolio level for a restricted set of portfolios

2. Overall some weak evidence of increased beta at the individual firm level based on last five years data set.

3 No evidence of changes in beta at the individual firm level for the maximum length data set.

However if we transfer our focus onto the raw equity betas, we see little evidence of change and so we are led to conclude that any beta change (if there is change) comes from gearing adjustments. Given our concerns about the element of arbitrariness in re-levering beta and upward bias in the method used, we are not convinced that there has been material change in beta.

The key issue in respect to the Frontier report is whether the MRP (market risk premium) is currently higher or lower than the long run mean of the historic MRP. Our priors are that, if anything, the MRP is likely to be lower than the long run historic mean. Frontier attempts to make the case that the MRP is higher, but we are unconvinced and as with the CEG report we note that there is little in the way of hypothesis testing in Frontier's analysis. Frontier places considerable weight on estimates from the DGM (dividend growth model) but as we

point out it would be unwise to overweight the DGM. We also present independent results from a DGM, which suggest that the cost of equity in the Australian market has gone down since 2013, while the MRP has stayed constant. This is the exact reverse of the case that Frontier is trying to make.

With respect to the APTPPL submission the key issue is whether the MRP should be estimated as the long run mean return on the market less the current risk free rate, or as the long run mean MRP. The former is a possibility, but the latter is standard practice. We review the empirical evidence upon which APTPPL base the argument for using the long run mean return and do not find it compelling.

Part A.

A1. CEG, Replication and extension of Henry's beta analysis, September 2016. In this report, CEG (among other things):

The analysis by CEG *Replication and extension of Henry's beta analysis* seems to have been carefully done. We are not critical of the calculations per se, our concerns are much more to do with the interpretation of what the calculations might mean. We also have some concerns about the suitability of calculating betas using the re-levering approach.

i. Considered that the equity beta is time varying.

In respect to the time variation in beta, we begin by explaining the underlying structure of problem. The equity beta is an unknown parameter and the fundamental issue is to find reliable estimates of that unknown parameter. These estimates, such as the numbers that CEG are reporting, are, in the above interpretation, random variables. As such, we would expect the estimated equity beta to show variation over time. The essential issue is whether the variation in the estimate has become so large that we might be led to conclude that the underlying unknown equity beta has changed.

Unfortunately, CEG do not seem to address this question. There are a number of possible ways in which they could have done so. The most likely, and the most obvious, is to carry out a hypothesis test using the data since the 2013 guideline to see if the estimated beta

has changed significantly. The standard procedure for this is the Chow test (Chow, 1960) and in principle this should be straightforward to calculate. It is surprising that CEG have not done this. We recommend that this be done in order that the AER can be better informed about the evidence.

It would also possible to look at the components of the equity beta and see whether an increase in the beta is plausible given the behaviour of the Australian stock market. For example, beta can be defined as the population co-variance of the portfolio of interest with the market, divided by the population variance of the market. If it were the case that the population variance of the market had decreased, we would, ceteris-paribus, expect to see increases in beta, not just in the energy sector, but also across many other sectors. A rise in the covariance might be based upon an increase in the capitalisation of the energy sector relative to the rest of the market and also changes in fundamental risk parameters inter alia.

A further issue is the time interval that beta is defined over. Except under strong assumptions, see Corhay (1992), beta will vary depending on the holding period. Depending on whether the returns are positively or negatively correlated, we could, following Corhay (1988, 1992), demonstrate an increase/decrease of beta as we increase the holding period of the asset. Relevant to this point, Henry presents results for monthly holding periods alongside results for weekly holding periods. The results, see Henry (2014, Table 8, page 27), show that throughout the table estimated monthly betas are generally lower (crudely about 20% lower) than estimated weekly betas.

Unfortunately CEG do not present monthly portfolio results for the post 2013 period so we cannot say if there has been a change in the estimate. What we can say is that, if the correct beta should be for a holding period longer than a week, then the evidence suggests that the weekly betas are over-estimates based on the lower monthly betas in Henry's Table 8.

ii. Considered that an extension of Henry's analysis shows that the average re-levered equity beta has increased materially since the 2013 Guideline due to increase/decrease in the raw equity betas/gearing ratios of the remaining listed stocks and an increase in the weighting of high-beta stocks in the value-weighted portfolios.

We have long expressed concerns about the re-levered (geared) equity beta. Multiple re-levering formulae are possible, the application of which can result in quite different betas. Which of the alternative formulas should be used is the subject of continuing debate. However, it is clear that a leverage adjustment formula that assumes the debt beta is zero, as in the Henry and CEG analysis, will result in upward biased estimates of the equity beta.

CEG (page 11) claim that there has been increased capitalisation in APA in various portfolios post 2012. Turning to Table 5, page 7 CEG, we see that the APA beta has moved from 0.606 to 0.703, which is the second largest movement for an individual firm (based on CEG's notion of re-levering). Thus it does seem to be the case that an increase in the weighting of high-beta stocks in the value-weighted portfolios may have led to overall increases in portfolio beta. However, if we drop the somewhat arbitrary choice of gearing adjustment and focus on raw betas, then the increase is much smaller. In fact, for APA the change is 0.542 to 0.566 (CEG, Tables 4 and 5 row 3, column 2). It seems that re-levering is making a contribution to increases in CEG's beta estimates.

Moving beyond these concerns, we address the question as to whether the average beta has increased materially. As we have discussed above, any inference about this should be based on statistical testing. A quick and simple test could be based on the 95 % confidence interval as reported for 2013. This is a poor way of conducting the test, but it is all we can do given the information available. We start from Olan Henry's report, Estimating beta: an Update (April 2014). This report gives the standard errors for betas estimated using data from May 1992 to June 2013. Beta is estimated from weekly and monthly data and we shall focus on the OLS estimates of beta for weekly data. We note that our approach of creating

95% confidence intervals by adding and subtracting two standard errors of the estimator to the estimated value (as reported by Henry) then checking if the new values (as reported by CEG) lie inside this interval is rather crude, but it gives us some initial sense as to whether beta may have changed.

The Henry results indicate substantial standard errors and low R^2 for individual firms. Estimated standard errors for the weekly betas of individual firms average about 17% (see Henry, Table2, page 17). With one exception,[4] all the betas resulting from the new calculations by CEG (Table 5, page 7), lie within the confidence intervals. Based on this evidence, we would not accept that there has been a material change in the weekly beta. However, if we look at the last five years, (Henry, Table 4, page 21) compared with CEG, (Table 11, page 13) we see evidence of changes beyond the confidence intervals for three of the four companies. CEG restricts the analysis to companies for which there are 155 new data points post 2013. One company ENV, was excluded on the grounds that there were only 63 points available of new data. The five year samples seem to offer evidence of parameter change, but this is for a reduced set of companies, and it would be interesting to know the ENV result, however imperfect.

Turning now to portfolios, Henry uses five portfolios labelled P1 to P5 to estimate portfolio betas. These portfolio estimates typically have higher R^2 due to the diversification provided by the use of portfolios. In the analysis of beta estimates, for equally weighted portfolios of weekly betas, CEG (Table 8) reports zero change for three of the five portfolios due to a lack of data to estimate updated values. Thus there are only two portfolios requiring application of the confidence interval. These portfolios are P1 and P5; and only one of these has a beta outside the confidence interval. In the case where portfolios P1 and P5 are constructed by value weighting the stocks in the portfolio, both have updated betas outside the confidence interval.

Collecting all this together, there is evidence of changes in beta post 2013, at the portfolio level, but on a reduced set of portfolios. The evidence of change, however, has to be tempered, by the recognition that the CEG's portfolio betas for the period up to 2013 are

[4] That exception is for SKI, which is the company where it proved most difficult to replicate Henry's original estimate. In the case of SKI, CEG starts with a beta estimate for the period up to 2013 that is 57% higher than Henry's estimate.

bigger than Henry's estimates for this period, particularly in the case of P5. P5 contains SKI which is where the biggest discrepancy (57%) arises in CEG's replication of Henry's individual stock betas. Since our test benchmarks are Henry's original beta estimates it is an open question how much beta values lying outside the confidence intervals owe to changes over time and how much to having a higher starting point. Furthermore, if we consider the raw equity betas, and not the levered/de-levered betas, then all increases seem rather small and are very likely statistically insignificant.

iii. In updating Henry's portfolio beta estimates, considered that it is appropriate to estimate a beta for a portfolio of companies where some constituents are no longer listed (and thus the number of observations different materially between constituents)

If we wish to estimate, as accurately as possible, beta before the 2013 guideline and beta after the 2013 guideline, then it is appropriate to use the companies no longer listed in calculating the beta before the 2013 guideline. However, the assumption is that the sample of companies available both before and after the 2013 guideline is representative of the target population. Alternatively, if we wish to see whether the betas have changed, for the sample of companies available after 2013, then the appropriate benchmark is the same sample of companies pre-2013.

We note that Henry 2014, see page 52, is sceptical of the merits of estimating beta based on the use of portfolios whose portfolio weights change with time. We disagree with this position as we would argue that this problem is standard in finance. For example, as we discuss below, the weights of the market portfolio change through time. It may be that Henry's scepticism persuaded CEG not to pursue this analysis post-2013, but it would be insightful if it had been carried out

We point out that even in a fixed weight portfolio analysis the weights of the market proxy typically change with time. This is considered appropriate because the market proxy is interpreted as a factor-mimicking portfolio for the unobserved factor called the market factor. Likewise the dependent variable (stock portfolio returns) which may have companies that no longer trade, or newly listed companies, is a factor-mimicking portfolio for the

unobserved energy portfolio. Henry's Table 25, for example, provides a factor mimicking portfolio intended to proxy for the returns on the unobserved energy portfolio.

With the caveat, that we would like to see the results of the Chow test from the CEG data, our first pass conclusions are as follows:

With respect to re-levered betas:

1. Overall some weak evidence of increased beta at the portfolio level for a restricted set of portfolios

2. Overall some weak evidence of increased beta at the individual firm level based on last five years data set.

3 No evidence of changes in beta at the individual firm level for the maximum length data set.

However if we transfer our focus onto the raw equity betas, we see little evidence of change and so we are led to conclude that any beta change (if there is change) comes from gearing adjustments. Given our concerns about the element of arbitrariness in re-levering beta and upward bias in the method used, we are not convinced that there has been material change in beta.

A2. Frontier Economics, *The market risk premium*, September 2016. In this report, Frontier Economics (among other things):

Frontier, page 10 quotes our earlier report:

> "In this regard, Partington and Satchell (2016) have recently advised the AER that:
>
> > We begin by stating our position that it seems likely that the risk premium changes over time. It is also entirely possible that the risk premium sometimes changes at the same time as interest rates change, but that change may either be in the same direction as the interest rates, or in the opposite

> direction. At any point in time, there are three possibilities for the market risk premium, it may remain unchanged, it may go down, or it may increase. There is no compelling reason for an interest rate decrease to automatically be associated with an increase in the market risk premium.
>
> We agree with everything that Partington and Satchell have said in the above paragraph. However, just as there is "no compelling reason for an interest rate decrease to automatically be associated with an increase in the market risk premium," there is equally no compelling reason for an interest rate decrease to *never* be associated with an increase in the market risk premium."

There is a high level of agreement here, as we agree with everything that Frontier have said in the above paragraph. Thus both we and Frontier agree that just because there has been a large fall in government bond yields does not necessarily mean that an increase in the MRP will offset reduced required returns to stocks. Nor is there anything necessarily unnatural about the required stock return falling one for one with falls in the government interest rate. Ceteris paribus that is to be expected. Nonetheless, we agree with Frontier and accept that on occasion it is entirely possible that the MRP may increase as interest rates fall. However, we remain unconvinced by the evidence that Frontier subsequently present for a current increase in the market risk premium.

As in A1 we remind the reader that the market risk premium is a parameter based on population moments which economists and statisticians are trying to estimate. Much of the discussion by Frontier Economics is about estimates and what we are really interested in whether there has been a parameter change. There seems to be little to no statistical testing by Frontier of any change to the estimate of the MRP.

Another approach favoured by Frontier is the notion of adjustments apparently made by consultants worldwide. We would like to comment on this. It is clear that in European/British/American financial markets there is a great deal of political uncertainty. It is virtually impossible to quantify this in terms of what might happen to financial markets. One response by an analyst or a consultant might be to add some adjustment (say, 1/2%) to historical measures of the market risk premium. However, we note the evidence of the

KPMG Valuation Practices Survey (2015), which reports that firms involved in valuations in the UK and USA most commonly used an MRP of 5%, and compared with the 2013 survey there was less reporting of MRPs above 5%.Thus despite quantitative easing and very low interest rates in the US and UK there is evidence that valuation practitioners are using an MRP lower than the 6% favoured in Australia and there is no evidence that the MRP being used is going up.[5]

It is by no means clear that an upward adjustment, that might be used say in the UK, is appropriate for the Australian economy. Furthermore, the approach seems too ad-hoc to be a regulatory tool. Whilst, for example, we may be concerned about the potential future of exports, the nature of political uncertainty in China, and limited growth in the world economy, these risks have been around for some time. It is debatable that they have significantly worsened since 2013 and at least some of these risks would have been anticipated prior to that date.

i. Considered that the decline in government bond yields since the AER's December 2013 Rate of Return Guideline has not caused a commensurate reduction in the required return on equity, which has remained relatively stable.

We begin by presenting below three versions of the CAPM

Where μ_p is the equilibrium expected rate of return for a portfolio p, r_f is the riskless rate of return, nominally taken as the yield of a 10 year government bond, β_p is the beta of portfolio p with respect to the market portfolio m, $(\mu_m - r_f)$ is the risk premium of the equity market, μ_m is the expected rate of return of the equity market, and $\beta_p(\mu_m - r_f)$ is the risk premium of portfolio p.

Equation (1) is the CAPM. This gives a formula for the risk premium of portfolio p.

[5] If anything the evidence suggests the MRP is going down, but this could easily be a consequence of sampling variation.

$$\mu_p - r_f = \beta_p(\mu_m - r_f) \quad (1)$$

Equation (2) gives a formula for the cost of capital, based on the CAPM. It is convenient to think of this formula as expressing the cost of capital in terms of the riskless rate, beta, and the market risk premium.

$$\mu_p = r_f + \beta_p(\mu_m - r_f) \quad (2)$$

Equation (3) is an alternative formula for the cost of capital. It is expressed in terms of the riskless return and the expected rate of return of the market.

$$\mu_p = r_f(1 - \beta_p) + \beta_p(\mu_m) \quad (3)$$

It is clear that all 3 equations are mathematically identical. The distinction between equations (2) and (3) is what we take to be the exogenous factors. In equation (2), which is typically how practitioners see the world, the two factors are the riskless rate and the market risk premium. In equation (3), the factors are the riskless rate and the market expected return. Taking either equation (2), or (3), we can see that for the cost of equity to remain the same, a decline in government bond yields since the AER's December 2013 Rate of Return Guideline would require compensating changes in either the market risk premium, beta, or the expected rate of return of the market. Such a compensating change seems at first glance to be unlikely given the substantial decrease in government bond yields. In equation (2) for example, we would need an increase in the market risk premium and/or an increase in Beta. We taking as our starting points, the 2013 Guideline values of Beta = 0.7, an MRP= 6.5% and a bond yield of 4.1% (see, Frontier Economics, paragraph 24, Sep 2016). This gives a starting regulatory rate of return of 8.65%. Then, given a current 10 year yield of 1.9%; we can ask what changes in beta and MRP, which we denote ΔB and ΔMRP respectively, are compatible with the required return on equity staying constant?

The answer can be obtained by rewriting equation 2 (in percentages) and solving for ΔB and ΔMRP:

$$8.65 = 1.9 + (0.7 + \Delta B)(6.5 + \Delta MRP)$$

We see that if there is no change in beta, the required value for $\Delta MRP = 3.14\%$, which seems an implausibly large change, resulting in an implausibly high MRP of 9.64%. Alternatively, suppose beta is allowed to increase by the maximum increase in the summary of CEG's (2016, Table 14) analysis of beta increases, then $\Delta B = .17$. The required change in the MRP is then 1.26%. This change in MRP is greater than the largest change for the Australian MRP listed in ATCO final gas decision, June 2015, Table2, page 32, which is $\Delta MRP = 1.1$. It is not clear to us that either beta or the MRP have changed, but even if we allow for the maximum claimed for such changes the return on equity goes down. It is still debatable whether the fall is as big as the fall in the yield on government bonds, but it is clear that an increase in the market risk premium alone would have to be implausibly large if the cost of equity was to remain unchanged. Furthermore, as we discuss below, we consider it more likely that the MRP has gone relative to the historic average rather than having increased.

Turning to equation (3) we would need an increase in the expected rate of return of the market and/or an increase in beta. Using the same inputs as above equation (3) can be written as:

$$8.65 = 1.9\big(1 - (\beta_p + \Delta B)\big) + (\beta_p + \Delta B)(\mu_m + \Delta\mu_m)$$

With no change in beta then $\mu_m + \Delta\mu_m$ would need to be 11.54%%. If, again, $\Delta B = .17$, then $\mu_m + \Delta\mu_m$ would need to be 9.66%. This suggests that if the required return on equity for regulated entities is to be constant it requires an optimistic view about the future performance of Australian shares. With no change in the value of beta then the current MRP would again have to be an implausibly high 9.64% to hold the regulated cost of equity constant.

We have previously expressed our view that it is more likely that the MRP is below the long run historic average, than that it has risen. We explained this in Partington and Satchell (2016, p18) as follows:

> "Our sympathies lie with the view that the tendency has been for the market risk premium to fall over time as diversification and risk management has got easier and cheaper, as individuals and populations have got wealthier and as volatility in

> equity markets has tended to be lower (although there have been relatively short periods of extreme volatility) and this is consistent with lower average realised risk premiums in equity markets from the 1970's onwards. We are also sympathetic to the view that the twentieth century was the American century and that Australia has been the lucky country. In other words investors in these two countries have on average been the beneficiaries of pleasant surprises over a century or so. As a consequence it seems plausible that the returns they received were higher than the equilibrium returns that they expected. There are also the arguments that survivorship bias inflates the historic returns record and also that investors' underestimated inflation and so accepted ex-ante interest rates that were too low. The consequence of interest rates that were too low is that the realised risk premium provides an upward biased estimate of the equilibrium risk premium. As a result of the foregoing factors, we consider it more likely than not that the historic equity risk premium in both Australia and the US overstates the current forward looking equity risk premium."

