# The Allen Consulting Group

# Australian Energy Regulator's draft conclusions on the weighted average cost of capital parameters

Commentary on the AER's analysis of the equity beta

#### January 2009

Report to Energy Networks Association, Grid Australia and Australian Pipeline Industry Association

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### Key findings

- The AER has no basis for adopting an *a priori* view that the *equity beta* for a benchmark electricity network business would be less than 1. The AER is the first economic regulator to our knowledge to conclude that theory alone suggests an *equity beta* of less than 1, and its logic for doing so is flawed and inconsistent with how it adjusts estimated betas for leverage.
- A key difference between the AER's and our analysis is how the Rules requirement for persuasive evidence is interpreted.<sup>1</sup> We interpreted this as requiring the new evidence to demonstrate that the previously adopted values were incorrect, whereas the AER has decided that this is met if the new information justifies a different value for beta. However, we note that the majority of issues addressed in this report remain relevant irrespective of how the need for 'persuasive evidence' is interpreted.
  - Under any interpretation of the Rules requirement, the AER is wrong to ignore measures of statistical precision (of which a confidence interval is a representation). It is standard practice to consider point estimates obtained from statistical techniques like regression analysis together with measures of statistical precision because such measures tell us how much faith we can place in a particular point estimate (and the bounds of that faith). Accordingly, measures of statistical precision are relevant for informing the degree of 'persuasiveness' of the empirical evidence.
  - The AER's statement that it will have regard to the upper and lower end of confidence intervals does not make sense only one end of the interval is relevant to the task at hand.
  - Standard estimates of precision are likely to understate the true level of imprecision in beta estimates – the AER's analysis of parameter instability does not remove this concern.
- The AER has understated the range for the central estimate of beta. The AER's own results and a proper interpretation of our empirical work justify a range for the central estimate of the equity beta of between 0.60 and 0.90 (rounded):
  - The simple average of the AER's beta point estimates for Australian firms is approximately 0.60, which is consistent with our estimates, and materially above the AER's preferred estimate from Australian data (0.44).
  - Our long term portfolio beta estimates are a relevant piece of information should be considered – these estimates take account of a greater diversity of macroeconomic conditions, even though AGL and Envestra have a high weight. These point estimates range from 0.70 to 0.90.
  - The AER has understated the range for betas from US firms and does not have a sound basis for concluding that these must be revised downwards to be applied in Australia.
- Central estimates of the equity beta do not necessarily answer whether there is 'persuasive evidence' for a change to the equity beta from the previously adopted value. The strength of the empirical evidence that is available cannot demonstrate that the true value may not lie materially above (or below) the range of the central estimates. We remain of the view expressed in our previous report that, if the full imprecision of the current beta estimates is taken into account, there is not persuasive evidence for concluding that the equity beta for a benchmark electricity transmission or distribution entity is different to the previously adopted value of 1.
- Our advice is consistent with the advice we provided earlier to the Victorian ESC. Indeed, while the additional data now available (almost two years) has led to an increase in the beta estimates compared to those available to the ESC, the AER has adopted a lower range for beta than the ESC.

A reference to 'our' in this report is a reference to the Allen Consulting Group.

## Section 1 AER positions and commentary

#### 1.1 Purpose

The purpose of this report is to comment on the Australian Energy Regulator's (AER) conclusions in its draft decision on the WACC parameters for the electricity transmission and distribution businesses with respect to the equity beta that is to be assumed when determining regulatory weighted average cost of capital for regulatory proposals that are submitted after 31 March 2009.<sup>2</sup> The AER's analysis relied upon empirical work undertaken by Associate Professor Henry.<sup>3</sup> We prepared a report on this matter for the Joint Industry Associations,<sup>4</sup> which was submitted to the current review and has been considered by the AER. The scope of this report is limited to comment on the matters that were addressed in the earlier report that are the most material.

We have been engaged for this task by the Joint Industry Associations (JIA), which comprises Grid Australia, Energy Network Association and the Australian Pipeline Industry Association. Our previous report referred to some of the earlier work that we have undertaken on equity betas for energy network businesses, including a report in 2007 for the Victorian Essential Services Commission,<sup>5</sup> and in 2002 for the AER's predecessor, the Australian Competition and Consumer Commission.<sup>6</sup>

#### 1.2 AER draft conclusions

The key conclusions or propositions of the AER that are addressed in this report include the following:

- The AER considers that it can be assumed, *a priori*, that the equity beta for electricity transmission and distribution is likely to be less than one.
- The AER reached conclusions on a number of methodological issues, including that it would place most weight on betas estimated using weekly observations and that it should examine portfolio betas where the weight assigned to firms in the portfolio should be equal across firms or reflect that firm's relative equity market value.
- The empirical evidence on equity betas suggests that the range is between 0.44 and 0.68, which was based upon:
  - <u>at the lower end</u>, the AER's estimate of the equity beta for a portfolio of firms over the period 1 January 2002 and 1 September 2008 (which comprised the firms the AER considered to be sufficiently comparable

Australian Energy Regulator, 2008, Electricity transmission and distribution network service providers – review of the weighed average cost of capital (WACC) parameters, Explanatory statement, December.

Henry, O., 2008, Econometric advice and beta estimation, Report for the Australian Energy Regulator, November.

Allen Consulting Group, 2008, Beta for regulated electricity transmission and distribution, Report to Energy Networks Association, Grid Australia and APIA, September.

Allen Consulting Group, 2007, Empirical evidence on proxy beta values for regulated gas distribution activities, Report to the Essential Services Commission of Victoria, June.

Allen Consulting Group, 2002, Empirical Evidence on Proxy Beta Values for Regulated Gas Transmission Activities, Final Report, Report for the Australian Competition and Consumer Commission, July.

entities, less GasNet and Alinta, leaving 7 firms) – with the reduced sample set reflecting Associate Professor Henry's view that the estimates for GasNet and Alinta were affected by takeover speculation;<sup>7</sup> and

- <u>at the upper end</u>, our estimate of the equity beta for a portfolio of US energy network firms (i.e., electricity and gas) over the period between 1990 and May 2008 (excluding 1998 to 2001).
- The AER concluded that an examination of the confidence intervals for beta was irrelevant to its decision on the equity beta, noting that:<sup>8</sup>

... the AER does not consider that having regard to the need for persuasive evidence translates into a specific statistical hypothesis that would require the selection of a particular set of standard errors to create confidence intervals for the purposes of testing the unknown true value of the equity beta.

That said, the AER notes even if it were to consider confidence intervals it would be appropriate to consider both the lower and upper bounds generated by the estimation as it is equally likely that a 'true' equity beta point estimate may be observed at the lower or upper bound. Given that upper and lower bounds are less likely to represent the 'true' point estimate the AER has had regard to the point estimates rather than the range of possible estimates within confidence intervals.

Later the AER remarked that:

... extreme caution should be exercised when considering confidence limits

The AER also rejected our view that the standard errors estimated using standard methods (whether or not an adjustment is made for hetroskedascitity and autocorrelation) would be likely to understate the imprecision of the beta estimates, although the sum of the AER's analysis was to note that:<sup>9</sup>

The ACG has argued in its report that the low level of market volatility (driven by macroeconomic stability) has resulted in the level of uncertainty to be understated in the confidence intervals. The AER considers that the ACG has not demonstrated the link between market volatility and macroeconomic stability, and the impact on confidence intervals.

The AER also summarised our conclusions as arguing that the absence of macroeconomic factors has led to measured betas being downward biased.<sup>10</sup>

Related to this, the AER referred to the Henry's application of the 'Hansen test' to conclude that:<sup>11</sup>

the AER considers that there is little evidence of parameter instability in the point estimate of the equity beta

Regarding our work in particular, the AER has made a number of assertions that we consider to reflect a misunderstanding or selective interpretation of our work. First, the AER's comparison of our conclusions with those of Henry implied that, in a fair comparison, our conclusions were materially different to those of Henry, for example:

AER, Op. Cit., p.238.

Henry, Op. Cit., p.14. Henry noted that an alternative would be to reduce the sample size, but asserted that the period to be removed is 'entirely arbitrary' after having concluded that Alinta was affected by speculation 'as 'from at least January 2007' and GasNet was affected by speculation 'as early as June 2006' (Henry, Op. Cit., p.14).

AER, Op. Cit., p.219.

<sup>&</sup>lt;sup>^</sup> AER, Op. Cit., p.219.

AER, Op. Cit., p.206.

the conclusions of Associate Professor Henry and the ACG are different. Henry concludes that the balance of evidence points towards the equity beta for a benchmark efficient service provider lying in the range of 0.4 to 0.7 ... [t]he ACG concludes that with its updated evidence there is no persuasive evidence that the equity beta is different from one.

