REPORT TO THE AER: ISSUES IN RE-LEVERING BETA AND TESTING FOR STRUCTURAL BREAKS

By Graham Partington and Stephen Satchell

21 September 2017

Author's Credentials

This report has been prepared by Associate Professor Graham Partington and Professor Stephen Satchell. We are senior finance academics who have published several 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 their report on the estimation of the equity beta. The full terms of reference are attached as Appendix 1. The main requirements were to present our views with respect to the following issues:

Regulated businesses have submitted that empirical estimates of the equity beta have increased since Professor Henry's report in 2014.[1] In support, these businesses have submitted consultant reports extending Professor Henry's study using more recent data (CEG and Frontier) and analysing for structural breaks (CEG).[2]

The AER has now conducted its own empirical estimation of equity beta to update Professor Henry's study for more recent data. The AER has also extended Professor Henry's study by analysing for structural breaks, which is an issue that has been raised in recent submissions. Accordingly, the AER requires the consultant to review and provide feedback/view on its estimation. As part of this work, the consultant should advise on the following:

a) The AER's initial analysis used gearing information directly from Bloomberg (using the 'Total debt to total capitalisation' data). It was subsequently identified that this was inconsistent with the earlier gearing estimation methodology for SKI (used by AER staff to provide gearing results to Professor Henry for his 2014 report) that took into account asset level debt and lending to related parties.[3] The gearing calculation in the latest AER work was subsequently changed to the method considered consistent with the earlier gearing analysis performed by AER staff for Professor Henry to use in his 2014 report. Given the initial estimation of gearing (using information directly from Bloomberg) and subsequent change (to the method used by AER staff previously to provide gearing estimates to Professor Henry) and its materiality on the re-levered beta estimates, the AER requires a review of the consistency (with respect to the AER's earlier methodology) and reasonableness of the gearing for SKI.
b) The reasonableness of the AER's analysis of structural breaks.

[1] For example, see Multinet proposal at: https://www.aer.gov.au/networks-pipelines/determinations-access-arrangements/multinet-gas-access-arrangement-2018-22

[2] CEG, Replication and extension of Henry's beta analysis, November 2016; Frontier, An equity beta estimate for Australian energy network businesses, December 2016.

[3] SKI owns a proportion of ETSA (now called SA Power Networks) and CitiPower/Powercor and provides financing to CitiPower/Powercor. The AER's earlier gearing methodology took into account the related party financing and the asset level gearing (from SKI's share of SA Power Networks and CitiPower/Powercor).

c) Any area in the AER's estimation that would suggest inconsistency with the approach in Professor Henry's 2014 study.

The consultant is not required to undertake any specific empirical work other than to the extent considered necessary to test and verify issues and/or concerns with the AER's empirical estimation of equity beta.

Part a.

The AER's initial analysis used gearing information directly from Bloomberg (using the 'Total debt to total capitalisation' data). It was subsequently identified that this was inconsistent with the earlier gearing estimation methodology for SKI (used by AER staff to provide gearing results to Professor Henry for his 2014 report) that took into account asset level debt and lending to related parties.[4] The gearing calculation in the latest AER work was subsequently changed to the method considered consistent with the earlier gearing analysis performed by AER staff for Professor Henry to use in his 2014 report. Given the initial estimation of gearing (using information directly from Bloomberg) and subsequent change (to the method used by AER staff previously to provide gearing estimates to Professor Henry) and its materiality on the re-levered beta estimates, the AER requires a review of the consistency (with respect to the AER's earlier methodology) and reasonableness of the gearing for SKI.

The question at hand is what is the correct way to measure leverage when re-levering beta? The process of re-levering the equity beta and the calculation of the WACC are based on portfolio formulas that relate to the same portfolio of securities. This is shown in equation (1) and equation (1A) below. Therefore it is desirable that the leverage definition is consistent between the re-levering process and the computation of the WACC.

Ignoring taxes, β_A, which is the beta of the assets, is equal to the beta of the portfolio of the firm's issued securities and this can be written as:

$$\beta_A = \beta_E \times \frac{E}{E+D} + \beta_D \times \frac{D}{E+D} \quad (1)$$

Where: *E* = the market value of equity,

D = the market value of debt,

β_E = the beta of levered equity

β_D = the beta of debt.

[4] SKI owns a proportion of ETSA (now called SA Power Networks) and CitiPower/Powercor and provides financing to CitiPower/Powercor. The AER's earlier gearing methodology took into account the related party financing and the asset level gearing (from SKI's share of SA Power Networks and CitiPower/Powercor).

And the plain vanilla WACC is given by:

$$r_{wacc} = \ r_E \times \frac{E}{E+D} + r_D \times \frac{D}{E+D} \qquad (1A)$$

Where:

r_{wacc} = the weighted average cost of capital.

r_E = the cost of levered equity

r_D = the cost of debt.

We begin by considering the fundamental relations between the beta of the assets, leverage and the beta of equity. While the true beta of the assets is unaffected by leverage (gearing), the *estimate* of the asset beta is affected by the leverage adjustment used to convert the equity beta to an asset beta.

It is common for the beta of the firm and the beta of the assets to be considered to be the same and to be equal to the beta of the equity of an unlevered firm. However, where debt financing gives rise to an interest tax shield this set of relations does not strictly hold. It is then necessary to distinguish between the beta of the levered firm β_F and the beta assets β_A. This latter is equal to the beta of unlevered equity β_u.

The beta of the firm β_F represents the beta of the cash flow from the portfolio of the firm's issued securities and this can be written as:[5]

$$\beta_F = \ \beta_E \times \frac{E}{E+D} + \beta_D \times \frac{D}{E+D} \qquad (1B)$$

The value of the firm can be written as the value of the firm with no leverage plus the value of the interest tax shield:

$$V_F = E + D = \ V_U + \ V_T \qquad (2)$$

Where: V_F = the value of the firm,

V_U = the value of the firm with no debt (unlevered),

[5] The distinction between equation (1A) and equation (1B) is that although they look very similar, the latter allows for taxes and the former does not.

V_T = the value of the interest tax shield.

Recognising that the value of the firm depends upon the value of the portfolio of underlying assets plus the tax shield leads to the recognition that the beta of the firm depends upon this portfolio. Thus the beta of the firm depends upon the beta of the underlying assets (β_A) and the beta of the tax shield (β_T). The beta of the firm is given by:

$$\beta_F = \beta_A \times \frac{V_U}{E+D} + \beta_T \times \frac{V_T}{E+D} \quad (3)$$

Rearranging equation (1B) gives the equity beta as:

$$\beta_E = \beta_F \times \left(1 + \frac{D}{E}\right) - \beta_D \times \frac{D}{E} \quad (4)$$

From inspection of equations (3) and (4) it is evident that the beta of equity depends upon the level of leverage, the beta of debt (β_D), and the beta of the firm (β_F). The latter in turn depends upon the beta of the assets ($\beta_A = \beta_U$), and importantly both the value and the beta of the interest tax shield (V_T and β_T).

The riskiness of the interest tax shield, and consequently both the value of the tax shield and the beta of the tax shield(V_T and β_T), will vary according to the debt financing policy that the firm pursues.[6] As a result there are a number of alternative formulas that have been developed to re-lever the equity beta. These alternative formulas can give substantively different values for the re-levered beta, see Fernandez (2008). Since it is not clear which formula is unambiguously the best choice we have repeatedly cautioned against the use of re-levered betas.

The AER have chosen to use the following re-levering formula:

$$\beta_E = \beta_A \times \left(1 + \frac{D}{E}\right) \quad (5)$$

[6] Key choices in this regard are whether the firm has a fixed level of debt, or a fixed target leverage ratio, and if the later how frequently the firm rebalances to its target leverage ratio. For example, if the firm has a fixed level of debt and will always be able to fully utilise the interest tax shield, the tax shield is risk free. If the firm continuously rebalances to a fixed target leverage, the level of debt and hence the value of the tax shield depends upon the value of the firm's and hence has the same risk as the firm's assets. Reality is likely to lie somewhere between these two extremes.

This formula omits any interest tax shield adjustments and assumes the debt beta is zero. The omission of tax adjustments avoids a potentially contentious issue by eliminating it from consideration. Omitting the interest tax shield adjustment can be justified theoretically if we assume that firms' continuously rebalance to their target leverage ratio (measured in market values). Then the magnitude of the debt changes continuously. As a result the debt tax shield is continuously uncertain, varying with the market value of the firm's assets. In this case the beta of the tax shield and the beta of the assets are the same.

The assumption of a zero beta for debt is clearly not correct given the riskiness of the BBB debt rating that the AER assumes in calculating the regulated rate of return. Due to thin trading, the estimation of debt betas is substantially more difficult than the estimation of equity betas.[7] Consequently, estimating the value for the debt beta would be even more contentious than the estimation of equity betas. However, we would expect the debt beta for BBB rated debt to be of the order of 0.2. With an asset beta of 0.4, a debt beta of 0.2 and a leverage ratio of 60% (D/E =1.5), then, ignoring taxes, the equity beta is 0.7. The value of 0.7 is computed as follows:

$$\beta_E = \beta_A \times \left(1 + \frac{D}{E}\right) - \beta_D \times \frac{D}{E}$$

$$\beta_E = 0.4 \times (1 + 1.5) - 0.2 \times 1.5 = 0.7.$$

Whereas, if the debt beta is assumed to be zero the resulting estimate of the equity beta is 1. The assumption of a zero beta for debt thus biases the equity beta up on re-levering. However, assuming a zero beta for debt biases the estimated asset beta down when un-levering the equity beta. The net result of un-levering and re-levering, with debt beta assumed to be zero, depends upon the level of leverage observed relative to the assumed level of 60%. Where the actual leverage ratio (D/V) observed for the firm is less than 60% there is an upward bias in the estimated equity beta and where the leverage ratio observed is greater than 60% there is a downward bias.

We have previously concluded that the use of equation (5) in re-levering results in an upward biased estimate of the equity beta. However, combining un-levering and re-levering the

[7] Using the insight that equity in a levered firm can be viewed as a call option on the assets it is conceptually possible to estimate debt betas from equity betas, but this will likely entail practical difficulties.

direction of bias can be up or down. This potential for bias provides a second reason why we caution against the re-levering process.

A third issue, which we have not previously addressed, is the measurement of leverage. The question of the gearing adjustment is particularly important in relation to recent submissions by the regulated businesses on increases in beta. This is because both CEG (2016) Partington and Satchell (2017) have pointed out that the reported changes in beta estimates are substantially driven by the leverage adjustment, rather than changes in the estimates of the raw equity betas. Furthermore the relatively modest differences in the way leverage was measured in reports by Frontier (2016) and CEG (2016) led to rather more substantive differences in the estimates of re-levered betas. Thus, not only were the reported changes in beta estimates driven by the reported leverage changes, the results were somewhat sensitive to exactly how leverage was measured.

Let us consider the conceptual issues relevant to the measurement of leverage. The correct measurement of leverage for valuation purposes depends on application of the consistency principle. The cash flow and the asset or securities being valued must be defined consistently and the discount rate must also be defined consistently with the cash flow. The starting point for a valuation is usually to compute the expected free cash flow available for distribution to the security holders, both debtholders and shareholders. What is then being valued is the market value of the portfolio of issued securities, which in turn is equal to the market value of the underlying portfolio of assets that provide the cash flow for the securities.

The AER's computation of the regulated return uses a plain vanilla approach to calculate a weighted average cost of capital that is consistent with the value effect of the interest tax shield being accounted for in the cash flow. The AER also presumes a leverage ratio of 60%, which implicitly assumes that regulated businesses rebalance their capital structure over time to maintain this leverage ratio. The frequency of that rebalancing, however, is not clearly defined. What is clear, since we are dealing with market values, is that consistency requires the 60% to be a market value leverage ratio.

Consistent with the foregoing, the portfolio weights used in equations (1), (1A) and (1B) are defined as market value weights. Also consistent with the foregoing the debt and equity referred to in these equations are securities, that is shares and interest bearing debt.

Conceptually then, the measurement of the leverage ratio is clear, it should be the ratio of the total market value of interest bearing debt to the sum of the total market value of shares and the total market value of interest bearing debt. Practical implementation of this concept is more difficult.

