the australian PIPELINE industry association Ltd


# Capturing the Risk?

Submission to the AER's Equity Beta Issues Paper from the Australian Pipeline Industry Association

28/10/2013

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# Executive Summary

This submission provides APIA's response to the AER's recent beta paper. Our main concern is that the range chosen by the AER (0.4 to 0.7) significantly under-represents the actual range of values for beta in the dataset it has chosen. The AER has not made it clear what robust, transparent methodologies it has used to choose its preferred range, but what is clear is that the Australian studies which appear to have formed the primary source of information understate the true variability in beta, because (for the most part) they only use weekly/monthly return series measured to a single day of the week/ month to estimate beta. In principle, this should not matter; systematic risk is not different on a Thursday compared to a Tuesday. However, in the context of the small dataset of Australian energy utilities used by the AER as its primary data-source it does matter, as shown in Figure ES1.

**Figure ES1: Australian OLS beta estimates with different sampling intervals**

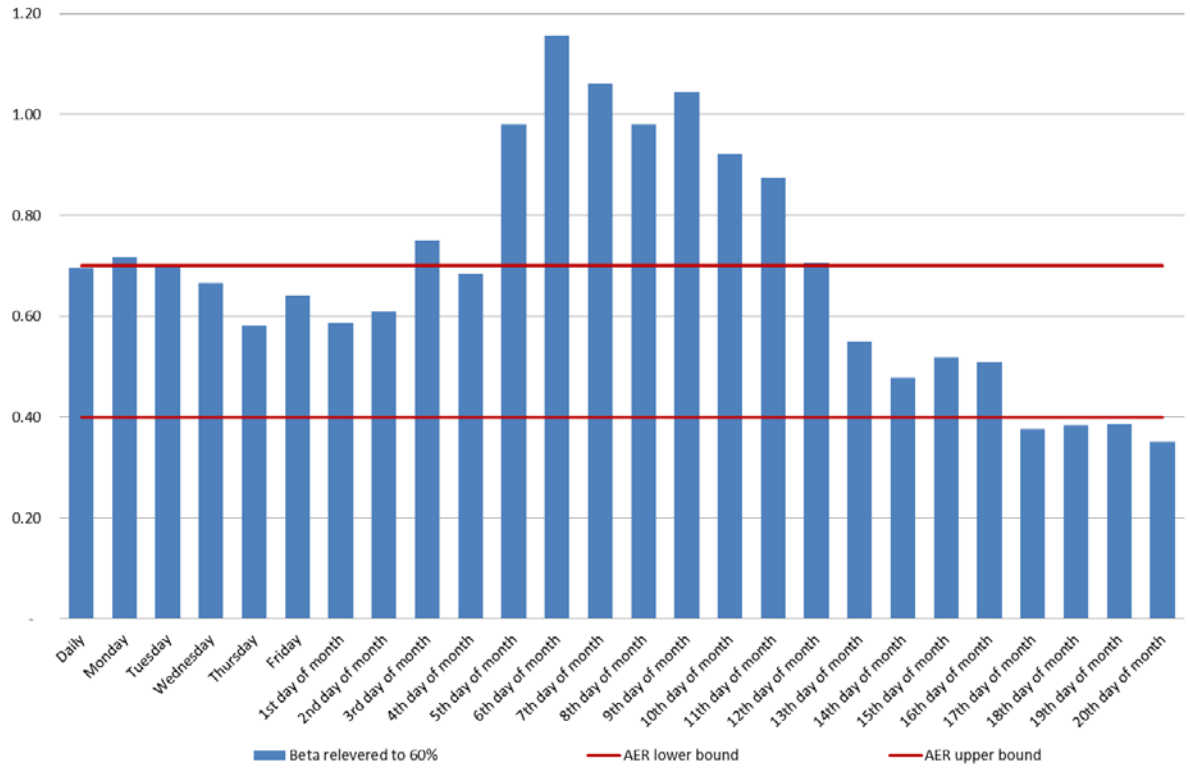



Figure ES1 is based upon Portfolio 3 (see Table 6.1) in the AER's beta paper, but similar results obtain for other portfolios. In Figure ES1, the average beta for firms in Portfolio 3 is above the top end of the AER's proposed range in fully 10 of the 26 sampling periods examined. Moreover, four estimates sit below the bottom end of that range such that more estimates are outside the AER range than within it – although more estimates are above than below. Based on this sample of firms and time period, a better estimate of the uncertainty in the range for the true beta is given by the 97.5$^{th}$ and 2.5$^{th}$ percentiles from the above observations. This results in a range for beta of 0.37 to 1.1, although we note that this may understate the true range, because we have not varied other implicit assumptions such as the time period over which the analysis has occurred (such as the firms in the sample and the time period under analysis).

This wider range has profound consequences for the AER's proposed foundation model approach, because it means that the models proposed for use in the AER's stages four to six (after the initial range has been developed) will play a much larger role than appears to have been envisaged; they will not be "fine-tuning" an initial result. As we suggest in our submission to the AER's *Draft Guidelines* process, we do not believe that the models it has chosen for stages four to six of the foundation model are sufficiently robust and precise for this task. This means that, regardless of it preferences for particular approaches and data-sources, we believe the AER will soon find itself forced by the lack of robustness in its beta estimates to do one (or both) of two things when it applies its foundation model:

- Use data from overseas and/or from different sectors of the Australian economy.
- Use a wider suite of models that are not subject to this beta problem.

Given this, we consider it important that robust ways of making use of both need to be considered in advance, and we provide an indication of our considerations in this respect in our submission to the *Draft Guidelines*, as well as in this submission.

# 1. Introduction

This is a submission by the Australian Pipeline Industry Association (APIA) responding to the Australian Energy Regulator's (AER's) recent *Equity Beta Issues paper* (the "beta paper"), which is being used to inform the creation of rate of Return Guidelines. It complements APIA's submission to the AER's *Draft Rate of Return Guidelines* (DG) and its accompanying *Explanatory* Statement (ES) and, where appropriate, we make reference to arguments described in more detail in that submission.

There are a number of issues with the AER's beta paper, which we cover in the various chapters of this submission. However, there are two over-arching issues, which we believe to be of significant importance. Firstly, we appreciate that the AER had commissioned work from a consultant to update earlier estimates of beta, and that the original intent was for that consultant to provide a paper on beta as part of the draft Guidelines process. We appreciate further that, through no fault of either the AER or the consultant involved, this has not been able to occur. We appreciate finally that the AER has therefore chosen (which it did not need to do) to release its own considerations on beta using extant information, and that doing so meant the beta paper was written to a tight timeframe.

However, we are concerned at the limited evidentiary basis which underpins many of decisions made by the AER. For example, Australia and the US are deemed to be very different from one another, but the analytical process and reasoning that lead the AER to this conclusion has not been provided. At the same time, the AER has frequently dismissed evidence from stakeholders as being "not-convincing" without providing its reasons and rationale for this finding. Finally, the very range for beta which is the core output of the paper has not been transparently derived.

We would point the AER to its own statements in the ES (p201), supporting the use of regulatory determinations as information sources because, under the requirements of administrative law, regulators are required to be "well-reasoned, transparent and publicly-available". We believe it is crucial that the AER hold itself to these high standards in each of its publications, regardless of tight timeframes.

A second over-arching issue is the continued use of the AER's criteria, rather than the Allowed Rate of Return Objective (ARORO), as the criteria to be applied for making decisions. We see no evidence that the AER has considered the ramifications of its choices for data, or indeed the range it suggests for beta itself, against the ARORO to ascertain whether it produces suitable results. As we discuss in our response, this has caused a number of problems in the conclusions about the appropriateness of the beta estimates that the AER has made.

These over-arching issues aside, our submission is structured as follows:

- Chapter Two provides an overview of our concerns about the conceptual analysis used by the AER to support its findings of beta. We note that one of the hypotheses it presents in particular (similarity in systematic risk amongst Australian regulated energy firms) is flatly rejected by the empirical evidence the AER itself presents. This ought to have profound implications for the AER's approach, but it simply ignores the contradiction.

- Chapter Three provides an overview of our concerns in regard to the data the AER has chosen to inform beta in the benchmark efficient entity (BEE). We believe that the AER has too quickly dismissed evidence form international energy firms, and too quickly accepted the water sector as a means of checking its estimates for energy, and we present evidence in support of both positions in this chapter. We also explore the issue of the sample period for beta estimates, the stability of beta and the issue of outliers.
- Chapter Four contains the bulk of our submission, and focusses on its key issue; that the AER significantly understates the total amount of variation in estimates of beta, basing its estimate of 0.4 to 0.7 on arbitrary filtering of data which is not even supported by the evidence it does present, let alone the evidence which it ignores. We illustrate our point by making what ought to be an inconsequential change, changing the day of the week and month that returns are estimated, and show that it has profound effects on beta estimates.
- Chapter Five draws some overall conclusions.

## 2. Conceptual Analysis

The AER has undertaken a "conceptual analysis" by which it seeks to provide an underpinning to its empirical findings on beta. We understand this as being representing nothing more than the standard process in empirical work of defining one's prior beliefs about relationships between variables (priors), and within this context, have no issue with the AER stating its priors in this manner. The AER's priors are:

- Systematic risks are similar (ie – not materially different) across all Australian regulated energy firms.
- Energy firms are likely to face less risk than the market as a whole.

The problem we have is what the AER does with these priors. Normal empirical practice would be to examine and test these priors in light of the data, and then make conclusions which one can argue have both a theoretical and empirical basis. In the event that the data and priors conflict, normal empirical practice would be to go back and reconsider priors, or consider problems with the data, or consider problems with both, and attempt to explain what conclusions can be drawn in light of these problems.

In respect of the first of the AER's priors, its own data flatly contradict its conceptual analysis. The (OLS) betas for individual firms range from 0.07 to 0.7 in Table 4.4, from 0.22 to 1.34 in Table 4.5 and 0.05 to 1.2 in Table 4.6.[1] We struggle to understand how such a wide range of results could be consistent with investors viewing these firms as facing similar systematic risks. Despite not finding any support for its hypothesis, the AER does not change its hypothesis, or attempt to explore problems in the data; it simply ignores the result.

This has profound consequences for the AER's whole model. If the relevant energy firms are not similar, it needs to recast much of its DG, which relies upon making one estimate for each of the rate of return parameters. If the data are not robust enough to produce the "right" answers, then the AER ought to question whether it is in fact estimating beta robustly in the first instance, and alter its conclusions about where it gets its data from to inform the estimate of beta and its preferred range of 0.4 to 0.7. The AER has done neither, and this substantially weakens its entire foundation model approach. This is one area where we believe testing final results against the ARORO could have assisted in avoiding errors.

In respect of the second of its priors, the empirical evidence is mixed. The Australian evidence presented by the AER suggests that most (but not all) utilities have low systemic risk. Wider evidence (see below) suggests that the actual values are likely to be higher than the AER has suggested, weakening its conclusions based on a narrow subset of Australian data. US evidence presented by CEG (2013) suggests that betas there are higher, around 0.9. Other evidence cited by the AER suggests the range is between 0.5 and 1.09, although most estimates appear to be around the 0.8 mark.

However, we note the work of CEG in the ENA submission to this beta paper which shows that the AER has made some relatively simple errors, particularly in respect of its interpretation of Damodoran's work, which suggests that US betas are higher than the AER believes. We note further

[1] LAD and other "robust" regression models give smaller ranges, but still exhibit roughly the same effects.

that Lally (2004, 2005, 2008), in advice to the New Zealand Commerce Commission, suggests that betas in New Zealand ought to be higher, as firms there face a price cap, compared to the US rate of return regime. This would seem to carry over to price cap regimes in Australia, and weaken support for the conclusion (beta paper p17-18) that equity betas ought to be substantially lower than one; if this conclusion were true, we would expect to see much more evidence of it in the international data.

