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Appendix F

Comment on the UT5 draft decision on equity beta

REPORT PREPARED FOR AURIZON NETWORK

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Comment on the UT5 draft decision on equity beta

Contents

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Figures

Tables

1   Executive summary

1   Frontier Economics has been retained to review and respond to the Queensland Competition Authority's (QCA's) equity beta estimate in its Draft Decision[1] in relation to Aurizon Network's (Aurizon's) 2017 Draft Access Undertaking for the UT5 period.

1.1   Key findings

2   My key conclusions in relation to the equity beta estimate in the UT5 Draft Decision are set out below.

3   **Inconsistent processing of the evidence (see Section 2 of this report):**

a. The QCA adopted an asset beta estimate of 0.45 (and an associated equity beta estimate of 0.8) for UT4, but in its Draft Decision for UT5 has proposed an asset beta estimate of 0.42 (and an associated equity beta estimate of 0.73). However, relative to the UT4 case, for UT5 the QCA's adviser's point estimate of the asset beta for Aurizon Network was identical and its proposed reasonable range was slightly higher. Notwithstanding that it was presented with essentially the same advice in relation to UT5, the QCA has decided to lower the asset beta estimate from 0.45 to 0.42. The Draft Decision does not set out the basis on which it has been determined that a reduction to the beta estimate is appropriate.

b. The fact that the same (or slightly higher) evidence has resulted in a lower beta allowance is inconsistent with the promotion of regulatory certainty, which the QCA has identified as a key principle. In adopting a beta allowance of 0.8, above the consultant's point estimate of 0.73, the QCA stated:

> The QCA's assessment of beta for the 2016 Undertaking determined that the equity beta estimate be set at 0.8 but recognised that Incenta's recommended estimate of 0.73 was justifiable. In approving an equity beta of 0.8, among other considerations, the QCA acknowledged the need for regulatory certainty.[2]

c. In making the UT5 Draft Decision, it appears that the QCA has overlooked a key consideration it cited in its UT4 decision for selecting an asset beta estimate of 0.45, above the mean point

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[1] QCA, Aurizon Network's 2017 draft access undertaking, Draft Decision, December 2017 (Draft Decision).

[2] Draft Decision, p. 90.

estimate of 0.42—namely, that estimating betas with high precision is extremely difficult, which suggests that:[3]

  i. "caution be shown in making significant changes to previous estimates"; and

  ii. "selecting a point estimate as precise as 0.73 may represent an attempt to be over-precise."

  d. The UT4 Final Decision stated that the "best" possible estimate of beta had been adopted, given the evidence available at the time. For the UT5 period, the QCA has proposed to adopt a lower beta estimate, notwithstanding that the available evidence is essentially unchanged (and, if anything, slightly *higher*) since its UT4 Final Decision. If the QCA's approach for the UT4 period was to adopt the best possible estimate of beta, and the empirical evidence on Aurizon's beta has not changed since, then it follows that by adopting a lower estimate of the beta for the UT5 period, the QCA has not adopted the best possible estimate of the beta for the UT5 period.

  e. Put another way, if the asset beta allowance for the UT4 period was set to compensate Aurizon fairly for the opportunity cost of capital, and the evidence has not changed since, it follows that reducing the asset beta allowance for the UT5 period would result in Aurizon being undercompensated over that period.

4   **Failure to correct for low-beta bias (see Section 0 of this report):**

  a. The UT5 Draft Decision does not address the well-recognised "low-beta bias" phenomenon. The low-beta bias problem refers to the tendency for the Sharpe-Lintner Capital Asset Pricing Model (SL-CAPM)—the model adopted by the QCA for the purposes of determining the cost of equity allowance—to systematically underestimate the required returns for stocks with an equity beta estimate less than 1.0.

  b. The QCA's adviser, Incenta, has not considered the low-beta bias problem in its advice to the QCA, so Incenta's mean estimate of beta makes no correction or allowance for this problem.

  c. In our view, the Draft Decision should account for the low-beta bias problem by selecting a point estimate for beta that is greater

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[3] QCA, Aurizon Network 2014 Access Undertaking — Volume IV—Maximum Allowable Revenue, Final Decision, April 2016, p. 249.

than the raw mean estimate of beta derived through empirical application of the SL-CAPM to returns data.

d. In our view, the evidence of low beta bias is compelling. It has been consistently reported over several decades and across many markets, it is discussed in standard textbooks, and adjustments are made in relation to it by other regulators. For example, in its recent decisions, the AER recognises (a) that beta estimates are inherently imprecise and cannot be precisely measured to two decimal places, but can only be narrowed down to a reasonable range, and (b) there is evidence that the SL-CAPM systematically under-states the return on low-beta stocks. This leads the AER to select an allowed beta from the top of the reasonable range.