The first problem that we strike is in determining the market value of debt. The bulk of corporate debt is not actively traded, so determining market values is not so straightforward. One possibility is to estimate the market value that the debt would have if it were traded, but the more common practice is to take the book value of debt as a proxy for the market value of debt, as on Bloomberg. This will be quite an accurate proxy if the debt is floating rate debt with negligible default risk. Unfortunately the latter is probably not true for BBB rated debt. This will result in an upward bias in using the book value of debt as a proxy for market value. The question is whether this is a material effect. A further issue is that if the debt is not floating rate debt, but fixed rate debt, then the book value of debt will understate (overstate) the market value if the spot rate of interest for the debt's maturity is below (above) the debt's fixed rate.[8]

A further complication is in determining what constitutes "interest bearing debt". For example, how should leases be handled? Financial leases are economically equivalent to debt and under accounting standards the value of outstanding financial lease payments is capitalised and included as a liability in the balance sheet. Hence book value calculations of the quantity of debt could include capitalised leases. Whether this is appropriate in computing the WACC will depend upon the consistency principle. In computing the free cash flow how were lease cash flows accounted for? Were they treated as an operating cash flow and hence the measurement of free cash flow is after deduction of lease payments, or were the leases treated as a source of capital and part of the free cash flow consists of service for the lease payments? In the former case leases should not be included in the debt, in the latter case they should be included as a source of capital in the WACC. This could be done by including the leases with the debt, but this assumes the leases have the same cost as the debt.

If the quantity of leases is material then the impact of leasing may be an issue worthy of more extensive study. For example, the measured equity beta will reflect the impact of fixed charges,

[8] The effect on the value of the firm is conditional on the extent to which hedge transactions have transformed the effective interest rate on the debt.

such as lease payments. These fixed charges are deductions from the cash flow prior to determination of the cash flow to equity. Consequently they affect the riskiness of returns to equity. Thus, variation in the extent of leasing causes variation in the equity beta. Conceptually, such changes in the equity beta may be regarded as due to changes in operating leverage and thus are driven by changes in the asset beta. Alternatively, changes in the use of leases may be regarded as causing changes in financial leverage and thus directly affect the equity beta. Either way, differences in leasing can drive differences in equity betas across firms.

Another classification issue arises in the case of hybrid securities. Such securities have characteristics of both debt and equity. If material to a firm's financing, then they should be a separate component in the WACC calculation, but this is not an option in the current context. The question, therefore, is whether they should be treated as debt or equity.

There is also the question of whether to use total debt, or net debt (ND). Net debt is defined as:

Net debt = Total debt – Surplus cash and near cash securities.

The logic of using net debt is that the surplus cash and near cash securities are not required to support future free cash flow and could be used to reduce debt. In practice net debt is often computed by deducting all cash and near cash securities, rather than attempting to determine what constitutes the surplus. Where net debt is used, the leverage ratio should be calculated as net debt to enterprise value (EV)[9] and is given by:

$$\text{Debt to EV} = \frac{ND}{E + ND}$$

The use of net debt implies re-levering at less than the 60% leverage ratio. How much less would depend on the average level of cash and near cash assets held by the regulated businesses. The WACC equation should also be modified so that the weight applied to the cost of debt is given by the net debt to enterprise value ratio.

Another issue with the leverage ratio adjustment is that beta is typically estimated over a number of years and over this time the market value leverage ratio will very likely have

[9] This ratio is available in Bloomberg.

changed.[10] Thus the estimated beta does not reflect a specific debt ratio, but rather involves an averaging of the debt ratios over time.

The AER have asked us to address the particular issue of the leverage adjustment for SKI. We note that the AER adjusted leverage ratios for SKI over the five most recent years (the updated data) are quite close to 60%. All observations lie in the range 60% plus or minus 3.6% with an average difference of minus 0.66%. Consequently, the un-levering and re-levering process will have relatively little effect on the equity beta for SKI and any bias, arising from the assumption that the debt beta is zero, will be small.

Our advice from the AER is that the adjustment to SKI's leverage was done for two reasons. Firstly to maintain consistency with the prior analysis of Henry (2014) which also used an adjusted leverage ratio for SKI. Secondly, SKI holds substantial stakes (of the order of 49%) in regulated energy assets, but these stakes are treated as a minority interest and so equity accounting is used in SKI's financial reporting. Consequently SKI's balance sheet does not reflect the debt of the associated entities The AER considers that this may understate SKI's leverage.

With respect to consistency of the leverage measurement in the prior analysis and the updated analysis, it is appropriate that leverage should be measured on the same basis as used in the prior study. The objective of the updated analysis was to determine whether there had been a change in the estimate of the equity beta over time. This was done by making a comparison of updated estimates with the prior estimates. Had the method of estimating leverage been changed, then any observed change in the estimated beta might have been due to a change in the underlying beta, or simply due to the changed method of analysis, or both. It is therefore desirable to replicate the prior method of analysis as closely as possible in determining whether a change in estimates of beta has occurred. It is still possible, however, to question whether the prior method of adjustment was appropriate. To this issue we now turn.

Had SKI been considered to have control over its associated entities, for example by having more than 50% of the equity as opposed to a 49% stake, then the SKI's financial reports would have been compiled on a consolidated basis. The balance sheet would thus have reflected SKI's share of the debt in the associated entities. The leverage ratio based on book debt would then

[10] Lease arrangements may also have changed as discussed above.

have included the debt consolidated from the associated entities. The AER's approach to computing SKI's adjusted debt level for use in the leverage calculation is a form of proportional consolidation. Thus SKI's adjusted debt level reflects its proportional share of the debt in associated energy companies. This seems appropriate given that SKI is close to crossing the ownership borderline requiring consolidation. More importantly the adjustment reflects the economics of the situation, rather than accounting conventions (consolidation or equity accounting) determining the leverage ratio. The existence of the debt in the associated entities contributes to the volatility of the cash flows to equity for SKI and that will be reflected in SKI's equity beta.

In order to clarify the principles involved, consider the case of firm A which is one hundred percent equity financed. Firm A has only one asset and that is shares in Firm B. Firm B is levered, so the equity beta for firm B reflects leverage. Clearly, the asset held by firm A has the same beta as the equity in Firm B since it is equity in firm B. Also, since firm A is all equity financed the beta of equity for firm A is exactly equal to the beta of firm A's asset. Thus the beta of the equity for firm A is equal to the beta of the equity for firm B. Consequently, the equity beta for firm A reflects the effect of exposure to leverage through the equity investment in firm B.

The effect of exposure to the leverage of another firm via an equity investment is quite clear in the case of firm A, but it applies more generally when any firm makes an equity investment in a levered firm. A question that naturally occurs is when an adjustment to the firm's leverage ratio should be made for the additional debt exposure. Such an adjustment should be made when the effect is material. In the case of SKI the AER has judged the effect to be material and thus has made an adjustment. This seems to be an entirely appropriate exercise of regulatory judgement by the AER.

The foregoing issues in estimating the leverage ratio provide a third reason for us to recommend caution in re-levering the equity beta. Our prior recommendation in Partington and Satchell (2016, p10) was:

"…our advice is for the AER to use the raw estimate of the industry beta and avoid relevering. This should be entirely adequate if there is no great difference between the industry leverage and the assumed level of 60%. Under these circumstances we would consider any leverage adjustment a worthless pursuit of spurious precision. On the other hand if the industry leverage was very

different (to) 60% then that might suggest that the AER should reconsider the assumption of 60% leverage. Furthermore, by not applying relevering we eliminate one avenue that can be used to game the value of beta."

Part b

The reasonableness of the AER's analysis of structural breaks.

The AER's two step approach to identifying structural breaks is discussed on pages 47 and 48 of the AER (2017) report. Since the two step approach is based on determining specific points for possible structural breaks, this is consistent with the use of the Chow test. As discussed by Partington and Satchell (2016), an alternative procedure (used by CEG (2016) is the Quandt-Andrews test which treats the potential break-time as unknown and considers all possible breaks. Whilst this test statistic is well-founded in statistical theory, its power in situations where the detected breaks are near the end-points of the sample is questionable and its finite sample properties are unknown.

In the CEG approach (AER, 2017, page 11), they report a maximum F value occurring at August, 2014 (for a value weighted portfolio) which is their suggested break-point. This suffers from being near the end of the sample period and not being linked with a clear event. One could search through 2014 for potential candidate events, as the AER does, and an extensive list could be generated. A list of the US/world events includes the Veterans Administration hospital scandal, the Ukraine conflict (including the shooting down of the Malaysia Airlines aeroplane), the child migrant crisis in the U.S. (and many migrant sea incidents in Europe), the Israel/Gaza conflict, ISIS, Ebola, ending QE by the US(October), Bill Gross leaving PIMCO, the Scottish independence referendum, a big oil price drop, meltdown of the Russian economy, racial tensions after the police shooting of a black man in Fergusson, North Korea (allegedly) hacking Sony and possibly some Australia-specific events as well, but none of these give us much insight into why energy companies in Australia would have a higher beta with respect to the equity market without further and, we suspect, much deeper analysis.

By contrast, the properties of the Chow Test are well-understood and since there is a requirement to pre-specify the break point this encourages a-priori analysis of the reason for a change in beta. To the extent that the break-points are clearly pre-determined, the test is reasonably reliable in

that both small-sample and large-sample properties of the Chow test are known. Specifically, under normally distributed errors, the Chow Test has an F distribution, whilst under more general assumptions, the asymptotic distribution is chi-squared. This is in contrast to the Quandt-Andrews test where only the asymptotic distribution is available.

The AER (2017) stresses the two-stage nature of the structural break approach that they advocate. Prior to the calculation of the Chow Test, a necessary condition of their approach is the identification of a major event that can be used to identify a break point. Conversely, as they discuss, application of the Quandt-Andrews test and the discovery of a break point that has no obvious connection with real-world activity is unconvincing. We strongly agree with the key principle of the AER's two–stage approach, that an a-priori reason for the change in beta should be a pre-requisite to testing. We argue that, consistent with the scientific method, the strongest evidence of a change in beta is where the reason for expecting a change is identified a priori and then a statistical test is applied that finds support for the hypothesised change. The evidence is considerably weaker where a statistical test detects a change and the reason is sought ex-post and weaker still is a statistically significant test with no explanation for the change.

There are now only four firms left for analysis going forward (still trading in April 2017) APA, DUE, SKI and AST. With such a small number of firms being considered, changes in beta may be driven by the individual characteristics of the firm, rather than market wide, or industry wide changes. A potential source of firm-specific breaks is given in a Credit Suisse (2017) equity research paper. The Credit Suisse paper provides discussion of three of the above companies changing to/from stapled security structures in recent years (APA, AST, and SKI are all discussed in this report).The dates of changes in security structures are potentially interesting points to examine whether the individual firm's experienced structural breaks.

This raises the issue of what might constitute a relevant structural break. In a large well-diversified portfolio the only structural breaks to consider would be breaks associated with the market. However, in a small portfolio of four stocks firm-specific breaks could change the beta of the portfolio. The issue then is whether these firm specific breaks are representative of the broader industry. For example, if firm level structural breaks for APA, AST, and SKI were associated with moving to/from a stapled security structure, is it the case that such changes were also happening

to other firms in the industry? If not, it would be appropriate to conclude that the changes observed for beta were sample specific and were not evidence of an industry level change in beta.

In order to explain changes in risk measures, we present a formal analysis of both systematic and unsystematic risk at the level of the firm. Let y be the return of the stock and x be the return of the market. We assume that x is distributed as (μ_x, σ_x^2); also that y is distributed as (μ_y, σ_y^2) and that the correlation between x and y is ρ .We assume a joint distribution such that the CAPM holds, for example multivariate normality. The model assumed by both AER and Henry is the linear factor model with raw returns which has three parameters; these are the intercept, beta and the residual variance, which we denote as $\alpha, \beta, \text{and } \sigma^2$. It follows from regression theory that $\beta = \frac{\rho\sigma_y}{\sigma_x}$. An increase in market-wide risk would be reflected as an increase in σ_x and, other things equal, this would reduce beta. An increase in correlation, or an increase in the standard deviation of returns for the firm, would also tend to increase beta. It was also shown in our analysis for Part a above that the equity beta will change with changes in leverage and this seems to be the main driver of change in the work of CEG (2016) and Frontier (2016).