At the outset of this chapter, we pointed to the use of priors, and our interpretation of the AER's "conceptual analysis" in this light. As we note in our submission to the DG, we are not convinced that "conceptual analysis" that seeks to do more than establish priors adds much to the regulatory debate. If the AER really wishes to understand the different factors which impact upon risk and return, then it ought to commission an empirical arbitrage pricing (APT) model study, rather than a qualitative, quasi-APT study such as Frontier (2013).

McKenzie and Partington (2013) appear to hold similar views, noting the impossibility of mapping from a list of systematic risks to values (or parts of values) of beta. In our submission to the DG, we also argue that the qualitative debate about what supposed aspects of systematic risks regulated firms are and are not exposed to is an unnecessary distraction in the formulation of the BEE for which it is not required. We would therefore not be supportive of the AER making use of "conceptual analysis" for anything other than forming priors that are then empirically tested.

# 3. Comparator Set

In this chapter, we provide an overview of our conclusions in respect of the AER's "comparator set"; the firms which will form the BEE, and thus whose data will be used as an input for calculating beta and other rate of return (and debt) parameters. We believe that there are two key problems. Firstly, the AER has not made a convincing case for the exclusion of US energy data when formulating the BEE (it accepts such information at a later, checking stage). It has made assertions, but has provided no evidence or reasoning to support these assertions. Secondly, the AER appears far too ready to accept information from other regulators' assessments of beta in the water industry. These data are not particularly robust, and their use introduces a degree of circularity into the regulatory process, which is not appropriate.

The first two sections of this chapter deal with these twin problems. A third and final section makes some suggestions in respect of time periods and the use of outliers.

## 3.1 Australian and US energy utilities

The AER considers the issue of the use of information from overseas from the perspective of a trade-off between relevance and statistical robustness. This is incorrect in our view. The concept of "relevance" is tied to the AER's assertion that all energy firms in Australia face the same similar levels of risk, and a further implicit assumption that any US energy firm would face different levels of risk by virtue of being located outside Australia. We have shown in the previous chapter that, if one puts great store in the accuracy of beta regressions as reflecting actual risk, the beta data provided by the AER itself flatly contradicts its assertion that Australian energy utilities face similar levels of risk. The assertion that all US energy firms are different to all Australian energy firms seems difficult, in the absence of evidence, to accept. Moreover, we cannot reconcile the AER's assertion (beta paper p 33) that the evidence provided by SFG and CEG is insufficient to show that US energy firms are "close comparators" to the BEE with its (implicit) finding that firms in Australia with betas ranging from 0.07 to 1.34 are sufficiently close comparators to each other that there can be a single BEE in the first instance. It appears the AER is being inconsistent in its treatment of Australian and US data. This impression is strengthened by its rejection (beta paper p34) of part of CEG's US dataset on the basis that some firms in it are vertically-integrated, but its acceptance of vertically integrated Australian firms such as Alinta and AGL; which owned generation plant in this time period and was a gas retailer.[2]

The AER approaches the issue of US data first from the perspective of whether Australia and the US are similar, rather than considering whether certain firms in Australia and the US might face similar levels of systematic risk. It asserts that the US has different economic, geographic and market conditions (beta paper p32) and that it is not possible to correctly adjust for the differing environments across countries (beta paper p33). It has provided no evidence of the extent of these differences, nor their impact on beta. Moreover, despite asserting that correction is impossible, the AER provides evidence of two regulators who have done exactly this in energy (The Commission for Economic Regulation – CER - in Ireland and the NZCC) and, moreover, proposes to use beta

[2] We note Frontier's (2010) conclusions, based on evidence from Alexander, Mayer & Weeds (1996) that vertically integrated firms are likely to have lower betas than their component parts, which means that CEG's sample set has potentially under-estimated beta in the US.

estimates in water from Australian regulators (IPART and the QCA) who have likewise used overseas information to formulate their betas.[3] We find this inconsistency difficult to reconcile.

A test of economic/market/geographic similarity between two countries is, to our minds, the wrong place to start. There are hundreds of comparative economic, social, institutional, climate, geographic and other datasets available,[4] and teams of consultants could argue backwards and forwards about which set of indicators best captured similarity or difference for many years without coming to a firm conclusion. The NZCC has avoided the question by assuming sufficient similarity between the US and New Zealand, and moved on to assessing whether firms in the US are sufficiently similar to the firms it regulates (using some relatively simple metrics; see NZCC, 2010). The AER has avoided the question by asserting dissimilarity without proof, and moved on to using only Australian data for the BEE.

Neither approach is entirely satisfactory from a methodological perspective; although the NZCC approach has the practical benefit of robust beta estimates. We consider a different starting point is necessary if the question of "should we make use of foreign data?" is to be answered effectively.[5] Our starting point is to ask whether if an Australian energy firm was transported to the US (or indeed any foreign country; the US simply has the best data) with exactly the same mix of customers and cashflows, could one find other US energy firms around it which have the same, or at least similar levels of systematic risk; in the context of the CAPM?[6]

There are several ways in which one might do this.[7] Perhaps the simplest method is to re-weight the Australian market index to reflect the weights of different industries in the US stock-market, recalculate beta and then, for each reference service being examined, make use of the US energy firms that have similar beta values.[8] This is not the same as transporting an Australian energy firm to the US, but it is a simple way of understanding what the consequences would be for an Australian firm would be, in a modelling sense, if it faced the same composition of industries in the marketplace as its US peers do.

Once the US peers have been chosen for (each) reference service, the issue of how to "translate" those beta values into the Australian context arises. Frontier (2010, p10) note that different stock markets have different weights and the fact that this gives different estimates for beta in an empirical sense, suggesting that "any international comparator should be adjusted to account for the relative diversification of the Australian and foreign stock markets". However, this assertion is

[3] The AER also cites ESCOSA in respect of water. Whilst it is true that ESCOSA considered such overseas evidence, amongst other sources, it ultimately made its determination based on a perceived need for "regulatory stability".

[4] See, for example, http://www.qog.pol.gu.se/.

[5] We note that we would be just as happy for the AER to follow the path of the NZCC, and not bother with this question' we believe that Australia and the US are sufficiently similar to make use of US data in the same way that the NZCC has done.

[6] Note that we are not advocating the use of the CAPM as the only model. More broadly, we would suggest the relevant test ought to be associated with exposure to risk factors, as per our risk and similarity framework outlined in our submission to the DG. We make use of beta here to be consistent with the AER's CAPM-centric framework, and thus to express the approach in a familiar way.

[7] Our submission to the DG presents a more detailed framework for considering risk, which could also be used in this context.

[8] Noting that, if it really were the case that Australian energy firms all faced similar risks, one would obtain the same set of US firms each time.

predicated upon an implicit assumption that a portfolio containing the stocks of the ASX200 in the same weightings as in the ASX 200 represents a mean-variance efficient portfolio (or at least, one with the same Sharpe ratio as in the US) in which all diversifiable risk can be diversified. NERA (2013) presents evidence that it does not. In this instance, a more accurate reflection of the "true" systematic risk faced by the energy industry may in fact be gained by following the example of the NZCC and not adjusting US betas to reflect the weightings of the ASX200.

We have not, in the short time-frame provided for response to the beta paper, sought to develop a worked example of the above process. However, in its submission to the ERA's *Draft Rate of Return Guidelines* process, DBP presented evidence from SFG (2013a) which re-weights the ASX200 to reflect firstly the proportion of industries in the US stock market and secondly to reflect the proportion of industries in the Australian economy as a whole. The findings are illuminating.

The ASX200 is heavily weighted towards minerals (26.2 percent – including oil and gas) and financials (45.3 percent). Reweighting the index to reflect the composition of industries in the US stock market, and then calculating Australian energy firm betas against this re-weighted market index gives results for beta which are very close to estimates for US firms in their home market made by SFG (2013c) as part of the ENA submission to the DG, and also to the betas used by the NZCC. This suggests that, from the perspective of systematic risk, Australian and US energy firms face similar risk levels, and thus suggests that it may not be either difficult, or inappropriate, to find comparators for Australian energy firms in the US. This is essentially the same conclusion that the NZCC came to after a more qualitative consideration of available evidence (see NZCC, 2010).

If overseas comparators are used, the question remains as to whether (and how) their data ought to be adjusted to reflect Australian conditions.

## 3.2 Utility of information from the water sector

The AER has determined that information from regulatory decisions in the water sector can be used (along with information from international energy firms) as a check of the robustness of the range of its estimates of Australian energy betas. Whilst we would argue that the AER is using international energy firm data too little, we would argue that it is using water utility data too much.

The AER supports its use of regulatory decisions in water using a report produced by Frontier (2010) in which it suggested that information from energy utilities could be used to inform the beta of a rural water provider. We would disagree with this assertion, and suggest that a rural water service provider whose demand is influenced largely by the weather faces substantially different systematic risks to an energy producer whose demand is strongly influenced by economic conditions. We note that other consultants, making use of actual data in countries where both energy and water utilities are listed on the stock exchange, have reached different conclusions, finding that water utilities have lower betas than energy utilities in the UK and higher betas in the US (NERA, 2011).

The AER motivates its decision to use water utilities by noting that the confidence interval in a recent SFG (2011) study in the water sector matches its own range for the energy sector; 0.4 to 0.7. In so doing, it ignores two key issues. Firstly, it neglects from its quotation of SFG's work, SFG's conclusion that the range calculated likely underestimated systematic risk in the relevant water provider (which is itself hardly typical of the water sector). Secondly, the AER neglects to mention that its range of

0.4 to 0.7 was not chosen through any kind of transparent, statistically rigorous means, but appears to be (see below) merely a product of regulatory judgement.

More concerning than this weak reasoning is where the beta numbers informing water decisions come from. There are no listed water utilities in Australia and, as the AER notes, some regulators have relied upon previous decisions in energy, and some have relied upon information from overseas water utilities. It is worthwhile having a little more clarity than the AER provides on just where regulators have derived their estimates of beta in the water sector from. We do this in Table 1, which is based on Table A1 in the beta paper.