The AER has also made a number of statements implying a material inconsistency with the advice that we provided to the Victorian ESC in 2007, including the following:

• The AER asserted that the period over which we presented beta estimates were materially different between our earlier report for the ESC and our 2008 report for the JIA:<sup>12</sup>

For the post-tech boom period, ACG (2008b) has calculated equity betas using only the last five years of data, rather than all data available post-2002. In contrast, the AER has utilised all available data post-2002, which seems more consistent with ACG's (2008b) advice. Following the same principle, in previous advice (ACG (2007)), ACG included all available data post-tech boom and did not limit its estimation period to the past 5 years of data.

- The AER implied that our presentation of portfolio beta estimates over an extended period which means that the effects of AGL and Envestra have a large effect on the results differed to our advice to the ESC.
- The AER also verified the lower end of its range (of 0.44) by referring to one of the Australian beta estimates that was included in our advice to the ESC (of 0.33).

#### 1.3 Comments on the AER's conclusions

This section sets out our comments on the AER's conclusions. Section 2 of the report expands upon these comments with respect to three matters, namely:

- whether the AER is justified in forming an a priori view that the equity beta for a benchmark regulated electricity network business is less than 1;
- the meaning of 'persuasive evidence' and the role of confidence intervals and related matters; and
- the interpretation of the empirical evidence on betas.

#### A priori view about the equity beta

The logic the AER has applied to form an *a priori* view that the equity beta would be less than 1 suffers from serious error and is inconsistent with the method that the AER and Associate Professor Henry have applied to adjust beta estimates for leverage.

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We agree (and have noted previously) that the *asset* beta for regulated energy networks would be expected to be less than that of the firm of average risk. However, there is no basis for asserting on the basis of theory alone that the *equity* beta should be less than that of an average firm given that regulated networks are being assumed to have almost twice the gearing level as the average firm. A critical assumption to the AER's argument is that benchmark regulated electricity networks are able to pass through their actual debt costs. This is a significant misunderstanding of the regulatory regimes set out in Chapters 6 and 6A of the Rules, under which allowances for debt costs are fixed for 5 years at a time and are based on benchmark rather than actual costs. The AER's argument also assumes that gearing has a different effect on equity betas for regulated businesses than for unregulated firms – which is inconsistent with how the AER and its expert have adjusted estimated betas for financial leverage.

# Meaning of persuasive evidence, use of confidence intervals and parameter stability

A key difference between the AER's analysis and our work is the threshold that the AER would need to satisfy to determine that there is 'persuasive evidence' for a change from the previously adopted value for the equity beta. Our assumption was that the Rules set a high threshold and effectively the new evidence to demonstrate that the previously adopted value to be incorrect.<sup>13</sup> This assumption was based upon our view of the policy rationale for the requirement in the Rules for such a requirement. Given our interpretation of the requirements of the Rules, we focussed on statistical techniques for assessing whether the current evidence could demonstrate error in the previously adopted value, for which measures of statistical reliability (of which confidence intervals are an outworking) become a central concern. The AER, in contrast, decided that there would be persuasive evidence if an examination of the current evidence would in its view lead it to a different conclusion to the previously adopted value.

Which of these views is correct is a legal matter, which is beyond our area of expertise. However, we note that the majority of issues addressed in this report remain relevant irrespective of how the need for 'persuasive evidence' is interpreted.

On the technical issue of the AER's consideration of confidence intervals, we make the following observations.

First, irrespective of how the requirement for 'persuasive evidence' is to be interpreted, the AER is wrong to ignore measures of statistical precision (of which a confidence interval is a representation). A confidence interval (in broad terms) shows the limit that the true value reasonably could have in either direction given the data that is being analysed. It is standard practice to consider point estimates obtained from statistical techniques like regression analysis together with measures of statistical precision because such measures tell us how much faith we can place in a particular point estimate (and the bounds of that faith). Accordingly, measures of statistical precision are relevant for informing the degree of 'persuasiveness' of the empirical evidence.

<sup>&</sup>lt;sup>13</sup> The first paragraph of our Executive Summary noted that our 'blank sheet of paper' estimate of beta was between 0.70 and 0.90.

Secondly, the AER's suggestion that it will look at both the upper and lower end of confidence intervals displays a lack of understanding of the relevance of confidence intervals for the AER's purposes. As virtually all of the point estimates of beta are below 1,<sup>14</sup> the question is whether the data nonetheless could be consistent with the true value being 1. Only the upper end of the confidence interval is relevant to this question.<sup>15</sup>

Thirdly, the AER's assertions that we argued that low levels of market volatility have caused greater uncertainty in beta estimation or a downward bias in beta estimates is a misrepresentation of the argument that we presented. We did not argue that beta estimates were downward biased and we did not assert that low market volatility of itself meant that betas were more uncertain than their standard error suggest.<sup>16</sup>

Rather, we argued that the measured beta over a period will reflect the macroeconomic events that took place during the measurement period. Whether betas measured in one period will reflect the expected beta will depend upon how representative the events in the measurement period were of the future. We then argued that it is unlikely that a particular measurement period will experience macroeconomic events that are in line with what was expected, which we argued creates another source of uncertainty (imprecision) in beta estimates that is not reflected in the standard errors that are estimated for the beta.

The AER's conclusion that there is no instability in the beta estimates is not consistent with the evidence (4 of the 9 beta estimates are significantly unstable), does not provide much comfort (the imprecision of beta estimate makes it hard to discern instability from estimation error) and also does not address fully the proposition above (stability in the measurement period does not mean that the measured beta will coincide with the expected beta if market conditions are expected to be different).

#### Interpretation of the empirical evidence on betas

The range the AER has determined for the beta is a lower range than the AER's own beta estimates and a proper interpretation of our analysis would justify.

The lower end of the AER's range (0.44) is determined by its 'portfolio' beta estimate for the period after the end of 2001 (the agreed end of the technology bubble). However, it is difficult to reconcile this portfolio beta with the simple average of the AER's beta estimates of 0.58 (which is the average if all of the companies are included) and 0.56 if Alinta and GasNet are excluded.<sup>17</sup> We also do not agree with the exclusion of Alinta and GasNet – if the potential bias caused as a result of merger and acquisition activity is considered sufficiently material, then the affected observations – rather than the whole firm – only should be excluded, given the small number of listed Australian comparable entities.

<sup>&</sup>lt;sup>14</sup> Two of our beta estimates for US energy network firms were at or above 1. However, as noted above, our stated upper limit to our range nonetheless was 0.90.

In contrast, if the majority of the current point estimates for betas were above 1, then the lower end of the confidence limits would have been 'in play'.

<sup>&</sup>lt;sup>10</sup> Periods of low market volatility are likely to raise the standard error of beta estimates – but this would be reflected in the measured standard error.

The average of Professor Henry's beta estimates (re-levered using Henry's leverage assumptions) using monthly observations for the set of firms excluding Alinta and GasNet was 0.55 (calculated from Henry, Op. Cit., pp.14, 18). Henry did not report beta estimates for Alinta and GasNet using monthly observations.

The upper end of the AER's range (0.68) is determined by our portfolio estimate of betas for US energy network firms over the period since 1990.<sup>18</sup> Without discussion, the AER ignores its expert's own estimates, the point estimates of which ranged between 0.75 and 0.87 (the upper end of which we would place most weight upon).<sup>19</sup> Moreover the AER has misapplied our results – after having decided to look only at electricity firms, the AER employed a beta estimate that included electricity and gas firms. The simple average of the equity betas for the AER's preferred sample is 0.77.<sup>20</sup> The AER also has no basis upon which to conclude that adjustments that may be made to US betas would lead them to be revised downwards for Australia – the adjustments go in different directions and are imprecise and so have an indeterminate effect on the Australian-equivalent beta.

We note that the AER has ignored our portfolio beta estimates that make use of the full period on the basis that a disproportionate weight is implicitly applied to the beta estimate for AGL. We remain of the view that this estimate is a valid piece of information, and one that we advised the Victorian ESC to take into account. While AGL may be overweighted in the estimate (which is undesirable), the long term beta estimate relates to a greater diversity of market conditions (i.e., by including the influence on betas of macroeconomic conditions prior to the 'technology bubble').<sup>21</sup> It also appears that the AER's concern about the relevance of AGL is overstated – while AGL had retail interests prior to 1998, this period predated the introduction of 'full retail contestability', and hence its retail activities were largely regulated. The long term portfolio estimates implied a range for the point estimate of between 0.70 and 0.90 depending on the estimation method and portfolio applied.

However, we note that an alternative that applies an equal weight to all firms, but maximises the use of information, is to consider the average of the beta for each firm calculated using the full period of observations available (or 1990 for AGL). This implies an average OLS beta of 0.54 for all of the firms and 0.57 and 0.62 if only firms with more than 3 and (almost) 5 years of trading history are included in the sample.<sup>22</sup>

In our view, the AER's own results and a proper interpretation of our empirical work justify a range for the central estimate of the equity beta of between 0.60 and 0.90 (rounded). We note, however, that central estimates of the equity beta do not necessarily answer whether there is 'persuasive evidence' for a change to the equity beta from the previously adopted value. In our view, the strength of the empirical evidence that is available cannot demonstrate that the true value may not lie materially above (or below) the range of the central estimates.