What would a structural break in firm specific (unsystematic) risk constitute? This would be a change in σ . The link between firm-specific risk and the fundamental parameters of the joint distribution of x and y is that:

$$\sigma^2 = \sigma_y^2 - \frac{\rho^2\sigma_y^2}{\sigma_x^2}$$

Thus, an increase in the residual variance (unsystematic risk) occurs if the variance of the market or the stock rises, or if correlation falls.

Part c

Any area in the AER's estimation that would suggest inconsistency with the approach in Professor Henry's 2014 study.

The AER's analysis seems to us to be very much in line with that of Henry (2014). Henry's work was extended by CEG (2016) to consider a longer time period and an additional portfolio, labelled portfolio (6), was added. There was also the addition of testing for structural breaks. The AER approach incorporates all of CEG's extensions to Henry's work. The AER's analysis thus provides a comprehensive study consistent with the work that has gone before and provides a thorough analysis of both individual firms and portfolios.

Henry's approach is being followed closely by the AER, but there are some aspects of Henry's approach that merit comment. We quote from Henry (2014); see also the AER report (2017), page 13)

"Value weighted portfolios. The weighting on each firm will be proportional to the market capitalisation of the firm relative to the market capitalisation of the entire portfolio. In all cases, market capitalisation will be measured as the average across the portfolio duration. Hence, the weight on each firm will be $\overline{E_l}/\overline{E_P}$ where $\overline{E_l}$ is the average market capitalisation of the firm (across the relevant period) and $\overline{E_P}$ is the average market capitalisation of the entire portfolio (again, across the relevant period). "

This specific portfolio is based on the idea that weights are fixed at the average value in the estimation period. However this construct means that the weights are forward-looking and, as a consequence, this portfolio bears no relation to any actual investible portfolio that could be used to inform us about the average value of beta. The origin of this particular construction is based on a claim by Henry described in footnote 52 of the AER document which we quote.

"[1] Varying weighted approach is not utilised in this study on the ground of Henry (2014) study. Henry considered that great caution should be exercised when interpreting the β estimates from the resulting 'time-varying portfolios' as they are not grounded in financial theory (Henry 2014, page 52)."

We are not entirely convinced by this claim of Henry's. For a very thorough discussion of when CAPM applies period by period when investors are maximising multi-period expected utility and where the consequent optimal portfolios could well have time-varying weights, see Levy and Venezia (1993). The point here is that time-varying weights can be justified by theory. Furthermore, the AER's estimates of beta are obtained using the ASX-300 as the market portfolio, an index that has capitalisation-based weights that vary through time. We also point out that the firms for which beta is being estimated consist of portfolios of real assets, which very likely have time varying weights.

A feature of a capitalisation weighted portfolio is that as long as there is no change in the number of shares on issue, for firms in the portfolio, no rebalancing of the portfolio is required. While the value of the firms changes, the number of shares held in each firm remains unchanged. Rebalancing is only required if the number of shares on issue for a particular firm changes. Thus the beta estimated for a capitalisation weighted portfolio is an estimate for a passively held portfolio.

We would recommend calculating the capitalisation-weighted beta as a complement the existing calculations. Indeed, the legitimacy of a capitalisation weighting in providing a sensible value of beta seems to us to be greater than given by the existing weighting scheme. Since the time varying capitalisation weighting has not been the focus of interest of the various submissions on beta we suspect that it does not produce an especially large beta.

Another topic raised in Henry (2014) is the use of raw returns combined with the estimation of a linear regression with intercept and slope as opposed to working with excess returns and a slope but no intercept. This is discussed very clearly in Henry (pages 6 & 7, 2014) and we agree with his recommendation that raw returns be used. We suggest the following to further justify this approach.

Firstly, current interest rate levels and their volatility are low, which suggests that treating the interest rate like a constant will not introduce too much error. Secondly, if we move to excess returns we need to take a view on what interest rate to use. They could be based on the either the implicit holding period for equity (typically less than a year). An alternative view might be to calculate the duration of equity and use an interest rate with a maturity equal to the duration of equity (possibly in excess of ten years).There is a case for either alternative and we can avoid

having to choose between the two by using raw returns. Of course, if the term structure is flat and the volatilities of the term structure at the different holding periods are also low the choice of interest rate should not matter greatly.

The use of Hansen's Stability Test to test for parameter stability is referred to in Henry (2014) and stability testing is mentioned in the AER (2017) report, but we could not find any reported results for Hansen's test in the AER report. The evidence for stability seems to rest on time series plots of the beta estimates from regressions using expanding and rolling windows. Henry's procedure is based on a simplified version of Hansen's parameter stability test referred to in Hansen (1992).This test looks at the joint stability of the intercept, slope, and residual variance so a finding of instability does not imply, without further analysis, that there has been instability in beta. Hansen does provide a test for the stability of beta alone; see equations (6) and (7), Hansen (1992). Henry (2014) recognises these distinctions and provides results in Tables 12 and 13. We recommend that the AER also report such tests

References

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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 EMPIRICAL BETA REVIEW JULY 2017

Terms of Reference

The AER requires expert advice as set out below. The request is for a capped-price contract.

The rate of return guideline sets out the AER's approach to determining the allowed rate of return for the benchmark efficient entity (BEE) in accordance with the relevant legislation, including the equity beta.[11] The guideline estimates the equity beta based on the following material:[12]

- We give most weight to empirical Australian estimates of comparable Australian energy networks firms.
- We use the theory of the Black CAPM and some consideration of international estimates to inform for a point estimate towards the upper end of empirical Australian estimates

The current empirical estimates are based on Professor Olan Henry's 2014 report[13] which determined a range of 0.3–0.8 and from which the AER determined a range of 0.4–0.7. A top-of-the-range point estimate of 0.7 is selected using the theory of the Black CAPM and giving some consideration to international estimates.

Services required

Regulated businesses have submitted that empirical estimates of the equity beta have increased since Professor Henry's report in 2014.[14] In support, these businesses have submitted consultant reports extending Professor Henry's study using more recent data (CEG and Frontier) and analysing for structural breaks (CEG).[15]

11 AER, Better Regulation Explanatory Statement Rate of Return Guideline, December 2013.

12 AER, Better Regulation Explanatory Statement Rate of Return Guideline, December 2013, p. 11.

13 Henry, Olan, Estimating β: An update, April 2014.

14 For example, see Multinet proposal at: https://www.aer.gov.au/networks-pipelines/determinations-access-arrangements/multinet-gas-access-arrangement-2018-22

15 CEG, Replication and extension of Henry's beta analysis, November 2016; Frontier, An equity beta estimate for Australian energy network businesses, December 2016.

The AER has now conducted its own empirical estimation of equity beta to update Professor Henry's study for more recent data. The AER has also extended Professor Henry's study by analysing for structural breaks, which is an issue that has been raised in recent submissions. Accordingly, the AER requires the consultant to review and provide feedback/view on its estimation. As part of this work, the consultant should advise on the following:

a) The AER's initial analysis used gearing information directly from Bloomberg (using the 'Total debt to total capitalisation' data). It was subsequently identified that this was inconsistent with the earlier gearing estimation methodology for SKI (used by AER staff to provide gearing results to Professor Henry for his 2014 report) that took into account asset level debt and lending to related parties.[16] The gearing calculation in the latest AER work was subsequently changed to the method considered consistent with the earlier gearing analysis performed by AER staff for Professor Henry to use in his 2014 report. Given the initial estimation of gearing (using information directly from Bloomberg) and subsequent change (to the method used by AER staff previously to provide gearing estimates to Professor Henry) and its materiality on the re-levered beta estimates, the AER requires a review of the consistency (with respect to the AER's earlier methodology) and reasonableness of the gearing for SKI.
b) The reasonableness of the AER's analysis of structural breaks.
c) Any area in the AER's estimation that would suggest inconsistency with the approach in Professor Henry's 2014 study.

The consultant is not required to undertake any specific empirical work other than to the extent considered necessary to test and verify issues and/or concerns with the AER's empirical estimation of equity beta.

Project Deliverables

The key deliverable is a written note for 'Services required' addressing the advice sought. Prior to finalisation, the consultant will provide a draft of the note for review by AER staff.

[16] SKI owns a proportion of ETSA (now called SA Power Networks) and CitiPower/Powercor and provides financing to CitiPower/Powercor. The AER's earlier gearing methodology took into account the related party financing and the asset level gearing (from SKI's share of SA Power Networks and CitiPower/Powercor).

Timeline[17]

Part A

Contract signed (X)	Work commences (16 August 2017)
X + 1 days	Commencement discussion with AER staff (17 August 2017)
X + 10 business days	Draft note to AER staff (30 August 2017)
X + 13 business days	AER staff comments on draft note (4 September 2017)
X + 16 business days	Final note to AER (7 September 2017)

Merits and judicial review

The regulatory determinations made by the AER under the NER and NGR are subject to merits review by the Australian Competition Tribunal and judicial review in the Federal Court of Australia. Accordingly, the consultant's services and the consultant's final report must be performed to the following standards:

- To a professional standard which is robust, transparent, well-reasoned and defendable.
- Conform with the updated expert evidence practice note issued by the Federal Court of Australia in October 2016, including the Expert Witness Code of Conduct[18]

Any work required of the consultant as a result of a merits review would be the subject of a separate contract. The consultant may be requested to provide services in support of the final decision of the AER and the consultant must not unreasonably decline a request for assistance.

Relevant material

- Henry, Olan, Estimating β: An update, April 2014

[17] Dates within brackets are indicative based on the assumed contract signing date.

[18] http://www.fedcourt.gov.au/law-and-practice/practice-documents/practice-notes/gpn-expt

Useful material

- CEG, Replication and extension of Henry's beta analysis, November 2016
- Frontier, An equity beta estimate for Australian energy network businesses, December 2016.
- 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

Legal requirements for the allowed rate of return

In determining the rate of return, the AER is guided by requirements in:

- the national electricity law (NEL) and national gas law (NGL)
- the national electricity rules (NER) and national gas rules (NGR).

The expert advice is required in the context of these requirements.

Requirements of the law

Under the NEL and the NGL, the AER must determine the rate of return in a manner that will or is likely to contribute to the achievement of the national electricity objective (NEO) and the national gas objective (NGO).

> The **national electricity objective (and NGO)** is to promote efficient investment in, and efficient operation and use of, electricity (gas) services for the long term interests of consumers of electricity (gas) with respect to:
>
> - price, quality, safety, reliability and security of supply of electricity (gas), and
> - the reliability, safety and security of the national electricity system.

If the AER is making a decision and there are two or more possible decisions that will or are likely to contribute to the achievement of the national electricity objective (NGO), the AER must make the decision that the AER is satisfied will or is likely to contribute to the achievement of the national electricity objective (NGO) to the greatest degree.

The AER must also take into account the revenue and pricing principles when determining the rate of return.

Of relevance to the rate of return are the following **revenue and pricing principles**:

- A regulated network service provider should be provided with a reasonable opportunity to recover at least the efficient costs the operator incurs in:
    - providing regulated network services, and
    - complying with a regulatory obligation or requirement or making a regulatory payment.
- A regulated network service provider should be provided with effective incentives in order to promote economic efficiency with respect to regulated network services the operator provides. The economic efficiency that should be promoted includes:
    - efficient investment in a distribution system or transmission system with which the operator provides regulated network services; and
    - the efficient provision of electricity network services; and
    - the efficient use of the distribution system or transmission system with which the operator provides regulated network services.
- A price or charge for the provision of a regulated network service should allow for a return commensurate with the regulatory and commercial risks involved in providing the regulated control network service to which that price or charge relates.
- Regard should be had to the economic costs and risks of the potential for under and over investment by a regulated network service provider in, as the case requires, a distribution system or transmission system with which the operator provides regulated network services.
- Regard should be had to the economic costs and risks of the potential for under and over utilisation of a distribution system or transmission system with which a regulated network service provider provides regulated network services.

Equivalent provisions apply under the NGL.

The NEO and revenue and pricing principles have been in place for some time, and previous AER decisions were also conducted under this framework. However, what is new

is the requirement concerning adopting the decision that would contribute to the achievement of the NEO 'to the greatest degree' if two or more decisions are possible.

