Estimating the NER equity beta based on stock market data – a response to the AER draft decision

A report for the JIA

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Table of Contents

Executive summary

1. Our report can only be understood in the context of the overall objective of the AER's WACC review of the cost of equity (this report does not concern itself with estimating the cost of debt).

2. We understand this objective is, at its economic core, the objective of accurately estimating the risk adjusted return on equity efficient regulated firms must offer equity investors. Unless this holistic objective is kept at the forefront there is a risk that the AER may define parameters in a particular way such that, even if they are then accurately estimated according to that definition, they nonetheless do not result in an accurate estimate of the cost of equity.

3. In our view, this is precisely what the AER draft decision does in relation to the NER equity beta. The draft decision makes a critical assumption about the definition of the equity beta. This assumption is that the NER equity beta can be accurately proxied by estimating the historical covariance between the return on a publicly listed equity with the historical average return on the listed equity market. For short hand, we refer to this as equity betas estimated from stock exchange data. The draft decision does not seek to test whether this assumption is reasonable and does not appear to give any weight to the evidence we provide that it is not.

4. There are well known theoretical reasons why this may not be a good proxy for the equity beta in the CAPM (be that the Sharpe CAPM or any other variant of the CAPM). In particular, the theoretically correct definition of the equity beta is the covariance between returns on one asset and the average returns on *all* assets in the economy (not just listed equity). Importantly, all assets include housing, other property, land (including agricultural land), human capital (eg, the return to education) and debt. This makes estimation of equity betas purely from stock market data an imperfect proxy for what, in theory, one is attempting to measure. This is precisely the advice that the AER received from Associate Professor Handley[1] when it sought advice on our first paper.[2]

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[1] Handley *Comments on the CEG reports*, 20 November 2008 ('Handley'). See second dot point on page 5. Handley summarises the finding of Roll (1977) that implementation of the CAPM is "*extremely sensitive to the choice of the proxy for the market portfolio*" Handley also quotes Roll saying that estimation of equity beta and MRP from stock market data alone is consistent with a "specification error in the measured 'market' portfolio".

[2] CEG, *Estimation of, and correction for, biases inherent in the Sharpe CAPM*, 15 September 2008. This paper noted other reasons why estimating beta using stock market data and inserting this estimate into the NER cost of equity formula may result in an inaccurate estimate of the cost of equity. In summary, the Fisher Black version of the CAPM (based on Black (1973) predict that the sensitivity of required returns is less than envisioned by Sharpe (1964) once one relaxes the assumption that all investors can borrow unlimited amounts at the risk free rate (eg, at

5. These theoretical reasons why equity betas derived from stock market data *may* be imperfect indicators of investors' required returns do not, of themselves, establish that they *are* imperfect. It may be that, as imperfect as they are, they are the best available to us and that, on that basis, the AER should still rely on them.

6. Whether this is true can only be established by having regard to empirical testing. Fortunately, such empirical testing has been repeatedly performed by finance academics. This literature examines whether, going back over long periods of time, firms with low equity betas derived from stock market data tend to have proportionally lower returns (in excess of the government bond rate) than firms with high equity betas. The uncontested finding from that literature is that:

   ▪ this is not the case; and

   ▪ an estimate of 1.0 for the equity beta provides a better estimate of the cost of equity than an equity beta derived from stock market data.

7. We performed our own test using Australian stock market data, consistent with established methodology in the literature, and found the same result. CEG presented this empirical evidence (a survey of the literature and our own) to the AER in our previous report. We concluded that this provided an important reason for AER not to move away from the NER equity beta of 1.0 even if equity betas estimated from stock market suggested a lower figure.

8. Handley, advised the AER that the results were established in the literature (although Handley used the phrase 'not new excluding the results of [CEG's] own study')[3] and did not present any contrary evidence.

9. Nonetheless, the draft decision responded that under the NER it was not permissible to rely on this evidence and that, in any event, this was not problematic because the evidence was not persuasive:[4]

   The AER agrees with the JIA that the NER mandates the use of the Sharpe CAPM in determining the cost of equity. Essentially this means that neither

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the same rate that Governments can borrow). Similarly, extensions by Merton also create the possibility that beta plays a less important role in determining expected returns

3   Handley, p.5

4   AER, *Review of the Weighted Average Cost of Capital (WACC) Parameters: Explanatory Statement*, December 2008 (hereafter 'Draft Decision'), p.242

recommendation of CEG, both of which are a departure from the Sharpe CAPM, is permissible under the NER. This could present a dilemma if this requirement was in conflict with other requirements of the NER, however the AER does not consider the JIA or CEG have provided persuasive evidence that there is a conflict with the use of the Sharpe CAPM and the other requirements of the NER."

10. The draft decision also states:[5]

    "Most significantly, even if the AER was able to depart from the Sharpe CAPM, given the lack of consensus on an alternative, switching between different asset pricing models at each review as various alternative models fall in and out of favour would be highly likely to increase regulatory uncertainty. Such an outcome would not be consistent with the National Electricity Objective. A departure from the Sharpe CAPM should only be to an alternative that is clearly superior to other models and well-accepted. Such an alternative does not exist."

11. It appears that the AER has not fully understood the key implication of our report for its decision making. The key implication is not that the AER must '*depart from the Sharpe CAPM*' or should '*switch between different asset pricing models at each review as various alternative models fall in and out of favour*'.

12. The key implication is that the AER should have regard to the uncontested empirical fact that equity beta's measured from stock market data do not provide a good indication of the actual returns required by equity investors. This maybe because the Sharpe CAPM formula is imperfect or it may be because equity beta's derived from stock market data are poor proxies for the true equity beta. Ultimately, it doesn't matter *why* estimating equity betas in this fashion 'does not work'. What matters is the fact that it does not work.

13. Finally, notwithstanding the inference to the contrary, the draft decision does not provide any basis for the conclusion that the empirical evidence presented by us is not persuasive.

14. In fact, the AER does not address the published literature at all except to quote Handley as if the quote supported the use of stock market equity betas:[6]

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5   Ibid, p.247

6   Ibid, p.244

> *"Noting the studies cited by CEG that test the Sharpe CAPM, Handley (2008) further states '[t]here is no consensus as to how the empirical evidence should be <u>interpreted</u>.'"* [Emphasis in original.]