**Table 1: Sources of regulatory estimates of beta in the water sector.**

| Regulator | Regulated Entity | Date | Beta sources as noted in documents cited by AER | Notes |
|---|---|---|---|---|
| ESC | Greater metro water businesses | June 2013 | "reflects previous decisions and generally accepted regulatory precedent" p103 | Actually derives from 2008 process for regional and rural water services which began with a beta of 0.75 in line with earlier 2005 decision, but during the process, the ESC delivered its findings on gas utilities, which was a beta of 0.7 (ESC, 2008, p85-6) and, in keeping with 2005 decision that water was slightly less risky than gas, beta was revised down to 0.65. 2009 metro process (ESC, 2009) also cited evidence from AER (2009) WACC review. |
| ESC | Regional urban water businesses | June 2013 | Ditto p78 | |
| ESC | Rural water businesses | June 2013 | Ditto p42 | |
| IPART | Hunter Water Corporation | June 2013 | Based upon the SDP decision, p192, but uses a range of 0.6 to 0.8. | 2011 SDP decision caused IPART to bring down its estimate on beta from a range of 0.8 to 1.0, to a range of 0.6 to 0.8. The work was empirical, by SFG (2011), based on 11 US and 5 UK water utilities, and peer-review of that work by Davis (2011). The result was not purely regression-based, but also on maintaining "internal consistency" between the cost of debt and equity. Reports (IPART, 2013a,b, 2012a,b) also cite IPART's own research, but not how it was used. |
| IPART | Gosford City Council and Wyong Shire Council | May 2013 | Ditto (in draft, not final decision), p168 | |
| IPART | Sydney Catchment Authority | June 2012 | Ditto – but more detail on work by SFG and Davis in the SDP Decision, p128 | |
| IPART | Sydney Water Corporation | June 2012 | Ditto, p208 | |
| IPART | Sydney Desalination Plant Pty Ltd (SDP) | December 2011 | Beta of 0.7 based on consideration of SFG and Davis work. | |
| ESCOSA | SA Water | May 2013 | Based on "regulatory precedent" p136 | Advice to Treasurer (ESCOSA, 2012, p32) discusses report by VAA which assesses SFG work for IPART on SDP, but actually uses a table of evidence from Australian regulatory decisions (some energy, some water, p32) and divides the decisions into those with an empirical basis and those focussing on regulatory stability. ESCOSA opts for the latter, to gives a beta of 0.8. |
| ERA | Water Corporation Aqwest & Busselton Water Board | March 2013 | Views that a beta of 0.65 is reasonable, p164. | Non-transparent reasoning as to how beta determined, discussion relates to energy betas, and ERA's 2012 Western power decision in particular. |
| QCA | Seqwater's water supply schemes | April 2013 | Based on the findings of the SunWater report p274-5 | QCA commissioned work by NERA (2011) for the SunWater decision, but did not accept NERA's empirical finding (based on a sample of Australian energy, UK and US energy and water firms), instead relying on ACG (2004), and on Lally (2011) for the 2010-11 SEQ prices review, which used a sample of Australian energy firms, plus water firms from the US and – at a lower weight – UK). |
| QCA | SunWater's water supply schemes | June 2012 | Asset beta of 0.3 chosen to be slightly lower than retail water suppliers (asset beta of 0.35) and water suppliers to industry (asset beta of 0.4). | |
| QCA | Gladstone Area Water Board | June 2010 | Retain 2005 decision level because could perceive no change in systemic risk , p127 | 2005 result based on ACG (2004) which is based on a sample of Australian energy and US and UK water utilities. |

As Table 1 makes clear, the pathway back to the original estimates of beta used by different regulators in the water sector is often twisted, and can stretch back a decade. Sometimes, there is no transparent empirical basis for the beta decisions, as in the case of the ERA and ESCOSA. At other times (the ESC and QCA), regulators appear to have used empirical evidence from a different utility and/or sector, and then arbitrarily adjusted the results downward to reflect what the regulator believes is a difference in the systematic risk profile of the entity being regulated in that particular decision. In the cases where the regulator in question has made use of empirical evidence, it is, in all cases but one, a mix of domestic energy firms and international water firms that is used, and no indication is given as to exactly how, in a statistical sense, each piece of information is used to form the final estimate. For these reasons, we do not consider that these reports would meet the AER's criteria of results being supported by robust and transparent analysis.

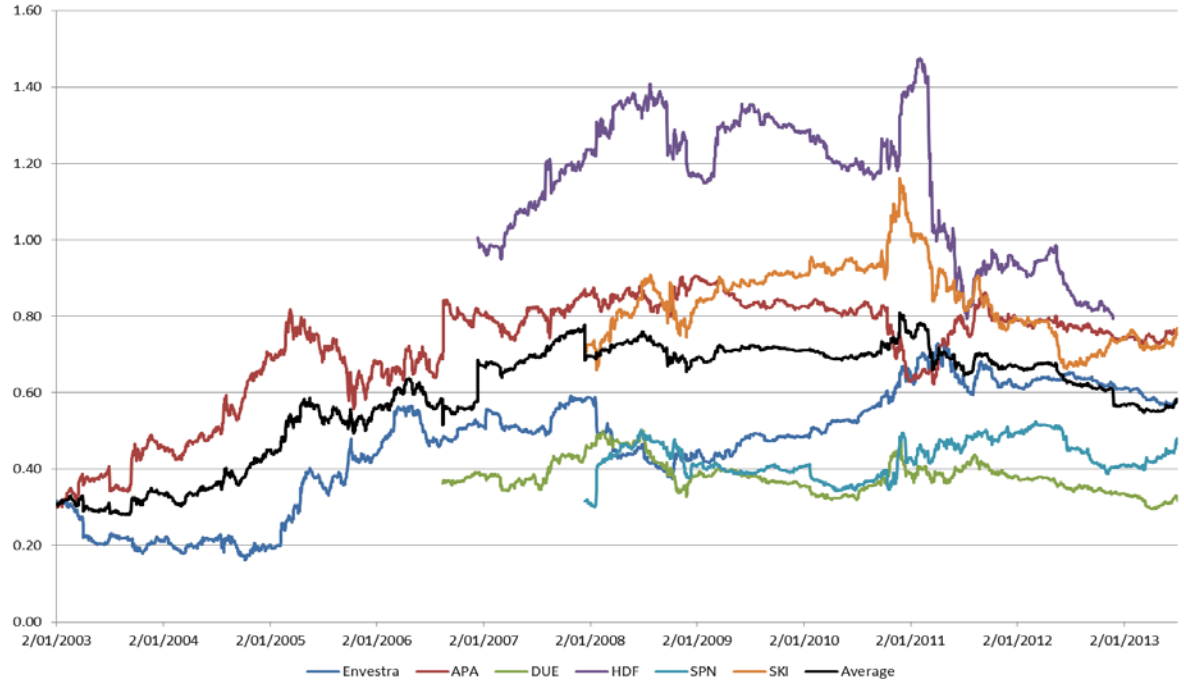
The fact that many of the beta decisions shown in Table 1 contain information from previous energy decisions raises a further issue. Apart from the issue of circularity (energy decisions influence water decisions, which the influence energy decisions again), we note that the AER proposes (ES p201) to make use of former regulatory decisions to inform where in the range it ought to move in stages four to six of its foundation model approach. We note also that it has criticised the ENA (ES p70) concerning its multiple model approach on the basis that the AER believes (incorrectly) that information would be used more than once. However, if information from previous energy decisions is being used to determine beta in stage three of the AER's foundation model approach, and is then being used in stages four to six to inform how the AER ought to move from its initial point estimate, then it appears the same issue of multiple use of the same information will arise.

## 3.3 Consideration of time periods and outliers

In respect of time periods, we do not have a particular issue with the AER's suggestion that it will use at least five years' worth of data, but we do have two concerns. The first is the AER's assertion that beta is stable through time, which appears to be based (beta paper p 41) on its observation that beta results are roughly the same in 2008 and 2013. This does not represent evidence of stability through time. In its submission to the ERA's *Draft Rate of Return Guidelines* process, DBP presented evidence from CEG (2013) which shows several structural breaks in the series from 2002. We have commissioned more work from CEG on this topic, and present the results below.

The results clearly show that the betas are neither stable through time for a given company, and nor are they similar at any point in time across the companies; in fact, even the relative position of each company vis-à-vis the others changes over time. This can be seen in a plot of daily betas based on two-years of data, shown in Figure 1.

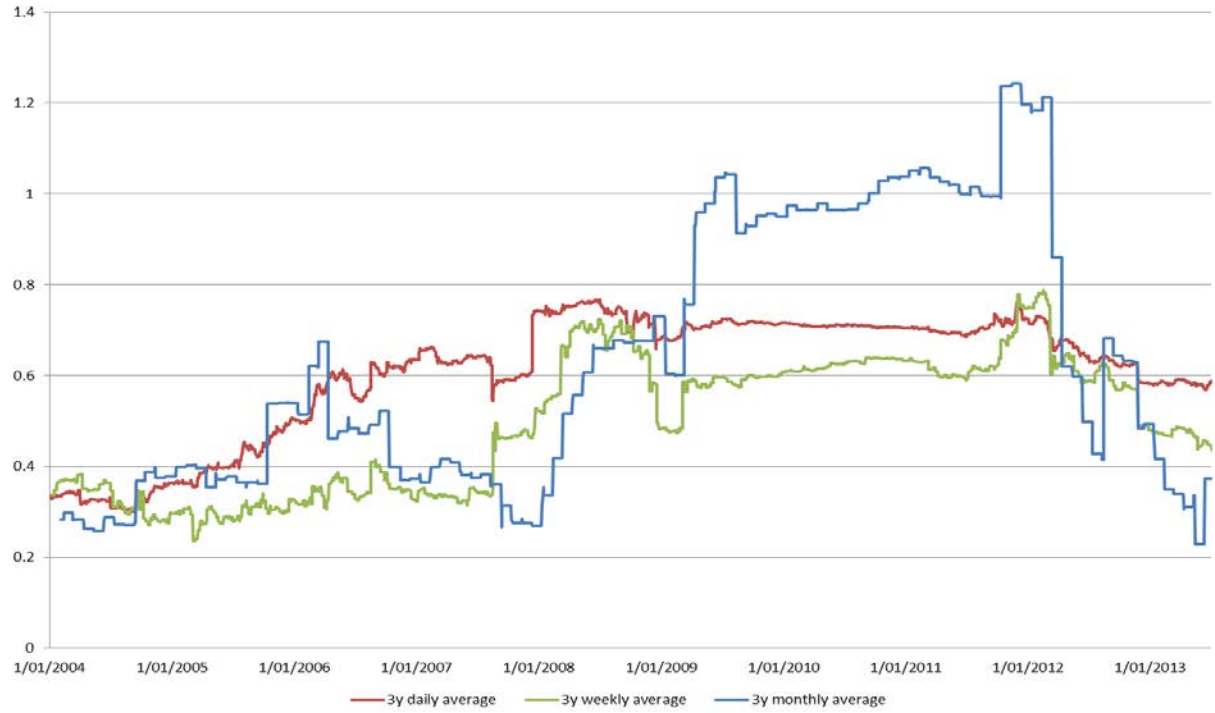
**Figure 1: Rolling two-year daily betas**




Source, Bloomberg, CEG analysis. * Relevered to 60% gearing.