5 **Over-emphasis on the influence of regulation and market power on systematic risk (see Section 4 of this report):**

a. The QCA's overriding consideration when selecting comparator firms for the task of beta estimation appears to be the influence of regulation and market power on Aurizon's exposure to systematic risk. This is evident from the fact that the QCA has adopted a beta estimate for Aurizon derived exclusively using a sample of regulated energy and water businesses, and Incenta's reasons for recommending these firms as relevant comparators rely heavily on the extent to which potential comparators are either subject to cost-based regulation or enjoy significant market power.

b. This means little or no weight is given to other relevant factors (such as industry characteristics, customer concentration and exposure to certain types of customer) that affect beta and should therefore inform the selection of comparators.

c. All of the comparator groups considered by the QCA—regulated energy and water businesses, toll roads, pipelines and railroads— likely have some useful information to contribute to the task of estimating Aurizon's beta. Therefore, in our view, at least some weight should be afforded to all of that relevant evidence, rather than assigning effectively 100% weight to a single sub-sample.

d. The UT5 Draft Decision gives no weight to toll roads, pipelines or other railroads. If *any* weight was given to *any* of this evidence, the beta estimate would increase. Our view is that at least some weight should be given to some of this relevant evidence.

1.2   Author of report

6   This report has been authored by Professor Stephen Gray, Professor of Finance at the UQ Business School, University of Queensland and Director of Frontier Economics, a specialist economics and corporate finance consultancy. I have Honours degrees in Commerce and Law from the University of Queensland and a PhD in Financial Economics from Stanford University. I teach graduate level courses with a focus on cost of capital issues, I have published widely in high-level academic journals, and I have more than 20 years' experience advising regulators, government agencies and regulated businesses on cost of capital issues. I have published a number of papers that specifically address beta estimation issues. A copy of my curriculum vitae is attached as an appendix to this report.

7   My opinions set out in this report are based on the specialist knowledge acquired from my training and experience set out above. I have been provided with a copy of the Federal Court's Expert Evidence Practice Note GPN-EXPT, which comprises the guidelines for expert witnesses in the Federal Court of Australia. I have read, understood and complied with the Practice Note and the Harmonised Expert Witness Code of Conduct that is attached to it and agree to be bound by them.

8   I have been assisted in the preparation of this report by Dinesh Kumareswaran and Simon Lang from Frontier Economics.

2   Inconsistent regulatory decision-making

9   The UT5 Draft Decision adopts an equity beta estimate of 0.73. This equity beta estimate is derived using:

> a.   The Conine formula;
>
> b.   An asset beta estimate of 0.42;
>
> c.   A debt beta of 0.12;
>
> d.   A benchmark level of gearing of 55%;
>
> e.   A corporate tax rate of 30%; and
>
> f.   A gamma estimate of 0.46.

2.1   Incenta's advice in relation to UT5

10   The asset beta estimate of 0.42 adopted by the QCA was informed by analysis conducted by its adviser, Incenta.

11   Incenta concluded that:[4]

> a.   The mean raw statistical estimate of the asset beta is 0.42. This estimate is derived using a sample of regulated energy and water businesses, and using 10-year monthly and weekly data; and
>
> b.   An upper bound estimate of the asset beta is 0.50. This estimate is derived using a sample of toll road comparators, and using 10-year monthly and weekly data.

12   Incenta did not derive a lower bound estimate noting that such a task "would entail considerable imprecision."[5]

13   The QCA concluded that:

> The QCA's view is that 0.42 reflects the most appropriate empirical estimate of Aurizon Network's asset beta at this time and is commensurate with the regulatory and commercial risks involved in providing access to the service. This asset beta converts to an equity beta of 0.73, using the Conine re-levering approach applied by both Aurizon Network and Incenta. The QCA's draft decision is to adopt these point estimates, specifically an asset beta of 0.42 and equity beta of 0.73.[6]

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[4] Incenta, Aurizon Network's WACC for the 2017 DAU, December 2017, p. 15.