> *"For example, Roll (1977) argues the choice between alternative forms of the CAPM is extremely sensitive to the choice of the proxy for the market portfolio and in particular, while the results of Black, Jensen and Scholes (1972) and Fama and MacBeth (1973) appear to support the Black CAPM over the Sharpe CAPM, "their results are fully compatible with the Sharpe-Lintner model and a specification error in the measured 'market' portfolio" (p.131)."*

15. The draft decision does not appear to understand that this discussion from Handley is simply pointing out that one reason why stock market betas are unreliable predictors of investors required returns is that they are unreliable estimates of the true equity beta (measured relative to all assets including housing, land, human capital etc). That is, assuming beta can be measured relative to the return on the stock market only *involves specification error in the measured 'market' portfolio.*

16. The draft decision does not appear to have regard to any evidence, persuasive or otherwise, to contest the established empirical findings we present. These empirical findings demonstrate that the AER cannot reasonably rely on stock market betas that are below 1.0 to set the NER equity beta below 1.0.

1. Introduction and background

17. The AER's draft decision in relation to the weighted average cost of capital (WACC) parameters to be set under the National Electricity Rules (NER) was issued in 11 December 2008. One of the most significant changes proposed by the AER is to reduce the equity beta to apply to electricity network businesses under the NER from 1.0 to 0.8.

18. The Joint Industry Associations (JIA) have asked CEG to review the AER's reasons for coming to this decision and, specifically, the regard that the AER has had for the September 2008 CEG report *Estimation of, and correction for, biases inherent in the Sharpe CAPM formula*. The JIA have also asked us to answer the following questions:

    i. In your view, is a 1.0 for equity beta appropriate for a benchmark efficient network service provider?

    ii. In your view, would an equity beta of 1.0 combined with an appropriate risk free rate provide the network service providers with a reasonable opportunity to recover at least their efficient costs of equity?

    iii. In your view, would an equity beta of 1.0 combined with an appropriate risk free rate for network service providers be consistent with the promotion of efficient investment electricity network services?

    iv. Would your answers to any of the above questions be different for an equity beta of 0.8?

19. This earlier report reviewed the empirical finance literature on whether the AER's method for estimating equity beta (ie, from stock market data) resulted in an accurate estimate of the cost of equity actually observed in the market place. Specifically, we asked whether an estimate of a firm's equity beta (estimated from stock market data) that is lower than 1.0 provides a basis for believing the risk premium demanded by investors (relative to government bond yields) is also proportionally below the average risk premium demanded by investors in listed stocks on that stock market.

20. Our conclusion was that the empirical literature, including work by Nobel Prize winning economists, is unanimous on this issue. Repeated tests of this

proposition find that the risk premium demanded by investors is *less than proportional* to the equity beta estimated using stock market data.[7] Many of these studies find that there is *no statistically significant* relationship between the equity beta estimated from stock market data and the risk premium demanded by investors – and some even find a negative relationship. We repeated the standard test using Australian data and similarly found that no statistically significant relationship existed between equity beta estimated from stock market data and return required by investors.

21. Notwithstanding our conclusions, the principal justification for the change proposed by the AER is that estimates of regulated business equity betas derived from stock market data are less than 1.0. This is based on the econometric work of Professor Ólan Henry of the University of Melbourne.[8] Based on Professor Henry's work, the AER concludes that:[9]

> *"... the empirical estimates would suggest a beta in the range of 0.44 to 0.68..."*

22. However, the AER then decides to adopt a value of 0.8 for the equity beta in recognition of the imprecision of the beta estimates, continuity of regulatory precedent and, in doing so, avoiding a 'mechanistic' adoption of the empirical estimates.

23. The draft decision does not refer to our results as one of the reasons for setting the equity beta above the range estimated empirically. But it does state on page 248 that:

> *Even if these concerns [CEG's concerns] were valid, the AER notes that the equity beta it has adopted is 0.12 to 0.36 higher than suggested by regression analysis using the Sharpe CAPM, being that any possible issue of bias is likely to have been negated.*

24. By questioning the validity of CEG's concerns, it appears that the AER does not accept, or at least believes that there is room for doubt about, CEG's summary of the empirical evidence. It is unclear to us on what basis the AER reaches this conclusion. The draft decision provides no reason not to have regard to this evidence and the advice that the AER commissioned from Associate Professor

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[7] See section 2.1 of our earlier report.

[8] Henry, O., *Econometric advice and beta estimation*, 28 November 2008

[9] Draft Decision, p.230

Handley confirms and does not contest our empirical findings.[10] Therefore it is difficult for us to respond to the AER's concerns as they are not clear to us.

25. Nonetheless the AER does claim to have made an adjustment that 'likely' negates the concerns we raise. However, no basis for reaching a conclusion that the concern is negated by such an adjustment is provided. Certainly, it is not based on an analysis of the empirical studies we report on, nor is any explanation given as to why setting equity beta *0.12 to 0.36 higher than suggested by regression analysis using the Sharpe CAPM* would likely negate the biases reported in those studies.

26. This report is structured as follows:

- section 2 provides a summary of our analysis. It sets out the key recommendations that CEG made in our initial report and the way in which these are misunderstood by the AER. It also discusses the analysis of Professor Handley, which supports our conclusions;

- section 4 provides our conclusions; and

- Appendix A provides a page-by-page description of the draft decision discussion by reference to findings. We do so in an attempt to reduce the scope for further misunderstanding of the relevance of our report.

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[10] Handley, Comments on the CEG reports, page 5 first dot point and associated footnote.

2. Summary

2.1. What did CEG recommend?

27. The primary conclusion of our previous report was intended to be simple and clear. We restate here what the key conclusion of this report was.

> **CEG key conclusion:** *Finance academics have repeatedly tested whether the required equity premium, above the government bond rate, is proportional to estimates of beta derived from stock market data. The unambiguous conclusion of this literature, across different stock markets and different time periods, is that no such proportionality exists. CEG also tested for the existence of this proportionality using Australian stock market data from 1964 to 2007. We found no statistically significant relationship between betas estimated from stock market data and investors' required returns.*

28. This is highly relevant to the AER's WACC review because the NER formula for the cost of equity is given by:

$$k_e = R_f + \beta_e \cdot (\mathbb{E}[R]_m - R_f) \tag{i}$$

where: R_f is the prevailing yield on nominal Commonwealth Government Securities (CGS);

β_e is the equity beta; and

$R_m - R_f$ is the expected market risk premium (MRP) being the expected return on the market less the risk free rate.