Requirements of the rules

Under the NER, the allowed rate of return is to be determined such that it achieves the allowed rate of return objective.[19]

> 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 regulated network services.

The NER require that the allowed rate of return for a regulatory year must be:[20]

- a weighted average of the return on equity for the regulatory control period in which that regulatory year occurs and the return on debt for that regulatory year
- determined on a nominal vanilla basis that is consistent with the estimate of the value of imputation credits.

In determining the allowed rate of return, the NER also require that regard must be had to:[21]

- relevant estimation methods, financial models, market data and other evidence
- the desirability of using an approach that leads to the consistent application of any estimates of financial parameters that are relevant to the estimates of, and that are common to, the return on equity and the return on debt
- any interrelationships between estimates of financial parameters that are relevant.

[19] NER, clauses 6.5.2(b) and 6A.6.2(b).
[20] NER, clauses 6.5.2(d) and 6A.6.2(d). The value of imputation credits is referred to in clause 6.5.3 and 6A.6.4 of the NER and rule 87A of the NGR.
[21] NER, clauses 6.5.2(e) and 6A.6.2(e).

There are also provisions in the NER that refer specifically to the return on equity, the return on debt and the value of imputation credits.[22]

Equivalent provisions apply under the NGR.[23]

The NER and NGR concerning the determination of the rate of return were revised in 2012 by the AEMC. The AER's recent rate of return guideline was conducted under this framework.

However, these rules differ from the framework under which the AER made regulated determinations in the past. The current regulatory determinations are the first ones to be conducted under this new rules framework.

Of particular importance under the new rules framework is the introduction of the allowed rate of return objective, and the primacy given to this objective over other rule requirements.

Context for the determination of the allowed rate of return

Better regulation rate of return guideline

In November 2012, the Australian Energy Market Commission (AEMC) published changes to the National Electricity and Gas Rules (NER, NGR). The AER's Better Regulation program was initiated to update and improve its processes under these new rules, with the aim of delivering an improved regulatory framework focused on the long term interests of electricity and gas consumers.

The Better Regulation program involved the publication of several guidelines. The Rate of Return Guideline (the Guideline) was developed through extensive consultation with service providers, consumer representatives and other stakeholders and sets out the AER's approach to determining the allowed rate of return in accordance with the relevant legislation.[24] An explanatory statement (including appendices to the explanatory

[22] See NER, clause 6A.6.2 and clause 6.5.2.
[23] See NGR, rule 87.
[24] AER, *Rate of return guideline*, December 2013.

statement) accompanies the Guideline, and sets out the AER's reasons for the positions it reached in the Guideline.[25]

The Guideline and explanatory statement apply to both electricity and gas distribution and transmission service providers.

The Guideline sets out the approach the AER proposes to use to estimate the returns on equity and debt for a benchmark efficient entity.[26] The Guideline also sets out the approach the AER proposes to use to estimate the value of imputation credits under the Australian tax system. The value of imputation credits mostly impacts on the separate corporate income tax building block. However, the rate of return must be set on a nominal vanilla basis consistent with the estimate of the value of imputation credits.

The Guideline does not consider the AER's position on forecast inflation or transaction costs (equity and debt raising costs), though the AER's position on these matters has been established through previous regulatory determinations.

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.

Return on equity approach

The rate of return guideline sets out the AER's proposed approach for estimating the expected return on equity. The AER's proposed approach uses the Sharpe–Lintner capital asset pricing model (CAPM) as our 'foundation model'. Our foundation model estimate provides a starting point, and our final estimate of the expected return on equity has regard to a broad range of relevant material. This foundation model approach contains six steps, and results in a single point estimate for the expected return on equity. The six steps are outlined below.

[25] AER, *Explanatory statement—Rate of return guideline*, December 2013; AER, *Explanatory statement—Rate of return guideline—Appendices*, December 2013.

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

Step one: identify relevant material—the relevant legislation requires the AER to have regard to all relevant estimation methods, financial models, market data and other evidence when determining our estimate of the return on equity for the benchmark efficient entity. The first step therefore, is to identify the relevant material that may inform the AER's estimate of the return on equity.

Step two: determine role—the relevant material (identified in step one) is assessed against the AER's criteria to determine where the relevant material may inform its estimate of the return on equity. Specifically, the AER may use relevant material in one of four different ways:

1. As the foundation model
2. To inform the estimation of parameters within the foundation model
3. To inform the overall return on equity estimate
4. Not used to estimate the return on equity.

Step three: implement foundation model—the Sharpe-Lintner CAPM will be estimated as the sum of the risk free rate, and the product of the equity beta and market risk premium (MRP). Both a range and point estimate will be determined for equity beta and the MRP. Various relevant estimation methods, financial models, market data and other evidence will be used to estimate each of these parameters (outlined in the Return on equity Sharpe-Lintner CAPM parameters sub-section).

Step four: other information—other information that may inform the AER's final return on equity estimate is considered. The manner in which the AER uses the other information may differ for each alternative source. Specifically, some of the other information may provide a range (at a point in time) for the return on equity, while others may provide only directional information.

Step five: evaluate information set—evaluation of the full set of material that we propose to use to inform, in some way, the estimation of the expected return on equity. This includes assessing the foundation model range and point estimate alongside the other information from step four. In evaluating the full information set, the consistency (or otherwise) of the information is expected to be important. The strengths and limitations of each source of additional information will also be an important factor.

Step six: distil a point estimate of the expected return on equity— the final point estimate is expected to be selected from within the foundation model range. The final estimate of the expected return on equity, however, will ultimately require the exercise of regulatory judgement so may result in a point estimate outside the foundation model range. This recognises that, ultimately, our rate of return must meet the allowed rate of return objective. Further, under our approach, if the foundation model point estimate is not adopted the final estimate of the return on equity will be determined as a multiple of 25 basis points. This recognises the limited precision that the return on equity can be estimated.

Return on debt approach

The rate of return guideline sets out the AER's proposed approach for estimating the return on debt. The AER's proposed approach is to adopt a 'full transition'. That is, start with an on-the-day[27] rate for the first regulatory year and gradually transition into a trailing average[28] approach over 10 years.

AER regulatory determinations / access arrangements recently finalised

The AER finalised regulatory determinations for a number of service providers in 2015:

- Trans Grid, TasNetworks (formerly Transcend), Directlink, Ausgrid, Endeavour Energy, Essential Energy, ActewAGL and Jemena Gas Networks (JGN) were finalised across April and June 2015
- SA Power Networks (SAPN),

[27] The 'on-the-day' approach estimates the allowed return on debt based on prevailing interest rates at the start of the regulatory control period (electricity) or access arrangement period (gas). At the next determinations (electricity) or access arrangement decision (gas), the allowed return on debt is reset based on prevailing interest rates at the start of the new regulatory control period (electricity) or access arrangement period (gas)

[28] The 'trailing average' approach estimates the allowed return on debt based on interest rates averaged over a moving historical period. Each year, prevailing interest rates from each new year are added to the trailing average, and interest rates from the last year of the trialing average 'fall out' of the trailing average.

- Energex and Ergon (QLD Electricity distribution network service providers [DNSP]) were finalised in October 2015.

A number of these service providers[29] appealed the AER's final decision on the rate of return (including the return on equity) to the Australian Competition Tribunal (Tribunal). The Tribunal's February 2016 decision[30] found no error with the AER's approach for the return on equity.[31]

The AER also finalised regulatory determinations / access arrangements for the following service providers in May 2016 following the submission of revised regulatory proposals in January 2016 (published on the AER's website):

- AusNet Services—VIC electricity distribution network
- Citipower —VIC electricity distribution network
- Powercor—VIC electricity distribution network
- Jemena—VIC electricity distribution business.
- United Energy—VIC electricity distribution network
- ActewAGL—ACT gas distribution network
- Australian Gas Networks (AGN)—SA gas distribution network
- APTNT— Amadeus gas pipeline in NT.

These service providers[32] have appealed the AER's final decision to the Tribunal, although they have not appealed the return on equity.

The AER finalised decisions for the following service providers in April 2017:

- AusNet Services (VIC electricity transmission network)
- Powerlink[33] and TasNetworks[34]

29 ActewAGL, Ausgrid, Endeavour Energy, Essential Energy, Jemena Gas Networks, and SA Power Networks.

30 Effectively for appeals from the following service providers: ActewAGL, Ausgrid, Endeavour Energy, Essential Energy, Jemena Gas Networks. SAPN's appeal on the AER's rate of return decision did not include the return on equity.

31 http://www.judgments.fedcourt.gov.au/judgments/Judgments/tribunals/acompt/2016/2016acompt0001

32 United Energy Distribution, CitiPower, Powercor, JEN, AusNet Services (distribution), ActewAGL (ACT gas distribution),

33 QLD electricity transmission network

34 TAS electricity distribution network.

AER regulatory determinations / access arrangements under consideration

The AER is currently considering determinations/access arrangements from the following service providers:

- Roma to Brisbane pipeline (gas transmission) – The AER received regulatory proposal from APTPPL (for the Roma to Brisbane pipeline) in September 2016.[35] APTPPL claims application of the Guideline for the return on equity but appears to depart on many aspects. The AER published its draft decision in July 2017.
- APA GasNet (APA VTS) – The AER received regulatory proposal from APA VTS in January 2017.[36] APA VTS claims application of the Guideline for the return on equity but appears to depart on many aspects. The AER published its draft decision in July 2017.
- Australian Gas Networks (Albury and Victoria) – The AER received regulatory proposal from Australian Gas Networks (AGN) in January 2017.[37] AGN adopted our Guideline for the return on equity and debt but still submitted material arguing for departures. The AER published its draft decision in July 2017.
- AusNet Services (gas distribution) – The AER received regulatory proposal from AusNet Services in January 2017.[38] AusNet Services claims application of the Guideline for the return on equity but appears to depart on the market risk premium. The AER published its draft decision in July 2017.
- Multinet Gas – The AER received regulatory proposal from Multinet Gas in January 2017.[39] Multinet Gas claims application of the Guideline for the return on equity but appears to depart on many aspects. The AER published its draft decision in July 2017.

[35] https://www.aer.gov.au/networks-pipelines/determinations-access-arrangements/roma-wallumbilla-to-brisbane-pipeline-access-arrangement-2017-22

[36] https://www.aer.gov.au/networks-pipelines/determinations-access-arrangements/apa-victorian-transmission-system-access-arrangement-2018-22/proposal

[37] https://www.aer.gov.au/networks-pipelines/determinations-access-arrangements/australian-gas-networks-victoria-and-albury-access-arrangement-2018-22

[38] https://www.aer.gov.au/networks-pipelines/determinations-access-arrangements/ausnet-services-access-arrangement-2018-22

[39] https://www.aer.gov.au/networks-pipelines/determinations-access-arrangements/multinet-gas-access-arrangement-2018-22

- TransGrid – The AER received regulatory proposal from TransGrid in January 2017.[40] TransGrid claims application of the Guideline for the return on equity but appears to depart on the market risk premium.
- ElectraNet – The AER received regulatory proposal from ElectraNet in March 2017.[41]
- Murraylink – The AER received regulatory proposal from Murraylink in January 2017.[42] Murraylink claims application of the Guideline for the return on equity but appears to depart on the market risk premium.

40 https://www.aer.gov.au/networks-pipelines/determinations-access-arrangements/transgrid-determination-2018-23
41 https://www.aer.gov.au/networks-pipelines/determinations-access-arrangements/electranet-determination-2018-23
42 https://www.aer.gov.au/networks-pipelines/determinations-access-arrangements/murraylink-determination-2018-23

Appendix 2

CURRICULUM VITAE GRAHAM PARTINGTON

PERSONAL

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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).

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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.

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

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

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

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

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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,.

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

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

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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.

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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

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

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

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

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

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

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

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

2013 PUBLICATIONS

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

Sequential Variable Selection as Bayesian Pragmatism in Linear Factor Models

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

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

2012 PUBLICATIONS

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

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

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

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

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(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

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2011 PUBLICATIONS

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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).

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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).

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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[43] 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.

[43] 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[44]

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

[44] 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[45] 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

[45] 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.