[5] Incenta, Aurizon Network's WACC for the 2017 DAU, December 2017, p. 15.

[6] UT5 Draft Decision, p. 90.

2.2   Incenta's advice in relation to UT4

14   Incenta was also engaged by the QCA to advise on rate of return matters in relation to Aurizon's 2016 undertaking. Incenta's recommendation in relation to the asset beta were, for the UT4 period, almost identical to its recommendations for the UT5 period.

15   Specifically, Incenta concluded that:[7]

   a.   Its preferred asset beta estimate was 0.42. This estimate was (like Incenta's advice for the UT5 period) derived using a sample of regulated energy and water businesses; and

   b.   An upper bound estimate of the asset beta was 0.49. This estimate was (like Incenta's advice for the UT5 period) derived using a sample of toll road comparators.

16   In its Final Decision for the UT4 period, the QCA adopted an asset beta estimate of 0.45, which was higher than the mean energy/water estimate of 0.42 recommended by Incenta.

17   In explaining its decision to adopt a higher estimate than the one recommended by Incenta, the QCA noted that it had taken the following considerations into account:[8]

   a.   Estimating betas with high precision is difficult—suggesting: (a) caution be shown in making significant changes to previous estimates; and (b) selecting a point estimate as precise as 0.73 may represent an attempt to be over-precise.

   b.   The need for regulatory certainty, particularly noting the 2014 Draft Access Undertaking approval process is Aurizon Network's first regulatory reset since privatisation of its parent company.

   c.   The QCA's proposed asset beta of 0.45 was well within the range of 0.35 to 0.49 identified by Incenta—also noting this range is close to the 0.35 to 0.50 range used in previous decisions.

   d.   Changes to the regulatory arrangements, such as introduction of the revenue cap and accelerated depreciation, were already considered as part of the 2010 undertaking decision.

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[7] Incenta, Review of regulatory capital structure and asset / equity beta for Aurizon Network and response to stakeholder comments, April 2014.

[8] QCA, Aurizon Network 2014 Access Undertaking — Volume IV—Maximum Allowable Revenue, Final Decision, April 2016, pp. 249-250.

e. The QCA's intent to maintain an environment conducive to investment in new infrastructure, including user-funded investment.

2.3 The QCA position adopted in the UT5 Draft Decision

18 As explained above, the QCA was provided with almost identical recommendations on the asset beta by Incenta in relation to the UT4 and UT5 periods, except that the upper bound of the range had *increased* from 0.49 to 0.50. However, in the UT5 Draft Decision, the QCA has proposed to adopt a *lower* asset beta than the estimate it adopted in the Final Decision for the UT4 period.[9]

19 In other words, the QCA appears to have processed the same evidence differently in the two regulatory periods. No clear reasoning has been provided for this change of approach. For example:

a. In its Final Decision for the UT4 period, the QCA explained that caution should be shown in departing from previous estimates because estimating betas with high precision is difficult. The Draft Decision for UT5 does not explain why this is no longer true. Nor does it explain why it is reasonable to depart from the previous decision when the updated empirical evidence is essentially unchanged, and if anything higher.

b. The UT4 Final Decision stated that "selecting a point estimate as precise as 0.73 may represent an attempt to be over-precise." The UT5 Draft Decision does not explain why this consideration is no longer important.

c. The UT4 Final Decision noted that the asset beta adopted, 0.45, lay comfortably within the range identified by Incenta. Although Incenta did not estimate a lower bound for the asset beta in its latest advice to the QCA, Incenta did recommend a preferred estimate and an upper bound, which were almost identical (with upper bound slightly higher) to those recommended by Incenta in

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[9] The Draft Decision implies (p. 91) that it is reasonable for the QCA to arrive at a different decision on the appropriate asset beta for the UT5 period because the methodology used by Incenta "is different here to the approach adopted for the 2016 Undertaking." Specifically, notes the QCA, Incenta considered monthly and weekly returns data when formulating its recommendations in relation to the UT5 period, but Incenta considered only monthly data when deriving its estimates for the UT4 period. In our view, this is not a sound reason to adopt a different decision because, as is evident, the difference in approach highlighted by the QCA had no influence on the estimates it recommended to the QCA: the point estimate and upper bound for the asset beta recommended by Incenta for the UT4 and UT5 periods were virtually identical.