29. This formula has, as a mathematical property, a proportional relationship between the equity premium above the government bond rate ($\beta_e \cdot (\mathbb{E}[R]_m - R_f)$) and the equity beta ($\beta_e$) .

30. It follows that, given our key conclusion above, the AER should put little weight on estimates of equity beta derived from stock market data to set beta in this equation. Put simply, finance economists have repeatedly tested whether setting equity beta *in the above formula* based on estimates of equity beta from stock market data will accurately determine the cost of equity (k_e) . They have repeatedly found that it will not do so. These studies have consistently found, and our own study using Australian data finds, that using an estimate for the equity beta of 1.0 was more reliable than using an estimate derived from stock market data.

31. Put simply, estimating an equity beta for regulated businesses from stock market data of less than 1.0 does not provide persuasive evidence that the equity beta in the NER should be set below 1.0. This is the case so long as the point of selecting an equity beta is to attempt to accurately estimate required returns demanded by equity investors. In the context of the NER equation above the key implication of the empirical literature is:

> ***Key implication of the empirical literature:*** *When implementing the NER CAPM formula do not assume that equity betas derived from stock market data provide a sound basis for determining the equity beta in the NER CAPM.*

32. This conclusion is based entirely on empirical facts. For the readers convenience these empirical facts are re-summarised here by setting out the empirical estimates of the difference between the expected return on a zero beta stock and the government bond rate. We note that Handley is in error, when he states that we do not estimate the expected return on a zero beta portfolio. This is a result of our regression analysis and the regression analysis of the studies we cite [11]

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[11] The second dot point of section 2.2 of the Handley report states that *"CEG does not identify the zero beta portfolio let alone directly estimate its expected return"*. The zero beta portfolio of the Black CAPM is the minimum variance portfolio with zero beta. Page 245 of the AER Decision states that CEG *"interpret"* the intercept in a regression of average return on betas as the return on the zero-beta portfolio." It should be noted that (A) the claim in Handley is false in that CEG do identify the zero beta portfolio and estimate its return and (B) that the CEG 'interpretation' is the correct one. In a regression of Y on X the estimated intercept is a weighted combination of the Y variables, with the weights chosen such that (i) that weighted combination of the X variables is zero and (ii) the variance across all weighted combination of the Y variables satisfying (i) is minimized. In the context of a regression of returns (the Y vector) on betas (the X vector), the intercept is in fact equal to the return on an appropriately constructed portfolio; i.e., the intercept is a weighted combination of the returns on the set of assets. The portfolio is constructed such that (i) its beta is zero and (ii) its variance is the minimum across all portfolios that could have been so constructed. The regression intercept identifies the return on the zero beta portfolio. The $(X'X)^{-1}X'$ matrix identifies the portfolio weights of the zero beta portfolio. For a complete discussion of the relation between the regression intercept and the return on the zero beta portfolio see Chapter 9 Section D Least Squares Coefficients as Portfolio Returns of the classic text Fama (1976) Foundations of Finance (New York: Basic Books).

Table 1: Summary of empirical results

Study	Return on zero beta stock *above* the Government bond rate (% pa)
Black Jensen and Scholes (1972)	4.4%
Fama and Macbeth (1973)	6.0%
Fama and French (1992), Reinganum (1981), Stambaugh, (1982), Lakonishok and Shapiro, (1986).	Consistent or higher than above
Campbell and Vuolteenaho (2004)	Above the market return
Professor Jagannathan (presented in capacity as ACCC guest speaker at 2008 Conference)	7.8%
CEG – 300 largest Australian stocks	7.3%

33.   The relevant context for these results is that the draft decision is proposing to reduce the return above the risk-free rate required by regulated businesses from 6.0% to 4.8%. This proposal is based entirely on estimates of equity betas derived from stock market data of between 0.44 to 0.68. However, the empirical studies listed in Table 1 suggest that even if regulated businesses had zero equity betas they would still earn returns that were more than 4.8% above the risk-free rate.

2.2. Theoretical explanation of these empirical regularities

2.2.1. Explanations provided in CEG's report

34.   Notwithstanding the fundamentally empirical nature of our conclusions, we did provide a discussion of the possible theoretical explanation for the empirical facts. In doing so, we noted that the NER formula is consistent with an implementation of the Sharpe CAPM[12] with the additional assumption, not made by Sharpe, that the yield on CGS is an appropriate proxy for the unobservable risk free rate. We noted that the finance literature had since Sharpe's seminal 1964 paper relaxed many of his assumptions which he himself described as restrictive and unrealistic. We described, as a matter of theory, these amendments could explain the empirical results documented in the finance literature.

35.   The purpose for doing so was simply to provide a theoretical background to the empirical results. We also felt it was important for the AER to understand the

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[12]   Following, Sharpe, William F., 1964, "Capital asset prices: A theory of market equilibrium under conditions of risk," Journal of Finance 19, pp. 425-442. CAPM stands for capital asset pricing model.

state of current finance theory and the uncertainties in that theory. We continue to believe that the AER should understand that the simplistic estimation of equity betas from stock market data does not provide a sound basis for setting the cost of equity for a regulated business either as a matter of:

- empirical fact based on repeated testing of the proposition; or

- as a matter of theory based on the state of current finance theory.

2.2.2. Explanations provided in Professor Handley's report

36. The AER commissioned a report from Professor Handley to assess our report. It is important to note that Handley:

    v. acknowledges the veracity of our survey of the literature and that our own study of Australian data is consistent with this survey. Handley does not provide any criticism of our empirical conclusions or any basis to consider them unsound; and [13]

    vi. provides an additional theoretical explanation for these empirical results that we did not discuss in our study.

37. This additional theoretical explanation is important in the context of the logic of the draft report so we provide a brief discussion of it here.

38. The empirical literature has established that the use of the Sharpe CAPM formula in conjunction with an equity beta estimated from stock market data provides a biased estimate of the cost of capital for those firms with equity betas so estimated that are either above or below 1.0. Handley notes that there are two theoretical explanations for this:

- First, it could be that the unrealistic assumptions underlying the derivation of the Sharpe CAPM formula cause it not to accurately predict reality (this was the focus of the theoretical discussion in our report);

- Second, it could be that the formula is correct but estimates of equity beta derived from stock market data are biased proxies for the true Sharpe CAPM equity beta.