REPORT TO THE AER: DISCUSSION OF COMPARATOR FIRMS FOR ESTIMATING BETA

By Graham Partington and Stephen Satchell

June, 2016

Author's Credentials

This report has been prepared by Associate Professor Graham Partington and Professor Stephen Satchell. We are senior finance academics who have published several books and many research papers in finance and we have extensive consulting experience, particularly with respect to the cost of capital and valuation. Our *curriculum vitae* can be found in Appendix 3.

We have read "Expert witnesses in proceedings in the Federal Court of Australia" which are attached as Appendix 4. This report has been prepared in accordance with those guidelines. 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 comparator firms to use when estimating beta. The full terms of reference are attached as Appendix 1. The main requirements were to present our views with respect to the following issues:

1. The desired characteristics of a comparator firm, and considerations regarding the choice of a suitable comparator firm (or firms), for empirically estimating an equity beta to use in determining an allowed rate of return that is commensurate with a similar degree of risk as a regulated Australian energy network service provider.

2. Any practical considerations regarding the choice of a suitable comparator firm (e.g. time/trading period on the ASX).

3. The suitability of using international energy firms as comparator firms, and considerations required if international energy firms are used as comparators.

4. The suitability of using Australian non-energy infrastructure firms as comparator firms, and considerations required if Australian non-energy firms are used as comparators.

5. The appropriate comparator firms to use in estimating the equity beta for the benchmark efficient entity.

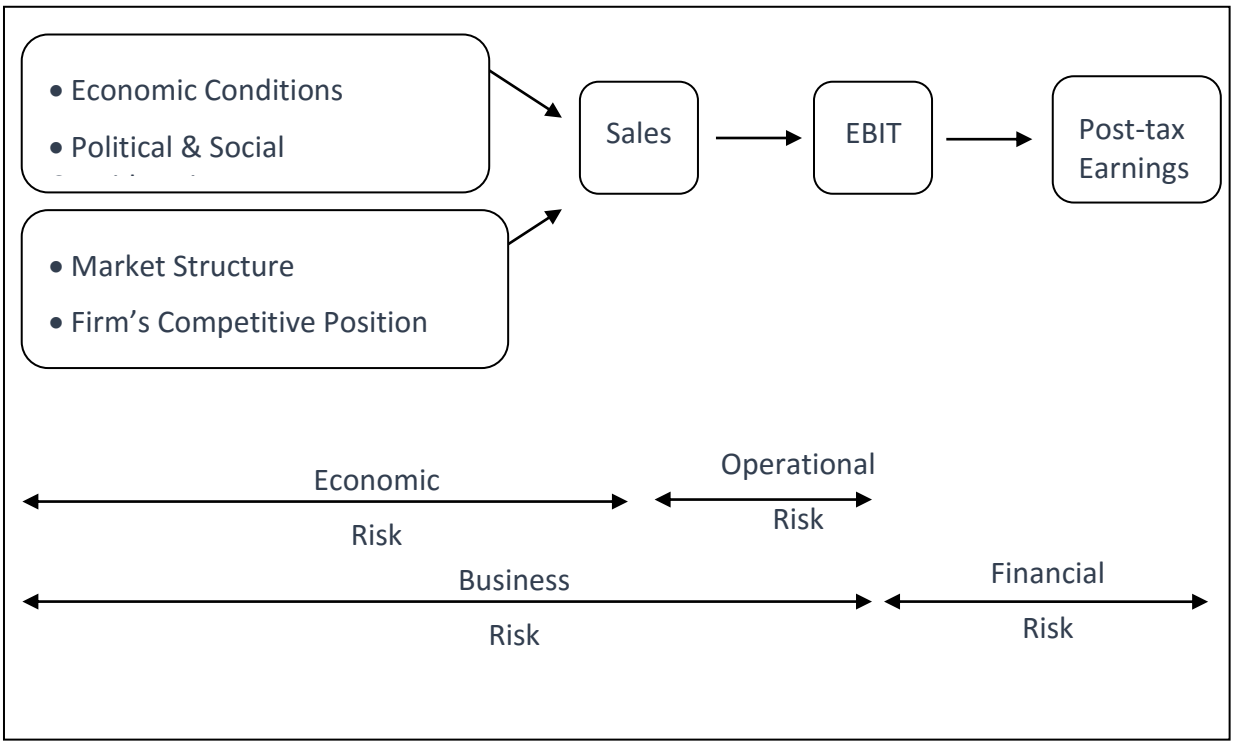
1. The desired characteristics of a comparator firm, and considerations regarding the choice of a suitable comparator firm (or firms), for empirically estimating an equity beta to use in determining an allowed rate of return that is commensurate with a similar degree of risk as a regulated Australian energy network service provider.

We begin by considering the determinants of equity betas. This is conveniently achieved by reprising part of the work of McKenzie and Partington (2012) on what determines equity betas. What follows is a somewhat modified version of that discussion. We emphasise that although the discussion uses terms such as sales revenue and EBIT, the conceptual basis of the analysis is cash flows not accounting numbers.

An equity beta is a measure of a share's systematic risk and it is useful to conceptualise the systematic risk of equity as having three main components to the risk – economic risk, operational risk and financial risk. Figure 1 shows the relation between these different aspects of systematic risk.

Figure 1

Dimensions of Systematic Risk



Source: Adapted from Hawawini and Viallet (1999)

Economic (or intrinsic) risk is determined by factors such as barriers to entry in the firm's market, the firm's position within the industry including elements of monopoly and monopsony power, the firm's competitive strategy and so on. These factors all determine how the business cycle impacts on the firm. The sales of some firms will be highly sensitive to the business cycle – growing through the expansionary phase and contracting through the recessionary phase. However for other firms, their sales will hardly vary at all through the business cycle. We can think of this economic risk as being captured by a revenue beta.

The operational risk of the company refers to the firm's operating leverage, ie. the firm's proportion of fixed to variable costs. Recall that variable costs directly scale in proportion to sales, while fixed costs do not. Thus, as the firm's sales vary during the business cycle, their variable costs will also vary. Their fixed costs however, do not vary and must continue to be met. The higher are the firm's fixed costs therefore, the higher will be the variability of the firm's earnings before interest and tax (EBIT) for a given change in sales Thus, operating leverage intensifies the effect of the business cycle on a company's earnings and this higher risk translates into a relatively higher beta. The economic and the operational risk of the firm are frequently referred to as the business risk of the firm and are captured in the firm's asset beta. The relationship between asset beta and revenue betas is sometimes written as:

$$\beta_{\text{asset}} = \beta_{\text{revenue}} \left[1 + \frac{\text{Present value(fixed cost)}}{\text{Present value(assets)}} \right]$$

This equation clearly shows how the inherent cyclicality of the firm's revenue, as captured in the revenue beta, is amplified by operating leverage.[1] We note that an alternative version of this formula replaces the ratio of the present value of fixed costs to the present value of the assets, with the ratio of fixed to variable costs.

The financial risk of a company relates to the financial leverage of the firm. The interest charge on debt is another form of fixed cost and just as the fixed costs of operations cause EBIT to vary with changes in sales, so too the fixed financing costs cause after tax cash flows to vary with changes in EBIT. Thus financial leverage amplifies the effect of cyclical variations in revenue in a fashion analogous to operating leverage.

[1] This formula rests upon a number of assumptions such as the beta for variable costs and revenue being the same.

Each of these three different components - economic, operational and financial risk - come together to form the systematic risk for the firm's equity. Thus, in forming a comparator group, we would ideally have firms with revenue betas, operating leverage and financial leverage appropriate for the benchmark efficient entity. The AER's definition of the benchmark efficient entity is a pure play, regulated energy network business operating within Australia. Given the monopoly power of a network business and the nature of regulation we can confidently say that the revenue beta is likely to be rather low relative to the average firm, and this will be a key determinant of a relatively low equity beta. In this respect our views are consistent with the AER who have previously stated that in its view, regulated businesses will:

"...face lower systematic risk than the market, primarily due to the stable cash flows of these businesses. The lower equity beta is the result of a regulatory regime that provides protection to regulated businesses that are not available to those in the competitive environment, including:

- tariff variation mechanism allows for the annual adjustment for inflation, lowering exposure to inflation risk
- roll forward of the capital asset base occurs in a manner that lowers exposure to cost overruns for capital expenditure
- cost pass through mechanism allows for certain costs to be passed on to consumers during the access arrangement period, lowering exposure to costs not forecast at the commencement of the access arrangement period
- the access arrangement provides for acceleration of the review submission date on occurrence of a trigger event
- a service provider may submit an access arrangement variation proposal for the AER's approval."[2]

We have less well formed priors on the operating leverage of the benchmark entity. Businesses with high capital investment tend to have high fixed costs, but we need to distinguish between depreciation which will be substantial but involves no cash and the cash fixed costs of operations, as it is the latter which are relevant. We do not have data on the present value of cash fixed costs relative to the present value of the assets, or the ratio of fixed to variable costs. However, we expect that operating leverage for an energy network is likely to be higher than for the average firm.

The level of financial leverage is known exactly. The AER have chosen to set leverage at 60% debt based on an analysis of the capital structure of network businesses. The analysis of

[2] AER (2011) Final Decision - Public, N.T. Gas: Access arrangement proposal for the Amadeus gas pipeline, p. 69, July.

leverage, however, is not without its issues. Where leverage differs across firms it is common practice to adjust comparator firms' betas to a common level of leverage. As we have observed in previous reports this process is problematic and we have more to say about this in the section that follows.

The AER defines the benchmark efficient entity as operating in Australia and uses a domestic CAPM in setting regulated returns which immediately suggests Australian firms are the appropriate comparators. It is also desirable for the firm to be listed so that the equity beta can be directly estimated from market returns data. Logically, therefore, the appropriate comparator firms will be operating in Australia and listed on the ASX. These Australian firms should have revenue betas, asset betas and financial leverage that are appropriate to the benchmark efficient entity. The firms most likely to meet the foregoing requirements are listed network service providers with a substantial component of their revenue that is regulated. These firms will probably not be a perfect match for the conceptual benchmark efficient entity and there will probably be differences in revenue betas, operating leverage and financial leverage that will result in differences in equity betas across the firms. However, we anticipate that these differences will not in general be of great magnitude and this view is consistent with the empirical evidence of Henry (2014).

We note that a key cause of differences in beta across the foregoing comparators may be the proportion of unregulated revenue that firms have. Our priors are that unregulated revenue is likely to have a higher systematic risk than regulated revenue. Consequently the higher the proportion of unregulated revenue the higher the revenue beta and hence the higher the equity beta. If so, it would be desirable to restrict comparators to those firms that only had regulated revenue. In this respect there is some merit in the arguments of Mountain (2015) to exclude HDF, AAN and/or AGL from the AER's comparator set. On the other hand excluding these firms from the sample of comparators dramatically shrinks an already small set of comparators. One possibility is to retain them in the sample but in interpreting the estimated betas and in forming regulatory judgements consider the potential for upward bias.

We note that the issue, as posed by the AER at the start of this section, does not directly refer to the benchmark efficient entity, but rather asks about estimating an equity beta: "that is commensurate with a similar degree of risk as a regulated Australian energy network service

provider." In which case it is clear that the appropriate beta is the industry beta for listed regulated Australian energy network service providers.

The CAPM states that the returns of a firm are described by a linear factor model and that the single risk factor is the market. While the revenue beta, operating leverage and financial leverage determine the equity beta, we do not need separate estimates of these variables in order to determine the equity beta. The equity beta can be estimated directly from the covariance between the return on equity and the single risk factor, the market. Such estimates are likely to differ across comparator firms. However, this can be conveniently handled by utilising an industry estimate of beta.

2. Any practical considerations regarding the choice of a suitable comparator firm (e.g. time/trading period on the ASX).

Our discussion of in section 1 is consistent with the use, as comparators, of those firms in the ASX utilities sector that have been previously utilised by the AER. The comparators that the AER have previously used are given in Table 1 below:

Table 1: Comparator ASX utility firms used by the AER.