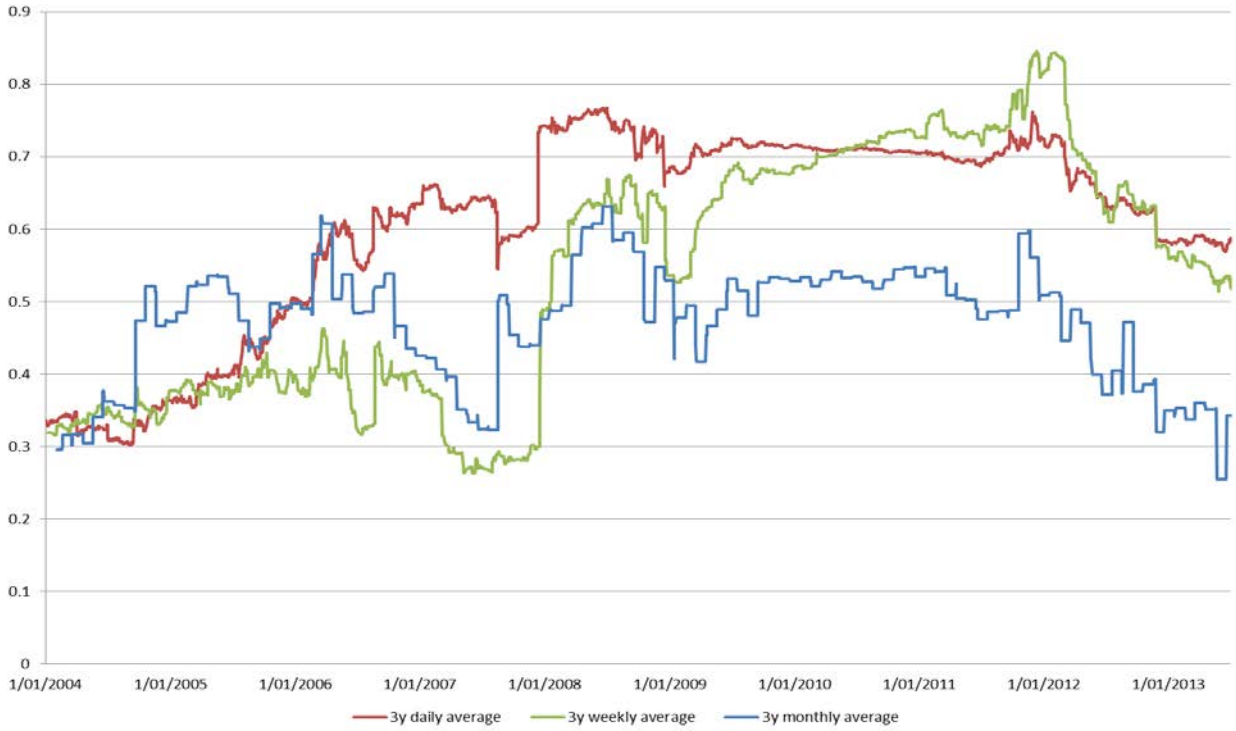
Similar patterns emerge with weekly and monthly beta, and in the portfolios used by the AER (see beta paper Table 6.1). This is shown in Figures 2 and 3

**Figure 2: Three-year rolling average daily, weekly and monthly betas (version 1)**




Source, Bloomberg, CEG analysis. * Relevered to 60% gearing. Week defined as ending Friday, month defined as ending on the 8th trading day.

**Figure 3: Three-year rolling average daily, weekly and monthly betas (version 2)**




Source, Bloomberg, CEG analysis. * Relevered to 60% gearing. Week defined as ending Tuesday, month defined as ending on the 13th trading day.

The AER also asserts that the period prior to 2008 was a period of stability in the Australian stock market. However, as the attached CEG report shows, it was a period of dramatic market gains in resource stocks, as a one in a lifetime minerals boom had its effect on market valuations. In considering the forward-looking risk profile for investors in the energy sector, the AER will need to consider whether this kind of change evident in the historical data is likely to be repeated over the next decade and, if it concludes that it is not, it needs to consider how this might influence conclusions in respect to a beta calculated using historical data from a period of significant change in the Australian stock market.

The second issue is the AER's comments (beta paper pp22-3) about potentially excluding "unrepresentative events". We concur with PIAC's assessment (ibid p23) that extreme care ought to be taken before excluding data. Ordinarily, in econometrics, outliers which do not reflect the "usual" relationship between a set of variables can be slated for exclusion from the dataset, because their inclusion would "artificially" skew the results. This is particularly true in respect of Ordinary Least Squares, where the estimated relationships are found by squaring the distance between each observation and the line of best fit (as opposed to taking the absolute values in LAD regression). There are no hard and fast rules to determine which data-point is an outlier; empirical tests of outliers will highlight points that are distant from the centre of the sample, but the decision as to whether that distant data-point represents "true" information germane to the relationship between the variables in question, or whether it ought to be discarded, remains with the analyst. It is not, in other words, a mechanistic process.

However, in respect of understanding the value of certain stocks or portfolios to an investor, the theory behind CAPM suggests that data-points far from the centre of a distribution may well contain information which is highly relevant to an investor. For example, if a stock happens to deliver returns close to the average most of the time, but delivers a highly counter-cyclical return in time periods when the market is either peaking or crashing, then this stock has high value to an investor seeking to diversify risk, and thus investors are arguably very interested in what stocks do during "atypical" periods for the market as a whole.

SFG (2013b) have undertaken considerable work showing that "robust" regression techniques such as LAD systematically bias beta downwards, and the ENA has therefore argued against their use in its submission to the AER's consultation paper. We would endorse the ENA's position in this respect, and would suggest the brief discussion above as motivation for our conclusions.

This gives rise to two considerations in respect of regulatory practice. Firstly, it argues against the mechanistic removal of outliers without considering the potential information content they may have.[9] Secondly, it argues for caution in making use of techniques which, in general, limit the influence of outliers on results, before developing a proper understanding of how important outliers might be in principle in understanding what drives investors. We are concerned at the growth of use of "robust" regression techniques, particularly by the ERA, when there has been no debate about the appropriateness of these techniques within the context of what regulators are actually supposed to be doing; examining the degree to which rate of return methodologies meet the ARORO.

[9] Indeed, if the AER does omit any data points, we would suggest it ought to indicate precisely which have been removed, to aid transparency when attempting to replicate its results.

# 4. Empirical Analysis

This chapter forms the core of our response to the AER's beta paper, as it is the range and point estimate for beta which is clearly the core output of that paper. We discuss first the way in which the AER has arrived at its conclusions in regards to the likely range, before providing our own conclusions as to what the likely range will be, and close by looking at the policy implications of these considerations.

Our basic position is that the AER has not considered the true range of variability because the data it uses as its inputs has been arbitrarily filtered, and the AER has then chosen a narrow range within this arbitrarily-filtered data in a second largely arbitrary step. This means that any estimates of the return to equity made using CAPM, such as in the AER's foundation model, will not accurately represent the true levels of uncertainty associated with rates of return on equity and this, in turn, means that the foundation model will have significant problems when it comes to producing results which can be shown to meet the ARORO.

Our conclusion, however, is not for more estimation work on beta, because it is the nature of the small dataset that is the core of the problem. Something else other than the way beta is estimated needs to change, and we discuss this in our conclusions to the chapter.

## 4.1 The derivation of the AER's range

The normal approach in economics, when one is looking to distil the findings of a large number of empirical papers that examine a parameter of interest is to undertake a meta-analysis, to ensure the data that informs all the estimates is treated correctly from a statistical perspective. Such analyses are invariably laborious and we appreciate that this may not have been feasible in the tight timeframe faced by the AER.

However we would have expected some form of data-driven, transparent assessment which explained how the relevant conclusions were reached. This has not occurred; it is not clear how the AER has arrived at its range of 0.4 to 0.7. None of the studies examined by the AER have this range for their beta estimates. Indeed, the work cited in Tables 4.4 to 4.6 shows that fully two-thirds of the estimates fall outside the range chosen rage. The only study that comes close is that of SFG (2013c) which has confidence intervals from 0.41 to 0.68. The only indication we have of the AER's reasoning is that its assessment of the available information did not cause it to change its 2009 WACC review finding, which had a similar range, and that the available data are now (in the AER's judgement; again with no real statistical evidence) sufficiently robust to suggest a point estimate at the top of this range.

This is not sufficient. In the context of the foundation model, beta is a crucial parameter. We appreciate that the AER is not obliged to provide an indicative number, but if it does, it ought to follow the same standards of rigour it asserts (ES p201) characterise any regulatory paper prepared under the requirements of administrative law.

One thing we do know is that the AER has not based its estimate on confidence intervals,[10] which it suggests (beta paper p39) are not particularly useful in comparisons across beta estimates. This is

[10] Except on page 30 of the beta paper, where it cites SFG's (2013c) confidence intervals in support of its own preferred range.

not true. Under the electricity regulatory regime which existed before November 2012 (and was in effect applied in gas even though the NGR provided for financial models other than the SL-CAPM), regulators were required to obtain the single best estimate of each parameter in the single best model, in the hope that this would produce the single best return on equity result. Within this context, if regulators use the mean of any distribution, and that distribution is symmetric, then it is true that the confidence intervals add little to the regulatory task; they might tell the regulator that its estimate of beta (say) is not robust, but they will not point to a better estimate.

However, in the beta paper, there are two problems with the AER's viewpoint. Firstly, it has not chosen the mid-point, but the upper-bound of a distribution, and the confidence interval obviously matters very much in understanding where the upper bound lies. Secondly, the rules have changed. The AER is now empowered to make use of any relevant models, and compare how each meets the ARORO before deciding which to use (and how). In this respect, confidence intervals are very important because, all else being equal, they can be used to support one model over another.

### Consequences of choosing 0.7 as the point estimate

The AER's decision to choose the top of its range for beta as the point estimate at stage three of its foundation model is obviously preferable for regulated businesses and their investors than a choice at the bottom end of the range would have been. However, it does give rise to some potentially unforeseen consequences. The DG (p17) suggests that the lower end of the range formed at stage three of the foundation model process will likely comprise the bottom of the range of beta estimates and the lowest MRP estimate. We presume this means the top end of the range will contain the highest values for each of these parameters.

By choosing a point estimate for beta at the top of its range, the AER ensures that the point estimate for the rate of return on equity formed at stage three of its foundation model process will also sit at or near the top end of its range. Indeed, the Financial Investors Group submission to the beta paper suggests that the recent Victorian Gas Access Arrangement decision may well establish six percent as the maximum market risk premium, using the methodologies the AER has chosen and, if this is true, the point estimate for the rate of return will sit at the top of its range.

This raises the question of what will happen at stages four, five and six of the AER's foundation model process. We see two possibilities. Firstly, if the range is held as sacrosanct, other information at these stages will only be used to reduce the initial estimate of the return on equity. This would introduce an unconscionable bias to the process, as some information would be systematically ignored. We doubt the AER would deliberately bias its approach in this way.

Alternatively, if the initial range is not held sacrosanct, the new information at stages four to six will (if indicates the AER's initial range is too low) be used to change the initial range. Given the way in which the AER has determined the range and the point estimate of beta, this most likely means a re-calculation of beta, or potentially a need to consider anew the appropriateness of putting the SL-CAPM at the centre of its approach in the way the foundation model does.

Since we believe (presenting evidence in support of this belief below) that the top end of the range of beta is not 0.7, and since we also believe that using a multiple model approach is preferable to the AER's foundation model approach (see our DG submission), the second of the two alternatives above is not something we would regard as particularly problematic. However, we would suggest

that a regulatory process that risks producing biased results or revisitation of the modelling framework is not a particularly robust process. This underscores our call in our DG submission that the AER ought to test its models in case studies in the final Guidelines, to prevent some of these issues only becoming apparent as the model is actually used at the regulatory decision stage.

## 4.2 A more likely range for beta

Given our conclusions above that the AER has not provided an accurate representation of the true range of beta, it behoves us to provide a more accurate representation of the range. We do so in this section, though we emphasise that it is not a final estimate, and that we are still likely to be under-estimating the true range of uncertainty.

We begin by looking at the assumptions underlying the calculations of beta cited by the AER, but not actually made clear. These are:

- That investors form their expectations of forward-looking beta risk on the basis of regression analysis.
- That investors only have regard to betas estimated using a single return series ending on a particular day of the week or month.
- That investors only have regard to the time period 4/01/2002 to 19/04/2013.
- That investors only have regard the average behaviour of beta in that period (i.e., that investors believe that beta is stable over time).
- That investors only have regard to the betas for the energy firms in the BEE (as described by the AER).

In this section, we relax just one of these assumptions; the assumption that investors use just one day of the week or month to estimate returns. On the face of things, this ought to make no difference at all to results; choosing week ended Thursdays returns rather than week ended Friday ought to be entirely immaterial within the context of the theory underpinning CAPM.