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[13] Handley's phraseology is: "the empirical evidence presented by CEG is not new – excluding the results of its own study". See page 5 of Comments on the CEG Reports 20 November 2008. .

39. Handley elaborates on the second of these possible explanations in section 2.1 of his report. In summary, Handley states that an alternative theoretical explanation for the failure of the Sharpe CAPM formula using equity betas derived from stock market data, following Roll (1977),[14] is that these equity betas (and the MRP for that matter) are biased estimates of the true underlying Sharpe CAPM equity beta.

40. The reason why this might be the case is that the true Sharpe CAPM equity beta (and MRP) should be measured relative to all assets in the economy. In addition to listed equity these include: non-listed equity, housing and other property, human capital, and debt. In order to implement the Sharpe CAPM correctly, beta should be measured relative to the returns on all of these assets – not just listed equities.

41. Put simply, under this explanation proffered by Handley (which we agree is a possible explanation) the reason why the AER's methodology does not work is not because the Sharpe CAPM is flawed but is because the AER methodology is not a proper implementation of the Sharpe CAPM.

42. Of course, the important point is not so much why the AER methodology is flawed but the fact that it is.

43. The draft decision does not appear to fully comprehend the implications of the point that Handley was making when referencing Roll (1977). For example, the draft decision states, as if it were critical of our key conclusions, the following passage:[15]

> *"Noting the studies cited by CEG that test the Sharpe CAPM, Handley (2008) further states '[t]here is no consensus as to how the empirical evidence should be <u>interpreted</u>.'"* [Emphasis in original.]

> *"For example, Roll (1977) argues the choice between alternative forms of the CAPM is extremely sensitive to the choice of the proxy for the market portfolio and in particular, while the results of Black, Jensen and Scholes (1972) and Fama and MacBeth (1973) appear to support the Black CAPM over the Sharpe CAPM, "their results are fully compatible with the Sharpe-Lintner model and a specification error in the measured 'market' portfolio" (p.131)."*

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[14] Roll, Richard, 1977, A critique on the asset pricing theory's test Part 1: On past and potential testability of the theory, *Journal of Financial Economics*, 4, pp.129-176.

[15] Draft decision, p.244

44.   CEG relied on the studies by Black Jensen and Scholes (1972) and Fama and Macbeth (1973) in our report (and other studies like them including our own which employed the same methodology using Australian data). The AER appears to suggest that the work of Roll (1977) implies a criticism of the empirical results of Black Jensen and Scholes (1972) and Fama and Macbeth (1973) that gives the AER cause to give less weight to these studies' empirical results.

45.   Quite the opposite is the case. As described above, Roll's work takes as given that applying the Sharpe CAPM using equity betas from market data provides biased estimates of the cost of capital (ie, takes the empirical results we present as given). Roll simply states that this may be because the betas so estimated are biased rather than because the Sharpe CAPM is incorrect.

46.   This is the 'specification error' in the above quote from Handley. It is also a specification error that would apply to the AER's proposed estimates of beta. Rather than providing a basis for not having regard to the empirical results we report, the Handley/Roll discussion provides another theoretical reason for scepticism about the AER's method.

47.   This is clearly the implication of Handley when he states (and the draft decision quotes) *'[t]here is no consensus as to how the empirical evidence should be interpreted'*. The emphasis in this quote is Handley's and clearly not meant to suggest a lack of consensus over the empirical results we rely on. Rather it is simply a statement that there are many competing theoretical explanations for these results.

> **Conclusion**
>
> The AER's proposed implementation of the Sharpe CAPM, based on equity beta estimates from stock market data, is not a pure implementation of the Sharpe CAPM. This point is made by Handley and we agree.
>
> The AER's method of implementing the Sharpe CAPM has been rigorously tested in the finance literature, including by us using Australian data, and found to be unreliable. An implementation that used equity beta's closer to 1.0 would be more accurate.
>
> This is the relevant conclusion of our report and it is a conclusion with which Handley appears to agree and certainly does not dispute in his report.

2.3. AER treatment of CEG results

48. The draft decision states:[16]

    "CEG recommends that the AER either:

    - *rejects the use of the Sharpe CAPM and replaces this with the Black CAPM, or*

    - *makes an adjustment to the Sharpe CAPM to make it mathematically equivalent to the Black CAPM.*

    CEG notes that implemented consistently, either approach will give the same result. Accordingly which option is adopted 'is a matter of form and not substance'.

    Issues and AER's considerations

    The AER agrees with the JIA that the NER mandates the use of the Sharpe CAPM in determining the cost of equity. Essentially this means that neither recommendation of CEG, both of which are a departure from the Sharpe CAPM, is permissible under the NER. This could present a dilemma if this requirement was in conflict with other requirements of the NER, however the AER does not consider the JIA or CEG have provided persuasive

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[16]   Ibid, p.242

evidence that there is a conflict with the use of the Sharpe CAPM and the other requirements of the NER."

49. From this quote the logic of the draft decision appears to be:

    vii. CEG's recommendation not to rely on estimates of beta from stock market data to set beta in the NER formula constitutes a departure from the Sharpe CAPM. The Sharpe CAPM is mandated by the NER and, consequently, it is not permissible for the AER to act on CEG's recommendations;

    viii. This would cause a dilemma if CEG's empirical evidence were persuasive but the AER does not believe it is.

50. We take each of these logical steps in turn.

2.3.1. Departure from the Sharpe CAPM

51. In our opinion as professional economists the NER mandates, at most, the use of the Sharpe CAPM functional form, but makes no mention of how the AER should populate this formula other than requiring the AER to have regard to:[17]

    "the need for the rate of return calculated for the purposes of clause 6.5.2(b) to be a forward looking rate of return that is commensurate with prevailing conditions in the market for funds and the risk involved in providing standard control services"

52. In our view this would suggest that the AER is required *to* have regard to the key implication of our report, as described at paragraph 31 above (rather than a requirement to do the opposite).