<sup>&</sup>lt;sup>18</sup> We note that this estimate of 0.68 is a point estimate rather than an upper limit to the associated confidence interval that we reported.

This is because the beta estimate of 0.87 is obtained using monthly estimates and using OLS. The 0.75 estimate is derived from monthly data and the use of the LAV method.

The AER asserted that US gas betas tend to be higher than electricity betas (AER, Op. Cit., p.239). The AER does not cite any source for this belief, which is not consistent with the evidence that we provided. Having said that, we do not think that our estimates provide a basis for believing that US electricity and gas network business asset betas are different.

Portfolio beta estimates apply an equal weight to each time period during the measurement period, using the best representation of firms available at any given point in time. As such, individual firms receive a different weight. In contrast, simple averages of betas apply an equal weight to each firm, but in doing so apply a different weight to the time periods within the measurement period.

In our report to the Victorian ESC, we reported simple averages for the five longest-trading firms, the shortest of which was GasNet with 59 observations, which is just short of a 5 year trading history. Accordingly, the 'almost 5 years' criterion would be consistent with our advice to the ESC.

#### Methodological choices when estimating beta

While we agree with many of the AER's conclusions on the methodological choices for estimating beta, we disagree with using weekly data to estimate betas,<sup>23</sup> and with estimating betas for value-weighted portfolios of firms.

The AER acknowledges that using weekly observations to estimate betas is not consistent with standard practice. We note that using weekly observations is more likely to be susceptible to bias than when monthly estimates are used where stocks are traded less than the (value-weighted) average of listed entities, which is likely to be the case for some of the firms in the set of Australian comparable entities. In addition, it is not clear that the use of weekly data improves the overall statistical performance of the model that is used to estimate the betas.

In particular, while the use of additional observations (i.e., by using shorter trading intervals) may improve the (apparent) standard errors of the beta estimates, it is also generally the case that using shorter trading intervals will reduce the overall 'goodness of fit' of the model (as measured by the 'r-squared value').<sup>24</sup> These two criteria – namely, the precision of the individual parameters and the model's overall ability to explain the data – are both widely used for assessing the performance of an econometric model. As they move in different directions, it is not possible to conclude without further analysis that beta estimates obtained using weekly estimates would be better than those obtained using monthly estimates. We would therefore caution the AER against drawing any conclusions from the use of weekly estimates that would not be defensible were monthly estimates used.

Regarding the measure of portfolio return that is used to estimate the portfolio betas, we note that the AER has not advanced any reason for favouring the use of value-weighted returns, but has merely asserted that:<sup>25</sup>

... it is important to acknowledge that a portfolio may be equal-weighted (same weight applied to each stock) or value-weighted (weight commensurate with market capitalisation).

Applying a value-weighting to the returns from the firms within the portfolio will lead to a greater weight being applied to the returns of the larger firms. Unless the beta estimates for the larger firms are considered more accurate, then there is no reason that such a weighting would improve the accuracy of the resulting beta estimate. In our work, we have always presented the simple average of individual beta estimates (rather than presenting the weighted average beta with weights that reflect firm size) and used a central estimate of the return of the portfolio when presenting beta estimates for portfolios.

#### Comparison of our conclusions with those of Associate Professor Henry

Turning to the AER's characterisation of our conclusions compared to those of Associate Professor Henry, the AER has exaggerated the difference of view between us and Henry by not considering or quoting our full conclusions. Our full conclusions were that:

<sup>&</sup>lt;sup>23</sup> In our advice to the Victorian ESC we stated that: 'we would recommend being extremely cautious about placing weight on these estimates given the material potential for biases to affect the estimates' (ACG, 2007, p.21).

For example, this result is found in Brailsford, T., (1997), The impact of the return interval on the estimation of systematic risk, *Pacific-Basin Finance Journal*, Vol 5, p.367.

Statistical estimation of beta values for nine Australian businesses for periods up until May 2008 indicates central estimates of an equity beta value for an Australian electricity transmission or distribution business (at a gearing of 60 percent debt to assets) of 0.7 to 0.9 depending on the estimation method applied.

•••

Taking into account the limitations of the data set, the size and incompleteness of statistical error margins around the beta estimates, and evidence of a recent rising trend in beta estimates, we do not consider that current empirical evidence on beta values would provide convincing or persuasive evidence to conclude that the (60 percent geared) equity beta for a regulated electricity transmission or distribution business is different from one.

Thus, a fair comparison of our conclusions to those of Henry would compare Henry's conclusion of 0.40 to 0.70 with our conclusion that the range is between 0.70 and 0.90.<sup>26</sup> In addition, it is not clear how Henry formed the view about this range.

- It would appear that Henry has ignored the data from the US given that the simple average of the re-levered betas for the US firms varied between 0.75 and 0.87 depending on the sampling frequency and estimation method. If Henry had have placed weight on the US data, presumably he would have extended the upper limit of his range to 0.90, which would have coincided with ours.<sup>27</sup>
- In addition, it would also appear that for Henry to form a view that the beta may be 0.40 he must have placed substantial weight on the estimates of beta for portfolios of firms and/or LAV estimates, and ignored the simple averages of betas. If Henry had have placed weight on simple averages and less weight on LAV estimates, then it is difficult to see how he could have concluded that 0.40 would be a reasonable interpretation of the Australian data.

In addition, the AER did not ask Henry to advise on whether the empirical evidence satisfied the 'need for persuasive evidence' that the Rules require before the AER may adopt a beta that is different to the previously accepted value. Indeed, the AER did not even ask Henry to advise as to whether statistical theory provided tools for testing the extent of persuasiveness of the empirical evidence. It follows that the question that Henry has sought to answer is not the question the AER is required to answer, and so the actual conclusions that Henry reaches should be of little direct relevance.

#### Consistency with our earlier advice

Turning to the AER's various explicit or implicit suggestions of inconsistency between our work for the JIA and our earlier advice to the ESC, we make the following points.

First, notwithstanding the AER's assertions otherwise, the short term beta estimates that we provided to the ESC used a 5 year period of observations. In that report, we remarked as follows:<sup>28</sup>

We note that on a matter where our results were directly comparable – the simple average of the beta estimates for the AER's full set of comparable entities over the recent period – our estimates and those of Henry are surprisingly similar (Henry's average being 0.58 and ours 0.61, both of which we would round off to 0.60).

The upper end of this range corresponded to the use of simple OLS estimation and monthly observations, which we would consider to be the most convincing of the estimates.

Our recommendations on methodological issues arising from the studies noted above are as follows:

•••

The maximum amount of data available should be reviewed, together with more recent data based on 5 years of monthly observations;

The AER's confusion appears to have arisen from the fact that our dataset spanned exactly 5 years of observations since the end of the technology bubble, but it is clear that nonetheless we intended to direct the ESC to consider observations calculated using 5 years of observations.

Secondly, while we indicated to the ESC that our long term portfolio beta estimates implicitly applied a high weight to AGL and Envestra, we did not advise the ESC to ignore this information, as the AER has implied. Rather, we advised the ESC to take account of the long term estimates together with the short term ones, notwithstanding the weight accounted for by AGL and Envestra:<sup>29</sup>

As noted above, we consider it preferable to place the greatest reliance on Australian data, albeit with regard also had to beta estimates for overseas firms (i.e. US firms). This would argue for placing the greatest weight on the beta estimates for Australian firms measured over the longest period. However, a problem with the full period data is the relatively heavy weighting of two securities (AGL and Envestra). Accordingly, reliance should also be placed upon beta estimates for the period since the end of the technology stock bubble given the greater number of firms that were in existence during this period.

As we noted earlier, the long term portfolio beta estimates have both desirable and undesirable features and contain useful information that should not be ignored.

Thirdly, the AER's reference to an estimate presented in our report to the ESC of 0.33 to gain comfort for the lower end of its range appears misplaced. That point estimate was one of numerous estimates the ESC had regard to when identifying a plausible range for beta. It is notable that the AER has determined a lower range for the equity beta than the ESC (0.44 to 0.68 for the AER compared to the ESC's range of 0.50 to 0.80) notwithstanding the generally higher estimates for betas considered by the AER compared to the ESC.

## Section 2 Elaboration on comments

#### 2.1 A priori belief about the equity beta

#### AER position

The AER has concluded that it is reasonable to form a prior belief that the equity beta for a benchmark efficient service provider 'is likely to be less than one'.<sup>30</sup> The AER's full reasoning for this belief is as follows:<sup>31</sup>

Through having regard to both the nature of the industry and regulatory regime, the AER considers there are strong conceptual reasons to suggest that the exposure of a benchmark efficient service provider's to non-diversifiable risk due to business activities would be less than that of the market. That is, the asset beta of a benchmark efficient service provider would be less than the asset beta of the market. There appears to be general agreement, from both the MEU and JIA, on this point.