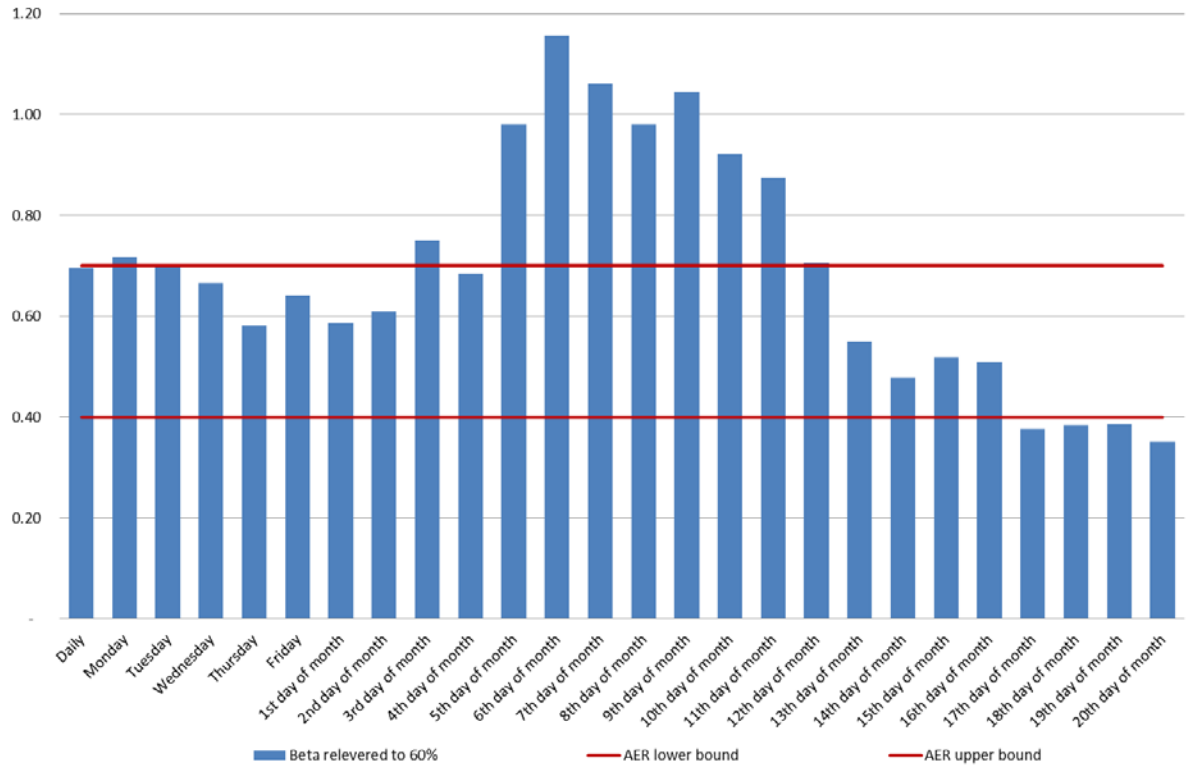
Unfortunately, this seemingly small change to assumptions makes a very large change to the results for beta. DBP, as part of its submission to the ERA's *Draft Rate of Return Guidelines*, asked CEG to make use of exactly the same dataset that the ERA (2013) used, but to change just the day of the week and month used in estimating returns. The results showed that average betas, across all energy firms in Australia, ranged from 0.29 to 0.94, depending upon whether the estimate was a monthly beta calculated on the 6$^{th}$ day of the month, or a monthly beta calculated in the 17$^{th}$ day of the month.[11]

We have asked CEG to extend this analysis by considering confidence intervals around these estimates, which are a better estimate of the true range of beta values, and asked them to do so for Portfolio 3 in Table 6.1 in the beta paper.[12] The results are shown below.

[11] Average weekly betas varied from 0.53 to 0.62.

[12] The work undertaken in response to the ERA *Draft Rate of Return Guidelines* used Portfolio 4 as its basis. Thus, whilst the exact values in the results change from one portfolio to the next, the overall story does not.

**Figure 4: Australian OLS beta estimates with different sampling intervals**




The bar on the far left hand side of Figure 4 is the average daily beta, the next five bars represent the average weekly betas (one bar for each possible definition of a week (week ended Monday first, then week ended Tuesday etc.). The next 20 bars each represent different definitions of a month. The first monthly bar represents the beta associated with measuring returns to the first trading day of each month. The second monthly bar represents the beta associated with measuring returns to the second trading day of each month, etc. There are only 20 monthly beta estimates defined in this manner because there are only 20 trading days in February.

The horizontal lines in Figure 4 show the upper and lower bounds as proposed by the AER beta paper. In total, 38% of all observations (10 out of 26) are above the AER upper bound. By contrast, only four estimates are below the lower bound. This suggests that the AER upper bound is set unrealistically low.

In reality, any one of the beta estimates in Figure 4 is equally as likely to be the 'true beta' estimate that informs investors' valuations. In which case, a better estimate of the 97.5 upper bound is one that takes account of the different sampling assumptions that might inform investors' forward-looking beta estimates. In this context, the 97.5$^{th}$ percentile of the 26 different beta estimates derived above provides a better estimate than the 97.5$^{th}$ upper bound estimate of the (single) beta regression coefficient using week ended Friday return sampling. The 97.5$^{th}$ percentile from the above sample is 1.1. By the same logic, a better estimate of the lower bound is 0.37 (the 2.5$^{th}$ percentile estimate).

Note that this conclusion is based on relaxing only one of the implicit assumptions listed above. Relaxing additional assumptions is likely to add further variation to the estimates.

We would consider that the minimum that regulators ought to do when publishing information about beta is to publish the beta results for a given time period, using a given comparison set, for the different days of the week and month. It is not good enough to simply quote one of these results, or to quote an average across different days of the month (given the requirement to show the rate of return meets the ARORO; see below) because this gives a false impression of the degree of precision in estimates.

## 4.3 Implications for sound regulatory practice

We would suggest that there are important implications for regulatory practice from the discussion above on the more likely range of beta. It will not be sufficient to make use of more and different models (as the ERA, for example, has done). In the first instance, it might not reduce variation by much. Secondly, if it does, the AER will need to have a firm understanding why; relating back to our discussion about removal of "unrepresentative events", removing variation may in fact result in important information being lost.

It is also not sufficient to make use of an expedient approach such as using averages. The relevant test in the rules is whether the resultant return on equity meets the ARORO. An average might do this, but there is no a-priori reason to suspect that it necessarily would; the test would still need to be done.

We in fact consider that the implications of our discussion above are much more profound. The AER has suggested (beta paper p33) that overseas data should only be used if there is evidence that this would produce more robust estimates of beta than solely using Australian data. PIAC (2013, p36) suggest that:

"*It is not at all clear why the AER should introduce a relatively untested modelling framework such as the Wright CAPM into the regulated analysis to 'inform' the outcomes of a reasonably robust and tested model, the Sharpe-Lintner CAPM*"

We would submit to the AER that it would be hard-pressed to produce a less-robust estimate of beta than eventuates from applying its approach using only Australian data, and that the case for using international data is clear. This is, indeed, precisely the conclusion that the NZCC, the CER, IPART, ESCOSA and the QCA have already come to when faced with the same issues.

We would submit that it is perfectly clear why other models (such as the Black CAPM, the FAMA French Model, the Dividend Growth Model and the APT) are needed; the CAPM as applied by the AER, simply does not work in respect of providing "reasonably robust" results.

Certainly it is dangerous to downplay the problem by asserting, as PIAC does, (ibid, p29) that:

*"The Sharpe-Lintner CAPM has limitations, however, these limitations are well known and therefore allowances can be made for these in a systematic and transparent way."*

We consider that there are only two approaches which the AER will realistically be able to employ:

- It will need to make more comprehensive use of data from overseas to overcome the small sample problem that is a key cause of the wide range for beta evinced above.[13]
- It will need to make use of models outside the SL-CAPM to provide further information to support a rate of return which can be shown to meet the ARORO.

We have made these points in our submission to the DG, and have highlighted how these two approaches, which are not mutually exclusive, could be effectively implemented. We believe that the most important implication for sound regulatory practice from a proper study of the variation in beta which arises from the way in which the AER proposes to employ the CAPM is that it underscores the point that the SL-CAPM cannot play the role which the AER hopes it can play in its foundation model.

[13] See Brooks, Diamond, Gray & Hall (2013) for further information on the influence of small samples of firms on the robustness of beta parameter estimates in the Australian context.

# 5. Conclusions on Range and Point Estimate

This response has highlighted some clear problems associated with the AER's choice of beta estimates. The range chosen by the AER, which it has not supported with a robust, transparent account of how it considered the various data it had available, significantly under-estimates the true range of beta. Making one small change to the assumptions underpinning several of the studies cited by the AER in the Australian context (the day of the week or month used to estimate returns) shows the range of beta is likely to be from 0.37 to 1.1; significantly larger than the AER suggests is the case.

We suggest that the only way in which to address this issue is to make use of data from overseas and/or to make more fulsome use of other models that are not subject to the same beta problems, and which can deliver robust results. These are both issues we discuss in more detail in our DG submission.

In this respect, the AER's rejection of overseas energy data is disappointing. The AER has provided no evidence to support its reasoning why rejection was the decision made, but we nevertheless point out several reasons why the use of overseas data may be a useful addition to the regulatory toolkit. Indeed, we are concerned that the AER has been inconsistent in its arguments pertaining to the BEE; it has ignored its own evidence that clearly shows investors do not perceive that Australian energy utilities are similar, misinterpreted some overseas data and determined that it is appropriate to make use of information from international water utilities (indirectly; through the use of beta estimates made by regulators in water in Australia) whilst giving a reduced role for information from international energy companies.

We recognise that the beta paper was prepared over short timeframe, to fill a gap left when a consultant proved unable to complete a more detailed empirical analysis due to unforeseen circumstances. However, even given these caveats, the paper falls far short of the kinds of levels of robustness and transparency which the AER itself has listed as its criteria for making decisions. Perhaps more importantly from a practical perspective, it has perpetuated a problem in beta estimation, by sticking to small samples of Australian firms, which has caused problems in the past and which will be exacerbated in the future due to the rule change which puts meeting the ARORO at the centre of regulatory determinations. We believe that this will make the Guidelines unworkable when applied in determinations.

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# Appendix: CEG Report on the Precision of Equity Betas


# Precision of beta estimates

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# 1 Introduction and summary

1. APIA has asked CEG to provide a replication and analysis of the ERA's beta estimates in section 6.2 of its recently released issues paper (*Equity beta issues paper*, October 2013).

2. My analysis is provided in the section 2 below. In summary, I conclude that the AER has incorrectly interpreted the data before it as implying that there is a relatively narrow range for the best estimate of equity beta (o.4 to 0.7). Correctly interpreted, the true range extends well above the top of the AER range.

3. I have read, understood and complied with the Federal Court Guidelines on Expert Witnesses. I have made all inquiries that I believe are desirable and appropriate to answer the questions put to me. No matters of significance that I regard as relevant have to my knowledge been withheld.

# 2 Analysis

## 2.1 AER analysis and conclusions

1. In section 6.2 of the issues paper the AER argues that the addition of data to previous equity beta estimates does not alter the central estimates materially but does reduce the statistical confidence intervals around those estimates – therefore justifying a reduction in the AER's proposed range for equity beta. The AER's basis for this conclusion is set out in the below quote (emphasis added).[1]

> *However, relative to the situation in 2009, we now have greater confidence in the empirical estimates. At one level, this reflects the substantial increase in the available data set. The core regressions in the 2009 WACC review were based on the periods from January 2002 to September 2008 (six years and eight months) and September 2003 to September 2008 (five years). Extending the data set to 2013 allows (up to) an additional five years of data. A larger data set allows the generation of estimates with lower standard errors,* ***which provides a more reliable basis for our assessment of equity beta.***
>
> *The increase in reliability is shown through the reduction in the standard errors around the point estimates discussed in section 4. This can be illustrated by comparing empirical estimates generated using the same econometric techniques but different data sets. The best available example compares the 2009 Henry estimates for fixed weight portfolios against the 2013 ERA analysis of the same type.* ***The ERA adopted the same regression permutations*** *as Henry, using both equal weighted and value weighted portfolios, and both OLS and LAD regressions calculations. The key difference is that the ERA extended the data set from September 2008 through to April 2013. Table 6.1 shows the standard errors around the point estimates from this set of regressions.*

[1] AER, *Equity beta issues paper*, October 2013, page 41.