The most recent evidence from the Credit Suisse Global Investment Yearbook 2017 compares the equity market returns from 1900 to 2016 with returns for the latter half of this period (1967-2016). Consistent with our argument the average risk premium for Australia based on geometric returns was 5.0% for the period 1900 to 2016, but fell to 3.2% for the period 1967 to 2016. We agree with Frontier that the standard errors in the estimation of the historic average returns are substantial and the more so the shorter the sample period. Consequently, we would not overweigh the evidence from Credit Suisse, however the evidence is clearly inconsistent with the MRP over recent decades having increased above the longer run historical average.

iii. Considered that investors' required return on equity is relatively stable since the AER's 2013 Rate of Return Guideline based on evidence from DGM estimates, expert reports, bank statements and other regulators' decisions

The arguments from Frontier that relate to this section are largely a rehash of arguments previously presented by Frontier in submissions to the AER. We have previously addressed and rebutted these arguments and rather than repeat that material we refer the interested reader to Partington and Satchell (2016), particularly pages 17 to 22, and pages 27 to 32. We do, however, reproduce our analysis of earnings yields and their inverse, the price earnings ratio (PE), since it seems that the lesson of being cautious in interpreting yields and PE ratios has not been heeded. There is continuing and unqualified reliance on earnings yield and PE based evidence in the Frontier report.

> "What price earnings ratios and earnings yields really reveal
>
> Frontier (2016b) seek additional support from selected opinions of financial experts, mixed in with arguments based on earnings yields and price earnings ratios. There is considerable confusion about what the behaviour of price earnings ratio and its inverse the earnings yield really means, even it seems among experts such as Dobbs Koller and Lund (2014) who Frontier quote on p21. The behaviour of the required return on equity cannot be simply inferred from the behaviour of price earnings (PE) ratios, neither can it simply be inferred from the behaviour of the earnings yield (earnings price ratio). The earnings yield (and the PE ratio) is a function of the cost of equity, the growth rate and the dividend payout rate. We can examine this relation with the assistance of the dividend growth model.
>
> We start from the simple Gordon dividend growth model. More complex dividend growth models could be used, but would add little for the purpose of exposition, other than complexity. The key message would be the same, the earnings yield (price earnings ratio) depends on the cost of equity, the rate of growth and the dividend payout ratio (or equivalently 1 minus the

retention ratio). To see this we start with the equation for the Gordon model:

$P = \frac{D_1}{r_e - g}$ the next period's dividend can be written as bE_1, which gives:

$P = \frac{bE_1}{r_e - g}$ and dividing both sides with E_1 gives $\frac{P}{E_1} = \frac{b}{r_e - g}$

rearranging gives the earnings yield $\frac{E_1}{P} = \frac{r_e - g}{b}$.

Where P = the share price, b = the dividend payout ratio, E_i = Earnings per share in period i, g = the growth rate and r_e = the required return on equity.

The foregoing equations give the prospective earnings yield and prospective PE ratio, but this is easily converted to a current earnings yield, or current PE ratio, since in Gordon growth model earnings are assumed to grow at the constant rate g. Thus, $E_1 = E_0(1 + g)$, so $\frac{E_0}{P} = \frac{r_e - g}{b} \times \frac{1}{1+g}$. For example, if the growth rate were 2%, the cost of equity was 7% and the dividend payout ratio was 50%, then the prospective earnings yield would be 10% and the current earnings yield would be 9.8%

Having established that the earnings yield is not at all the same thing as the cost of equity, but rather is a consequence of interactions between the cost of equity r_e, the growth rate g and the dividend payout ratio b, it is clear that inferences about the cost of equity based on plots of earnings yields or PE ratios are highly suspect. In particular, just because the earning yield stays flat, or even rises, when interest rates are falling, does not mean that we can infer that the market risk premium has risen. If there has also been a reduction in the growth rate g, or a decline in the payout ratio b, the earnings yield can remain relatively flat, or rise, even though the cost of equity is going down. For example, continuing the earlier example if the growth rate drops to 1% and the cost of equity comes down to 6% then the prospective earnings yield remains at 10%, while if the growth rate drops to 1% and the cost of equity drops to 6.5% then the prospective earnings yield rises to 11%

So what is the likely story over recent history? In the environment of the last few of years it seems very likely that expectations of growth have been depressed. Current low interest rates are the RBA's attempt to try and stimulate flagging growth and flagging investment. Reduced expectations of growth would push the earnings yield up, so if the expectations of the payout ratio have not changed, a relatively flat earnings yield implies that the cost of equity has come down. This latter is what we normally expect to happen if interest rates are low.

What is happening to the expectations of the payout ratio is less clear. In the short run, due to the stickiness of dividends, when profits are depressed payout ratios tend to rise as companies hold their dividends at the pre-existing levels, or even try to keep increasing them. In the long run the payout ratios are expected to converge to the firm's long run target payout ratio. Whether firms, or investors, are revising these targets is unknown. However, changes in target payout ratios by firms tend to be infrequent events. On balance, therefore, it is likely that changes in the payout ratio are likely to be a second order effect in explaining changes in the earnings yield. In our opinion reductions in the growth rate that are offset by reductions in the cost of equity are the most likely explanations for earnings yields not falling as interest rates fall.

For PE ratios, as the growth rate comes down the PE ratio falls, *ceteris paribus*. If the PE ratio instead remains relatively flat, as growth falls the likely explanation is that the cost of equity has come down. "

Frontier also claims the evidence from higher dividend yields supports a higher cost of equity. Thus it is instructive to consider what the evidence from dividend yields tells us. From the Gordon Growth model:

$$\frac{D_1}{P} = r_e - g$$

Thus, if the expected growth rate *g* goes down and r_e remains constant the dividend yield goes up.[6] Thus, higher dividend yields do not automatically mean that the cost of equity has gone up. Considering our earlier example where the growth rate was 2% and the cost of equity was 7%, then the dividend yield would be 5%. If the growth rate *g* fell to 1% and the cost of equity remained at 7%, then the dividend yield would rise to 6%. If growth fell to 1% and the cost of equity fell to 6.5% than the dividend yield would rise to 5.5%.

What matters in interpreting the dividend yield, earnings yield, or PE, is what is happening to expectations of growth. Unfortunately, growth expectations are difficult to reliably measure. This is a major problem in using dividend growth models to estimate the cost of equity.

iii. Considered the prevailing market conditions are currently materially dissimilar to the average historical conditions. Considered that a technique that estimates the MRP by subtracting the average government bond yield from the average market return would not produce a reasonable estimate of the prevailing MRP in current conditions.

We agree with Frontier Economics that the prevailing market conditions are currently materially dissimilar to the average historical conditions globally. Global quantitative easing has increased the price of bonds thereby lowering the yields, as a consequence yields are very low in many countries. Australia has lagged behind other countries such as USA, UK, Europe and Japan in that they have all implemented QE whilst Australia is yet to implement QE. Indeed in a previous response on this issue we argued that the interest rates in Australia, although at historic lows, are not so dramatically dissimilar to the past as to require a change in the standard method of computing the MRP (see Partington and Satchell (2016, pages 23 to 26). Our conclusion was as follows:

> "The conclusion we reach is that a low interest rate environment over extended periods has been a common experience in Australia and elsewhere. Current 10 year

[6] Assuming the dividend is unchanged the price falls in order to restore equilibrium.

> Australian bond yields are 40 basis points below the previous minimum, so we have struck a new minimum. However, we do not consider that the magnitude of current interest rates is so dissimilar to the past as to invalidate the historic MRP informing an estimate of the current MRP. [7] We also observe that in Brailsford *et. al.* (2012) the arithmetic average risk premium (in excess of bonds) computed over 128 years from 1883 to 2010, a period over which low interest rates were in the majority, is exactly the same at 6.1% as the estimate over the 53 years from 1958 to 2010, where high interest rates were a dominant feature."

We note that at the time of writing ten year bond yields are 48 basis points below the previous minimum.

iv. Considered that more weight should be given to DGM-based estimates of the MRP because it produces a forward looking MRP that is commensurate with the prevailing conditions in the market for equity funds.

We certainly agree that DGM-based estimates of the MRP are forward looking and that this is an attractive property. The usefulness of this approach rather depends upon the accuracy of the forecast and the horizon that it is evaluated over. It is unfortunately the case that forecasts of future earnings and dividends tend to be fairly inaccurate over more than 2 years. Indeed, even over a one or two year horizon the evidence is that analyst's forecasts are upward biased. Thus, a 10 year horizon, which seems implicit in many of the calculations here, is probably going to lead to poor forward looking estimates of the risk premium. Unless there is some reliable evidence offered that has looked historically at the accuracy of DGM based estimates versus estimates based on historical averages for the MRP, it seems very unclear to us, that more weight should be given to the DGM estimates. We do not find this evidence in Frontier Economics September 2016 report. Indeed we hypothesise that

[7] "The context is somewhat different, but Frontier (2016b) observe in relation to the DGM estimate of the market return ' We note that even this significant bias in dividend forecasts results in only 30 basis point differential in the estimate of the required return on the market, which is economically small.' p40. "

arguments based on forecast accuracy would probably result in down-weighting DGM based estimates.

Evidence in support of the foregoing hypothesis can be found in a study by Duarte and Rosa (2015) based on 20 different models of the US MRP, shows the DGM approaches tend to be negatively weighted within the first principal component constructed from the covariance matrix of forecasts of the 20 models. By contrast, the historical MRP is positively weighted. The idea of principal components analysis is to reduce a multidimensional data set to a smaller set of principal components that capture most of the variability in the data. The first principal component (FPC) is the vector that explains the most variability of the components in the data. For example, if we take as our components the stock returns in the Australian market, then the FPC would correspond to a portfolio of returns very highly correlated with the market index. The FPC for 20 models of the MRP, would correspond to a portfolio that should be highly correlated with the MRP. The historical mean is positively correlated with the FPC of the 20 models, the DGM is not; this is circumstantial evidence for the historical mean and against the DGM as a valid measure of the MRP.

DGM-based estimates of the MRP in a 10 year horizon context, are probably better down-weighted than given more weight. We are not completely dismissive of the DGM approach, but it is more useful as a conceptual tool than a forecasting model.[8] By contrast, the historical mean equity return minus the current 10 year bond rate has much to recommend it. To quote Duarte and Rosa (2015), page 5, "This model is very simple and, as shown in Goyal and Welch (2008), quite difficult to improve upon when considering out-of-sample predictability performance measures."[9]

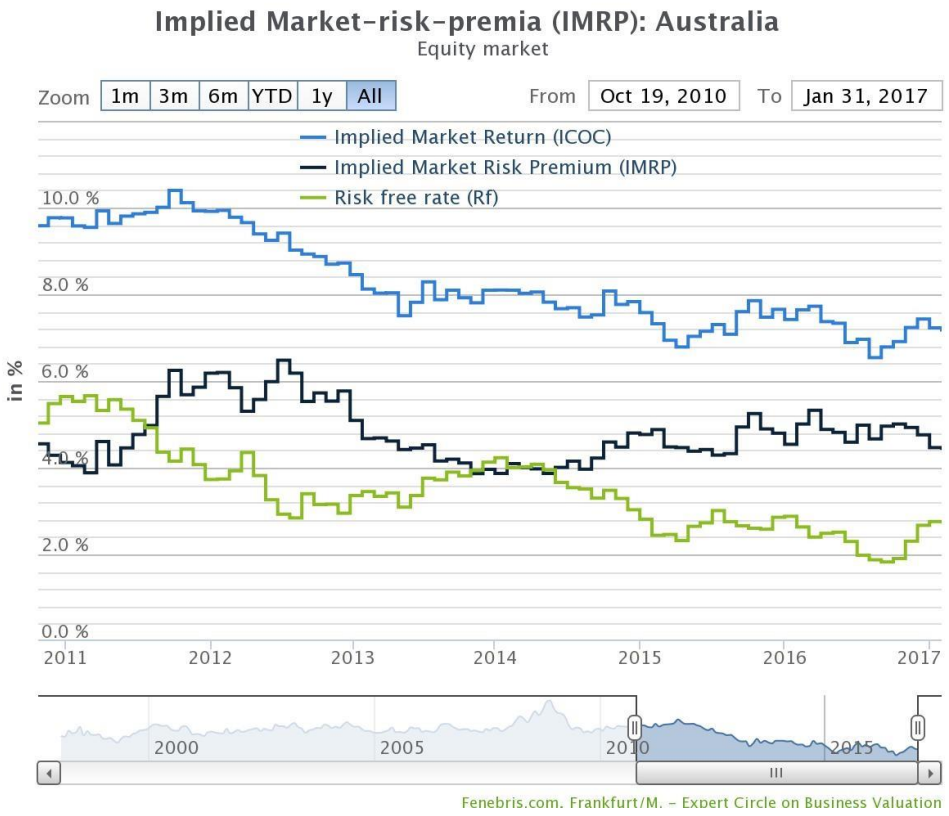
Due to the foregoing considerations and other weaknesses of the DGM, on which we have previously commented extensively, see for example Partington and Satchell (2016, pages 25 to 29), we think it very unlikely that the DGM will produce a forward looking MRP commensurate with the prevailing conditions in the market for funds. Very different results can be obtained depending on the model used and particularly the assumptions about

[8] See for an example of conceptual use our answer to A2,ii.

[9] We note that Duarte and Rosa (2015) suggest that the MRP in the USA has been at very high levels recently and was caused by unusually low yields on government securities. However, they also caution that there is "considerable uncertainty around these estimates" (p.1)

growth. Below we provide a chart from Fenebris.com which gives their estimate of the Australian market implied cost of capital and implied risk premium (based on their DGM model) from October 2010 to January 2017. This shows, contrary to Frontier's arguments, that the cost of capital has tended to be lower since 2013. The risk premium post 2013 has moved sideways because the falling cost of capital has been accompanied by falling government bond yields, thus leaving the MRP relatively unchanged. However, from the previous high of 6.48% in July 2012 to the most recent value as at the end of January 2017 of 4.42%, the risk premium fell 32%. While the evidence of Fenebris is supportive of the AER's position on a reduction in the allowed return, we would not give this evidence substantial weight because it comes from a DGM model. In just the same way, we would we would not give the AER's estimates from their DGM substantial weight.

We repeat our past advice to the AER that if the DGM is to be given any significant weight we recommend that the AER should consider not only the effect of different assumptions about the magnitude of the growth rate, but also consider the output of different DGM models such as the Gordon and Gordon model and the Fenebris model and that consideration should also be given to the impact of dividend reinvestment plans. We also reiterate our past advice that year by year estimates from the DGM are likely to be unreliable.



v. Recommended estimating the risk premium by effectively applying equal weighting to the DGM and historical excess returns evidence, and cross checking using the Wright approach estimates of market risk premium, expert report estimates, conditioning variables, market participants and other regulators' decisions.

Again, similar to (A2.iv) it is not clear to us that it is appropriate to apply equal weights to the two estimates and use cross-checking based on 'the Wright approach estimates of market risk premium, expert report estimates, conditioning variables, market participants and other regulators' decisions'. This is only a good idea if we are prepared to believe that these are different estimates of the market risk premium, which are on average unbiased. The notion that averaging over different estimates of the same parameter leads to better outcomes depends on the quality of the additional estimates used in the averaging. Considering the earlier discussion, the evidence that any of the cross-checking aspects add much to the accuracy of the risk premium estimate seems rather small.

To us the value in cross-checking does not lie in a belief that the cross-check estimates necessarily provide accurate and unbiased benchmarks, but rather that they can provide a pause for thought. If there are abnormally large discrepancies between the cross-checks and the MRP chosen by the AER then the AER should consider the reasons for the difference and be satisfied that it is not due to problems with their own estimate.

We feel that the Wright approach has no support based on any clear evidence in the Australian context. Analysts' beliefs seem somewhat unreliable (upward biased) and overseas regulators decisions are not likely to be convincing unless one can show great similarities in the economies considered. Expert evidence from the Houston Kemp (2016) report was that across 29 firms of valuation experts, the average risk premium was 6.38%. The strongest evidence in favour of increased MRP is probably the DGM estimates, but as we argue in A2.ii and A2.viii this is unreliable and it is easy to find DGM estimates where the risk premium has gone down.

vi. Considered that it is difficult to draw conclusions from conditioning variables in the absence of formal econometric mapping to a point estimate of the MRP. However, the one conclusion is that it does not support is that the required return on equity falling 25 per cent since the 2013 Guideline.

We agree with the former statement that it is difficult to draw conclusions from conditioning variables in the absence of formal econometric mapping to a point estimate of the MRP. This the substance of a well-regarded paper by Goyal and Welch(2008) who demonstrate that over a long period of time there seems to be no stable relationship between forecasts of MRP and actual market excess returns in the US. We would expect similar results elsewhere. Note that this does not necessarily say that you cannot forecast market excess returns but that the forecasting relationship changes with time, hence the difficulty above. This difficulty with conditioning seems to us to have little to nothing to do with the required return on equity falling 25 per cent since the 2013 Guideline. A discussion of the change in the cost of equity and the changes in parameters required to offset it is discussed in some detail in A2.i.

vii Considered that the DGM should be implemented without a downward adjustment to the long-run DGP growth rate because it is based on out-dated US evidence.

The need for a downward adjustment to the GDP growth rate is not a consequence of the lessons of history about rates of corporate earnings growth relative to GDP growth. It is a consequence of the fact that all of the capital required for growth will not come from the internal resources of current firms. Additional equity capital will have to be raised in the future. This means a dilution of existing equity and a consequent reduction in its share of growth. A classic analysis of the effects of share issues and the resulting reduction of the growth rate of dividends for existing shareholders can be found in Miller and Modigliani (1960).

With respect to the idea that growth in the long run can be greater than GDP growth, then at the level of the individual firm this means that the individual firm eventually becomes bigger than the economy, or at the level of the market it means that the stock market eventually becomes bigger than the economy. Neither of these conditions seems plausible for the Australian economy. It is possible in the short-run and perhaps the medium-term for growth rates in earnings and dividends to be above the GDP growth rate. This can happen, for example, when there is an increase in the share of GDP going to capital at the expense of labour, and this latter does appear to have been happening in the USA. Such effects, however, are likely to be of finite duration.

viii. Considered that issues with the DGM estimates of the MRP (noted by the AER) are overstated and have not intensified since the Guideline.