Firm (symbol)	Time/trading period	Sectors
AGL Energy Limited (AGK)	January 1990 – October 2006	Electricity & Gas
Alinta (AAN)	October 2000 – August 2007	Gas
APA Group (APA)	June 2000 – present	Gas Minority interest in other energy infrastructure
DUET Group (DUE)	August 2004 – present	Electricity & Gas
Envestra Ltd. (ENV)	August 1997 – October 2014	Gas
GasNet (GAS)	December 2001 – November 2006	Gas
Hastings Diversified Utilities Fund (HDF)	December 2004– November 2012	Gas
Spark Infrastructure Group (SKI)	March 2007 – present	Electricity & Gas
AusNet Services (AST) (formerly SP AusNet (SPN))	December 2005 – present	Electricity & Gas

Source: Appendix 2 of this document

It is immediately apparent from Table 1 that the sample size is not large. Larger sample sizes can increase the precision of the beta estimate, but the trade-off is that increasing the sample size is likely to reduce the relevance of the comparators. The comparators are likely to be an increasingly poor match in terms of revenue beta and operating leverage as we move away from

firms that operate regulated energy networks. In weighing up the merits of expanding the sample size in order to increase precision it should be borne in mind that it is better to be approximately correct than precisely wrong.

In subsequent sections we consider the suggestion of expansion to additional comparator sets internationally and domestically. In any such expansion there are some criteria that need to be met by additional comparator groups. There needs to be a strong case for believing that the data is relevant to Australia and that the revenue betas and operating leverage are likely to be similar between the regulated network businesses and the additional comparators. Second the estimated equity betas for the comparators should be similar to the betas of the regulated firms, as well as having similar residual risk. This is essentially based on the principle of choosing comparators to be firms with the same distribution as the firms that we wish to compare them to.

It is also evident from Table 1 that the number of firms in the comparator group either, still trading, or with operations appropriate for comparison, is down to four. This is a small sample on which to compute an industry beta. However, we could still keep the 'dead' firms in the sample as they will provide information that is useful in forming historical estimates of beta. Thus we see no need to drop these firms from the set of comparators as they contribute nothing going forward, but are valuable looking backwards. The question then becomes how relevant is history to current conditions? This question can be addressed by testing for a structural break in the data, or by testing estimates from different periods to determine whether they are significantly different.

A practical issue that arises in the estimation of betas is the adjustment for different levels of leverage. We have previously pointed out that different leverage adjustment formulas can be used and that the results are sensitive to which formula you use and what assumptions you make. For example, there can be material differences in relevered beta estimates depending on whether or not you assume the debt beta is zero. To illustrate this point we present the results from Fernandez (2008) in Table 2. Fernandez identifies seven alternative formulae for relevering beta and applies these to a case where the unlevered beta is 0.7 the corporate tax rate is 40% and the book leverage ratio is 50% debt. Applying the seven alternative formulae to the unlevered beta, while allowing the firm's growth rate to vary, gives the levered betas as in Table

2. Clearly there are considerable variations in the levered betas that result. Even after disregarding the implausible negative values, there are differences in beta of the order of 0.5 or more.

Table 2: Variation in relevered betas depending on the formula used and the growth rate

Growth rate:	*0.00%*	*1.00%*	*3.00%*	*4.00%*	*5.00%*	*6.00%*	*7.00%*	*7.50%*
Modigliani-Miller	0.84400	0.80689	**0.70000**	**0.61628**	**0.48776**	**0.24563**	**-0.55638**	**-3.68750**
Myers	0.84400	0.82384	0.77125	0.73564	**0.68974**	**0.62653**	**0.52707**	**0.44488**
Fernandez	0.84400	0.83787	0.82293	0.81368	0.80286	0.79000	0.77448	0.76545
Miles & Ezzell	0.94372	0.93404	0.91020	0.89528	0.87763	0.85642	0.83046	0.81516
Harris-Pringle	0.95210	0.94215	0.91762	0.90225	0.88405	0.86216	0.83534	0.81952
Damodaran	0.96638	0.95598	0.93029	0.91416	0.89505	0.87201	0.84373	0.82702
Practitioners	1.18724	1.17132	1.13109	1.10514	1.07367	1.03466	0.98507	0.95485

Source: Fernandez (2008)

In the light of such variation, our advice is for the AER to use the raw estimate of the industry beta and avoid relevering. This should be entirely adequate if there is no great difference between the industry leverage and the assumed level of 60%. Under these circumstances we would consider any leverage adjustment a worthless pursuit of spurious precision. On the other hand if the industry leverage was very different 60% then that might suggest that the AER should reconsider the assumption of 60% leverage. Furthermore, by not applying relevering we eliminate one avenue that can be used to game the value of beta.

There are significant advantages to utilising an industry beta, rather than firm specific betas as precision is usual greater as is time series stability. Another attraction of using an industry estimate of beta is that the evidence from tests of the CAPM using industry betas, as opposed to betas for size and market to book sorted portfolios, is supportive of the Sharpe Lintner CAPM (see DBP (2015) and Da, Guo and Jagannathan (2008)).

The question is how to weight returns in computing an industry beta. The usual way to estimate a portfolio beta is to use a capitalisation weighted value, but a case can be made for equal weighting. The case is particularly strong where one firm has a much bigger weighting than other firms, in which case a capitalisation weighted average may largely reflect the beta of the dominant firm. A judgement needs to be made of the extent to which individual firms provide equally good information on the magnitude of beta for the typical firm, in which case equally weighting firms may be appropriate.

One problem with a capitalisation-weighted beta is that capitalisation is always changing with the share price. For that reason if a capitalisation weighting is desired it is convenient to use industry returns for an industry index, thus providing cap-weighted beta by construction in every period. One could in principle use the utility sector of ASX however, some constituents of the index may be relatively poor comparators in terms of revenue betas and operating leverage.

A final practical consideration is frequency with which we measure data in computing beta. The procedure, advocated by Henry (2014), is to use weekly data and we do not disagree with this. However, we note that the estimated beta will have essentially the same distribution if asset and market returns are measured logarithmically and they are jointly white noise so that, in this case, the frequency should not matter. In other cases, however, beta will depend on autocorrelation in the returns; whilst the market return may be white noise, the regulated firm may not be; the presence of autocorrelation in regulated returns may indeed be the consequence of regulation. Some discussion of the effect on beta of autocorrelation is discussed Hong and Satchell (2014).

3. The suitability of using international energy firms as comparator firms, and considerations required if international energy firms are used as comparators. Source: Frontier (2016a)

As we observed in Partington and Satchell (2016, p11)

"Considerable caution in reaching conclusions about beta needs to be exercised when the comparators are drawn from overseas countries. This is because of differences in industry structure, technology, the nature of competition, the economic environment and regulatory and tax systems."

Furthermore, it is evident that beta estimates for utilities vary quite substantially across countries. This raises opportunities for cherry picking, with the regulated businesses likely to favour the selection of countries where utilities have high betas and consumer groups likely to favour the selection of countries where utilities have low betas.

Thus, there are serious problems involved if we plan to add additional US energy companies to our universe to get a more precise measure of average beta. A particular problem is clearly evident when considering what the beta of a US comparator really represents. We remind

readers that the beta for the comparators currently used by the AER represents the exposure of an Australian network utility to the Australian market return. If we were to include US energy companies in the sample their betas would measure the exposure of US energy companies to the US market return. Clearly, there is a serious aggregation issue here as there is no guarantee that the US market and the Australian market are similar, both in terms of each other and also in terms of their relationships with other financial entities.

It may be possible to carry out an estimation and testing procedure that would allow one to aggregate these two groups; this would be a topic for future research. In our opinion the evidence presented by regulated businesses on this topic has not come close to presenting a reasonable case. It is more likely that additional firms will be found within the Australian stock market, we shall discuss this further under point four.

We previously undertook a review Partington and Satchell (2016) of the report by Frontier (2016a) which considered expanding the comparator set to include energy companies in the US and tested for significant differences between the betas for the US firms and the current AER comparator group. Contrary to Frontier's arguments we concluded that the US data did not supply suitable comparators. We include relevant extracts from our report as Appendix 2. The key results were:

- The potential improvement in precision by adding US firms to the industry portfolios appeared small and came at significant risk of utilising inappropriate comparators
- The industry betas for the US appeared to be more volatile than the Australian industry betas.
- The statistical tests that were used had been inappropriately applied.
- The statistical tests appeared to be based on small sample sizes, in which case they were likely to have low power to detect significant differences between groups of comparators
- One of the test statistics had been misinterpreted
- The evidence based on comparison of betas estimated using weekly data was that the use of US firms was inappropriate .The results showed that for estimates based on weekly data, the beta estimates for US firms were significantly higher than the Australian beta estimates for the comparators firms used by the AER.[3]

[3] In this context it is worthwhile noting that weekly data was selected by Henry (2014) as being the preferred choice for estimating the equity beta for the AER comparator firms.

4 The suitability of using Australian non-energy infrastructure firms as comparator firms, and considerations required if Australian non-energy firms are used as comparators.

In this section we discuss the possibility of using additional energy firms as comparators. In principle we could do this and there are a number of possible approaches we could take. However, Frontier's (2016a) analysis of comparators was unconvincing and a more detailed discussion in the extract from our previous report is included in Appendix 3. They key points were:

- The potential improvement in precision by adding Australian non-energy infrastructure firms to the industry portfolios appeared small and came at significant risk of utilising inappropriate comparators
- The statistical tests that were used had been inappropriately applied.
- The statistical tests appeared to be based on small sample sizes, in which case they were likely to have low power to detect significant differences between groups of comparators

Using segmental disclosure it might be possible to identify Australian firms, which have a direct exposure to the energy industry, and such firms could be used directly as candidates for a comparator firm. Using a sample of such companies the implied return to the energy industry can be computed. Again depending upon data availability one could construct a time series of industry returns and use them to estimate an industry beta directly. In this framework any company with the reasonable exposure to energy could be deemed a comparator. The problem, is likely to be that there are significant differences between the revenue betas of firms that have regulated revenue and those that don't. If, however, the firms had regulated revenue and if the different proportions of regulated and unregulated revenue could be identified, it might be possible to proceed. There is also the problem that the betas might be confounded by the other segmental activities of the firms identified as having energy industry exposure.

We note that Henry (2014, pp52-55,) provides a detailed analysis of the effect, when computing beta, of different firms entering/leaving the database. This, at least partially, addresses the issue of the impact of different firms on the beta of the industry portfolio. Whilst the results are carefully presented, Henry does not really provide criteria which would allow readers to decide which of the approaches is the best one.

There are possible ways to address this problem, we suggest a procedure next. In portfolio analysis, one is often interested in finding out whether one set of risky assets can improve the investment opportunity set of another set of risky assets. If an investor chooses portfolios based on mean and variance, then the question becomes whether adding a new set of risky assets can allow the investor to improve the minimum-variance frontier from a given set of risky assets. This question was first addressed by Huberman and Kandel (1987, HK hereafter). They proposed a multivariate test of the hypothesis that the minimum-variance frontier of a set of K benchmark assets is the same as the minimum-variance frontier of the K benchmark assets plus a set of N additional test assets. This test has been developed in various directions by many authors. There are at least two alternative ways one can use such a test. If the set containing the N assets was deemed appropriate, then not rejecting the null would allow one to add the K new assets to the N existing assets. The new set of N+K assets could then be used for more accurate parameter estimation. If one was dissatisfied with the N initial assets in they collectively failed to describe the comparator set (equivalently, the assets in the industry portfolio), then rejection of the test might be construed as an improved description of the comparator set; this latter interpretation would require us to assume that the new assets contained relevant information.

5 The appropriate comparator firms to use in estimating the equity beta for the benchmark efficient entity.

To compute the equity beta for the benchmark efficient entity, we would advocate using industry returns. As argued above we would strongly disagree with the use of international energy firms which have been advocated by various consultants, but without the necessary statistical argument to support it. We are pessimistic that such arguments can be properly constructed.

Turning to Australian companies, we have a number of choices.

- We could essentially take some known index such as the ASX energy and utilities sector and compute Betas directly from this. This is certainly feasible and worth further research but there may be many companies in here which are not appropriate for the calculation of regulatory Beta but one could consider a subset of firms that are wholly or broadly regulated.
- We could use the whole ASX universe and given adequate segmental disclosure, infer an implied energy return and use this. This has some advantages in that it will filter out energy companies doing extensive non-energy business and include non-energy

companies doing energy business, but it does require a level of data detail which may not be currently available.