As noted above, the JIA consider that regulated utilities face higher exposure to financial risk than the market due to the higher leverage. This assumes that a businesses exposure to financial risk is determined by financial leverage alone. The AER notes that an additional aspect of the regulatory regime is that the cost of debt is based on prevailing market conditions as sourced from a reliable data service provider at the time of the determination. This 'pass-through' nature of borrowing costs is likely to reduce exposure to financial risk, compared to an unregulated business (or the market in general) with the same benchmark level of gearing.

Accordingly, the AER considers that the exposure of a benchmark efficient service provider to business risk and to financial risk overall, is less than that of the market. That is, that the equity beta is likely to be less than one.

#### Comment on the AER's conclusion

The AER is the first economic regulator that we are aware of that has asserted that it is possible to infer from a consideration of theory alone that the *equity* beta for an energy utility firm should be less than 1. To date, there has been collective agreement that the *asset* beta for an energy utility firm should be less than the *asset* beta for the firm of average risk, which reflects the fact that the *business risk* of an energy utility should be low. However, it is another matter again to assert that an energy utility should have an equity beta that is less than that of a firm of average risk given that the AER's benchmark gearing assumption is that a benchmark efficient electricity transmission or gas business would have approximately twice the gearing of the average firm (i.e., an energy utility would have a much higher level of *financial risk* than the average firm). After adjusting for relative levels of financial risk, the following comparisons can be made:<sup>32</sup>

• an equity beta of 1 for the regulated firm compares to an equity beta of 1.65 that the firm of average risk would have if geared to 60 per cent;

AER, Op. Cit., pp.10, 194, 251.

<sup>&</sup>lt;sup>31</sup> AER, Op. Cit., pp.193-194.

These calculations assume an average gearing level for Australian firms of 34 per cent and use the simplest levering equation.

• an equity beta of 1 for the regulated utility firm translates into an asset beta of 0.40, which compares to an asset beta of 0.66 for the firm of average risk and gearing.<sup>33</sup>

The AER's proposition as to why an *equity* beta of less than 1 can be inferred for regulated utilities is because regulated businesses are said to face less financial risk than the average (or unregulated) firms because of the 'pass through' nature of debt financing costs. This is said to reduce businesses' exposures to financing risk compared to the average firm.

The AER's assertion in the passage quoted above that regulated transmission and distribution businesses receive a 'pass through' of their debt costs is a serious misunderstanding of the regulatory regime that it administers. The assumption about the cost of debt that is factored into prices/revenues is only reviewed at periodic price reviews, along with the assumption about the cost of equity. Thus, the regulated businesses bear the risk associated with changes to financing costs – along side all other costs<sup>34</sup> – between reviews, of which 5 years is the current norm or requirement. In addition, it is incorrect to assert that regulated businesses even receive a 'pass through' of debt costs at the time of the periodic price review. The standard practice in Australia – and which is mandated in the Rules – is to set an allowance for debt financing costs that is based upon a benchmark level of gearing and a benchmark cost of debt. Businesses will therefore be exposed to differences between their actual debt financing costs – reflecting, amongst other things, the cost of debt at the time it was raised – and the benchmark debt raising costs that are computed at the periodic price review.

The capacity for regulated firms to pass-through cost (including debt and equity financing cost) or revenue changes at periodic price reviews is a key reason as to why the asset beta associated with the activity is likely to be lower than a firm of average risk. However, for a given capacity to pass through cost (and hence, for a given asset beta), it remains the case that as the level of gearing for a regulated business increases, the variance of the residual cash flow (i.e., returns to the equity providers) will increase, and with it the covariance of that cash flow with the market portfolio will also increase. That is, when revenue or expenses vary from the forecast values during the regulatory period as random events occur," the equity providers would bear the consequences of the variation (i.e., through an increase or decrease in the cash flow to equity), irrespective of whether there was an ability to pass through changes to debt financing costs. There is no difference between regulated businesses and other firms in this regard. Indeed, the AER's assertion that the relationship between beta risk and gearing is different for utility firms than for all other firms also is not consistent with its subsequent discussion in the chapter about the relationship between the equity beta and gearing. In this later discussion, the AER does not question the accepted position that the relationship between gearing and the equity beta is no different between regulated utilities and other firms.

<sup>&</sup>lt;sup>33</sup> The AER's proposed equity beta of 0.80 equates to an asset beta of 0.32.

That is, apart from the cost associated with events that are covered by pass-through or contingent project arrangements.

Note that a random event any event that was not forecast to occur with certainty. The probability distribution for the event may be known.

As discussed above, the equity beta of a business reflects both the business risk of its assets, and the financial risk from the business' level of financial leverage or gearing. Payments to debt holders are generally obligatory, independent of a business' contemporaneous revenue, and have precedence over payments to equity holders. Therefore the higher a business' financial leverage, the greater the volatility of its free cash flows are assumed to be, leading to more volatile returns to equity holders. An increase in a business' gearing is expected to lead to a higher exposure to systematic risk and consequent higher equity beta, all else being equal.

As the equity betas of comparator businesses will reflect varying levels of actual financial leverage between the businesses, these equity betas can be 'de-levered', to obtain the asset beta of the business. The result of 'de-levering' is the underlying beta of the asset, which is the beta of the asset if the asset was financed 100 per cent by equity, with zero debt. The resulting asset beta would reflect only the underlying business risk of the business' assets. These asset betas can then be 're-levered', based on the benchmark gearing level adopted by the regulator to obtain an equity beta based on the benchmark level of gearing. In general, the preferred approach of the AER and ACCC to de-levering and re-levering is to use the Monkhouse formula, with an assumed debt beta of zero.

•••

However, the AER notes that the ACG prefers a simplified de-levering and re-levering formula (the Brealey and Myers formula with a debt beta of zero), and has adopted this approach in recent reports. This approach has also been adopted by Associate Professor Henry.

•••

The AER notes that it is generally accepted that the choice of de-levering and re-levering formula, in general, does not make a significant difference to the resultant estimates, so long as the same formula is adopted for both de-levering and re-levering. The AER also notes that the use of the same formula across the ACG's current and recent reports, and Associate Professor Henry's report, also allows for ease of comparison across the various reports.

We agree with the discussion above – the conclusion of which is that the AER, its expert, Associate Professor Henry and ourselves are in agreement that there is a need to adjust measured equity betas to be consistent with the benchmark level of gearing and that we are also in agreement about which formula to employ for this purpose. Importantly, the formula the AER agreed to use – and the other formula that it discussed as being its erstwhile preference – are formulae that are employed commonly to adjust equity betas for unregulated firms to ensure that the equity beta is consistent with the relevant firm's level of gearing. Therefore in this area of the AER's report, there is no suggestion that the relationship between equity betas and gearing differs in any way between regulated firms and unregulated firms.

In conclusion, while the AER is justified in assuming that the asset beta for regulated utility firms should be less than the asset beta for the firm of average risk, there is no basis for an *a priori* view that the equity beta also would be less than one given that the AER is assuming that regulated utilities have approximately twice the level of gearing to the average firm. In particular, the AER's argument that regulated businesses are able to pass through debt costs and that this would mean that the risk of the equity does not rise with gearing is incorrect and inconsistent with the approach to adjusting equity betas for leverage that its expert has adopted and it has endorsed.

# 2.2 Meaning of persuasive evidence, use of confidence intervals and related matters

#### **AER** position

The AER concluded that an examination of the confidence intervals for beta was irrelevant to its decision on the equity beta, noting that:<sup>37</sup>

... the AER does not consider that having regard to the need for persuasive evidence translates into a specific statistical hypothesis that would require the selection of a particular set of standard errors to create confidence intervals for the purposes of testing the unknown true value of the equity beta.

That said, the AER notes even if it were to consider confidence intervals it would be appropriate to consider both the lower and upper bounds generated by the estimation as it is equally likely that a 'true' equity beta point estimate may be observed at the lower or upper bound. Given that upper and lower bounds are less likely to represent the 'true' point estimate the AER has had regard to the point estimates rather than the range of possible estimates within confidence intervals.

#### Later the AER remarked that:

... extreme caution should be exercised when considering confidence limits

The AER also rejected our view that the standard errors estimated using standard methods (whether or not an adjustment is made for hetroskedascitity and autocorrelation) would be likely to understate the imprecision of the beta estimates, although the sum of the AER's analysis was to note that:<sup>38</sup>

The ACG has argued in its report that the low level of market volatility (driven by macroeconomic stability) has resulted in the level of uncertainty to be understated in the confidence intervals. The AER considers that the ACG has not demonstrated the link between market volatility and macroeconomic stability, and the impact on confidence intervals.