First we address the problem of slowly changing dividends. The issue here is can be simply illustrated by the Gordon Growth model, which tells us that $r_e = \frac{D_1}{P} + g$ thus the higher the dividend yield and the higher growth rate the higher the estimate of the cost of equity, so it is important to have the correct values for the dividend yield and for the growth rate. Frontier's discussion seems to be focussed on the dividend yield, but the problem is

simultaneously getting the correct value for both the dividend yield and the growth rate. The problem in getting the correct values particularly arises when there are changes in growth rates. At such times companies tend to hold their dividends unchanged resulting in dividends being a smoothed version of free cash flow to equity FCFE and earnings (profits). We discussed the resulting problem in McKenzie and Partington (2014, p29) as follows:

> "Dividends are a smoothed version of both FCFE and profits. As profits go up and down, dividends follow slowly and indeed profits can change without any change being made in the dividend. Dividends are therefore said to be sticky. They are particularly sticky downwards because companies are particularly averse to cutting the dividend. Thus, profits and FCFE may drop and if this leads investors to revise their growth expectations downwards the share price may drop significantly, but the dividend is likely to be held unchanged. An unchanged dividend divided by a smaller share price results in a higher dividend yield. The outcome, unless appropriate downward adjustments are made to the growth parameter in the DGM, is that the combination of higher yield and overestimated growth gives an upward biased estimate of the cost of equity.
>
> We suspect that the downward growth adjustment, if any, is likely to be insufficient. Firstly, if we rely on analyst's forecasts for our growth estimates we know that their adjustment to the information already impounded into prices is sluggish (see inter alia Guay, Kothari and Shu, 2011). So, the change in the dividend yield is likely to lead any growth rate updates. In any case, we know that analysts' forecasts are upward biased. Secondly, in our observation the long term growth rate is rarely changed, whereas in reducing the price investors may well have revised their expected long term growth rate down.
>
> Of course there is the reverse effect when FCFE and profits rise, but the greater reluctance to cut dividends as opposed to increasing them is likely to create an asymmetry in the effects. Thus, the potential bias from dividend financing and the effect of dividend yield inflation are likely to be greater

when profits and FCFE fall. This is likely to be a particular and market wide problem in times of crisis. During these times, we are likely to see a market wide drop in prices, profits and cash flow, but most companies try and hold their dividends. This means that dividend yields will rise sharply and this is what we observed during the GFC. Some downward adjustment to growth rates is almost certainly required, but exactly how much is obscured by debates about how much of the price change is due to reduced estimates of growth and how much is due to an increase in the cost of equity. 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. "

We also point out that issues of bias can arise in multistage growth models. Writing the dividend yield as $d = D_1/P$ and the required return of equity r_e, the Gordon Growth model can be written as $r_e = d + g$. Both d and g are forward looking estimates of the dividend rate and the growth rate of dividends respectively. This follows from the relationship $P=\frac{\frac{D_1}{1+re}}{1-\frac{1+g}{1+re}}$; where P and D_1 are price and dividend levels. There is one main parameter to estimate, g; although we may choose to estimate d as well.

Thus, if we were to have unbiased estimates of d and g then we could expect that the required rate of return on equity is unbiased as well. However, if we assume variation in g and/or d through time, as the AER do in their two or three stage DGM model, then this attractive property of unbiasedness is lost. This can be seen immediately by considering a two period model in which the two period growth rate is different from the one-period growth rate and we can see that the solution for r_e will be the solution of a quadratic equation, which will be non-linear in the estimated growth rates. In this case unbiased estimation of the components is not enough to guarantee unbiased estimation of r_e. Furthermore, increases in the volatility of the estimates will in general lead to increased biases so we might expect DGM estimates to be worse as volatility increases.

The issue of bias in analysts' forecasts is a serious one and much of this material is well-known. We do not attempt to review this literature but refer readers to a thorough recent review with references to some Australian papers, see Thomson (2011). Whilst there is variation in the findings depending which markets and which analysts are being considered, there seems to be strong evidence of analyst forecast inaccuracy, in particular analyst optimism, and no evidence that this is corrected in some way looking forward over 10 years.

With respect to the evidence that Frontier offer on analysts forecast bias in Australia, we would place little weight on a non-random sample of twenty firms and one year's observations. The dating of the forecasts relative to the earnings announcement is not stated, but it is important. It is well known that analyst accuracy increases substantially as the earnings announcement date becomes close.

If we assume the market is unbiased, then the AER are correct in observing that any upward bias in analysts' forecasts will result in a higher implied return on the market for a given method of inferring that implied return. Frontier are then incorrect in their assertion at paragraph 233 that any bias is irrelevant since "…it follows mechanically that the implied discount rate must be an estimate of the market's required rate of return on equity".

As its name attests the implied discount rate is intended as an estimate of the market's implied return on equity, but it is not necessarily an unbiased estimate. The implied cost of capital is obtained by finding the internal rate of return that equates cash flows based on analysts' forecasts to the current price using some discounted price model, such as the DGM. If the analysts' forecasts of the cash flows are upward biased and if the market's estimates of expected cash flow are unbiased then the internal return is an upward biased estimate of the implied cost of capital.

If we assume that the analysts' estimates are the same as the market's expectation the assumption then becomes that the market expectation is upward biased. Whether we then get the market's implied cost of capital depends upon whether the market price is being set using the same pricing model used in the implied cost of capital calculation, in this case a DGM model. It also depends on whether the inputs used other than the analysts' forecasts, such as the long term growth rate, also match market expectations. Thus, there is plenty of scope for implied cost of capital estimates to go astray.

With regard to the term structure of required returns we agree with Frontier that there has been extensive debate about whether there is a term structure for equity returns and that we would not currently recommend that the AER estimate the cost of equity assuming a term structure. However, the AER is correct in their statement that if there is a term structure this further distorts the implied cost of capital estimates from the DGM.

ix. Considered that the AER's consultants also noted that the allowed return on equity falls one for one with falls in the government bond yields

At paragraph 22, Frontier state:

> "Since its 2013 Guideline, the AER has allowed an MRP of 6.5% in every one of its draft and final decisions. The AER's advisors note that this approach results in the allowed return on equity moving one-for-one with changes in risk-free rates:
>
> > 'The AER decisions hold the risk premium nearly constant (although upward adjustments of 0.5% have been made). As (sic) result the regulated return tends to fall 1 for 1 with falls in the risk free rate.' "

This latter paragraph correctly reports what we wrote. As we also state at A2 in this report, ceteris paribus, a fall 1 for 1 is what is expected. It can be seen from equations (2) and (3) above in A2i, that if the MRP and beta have not changed then the return on equity falls one for one with falls in the government bond yield.

x. Considered that the AER's consultants recognise that the AER sets a nearly constant MRP

We have recognised, as at A2 ix, that the AER has set a nearly constant MRP. As discussed at A2 we have also agreed that the MRP is not necessarily constant and that our priors are that the MRP is likely to have fallen below the historic average. However, as we have also discussed in this report, for the AER to consider changes in the MRP requires some statistical evidence based on hypothesis testing. In addition to statistical evidence, if the argument is to raise rates, then if we follow equation (3) where it is the return on the market that is exogenous, the AER should be convinced why it is that the expected rate of return on the

market rises to offset the fall in interest rates. In terms of equation (2), where the risk premium is exogenous, the AER needs to be convinced why investors should require more compensation for the risk of holding equity as interest rates fall.

A3. APTPPL, *RBP Access Arrangement submission*, September 2016. In this report, APTPPL (among other things):

i. Considered that the MRP should be estimated as the difference between the expected return on market and the prevailing risk free rate. It should not be estimated using historical excess returns.

The main discussion of this issue is found in APTPPL (2016), 7.3.4.2., and relates to our discussion at A2.i about whether it is the MRP or the market rate of return that is considered to be exogenous to the model. As we stated in A2.i, practitioners tend to treat the MRP as the exogenous variable. We also note that in the development of the capital market line, used in deriving the CAPM, the equilibrium equation is characterised in terms of the price of risk. The market portfolio is selected as the efficient portfolio that gives the biggest risk premium per unit of risk. In other words it is the risk premium that determines the market portfolio. We further note that the CAPM is a one period model and in a one period model there is only one MRP and one risk free rate. Thus given the MRP the value of market return is uniquely defined and given the market return the value of the MRP is also uniquely defined. The issue of multi-period estimation does not arise in this theoretical framework.

ii. Considered that a long term average of past returns on the market portfolio may be used as an estimate of the expected return on the market.

This refers to the parameter μ_m discussed in A2.i. If the process generating market returns is stationary, then a long-term average of past market returns may be used as an estimate of the expected return of the market. The argument that APTTTL (2016) make for the stationarity of μ_m is based on the ERA's (2016) statement about returns being mean reverting and the ERA's interpretation that this implies stationarity. The relevant statements are as follows:

APTPPL (2016, p. 144) make the following statement regarding stationarity and also make a similar statement on page 155.

> "However, the ERA found the market return on equity series to be stationary, with the implication that an average of a long span of data could provide a cross check on any estimate of the market return on equity made using the dividend growth model."

APTPPL justify this statement by referencing ERA (2016, para. 1011) which in turn states:

> "This is an important marker for the market return on equity. As the available evidence supports the hypothesis that the market return on equity is mean reverting, this historic outcome from a long span of data may be used as a cross check for the long run average of the forward looking market return on equity from each regulatory period."

The ERA (2016, para. 960) also discusses "stationarity (in the sense of being mean reverting)". At paragraph 961 the ERA references the empirical results supporting stationarity as coming from empirical work contained in the ERA's Guidelines (December 2013, Appendix 16).

We discuss the ERA's empirical evidence at (A3, iv) below. Here we provide definitions of stationarity and mean reversion and we make the point that mean reversion and stationarity are not necessarily the same thing and compatibility between them requires the imposition of various assumptions on the behaviour of the time series under consideration. We start with definitions of stationarity and mean reversion. The ERA (2013, p. 135, fn. 223) provide the following definition of weak stationarity:

> "In order to better understand the issue, a brief explanation of stationarity is as follows. A series of observations on a variable $X_t$through time is 'covariance-stationary' (also referred to as weakly stationary or just stationary) if it has a finite mean and variance. That is, its mean and covariance are not dependent on the point in time they are observed. The

covariance however can be a function of the distance between two observations, $X_t$and $X_s$where the covariance is constant for all t given s, but can vary with a change in s. in other words, change with the distance between two points in time. It should be noted that when s is equal to zero the covariance is equal to variance. The concept of stationarity is important in time series because data from the past is used to quantify relationships to inform future outcomes. If a series is not stationary, this implies the future can differ fundamentally from the past. In the context of data, if the mean and covariance are dependent on time, the distribution of a time series variable can change over time. This point is important in relation long run average values or point estimates of time series (such as the MRP). Averages and point estimates are based on past observations and if not stationary, may not say much, if anything about the future."

We present two versions of mean reversion. The first is from Weisstein (undated):

"Reversion to the mean, also called regression to the mean, is the statistical phenomenon stating that the greater the deviation of a random variate from its mean, the greater the probability that the next measured variate will deviate less far. In other words, an extreme event is likely to be followed by a less extreme event.

Although this phenomenon appears to violate the definition of independent events, it simply reflects the fact that the probability density function $P(x)$of any random variable x, by definition, is nonnegative over every interval and integrates to one over the interval $(-\infty, \infty)$. Thus, as you move away from the mean, the proportion of the distribution that lies closer to the mean than you do increases continuously."

This implies, as you move away from the mean, that in the next period the probability that you will get a value smaller than the previous value, should have gone up.

The second version of mean reversion is based on a quote by Poterba and Summers (1988):

> "The extent to which stock prices exhibit mean-reverting behavior is crucial in assessing assertions such as Keynes(1936) that 'all sorts of considerations enter into market valuation which are in no way relevant to the prospective yield' (p. 152). If market and fundamental values diverge, but beyond some range the differences are eliminated by speculative forces, then stock prices will revert to their mean. Returns must be negatively serially correlated at some frequency if 'erroneous' market moves are eventually corrected. Merton (1987) notes that reasoning of this type has been used to draw conclusions about market valuation from failure to reject the absence of negative serial correlation in returns. Conversely, the presence of negative autocorrelation may signal departures from fundamental values, although it could also arise from variation in risk factors over time."

This latter definition is based on return to fair value so that, if an asset, is sufficiently under or over-valued, we might expect the forces of arbitrage to bring it back to its fair value. While similar, the two concepts of mean reversion are not identical.

To illustrate the relation between stationarity and mean reversion we work with a simple model, the autoregressive model of order 1 with intercept. Constrained versions of this model lie behind the Dickey-Fuller Test and other statistical procedures used in the ERA's (December 2013, Appendix 16) tests for stationarity. We note that the arguments below could be made with more complex models, but at some cost to clarity of exposition.

$$P_t = \alpha + \beta P_{t-1} + V_t \quad (1)$$

where P_t can be thought of as the random price of some asset at time t,
V_t is a random error at time t that is unobserved, which we can assume is independent of P_{t-1} and has a mean of zero. We make the assumption that the values α and β are unknown parameters to be estimated by the statistician.

We assume that the market opened for the first time at t=0 and the opening price was P_0. If we back-solve this equation t-1 times, we get:

$$P_t = \alpha \frac{(1-\beta^t)}{(1-\beta)} + \beta^t P_0 + \sum_{j=0}^{t-1} \beta^j V_{t-j} \quad (2)$$

We see, if $|\beta| < 1$; as t tends to infinity, the process in (2) tends to:

$$P_t = \frac{\alpha}{(1-\beta)} + \sum_{j=0}^{\infty} \beta^j V_{t-j} \quad (3)$$

If V_t is assumed to be independent and identically distributed with mean 0 and variance σ_v^2, then $P_t$as described by (3) is weakly stationary (as described in the ERA definition) with mean $\frac{\alpha}{(1-\beta)}$ and variance $\frac{\sigma_v^2}{(1-\beta^2)}$.

Notice that if we start with P_0 as a constant, the process is not stationary, it only becomes stationary in the limit as t becomes large. This is because E $(P_1) = \alpha + \beta P_0$.
E $(P_2) = \alpha + \beta \mathrm{E}(P_1) = \alpha + \alpha\beta + \beta^2 P_0$. This shows that the expected price is not a constant.

Is this process mean-reverting? The answer to this depends on the definition of mean reversion. If we mean that a large value tends to be followed by a smaller value next period, we can determine if the above model (1) is mean-reverting. To do this assume that $|\beta| < 1$ and that t is large enough that (2) holds and that E$(P_t) = \frac{\alpha}{(1-\beta)}$ = μ. We can rewrite (1) as:

$$P_t - \mu = \beta(P_{t-1} - \mu) + V_t$$

Now, if $P_{t-1} > \mu$ and 0<$\beta < 1$ (the latter is likely to be true for prices) and V_t is assumed to be small, then $P_t - \mu$ should be smaller than $P_{t-1} - \mu$ so that, in this sense , the process (2) is mean-reverting about its unconditional mean μ even though it is not weakly stationary.

Can we make weak stationarity imply mean reversion given equation (2)? Yes, if we assume that P_0 is uncorrelated with the errors and has mean $\frac{\alpha}{(1-\beta)}$ and variance $\frac{\sigma_v^2}{(1-\beta^2)}$. Then the price process is weakly stationary and mean-reverting in the above sense. The conclusion from the foregoing analysis is that mean reversion does not necessarily imply that long-term averages are stationary. It depends on the assumptions that the time series process conforms to.

In general, the issue of concern is not mean reversion, but whether the sample mean is a consistent estimator of the population mean. This is true for most, but not all, weakly

stationary processes. For example, assume that the process has mean μ, variance σ^2 and autocorrelation function $\gamma(s)$; s=0,1,2,…; $\gamma(0) = 1$. Suppose the sample mean is $\frac{\sum_{s=1}^{T} X_s}{T}$, then its variance is $\frac{\sigma^2}{T^2}$(T+2 $\sum_{s=1}^{T}(T-s)\ \gamma(s)$) and by mean-square convergence, $\frac{\sum_{s=1}^{T} X_s}{T}$ is a consistent estimator of μ, if $\frac{\sigma^2}{T^2}$(T+2 $\sum_{s=1}^{T}(T-s)\ \gamma(s)$) tends to 0 as T tends to infinity. It can be shown (proof omitted) that if the process is given by (3) and is weakly stationary that this is satisfied, but it is not satisfied if, for example, if $\gamma(s)$=c for all s. In simple terms, for stationarity the autocorrelation needs to decrease at a sufficient rate as the time-points become further apart.

iii. Considered that it does not apply the Wright approach.

APTPPL state clearly on page 153, para 4, that "APTPPL does not apply the Wright approach". They also explicitly mention that they do not assume that the real required rate of equity is constant, which is the critical assumption of the Wright approach. These statements appear to be consistent with what they have done. We see no attempt to compute a real rate of return and then add back the projected inflation rate to estimate a current nominal rate of return on equity.

APTPPL argue for estimation of the MRP using the historic nominal mean return less the current risk free rate. They argue for 10% as a conservative value for the mean return on the market as it is the lowest value in a range of long term mean market returns that they claim were reported by the AER. They support the choice of this value with the ERA's estimate of the average return on the market of 10.3%. In turn the ERA's estimate of 10.3% comes from the application of the Wright approach. So indirectly there is some weak reliance by APTPPL on the Wright approach.

iv. Considered that the ERA found that the market return on equity series was stationary, with the implication that a long span of data could provide an estimate of the expected return on the market portfolio.

The tests for stationarity conducted by the ERA (2013) Appendix 16, are based on testing for a unit root in the return time series using variants of the Dickey Fuller test. The issue here is that tests for a unit root are used to determine whether or not the series is a random walk. The form of "stationarity" of "not being a random walk" is not identical to the concept of (weak) stationarity as defined earlier, but the differences are usually minor. In the context of testing for a unit root, "stationary" means that $\beta < 1$ in equation 1 (reproduced below) while the null is that the process is a random walk ($\beta = 1$).

$$P_t = \alpha + \beta P_{t-1} + V_t \text{ (1)}$$

where P_t can be thought of as the random price of some asset at time t, V_t is a random error at time t that is unobserved, is assumed to be independent of P_{t-1} and has a mean of zero. The values α and β are unknown parameters that are to be estimated.

The ERA (2013) uses long time-series of Australian data (128 years) to investigate the presence of stationarity in, equity index returns, the yield on bills of less than one year maturity and yield on bonds with maturities of ten years or more. Essentially, they use a version of equation (1) where returns/yields are substituted for the price variables. The Dickey-Fuller test is used to test the null that the process is a random walk ($\beta = 1$) against the alternative that it is not ($\beta < 1$).