53. It is correct that we expressed the view that maintaining the NER equity beta at 1.0 despite estimates of equity betas for regulated businesses (derived from stock market data) of less than 1.0 would be both:

    ▪ consistent with the empirical evidence on the cost of equity actually required by investors and consistent with providing the best estimate of the cost of equity actually required by investors; and

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[17]   NER, clause 6.5.4(e)(1)

- consistent with the theoretical underpinnings of the Black CAPM (as well as the Merton CAPM, etc).

54. However, the *key implication of the empirical literature* (as described at paragraph 31 above) does not rely on a particular interpretation of *why* those results exist.

55. We do not know with any certainty *why* the empirical evidence is as it is. But we do know with certainty that it *is* what it is. It is the latter that we think should be of primary concern to the AER when interpreting Professor Henry's empirical estimates of beta. We do not believe that the AER should be deterred from having regard to *what are the empirical facts* simply on the basis that the *explanation* may involves a departure from the assumptions of Sharpe (1964),[18] especially not when Sharpe (1964) himself described those assumptions as:[19]

   "Needless to say, these are highly restrictive and undoubtedly unrealistic assumptions."

56. Even if the AER is required not to consider theoretical explanations for the uncontested facts where those explanations involve a departure from the *highly restrictive and undoubtedly unrealistic assumptions* of the Sharpe CAPM, we assume that the AER can still have regard to the uncontested facts. This is especially given that, consistent with the advice from Handley,

57. those facts can be explained by the fact that equity betas estimated from stock market data (such as estimated by Professor Henry) can be poor proxies for the true underlying Sharpe CAPM equity betas.

58. In any event, we note that firms must raise equity in the real world not a hypothetical theoretical model. The empirical facts we provide reveal that equity betas derived from stock market data are not a good indicator of the cost of raising equity in the real world.

2.3.2. AER conclusion that the evidence we present is not persuasive

59. We are unable to respond directly to this claim by the AER as we cannot identify any discussion where the AER addresses itself to the persuasiveness of the empirical literature we summarise (and with which Handley concurs). The draft

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[18] Sharpe, William F., 1964, A Theory of Market Equilibrium Under Conditions of Risk, *The Journal of Finance*, 19, pp.425-442.

[19] Ibid, p.434.

decision does quote from Handley about a *lack of consensus* about this literature. However, as described above, Handley refers to a lack of consensus on *why* the empirical facts are as they are – not a lack of consensuses on *what* the empirical facts are.

60. Most of the AER's discussion of our report is focussed on the difficulties the AER perceives with implementing a departure from the Sharpe CAPM. This may well be the case, but it is irrelevant. The AER does not need to depart from the Sharpe CAPM to implement the key implication of the empirical literature as described at paragraph 31 above and repeated here.

> ***Key implication of the empirical literature:*** *When implementing the NER [Sharpe] CAPM formula do not assume that equity betas derived from stock market data provide a sound basis for determining the equity beta in the NER [Sharpe] CAPM.*

61. Finally the draft decision does provide some criticisms of the CEG empirical estimates for Australia. Neither of these criticisms are found in Handley's advice to the AER so we assume that they are generated internally. In our view, these criticisms are symptomatic of the general failure of the draft decision to understand the empirical literature and its important implications. Specifically, on page 245 the AER states:

> *"Furthermore, CEG finds that there does not appear to be any significant relation between equity beta and equity returns in the Australian market. Accordingly, the AER considers that little, if any, useful information can be obtained from the shape of the slope (which was not found to be statistically significant)."*

62. This statement suggests a profound lack of understanding of statistical concepts. CEG's finding was that there was little relationship between the empirically estimated equity beta and equity returns in the Australian market.[20] That is, the slope coefficient was insignificantly different from zero.

63. The AER appears to interpret this as evidence that our results are themselves statistically insignificant. Quite the contrary, the result of statistical insignificance is powerful evidence that a beta estimated from stock market data is a very poor predictor of actual returns. Put simply, the draft decision is using the key finding

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[20] Note that this is an empirical result and does not necessarily suggest that, in theory, the Sharpe CAPM may be an adequate representation of reality. The result may, as suggested by Handley, be caused by problems in the estimation of beta. This is precisely the point of our conclusions – that it would not be appropriate to rely on empirical estimates of beta to the extent that the AER does.

of our report (a lack of statistical evidence that stock market beta influence market returns) as if it is somehow undermining of our conclusion.

64. Second, the AER offers an opinion on the validity of the statistical tests applied by CEG, by suggesting:

*"Furthermore, of the six different data sets used by CEG to test the Sharpe CAPM – five comprise equal-weighted portfolios and one comprises value-weighted portfolios. As the market portfolio in the Sharpe CAPM is value-weighted, this **may** mean that the five regressions based on equal-weighted portfolios are not a test of the Sharpe CAPM."* [emphasis added]

65. The AER's implication is incorrect. The regressions based on equal-weighted portfolios are a valid test of the Sharpe CAPM as implemented by the AER (ie, based on equity betas derived from stock market data). Weighting stocks in the portfolio equally or based on their market capitalisation does not affect the validity of the test. In fact we note this is the same method as used by Black, Jensen and Scholes (1972)[21] and Fama and Macbeth (1973).[22] These are amongst the top finance academics and include Nobel Prize winner Merton Scholes. If the CAPM accurately described expected returns, then the expected return on both equal-weighted portfolios and value-weighted portfolios would be described by the CAPM. The CAPM can be validly tested using either equal-weighted or value-weighted portfolios.

66. Either the regressions do, or do not, result in invalid statistical tests. Whether this is so is a matter of fact, not a matter of opinion. In our opinion, the use of 'may' reflects a confusion on the part of the AER between the role of the value-weighted market when estimating beta and the nature of portfolios whose returns should be described by the CAPM. In our opinion, a fundamental misunderstanding of the CAPM and the empirical tests thereof (as suggested by its use of 'may') should not form part of the reasoning in the AER's draft decision.

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[21] Black, Fisher, Michael C. Jensen and Myron Scholes, 1972, "The Capital Asset Pricing Model: Some empirical tests," in M.C. Jensen (Ed), Studies in the Theory of Capital Markets, Praeger, NY.

[22] Fama, Eugene F. and James D. Macbeth, 1973, "Risk, return and equilibrium," *Journal of Political Economy* 81, pp. 607-636.