The AER also summarised our conclusions as arguing that the absence of macroeconomic factors has led to measured betas being downward biased.<sup>39</sup>

Related to this, the AER referred to Associate Professor Henry's application of the 'Hansen test' to conclude that:40

the AER considers that there is little evidence of parameter instability in the point estimate of the equity beta

#### Comment on the AER's conclusion

#### Need for persuasive evidence

In our report for the JIA, we were asked to analyse the empirical evidence on equity betas for a benchmark regulated electricity business and provide an opinion as to whether that evidence provides 'persuasive evidence' that the equity beta should be moved from the previously adopted value (we noted that we interpreted 'previously adopted value' as meaning a value of 1).<sup>41</sup>

<sup>&</sup>lt;sup>37</sup> AER, Op. Cit., p.219.

AER, Op. Cit., p.219.

AER, Op. Cit., p.206.

<sup>&</sup>lt;sup>40</sup> AER, Op. Cit., p.238.

ACG, 2008, Op. Cit., p.2.

A key difference between the AER's and our analyses is the correct interpretation of the term 'persuasive evidence', and more specifically, the threshold that this imposes before the AER is entitled to vary the equity beta from the previously adopted value. We note that the requirement in the Rules for there to be 'persuasive evidence' is a requirement that has not been present in the any of the regulatory regimes that predated the new Chapters 6 and 6A of the Rules. Our assumption was that this was a high threshold and would require the new empirical evidence to establish that the previous value is incorrect.<sup>42</sup> For this reason, we focussed on statistical techniques for assessing whether the current evidence could demonstrate error in a previous estimate, for which measures of statistical reliability (of which confidence intervals are an outworking) become a central concern. The AER's arguments, in contrast, demonstrated its belief that the requirement for 'persuasive evidence' would be satisfied if its examination of the current evidence leads it to a different conclusion to the previously adopted value.

Which of these views is correct is a legal matter and therefore beyond our area of expertise. However, we note that the majority of issues addressed in this report remain relevant irrespective of how the need for 'persuasive evidence' is interpreted.

The AER has made a number of comments about the use of confidence intervals and the 'stability' of the beta estimates, which we address in turn below.

#### Use of confidence intervals

As noted above, the AER asserted that 'confidence intervals' were not relevant to the decision that it had to make, but also stated that if it was to have regard to confidence intervals that it would look at both the upper limit and the lower limit of the intervals.

In our view, these comments display a lack of understanding of the role of confidence intervals (or, more specifically, measures of statistical reliability) and their relevance for the AER's purposes.

Central to the notion of a confidence interval is that estimates of parameters like the beta are imprecise. This means that, even though we may obtain a 'best estimate' for a parameter, from the evidence being examined, the true value could easily be higher or lower, given the imprecision of the estimate. A confidence interval, in broad terms, describes the limit of our confidence about the true value given the evidence that has been considered – on the strength of the evidence examined, the true value could lie anywhere within the outer bounds of the confidence interval, but in contrast, we are confident that the true value cannot lie outside of those bounds. Thus, confidence intervals are a succinct statement from statistical theory about the degree of 'persuasiveness' of the relevant piece of empirical evidence.

Thus, while we agree with the AER that administrative decisions on matters like beta cannot be reduced to a mechanical statistical test, well-known techniques for measuring the precision of empirical estimates – like confidence intervals – provide relevant information given the express requirement in the Rules for the AER to establish that there is 'persuasive evidence' for a change to beta.

<sup>&</sup>lt;sup>42</sup> The first paragraph of our Executive Summary noted that our 'blank sheet of paper' estimate of beta was between 0.70 and 0.90.

Equally, we consider the AER's alternative position that it should consider both the upper and lower limits of confidence intervals to be misplaced.

The AER's first task with respect to the equity beta is to establish that there is persuasive evidence for a change to beta from the previously adopted value. As noted above, we interpreted 'previously adopted value' as meaning a beta of 1. It is clear that virtually all of the new point estimates of beta are below 1.<sup>43</sup> Accordingly, the relevant question is: how high could the true value for beta actually be given the new empirical evidence – and, in particular, are confident that the true value is less than 1. Only the upper end of the confidence interval is relevant to this question. In contrast, if the new beta estimates were above 1, then the question would have been: how low could the true value for beta actually be given the new empirical evidence, in which case we would have been examining the lower bound of the confidence intervals.

Thus, there is nothing inappropriate nor asymmetric about concentrating in the current case on the upper limit of the confidence intervals for the new beta estimates. When testing whether the evidence for change is 'persuasive' given the reliability of the evidence, only one end of the confidence interval would be relevant (with the relevant 'end' depending upon whether the new point estimates are above or below the previously adopted value).

#### Reliability of beta estimates and stability of betas

In our report for the JIA, we presented a discussion on the reliability of beta estimates, which included a discussion about the limits of standard estimates of the standard errors of betas as an indicator of the precision of that estimate. We concluded that there are sound reasons to expect that standard estimates of standard errors do not reflect the full uncertainty in beta estimates.

The AER summarised our report as arguing that the low levels of market volatility that were experienced prior to the start of 2008 have caused greater uncertainty in beta estimation or a downward bias in beta estimates, and proceeded to reject our argument (albeit merely by asserting that we did not make out our case). The AER's summary of our report misrepresented our arguments and as a consequence, those arguments were neither considered nor addressed.

In contrast to the AER's summary, we did not argue that beta estimates were downward biased and we did not assert that low market volatility of itself meant that betas were more uncertain than their standard error suggest.<sup>44</sup> Rather, we argued that beta estimates inherently are a product of the market conditions that prevailed during the measurement period. As a consequence, we argued that there is an additional source of imprecision in beta estimates, which is caused by the potential for the market conditions that prevailed during the measurement period not to be representative of the future. The implication of this argument is not that estimates necessarily are biased, but rather that the standard estimates of precision of betas (standard errors) are likely to understate the true imprecision of the beta estimates.

<sup>&</sup>lt;sup>43</sup> Two of our beta estimates for US energy network firms were at or above 1. However, as noted above, our stated upper limit to our range nonetheless was 0.90.

Periods of low market volatility are likely to raise the standard error of beta estimates – but this would be reflected in the measured standard error.

One of the apparent responses of the AER to this argument was to quote Associate Professor Henry's conclusions about stability of beta estimates. Henry concluded that his application of the 'Hansen test' did not detect instability in his estimates of the equity beta for the Australian firms (although the variance of the error terms was found to be unstable).

First, we note that Associate Professor Henry's conclusion that there is no instability in the beta estimates is not particularly comforting. Notwithstanding his conclusion, Henry does find statistically significant instability in the beta estimates for 4 of the 9 firms in the AER's sample of comparable entities (i.e., excluding Origin Energy), which is almost half of the sample. Secondly, given the imprecision with which betas are estimated, the odds are stacked against finding evidence of statistically significant instability in those estimates – an alternative explanation for the finding of no statistically significant instability in the true beta is that it reflects the poor precision of the underlying beta estimates.

Thirdly, the test applied by Henry – as with the visual test that we proposed in our previous report – does not address fully the proposition above, which is that beta estimates in one period (reflecting as they do the events that occurred during the measurement period) may not reflect the expected beta for future periods. If the estimates within the measurement period are found to be unstable, then the potential for the future beta to vary from the measured beta would be more likely (i.e., using the logic that if the beta had changed once, it is more likely to change again). However, the absence of a finding of instability during the measurement period does not mean that the macroeconomic events that occurred during the measurement period are expected to continue in the future – and so the measured beta will be the expected future beta.

We argued in our previous report that a key feature of much of the period the AER has analysed was characterised by benign market conditions. These included stable growth, low and stable interest rates and the capacity for businesses to raise and refinance large quantities of debt. It is clear that conditions have changed substantially since that time, and a return to such benign market conditions is not expected in the near term. There is no way to test empirically whether this change of market conditions is likely to mean that the historically measured beta for regulated utility firms will overstate or understate the expected future beta, although qualitative arguments could be advanced. However, we remain of the view that the change in market conditions – and the likelihood of future changes to market conditions – adds another layer of imprecision to the current estimates.

#### Conclusion

A key difference between the AER's analysis and our work is the question that the AER needs to answer when determining whether there is 'persuasive evidence' for a change from the previous value. Our assumption was that this was a high threshold and would effectively require the previous value to be found to be wrong.<sup>45</sup> For this reason, we focussed on statistical techniques for assessing whether the current evidence could demonstrate error in a previous estimate, for which measures of statistical reliability (of which confidence intervals are an outworking) become a central concern. The AER, in contrast, decided that there would be persuasive evidence if an examination of the current evidence would lead it to a different conclusion to the previously adopted value.

Which of these views is correct is a legal matter, which is beyond our area of expertise. However, on the technical issue of the AER's consideration of confidence intervals, we make the following observations.