- We could build an industry portfolio based on the existing seven firms with the addition of other energy and utility firms whose business operations seem close in nature to those in the group. We can, in principle, test if these firms belong to the group, using such techniques as discriminant analysis or the HKtest discussed above, but we note that there may be statistical issues in doing this.

These are possibilities that are worthy of further consideration, but we anticipate that this will be challenging and it may well be that the AER's existing comparator set cannot be satisfactorily extended.

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Expert Witness Compliance Declaration

We have read "Expert witnesses in proceedings in the Federal Court of Australia" which are attached as Appendix 4. 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

Services required

The AER requires expert advice as set out below.

The AER is required to review its Rate of Return Guidelines every three years (or earlier). As part of a Guideline review, the AER is likely to update its empirical estimates of equity beta (to be used within a Sharpe-Lintner CAPM). The AER must have regard to these empirical estimates, as well as other non-empirical considerations, when determining an allowed rate of return for regulated energy networks.

An allowed rate of return must achieve the rate of return objective, which 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 regulated network services.

Accordingly, empirical estimates of equity beta should be based on a comparator set of firms that are commensurate with a benchmark efficient entity with a similar degree of risk as that which applies to an energy network service provider in respect of the provision of regulated services.[4]

In the current Guideline (and recent regulatory decisions), the AER adopted a single benchmark efficient entity, which applied to electricity and gas distribution and transmission network service providers. The AER defined the benchmark efficient entity as 'a pure play, regulated energy network business operating within Australia'.[5] It also adopted a benchmark gearing level of 60 per cent. The AER provided detailed reasoning for these decisions in the Guideline material.

In its recent regulatory decisions, the AER used a comparator set of nine listed Australian energy network firms. It considered these firms to be reasonable comparators to the benchmark efficient entity with similar degree of risk as an energy network service provider in providing regulated services. These firms are set out in table 2.

[4] Clauses 6.5.2 and 6A.5.2 of the National Electricity Rules, and rule 87(3) of the National Gas Rules.

[5] AER, *Better regulation rate of return guideline*, December 2013, p. 7; AER, *Better regulation rate of return guideline: Explanatory statement*, December 2013, section 3, p. 32-45.

Table 1 AER's current comparator firms

Firm (symbol)	Time/trading period	Sectors
AGL Energy Limited (AGK)	January 1990 – October 2006	Electricity & Gas
Alinta (AAN)	October 2000 – August 2007	Gas
APA Group (APA)	June 2000 – present	Gas Minority interest in other energy infrastructure
DUET Group (DUE)	August 2004 – present	Electricity & Gas
Envestra Ltd. (ENV)	August 1997 – October 2014	Gas
GasNet (GAS)	December 2001 – November 2006	Gas
Hastings Diversified Utilities Fund (HDF)	December 2004– November 2012	Gas
Spark Infrastructure Group (SKI)	March 2007[6] – present	Electricity & Gas
AusNet Services (AST) (formerly SP AusNet (SPN))	December 2005 – present	Electricity & Gas

Source: AER analysis; Bloomberg; AER, *Review of the WACC parameters: Final decision*, May 2009, p. 255.

The AER has received submissions from stakeholders suggesting it should:

- include international energy firms in its comparator set, specifically, a set of 56 US energy firms[7]
- include other (non-energy) infrastructure firms in its comparator set[8]
- exclude outdated Australian energy network firms from its comparator set[9]
- exclude HDF, AAN and/or AGL from its comparator set[10]
- maintain its comparator set (specifically, do not include a set of 56 US energy firms).[11]

Given the AER's definition of the benchmark efficient entity and benchmark gearing (60 per cent), the consultant is required to provide a report setting out its views (with reasons) regarding:

1. The desired characteristics of a comparator firm, and considerations regarding the choice of a suitable comparator firm (or firms), for empirically estimating an equity beta to use in determining an allowed rate of return that is commensurate with a similar degree of risk as a regulated Australian energy network service provider.

6 The SKI data is available from December 2005, but the data prior to March 2007 reflects stapled securities traded as instalment receipts—these instalments requires further leverage adjustment and makes beta estimation difficult.
7 Frontier Economics, *Estimating the equity beta for the benchmark efficient entity*, January 2016, pp. 26–34.
8 Frontier Economics, *Estimating the equity beta for the benchmark efficient entity*, January 2016, pp. 26–34.
9 CitiPower, *Revised proposal*, January 2016, pp. 310–311.
10 CCP3, *Response to proposals from Victorian electricity distribution network service providers for a revenue reset for the 2016–2020 regulatory period*, August 2015, pp. 75–77 (pp. 158-160 of the pdf); CCP2 (Bruce Mountain), *Submission on the AER's preliminary decisions for the Qld/SA distribution network service providers (2015-20)*, July 2015, pp. 9–10; CCP3, *Response to AER preliminary decisions and revised proposals for Victorian electricity distribution network service providers for a revenue reset for the 2016-2020 regulatory period*, February 2016, pp. 92–93.
11 PIAC, *A missed opportunity? Submission to the Australian Energy Regulator's Draft Determination for Ausgrid, Endeavour Energy and Essential Energy*, 13 February 2015, p. 44.

2. Any practical considerations regarding the choice of a suitable comparator firm (e.g. time/trading period on the ASX).

3. The suitability of using international energy firms as comparator firms, and considerations required if international energy firms are used as comparators.

4. The suitability of using Australian non-energy infrastructure firms as comparator firms, and considerations required if Australian non-energy firms are used as comparators.

5. The appropriate comparator firms to use in estimating the equity beta for the benchmark efficient entity.

Appendix 2

Considerable caution in reaching conclusions about beta needs to be exercised when the comparators are drawn from overseas countries. This is because of differences in industry structure, technology, the nature of competition, the economic environment and regulatory and tax systems.

Portfolio beta estimates would generally be the preferred way to estimate an industry beta. We observe from Frontier (2016a) that for the portfolio beta estimates, there is only a modest improvement in the precision of the estimate as comparator groups are added and samples get larger. This can be seen by comparing Frontier's (2016a) Figure 3, Figure 6, and Figure 9, which provide rolling monthly beta estimates and 95% confidence intervals for the AER sample, the AER sample expanded to include regulated Australian infrastructure firms, and the sample of US firms respectively. Comparing the figures in the Frontier (2016a) report is a little difficult as they are drawn at increasingly smaller scales, which creates the misleading impression that the confidence bands are narrowing substantially, when in fact they are not. On the following page we have reproduced the three figures at about the same scale to facilitate comparison. Not only does this show that improvements in the confidence intervals are modest, it also shows that the US betas are less stable that the Australian betas.

Figure 1: Portfolio beta estimates from Frontier

Figure 3: 10-year rolling monthly beta estimates for AER sample (portfolio beta estimates)

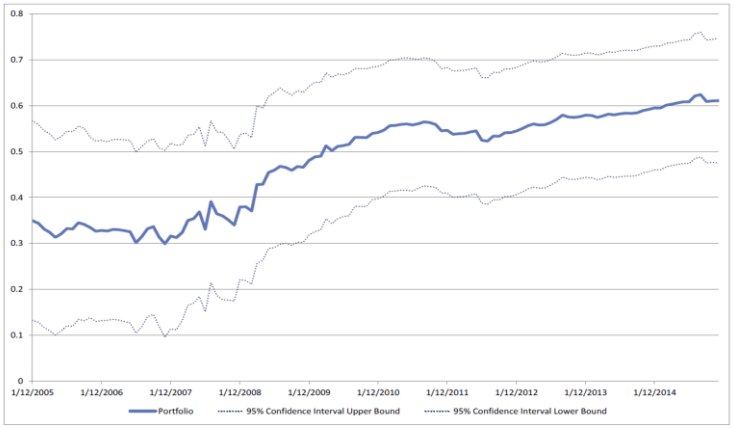


Figure 6: 10-year rolling monthly beta estimates for expanded Australian sample (portfolio beta estimates)

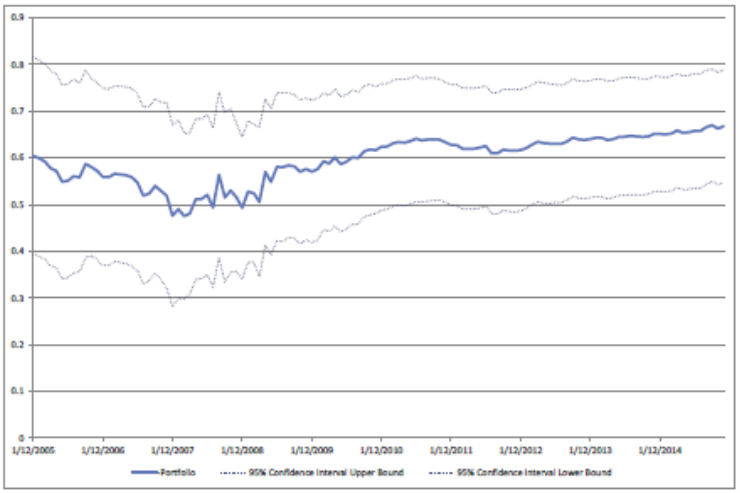
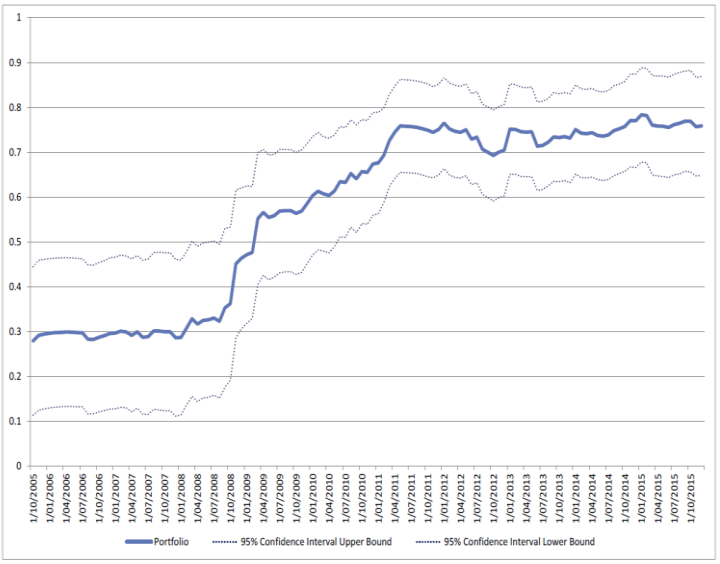


Figure 9: 10-year rolling monthly beta estimates for US utilities sample (portfolio beta estimates)



Source: Frontier (2016a)

Statistical testing of comparators

Frontier (2016a) address the question of appropriate comparators by testing whether the means of the beta estimates for the original AER data set and the additional comparator data-set are equal. They also use the Kolmogorov-Smirnoff (KS) test to compare the distributions for the estimates of beta. Unfortunately, it seems that both tests have been incorrectly applied (we make this claim whilst not having full and explicit details of exactly how they did the calculations, this should have been included in the Frontier report.)

Frontier(2016a) use the Kolmogorov-Smirnov (KS) test which compares two distribution functions, but Frontier's analysis is based on estimated parameters being used as the parameters of the distribution functions. It is known that the critical values of the KS test assume no unknown parameters; that is, they are based on the two empirical distribution functions, and will, consequently, be wrong for the problem being considered by Frontier. Generally, Monte Carlo analysis is necessary.

The second test, as for example in Table 5, is a *t*-test of the equality of means. Suppose for a country, country 1, we have sample estimates of N stock betas. $\hat{\beta}_1, \hat{\beta}_{2,\ldots,}\hat{\beta}_N$ where it is well known that $\hat{\beta}_i \sim N(\beta_i, \sigma_i^2 / \sum_{t=1}^{N} x_{mt}^2)$ This means that $\hat{\beta}_i$ is normally distributed with mean β_i and variance $\sigma_i^2 / \sum_{t=1}^{T} x_{mt}^2$.