> **Conclusion**
>
> The draft decision does not present a single basis for not having regard to the empirical evidence we present.
>
> Absent such a basis, the AER should determine its estimate of NER equity beta in the context of the key implication of that empirical evidence as set out at paragraph 31 above.
>
> In our view, doing so would result in the AER not lowering the NER equity beta below 1.0.
>
> Nonetheless, whatever decision the AER comes to should involve proper reconciliation to the empirical evidence.

3. Conclusion

67. The key implication of our first report for the JIA, as described at paragraph 31 above, is not inconsistent with a requirement under the NER to use the Sharpe CAPM (to the extent that such a requirement actually does exist). The AER has not provided any basis to question the validity of these empirical results.

68. In the absence of such basis the AER should accept the validity of these results and have regard to them when setting the equity beta in the NER formula. This requires more than setting the equity beta in the NER formula 'above' the empirically estimated equity betas using stock market data. It requires the AER to understand that literature and arrive at an NER equity beta that is consistent with that literature. The draft decision does not do this.

69. In our opinion, having proper regard to this literature would lead the AER to the conclusion that it has no persuasive evidence for lowering the NER equity beta parameter of the Sharpe CAPM in the determination of the return actually required by equity investors to a value below 1.0. This is true notwithstanding the fact that the AER has concluded that the range for the equity beta, derived from stock market data, is between 0.44 and 0.68.

70. In relation to the specific questions we have been asked:

   Q1: In your view, is a 1.0 for equity beta appropriate for a benchmark efficient network service provider?

71. Based on the evidence the AER has before it in this review our conclusion is that an equity beta of 1.0 is the estimate of the equity beta parameter in the NER that is most likely result the cost of equity being accurately estimated in the NER. This assumes that the MRP has been accurately determined relative to the relevant risk free rate proxy.

72. In our view this is consistent with the findings of the empirical literature set out in this report and in our previous report.

Q2: In your view, would an equity beta of 1.0 combined with an appropriate risk free rate provide the network service providers with a reasonable opportunity to recover at least their efficient costs of equity?

73. In our view the answer to this question is yes, provided that the remainder of the regulatory regime (including compensation for the cost of debt) works appropriately. This is consistent with our answer to question 1 and relies on the same logic. Given that the efficiently incurred cost of equity is best estimated with an NER equity beta of 1.0, a network service provider should have a reasonable opportunity to recover this efficient cost if the NER equity beta is set equal to 1.0 (and the rest of the regulatory regime works appropriately to allow other efficient costs to be recovered).

Q4 In your view, would an equity beta of 1.0 combined with an appropriate risk free rate for network service providers be consistent with the promotion of efficient investment electricity network services?

74. In our view the answer to this question is yes. Other things equal, if the NER cost of equity is underestimated then firms will have an incentive to under invest or to delay investment relative to an efficient level and timing of investment.

75. Unchecked, this may result in lower quality and security of supply and/or in higher electricity generation prices (to the extent that network congestion as a result of underinvestment causes high cost generators to be dispatched more frequently than they otherwise would be). If regulatory authorities cannot induce the efficient level of spending voluntarily (by offering a return commensurate with the cost of investing) they will be required to over compensate via resort to punitive measures to elicit the necessary spending - such as service quality penalties.

76. Apart from considerations of fairness, it is likely that this will be a second best method of eliciting the efficient level of investment. Consequently, setting the NER equity beta equal to 1.0 is likely to promote efficient investment by reducing the need for the AER to rely on punitive measures to elicit investment.

Appendix A. Page by page analysis of the draft decision

77. The section of the draft decision that is relevant to its consideration of the CEG report is section 8.5.5.1 and is titled "Sharpe-Lintner CAPM". Given the apparent misunderstanding of our results and the importance of this in the AER's reasoning, we consider it useful to address its arguments page by page.

78. In the remainder of this section, we set out each contention that the AER makes, in the order that it makes them, and indicate in summary boxes whether we agree or disagree with these contentions, and the extent to which we regard them as relevant.

A.1. Page 241

79. At page 241 the AER states that the functional form of the CAPM applied in the NER, whilst not named, is clearly the Sharpe-Lintner CAPM (or simply the Sharpe CAPM).

Not contested

The exact definition of the Sharpe-Lintner CAPM is not described by the draft decision. We note that this is potentially an issue that is open to interpretation.[23] However, we do not believe anything of importance turns on this so we do not contest it.

A.2. Pages 241-2

80. The JIA is quoted as conceding that the use of the Sharpe CAPM is mandated under the NER. However, based on CEG's report, the JIA recommend that the deficiencies of the Sharpe CAPM be accounted for in determining the WACC parameters under the NER.

81. The AER claims that these views, combined, may suggest a perceived conflict between the use of the Sharpe CAPM and the requirement to set a reasonable rate of return.

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[23] For example, the NER formula assumes the government bond rate is a the risk free rate but this is not an assumption in Sharpe (1964) nor Lintner (1965).

Disagree

The key implication of our report, as described at paragraph 31 above, is not inconsistent with a requirement under the NER to use the Sharpe CAPM (to the extent that such a requirement actually does exist).

A.3. Pages 242-3

82.   The AER ascribes views to CEG as follows:

> *"CEG argues on both theoretical and empirical grounds against using the Sharpe CAPM. It states that the Sharpe CAPM is based on a number of unrealistic assumptions, some of which have been relaxed in subsequent versions of the CAPM. In particular:*

> ▪   *the Black CAPM" ... ", and*

> ▪   *the Merton (or intertemporal) CAPM..."*

> *...*

> *"CEG recommends that the AER either:*

> ▪   *rejects the use of the Sharpe CAPM and replaces this with the Black CAPM, or*

> ▪   *makes an adjustment to the Sharpe CAPM to make it mathematically equivalent to the Black CAPM."*

> **Not contested**
>
> Here the AER associates our recommendations with a departure from the Sharpe CAPM. This is not how we would describe our recommendations.[24]
>
> However, nothing turns on this. The key implication of our report, as described at paragraph 31 above, is not inconsistent with a requirement under the NER to use the Sharpe CAPM (to the extent that such a requirement actually does exist).
>
> Handley's own advice to the AER elegantly demonstrates this by clearly setting out why the AER's implementation is itself inconsistent with the Sharpe CAPM (by virtue of it relying solely on equity betas derived from stock market data).