First, the AER's suggestion that it will look at both the upper and lower end of confidence intervals seems to display a lack of understanding of the relevance of confidence intervals (or, more specifically, measures of statistical reliability) for the AER's purposes. The confidence interval (in broad terms) shows the limit that the true value reasonably could have in either direction given the data that is being analysed. As virtually all of the point estimates of beta are below 1,<sup>46</sup> the question is whether the data nonetheless could be consistent with the true value being 1. Only the upper end of the confidence interval is relevant to this question.<sup>47</sup>

Secondly, the AER's assertions that we have argued that low levels of market volatility have caused greater uncertainty in beta estimation or a downward bias in beta estimates is a misrepresentation of the argument that we presented. We did not argue that beta estimates were downward biased and we did not assert that low market volatility of itself meant that betas were more uncertain than their standard errors suggest.<sup>48</sup> Rather, what we argued was that the measured beta over a period will reflect the macroeconomic events that took place during the measurement period. Whether betas measured in one period will reflect the expected beta will depend upon how representative the events in the measurement period were of the future. We then argued that it is unlikely that a particular measurement period will experience macroeconomic events that are in line with what was expected, which we argued creates another source of uncertainty (imprecision) in beta estimates that is not reflected in the standard errors that are estimated for the beta.

<sup>°</sup> Periods of low market volatility are likely to raise the standard error of beta estimates – but this would be reflected in the measured standard error.

The first paragraph of our Executive Summary noted that our 'blank sheet of paper' estimate of beta was between 0.70 and 0.90.

Two of our beta estimates for US energy network firms were at or above 1. However, as noted above, our stated upper limit to our range nonetheless was 0.90.

<sup>&</sup>lt;sup>4</sup> In contrast, if the majority of the current point estimates for betas were above 1, then the lower end of the confidence limits would have been 'in play'.

The AER's conclusion that there is no instability in the beta estimates is not consistent with the evidence (4 of the 9 beta estimates are significantly unstable), does not provide much comfort (the imprecision of beta estimate makes it hard to discern instability from estimation error) and also does not address fully the proposition above (stability in the measurement period does not mean that the measured beta will coincide with the expected beta if market conditions are expected to be different).

#### 2.3 Empirical estimates of betas

#### **AER** position

The AER concluded that the empirical evidence on equity betas suggests that the range is between 0.44 and 0.68.

The <u>lower end</u> of the range was set at the AER's estimate of the equity beta for a portfolio of firms over the period 1 January 2002 and 1 September 2008. The portfolio of firms comprised the set of firms that the AER had selected as being sufficiently comparable entities, less GasNet and Alinta. The reason for rejecting the two firms appeared to reflect Associate Professor Henry's view that the estimates for GasNet and Alinta were affected by takeover speculation.<sup>49</sup>

The <u>upper end</u> of the range appeared to be set at our estimate of the equity beta for a portfolio of US energy network firms (i.e., electricity and gas) over the period between 1990 and May 2008 (excluding 1998 to 2001). The AER asserted that this US beta estimate is likely to overstate the beta for an Australian electricity firm because:

- our sample included firms that have gas activities; and
- the sensitivities that we undertook suggest that the US betas should be revised down for Australia.

The AER rejected placing any reliance on the beta estimates that we reported for the longest period on the basis that those estimates placed an excessive weight on AGL.

In assessing the evidence, the AER reached conclusions on a number of methodological issues, including that it would place most weight on betas estimated using weekly observations.

Henry, Op. Cit., p.14. Henry noted that an alternative would be to reduce the sample size, but asserted that the period to be removed is 'entirely arbitrary', albeit concluding that Alinta was affected by speculation 'as 'from at least January 2007' and GasNet was affected by speculation 'as early as June 2006' (Henry, Op. Cit., p.14).

#### Comment on the AER's conclusion

In our view, the AER's range for the equity beta understates the range that should be derived from a proper consideration of the empirical evidence considered by the AER, including the material that we presented in our earlier report. The lower end of the range is set with reference to the AER's best estimate of the beta for the Australian listed firms, but in our view the AER has adopted an extreme interpretation of this evidence. The upper end of the range is set with reference to estimates of betas for US firms, but again the AER has been selective in interpreting this evidence, as well as inconsistent with its own earlier conclusions. These matters are discussed in turn.

#### Interpretation of the evidence from Australian firms

As noted above, the lower end of the AER's range (0.44) is determined by its 'portfolio' OLS beta estimate for the period after the end of 2001, the cut-off reflecting the agreed end of the technology bubble. However, it is difficult to reconcile the portfolio beta that the AER has considered with the simple average of the beta estimates that the AER reported, which were 0.58 if all of the set of comparable entities that the AER identified (which, coincidentally, mirrored ours) are included and 0.56 if Alinta and GasNet are excluded as suggested by Associate Professor Henry (this matter is discussed below).<sup>50</sup> We also note that Henry's beta estimates using monthly observations (re-levered using Henry's leverage assumptions) for the set of firms excluding Alinta and GasNet was 0.55,<sup>51</sup> which is surprisingly close to the results obtained using the weekly observations. Lastly, if Alinta and GasNet are included in the sample but firms with less than approximately 5 years of trading history are ignored, then the simple average of the OLS betas becomes 0.59.

It follows that the AER's own results using the OLS method and observing the individual beta observations rather than portfolios support a beta from the Australian evidence of approximately 0.60.

Regarding the evidence that we presented, the AER has rejected the beta estimates that we employed, arguing that:  $s^{2}$ 

- the portfolio beta estimates calculated over the longest period gave AGL a disproportionate weight; and
- the beta estimates calculated over the last 5 years should have been calculated over the period since the end of the technology bubble.

<sup>&</sup>lt;sup>50</sup> The average of Professor Henry's beta estimates (re-levered using Henry's leverage assumptions) for the set of firms excluding Alinta and GasNet was 0.55 (calculated from Henry, Op. Cit., pp.14, 18). Surprisingly, Henry did not report beta estimates for Alinta and GasNet using monthly observations.

Calculated from Henry, Op. Cit., pp.14, 18. Henry did not report beta estimates for Alinta and GasNet using monthly observations.

The AER also asserted or implied that, by drawing attention to <u>both</u> of these sources of information, we were being inconsistent with our earlier advice to the Victorian ESC (ACG, 2007, Op. Cit.). We reject both of these allegations – this matter was addressed in section 1.

First, we remain of the view that the estimates of beta for the Australian firms over the longest period are a valid piece of information that the AER should take into account. We agree with the AER that the long term estimate applies a high weight to AGL (as well as to Envestra), which we acknowledge is an undesirable aspect of these estimates.<sup>53</sup> However, our long term portfolio beta estimates have the desirable property of taking account of a greater diversity of macroeconomic conditions, including those that applied prior to the technology bubble. In this regard, we note that:

- *portfolio beta estimates* apply an equal weight to each time period during the measurement period, using the best representation of firms available at any given point in time (a consequence of which, however, is that individual firms receive a different weight); whereas
- *simple averages of beta estimates* apply the same weight to each firm within the sample, but in doing so apply a different weight to the different time periods within the measurement period if an unequal number of observations is available.

Thus, our long term portfolio beta estimates can be said to apply an equal weight to each time interval over the period between 1990 and 2008 (excluding June 1998 to December 2001), using the best representation of firms available at each point in time during this period. As discussed in Section 1, we advised the Victorian ESC to take account of both our long term portfolio beta estimates as well as alongside beta estimates that reflect a more representative cross-section of firms, and remain of the view that this is appropriate. These long term estimates implied a range for the point estimate of between 0.70 and 0.90 depending on the estimation method and portfolio applied, which are not changed if the latest available data is incorporated (see below).

We note that if the AER wants to have regard to the longest period of observations that are available (i.e., to maximise the use of information), but to apply the same weight to all firms, then the solution is to focus on the simple average of the beta estimates. By averaging the individual beta estimates that are calculated over the longest period the maximum use is made of the information available (even though the difference in the number of observations available for each firm means that the simple average of equity betas applies most weight to the period since the 'technology bubble').

Table 2.1 repeats our beta estimates using the longest period available for each of the firms in our sample, and Table 2.2 shows the equivalent estimates updated to use data to the end of November 2008.<sup>54</sup>

<sup>&</sup>lt;sup>53</sup> Having said that, the AER's concerns about the relevance of AGL appear overstated. While AGL had retail interests prior to 1998, this period predated the introduction of 'full retail contestability', and hence its retail activities were largely regulated.

This was the latest time at which it was practicable for us to update the data given the absence of our econometrician for the Christmas period and much of January. We also remedied several omissions in the previous data set, which extended the number of observations used for AGL, Envestra, SPI and DUET. Previously, observations were only included after the first balance sheet debt level was available – we have now assumed that the first available debt level is approximately the firm's level of debt from the start of trading. We note that small errors in the assumed level of debt for the first few months of trading would be very unlikely to have a discernable impact on the re-levered betas.