The ERA (2013) find that yields on bills and bonds are integrated of order one (I(1)) (random walks) whilst the rate of return on equity is integrated of order 0 (I(0)), what the ERA call "stationary". The former results might be thought to be surprising, the latter is unsurprising. The former seems likely to be a consequence of very high inflation sustained from about 1973 to 1986, which led to a large jump in interest rates. One suspects that had the analysis used real yields, the result may well have changed and it might be the case that the bill yields, bond yields and the MRP in real terms are "stationary". It would also be the case

that if the real bill and bond yields were "stationary" then the ERA's conclusion in paragraph 48.1 of Appendix 16 would no longer apply. That conclusion was:

> "That the risk-free rate is non-stationary and the return on equity is stationary. These findings imply that there is no cointegrating relationship between the risk-free rate and return on equity. This is because in time series, a non-stationary series combined with a stationary series is non-stationary - the ERP is then essentially a linear combination of a stationary and non-stationary series implying that the ERP is non-stationary."

If this conclusion did not apply, then it would substantially weaken the ERA case for using the mean return on equity rather than the mean MRP.

It would also be the case that if returns were computed as continuous rates of return, then the MRP computed using nominal returns would be identical to that computed using real returns. Thus working with continuous real returns would take out the impact of inflation, but would not affect the MRP. The data that the ERA (2013) uses is taken from Brailsford *et. al* (2012) and this data is comprised of discrete returns. When using discrete returns in computing the MRP and if inflation and interest rates are low, then either nominal or real returns will give approximately the same MRP. However, in a periods of high inflation and high interest rates, as in the seventies and eighties, the approximation is poor. Consequently the MRP using discrete real returns would have diverged from the MRP data that the ERA used for this period.

The analysis in the ERA (2013) is not especially convincing; the real questions are whether the price levels of these three series are I(1). To understand why the analysis is better done initially in levels of prices, we note that, except in very unusual circumstances, returns are stationary. Linear functions of stationary returns will also be stationary so there is nothing to be done. Prices, however, are usually I(1). This means they behave like random walks. Linear combinations of random walks are usually random walks. When they are not, we have what is called co-integration. As an economic example consider consumption and income. These aggregate variables behave like random walks, but when we construct a linear consumption function, the resulting error term is stationary. Likewise we might expect that the price of equity and the price of bonds to be random walks, but their returns will be

stationary. The fact that bond yields look non-stationary appears to only reflect the impact of inflation in the 1970's and 1980's and can be easily addressed by working with real prices/real returns as we discuss above.

Following a random walk is not the only notion of non-stationarity. A notion that is relevant here is the notion of non-stationarity implicit in an evolutionary process. By this we mean that the statistical process generating market returns is now fundamentally different from what it was before and may well be different again going forward. In this framework there is no guarantee that in the future, the process will return to what it was before. For this reason, it is not necessarily the case that taking a very long series of market returns and averaging them to estimate the expected market return is automatically the appropriate way to proceed. If we assume that market returns are generated in an evolutionary process, then a better procedure is to use a rolling window estimate, the length of which is based upon the rate of evolution of the process. Thus if things are changing more quickly than usual we should use a shorter window.

v. Stated that its estimation of the return on equity (including the use of the expected return on the market portfolio and the prevailing risk-free rate to estimate the MRP) is the correct implementation of the Sharpe-Lintner CAPM

In the light of the discussion above we do not agree that using the average return on the market as the measure of the expected return on the market is *the* correct way to implement the Sharpe Lintner CAPM, it is a way, but not the only way. As stated at point A2(i) above, practitioners tend to view the market risk premium, rather than the average market return, as the exogenous variable. We do have some sympathy with the view that *given* a stationary process one could use the expected return on the market portfolio and the prevailing risk-free rate to estimate the MRP. The usefulness of this approach is conditional not only on whether the process is stationary, but also on the standard error of the estimate for the expected return on the market. The AER might consider this approach to inform their current methodology. However, as noted above, we would also recommend that one should weight the data for past market returns either by a rolling window or

exponentially declining weights, or other schemes appropriate to one's beliefs about the past versus the future. The danger here is opening a Pandora's Box of continuing debate about what the weighting scheme should be.

References

APTPPL (2016), *Roma to Brisbane Pipeline Access Arrangement Submission*, September 2016.

Brailsford T., Handley J. and Maheswaran K. (2012) The Historical Equity Risk premium in Australia: Post-GFC and 128 Years of Data, *Accounting and Finance*, 52:237-247.

CEG (2016), *Replication and Extension of Henry's Beta Analysis*, September 2016.

Chow, G. C., (1960), Tests of Equality Between Sets of Coefficients in Two Linear Regressions, *Econometrica*, 28 (3): 591–605.

Credit Suisse (2017), *Global Investment Returns Yearbook 2017,* Credit Suisse Research Institute.

Duarte F. and Rosa C., (2015), *The Equity Risk Premium: A Review of Models*, Federal Reserve Bank of New York Staff Reports No. 714, February 2015.

Dobbs, R., T. Koller, and Lund S., (2014), What effect has quantitative easing had on your share price? *McKinsey on Finance*, 49, 15-18.

ERA (2013), Appendices to the Explanatory Statement for the Rate of Return Guidelines (Appendix 16), December 2013.

ERA (2016), *Final Decision on Proposed Revisions to the Access Arrangement for the Goldfields Gas Pipeline*, June 2016.

Frontier (2016), *The Market Risk Premium*, September 2016.

Frontier (2016b), *The Relationship Between Government Bond Yields and the Market Risk Premium*, January 2016.

Goyal A. and Welch I., (2008), A Comprehensive Look at The Empirical Performance of Equity Premium Prediction**,** *Review of Financial Studies* 21 (4): 1455-1508.

Guay, W., Kothari, S. and Shu, S. (2011) Properties of implied cost of capital using analysts' forecasts, *Australian Journal of Management*, 36(2), 125–149.

HoustonKemp (2016) *The cost of equity: Response to the AER's draft decisions*, January 2016.

McKenzie M. and Partington G., (2014) *Report to the AER Part A: Return on Equity*, October (2016).

Miller, M. and Modigliani F., (1961) Dividend Policy, Growth and the Valuation of Shares, *Journal of Business*, 34: 411-433.

Thomson W., (2011), *Are Financial Analysts Accurate and Relevant? A Review of Relevant Research*, SSRN ID: 1929976.

Partington G. and Satchell S. (2016) *Report to the AER: Cost of Equity Issues 2016 Electricity and Gas Determinations*, April 2016.

Poterba J. and Summers L., (1988) Mean Reversion in Stock Prices: Evidence and Implications, Journal of Financial Economics, 22(1): 27-59.

Weisstein, E., (undated) *Reversion to the Mean*, *MathWorld*--A Wolfram Web Resource, http://mathworld.wolfram.com/ReversiontotheMean.html

Expert Witness Compliance Declaration

We have read "Expert witnesses in proceedings in the Federal Court of Australia" which are attached as Appendix 3. 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

Appendix 1

REFERENCE NO: AER WACC ROE 2016.12

Terms of Reference

The Australian Competition and Consumer Commission (ACCC) / Australian Energy Regulator (AER) seeks an expert in corporate finance, specifically, the cost of capital. This is to provide an assessment of the return on equity for regulatory determinations and access arrangements occurring over 2017.

The AER is responsible for the economic regulation of electricity networks and gas pipelines in Australia.[10] In undertaking this role, the AER sets the allowed revenues or prices for these monopoly service providers[11] over a fixed period determined in advance (usually 5 years),[12] in accordance with the relevant legislation.[13] As part of determining the total revenues or prices that a service provider may earn, the AER applies a 'building block' framework that includes a return on capital building block, which is derived from a regulated rate of return.[14]

The expert advice is required in the following context and framework:

1. The overarching requirement is that the rate of return on capital must be consistent with the relevant legislation; the NEL, NGL, NER and NGR (see above 'Legal requirements for the allowed rate of return'). Specific to the return on equity, the NER and NGR require:

    a. The return on equity for a regulatory control period must be estimated such that it contributes to the achievement of the allowed rate of return objective.[15]

    b. In estimating the return on equity, regard must be had to the prevailing conditions in the market for equity funds.[16]

2. The rate of return guideline sets out the AER's approach to determining the allowed rate of return in accordance with the relevant legislation. The expert advice should have regard to the guideline approach when identifying issues put

10 Excludes Western Australia and the Northern Territory.

11 A list of these service providers can be find at: https://www.aer.gov.au/networks-pipelines/service-providers-assets

12 This period is known in an electricity context as a regulatory control period or in a gas context as an access arrangement period.

13 For electricity networks, this means the National Electricity Law (NEL) and National Electricity Rules (NER). For gas networks, this means the National Gas Law (NGL) and National Gas Rules (NGR).

14 That is, the rate of return on capital is multiplied by the regulated asset base (for electricity networks) or the capital base (gas networks) to derive the return on capital building block for a given year.

15 NER, clauses 6.5.2(f) and 6A.6.2(f). NGR, rule 87(6). The allowed rate of return objective is that the rate of return for a service provider is to be commensurate with the efficient financing costs of a benchmark efficient entity with a similar degree of risk as that which applies to the service provider in respect of the provision of its regulated services. The rate of return guideline defines the benchmark efficient entity as a pure play, regulated energy network business operating within Australia.

16 NER, clauses 6.5.2(g) and 6A.6.2(g). NGR, rule 87(7).

forward by the relevant service providers in their proposals. In the guideline, the AER proposes to estimate:

a. the returns on equity and debt for a benchmark efficient entity[17]

b. the WACC (post corporate tax, pre personal tax) using a the nominal vanilla formula $WACC_{vanilla} = E(k_e)\frac{E}{V} + E(k_d)\frac{D}{V}$

where:

i. $E(k_e)$ is the expected required return on equity

ii. $E(k_d)$ is the expected required return on debt

iii. E/V is the proportion of equity in total financing (comprising equity and debt)

iv. D/V is the proportion of debt in total financing, and is equal to the AER's proposed benchmark efficient entity gearing ratio of 0.6

v. $WACC_{vanilla}$ is updated annually as a result of the estimated return on debt being updated annually.[18]

The Guideline is not legally binding on the AER or service providers. However, if the AER or a service provider chooses to depart from the Guideline, it must state its reasons for doing so in the relevant regulatory determination.

The AER is currently considering regulatory proposals by APTPPL (for the Roma to Brisbane pipeline) and AusNet Services' electricity transmission services (TNSP). All of these service providers proposed the AER depart from its rate of return guideline.

The AER seeks expert advice to inform its decisions on the rate of return, in particular the return on equity component for:

- Final decision for AusNet Services (TNSP); and
- Draft decision for APTPPL.

[17] The guideline defines the benchmark efficient entity as a pure play, regulated energy network business operating within Australia.

[18] AER, *Better regulation rate of return guideline*, December 2013, pp. 7–9.

The AER expects regulatory proposals from the Victorian gas DNSPs[19], GasNet, TasNetworks and Powerlink in December 2016. The AER also expects to receive regulatory proposals from Murraylink Electranet and Transgrid in the first half of 2017.

These service providers may propose that the AER departs from its rate of return guideline for both the return on equity and the return on debt. And the AER may seek expert advice to inform its decisions on the return on equity and debt for these service providers.

Further context on the AER's role, recent determinations, and the rate of return guideline is provided at the end of this Attachment A.

Services required

The AER requires expert advice set out in Part A. The AER may also require expert advice set out in Part B and Part C below. The services relate to the return on equity and debt to be applied in the AER's determinations / access arrangements, and which contributes to the achievement of the allowed rate of return objective.

The request in Part A (and B and/or C if required) is for a capped-price contract. The material relevant to this consultancy is set out below.

The AER provides separate requests for Part B and C. The requests if required are for a capped-price contract. The AER requires the consultant to provide a quote for Part B (and/or C) before making a decision (in writing) on whether to proceed with Part B and/or C.

Part A.

B. Having reviewed the relevant material, provide a report setting out an overall view, with reasons, whether any matters in the relevant material would cause the consultant to:

[19] AGN (Albury), AGN (Vic), AusNet Services, Multinet

- advise the AER to change the manner in which it estimates return on equity from that applied in its recent decisions, and/or
- alter, or add to, any of the findings in the reports set out in Table 1 (in the Relevant Material section below)

for the purpose of estimating the forward-looking return on equity of a regulated 'pure-play' Australian energy[20] network[21] business, which is the return that is just sufficient to induce investors to invest in the business.[22]

The AER, without intending to directly or by implication provide a view of the relative importance of the expert reports and relevant material, wishes to highlight the reports listed in items A1 to A3 below. While the authors of those reports have expressed numerous views, under A1 to A3, some of their specific views are noted. These issues must be specifically addressed in the consultant's report.

In responding to these issues and reports, the consultant may comment on their assumptions, methodological choices and findings. The consultant is required to discuss the scope of any potential empirical work with the AER. 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 its overall conclusion.

The consultant is also required to respond to any criticisms levelled against positions/findings in previous advice to the AER (see Table 1 below).

A1. CEG, *Replication and extension of Henry's beta analysis*, September 2016. In this report, CEG (among other things):

i. Considered that the equity beta is time varying.

20 Being a gas or electricity business.

21 Being a transmission or distribution network.

22 Given a 60:40 debt to equity ratio.

ii. Considered that an extension of Henry's analysis shows that the average re-levered equity beta has increase materially since the 2013 Guideline due to increase/decrease in the raw equity betas/gearing ratios of the remaining listed stocks and an increase in the weighting of high-beta stocks in the value-weighted portfolios.

iii. In updating Henry's portfolio beta estimates, considered that it is appropriate to estimate a beta for a portfolio of companies where some constituents are no longer listed (and thus the number of observations different materially between constituents).

A2. Frontier Economics, *The market risk premium*, September 2016. In this report, Frontier Economics (among other things):

xi. Considered that the decline in government bond yields since the AER's December 2013 Rate of Return Guideline has not caused a commensurate reduction in the required return on equity, which has remained relatively stable.

xii. Considered that investors' required return on equity is relatively stable since the AER's 2013 Rate of Return Guideline based on evidence from DGM estimates, expert reports, bank statements and other regulators' decisions

xiii. Considered the prevailing market conditions are currently materially dissimilar to the average historical conditions. Considered that a technique that estimates the MRP by subtracting the average government bond yield from the average market return would not produce a reasonable estimate of the prevailing MRP in current conditions.

xiv. Considered that more weight should be given to DGM-based estimates of the MRP because it produces a forward looking MRP that is commensurate with the prevailing conditions in the market for equity funds.

xv. Recommended estimating the risk premium by effectively applying equal weighting to the DGM and historical excess returns evidence, and cross checking using the Wright approach estimates of market risk premium, expert report estimates, conditioning variables, market participants and other regulators' decisions.

xvi. Considered that it is difficult to draw conclusions from conditioning variables in the absence of formal econometric mapping to a point estimate of the MRP. However, the one conclusion is that it does not support is that the required return on equity falling 25 per cent since the 2013 Guideline.

xvii. Considered that the DGM should be implemented without a downward adjustment to the long-run DGP growth rate because it is based on out-dated US evidence.

xviii. Considered that issues with the DGM estimates of the MRP (noted by the AER) are overstated and have not intensified since the Guideline.

xix. Considered that the AER's consultants also noted that the allowed return on equity falls one for one with falls in the government bond yields

xx. Considered that the AER's consultants recognise that the AER sets a nearly constant MRP

A3. APTPPL, *RBP Access Arrangement submission*, September 2016. In this report, APTPPL (among other things):

vi. Considered that the MRP should be estimated as the difference between the expected return on market and the prevailing risk free rate. It should not be estimated using historical excess returns.

vii. Considered that a long term average of past returns on the market portfolio may be used as an estimate of the expected return on the market.

viii. Considered that it does not apply the Wright approach.

ix. Considered that the ERA found that the market return on equity series was stationary, with the implication that a long span of data could provide an estimate of the expected return on the market portfolio.

Project Deliverables

The key deliverable is a written report for Part A addressing the advice sought as per the services required. Prior to finalisation, the consultant will provide a draft of the report for review by AER staff.

Relevant material

The expert advice must engage with the key documents set out in Table 1 below (hyperlinks are provided for easy access).

It is expected that the consultant will engage more broadly, including relevant academic literature or other research.

Some submissions may specifically discuss or raise issues with the previous expert advice provided to the AER (set out in Table 1). If this occurs, then the consultant may need to engage with the material in these submissions. The AER staff will identify/nominate particular issues it seeks the consultant to specifically address. However, such identification and/or nomination are not intended to restrict or direct the consultant. The consultant is required to address all issues relevant to the formulation of their opinion.

The expert advice may also need to engage with the final decision by the Tribunal on the appeal of a number of the AER's recent decisions. This was determined on 26 February 2016.[23]

Table 1 Previous expert advice provided to the AER

Professor Michael McKenzie and Associate Professor Graham Partington (McKenzie and Partington)—*Report to the AER: Part A return on equity*, October 2014
Associate Professor John Handley (John Handley)—*Advice on the return on equity*, October 2014
Graham Partington—Report to the AER: Return on equity (Updated), April 2015
Associate Professor Graham Partington and Professor Stephen Satchell (Partington and Satchell)—Report to the AER: Return on equity and comment on submissions in relation to JGN, May 2015
John Handley—Further advice on return on equity, April 2015
John Handley—*Advice on the rate of return for the 2015 AER energy network determination for Jemena Gas Networks*, May 2015
Partington and Satchell—*Report to the AER: Analysis of criticisms of 2015 determinations*, October 2015
Partington and Satchell–*Report to the AER: Cost of equity issues 2016 electricity and gas determinations*, April 2016

[23] http://www.judgments.fedcourt.gov.au/judgments/Judgments/tribunals/acompt/2016/2016acompt0001

Table 2 AER rate of return guideline

AER's current rate of return guideline
AER's current rate of return guideline explanatory statement
AER's current rate of return guideline explanatory statement (appendices)

Table 3 Current regulatory proposals, revenue proposals, access arrangement proposals

Initial proposal from APTPPL for Roma to Brisbane pipeline – chapter 7
Revised regulatory proposal for AusNet Services (electricity transmission network)– chapter 6

Table 4 Previous regulatory proposals, revenue proposals, access arrangement proposals

Initial proposal from AusNet Services (electricity transmission network) – chapter 10

Key consultant reports attached to revenue proposals / regulatory proposals / access arrangement proposals are shown in Table 5 and Table 6 below.