A.4. Page 243

83. The AER begins its deliberations of the JIA's submission and CEG's report by stating:

    "The AER agrees with the JIA that the NER mandates the use of the Sharpe CAPM in determining the cost of equity. Essentially this means that neither recommendation of CEG, both of which are a departure from the Sharpe CAPM, is permissible under the NER."

> **Disagree**
>
> The key implication of our report, as described at paragraph 31 above, is not inconsistent with a requirement under the NER to use the Sharpe CAPM (to the extent that such a requirement actually does exist).
>
> In any event, it is unclear how the AER makes this logical connection. The NER mandates the use of the Sharpe CAPM functional form, but makes no mention of how the AER should populate this formula other than requiring the AER to have regard to:[25]
>
> *"the need for the rate of return calculated for the purposes of clause 6.5.2(b) to be a forward looking rate of return that is commensurate with prevailing conditions in the market for funds and the risk involved in providing standard control services"*

---

[24] We would describe our recommendations as describing how to take into account the overwhelming empirical evidence that using market derived betas in the NER cost of equity formula will result in errors. We would describe our report as noting that this is consistent with the predictions of the Black CAPM (and other versions of the CAPM).

> In our view this would suggest that the AER is required *to* have regard to the key implication of our report, as described at paragraph 31 above (rather than a requirement to do the opposite).

84. The AER goes on to state that whilst it shares some concerns about the CAPM with CEG, it regards the approach it has taken, by adjusting the range resulting from empirical estimates upward to 0.8, to have 'likely' addressed any concerns arising from the use of the Sharpe CAPM.

    "Even if these concerns [CEG's concerns] were valid, the AER notes that the equity beta it has adopted is 0.12 to 0.36 higher than suggested by regression analysis using the Sharpe CAPM, being that any possible issue of bias is likely to have been negated." [Page 248]

Disagree

The draft decision does not attempt to explain or test this conclusion against the empirical literature.

It is our conclusion that when we examine this literature that an observed equity beta (based on stock market data) of 0.44 to 0.68 *does not* provide a basis for setting the equity beta in the NER formula at 0.8. To the extent that the AER reaches a different conclusion we believe that it should explain how this conclusion is arrived at. To do so it needs to reference the empirical literature.

A.5. Page 243-5

85. The remainder of the AER's discussion focuses on its concerns with the CEG report. It introduces the opinions of Professor Handley here. Briefly summarised, Professor Handley's views, as summarised by the AER, are:

    ▪ that the empirical evidence regarding the Sharpe CAPM presented by CEG (other than the empirical evidence in the CEG study) is not new and the relevant literature dates back to the 1970's; and

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[25]   NER, clause 6.5.4(e)(1)

- that there is no consensus in the literature as to how this evidence should be interpreted.

86. The AER adds to this by observing that despite the existence of this literature, the Sharpe CAPM remains in use by regulators around the world, possibly due to the lack of consensus regarding how to interpret the literature.

> **Agree**
>
> We agree with Professor Handley's statements. However, we note that the lack of consensus relates to *why* the empirical results are as they are – not *what* they are.
>
> We agree that some regulators around the world utilise the Sharpe CAPM formula. We also note that others do not (such as US regulators who commonly use the dividend growth model). However, we are unaware of any other regulator in the world who would discount having regard to established empirical facts on the basis that they may be inconsistent with their implementation of the particular asset pricing model they use.

A.6. Page 245

87. CEG's results are briefly summarised and our conclusions represented as:

> *"CEG considers that these results suggest that the Black CAPM may be a better predictor of returns than the Sharpe CAPM, however it does not test the predictive power the Black CAPM."*

> **Disagree**
>
> The key implication of our report, as described at paragraph 31 above, is not inconsistent with a requirement under the NER to use the Sharpe CAPM (to the extent that such a requirement actually does exist).

88. The AER goes on to claim:

> *"Furthermore, CEG finds that there does not appear to be any significant relation between equity beta and equity returns in the Australian market. Accordingly, the AER considers that little, if any, useful information can be obtained from the shape of the slope (which was not found to be statistically significant)."*

> **Disagree**
>
> The AER's comments suggest a profound lack of understanding of statistical concepts. CEG's finding was that there was little relationship between the empirically estimated equity beta and equity returns in the Australian market.[26] That is, the slope coefficient was insignificantly different from zero.
>
> The AER appears to interpret this as evidence that our results are themselves statistically insignificant. Quite the contrary, the result of statistical insignificance is powerful evidence that an empirically estimated beta is a very poor predictor of actual returns.

89.   Finally, the AER offers an opinion as the validity of the statistical tests applied by CEG, by suggesting:

> *"Furthermore, of the six different data sets used by CEG to test the Sharpe CAPM – five comprise equal-weighted portfolios and one comprises value-weighted portfolios. As the market portfolio in the Sharpe CAPM is value-weighted, this **may** mean that the five regressions based on equal-weighted portfolios are not a test of the Sharpe CAPM."* [emphasis added]

> **Disagree**
>
> The AER's implication is incorrect. The regressions based on equal-weighted portfolios are a valid test of the Sharpe CAPM and utilise the same methodology as used by Black, Jensen and Scholes (1972)[27] and Fama and French (1973).[28]
>
> In any case, either this methodology does, or does not, result in invalid statistical tests. If the AER is not sure as to whether or not this is the case (as suggested by its use of 'may') then in our opinion its view on the matter should not form part of its reasoning in its draft decision.

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[26]   Note that this is an empirical result and does not necessarily suggest that, in theory, the Sharpe CAPM may not be an adequate representation of reality. The result may, as suggested by Handley, be caused by problems in the estimation of beta. This is precisely the point of our conclusions – that it would not be appropriate to rely on empirical estimates of beta to the extent that the AER does.

[27]   Black, Fisher, Michael C. Jensen and Myron Scholes, 1972, "The Capital Asset Pricing Model: Some empirical tests," in M.C. Jensen (Ed), Studies in the Theory of Capital Markets, Praeger, NY.

[28]   Fama, Eugene F. and James D. Macbeth, 1973, "Risk, return and equilibrium," *Journal of Political Economy* 81, pp. 607-636.

A.7. Page 245-6

90. Here, the AER goes at some length to discuss CEG 'recommendation' to adopt the Black CAPM. The AER suggests that:

- CEG's results themselves may be inconsistent with the Black CAPM;

- on the basis of our literature review, CEG ought to have recommended another form of CAPM, such as the Merton CAPM; and

- that CEG 'appears' to regard the Fama and French three factor model as the best predictor of returns and accordingly should have recommended this model.