Та	ble	2.1	1

AUSTRALIAN ENERGY RELATED SECURITIES: FULL MONTHLY BETA ESTIMATES (1990-1998 AND 2002-2008) – ORIGINAL ESTIMATES

Stock	Ν	OLS	Re-OLS	LAV
AAN	68	0.81	0.90	0.95
AGL	155	0.84	0.67	0.84
APA	77	0.68	0.70	0.81
GAS	59	0.38	0.31	0.34
ENV	78	0.36	0.33	0.04
DUE	36	0.38	0.30	0.38
HDF	41	0.54	0.64	0.80
SPN	27	0.25	0.23	0.06
SKI	29	0.57	0.56	0.59
Average portfolic	D	0.72	0.65	0.80
Median portfolio		0.72	0.65	0.87
Simple Average:	All	0.54	0.52	0.53
Simple Average:	> 3+	0.57	0.55	0.59
Simple Average:	> ~ 5+	0.62	0.58	0.60

#### Table 2.2

# AUSTRALIAN ENERGY RELATED SECURITIES: FULL MONTHLY BETA ESTIMATES (1990-1998 AND 2002-2008) – UPDATED ESTIMATES

Stock	Ν	OLS	Re-OLS	LAV
AAN	68	0.83	0.91	0.94
AGL	158	0.89	0.74	1.15
APA	83	0.71	0.77	0.81
GAS	59	0.38	0.31	0.34
ENV	93	0.32	0.34	0.23
DUE	51	0.50	0.46	0.39
HDF	47	0.58	0.48	0.67
SPN	35	0.17	0.14	0.06
SKI	35	0.47	0.37	0.61
Average portfoli	0	0.75	0.71	0.82
Median portfolio		0.73	0.69	0.91
Simple Average:	All	0.54	0.50	0.58
Simple Average:	~ > 4+	0.60	0.57	0.65
Simple Average:	~ > 5+	0.63	0.61	0.69

We note that the estimates in Table 2.2 use the additional data that has become available since our previous report and hence are the more reliable estimates.

We have identified in these tables the simple averages that would be obtained by including all firms in the sample, and have also presented the simple averages for the firms with the longer trading history, reflecting the greater reliability in the latter estimates. In our advice to the Victorian ESC, we explicitly reported the average for the longest-dated five firms, which corresponded to the firms with approximately 5 years or more trading history.<sup>55</sup> Accordingly, a consideration of the bottom row of estimates in the tables above would be most consistent with the advice that we provided to the Victorian ESC.<sup>56</sup>

Thus, our estimates demonstrate that, if attention is placed on the Australian data using information over the longest available period, while also placing equal weight on each of the firms, an equity beta of between 0.50 and 0.60 is indicated. Consistent with our earlier advice to the ESC, we would argue that less weight should be placed upon firms that have only a limited trading history, which in turn would suggest that 0.60 is the better estimate of beta from Australian data.

We note that the simple average of the updated LAV estimates provides a beta for the longer trading firms of approximately 0.70, using the most recent evidence; however, we would not recommend placing substantial weight on this estimate. Our estimates demonstrate that individual LAV estimates can be erratic (this point is discussed below). The pattern of the Re-OLS and LAV estimates suggests that outliers are not a material concern – at least if monthly return data is used – and so conventional OLS estimates should be preferred.

It follows from the discussion above that the lower limit of the AER's range for the equity beta estimate from Australian data – which reflects its portfolio estimate – is not consistent with the simple average of beta estimates from either its work or ours. This lower limit also reflects the exclusion of Alinta and GasNet, which is not consistent with the AER's own discussion. Most significantly, the AER's portfolio estimate (of 0.44) is materially lower than the simple average of the AER's beta estimates of all firms excluding GasNet and Alinta (of 0.56), notwithstanding that this latter estimate uses the same firms over the same period and also uses weekly observations. Lastly, the AER has ignored our long term portfolio beta estimates, which contain valid information, and would indicate a higher range to that are obtained if most or all weight is placed on observations after the technology bubble.

#### Removing Alinta and GasNet from the sample

The AER has decided during the course of its discussion to drop Alinta and GasNet from the set of comparable entities that are included in its portfolio estimates. This decision appeared to be based upon Associate Professor Henry's comments that he considered the returns to these stocks to be affected by takeover speculation.<sup>57</sup> The AER reached its position notwithstanding the AER's earlier statement that:<sup>58</sup>

<sup>&</sup>lt;sup>55</sup> In our report to the Victorian ESC, we reported simple averages for the five longest-trading firms, the shortest of which was GasNet with 59 observations, which is just short of a 5 year trading history.

From these tables, it could also be verified that the simple average using all firms except Alinta and GasNet (as argued for by Henry) was 0.52 in both cases using OLS and 0.50 (original) and 0.56 (updated) using the LAV method.

Henry, Op. Cit., p.14.

AER, Op. Cit., p.196.

The AER agrees with the JIA that Australian comparator businesses suffer from a number of problems. However, the AER notes that these problems are not unique to equity beta estimates and that any WACC parameter which is estimated using businesses from an industry sample is likely to be affected by such activities. The AER considers that these limitations need to be recognised and accounted for when analysing any estimate that uses data taken for industry samples. The AER has attempted to address this *by excluding observations that are likely to be influenced by mergers and acquisition activities*, and selecting businesses which predominantly operate as a regulated network business. Unlike the benchmark efficient level of gearing and the credit rating, the equity beta can only be estimated using data taken from stock prices (and not from government owned or unlisted businesses).

If the AER had sufficient concern about the potential for takeover speculation to affect the beta estimates of GasNet and Alinta, the appropriate course of action would have been to remove the period of observations that were considered to be affected and to justify the period of exclusion. The fact that Australian only has a small number of listed comparable entities with a reasonable trading history means that all effort should be made to maximise the use of the information that is available. Indeed, Henry set out the periods during which he considered GasNet and Alinta to be affected by takeover speculation but then decided not to follow his own advice on the basis that:<sup>59</sup>

... any choice of the reduced sample period is entirely arbitrary

Henry's view that the choice of which observations to remove is *entirely arbitrary* clearly is a matter of speech, least of which because Henry defined the periods during which he considered trading was affected by speculation, which presumably was not just a random series of dates. For share prices to be materially affected by the potential for a takeover, then the potential for the takeover needs to be public and sufficiently credible for investors to factor it into their firm valuations, which provides a basis for defining a period of observations to exclude. In our view, it would be preferable to exclude the affected observations for Alinta and GasNet than removing the companies from the sample altogether.

In our previous report, we were aware of the merger and acquisition activity for the firms in question, but opted to include all of the observations in order to apply the same approach as we did in our earlier report for the Victorian ESC. However, we have now recalculated the betas for the firms that either were taken over or involved in a substantial merger during the period of observation with the period during which their returns were likely to be most affected by that speculation being removed. These results are set out in Table 2.3. The periods of observations that have been removed and the basis for this are as follows:

- AGL February to October 2006 was removed. During this period there were merger negotiations with Alinta.<sup>60</sup>
- *Alinta* February to October 2006 and January to October 2007. During the first period there were merger negotiations with AGL.<sup>61</sup> During the second period there was takeover speculation.<sup>62</sup>

<sup>&</sup>lt;sup>59</sup> Henry, Op. Cit., p.14.

This is the time period that was nominated in NERA (2007), p,28.  $^{61}$ 

This is the time period that was nominated in NERA (2007), p,28.

<sup>&</sup>lt;sup>2</sup> This is the time period that was nominated by Henry (2008), p.28. Henry noted that Alinta de-listed in October 2007. In fact, the scheme of arrangement was implemented on 31 August 2007 and the firm de-listed on 7 September 2007.

Table 2.3

• *GasNet* – June to November 2006. During this period there was takeover speculation.<sup>63</sup>

#### AUSTRALIAN ENERGY RELATED SECURITIES: FULL MONTHLY BETA ESTIMATES (1990-1998 AND 2002-2008) - UPDATED ESTIMATES, TAKEOVER AND MERGER PERIODS REMOVED Stock Ν OLS **N**\* OLS\* AAN 51 0.71 68 0.83 ۵GI 0 97 158 0 80 1/0

Simple Average	: ~ > 5+	0.63		<b>0.67</b> <sup>64</sup>
Simple Average	: ~ > 4+	0.60		0.60
Simple Average	: All	0.54		0.54
SKI	35	0.47	35	0.47
SPN	35	0.17	35	0.17
HDF	47	0.58	47	0.58
DUE	51	0.50	51	0.50
ENV	93	0.32	93	0.32
GAS	59	0.38	53	0.39
APA	83	0.71	83	0.71
AGL	150	0.09	145	0.97

Note: N and OLS refer to the original sample size and OLS beta estimate while N\* and OLS\* refer to the sample size and OLS beta estimate with the merger and takeover affected periods removed.