Table 5 New expert reports

Frontier (Sep 2016)	Frontier, The market risk premium, September 2016
CEG (Sep 2016)	CEG, Replication and extension of Henry's beta analysis, September 2016

Table 6 Previously-submitted expert reports

CEG (2015a) (attached)	CEG, Measuring risk free rates and expected inflation, April 2015
Frontier (2015a)	Frontier (Kumareswaran & Sood), Review of the AER's conceptual analysis of equity beta, June 2015
Frontier (2015b)	Frontier, Key issues in estimating the return on equity for the benchmark efficient firm, June 2015
Frontier (2015c)	Frontier, An updated estimate of the required rate of return, AGN, June 2015
Frontier (2015d)	Frontier, Cost of equity estimates over time, Report prepared for Ergon Energy, June 2015
Frontier (2015d)	Frontier, Cost of equity estimates over time – excel model, June 2015
Grant Samuel (2015)	Grant Samuel & Associates Pty Ltd, Australian Energy Regulator – Draft Decision, January 2015
HounstonKemp (2015)	HoustonKemp, Implications for Jemena Gas Networks (NSW) of increasing competition in the consumer energy market, February 2015
Incenta (2015)	Incenta Economic Consulting, Further update on the required return on equity from independent expert reports, February 2015
Knecht (2015)	Knecht (Nevada State Controller) , Witness statement (on equity models) 19 June 2015
Malko (2015)	Malko Energy Consulting, Statement of Dr J Robert Malko, June 16 2015
NERA (2015a)	NERA, The cost of equity: Response to the AER's final decisions for the NSW and ACT electricity distributors and JGN, June 2015
NERA (2015b)	NERA, The relation between the MRP and the risk free rate: Evidence from independent expert reports, April 2015

NERA (2015c)	NERA, Further assessment of the Historical MRP: Response to the AER's final decisions for the NSW and ACT electricity distributors, June 2015
NERA (2015d)	NERA, Energy Regulation Insights: European regulators' WACC decisions risk undermining investment decisions (issue 41) February 2015
NERA (2015e)	NERA, Historical estimates of the market risk premium, February 2015
NERA (2015f)	NERA, Empirical Performance of Sharpe-Lintner and Black CAPMs, February 2015
NERA (2015g)	NERA, Review of the Literature in Support of the Sharpe-Lintner CAPM, the Black CAPM and the Fama-French Three-Factor Model, March 2015
RBA (2015a)	RBA, RBA Governor's speech: The world economy and Australia, 21 April 2015, New York, USA
RBA (2015b)	RBA, Firm's Investment decisions and interest rates, Lane and Rosewall, RBA Bulletin, June 2015
RBA (2015c)	RBA, Low inflation in a world of monetary stimulus, speech by Philip Lowe, 5 March 2015
RBA (2015d)	RBA, Opening statement to House of Representatives Standing Committee on Economics, speech by Glenn Stevens, 13 February 2015
RBA (2015e)	RBA, Global and domestic influences on the Australian bond market, speech by Guy Debelle, 16 March 2015
SFG (2015c)	SFG, The required return on equity for the benchmark efficient entity, 25 February 2015
SFG (2015d)	SFG, Using the Fama-French model to estimate the required return on equity, 13 February 2015

SFG (2015e)	SFG, Beta and the Black Capital Asset Pricing Model, 13 February 2015
SFG (2015f)	SFG, Share prices, the dividend discount model and the cost of equity for the market and a benchmark energy network, 13 February 2015
SFG (2015g)	SFG, The foundation model approach of the Australian Energy Regulator to estimating the cost of equity, 27 March 2015
Frontier (2016a)	Frontier, Estimating the equity beta for the benchmark efficient entity, January 2016
Frontier (2016b)	Frontier, The relationship between government bond yields and the market risk premium, January 2016
Frontier (2016c)	Frontier, The required return on equity under a foundation model approach, January 2016
Frontier (2016d)	Frontier, An updated estimate of the required return on equity: Report for Australian Gas Networks, January 2016
Frontier (2016e)	Frontier, Response to submissions on the relevance of the TransGrid sale: Report prepared for Jemena Electricity Networks, ActewAGL Distribution, and United Energy, February 2016
HoustonKemp (2016a)	HoustonKemp, The cost of equity: Response to the AER's draft decisions, January 2016
HoustonKemp (2016b)	HoustonKemp, Australian Gas Networks – AER Gas Price Review, A second report for Johnson Winter & Slattery, 4 February 2016

Any reports referenced in the above reports can be provided upon request.

Appendix 2

CURRICULUM VITAE GRAHAM PARTINGTON

PERSONAL

Name:	Graham Harold Partington
Address:	Codrington Building (H69),
	Finance Discipline, School of Business,
	University of Sydney
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	Australia
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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 forty 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 of the order of fifty 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).

1985-1988: Australian Research Grants Scheme, *The Determinants and Consequences of Dividend Policy* ($30,000).

PUBLICATIONS

Books

R. Brealey, S. Myers, G. Partington and D. Robinson, 2000, *Principles of Corporate Finance*, Australian Edition, McGraw-Hill (1st printing 2000, 2nd printing 2000.)

C.A. Martin, J. McKinnon, R. Hines, G. Harrison and G. Partington, 1983, *An Introduction to Accounting*, McGraw-Hill (1st edition, 1983, 2nd edition, 1988, 3rd edition 1990.)

Contributions and Chapters in Books

G. Partington, 2011, Valuation and Project Selection when the Market and Face Value of Dividends Differ, Reprinted in *Asset Management Tools and Strategies,* Bloomsbury Press.

G. Partington, 2009, Valuation and Project Selection when the Market and Face Value of Dividends Differ, in *Qfinance the Ultimate Resource*, Bloomsbury Press.

G. Partington, 2007, Dividend Imputation Credits and Valuation, in *Business Tax Reform*, Australian Tax Research Foundation.

R. J. Coombes, M. Craig-Lees, M. McGrath, P. O'Sullivan, G. Partington and J. M. Wood, 1991, *Business Studies Book Two*, Social Science Press.

R. J. Coombes, M. Craig-Lees, M. McGrath, P. O'Sullivan, G. Partington and J. M. Wood, 1990, *Business Studies Book One,* Social Science Press.

E. Carew, 1985, *The Language of Money,* George Allen and Unwin.

Refereed Journals

PUBLISHED

N. Pricha, S. Foley, G. Partington, and J. Svec, (2016) Underwritten Dividend Reinvestment Plans and Conflicts of Interest, *Journal of Business Finance and Accounting*, **43:9 & 10**, pp. 1361-84.

A. Ainsworth, G. Partington, G. Warren, 2016, The Impact of Dividend Imputation on Share prices, The Cost of Capital and Corporate Behaviour, *JASSA The Finsia Journal of Applied Finance,* 1, pp 41- 49

A. Ainsworth, K. Fong, D. Gallagher, and G. Partington, 2015, Institutional Trading Around the Ex-Dividend Day*, Australian Journal of Management,* **41:2**, pp.299-323.

M. Kim and G. Partington, 2015, The Dynamic Prediction of Financial Distress of Australian Firms, Australian Journal of Management, **40:1**, pp.135-60.

A. Jun and G. Partington, 2014, Taxes, International Clienteles and the Value of ADR Dividends, *Journal of Business Finance & Accounting*, **41:9 & 10**, pp. 1337–1360.

H. Dang and G. Partington, 2014, Rating Migrations: The Effect of History and Time, *Abacus*, **50:2**, pp. 174-202

Hodgkinson L and G. Partington, 2013, Capital Gains Tax Managed Funds and the Value of Dividends: the Case of New Zealand, *British Accounting Review*, **45:4**, pp.271-283.

Partington G**.,** 2013, Death Where is Thy Sting? A Response to Dempsey's Despatching of the CAPM, Abacus, **49:S1**, pp. 69-72

Yao J., G. Partington and M. Stevenson, 2013, Predicting the Directional Change in Consumer Sentiment, Australian Journal of Management, **38:1**, pp. 67-80

A. Jun, D. Gallagher and G. Partington, 2011, An Examination of Institutional Dividend Clienteles: Evidence from Australian Institutional Portfolio Holdings, *Journal of Business Finance and Accounting,* **38:1-2,** pp. 198–224.

M. Dempsey, M. McKenzie and G. Partington, 2010, The Problem of Pre-Tax Valuations: A Note, *Journal of Applied Research in Accounting and Finance*, **5:2**, pp. 10-13.

G. Partington, Discussion of an International Analysis of Dividend Payment Behaviour, 2009, *Journal of Business Finance and Accounting,* **36:3-4**, pp. 523-529.

G. Truong, G. Partington and M. Peat, 2008, Cost of Capital Estimation and Capital Budgeting Practice in Australia, *Australian Journal of Management,* **33:1,** pp. 95- 122.

M. Dempsey and G. Partington, 2008, The Cost of Capital Equations under the Australian Imputation Tax System, *Accounting and Finance,* **48:3**, pp. 439-460.

H. Chu and G. Partington, 2008, The Market Valuation of Cash Dividends: The Case of the CRA Bonus Issue, *International Review of Finance,* **8:1-2**, pp. 1-20.

L. Hodgkinson and G. Partington, 2008, The Motivation for Takeovers in the UK, *Journal of Business Finance and Accounting*, **35:1-2**, pp. 102-126

Jun, V. Alaganar, G. Partington and M. Stevenson, 2008, Price and Volume Behaviour around the Ex-dividend Day: Evidence on the Value of Dividends from ADRs and their Underlying Australian Stocks*, International Review of Finance*, **8:1-2**, pp. 21-55.

Truong and G. Partington, 2008, The Relation between Franking Credits and the Market Risk Premium: A Comment, *Accounting and Finance*, **48:1**, pp. 153-158.

B. Wong, G. Partington, M. Stevenson and V. Torbey, 2007, Surviving Chapter 11 Bankruptcies: Duration and Payoff? *Abacus*, **43:1**, pp.363-387.

G. Partington, 2006, Discussion of Dargenidou, Mcleay and Raonic (Expected Earnings Growth and the Cost of Capital: An Analysis of Accounting Regime Change in the European Financial Market) *Abacus* **42:3-4,** pp. 415-425.

S. Armitage, L. Hodgkinson and G. Partington, 2006, The Market Value of UK Dividends from Shares with Differing Entitlements, *Journal of Business Finance and Accounting*, **33:1**, pp 150-174.

G. Partington, M Stevenson and J. Yao, 2005, Run length and the Predictability of Stock Price Reversals. *Accounting and Finance*, **45:4**, pp. 653-671.

G. Partington, P Russell, M. Stevenson and V. Torbey, 2001, Predicting Return Outcomes for the Shareholders of Companies Entering Chapter 11 Bankruptcy, *Managerial Finance,* **27:4,** pp.78-96.

G. Partington and M. Stevenson, 2001, The Probability and Timing of Price Reversals in the Property Market, *Managerial and Decision Economics,* **22:7,** pp.389-398.

H. Chu and G. Partington, 2001, Dangers in Data Adjustment: The Case of Rights Issues and Returns, *Accounting and Finance,* **41:2,** pp.143-168.

G. Partington and S. Walker, 2001, A Note on Transactions Costs and the Interpretation of Dividend Drop-off Ratios, *Accounting and Finance,* **41:2**, pp. 229-241.

S. Walker and G. Partington, 2000, A Market Valuation for Optus Pre-listing: A Case Note, *Accounting Research Journal*, **13:2,** pp. 90-94. (This paper won the award for Best Paper: Education Notes.)

S. Walker and G. Partington, 1999, The Value of Dividends: Evidence from Cum-dividend Trading in the Ex-dividend Period, *Accounting and Finance*, **39:3,** pp. 275-296. (This paper won the Peter Brownell Manuscript Award).

G. Hobbes, G. Partington and M. Stevenson, 1996, Earnings Dividends and Returns: A Theoretical Model, *Research in Finance,* Supplement 2, pp. 221-244.

G. Partington, 1989, Variables Influencing Dividend Policy in Australia: Survey Results, *Journal of Business Finance and Accounting* **16:2,** pp.165-182.

C.A. Martin, J. L. McKinnon and G. Partington, 1986, Funds Statements and the Two Entity Test: A Response, *Abacus*, **22:1**, pp. 39-44.

G. Partington, 1985, Dividend Policy and its Relationship to Investment and Financing Policies: Empirical Evidence, *Journal of Business Finance and Accounting,* **12:4**, pp. 531-542.

G. Partington, 1984, Dividend Policy and Target Payout Ratios, *Accounting and Finance*, **24:2**, pp. 63-74.

G. Partington, 1984, Teaching Process Costing, *Issues in Accounting Education,* **2:1**, pp. 75-90.

C.A. Martin, J. L. McKinnon and G. Partington, 1983, Clarifying Funds Statements: The Two Entity Test *Accounting and Finance,* **23:1**, pp. 79-87.

R. H. Chenhall and G. Partington, 1983, Dividends Distortion and Double Taxation, *Abacus*, **19:1**, pp. 3-13.

G. Partington, 1981, Financial Decisions the Cost(s) of Capital and the Capital Asset Pricing Model, *Journal of Business Finance and Accounting,* **8:1**, pp. 97-112.

G. Partington, 1979, Process Costing: A Comment, **15:1**, *Abacus,* June pp.60-66.

G. Partington, 1979, The Tax Deductibility of Interest Payments and the Weighted Average Cost of Capital: A Comment, *Journal of Business Finance and Accounting*, **6:1**, pp.95-100.

Conference Papers

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.

G. Truong and G. Partington, 2006, *The Value of Imputation Tax Credits and Their Impact on the Cost of Capital*, Accounting and Finance Association of Australia and New Zealand Conference, Wellington.

A. Jun, D. Gallagher and G. Partington, 2006, *An Examination of Institutional Dividend Clienteles: Evidence from Australian Institutional Portfolio Holdings*, Accounting and Finance Association of Australia and New Zealand Conference, Wellington.

G. Partington and M. Stevenson, 2006, *A Distress Prediction Tool*, New Directions in Employment and Financial Security: Rethinking Employee Entitlements and Employee Buyouts. Workplace Relations Centre and Members Equity Workshop, Sydney.

H. Chu and G. Partington, 2005, *The Market Valuation of Cash Dividends: The Case of the CRA Bonus Issue*, The European Financial Management Association Annual Meeting, Milan.

G. Truong, G. Partington and M. Peat, 2005, *Cost of Capital Estimation and Capital Budgeting Practice in Australia*, Accounting and Finance Association of Australia and New Zealand Conference, Melbourne,.

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.

A. Jun, , V. Alaganar, G. Partington and M. Stevenson, 2004, *Price and Volume Behaviour around the Ex-dividend Day: Evidence on the Value of Dividends from ADRs and their Underlying Australian Stocks*, Accounting and Finance Association of Australia and New Zealand Conference, Alice Springs.

M. Dempsey and G. Partington, 2004, *The Cost of Capital Equations Under the Australian Imputation Tax System*, Accounting Association of Australia and New Zealand Conference, Alice Springs,.

S. Armitage, L. Hodgkinson and G. Partington, 2002, *The Value of Dividends to a Marginal Investor, Evidence using Contemporaneous Trading Data,* British Accounting Association Conference, Jersey.

H. Chu and G. Partington, 2001, *The Value of Dividends: Evidence from a New Method*, Accounting Association of Australia and New Zealand Conference, Auckland.

G. Partington, P Russell, M. Stevenson and V. Torbey, 2001, *Predicting Return Outcomes for the Shareholders of Companies Entering Chapter 11 Bankruptcy*, Accounting Association of Australia and New Zealand Conference, Auckland.

H. Chu, L. Hodgkinson and G. Partington, 2001, *Right's Trade Adjustments: Evidence from the UK,* British Accounting Association Conference, Nottingham

H. Chu and G. Partington, 2001, *The Value of Dividends Implicit in Rights Prices*, Australasian Finance and Banking Conference, Sydney.

L. Hodgkinson and G. Partington, 2000, *The Motivation for Takeovers in the UK*, British Accounting Association Conference, Exeter.

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.

H. Chu and G. Partington, 1999, *Dangers in Data Adjustment: The Case of Rights Issues*, Australasian Finance and Banking Conference, Sydney.

G. Hobbes, G. Partington and M. Stevenson, 1997, *A General Model of Earnings Dividends and Returns,* Australasian Finance and Banking Conference, University New South Wales, Sydney.

S. Walker and G. Partington, 1997, *The Ex-Dividend Drop-off: Evidence from Cum-dividend Trading in the Ex-dividend Period*, Accounting Association of Australia and New Zealand Conference, Hobart.

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

R. Philip, A. Kwan, G. Partington, 2015, *Is High Frequency Trading Good for Market Quality?* A Report to the Centre for International Finance and Regulation.

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

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, G. Partington, G. Warren, (2015) *Do Franking Credits Matter: Exploring the Financial Implications of Dividend Imputation,* Australian Tax Review 2015, Submission on the Australian Tax Discussion Paper, on Behalf of the Centre for International Financial Regulation (CIFR)

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.

CURRICULUM VITAE STEPHEN SATCHELL

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

<u>CURRENT RESEARCH</u>

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*

,PP. 230-236, Pub. Date: March 29, 2013

DOI: 10.4236/jmf.2013.31A022

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* (2*012)*

175, Part 3, pp. 1–21

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

Stability Conditions for Heteroscedastic Factor Models with Conditionally Autoregressive Betas. (with G. Christodoulakis); in *the Journal of Time Series Analysis*.. Article first published online: 10 JAN 2011 | DOI: 10.1111/j.1467-9892.2010.00706.x

'Social Welfare Issues of Financial Literacy and Their Implications for Regulation' with O. Williams in *Journal of Regulatory Economics.* Online first, (21st of April, 2011).

Uncertain Survival and Time Discounting: Intertemporal Consumption Plans for Family Trusts (with S. Thorp); in *Journal of Population Economics*, (2011) 24:239-266.

Hedge Fund Replication (with J. Grummit); in *Journal of Derivatives and Hedge Funds,(1-18, 2011)*

Managing the Risk of Hedge Fund Outflows, (with B. Scherer), *Journal of. Alternative Investments,* Fall, v14n2, p. 18-23 (2011).

2010 PUBLICATIONS

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).

How Loss Averse are Investors in Financial Markets? (with S. Huang), in *Journal of Banking and Finance.* vol. 34, issue 10, pp. 2425-2438.

ASSET ALLOCATION AND A TIME-VARYING RISK TARGET (WITH R. CHEN AND J. LUO), IN QASS, VOL. 4, NO. 2, PP. 1-28.