relation to the UT4 period. Since the estimates recommended by Incenta have not changed since UT4, except to increase the upper bound, it is unclear why the same evidence would now support a different beta estimate.

d. The UT4 Final Decision stated that the QCA sought to "maintain an environment conducive to investment in new infrastructure, including user-funded investment." The QCA's proposal to lower the allowed asset beta (and therefore the allowed rate of return) for the UT5 period (even though the evidence in unchanged) suggests that maintaining an environment conducive to investment in new infrastructure is now a less important consideration. However, the UT5 Draft Decision does not explain why—particularly since less than 21 months has elapsed between the publication of the UT4 Final Decision (April 2016) and the UT5 Draft Decision (December 2017).

20   In the UT5 Draft Decision, the QCA noted that it had adopted for the UT4 period an equity beta allowance that was higher than the estimate recommended by Incenta, but that an important consideration in making that decision was the promotion of regulatory certainty:

> The QCA's assessment of beta for the 2016 Undertaking determined that the equity beta estimate be set at 0.8 but recognised that Incenta's recommended estimate of 0.73 was justifiable. In approving an equity beta of 0.8, among other considerations, the QCA acknowledged the need for regulatory certainty, noting the 2016 Undertaking was Aurizon Network's first regulatory reset since the privatisation of its parent company.[10]

21   Now the QCA proposes to set the equity beta allowance in line with Incenta's mean energy/water beta of 0.73, even though the empirical evidence has not changed. This raises several questions:

a. Does this imply that regulatory certainty is no longer an important consideration for the QCA?

b. If that is the case, why is regulatory certainty no longer important?

c. If regulatory certainty still remains an important consideration for the QCA, how can the QCA's decision to set a lower beta allowance for the UT5 period (when presented with the same empirical evidence) be squared with the fact that the QCA adopted a *higher* allowance for the UT4 period in the interest of promoting regulatory certainty?

22   None of these questions are answered in the UT5 Draft Decision.

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[10] Draft Decision, p. 90.

23 Finally, the QCA justifies its decision to set a lower beta allowance for the UT5 period by noting that it had foreshadowed, when considering Aurizon's previous Draft Access Undertaking, that it may reduce Aurizon's beta allowance in future regulatory periods:

> In any case, the QCA indicated, as part of its assessment of Aurizon Network's 2014 DAU, that the evidence suggested that an equity beta of 0.8 (asset beta of 0.45) could be considered conservative. The QCA also noted that future considerations of a beta estimate for Aurizon Network could lead to reductions in this estimate.[11]

24 It is worth noting that nowhere in its Final Decision for the UT4 period did the QCA indicate that it would consider lowering the beta allowance in future periods. The QCA did suggest in its 2014 Draft Decision on Maximum Allowable Revenue that "future consideration of the betas for Aurizon Network may well lead to further reductions."[12] However, all such statements had been removed from the QCA's Final Decision for the UT4 period. So, it was by no means clear from the UT4 Final Decision that the QCA's intention was to consider setting a lower beta allowance in future periods.

25 However, the QCA's justification of its decision to reduce the beta allowance in this way is inconsistent with the statement in the UT4 Final Decision that it had selected the best available estimate at the time based on the evidence then available.

26 When the QCA was considering Aurizon's 2016 Draft Access Undertaking, a number of stakeholders (such as QRC, Anglo American, Vale and BMA) that the QCA had inappropriately adopted "an asset beta at the higher end of the identified range", which suggested a tendency for the QCA to "err on the high side."[13]

27 The QCA responded to these submissions by arguing that it had not "erred on the high side" or "inappropriately set an asset beta at the higher end of a range."[14] The QCA went on to state that its approach is to always adopt the best estimate for each parameter, and that that was the approach it had adopted in its Final Decision for the UT4 period:

> In our MAR draft decision, we stated that we do not consider it appropriate to estimate a WACC at the upper end of a range. We explained that our approach is to apply the best estimate for each WACC parameter, rather than to err on the high side. We added that we consider this approach best achieves a weighting of the factors set out in section 138(2) of the QCA Act that achieves an appropriate balance between the

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[11] Draft Decision, p. 90.