**Table 6.1** **Comparison of standard errors in Henry (2009) and ERA (2013)—regressions using fixed weight portfolios and weekly sampling frequency.**

| Portfolio (firms) | Henry or ERA (time period) | No. of weeks | Standard error from equal-weighted portfolios | | Standard error from value-weighted portfolios | |
|---|---|---|---|---|---|---|
| | | | OLS | LAD | OLS | LAD |
| P1' (ENV, APA) | Henry (2002–2008) | 349 | 0.06 | 0.06 | 0.06 | 0.06 |
| | ERA (2002–2013) | 589 | 0.04 | 0.03 | 0.05 | 0.04 |
| P1 (ENV, APA) | Henry (2003–2008) | 262 | 0.07 | 0.07 | 0.08 | 0.08 |
| | ERA (2003–2013) | 503 | 0.04 | 0.03 | 0.05 | 0.04 |
| P2 (ENV, APA, DUE) | Henry (2004–2008) | 211 | 0.06 | 0.06 | 0.06 | 0.06 |
| | ERA (2004–2013) | 453 | 0.04 | 0.03 | 0.05 | 0.03 |
| P3 (ENV, APA, DUE, HDF) | Henry (2004–2008) | 193 | 0.07 | 0.07 | 0.07 | 0.07 |
| | ERA (2004– 2013) | 415 | 0.06 | 0.04 | 0.05 | 0.03 |
| P5 (ENV, APA, DUE, HDF, SPN, SKI) | Henry (2007–2008) | 78 | 0.10 | 0.10 | 0.10 | 0.10 |
| | ERA (2005–2013) | 362 | 0.06 | 0.04 | 0.06 | 0.03 |
| **P1–P5 Average** | **Henry (X–2008)** | **219** | **0.07** | **0.07** | **0.07** | **0.07** |
| | **ERA (X–2013)** | **464** | **0.05** | **0.03** | **0.05** | **0.03** |

Note: Portfolio labelling follows Henry 2009. Portfolio P4 was omitted because it did not have consistent firm composition between the two analyses. Portfolio P5 has a different start date because of different data availability for SKI using Bloomberg (ERA) or Datastream (Henry) for the 2005–2007 period when this firm traded as an instalment receipt.

Source: AER, *Final decision: WACC review*, May 2009, p. 323; Henry, *Estimating β*, April 2009, pp. 23–24, and ERA, *Explanatory statement: Draft rate of return guidelines*, August 2013, pp. 173-177.

*As is evident in table 6.1, the standard errors decrease once the data is extended to 2013,* ***with the average change across the table representing a reduction from 0.07 to 0.04****. The equity beta estimates from the longer data series are more reliable.*

*Further, we now have empirical estimates generated from a broader set of different market conditions. The consistency of these results from markedly different environments also gives us increased confidence that the observed empirical range is reasonable. The empirical estimates from relatively stable period 2002–2008 (that is, after the tech boom but before the GFC) are consistent with recent analysis using the period 2008–2013, a period encompassing the GFC and its aftermath. This suggests that the equity beta for the benchmark efficient entity is relatively stable across time, even when there are major fluctuations in the business cycle. This increases our confidence in the observed equity beta range.*

2. There are a number of errors in the facts and logic set above, the effect of which is to render the AER's conclusion unreasonable.

## 2.2 The ERA adopted the same regression permutations as Henry

3. The statement in the issues paper that the ERA simply added additional data to the Henry regressions is not correct. The ERA weekly beta estimates reported in the Table 6.1 of the AER's issues paper week ended Friday beta estimates. The basis of the Henry weekly beta estimates is not disclosed by Henry, however, it is clear from other analysis that these beta estimates are week ended Monday beta estimates.[2] This means that the weekly returns used in each regression are different – even in the years that the regression results overlap. Consequently, the ERA results cannot be properly thought of as adding new observations to the Henry estimates – they are actually supplanting the Henry observations based on a different definition of a weekly return.

## 2.3 Lower standard errors in regressions do not imply beta estimates are more reliable

4. In a separate report for DBP[3] I have attempted to replicate the ERA analysis reproduced by the AER above. In this replication I estimate similar standard errors to the ERA.

**Table 1: CEG regression results using ERA data period (60% geared equity beta)**

| | P0 | P1 | P2 | P3 | P4 |
|---|---|---|---|---|---|
| **OLS method** | | | | | |
| OLS Standard Error | 0.0383 | 0.04 | 0.0339 | 0.0485 | 0.0476 |
| OLS t-stat | 12.9721 | 12.4636 | 12.4741 | 12.1009 | 11.3194 |
| OLS Beta Upper Bound | 0.5714 | 0.5767 | 0.49 | 0.682 | 0.6316 |
| OLS Beta Lower Bound | 0.4214 | 0.42 | 0.3569 | 0.4918 | 0.4452 |
| **LAD method** | | | | | |
| LAD Standard Error | 0.043 | 0.0413 | 0.0306 | 0.0308 | 0.0334 |
| LAD t-stat | 12.0358 | 13.1262 | 13.4708 | 17.4894 | 16.6081 |
| LAD Beta Upper Bound | 0.5766 | 0.6176 | 0.5036 | 0.6495 | 0.6265 |
| LAD Beta Lower Bound | 0.3947 | 0.4488 | 0.3299 | 0.4763 | 0.4237 |

*Source: Bloomberg, CEG analysis*

5. The AER examines these low standard errors (and lower than previously estimated by Henry), and concludes (at least implicitly) that the fact that the upper bounds of

[2] See CEG, WACC estimation, a report for Envestra, March 2011, Appendix A.

[3] CEG, *Regression estimates of equity beta*, September 2013.

these ranges are all less than 0.7 allow the AER to conclude that the appropriate range for the equity beta does not extend above 0.7.

6. However, this conclusion based on single regression statistics is not justified. Each of the estimates of statistical uncertainty are taken from a single regression for each stock using week ended Friday sampling interval of returns over the period 4/01/2002 to 19/04/2013 (up to 11.3 years if data is available for that long). However, this is only one of the many possible sampling intervals that could be examined.

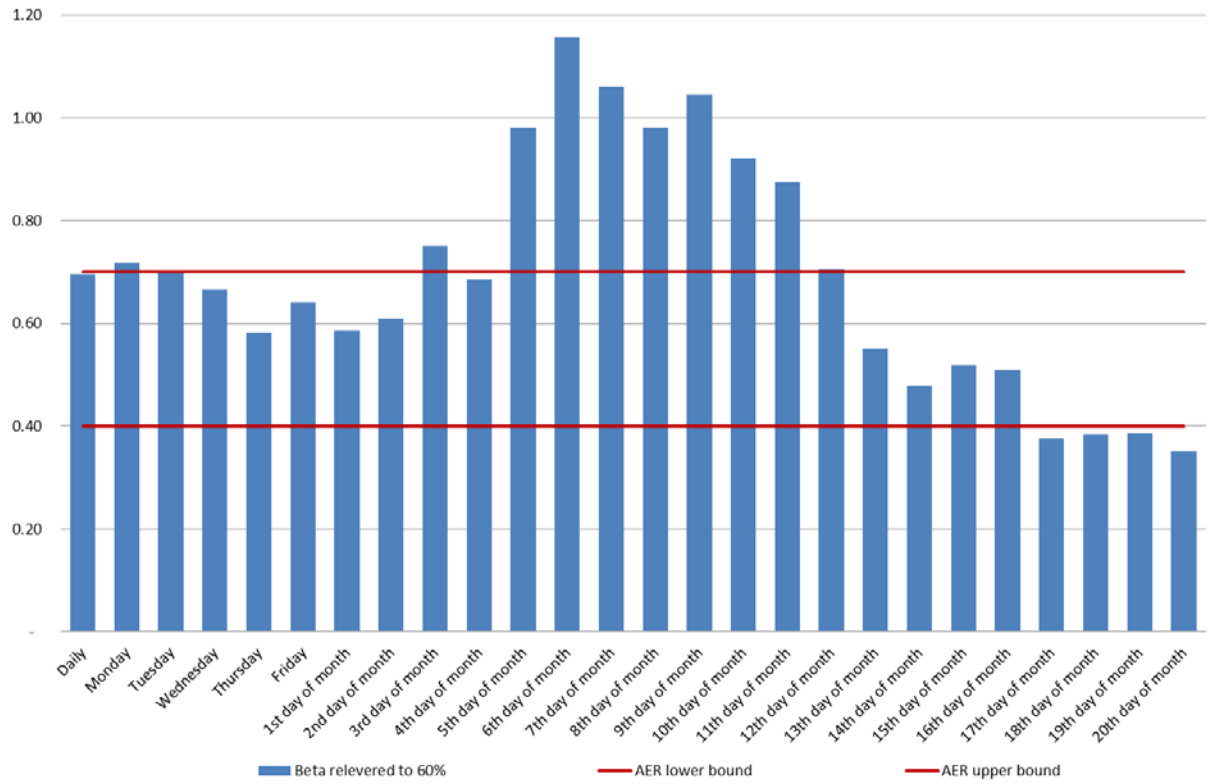
7. The analysis in the remainder of this subsection follows substantially the same logic as previously provided in my last report for DBP.[4] However, the illustrative tool used differs. In my previous report for DBP I used results based on the full portfolio of businesses (AER/ERA "Portfolio 4": ENV, APA, DUE, HDF, SKI, SPN). I now use AER/ERA "Portfolio 3" being ENV, APA, DUE, HDF. In doing so I demonstrate the results from my prior analysis were not dependent on the sample of businesses.

8. The below analysis shows the impact on beta estimates of adopting precisely the same data period but instead defining weekly returns over the week from Monday to Monday. Just this change raises the average beta 0.63 to 0.71. If we use monthly returns, the average beta estimate can be as high as 1.15 (if betas are estimated from/to the 6th trading day in each month) and as low as 0.35 (if betas are estimated from/to the 20th trading day in each month).

9. These and other results are set out in Figure 1 below. Figure 1 shows the average beta (averaged across the ERA's six proxy companies) using the ERA's data period but simply varying the sampling interval.

[4] CEG, *Regression estimates of equity beta*, September 2013. See section 4.

**Figure 1: Australian OLS beta estimates associated with different sampling intervals – ERA/AER portfolio 3 (ENV, APA, DUE, HDF)**




10. The bar on the far left hand side of Figure 1 is the average daily beta, the next five bars represent the average weekly betas (one bar for each possible definition of a week (week ended Monday first, then week ended Tuesday etc.). The next 20 bars each represent different definitions of a month. The first monthly bar represents the beta associated with measuring returns to the first trading day of each month. The second monthly bar represents the beta associated with measuring returns to the second trading day of each month, etc. There are only 20 monthly beta estimates defined in this manner because there are only 20 trading days in February.

11. The horizontal lines in Figure 1 show the upper and lower bounds as proposed by the AER issues paper. 10 out of 26 different average beta estimates are above the upper bound of the AER range. That is, 38% of all observations are above the AER upper bound. By contrast, only four of our 26 estimates are below the lower bound. This suggests that the AER upper bound is set unrealistically low.