An Experimental Survey of Investment Decisions for Retirement Savings,(with H. Bateman, J. Louviere, S. Thorp, and T. Islam), in *Journal of Consumer Affairs;* vol 44. No 3, pp. 463-482, (2010).

The Dangers of Double-Marking,(with J. Pratt) in *Higher Education Review*, vol 42, no 2, (Spring 2010).

Understanding Analysts' Forecasts (with R. J. Louth, P. Joos, and G. Weyns), in *European Journal of Finance*, 2010, 16.1-2, pp. 97-118.

Exact Properties of Measures of Optimal Investment for Benchmarked Portfolios (with J. Knight), in *Quantitative Finance,* 10.5, pp. 495-502 (May 2010).

Forecasting Risk and Return from Ordered Information (Lessons from the Recent Financial Crisis), (with S.M. Wright), in *Economic and Financial Modeling*, pp. 3-37, (Spring 2010).

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.

Implementing risk appetite in the management of currency portfolios, (with J. Luo and P. Saks), *Journal of Asset Management,* vol 9 (6), pp. 380-397.

Collecting and Investing in Stamps (with J. Auld.) in *Collectible Investments for the High Net Worth Investor*; chapter 8; S. Satchell (editor).

Computing the Mean/Downside Risk Frontiers: the Role of Normality. (with A. D. Hall), in *Optimizing the Optimizers,* S. Satchell (editor*).*

Some Properties of Averaging Simulated Optimisation Models (with J. Knight), in *Optimizing the Optimizers,* S. Satchell (editor*).*

Emerging From an Economic Crisis: Why Equity-Only Portfolios Remain a Bad Idea, (with R. Lewin and M. J. Sardy) in *Business and Economics Journal*, Academic & Business Research Institute (AABRI), (2009).

The Link between Macroeconomic Factors and Style Returns, (with Q. Jessica Zhang, P. Hopkins, and R. Schwob), in *Journal of Asset Management,* vol 10 (5), pp. 338-355.

Des Rating Qualitatifs por regagner le confiance des investisseurs; *L'Agefi Magazine*; 22/09/09, Fund Management Ratings *Investment Week* (July 2009).

2008 PUBLICATIONS

Testing for Infinite Order Stochastic Dominance with Applications to Finance, Risk and Income Inequality (with J. Knight), *Journal of Economics and Finance,* vol. 32(1); pp. 35-46.

The Accuracy of Credit Scoring Receiver Operating Characteristic in the Presence of Macroeconomic Shocks , (with G. Christodoulakis), *Journal of Risk Model Validation,* Volume 2/ Number 3, (Fall 2008).

2007 PUBLICATIONS

Endogenous Cross Correlation (with J. H. S. Yang), DAE Working Paper 0219, *Macro-economic Dynamics,* vol 11, S1, pp. 124-153.

The Underlying Return Generating Factors for REIT Returns: An Application of Independent Component Analysis (with C. M. Lizieri and Q. Zhang), *Journal of Real Estate Economics,* 35(4); pp. 567-596.

Analytic Models of the ROC Curve: Applications to Credit Rating Model Validation (with W. Xia), (QFRC Discussion paper, Number 181), *The Validation of Risk Models,* G. Christodoulakis *and* S. Satchell (editors), (2007).

Skew Brownian Motion and Pricing European Options (with R. Corns), in *European Journal of Finance* 13(6); pp. 523-544.

Bayesian Analysis of the Black-Scholes Option Price, DAE Working Paper no. 0102, University of Cambridge, (with T. Darsinos), (2001), in *Forecasting Expected Returns ;*S. Satchell(editor).

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. *Forecasting Expected Returns;* S. Satchell (editor).

Changing Correlation and Equity Portfolio Diversification Failure for Linear Factor Models during Market Declines (with A. Sancetta), in *Applied Mathematical Finance,* vol. 14, No 3, 227-242, (July 2007).

The Best of Intentions? The Allocation of Resources between Large and Small Subjects, (with O. Williams)*, Higher Education Review,* Vol 39.Number 2 , pp. 65-73, (Spring 2007).

The Disappearance of Style in the US Equity Market, (with S. Hwang), *Applied Financial Economics*, vol 17, pp 597-613, (May 2007).

The Behavioural Components of Risk Aversion (with G. B. Davies), *Journal of Mathematical Psychology,* vol 51, pp 1-13, (2007).

Will Private Equity and Hedge Funds Replace Real Estate in Mixed-Asset Portfolios?"(with S. Bond, S. Huang, P. Williams), in the Fall 2007 PREA sponsored special issue of the *Journal of Portfolio Management.*

Robust Optimisation for Utilising Forecasted Returns in Institutional Investment: (with C. Koutsoyannis) in *Forecasting Expected Returns;* S. Satchell(editor).

Optimal Forecasting Horizon for Skilled Investors, (with O. Williams); in *Forecasting Expected Returns,* S. Satchell (editor).

The Hidden Binomial Economy and The Role of Forecasts in Determining Prices, (with O. Williams) in *Forecasting Expected Returns;* S. Satchell (editor).

Stochastic Volatility Models with Markov Regime Switching State Equations' with S. Huang and P. Valls in J*ournal of Business ,Finance and Accounting,* vol 34, issue 5-6, pp 1002-1024, (June/ July 2007).

Analytic Models of the ROC Curve: Applications to Credit Rating Model Validation, *Journal of Risk Management in Financial Institutions*, (with W. Xia), volume 1, 1.

UK Measures of Firm-Lived Equity Duration: Value Creation in Multinational Enterprise, (with R. A. Lewin, M. J. Sardy), (editors J. J. Choi, R. W. Click), *International Finance Review*, vol. 7, pp. 307-338, (2007).

Enhancing Available Returns From Short-term Client Funds, with R. A. Lewin & M. J. Sardy, *Papers & Proceedings of Academy of Economics and Finance*, (2007).

2006 PUBLICATIONS

Estimation of the Risk Aversion of the Representative U.K. Pension Fund Investor, (with Wei Xia), published as S. Satchell, and W. Xei (2006),"A Matter of Attitude", *Life and Pensions*, (December 2006).

Measures of Equity Duration, (with R. A. Lewin and M. J. Sardy), in *International Finance Review,* vol. 7, *Value Creation in Multinational Enterprise*, (edited by J. J. Choi and R. W. Click), chapter 13, pp. 315-349, (2006) .

Asymmetry, Loss Aversion and Forecasting, (with S.A. Bond), in *Journal of Business*, vol. 79, no. 4, pp. 1908-1830, (2006).

Asymmetry and Downside Risk in Foreign Exchange Markets, (with S.A. Bond)

in *The European Journal of Finance*, vol. 12, no. 4, pp. 313-332, (2006).

2005 PUBLICATIONS

GARCH Model with Cross-sectional Volatility; GARCHX Models (with S. Hwang), in *Applied Financial Economics*, vol. 15, no. 3., pp. 203-216, (February, 2005).

A Re-examination of Sharpe's Ratio for Log-Normal Prices, (with J. Knight), in *Applied Mathematical Finance*. vol. 12, no. 1, pp. 87-100, (March 2005).

Valuing Information Using Utility Functions: How Much Should We Pay for Linear Factor Models? (with S. Hwang) in *The European Journal of Finance,* vol. 11, no. 1, pp. 1-17, (February 2005).

Simple and Cross Efficiency of CTA's Using Data Envelopment Analysis.(2003) (with Gregoriou, G, Rouah, F. and Diz, F.) in *The European Journal of Finance* October 2005, Vol. 11, No. 5, pp. 393-410.

New Test Statistics for Market Timing with Applications to Emerging Markets Hedge Funds (2004) (with A. Sancetta) in *The European Journal of Finance*, October 2005, Vol. 11, no. 5 pp. 419-443.

Edited special issue of Hedge-Fund Econometrics in *The European Journal of Finance* (October 2005).

Diversification When It hurts? The Joint Distribution of Real Estate and Equity Markets. (with J. Knight and C. Lizieri), 2005. *Journal of Property Research*, Vol 22,no 4.

Robust Cross-sectional Factor Modelling Approach to Equity Forecast Construction with S.M.Wright, *Economic and Financial Modelling*, Vol. 12 No. 4, Winter 2005, pp. 153-182.

2004 PUBLICATIONS

Forecast Evaluation in the Presence of Unobserved Volatility. In *Econometric Reviews* pp. 203-216 (with G. Christodoulakis). 2004.

Bayesian Estimation of Risk-Premia in an APT Context. Cambridge Working Papers in Economics 0329, in *Linear Factor Models in Finance*, J. Knight and S. Satchell (eds.) pp. 61-82, Butterworth and Heinemann. (with T. Darsinos)

Small-Noise Arbitrage Pricing Theory (in *Linear Factor Models in Finance*, pp. 141-162, edited by J. Knight and S. Satchell, Butterworth and Heinemann).

Linear Factor Models in Finance (with J. Knight, (eds)) (Butterworth Heinemann, 2004).

Draw Downs as a Measure of Hedge Fund Risk: Some Stylized Facts (with A. Sancetta and G. Lande). In G. N. Gregoriou, V.N. Karavas and F. Rouah (editors), *Hedge Funds: Inside the Black Box Using A Quantitative Approach*. Chapter 13, pp. 235-246. Washington: Beard Books.

The Copula Function as a Model and Approximation to Multivariate Distributions in *Econometric Theory 20* pp. 535-562 (with A. Sancetta)

Measuring Style Tilting and Decomposing Style Risk (2004). in *Journal of Asset Management* June, Vol. 5, No. 1 pp. 18-28 (with T. Darsinos).

Generalising the Universal Performance Measure. *Risk Magazine*, June 2004 pp. 80-84 (with T. Darsinos).

Data Pooling: a necessity for the majority of UK mortgage lenders. *Credit Risk International*, (June, 2004)

.

Calculating Hedge Fund Risk: the Draw Down and the Maximum Draw Down. in *Applied Mathematical Finance,(2004)* (with A. Sancetta), Vol. 11, pp 259-282.

., "Treasury Management of Core Banking Deposits",(with R.A. Lewin), *Journal of Bond Trading and Management*, Volume 2, Number 2, 2004.

2003 PUBLICATIONS

Assessing the Merits of Rank-based Optimisation for Portfolio Construction, in S. Satchell and A. Scowcroft eds., *New Advances in Portfolio Construction and Implementation*, Butterworth-Heinemann, London. (With S. Hwang, S. Wright)

New Advances in Portfolio Construction and Implementation, Butterworth and Heinemann (with A. Scowcroft) (eds.).

Some Exact Results for Efficient Portfolios with Given Returns, in S. Satchell and A. Scowcroft eds., *New Advances in Portfolio Construction and Implementation*, Butterworth-Heinemann, London. (with G. Hillier).

Value at Risk Linear Exponent (VARLINEX) Forecasts" (with Guoqiang Wang and Knight, J.), *Quantitative Finance 3* (2003) 332-344.

An Analysis of the Hedging Approach to Modelling Pension Fund Liabilities (with J. Randall) reprinted in *Asset and Liability Management Tools* A Handbook for Best Practice edited by Bernd Scherer.

Mortgage Default and Posession: A Competing Hazards Approach. *Journal of Money, Credit and Banking* Vol. 35(2), pp. 425-442. (with B.M. Lambrecht and W.R.M. Perraudin)

Utility Functions Whose Parameters Depend on Initial Wealth. Oct. 2003. *Bulletin of Economic Research*, Vol. 55, pp. 357-371 (with C. Pederson)

Can NN Algorithms and macroeconomic data improve OLS Industry Returns Forecasts?(with C. Pedersen). June, 2003. *The European Journal of Finance, Vol. 9,no 3,273-289.*

2002 PUBLICATIONS

Correlated ARCH (CorrARCH): modelling the time-varying conditional correlation between fianacial asset returns *European Journal of Operational Research*, Vol. 139 (2), pp 351-370. (with G. Christodoulakis) 2002.

On the Evolution of Global Style Factors in the MSCI Universe of Assets *International Transactions in Operational Research*, Vol. 9(1), pp 1-18. (with G. Christodoulakis) 2002.

Calculating the Misspecification in Beta from Using a Proxy for the Market Portfolio, in *Applied Financial Economics 12,* pp. 771-781 (with S. Hwang)

Performance Measurement of Portfolio Risk with Orthant Probabilities (with M. Lundin) in *Performance Measurement in Finance* (eds. J. Knight and S. Satchell), pp. 261-284. (Butterworth and Heinemann).

Performance Measurement in Finance, Butterworth and Heinemann. (With J. Knight) (eds.) 2002.

On the Foundation of Performance Measures under Assymetric Returns, *Quantitative Finance 2*, no. 3, pp. 217-223. (with C. Pederson) 2002.

Molten Lava meets Market Langour, *Quantitative Finance*, Vol. 2, no. 6, pp. 405-406 (with A. Sancetta), 2002.

Using Bayesian Variable Selection Methods to Choose Style Factors in Global Stock Return Models, *Journal of Banking and Finance* 26 pp. 2301-2325. (With S. Hwang and A. Hall), 2002.

Statistical Properties of the Sample Semi-Variance, with an Application to Emerging Markets Data. in *Applied Mathematical Finance*, Vol. 9, no. 4 pp. 219-239 (With S.A. Bond)

Efficient Estimation of the Stochastic Volatility Model via the Empirical Characteristic Function. *Australian and New Zealand Journal of Statistics* 44, pp. 319-335 (with J.L. Knight and J. Yu), 2002.

2001 PUBLICATIONS

Forward and Spot Rates in a Bi-variate TAR Framework, *European Journal of Finance* Vol. 7, pp. 131-143 (with R. Daccó) 2001.

Lower Partial-Moment Capital Asset Pricing Models: A Re-examination, 1996, *IFR Discussion Paper No.20*, (in *Downside Risk*, Butterworth and Heinemann). 2001.

On the Volatility of Financial Risk: An Investigation Using Returns from European Markets, *The European Journal of Finance*. (with C. Pederson, B. Eftekhari) 2001.

VaR versus Tracking Error: the Strengths and Weaknesses of Two Performance Measures, in E. Acar, eds., *Measuring Added Value: In Financial Institutions, Financial Times* Prentice Hall, London. (with S. Hwang) 2001.

Tracking Error: Ex-Ante versus Ex-Post Measures, *Journal of Asset Management,* Vol. 2, No. 3, 241-246. (with S. Hwang) 2001.

Modelling Emerging Market Risk Premia using Higher Moments, *International Journal of Finance and Economics 1999,* 4:4, pp271-293, reprinted in *Return Distributions in Finance* (Satchell S E and Knight J (eds.)), Butterworth and Heinemann 2001, pp75-115. (with S. Hwang) 2001

An Exponential Risk Measure with Application to UK Asset Allocation, *Applied Mathematical Finance* Vol.7 (2), 127-152. (with S. Hwang, and D.C. Damant) 2001.

Forecasting Nonlinear Functions of Returns Using LINEX Loss Functions, *Annals of Economics and Finance* Vol.2., 187-213. (with S. Hwang, J. Knight). 2001.

Pricing Derivatives Written on Assets with Arbitrary Skewness and Kurtosis, *Return Distributions in Finance,* pp.229-250, Butterworth and Heinemann. (with J. Knight) (eds.) 2001.

A Note on Bayesian Inference in Asset Pricing, *IFR Discussion Paper No. 45* 1997, *Econometric Theory 17,* No.2, pp475-482. (with J. Knight) 2001.

Returns Distributions in Finance, Butterworth and Heinemann. (with J. Knight) 2001.

Efficiency, Considerations in the Negative Exponential Failure Time Model, *Handbook of Applied Econometrics and Statistical Inference* (Marcel Dekker). (with J. Knight) 2001.

The Probability Functions of Options Prices, Risk-Neutral Pricing and Value-at-Risk, *Return Distributions in Finance,* pp.252-275. (With J. Knight and G. Wang) 2001.

Global Equity Styles and Industry Effects: Portfolio Construction via Dummy Variables, *Journal of International Financial Markets, Inst. And Money*, 11, pp1-28. (With G. Kuo) 2001

Investigating the Benefits of Mutuality: Mutual Versus Proprietary Annuity Provision. *Journal of Pensions Management*, Vol. 7, No. 1. (With R.A. Lewin) 2001.

Deriving the Arbitrage Pricing Theory when the Number of Factors is Unknown in *Quantitative Finance 1* (Sept. 2001), 502-508. (With L. Middleton) 2001.

On the Characterisation of Investor Preferences by Changes in Wealth, *Geneva Papers on Risk and Insurance: Theory* 26(3), pp. 175-194. (With C. Pederson) 2001.

Downside Risk, Butterworth and Heinemann. (with F. Sortino) (eds.) 2001.

<u>PUBLISHED (REFEREED) PAPERS - ECONOMICS/FINANCE</u>

Eighteenth Century British Trade: Home-spun or Empire Made, (with T.J. Hatton and J. Lyons) (1983), *Explorations in Economic History*, pp. 161-182.

Approximations to the Finite Sample Distributions for Non-stable First Order Stochastic Difference Equations, (1984), *Econometrica*, September , pp. 1271-1289.

Underestimation and Overestimation of the Leontief Inverse Revisited, (with S.Lahiri) (1985), *Economic Letters*, December , pp. 181-187.

The Validity of Edgeworth Approximations for the Distribution Function of Estimators in Linear Difference Equations, (with J.D. Sargan) (1986), *Econometrica*, January , pp. 189-240.

Properties of the Expected Value of the Leontief Inverse, Some Further Results, (with S. Lahiri) (1986), *Mathematical Social Sciences*, February 2:1, pp. 69-82.

Exact Results for Telser' Single Equation Estimator in the Seemingly Unrelated Regressions Model, (with G. Hillier) (1986), *Econometric Theory*, April, pp. 66-75.

Differential Mortality in Rural Bangladesh, (with J. McIntoch and A. Nasim) (1986), *Journal of Applied Econometrics*, October , pp. 345-354.

Source and Subgroup Decomposition Inequalities for the Lorenz Curve (1987) *International Economic Review*, June, pp. 323-330.

Asymptotic Properties of the Maximum Likelihood and Non-linear least Squares Estimators for Noninvertible Moving Average Models, (with K. Tanaka) (1989), *Econometric Theory*, pp. 333-353.

Conditional and Unconditional Independence, (with J. Knight) (1990), *Econometric Theory*, 6:2, p. 283.

Random Variable Generation via Double Sampling, (with J. Knight) (1990), *Econometric Theory*, 6:4, p. 487.