[12] QCA, Aurizon Network 2014 Draft Access Undertaking – Maximum Allowable Revenue, Draft Decision, September 2014, p. 253.

[13] QCA, Aurizon Network 2014 Access Undertaking — Volume IV—Maximum Allowable Revenue, Final Decision, April 2016, p. 267.

[14] QCA, Aurizon Network 2014 Access Undertaking — Volume IV—Maximum Allowable Revenue, Final Decision, April 2016, p. 268.

competing interests of the various stakeholders. We maintained that opinion in our consolidated draft decision.

On balance, we considered our estimate of Aurizon Network's asset beta represents the best estimate we could make using our judgement of all relevant information. The cross-check provided by the identified lower and upper bounds provided us with further comfort that our estimate was appropriate.[15]

28   If the QCA's approach for the UT4 period was to adopt the best possible estimate of the asset beta, and the empirical evidence on Aurizon's asset beta has not changed since, then it follows that by adopting a different (lower) estimate of the asset beta for the UT5 period, the QCA has not adopted the best possible estimate of the asset beta for the UT5 period.

29   Put another way, if the asset beta allowance for the UT4 period was set to compensate Aurizon fairly for the opportunity cost of capital, and nothing has changed since, it follows that reducing the asset beta allowance for the UT5 period would result in Aurizon being undercompensated over that period.

2.4   Selecting a point estimate from within the range

30   In its UT4 Final Decision, the QCA adopted an asset beta of 0.45 as the "best estimate" from the available evidence.[16] The QCA stated that it had not "erred on the high side" or "inappropriately set an asset beta at the higher end of a range,"[17] which extended to 0.49 at that time.

31   However, it may be appropriate to set an allowed parameter above the best point estimate in circumstances where:

> a.   The estimate of the parameter is inherently uncertain such that it cannot be reliably estimated to two decimal places, but can only be narrowed down to within a reasonable range; and
>
> b.   The regulator is required to ensure that the allowed return is *at least* sufficient to provide an appropriate return and to promote efficient investment.[18]

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[15] QCA, Aurizon Network 2014 Access Undertaking — Volume IV—Maximum Allowable Revenue, Final Decision, April 2016, p. 268.

[16] QCA, Aurizon Network 2014 Access Undertaking — Volume IV—Maximum Allowable Revenue, Final Decision, April 2016, p. 268.

[17] QCA, Aurizon Network 2014 Access Undertaking — Volume IV—Maximum Allowable Revenue, Final Decision, April 2016, p. 268.

[18] See for example, s 69E and s168A of the QCA Act 1997. Such provisions are designed to recognize the asymmetry of consequences. Setting the allowed return too high may encourage investment to be brought forward before it is required, whereas setting the allowed return too low may result in a lack of efficient investment.

32   In a similar context, the AER narrows down its beta estimate to within a reasonable range and then selects a point estimate from the top of that range. The reasons identified for that approach include the importance of transparency and predictability in rate of return decisions and the inherent uncertainty involved in the beta estimation exercise:

> We recognise the importance of providing stakeholders with **transparency** and **predictability** in our rate of return decisions…In this context, a point estimate of 0.7 is consistent with our Guideline.

> It also recognises the **uncertainty inherent** in estimating unobservable parameters, such as the equity beta for a benchmark efficient entity.[19]

33   In the context of the UT5 Draft decision:

   a.   There is a lack of predictability in that the evidence presented was the same (or slightly higher) than for the UT4 Final Decision less than two years prior, and yet a lower beta was adopted;

   b.   There is a lack of transparency in that the UT4 Final Decision indicated that the beta adopted there was the best estimate based on the available evidence, and the UT5 Draft Decision provides no explanation or why a different estimate has been adopted from the same (or slightly higher) evidence; and

   c.   There is a lack of recognition of the inherent uncertainty in beta estimates, in contrast to the UT4 Final Decision which explicitly recognised that beta cannot be reliably estimated to two decimal places.[20]

2.5   Conclusion on consistency of equity beta allowances

34   In summary:

   a.   Notwithstanding that the QCA was presented with essentially the same advice on the asset beta in relation to both UT4 and UT5, the UT5 Draft Decision does not explain the basis on which it has been determined that it is appropriate to lower the equity beta from 0.45 to 0.42.

   b.   In doing so, the QCA has overlooked a key consideration it cited in its UT5 period decision for selecting an asset beta estimate of

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[19] AER, November 2017, APA VTS Final Decision, Attachment 3, p. 65, emphasis added.