12. This demonstrates a clear problem with the methodology underpinning the upper bound estimates based on regression statistics – which are even lower than the upper bound the AER has adopted (as can be seen in Table 1).

13. The standard errors and associated upper bound estimate are based on a single regression where it is assumed that the data used in that regression represents all of the available information. In effect, it assumes that investors form their beta estimate solely based on the confidence interval around the estimation of betas using a "week ended Friday" sampling interval for returns – this is the source of the data used in the regressions.

14. In reality, the underlying data is far richer and more varied than this. A 'week ended Friday' sampling interval is ultimately arbitrary (as are all of the sampling intervals in Figure 1). Even if investors were to solely inform their forward-looking beta estimates by reference to historical betas using the ERA's sample of firms and using the same 11.3 years of data as used by the ERA, it is reasonable to assume that they might adopt a different sampling interval to the ERA.

15. In reality, any one of the beta estimates in Figure 1 is equally as likely to be the 'true beta' estimate that informs investors' valuations. In which case, a better estimate of the 97.5 upper bound is one that takes account of the different sampling assumptions that might inform investors' forward-looking beta estimates. In this context, the 97.5$^{th}$ percentile of the 26 different beta estimates derived above provides a better estimate than the 97.5$^{th}$ upper bound estimate of the (single) beta regression coefficient using week ended Friday return sampling. The 97.5$^{th}$ percentile from the above sample is 1.1. The 2.5$^{th}$ percentile is 0.37. That is the 2.5$^{th}$ percentile is in line with the AER's lower bound of 0.40 but the 97.5$^{th}$ percentile is well above the AER's upper bound of 0.70.

16. However, even this upper bound may be unrealistically low. This is because, it assumes:

    - That investors form their expectations of forward-looking beta risk on the basis of regression analysis;
    - That investors only have regard to the time period 4/01/2002 to 19/04/2013;
    - That investors only have regard the average behaviour of beta in that period (i.e., that investors believe that beta is stable over time); and
    - That investors only have regard to the betas for the proxy firms in the sample.

17. These issues are discussed in more detail in section 4 of my previous report for DBP. In relation to the last point I note that having regard to US betas materially increases the sample and reduces the sensitivity of the beta estimate to the sampling period (see Figure 4 in my previous report). Relaxing any of these assumptions will further materially increase the width of the true confidence interval that can be estimated using the historical beta estimates for the firms in the ERA sample.

## 2.4 Consistency between Henry and ERA results does not provide support for the AER's range

18. The AER issues paper states:

> *Further, we now have empirical estimates generated from a broader set of different market conditions. The consistency of these results from markedly different environments also gives us increased confidence that the observed empirical range is reasonable. The empirical estimates from relatively stable period 2002–2008 (that is, after the tech boom but before the GFC) are consistent with recent analysis using the period 2008–2013, a period encompassing the GFC and its aftermath. This suggests that the equity beta for the benchmark efficient entity is relatively stable across time, even when there are major fluctuations in the business cycle. This increases our confidence in the observed equity beta range.*

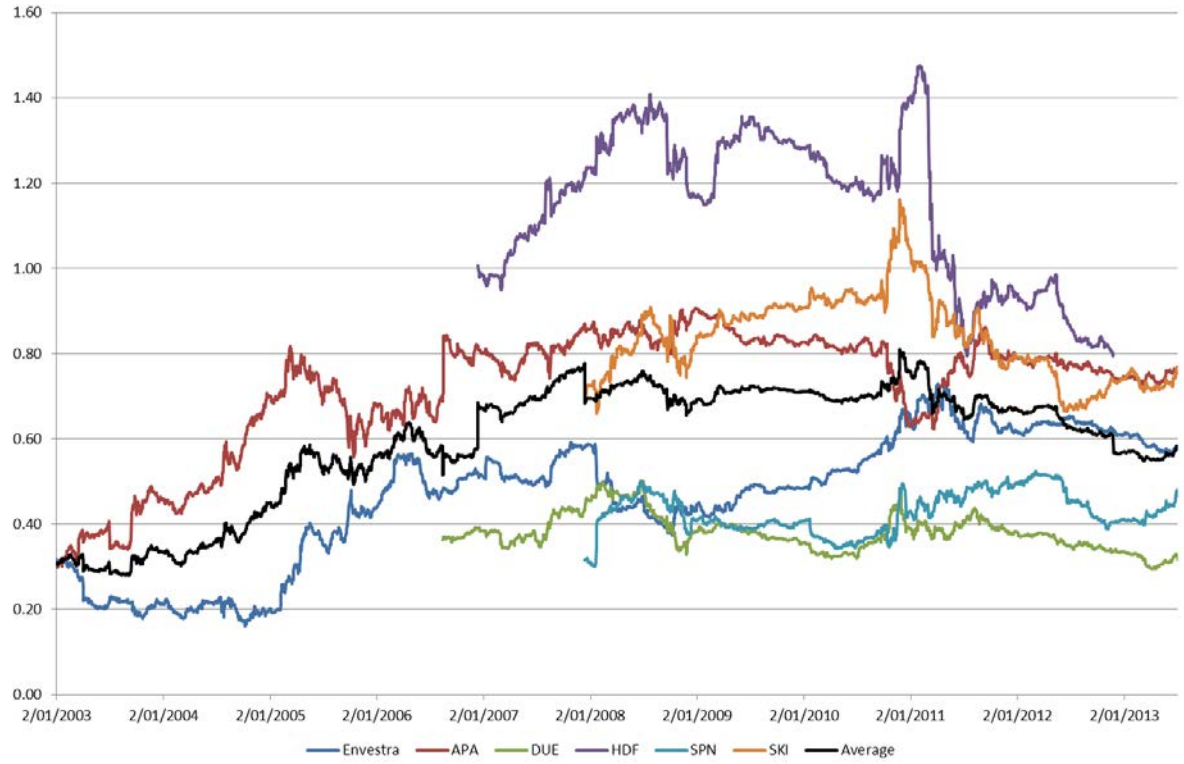
19. There are a number of problems with this statement. First, the AER asserts that the beta estimates are similar using 10 years of data to the estimates using 6 years of data. This is based on a narrow comparison of potential sampling periods. As can be seen from Figure 1, even with the same 10 years of data the average beta varies dramatically depending on the sampling period.

20. Second, for any given sampling period the beta estimated over shorter periods of data collection vary wildly. Consider the below figure which shows a time series of 2 year daily betas.[5] Relevantly, this shows that:

- at any given time there a very significant range between the betas of each regulated business in the sample; and
- neither the beta for an individual firm nor the beta for a the average of all firms was stable over this period.

[5] That is, betas estimated using the two prior years' worth of daily return data.

**Figure 2: Time series of 2 year daily betas* for firms in Henry/ERA sample**



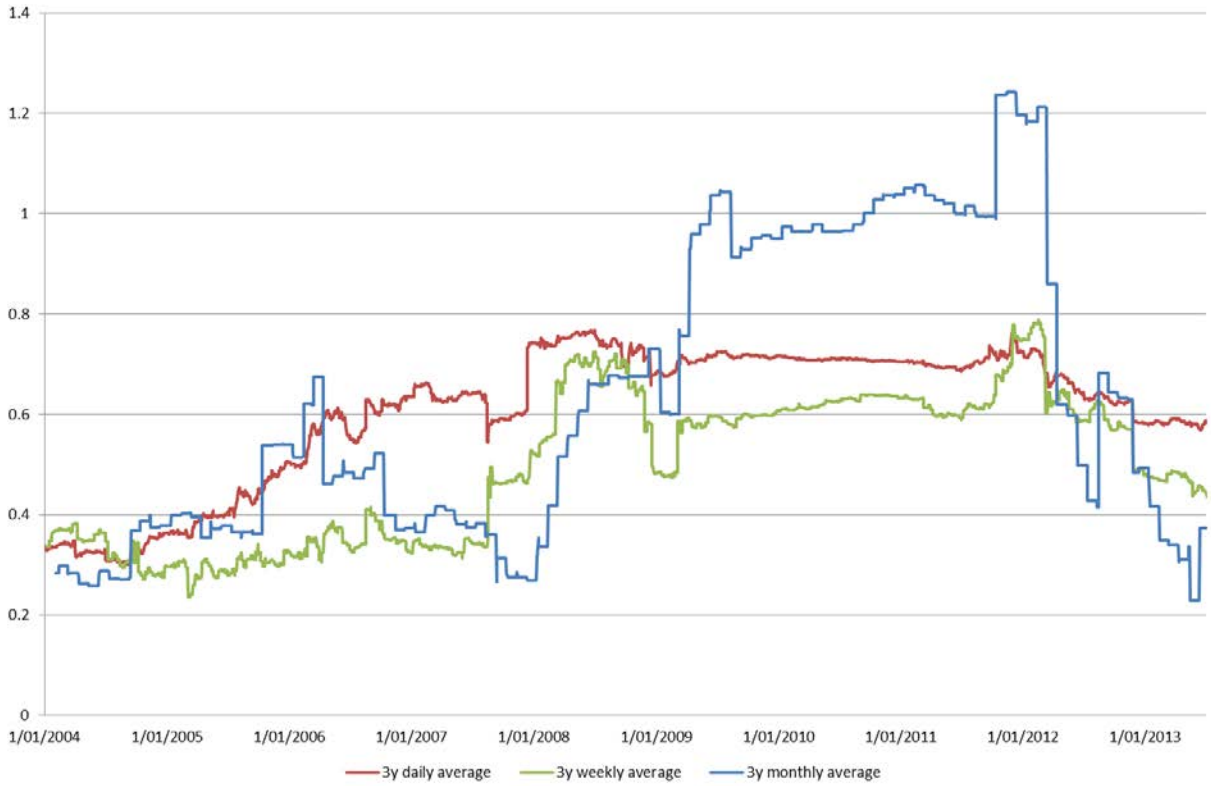

Source, Bloomberg, CEG analysis. * Relevered to 60% gearing.

21. Clearly the average beta rose materially over the period leading up to the GFC and was then sustained at an average level above the top of the AER's range over the period January 2008 to January 2012 (averaging 0.71 over this period).