Estimating Variance from High, Low, and Closing Price, (with C. Rogers) (1991), *Annals of Applied Probability*, 1:4, pp. 504-512.

The Variance of Property Returns, Some Problems of Time-Weighted Measures, (with C. Lizieri) (1992), *Journal of Property Valuation and Investment*, pp. 541-547.

Predicting British Financial Indices: An Approach Based on Chaos Theory, (with Y. Yoon and N. Linden) (1993), *Structural Change and Economic Dynamics*, 4:1, pp. 145-162.

Asymptotic Expansion for Random Walks with Normal Errors, (with J. Knight) (1993), in *Econometric Theory*, 9:3, pp. 363-376.

Exact Critical Regions and Confidence Intervals for the Maximum Likelihood Estimator in the Exponential Regression Model, (with J. Knight) (1993), *Economics Letters*, 41:3, pp. 225-231.

Some Generalisations of a Result by Muth on the Optimal Properties of Exponentially Weighted Forecasts, (with A. Timmermann), (1994) *Economics Letters*, 45:2, pp. 261-266.

Apprenticeships and Job Tenure: A Competing Risks Model with Time-varying Covariates, (with A. Booth) (1994), *Oxford Economic Papers*, 46, pp. 676-695.

A Bias Correction for Taken's Correlation Dimension Estimator (1994), *Econometric Theory*, 10:2, p. 439.

The Estimation of the Volatility of Stock Prices: A Comparison of Some Different Methods that Use High and Low Prices, (with C. Rogers and Y. Yoon) (1994), *Applied Financial Economics*, 4, pp. 241-247.

A Bias-Adjusted Black and Scholes Option Pricing Model, (with M. Ncube) (1995), *Applied Financial Economics*, 5, 51-60.

An Assessment of the Economic Value of Nonlinear Foreign Exchange Rate Forecasts, (with A. Timmermann) (1995), *Journal of Forecasting*, 14:6, pp. 477-497.

Statistical Modelling of Asymmetric Risk in Asset Returns, (with J. Knight and K. Tran) (1995), *Applied Mathematical Finance*, 1:2, pp. 155-172.

Some Statistics for Testing the Influence of the Number of Transactions on the Distribution of Returns, (with Y. Yoon) (1995), *Economic and Financial Computing*, Spring, pp. 21-37.

Option Pricing with GARCH and Systematic Consumption Risk I, (with A. Timmermann) (1995), *Derivatives Use, Trading and Regulation*, 1:3, pp. 279-291

Option Pricing with GARCH and Systematic Consumption Risk II, (with A. Timmermann) (1995), *Derivatives Use, Trading and Regulation*, 11:4, pp. 353-367.

The Hazards of Doing a Ph.D., (with A. Booth) (1995), *Journal of the Royal Statistical Society A*, 158, Part 2, pp. 297-318.

An Approximation to Garch, (with J. Knight) (1995), *Econometric Theory*, 11:1, Problem 95.1.3.

Testing for Short-Termism in the U.K. Stock Market, A Comment, (with D. Damant) (1995), *Economic Journal*, 105, pp. 1218-1223.

On the Optimality of Adaptive Expectations: Muth Revisited, (with A. Timmermann) (1995), *International Journal of Forecasting*, 11:3, pp. 407-416.

A Bias Correction for Taken's Correlation Dimension Estimator (Solution) (1995), *Econometric Theory*, 11:4, p. 804.

Confident Hedging-Finite Sample Properties of the Hedge Ratio, (with M. Ncube) (1996), *Derivatives Use, Trading, and Regulation*, 2:2, pp. 144-158.

Some Problems with Modelling Asset Returns using the Elliptical Class, (with B. Eftekhari) (1996), *Applied Economic Letters*, 3, pp. 571-572.

British Phd Completion Rates: Some Evidence from the 1980's, (with A. Booth) (1996), *Higher Education Review,* 28:2, pp. 48-56.

Finite Sample Results for the Negative Exponential Regression Model, (with J. Knight) (1996), *Journal of Statistical Planning and Inference*, 50, pp. 91-102.

Approximating the Finite Sample Bias for Maximum Likelihood Estimators using the Score, (with B. Lambrecht and W. Perraudin) (1996), *Econometric Theory*, 12:1, p. 199 (problem).

Pricing a Boost Option, (with J. Knight) (1997), *Derivatives, Use Trading and Regulation*, 3:4, pp. 362-371.

The Cumulant Generating Function Method Estimation, Implementation and Asymptotic Efficiency, (with J. Knight) (1997), *Econometric Theory*, 13:2, pp. 170-184.

The Analytic Properties of Trading Rules, (with E. Acar) (1997), *Applied Mathematical Finance*, 4, pp. 1-16.

Approximating the Finite Sample Bias for Maximum Likelihood Estimators using the Score, (with B. Lambrecht and W. Perraudin) (1997), *Econometric Theory*, 13:2, p. 310 (solution).

Interactions Between Property Shares and the Equity Market: An Investigation of Linkages in the UK 1972-1992, (with C. Lizieri) (1997), *Journal of Real Estate, Finance and Economics*, 15:1, pp. 11-26.

Property Company Performance and Real Interest Rates: A Regime-Switching Approach, (with C. Lizieri) (1997), *Journal of Property Research*, 14:2, June, pp. 85-98.

The Pricing of Market-to-Market Contingent Claims in a No-arbitrage Economy, (with R. Stapleton and M. Subramanian) (1997), *Australian Journal of Management*, 22:1 June, pp. 1-20.

The Black and Scholes Option Price as a Random Variable, (with M. Ncube) (1997) , *Mathematical Finance*, 7:3 July, pp. 287-305.

Existence of Unbiased Estimators of the Black/Scholes Option Price, Other Derivatives and Hedge Ratios, (with J. Knight) (1997), *Econometric Theory*, December, pp. 791-807.

The Simulation of Option Prices with Applications to Liffe Options on Futures, (with G. Christodoulakis) (1997), Birkbeck College IFR Discussion Paper No.7, in *European Journal of Operations Research*, 114, pp. 249-262.

Time to Default in the UK Mortgage Market, (with B. Lambrecht and W. Perraudin) (1997), *Economic Modelling*, 14, pp. 485-499.

An Analysis of the Hedging Approach to Modelling Pension Fund Liabilities, (with J. Randall) (1998), *Journal of Pensions Management*, Part I, 4:2 December, pp. 183-198.

Measurement Error with Accounting Constraints, (with R.J. Smith and M.R. Weale) (1998), *Review of Economic Studies*, 65:1 January, pp. 109-134.

A Comparison of the Likely Causes of Asian and U.S. Crashes, (with C. Pedersen) (1998), *Politics, Administration and Change*, 29 January-June, pp. 1-17.

Real Interest Regimes and Real Estate Performance: A Comparison of UK and US Markets, (with C. Lizieri, E. Worzala, and R. Daccó) (1998), *Journal of Real Estate Research*, 16:3, pp. 339-356.

Evaluation of Mutual Fund Performance in Emerging Markets, (with S. Hwang) (1998), *Emerging Markets Quarterly*, 2:3 Fall, pp. 39-50.

A Class of Financial Risk Measures, (with C. Pedersen) (1998), in *Geneva Papers On Risk and Insurance: Theory*, 23, pp. 89-117.

Why do Regime-Switching Models Forecast so Badly, (with R. Daccó) (1999), *Journal of Forecasting*, 18, pp. 1-16.

An Analysis of the Hedging Approach to Modelling Pension Fund Liabilities, Part II, (with J. Randall) (1999), in *Journal of Pensions Management*, 4:3, pp. 259-268.

Modelling Emerging Market Risk Premia Using Higher Moments, (with S. Hwang) (1998), DAE Discussion Paper No. 9806, and in *International Journal of Finance and Economics*, 1999, 4:4, pp. 271-296.

International Investors' Exposure to Risk in Emerging Markets, (with B. Eftekhari) (1999), Cambridge Discussion Paper in Accounting and Finance AF20, and in *Journal of Financial Research*, Spring 1999, 22:1, pp. 83-106.

Empirical Factors in Emerging Markets, (with S. Hwang) (1999), *Emerging Markets Quarterly,* Winter, 3:4, pp. 7-27.

Does the Behaviour of the Asset Tell Us Anything About the Option Pricing Formula - A Cautionary Tale, (with L.C. Rogers) (2000), *Applied Financial Economics*, 10: pp. 37-39.

On the Volatility of Measures of Financial Risk: An Investigation Using Returns from European Markets, (with B. Eftekhari and C. Pedersen) (2000), *European Journal of Finance*, 6:1, p. 38.

Formulation of Long/Short Portfolio Risk Based on Orthant Probabilities, (with M. Lundin) (2000), published as The Long and the Short of it, *Risk Magazine*, August, pp. 94-98.

A Demystification of the Black-Littermann Model, (with A. Scowcroft) (2000), *Journal of Asset Management*, 1/2, pp. 144-161.

Small Sample Analysis of Performance Measures in the Asymmetric Response Function Model, (with C. Pedersen) (2000), 1999 IFR Discussion Paper, and in *Journal of Financial and Quantitative Analysis*, 35/3, pp. 425-450

Using a Model of Integrated Risk to Assess U.K. Asset Allocation, (with D. Damant and S. Hwang) (2000), *Applied Mathematical Finance* 7:2, pp. 127-152.

Market Risk and the Concept of Fundamental Volatility: Measuring Volatility across Asset and Derivative Markets and Testing for the Impact of Derivatives Markets on Financial Markets, *Journal of Banking and Finance*, Vol. 24(5), 759-785. (With S. Hwang) 2000.

BOOK CHAPTERS

Finite Sample Properties of Cointegration Estimators with Applications to Testing, (with G. Ellison), 1988, published in R. Bergstrom's Festschrift, published in *Models, Methods and Applications of Econometrics*, edited by P.C.B. Phillips, 1993, 176-200, Blackwell.

On Apprenticeship Qualifications and Labour Mobility (with A. Booth) in refereed book. *The Skills Gap,* edited by A. Booth and D. Snower, 1996, 285-302, CUP.

Daily Stock Returns in European Stock Markets Non-linearity, Predictability, and Transaction Costs (with A. Timmermann), *Non-Linear Dynamics in Economics*, edited by W.A. Barnett, A.P. Kirman and M. Salmon, CUP, 369-392, 1996.

Investor Preference and the Correlation Dimension, (with A. Timmermann), *Chaos and Non-Linear Dynamics in the Financial Markets*, edited by L. Trippi, 1996, Irwin.

Non-Normality of Returns in Emerging Markets: A Comparison of Mean-Variance Versus Mean-Lower Partial Moment Asset Pricing Models, (with B. Eftekhari), in refereed book *Research in International Business and Finance, Supplement 1*, edited by J. Doukas and L. Lang, 1996, 267-277, JAI Press.

Mean Variance Analysis, Trading Rates and Emerging Markets, (with P. Matheussen) in *Advanced Trading Rules*, edited by E. Acar and S.E. Satchell, 1997, 41-50, Butterworth and Heinemann.

The Portfolio Distribution of Directional Strategies (with E. Acar) in *Advanced Trading Rules* edited by E. Acar and S.E. Satchell, 1997, Butterworth and Heinemann.

Regime Switching Models and Forecasting High Frequency FX, (with R. Daccó), in *Nonlinear Modelling of High Frequency Financial Time Series*, edited by C. Dunis and B. Zhou, 1998, 177-201, John Wiley and Sons.

Modelling Intraday Equity Prices and Volatility Using Information Arrivals - A Comparative Study of Different Choices of Informational Proxies, (with S. Lin and J. Knight) edited by P. Lequeux, (forthcoming in Financial *Markets: Tick-by-Tick*, 1998, 27-64, John Wiley & Sons Ltd).

Hashing Garch (with G. Christodoulakis), in *Forecasting Financial Volatility*, edited by J. Knight and S. Satchell, 1998, 168-192, Butterworth and Heinemann.

Implied Volatility Forecasting, (with S. Hwang), in *Forecasting Financial Volatility* edited by J. Knight, S. Satchell, 1998, 193-225, Butterworth and Heinemann.

GARCH Processes, Some Difficulties and a Suggested Remedy, (with J. Knight), *Forecasting Financial Volatility*, edited by J. Knight and S. Satchell, 1998, pp.321-346, Butterworth and Heinemann.

GARCH Predictions and Predictions of Options Prices Proccesses Applied to UK Stocks, (with J. Knight), *Forecasting Financial Volatility*, edited by J. Knight and S. Satchell, 1998, pp.226-244, Butterworth and Heinemann.

Choosing the Right Measure of Risk: A Survey, *The Current State of Economic Science*, (with C. Pedersen), edited by S.B. Dahiya, 1998.

An Assessment of the Economic Value of Non-Linear Foreign Exchange Rate Forecasts, with A. Timmermann, published in *Journal of Forecasting*, 14, 1995, 447-497, reprinted in *Economic Forecasting* edited by T.C. Mills, Edward Elgar (1999).

A Data Matrix to Investigate Independence, Over-reaction and/or Shock Persistence in Financial Data, (with R. Daccó), *Decisions Technologies for Computational Finance - Proceedings of the Fifth International Conference, Computational Finance* edited by A.P.N. Refenes. Kluwer Academic Publishers, 1999 pp. 49-60.

BOOKS AND UNPUBLISHED PAPERS

A) BOOKS

Advanced Statistical Methods in Social Sciences, Francis Pinter (with Dr. N. Schofield, M. Chatterjii, and P. Whiteley), 1986.

Advanced Trading Rules, Theory and Practice (edited with E. Acar), 1997, Butterworth and Heinemann.

Forecasting Financial Volatility (edited with J. Knight), 1998, Butterworth and Heinemann.,2nd edition,2004. 3rd edition, Elsevier, 2007

Returns Distributions in Finance (edited with J. Knight), 2001, Butterworth and Heinemann.

Managing Downside Risk (edited with F. Sortino), 2001, Butterworth and Heinemann..

Performance Measurement (edited with J. Knight), 2002, Butterworth and Heinemann.

Advances in Portfolio Construction and Implementation *(edited with A. Scowcroft), 2003. Butterworth and Heinemann*

Linear Factor Models in Finance (edited with J. Knight) (Butterworth Heinemann, 2004).

Forecasting Expected Returns (Elsevier, 2007).

Risk Model Validation (Edited with G. Christodoulakis) (Elsevier, 2007).

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)

Research Affiliations (past and present)

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.

FEDERAL COURT OF AUSTRALIA

EXPERT EVIDENCE PRACTICE NOTES (GPN-EXPT)

General Practice Note

1. INTRODUCTION

1.1 This practice note, including the *Harmonised Expert Witness Code of Conduct* ("**Code**") (see **Annexure A**) and the *Concurrent Expert Evidence Guidelines* ("**Concurrent Evidence Guidelines**") (see **Annexure B**), applies to any proceeding involving the use of expert evidence and must be read together with:

(a) the Central Practice Note (CPN-1), which sets out the fundamental principles concerning the National Court Framework ("**NCF**") of the Federal Court and key principles of case management procedure;

(b) the Federal Court of Australia Act 1976 (Cth) ("**Federal Court Act**");

(c) the *Evidence Act 1995* (Cth) ("**Evidence Act**"**),** including Part 3.3 of the Evidence Act;

(d) Part 23 of the *Federal Court Rules 2011* (Cth) ("**Federal Court Rules**"**)**; and

(e) where applicable, the Survey Evidence Practice Note (GPN-SURV).

1.2 This practice note takes effect from the date it is issued and, to the extent practicable, applies to proceedings whether filed before, or after, the date of issuing.

2. APPROACH TO EXPERT EVIDENCE

2.1 An expert witness may be retained to give opinion evidence in the proceeding, or, in certain circumstances, to express an opinion that may be relied upon in alternative dispute resolution procedures such as mediation or a conference of experts. In some circumstances an expert may be appointed as an independent adviser to the Court.

2.2 The purpose of the use of expert evidence in proceedings, often in relation to complex subject matter, is for the Court to receive the benefit of the objective and impartial assessment of an issue from a witness with specialised knowledge (based on training, study or experience - see generally s 79 of the Evidence Act).

2.3 However, the use or admissibility of expert evidence remains subject to the overriding requirements that:

(a) to be admissible in a proceeding, any such evidence must be relevant (s 56 of the Evidence Act); and

(b) even if relevant, any such evidence, may be refused to be admitted by the Court if its probative value is outweighed by other considerations such as the evidence being unfairly prejudicial, misleading or will result in an undue waste of time (s 135 of the Evidence Act).

2.4 An expert witness' opinion evidence may have little or no value unless the assumptions adopted by the expert (ie. the facts or grounds relied upon) and his or her reasoning are expressly stated in any written report or oral evidence given.

2.5 The Court will ensure that, in the interests of justice, parties are given a reasonable opportunity to adduce and test relevant expert opinion evidence. However, the Court expects parties and any legal representatives acting on their behalf, when dealing with expert witnesses and expert evidence, to at all times comply with their duties associated with the overarching purpose in the Federal Court Act (see ss 37M and 37N).

3. INTERACTION WITH EXPERT WITNESSES

3.1 Parties and their legal representatives should never view an expert witness retained (or partly retained) by them as that party's advocate or "hired gun". Equally, they should never attempt to pressure or influence an expert into conforming his or her views with the party's interests.

3.2 A party or legal representative should be cautious not to have inappropriate communications when retaining or instructing an independent expert, or assisting an independent expert in the preparation of his or her evidence. However, it is important to note that there is no principle of law or practice and there is nothing in this practice note that obliges a party to embark on the costly task of engaging a "consulting expert" in order to avoid "contamination" of the expert who will give evidence. Indeed the Court would generally discourage such costly duplication.

3.3 Any witness retained by a party for the purpose of preparing a report or giving evidence in a proceeding as to an opinion held by the witness that is wholly or substantially based in the specialised knowledge of the witness[24] should, at the earliest opportunity, be provided with:

(a) a copy of this practice note, including the Code (see Annexure A); and

(b) all relevant information (whether helpful or harmful to that party's case) so as to enable the expert to prepare a report of a truly independent nature.

[24] Such a witness includes a "Court expert" as defined in r 23.01 of the Federal Court Rules. For the definition of "expert", "expert evidence" and "expert report" see the Dictionary, in Schedule 1 of the Federal Court Rules.

3.4 Any questions or assumptions provided to an expert should be provided in an unbiased manner and in such a way that the expert is not confined to addressing selective, irrelevant or immaterial issues.