[20] QCA, Aurizon Network 2014 Access Undertaking — Volume IV—Maximum Allowable Revenue, Final Decision, April 2016, pp. 249-250

0.45 rather than the mean energy/water asset beta of 0.42—namely, that estimating betas with high precision is difficult, which suggests that caution be shown in making significant changes to previous estimates", and that selecting a point estimate as precise as 0.73 may represent an attempt to be over-precise.

c. In its Final Decision on the UT4 period, the QCA stated that it had adopted the "best" possible estimate of beta, given the evidence available at the time. If the QCA's approach for the UT4 period was to adopt the best possible estimate of beta, and the empirical evidence on Aurizon's beta has not changed since, then it follows that by adopting a lower estimate of the beta for the UT5 period, the QCA has not adopted the best possible estimate of the beta for the UT5 period.

d. Because beta estimates are known to be statistically imprecise, and because regulatory regimes reflect the asymmetric consequences of that estimation imprecision by requiring that allowed returns provide *at least* sufficient compensation, it is important that a regulator does not rely exclusively on a single statistically imprecise beta point estimate. Such an approach involves a substantial risk of under-compensating investors.

3 Failure to account for low-beta bias

3.1 The nature of low-beta bias

35   The QCA uses the Sharpe-Lintner Capital Asset Pricing Model (SL-CAPM) to determine Aurizon's return on equity allowance.

36   Since the publication of the SL-CAPM in the 1960s, numerous academic studies have been conducted, using 80 years of data, and in several countries, to test empirically how the SL-CAPM performs. A brief survey of some of the most well-known and cited of these studies is provided in the Appendix to this report.

37   The consensus from this literature, accumulated over a period of more than four decades of research using more than eight decades of data, is that the SL-CAPM performs poorly as an empirical model. The overwhelming evidence is that:
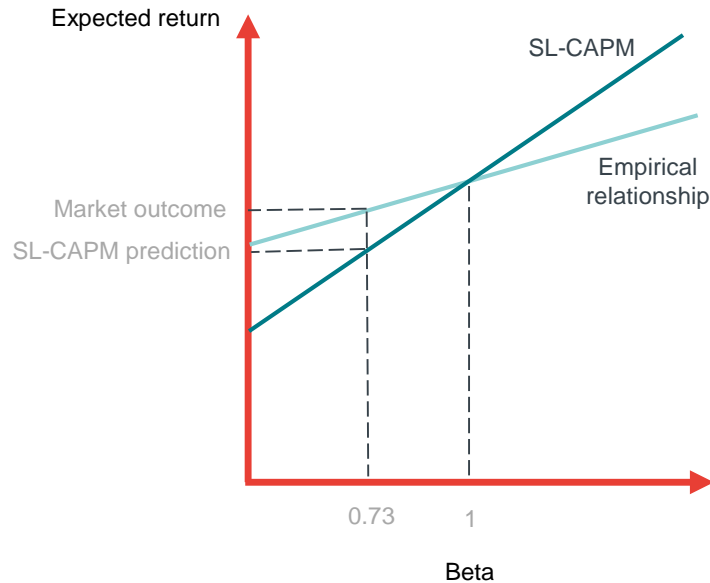
    a.   The SL-CAPM systematically underestimates the required return on low-beta stocks (i.e., those with a beta estimate less than 1);

    b.   The SL-CAPM systematically overestimates the required return on high-beta stocks (i.e., those with a beta estimate more than 1); and

    c.   The magnitude of the bias is greater when the beta estimate is further away from 1.

38   This result is now so well-accepted in the discipline of academic finance that it is described in standard finance textbooks,[21] and is taught in undergraduate university courses.

39   In the regulatory setting, the focus has been on stocks with a beta less than 1, because regulators tend to consider the infrastructure firms that they regulate to have lower than average systematic risk. Figure 1 below shows that for stocks with a beta less than 1, the SL-CAPM consistently underestimates actual stock returns. This empirical result is known as the 'low-beta bias.'

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[21] For example: Brealey, R.A., S.C. Myers, and F. Allen, 2011, *Principles of Corporate Finance,* 10th ed., McGraw-Hill Irwin.