Where x_{mt} is the excess return on the market at time *t* and σ_i^2 is the residual variance of asset *i*. If we consider the sample mean of the $\hat{\beta}_i$'s, $\hat{\bar{\beta}} = \frac{\sum \hat{\beta}_i}{N}$ then $\hat{\bar{\beta}} \sim N(\frac{\sum \beta_i}{N}, \frac{\sum \sigma_i^2}{\sum x_{mt}^2})$ (1)

Frontier (2016a), presumably calculate $\hat{\bar{\beta}}$ and also its standard deviations, s = $\left(\frac{\sum_{i=1}^{N}(\hat{\beta}_i - \hat{\bar{\beta}})^2}{N-1}\right)^{\frac{1}{2}}$. Now s^2 can be shown to be biased upwards as an estimate of $\frac{\sum \sigma_i^2}{\sum x_{mt}^2}$; this is due to the fact that, the sample of $\hat{\beta}_i$'s have different means, this upward bias will make the *t*-statistics smaller and we may not reject the null that the two groups are the same even when we should.

To prove the above, let $(\hat{\beta}_i)$ be represented as the vector $\hat{\beta}$, the true values by β and let *i* be a (N x 1) vector of ones. Define M = $I_N - \frac{ii'}{N}$ where I_N is the (N x N) identity matrix and the sample estimator used is $s^2 = \frac{\hat{\beta}' M \hat{\beta}}{(N-1)}$; we note that $\hat{\beta}$= β + V, where V $\sim N(0, D)$ and D is a diagonal

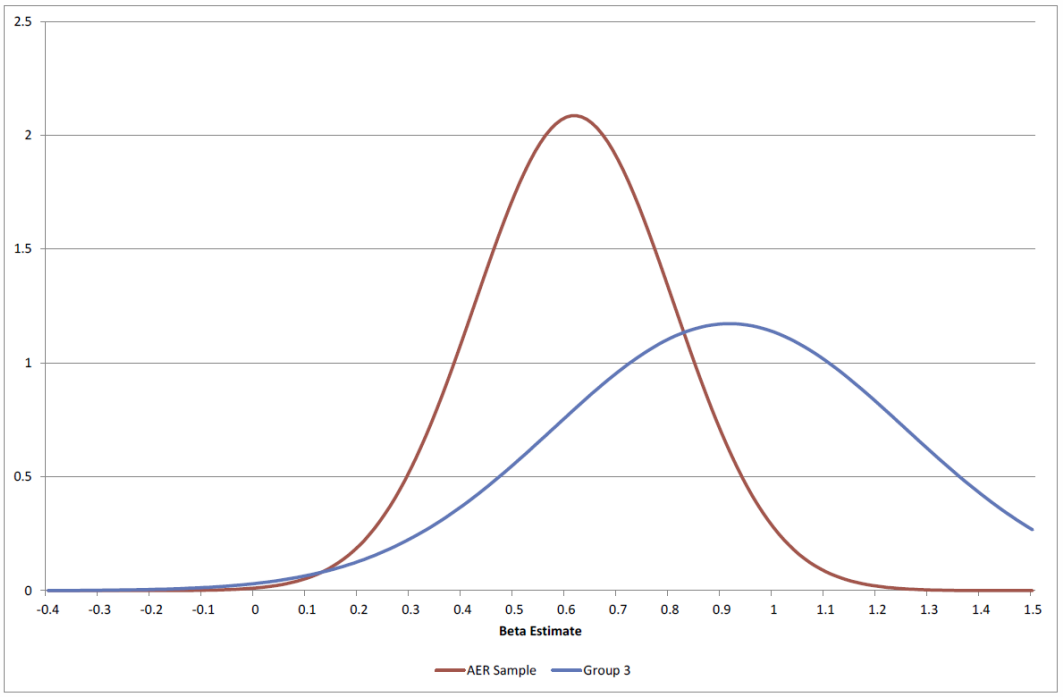
matrix whose ith element is $(\sigma_i^2/\sum r_{mt}^2)$. Now E($s^2$) $= \frac{\beta' M \beta}{N-1}$+ tr $\frac{(MD)}{(N-1)}$. Where tr() is the sum of the diagonals of the matrix. The first term is the cross-sectional variance of the true $\beta_i' s$ whilst the second term is approximately the average of variance of the individual estimators i.e. the $\sigma_i^2/\sum r_{mt}^2$, as in equation (1). We see that $\frac{\beta' M \beta}{N-1} \geq 0$ and this leads to upward bias.

Leaving aside the issues of test specification discussed above, the reported critical values for the test statistics suggest that rather small sample sizes were used for the tests. In this case the tests are likely to have low power in detecting significant differences between the comparator groups.

Inappropriate application, or low power, of the tests, is also likely to explain why despite the appearance of quite different distributions of beta for the AER sample and other listed Australian Infrastructure firms (see Frontier 2016a, Figure 4 reproduced below) the statistical tests fail to reject the null hypothesis of no difference between the beta estimates for the two groups.

FIGURE 2: Distribution of betas from Frontier

Figure 4: Distributions of 10-year monthly beta estimates for the AER sample (Groups 1 and 2) and other listed Australian infrastructure firms (Group 3)



Source: Frontier (2016a)

Finally and importantly, Frontier misinterpret the results of their own analysis comparing the weekly betas for the US and Australian data. They claim the result is borderline. Whereas, using their reported statistics the null hypothesis of equality in the betas is clearly rejected. There is a significant difference in the betas at the 5% level. Frontier 2016a, Table 11 (reproduced below) shows that the reported *t*-statistic at 2.33 exceeds the reported critical value for *t* of 2.26. Therefore, Frontier's own report shows that there are statistically significant differences in the means for the weekly betas. The mean of the US betas is higher than the mean of the Australian betas.

TABLE 1: Do sample betas differ?

Table 11: T-test for equality of means between AER sample and US utilities sample

Statistic	Estimate (Monthly)	Estimate (Weekly)
t-statistic	1.11	2.33
p-value	0.28	0.05
t-critical	2.14	2.26

Source: Frontier (2016a)

Calculated equity beta estimates for the nine firms in the AER's comparator set, as well as a set of eight Australian infrastructure firms and a set of 56 US energy firms. It considered (based on a number of tests) that the additional firms are statistically similar to the AER's comparator set; and broadening the comparator set produces equity beta estimates with improved statistical properties.

As explained above, the case that the samples are homogeneous has not been made. Also as explained above, for the portfolio estimates of beta, any improvements in the precision of the estimates appear to be modest as are any improvements in stability. Since portfolio estimates would be our preferred way to estimate an industry beta, we conclude that the improved statistical properties are modest and come at the cost of potentially biased estimates from comparators that may be inappropriate. Indeed on the basis of Frontier's analysis of the means

for weekly betas the US comparators are inappropriate, and in the time series of rolling portfolio beta estimates the US betas appear to be less stable than the Australian betas.

Appendix 3

CURRICULUM VITAE GRAHAM PARTINGTON

PERSONAL

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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 thirty years I have held Associate Professorships in finance at The University of Technology Sydney and The University of British Columbia. I have also held academic positions at Macquarie University and the University of Bangor I have had extensive teaching and research responsibilities in finance and accounting as well as being head, or deputy head, of University Departments and Schools. I have been very influential in the design of several undergraduate and masters degrees in finance and also PhD programs.

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

Awards and Major Research Grants

Awards

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

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

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

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

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

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

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

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

1985: Butterworths Travelling Fellowship

Major Research Grants

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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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,.

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

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

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

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

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

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

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

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Unpublished Working Papers

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

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

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

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

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

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

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

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

Miscellaneous

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

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

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

MEMBERSHIPS

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

American Finance Association (Current))

American Accounting Association (1978–1992)

European Accounting Association (1984–1987)

Australian Institute of Bankers (1993–1997)

Royal Forestry Society (1978-1984)

CURRICULUM VITAE 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

CURRENT RESEARCH

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

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

JOURNAL AFFILIATIONS

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

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

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

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

SUBMITTED PUBLICATIONS

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

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

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

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

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

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

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

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

FORTHCOMING PUBLICATIONS

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

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

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

2015 Publications

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

2014 Publications

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

2013 PUBLICATIONS

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

Sequential Variable Selection as Bayesian Pragmatism in Linear Factor Models

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

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

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

2012 PUBLICATIONS

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

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

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

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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

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2011 PUBLICATIONS

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

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

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

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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

Popular Articles

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

Practice Note CM 7

EXPERT WITNESSES IN PROCEEDINGS IN THE

FEDERAL COURT OF AUSTRALIA

Practice Note CM 7 issued on 1 August 2011 is revoked with effect from midnight on 3 June 2013 and the following Practice Note is substituted.

Commencement

1. This Practice Note commences on 4 June 2013.

Introduction

2. Rule 23.12 of the Federal Court Rules 2011 requires a party to give a copy of the following guidelines to any witness they propose to retain for the purpose of preparing a report or giving evidence in a proceeding as to an opinion held by the witness that is wholly or substantially based on the specialised knowledge of the witness (see **Part 3.3 - Opinion** of the *Evidence Act 1995* (Cth)).

3. The guidelines are not intended to address all aspects of an expert witness's duties, but are intended to facilitate the admission of opinion evidence[12], and to assist experts to understand in general terms what the Court expects of them. Additionally, it is hoped that the guidelines will assist individual expert witnesses to avoid the criticism that is sometimes made (whether rightly or wrongly) that expert witnesses lack objectivity, or have coloured their evidence in favour of the party calling them.

Guidelines

[12] As to the distinction between expert opinion evidence and expert assistance see *Evans Deakin Pty Ltd v Sebel Furniture Ltd* [2003] FCA 171 per Allsop J at [676].

1. General Duty to the Court[13]

1.1 An expert witness has an overriding duty to assist the Court on matters relevant to the expert's area of expertise.

1.2 An expert witness is not an advocate for a party even when giving testimony that is necessarily evaluative rather than inferential.

1.3 An expert witness's paramount duty is to the Court and not to the person retaining the expert.

2. The Form of the Expert's Report[14]

2.1 An expert's written report must comply with Rule 23.13 and therefore must

(a) be signed by the expert who prepared the report; and

(b) contain an acknowledgement at the beginning of the report that the expert has read, understood and complied with the Practice Note; and

(c) contain particulars of the training, study or experience by which the expert has acquired specialised knowledge; and

(d) identify the questions that the expert was asked to address; and

(e) set out separately each of the factual findings or assumptions on which the expert's opinion is based; and

(f) set out separately from the factual findings or assumptions each of the expert's opinions; and

(g) set out the reasons for each of the expert's opinions; and

(ga) contain an acknowledgment that the expert's opinions are based wholly or substantially on the specialised knowledge mentioned in paragraph (c) above[15]; and

[13]The "*Ikarian Reefer*" (1993) 20 FSR 563 at 565-566.
[14] Rule 23.13.

(h) comply with the Practice Note.

2.2 At the end of the report the expert should declare that "[the expert] has *made all the inquiries that* [the expert] *believes are desirable and appropriate and that no matters of significance that* [the expert] *regards as relevant have, to* [the expert's] *knowledge, been withheld from the Court*."

2.3 There should be included in or attached to the report the documents and other materials that the expert has been instructed to consider.

2.4 If, after exchange of reports or at any other stage, an expert witness changes the expert's opinion, having read another expert's report or for any other reason, the change should be communicated as soon as practicable (through the party's lawyers) to each party to whom the expert witness's report has been provided and, when appropriate, to the Court[16].

2.5 If an expert's opinion is not fully researched because the expert considers that insufficient data are available, or for any other reason, this must be stated with an indication that the opinion is no more than a provisional one. Where an expert witness who has prepared a report believes that it may be incomplete or inaccurate without some qualification, that qualification must be stated in the report.

2.6 The expert should make it clear if a particular question or issue falls outside the relevant field of expertise.

2.7 Where an expert's report refers to photographs, plans, calculations, analyses, measurements, survey reports or other extrinsic matter, these must be provided to the opposite party at the same time as the exchange of reports[17].

3. Experts' Conference

3.1 If experts retained by the parties meet at the direction of the Court, it would be improper for an expert to be given, or to accept, instructions not to reach agreement.

[15] See also *Dasreef Pty Limited v Nawaf Hawchar* [2011] HCA 21.
[16] The *"Ikarian Reefer"* [1993] 20 FSR 563 at 565
[17] The *"Ikarian Reefer"* [1993] 20 FSR 563 at 565-566. See also Ormrod *"Scientific Evidence in Court"* [1968] Crim LR 240

If, at a meeting directed by the Court, the experts cannot reach agreement about matters of expert opinion, they should specify their reasons for being unable to do so.

J L B ALLSOP

Chief Justice

4 June 2013