4. ROLE AND DUTIES OF THE EXPERT WITNESS

4.1 The role of the expert witness is to provide relevant and impartial evidence in his or her area of expertise. An expert should never mislead the Court or become an advocate for the cause of the party that has retained the expert.

4.2 It should be emphasised that there is nothing inherently wrong with experts disagreeing or failing to reach the same conclusion. The Court will, with the assistance of the evidence of the experts, reach its own conclusion.

4.3 However, experts should willingly be prepared to change their opinion or make concessions when it is necessary or appropriate to do so, even if doing so would be contrary to any previously held or expressed view of that expert.

Harmonised Expert Witness Code of Conduct

4.4 Every expert witness giving evidence in this Court must read the *Harmonised Expert Witness Code of Conduct* (attached in Annexure A) and agree to be bound by it.

4.5 The Code is not intended to address all aspects of an expert witness' duties, but is intended to facilitate the admission of opinion evidence, and to assist experts to understand in general terms what the Court expects of them. Additionally, it is expected that compliance with the Code will assist individual expert witnesses to avoid criticism (rightly or wrongly) that they lack objectivity or are partisan.

5. CONTENTS OF AN EXPERT'S REPORT AND RELATED MATERIAL

5.1 The contents of an expert's report must conform with the requirements set out in the Code (including clauses 3 to 5 of the Code).

5.2 In addition, the contents of such a report must also comply with r 23.13 of the Federal Court Rules. Given that the requirements of that rule significantly overlap with the requirements in the Code, an expert, unless otherwise directed by the Court, will be taken to have complied with the requirements of r 23.13 if that expert has complied with the requirements in the Code and has complied with the additional following requirements. The expert shall:

(a) acknowledge in the report that:

(i) the expert has read and complied with this practice note and agrees to be bound by it; and

(ii) the expert's opinions are based wholly or substantially on specialised knowledge arising from the expert's training, study or experience;

(b) identify in the report the questions that the expert was asked to address;

(c) sign the report and attach or exhibit to it copies of:

(i) documents that record any instructions given to the expert; and

(ii) documents and other materials that the expert has been instructed to consider.

5.3 Where an expert's report refers to photographs, plans, calculations, analyses, measurements, survey reports or other extrinsic matter, these must be provided to the other parties at the same time as the expert's report.

6. CASE MANAGEMENT CONSIDERATIONS

6.1 Parties intending to rely on expert evidence at trial are expected to consider between them and inform the Court at the earliest opportunity of their views on the following:

(a) whether a party should adduce evidence from more than one expert in any single discipline;

(b) whether a common expert is appropriate for all or any part of the evidence;

(c) the nature and extent of expert reports, including any in reply;

(d) the identity of each expert witness that a party intends to call, their area(s) of expertise and availability during the proposed hearing;

(e) the issues that it is proposed each expert will address;

(f) the arrangements for a conference of experts to prepare a joint-report (see Part 7 of this practice note);

(g) whether the evidence is to be given concurrently and, if so, how (see Part 8 of this practice note); and

(h) whether any of the evidence in chief can be given orally.

6.2 It will often be desirable, before any expert is retained, for the parties to attempt to agree on the question or questions proposed to be the subject of expert evidence as well as the relevant facts and assumptions. The Court may make orders to that effect where it considers it appropriate to do so.

7. CONFERENCE OF EXPERTS AND JOINT-REPORT

7.1 Parties, their legal representatives and experts should be familiar with aspects of the Code relating to conferences of experts and joint-reports (see clauses 6 and 7 of the Code attached in Annexure A).

7.2 In order to facilitate the proper understanding of issues arising in expert evidence and to manage expert evidence in accordance with the overarching purpose, the Court may require experts who are to give evidence or who have produced reports to meet for the purpose of identifying and addressing the issues not agreed between them with a view to reaching

agreement where this is possible ("**conference of experts**"). In an appropriate case, the Court may appoint a registrar of the Court or some other suitably qualified person ("**Conference Facilitator**") to act as a facilitator at the conference of experts.

7.3 It is expected that where expert evidence may be relied on in any proceeding, at the earliest opportunity, parties will discuss and then inform the Court whether a conference of experts and/or a joint-report by the experts may be desirable to assist with or simplify the giving of expert evidence in the proceeding. The parties should discuss the necessary arrangements for any conference and/or joint-report. The arrangements discussed between the parties should address:

(a) who should prepare any joint-report;

(b) whether a list of issues is needed to assist the experts in the conference and, if so, whether the Court, the parties o r the experts should assist in preparing such a list;

(c) **t**he agenda for the conference of experts; and

(d) arrangements for the provision, to the parties and the Court, of any joint-report or any other report as to the outcomes of the conference ("**conference report**").

Conference of Experts

7.4 The purpose of the conference of experts is for the experts to have a comprehensive discussion of issues relating to their field of expertise, with a view to identifying matters and issues in a proceeding about which the experts agree, partly agree or disagree and why. For this reason the conference is attended only by the experts and any Conference Facilitator. Unless the Court orders otherwise, the parties' lawyers will not attend the conference but will be provided with a copy of any conference report.

7.5 The Court may order that a conference of experts occur in a variety of circumstances, depending on the views of the judge and the parties and the needs of the case, including:

(a) while a case is in mediation. When this occurs the Court may also order that the outcome of the conference or any document disclosing or summarising the experts' opinions be confidential to the parties while the mediation is occurring;

(b) before the experts have reached a final opinion on a relevant question or the facts involved in a case. When this occurs the Court may order that the parties exchange draft expert reports and that a conference report be prepared for the use of the experts in finalising their reports;

(c) after the experts' reports have been provided to the Court but before the hearing of the experts' evidence. When this occurs the Court may also order that a conference report be prepared (jointly or otherwise) to ensure the efficient hearing of the experts' evidence.

7.6 Subject to any other order or direction of the Court, the parties and their lawyers must not involve themselves in the conference of experts process. In particular, they must not seek to

encourage an expert not to agree with another expert or otherwise seek to influence the outcome of the conference of experts. The experts should raise any queries they may have in relation to the process with the Conference Facilitator (if one has been appointed) or in accordance with a protocol agreed between the lawyers prior to the conference of experts taking place (if no Conference Facilitator has been appointed).

7.7 Any list of issues prepared for the consideration of the experts as part of the conference of experts process should be prepared using non-tendentious language.

7.8 The timing and location of the conference of experts will be decided by the judge or a registrar who will take into account the location and availability of the experts and the Court's case management timetable. The conference may take place at the Court and will usually be conducted in-person. However, if not considered a hindrance to the process, the conference may also be conducted with the assistance of visual or audio technology (such as via the internet, video link and/or by telephone).

7.9 Experts should prepare for a conference of experts by ensuring that they are familiar with all of the material upon which they base their opinions. Where expert reports in draft or final form have been exchanged prior to the conference, experts should attend the conference familiar with the reports of the other experts. Prior to the conference, experts should also consider where they believe the differences of opinion lie between them and what processes and discussions may assist to identify and refine those areas of difference.

Joint-report

7.10 At the conclusion of the conference of experts, unless the Court considers it unnecessary to do so, it is expected that the experts will have narrowed the issues in respect of which they agree, partly agree or disagree in a joint-report. The joint-report should be clear, plain and concise and should summarise the views of the experts on the identified issues, including a succinct explanation for any differences of opinion, and otherwise be structured in the manner requested by the judge or registrar.

7.11 In some cases (and most particularly in some native title cases), depending on the nature, volume and complexity of the expert evidence a judge may direct a registrar to draft part, or all, of a conference report. If so, the registrar will usually provide the draft conference report to the relevant experts and seek their confirmation that the conference report accurately reflects the opinions of the experts expressed at the conference. Once that confirmation has been received the registrar will finalise the conference report and provide it to the intended recipient(s).

8. CONCURRENT EXPERT EVIDENCE

8.1 The Court may determine that it is appropriate, depending on the nature of the expert evidence and the proceeding generally, for experts to give some or all of their evidence concurrently at the final (or other) hearing.

8.2 Parties should familiarise themselves with the *Concurrent Expert Evidence Guidelines* (attached in Annexure B). The Concurrent Evidence Guidelines are not intended to be exhaustive but indicate the circumstances when the Court might consider it appropriate for concurrent expert evidence to take place, outline how that process may be undertaken, and assist experts to understand in general terms what the Court expects of them.

8.3 If an order is made for concurrent expert evidence to be given at a hearing, any expert to give such evidence should be provided with the Concurrent Evidence Guidelines well in advance of the hearing and should be familiar with those guidelines before giving evidence.

9. FURTHER PRACTICE INFORMATION AND RESOURCES

9.1 Further information regarding Expert Evidence and Expert Witnesses is available on the Court's website.

9.2 Further information to assist litigants, including a range of helpful guides, is also available on the Court's website. This information may be particularly helpful for litigants who are representing themselves.

J L B ALLSOP
Chief Justice

25 October 2016

Annexure A

HARMONISED EXPERT WITNESS CODE OF CONDUCT[25]

APPLICATION OF CODE

1. This Code of Conduct applies to any expert witness engaged or appointed:

   (a) to provide an expert's report for use as evidence in proceedings or proposed proceedings; or

   (b) to give opinion evidence in proceedings or proposed proceedings.

GENERAL DUTIES TO THE COURT

2. An expert witness is not an advocate for a party and has a paramount duty, overriding any duty to the party to the proceedings or other person retaining the expert witness, to assist the Court impartially on matters relevant to the area of expertise of the witness.

CONTENT OF REPORT

3. Every report prepared by an expert witness for use in Court shall clearly state the opinion or opinions of the expert and shall state, specify or provide:

   (a) the name and address of the expert;

   (b) an acknowledgment that the expert has read this code and agrees to be bound by it;

   (c) the qualifications of the expert to prepare the report;

   (d) the assumptions and material facts on which each opinion expressed in the report is based [a letter of instructions may be annexed];

   (e) the reasons for and any literature or other materials utilised in support of such opinion;

   (f) (if applicable) that a particular question, issue or matter falls outside the expert's field of expertise;

   (g) any examinations, tests or other investigations on which the expert has relied, identifying the person who carried them out and that person's qualifications;

   (h) the extent to which any opinion which the expert has expressed involves the acceptance of another person's opinion, the identification of that other person and the opinion expressed by that other person;

   (i) a declaration that the expert has made all the inquiries which the expert believes are desirable and appropriate (save for any matters identified explicitly in the report), and that no matters of significance which the expert regards as relevant have, to the knowledge of the expert, been withheld from the Court;

   (j) any qualifications on an opinion expressed in the report without which the report is or

[25] Approved by the Council of Chief Justices' Rules Harmonisation Committee

may be incomplete or inaccurate;

(k) whether any opinion expressed in the report is not a concluded opinion because of insufficient research or insufficient data or for any other reason; and

(l) where the report is lengthy or complex, a brief summary of the report at the beginning of the report.

SUPPLEMENTARY REPORT FOLLOWING CHANGE OF OPINION

4. Where an expert witness has provided to a party (or that party's legal representative) a report for use in Court, and the expert thereafter changes his or her opinion on a material matter, the expert shall forthwith provide to the party (or that party's legal representative) a supplementary report which shall state, specify or provide the information referred to in paragraphs (a), (d), (e), (g), (h), (i), (j), (k) and (l) of clause 3 of this code and, if applicable, paragraph (f) of that clause.

5. In any subsequent report (whether prepared in accordance with clause 4 or not) the expert may refer to material contained in the earlier report without repeating it.

DUTY TO COMPLY WITH THE COURT'S DIRECTIONS

6. If directed to do so by the Court, an expert witness shall:

(a) confer with any other expert witness;

(b) provide the Court with a joint-report specifying (as the case requires) matters agreed and matters not agreed and the reasons for the experts not agreeing; and

(c) abide in a timely way by any direction of the Court.

CONFERENCE OF EXPERTS

7. Each expert witness shall:

(a) exercise his or her independent judgment in relation to every conference in which the expert participates pursuant to a direction of the Court and in relation to each report thereafter provided, and shall not act on any instruction or request to withhold or avoid agreement; and

(b) endeavour to reach agreement with the other expert witness (or witnesses) on any issue in dispute between them, or failing agreement, endeavour to identify and clarify the basis of disagreement on the issues which are in dispute.

ANNEXURE B

CONCURRENT EXPERT EVIDENCE GUIDELINES

APPLICATION OF THE COURT'S GUIDELINES

1. The Court's Concurrent Expert Evidence Guidelines ("**Concurrent Evidence Guidelines**") are intended to inform parties, practitioners and experts of the Court's general approach to concurrent expert evidence, the circumstances in which the Court might consider expert witnesses giving evidence concurrently and, if so, the procedures by which their evidence may be taken.

OBJECTIVES OF CONCURRENT EXPERT EVIDENCE TECHNIQUE

2. The use of concurrent evidence for the giving of expert evidence at hearings as a case management technique[26] will be utilised by the Court in appropriate circumstances (see r 23.15 of the *Federal Court Rules 2011* (Cth)). Not all cases will suit the process. For instance, in some patent cases, where the entire case revolves around conflicts within fields of expertise, concurrent evidence may not assist a judge. However, patent cases should not be excluded from concurrent expert evidence processes.

3. In many cases the use of concurrent expert evidence is a technique that can reduce the partisan or confrontational nature of conventional hearing processes and minimises the risk that experts become "opposing experts" rather than independent experts assisting the Court. It can elicit more precise and accurate expert evidence with greater input and assistance from the experts themselves.

4. When properly and flexibly applied, with efficiency and discipline during the hearing process, the technique may also allow the experts to more effectively focus on the critical points of disagreement between them, identify or resolve those issues more quickly, and narrow the issues in dispute. This can also allow for the key evidence to be given at the same time (rather than being spread across many days of hearing); permit the judge to assess an expert more readily, whilst allowing each party a genuine opportunity to put and test expert evidence. This can reduce the chance of the experts, lawyers and the judge misunderstanding the opinions being expressed by the experts.

5. It is essential that such a process has the full cooperation and support of all of the individuals involved, including the experts and counsel involved in the questioning process. Without that cooperation and support the process may fail in its objectives and even hinder the case management process.

CASE MANAGEMENT

[26] Also known as the "hot tub" or as "expert panels".

6. Parties should expect that, the Court will give careful consideration to whether concurrent evidence is appropriate in circumstances where there is more than one expert witness having the same expertise who is to give evidence on the same or related topics. Whether experts should give evidence concurrently is a matter for the Court, and will depend on the circumstances of each individual case, including the character of the proceeding, the nature of the expert evidence, and the views of the parties.

7. Although this consideration may take place at any time, including the commencement of the hearing, if not raised earlier, parties should raise the issue of concurrent evidence at the first appropriate case management hearing, and no later than any pre-trial case management hearing, so that orders can be made in advance, if necessary. To that end, prior to the hearing at which expert evidence may be given concurrently, parties and their lawyers should confer and give general consideration as to:

   (a) the agenda;

   (b) the order and manner in which questions will be asked; and

   (c) whether cross-examination will take place within the context of the concurrent evidence or after its conclusion.

8. At the same time, and before any hearing date is fixed, the identity of all experts proposed to be called and their areas of expertise is to be notified to the Court by all parties.

9. The lack of any concurrent evidence orders does not mean that the Court will not consider using concurrent evidence without prior notice to the parties, if appropriate.

CONFERENCE OF EXPERTS & JOINT-REPORT OR LIST OF ISSUES

10. The process of giving concurrent evidence at hearings may be assisted by the preparation of a joint-report or list of issues prepared as part of a conference of experts.

11. Parties should expect that, where concurrent evidence is appropriate, the Court may make orders requiring a conference of experts to take place or for documents such as a joint-report to be prepared to facilitate the concurrent expert evidence process at a hearing (see Part 7 of the Expert Evidence Practice Note).

PROCEDURE AT HEARING

12. Concurrent expert evidence may be taken at any convenient time during the hearing, although it will often occur at the conclusion of both parties' lay evidence.

13. At the hearing itself, the way in which concurrent expert evidence is taken must be applied flexibly and having regard to the characteristics of the case and the nature of the evidence to be given.

14. Without intending to be prescriptive of the procedure, parties should expect that, when evidence is given by experts in concurrent session:

    (a) the judge will explain to the experts the procedure that will be followed and that the nature of the process may be different to their previous experiences of giving expert evidence;

    (b) the experts will be grouped and called to give evidence together in their respective fields of expertise;

    (c) the experts will take the oath or affirmation together, as appropriate;

    (d) the experts will sit together with convenient access to their materials for their ease of reference, either in the witness box or in some other location in the courtroom, including (if necessary) at the bar table;

    (e) each expert may be given the opportunity to provide a summary overview of their current opinions and explain what they consider to be the principal issues of disagreement between the experts, as they see them, in their own words;

    (f) the judge will guide the process by which evidence is given, including, where appropriate:

        (i) using any joint-report or list of issues as a guide for all the experts to be asked questions by the judge and counsel, about each issue on an issue-by-issue basis;

        (ii) ensuring that each expert is given an adequate opportunity to deal with each issue and the exposition given by other experts including, where considered appropriate, each expert asking questions of other experts or supplementing the evidence given by other experts;

        (iii) inviting legal representatives to identify the topics upon which they will cross-examine;

        (iv) ensuring that legal representatives have an adequate opportunity to ask all experts questions about each issue. Legal representatives may also seek responses or contributions from one or more experts in response to the evidence given by a different expert; and

        (v) allowing the experts an opportunity to summarise their views at the end of the process where opinions may have been changed or clarifications are needed.

15. The fact that the experts may have been provided with a list of issues for consideration does not confine the scope of any cross-examination of any expert. The process of cross-examination remains subject to the overall control of the judge.

16. The concurrent session should allow for a sensible and orderly series of exchanges

between expert and expert, and between expert and lawyer. Where appropriate, the judge may allow for more traditional cross-examination to be pursued by a legal representative on a particular issue exclusively with one expert. Where that occurs, other experts may be asked to comment on the evidence given.

17. Where any issue involves only one expert, the party wishing to ask questions about that issue should let the judge know in advance so that consideration can be given to whether arrangements should be made for that issue to be dealt with after the completion of the concurrent session. Otherwise, as far as practicable, questions (including in the form of cross-examination) will usually be dealt with in the concurrent session.

18. Throughout the concurrent evidence process the judge will ensure that the process is fair and effective (for the parties and the experts), balanced (including not permitting one expert to overwhelm or overshadow any other expert), and does not become a protracted or inefficient process.