The results set out above show that the removal of the observations during the time periods that others have nominated as being characterised by merger or takeover speculation has very little effect on the average beta estimates, with the reduction in Alinta's beta being offset by the increase in the beta estimate for AGL and the slight increase in the beta estimate for GasNet. Thus, allowing for the effect of merger and takeover speculation provides no basis for a change to the conclusions set out above.

#### Interpretation of US evidence

The AER's upper bound has been set at our estimate of the portfolio beta for US firms over the period between 1990 and 2008 (excluding the technology bubble). The AER has then argued that these estimates provide a conservative view estimate of the beta that would apply for an Australian electricity network business, given that:

- our sample included gas network businesses as well as electricity network businesses; and
- the AER considered that the beta for a US firm would need to be revised down to be applied in Australia.

This is the time period that was nominated by Henry (2008), p.28.

<sup>&</sup>lt;sup>34</sup> This average includes only AGL, APA and Envestra as there are now less than approximately 5 years of observations for Alinta and GasNet. The average of the firms that have approximately 5 years or more of trading history – even if they have fewer observations – is 0.62.

First, the AER has focussed solely on our estimate of the portfolio beta for our set of US firms, and has ignored the simple average of the betas, which gives an estimate of 0.73 for the OLS estimate. The simple average is a relevant piece of information.

Secondly, the AER's use of our set of comparable entities is inconsistent with its earlier decision to have regard only to electricity network businesses. Contrary to the AER's assertion, including the gas businesses reduces the measured beta, and so the electricity-only sample would imply a higher beta – the simple average referred to above rises to 0.77 for the sample the AER identified as appropriate.

The AER also concluded that the factors that could lead to differences between US and Australian betas that can be quantified mean that the beta for the same activity in Australia is likely to be lower than in the US.

In our view, there is no basis for the AER to reach this conclusion. We note that the AER appears to have relied mostly upon our analysis to reach this conclusion, but also asserted that debt betas could differ between Australia and the US.

There are three factors for which a formula may be derived to adjust the beta estimated for a US firm to make it applicable for Australia, which are:

- the difference in the average gearing level in the respective markets, which we note is an adjustment that is typically applied by Associate Professor Martin Lally in his advice to regulators;
- the differences in the imputation-adjusted rate of company taxation between the respective markets; and
- the AER has argued that differences may also exist in the level of the debt beta between the US and Australia (presumably with a higher debt beta in Australia).

The effects of each of these factors considered separately on the adjustment that is required to the beta of a US firm to make it applicable to Australia are as follows:

- Average gearing level across the respective markets the difference in the average gearing level across the Australian and US markets would imply an increase in the US beta by 10 per cent to make it applicable to Australia;
- *Company tax rates* the difference in the company tax rates would imply an increase in the US beta by 9 per cent to make it applicable to Australia;<sup>65</sup> and
- *Debt betas* if a non-zero debt beta was assumed and the debt beta was assumed to be higher in Australia than in the US, then the re-levered equity in Australia would be lower than otherwise, depending on the differential assumed between US and Australian debt betas:
  - if the debt beta is assumed to be 0.10 in Australia but zero in the US,<sup>66</sup> then the US beta would be 15 per cent lower.

<sup>&</sup>lt;sup>65</sup> Including a tax term in the levering equation will reduce the re-levered betas for Australian firms, however.

<sup>&</sup>lt;sup>o</sup> The AER has not identified the differential in debt betas that it would expect to see between Australia and the US. However, the AER has stated that 'the preferred approach of the AER and ACCC to de-levering and re-levering is to use the Monkhouse formula, with an assumed debt beta of zero' (AER, Op. Cit., p.201). If the AER's preferred debt beta for Australia is zero, then it is difficult to see how the debt beta for US firms could be lower than this.

However, these factors are not additive, but interact strongly. If an allowance is made for different company tax rates together with differences in market-average gearing levels, then the adjustment implied by the latter falls and can reverse. Intuition also suggests that if an allowance is made for different debt betas, then the required adjustment for differences in market-average gearing levels would increase.<sup>67</sup>

In our advice to regulators – including in our reports to the ESC in 2007 and the ACCC in 2002 – we did not adjust for any of these factors, but rather applied the estimated betas from the US directly. This reflects our continuing view that the net effect of the factors discussed above is indeterminate, and largely a product of the assumptions adopted by the analyst. We have never presented adjustments that assume different betas between the US firms and those in Australia as the AER, and would find it hard to justify such an assumption. For the debt betas to vary materially, the gearing levels between the US and the regulatory benchmark assumption would need to be very different. As the average for the US firms in our sample was 44 per cent over the last five years and 46 per cent over the whole period, it is unlikely that the debt betas would vary materially as suggested by the AER.

The last of the sensitivity tests on the application of US betas in Australia that we reported were our US beta estimates calculated against the US share market index that had been re-weighted to resemble the weights of the various industry sectors in Australia. The process that we applied followed an earlier application of this approach by the Brattle Group for the Dampier to Bunbury pipeline. Our findings were that the US betas were lower when measured against the re-weighted index, which was the opposite result to what the Brattle Group obtained. We cautioned, however, that these estimates are subject to substantial imprecision, as we did in our report to the ACCC in 2002. Our comments to the ACCC included the following.<sup>68</sup>

The Brattle Group's concern with the use of the US market as the relevant market portfolio was that the difference in the weights of the various market sectors between the US and Australia may imply that a project in the US would have a different beta to an identical project in Australia.

This concern follows simply from the fact that a project's beta reflects the covariance of its returns with those of the market overall. Accordingly, if an entity is part of a sector that has a large representation on the stock exchange, then its returns would have  $_{107}$ higher covariance – and hence beta – than would be the case if its sector had a lower weight. More broadly, if an entity responds to macro-economic shocks in a similar manner to firms that have a large representation on the stock exchange, then that firm would be expected to have a higher equity beta than if those similar firms had a lower weight. Accordingly, the Brattle Group's adjustment of the US market to resemble Australia is considered a valid attempt to correct for the impact of market weights.

That said, it is impossible to know the accuracy of the adjustment for the difference in market weights. The sectors that the Brattle Group had regard to were broad industry groupings, and the composition of the industry groupings may vary substantially between Australia and the US. Accordingly, the adjustment for the change in market weights can only be considered an approximation. ...

The standard formula for adjusting for the effect of market gearing between two countries was set out in: Lally, M., 1998, 'Correcting betas for changes in firm and market leverage', *Pacific Accounting Review* 10(2): 99. Lally's formula assumed that company debt is riskless.

In addition, the impact of weights of the various market sectors is only one of the factors that may cause the beta for the same project to vary depending upon the country in which it is situated. Another factor is the sensitivity of asset prices in any market to macroeconomic shocks within that particular market, which will depend upon a number of matters, such as institutional factors and government policies. Accordingly, it is considered that these estimates should remain a secondary source of information, with primary regard to be had to evidence from the Australian market.

While we presented our results, the caveats above about the results remain.

Accordingly, given that the various adjustments that could be contemplated to US betas to make them appropriate for Australia change the beta in different directions and that the precision of an adjustments for differences in market weights in imprecise, it is our view that the AER does not have a basis concluding that US betas need to be adjusted downwards to be used in Australia and that unadjusted US betas are therefore 'conservative'. As noted above, in our previous advice to regulators, we have applied the estimated betas from the US directly, reflecting our continuing view that the net effect of the factors discussed above is indeterminate, and largely a product of the assumptions adopted by the analyst. Accordingly, the conclusion reached here is consistent with our earlier advice.

#### Conclusion

In our view, the AER's own results and a proper interpretation of ours justify a central estimate of the equity beta of between 0.60 and 0.90, when betas are rounded in a manner consistent with their precision.

We note that the Victorian ESC interpreted the data from our report to them in 2007 as giving rise to a range for the re-levered equity beta of 0.50 to 0.80. Given that the estimates of beta in our current report are all higher than those presented in our 2007 report to the ESC – by an amount that exceeds 0.10 – this conclusion is consistent with a proper consideration of that earlier advice.

We note, however, that this conclusion relates only to the question of the beta that would be arrived at if the AER were to start with a 'blank sheet of paper' and consider only empirical evidence on betas. As discussed above, the AER is not commencing with a 'blank sheet of paper', but rather the AER is required to demonstrate that there is 'persuasive evidence' before adopting a value for the equity beta that is different to the previously adopted value. In our view, the strength of the empirical evidence that is available cannot demonstrate that the true value may not lie materially above (or below) the range of the central estimates presented above. We remain of the view expressed in our previous report that, if the full imprecision of the current beta estimates is taken into account, there is not persuasive evidence for concluding that the equity beta for a benchmark electricity transmission or distribution entity is different to the previously adopted value of 1.