22. It is also constructive to consider, for example, the a time series of the average beta across all 6 companies in the ERA sample where the beta is estimated over 3 years of data and, for example:

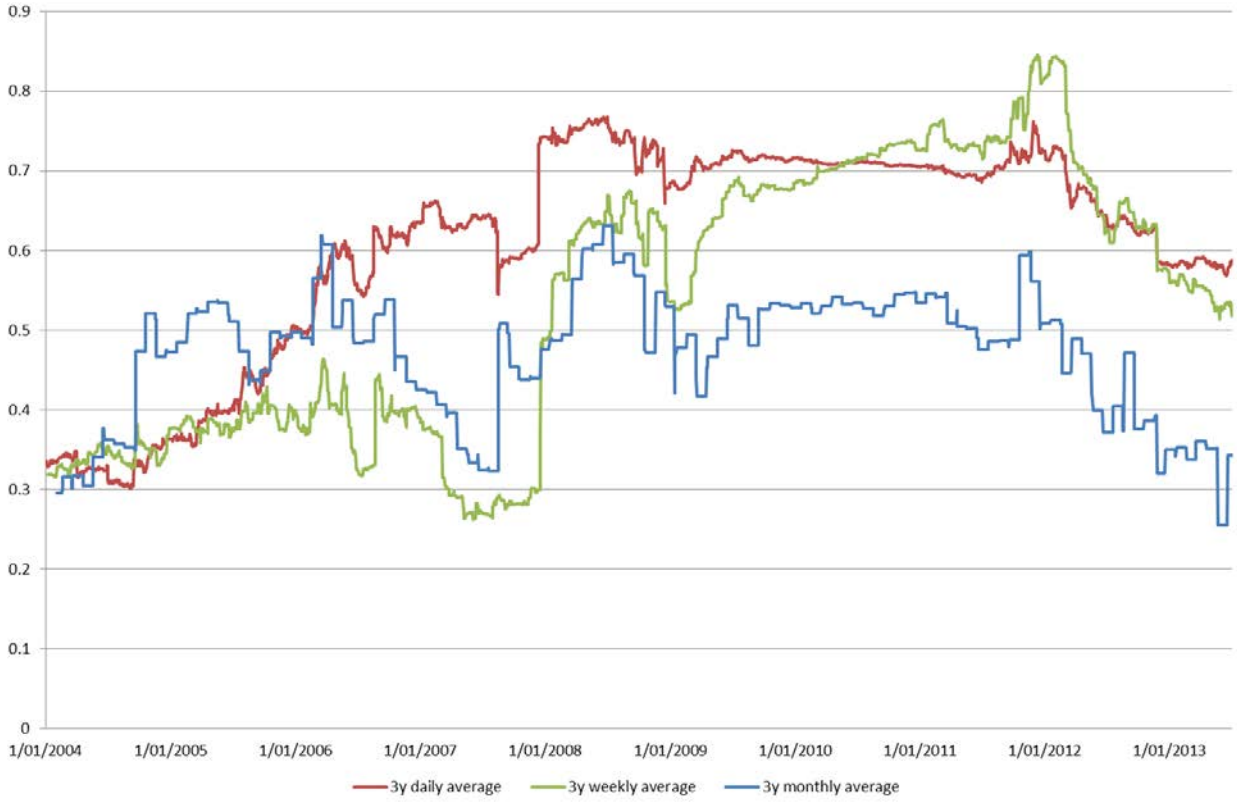
    - weekly betas are defined as week ended Friday and Monthly betas are estimated using returns to the 8th trading day of the month; versus
    - weekly betas are defined as week ended Tuesday and Monthly betas are estimated using returns to the 13th trading day of the month.

**Figure 3: Time series of 3 year average daily/weekly (ended Friday)/monthly (ended 8th trading day) betas for firms in Henry/ERA sample**




Source, Bloomberg, CEG analysis. * Relevered to 60% gearing. Week defined as ending Friday, month defined as ending on the 8th trading day.

**Figure 4: Time series of 3 year average daily/weekly (ended Tuesday)/monthly (ended 13th trading day) betas for firms in Henry/ERA sample**




Source, Bloomberg, CEG analysis. * Relevered to 60% gearing. Week defined as ending Tuesday, month defined as ending on the 13th trading day.

23. The wide dispersion between beta estimates for individual companies and the variability in beta estimates overtime (including the average beta) are in sharp contrast to the AER's conclusion that that

> *the equity beta for the benchmark efficient entity is relatively stable across time, even when there are major fluctuations in the business cycle. This increases our confidence in the observed equity beta range.*

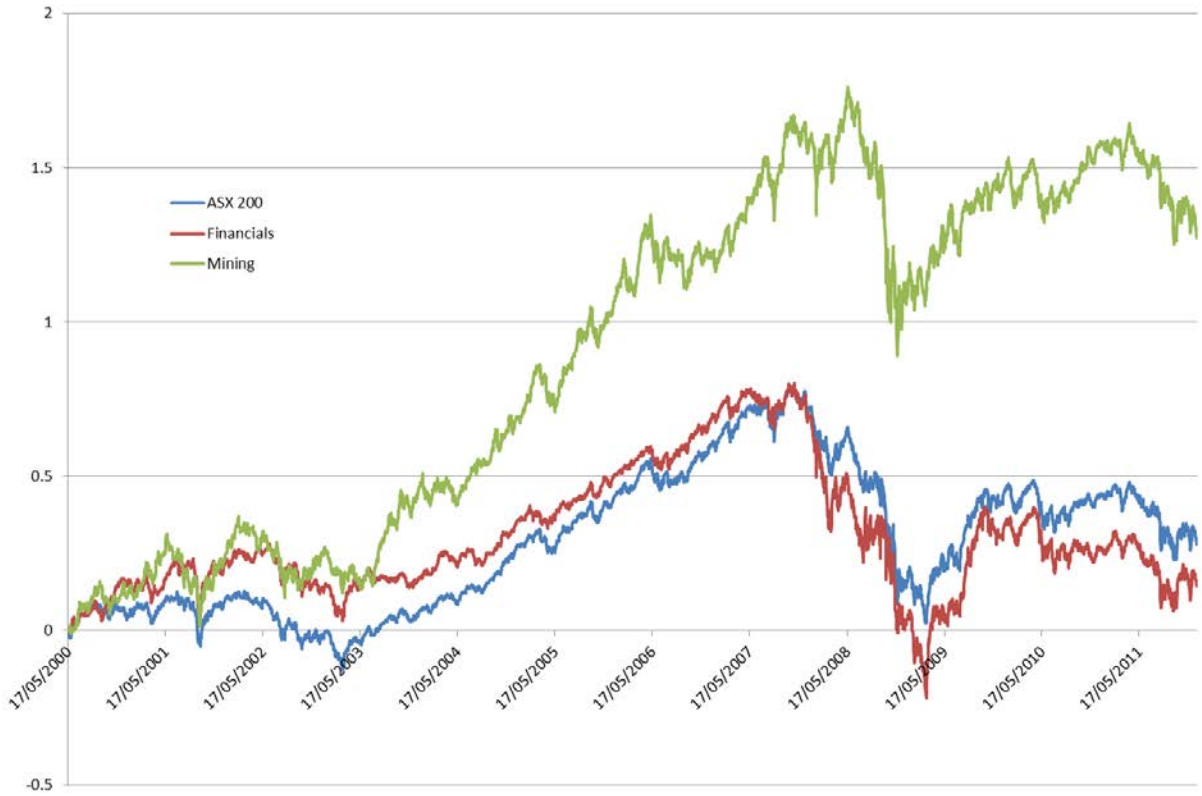
## 2.5 Alleged stability of market conditions pre 2008

24. I also note that the AER is wrong to describe as 'relatively stable' the period from 2002-2008 (that is, after the tech boom but before the GFC). This period was not a period of stability for the Australian stock market but, rather, was one of the most remarkable in the history of the Australian stock market.

25. Very large changes in resource stock valuations occurred over that time. The below figure shows the log of the S&P/ASX 200 Index, S&P/ASX 200 Resources Index, and

S&P/ASX 200 Finance Index. All indexes have been set equal to 1 on the 17th of May 2000. The log of the index value is used in order that the slope of each line can be viewed as the rate of growth in the index.

**Figure 5: Log of ASX200, Resources, Financials indices**




S&P/ASX 200 Resources Index, S&P/ASX 200 Finance Index

26. This figure illustrates the dramatic:

    - rate of growth in resource stocks from mid 2003 until late 2008;
    - rate of reduction in the value of resource stocks in the second half of 2008;
    - rate of growth in resource stocks over 2009.

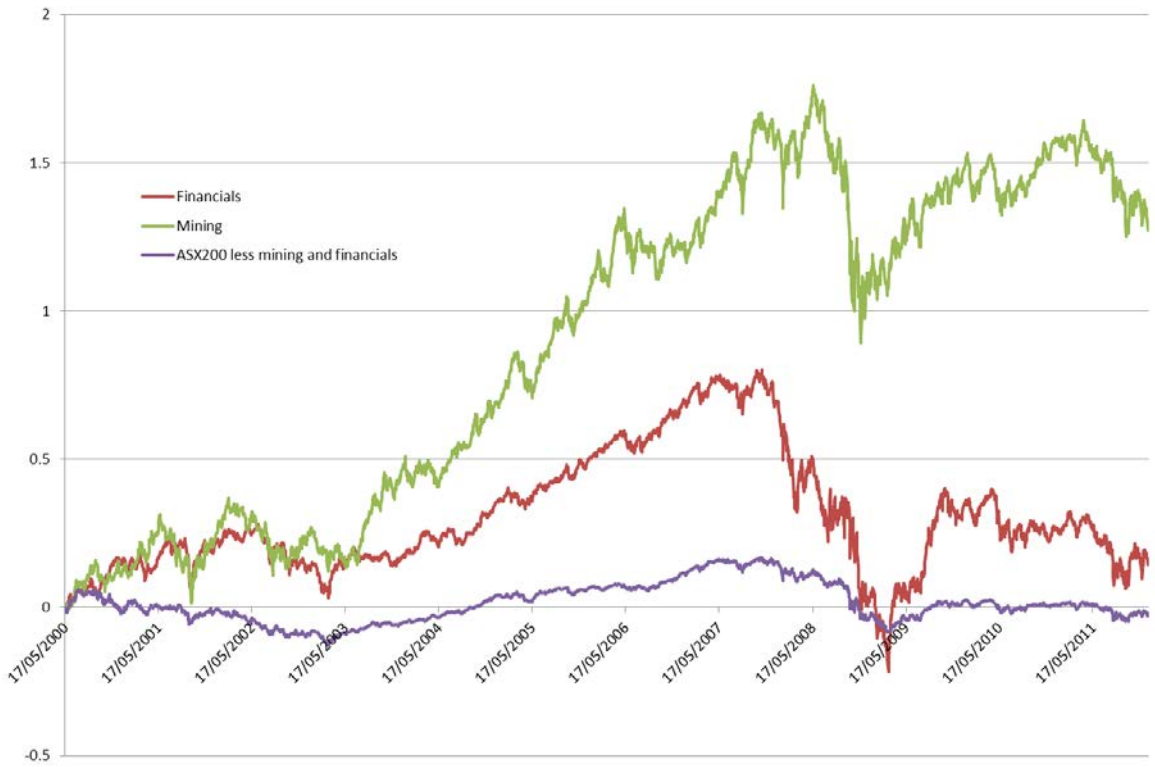
27. This pattern can reasonably be described as a sustained half decade boom, followed by a GFC related bust followed by another boom (a boom-bust-boom pattern).

28. The figure also illustrates a similar, although more subdued, pattern for financial stocks. That said, the fall and recovery in the Financial Index from 2008 to the worst of the GFC was, as would be expected given the financial nature of the crisis, worse than for the ASX200 and its bounce back was stronger.

29. If one looks at the above figure and notes that the Materials and Financial stocks are important components (over 50%) of the ASX200 index it is apparent that the boom

and bust in these sub-indices is, in effect, the driver of the boom and bust in the index as a whole. Below is the same figure but, instead of including the ASX200 a new series is incorporated that reflects the ASX200 net of Financials and Materials indices.

**Figure 6: Log of Resources and Financials indices versus non-Materials* and Financials**




*Materials indices are used as a proxy for the resources indices given we do not have a ready to hand time series for the weight of the resources indices.

30. Over the period shown, stocks other than those in the materials and financial sectors have followed a much less volatile path (even though they have had very similar average growth rates to the financial stocks – i.e, they end at the same level after 12 years).

31. A simple visual comparison of Figure 5 and Figure 6 is sufficient to conclude that the vast majority of the boom-bust-boom in the ASX200 over the period has been due to the boom-bust-boom in resource and financial stocks. When the effect of these sub-indices is removed from the ASX200 the pattern of the index is much more stable.

32. In summary, the period before the GFC was not a 'stable' period in equity markets. It was a period that was particularly affected by an unusual and unlikely to be repeated resources boom.