Disagree or not contested

The key implication of our report, as described at paragraph 31 above, is not inconsistent with a requirement under the NER to use the Sharpe CAPM.

A.8. Page 246-7

91. The AER expresses the view that if the Sharpe CAPM were 'fundamentally flawed' then this is a problem with the NER framework and should not be fixed by the regulator manipulating parameters of the framework. It states that it is unable to review the use of the Sharpe CAPM in the NER and in any case, there is no agreement on what might replace it. For example, the draft decision states:

> *"Most significantly, even if the AER was able to depart from the Sharpe CAPM, given the lack of consensus on an alternative, switching between different asset pricing models at each review as various alternative models fall in and out of favour would be highly likely to increase regulatory uncertainty. Such an outcome would not be consistent with the National Electricity Objective. A departure from the Sharpe CAPM should only be to an alternative that is clearly superior to other models and well-accepted. Such an alternative does not exist."*

92. In any case, the AER stated that since the issues raised by CEG were not new, businesses had already a chance to respond to the use of the Sharpe CAPM in the formulation of the NER.

Disagree or not contested

The key implication of our report, as described at paragraph 31 above, is not inconsistent with a requirement under the NER to use the Sharpe CAPM (to the extent that such a requirement actually does exist).

Having proper regard to this literature does not require the AER to *"switch between different asset pricing models at each review as various alternative models fall in and out of favour"*. In fact, the empirical results we refer to are very stable. Having regard to these results would make the regulatory regime more stable not less – insulating the change in equity beta at each review from variations in beta estimated from stock market data over time.

In simple terms, our recommendation is simply that the NER equity beta be set above the level derived by estimating equity beta from stock market data. This is precisely what the AER has itself done (setting the NER equity beta 0.12 to 0.36 above its estimated range). The only difference between our recommendation and the AER's implementation is that ours is based on having regard to established empirical literature and the AER's adjustment is a subjective judgement not obviously grounded in empirical facts.

93. We note that outside the AER's discussion of our report, when summarising its conclusions the draft decision states on page 252:

- *"Neither the Blume nor Vasicek adjustments (assuming a 'prior belief' of one) should be applied in a regulatory context as either adjustment is likely to introduce an upwards bias in the beta estimates."*

…

- *"In considering the empirical evidence, the AER's approach to reviewing the equity beta is to take a balanced approach to the application and interpretation of market data by having regard to the strengths and weaknesses of the market data available. In a practical sense this means that the AER does not propose to change the equity beta value as far as the market data would suggest, even though the market data suggests the value is substantially different to the previously adopted value(s). In reviewing the equity beta, as for the other parameters, the AER has given consideration to other factors, such as the importance of*

regulatory stability, in order to promote efficient investment, so as to contribute to the National Electricity Objective. Consequently, whilst the market data in isolation presents a strong case for establishing an equity beta at a point consistent with [the] above range, the AER has taken a broader view in the context of the National Electricity Objective and having regard to the current financial environment.

- *Finally, the AER notes the JIA submits that the use of the Sharpe Lintner CAPM may understate an equity beta which less than one. While, the AER has concerns over some of this analysis on the alleged biases of the Sharpe CAPM, the AER considers that even if these biases are valid, the AER has not adopted a 'mechanical' approach in applying the empirical beta estimates derived from regression analysis using the Sharpe CAPM."*

94. We consider this basis for decision making is flawed. In terms of the first two dot points:

- the basis for the AER not imposing a 'prior belief' of one (first dot point) is entirely theoretical. The uncontested empirical literature in our report suggests that such a prior belief *is* appropriate. However, the AER gives no consideration to these empirical results; and

- when the AER states in the second dot point *"this means that the AER does not propose to change the equity beta value as far as the market data would suggest"* it is referring only to the equity betas estimated by Professor Henry. The market data this is most relevant to is the market data we present which tests whether equity betas such as those estimated by Professor Henry are indicative of the return that investors actually require. Proper regard to this means that the AER has *proposed to change the equity beta value further than the (relevant) market data on equity investors' required returns would suggest.*

95. In terms of the reference to our report, this quote suggests that notwithstanding that the *"the AER has concerns over some of this analysis"*, '*even if*' the empirical results we present are '*valid*', the the AER has not implemented a mechanical approach to setting the equity beta. In response we note:

- the AER has presented no concerns over the empirical results from the published finance literature (and no valid concern over the empirical results we report using Australian data). Handley confirms that these results are established in the literature; and

- if these results are valid (and they are uncontested) then the fact that:

  "… the AER has not adopted a 'mechanical' approach in applying the empirical beta estimates derived from regression analysis using the Sharpe CAPM"

  is irrelevant. What the AER is required to do is have proper regard to those results. Had it done so it would not have come to the conclusions that we quote in the first two dot points at paragraph **Error! Reference source not found.** above..

A.9. Page 247-8

96. In coming to the nub of CEG's arguments, which the AER accurately quotes on page 247, the AER appears not to disagree with the fundamental contention that the use of empirically estimated equity betas in the Sharpe CAPM will result in a biased cost of equity.

97. However, the AER considers that it has appropriately addressed these concerns by selecting an equity beta of 0.8, even though its empirical estimates suggest a range of 0.44 to 0.68.

   "While the AER has concerns over some of CEG's analysis on the alleged biases of the Sharpe CAPM, even if these biases were valid, and as noted above the AER has not adopted a 'mechanical' approach in applying the empirical beta estimates derived from regression analysis using the Sharpe CAPM. Empirical estimates suggest an equity beta in the range of 0.44 to 0.68, however taking all considerations into account, the AER has adopted an equity beta of 0.8. Accordingly, even if the Sharpe CAPM did underestimate the beta these concerns are likely to have been addressed by the AER adopting an equity beta between 0.12 to 0.36 higher than what empirical estimates would suggest."

Disagree

We do not consider that it is sufficient to state that the draft decision has 'likely' addressed the empirical literature by setting the equity beta above the empirical estimates using stock market data. To reach this conclusion one would need to analyse that empirical literature. In our opinion, doing so leads to the conclusion that it has likely not addressed our concerns.

98.