Figure 1: Sharpe-Lintner CAPM vs. empirical relationship

40   The QCA has proposed an equity beta allowance for Aurizon of 0.73. This estimate represents the raw output from the empirical application of the SL-CAPM by Incenta. Neither Incenta nor the QCA made any allowance for the low-beta bias problem when selecting an equity beta point estimate.

41   In our view, in order to derive the "best" estimate of the equity beta—as the QCA has explained it seeks to do[22]—it must select a final point estimate of the equity beta above the raw statistical estimate compiled by Incenta. In other words, the QCA should have adopted:

    a.   An asset beta estimate greater than 0.42; and, therefore

    b.   An equity beta estimate greater than 0.73.

3.2   The AER's approach to low-beta bias

3.2.1 The AER's 2013 Rate of Return Guideline

42   In its 2013 Rate of Return Guideline materials, the AER stated that it will account for the evidence of low-beta bias,[23] noting that:

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[22] QCA, Aurizon Network 2014 Access Undertaking — Volume IV—Maximum Allowable Revenue, Final Decision, April 2016, p. 268.

[23] AER, 2013, Rate of Return Guideline, p. 13.

> …the Sharpe–Lintner CAPM may underestimate the return on equity for firms with equity betas less than one.[24]

43   The AER then goes on to demonstrate how the equity beta can be adjusted to correct for low beta bias. That is, the low-beta bias can be offset by increasing the equity beta used in the SL-CAPM.[25]

3.2.2   The AER's recent final decisions

44   In its recent final decisions, the AER has maintained the position set out in its Guideline insofar as it recognises the evidence that the Sharpe-Lintner CAPM[26] systematically understates the returns of assets with an equity beta less than 1.

45   The AER first computes a range for the equity beta and then adopts a point estimate at the top of that range. The AER cites two key reasons for selecting a point estimate at the top of the range. One reason is the fact that beta estimates are statistically imprecise and the regulator should avoid placing too much reliance on a single point estimate as that would risk under-compensating investors – as discussed in the previous section. The second reason is in relation to the evidence that the Sharpe-Lintner version of the CAPM systematically understates the returns of low-beta assets:

> The theoretical principles underpinning the Black CAPM are reasonably consistent with an equity beta towards the upper end of our range. For firms with an equity beta below 1.0, the Black CAPM theory may support using a higher equity beta than those estimated from businesses with a similar degree of risk as APA when used within a Sharpe-Lintner CAPM. This is a result of the Black CAPM relaxing an assumption underlying the Sharpe-Lintner CAPM, which allows for unlimited borrowing and lending at the risk free rate.[27]

3.2.3   The Tribunal's considerations of low-beta bias

46   The Australian Competition Tribunal has also considered the issue of low-beta bias, and the adjustments that may be made to correct for it, in the *PIAC-Ausgrid* case.[28] In those proceedings, the Public Interest Advisory Centre (PIAC) submitted that the AER had erred in making any uplift at all to its starting point equity beta estimate of 0.5. However, the Tribunal concluded that there was no error in concluding that there was evidence of low-beta bias and that there was no error in making an uplift to the equity beta in relation to that evidence.

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[24] AER, 2013, Rate of Return Guideline, Explanatory Statement, Appendix A, p. 18.

[25] AER, 2013, Rate of Return Guideline, Explanatory Statement, Appendix C, Table C.11, p. 71.

[26] The simplest version of the CAPM, as used in the UT5 Draft Decision.

[27] AER, November 2017, APA VTS Final Decision, Attachment 3, pp. 64-65.

[28] Applications by Public Interest Advisory Centre Ltd and Ausgrid [2016] ACompT 1.

47   In response to PIAC's submission that there was no evidence of low-beta bias that would justify the AER departing from its starting point beta of 0.5, the Tribunal concluded that:

> Upon reviewing the whole of the material before the AER, the Tribunal however is not satisfied that that material does not support a conclusion that the SL CAPM provided a low equity beta bias.[29]

48   In relation to the evidence of low-beta bias, the Tribunal concluded as follows:

> It is, as the AER noted, correct that the three parameters for the SL CAPM – equity beta, risk free rate, and MRP – are recorded as giving a low beta bias for businesses with a beta (that is, the risk of the asset relative to the average asset) of less than 1.0, and that the Network Applicants are all within that group. There was also evidence that the low beta bias is exacerbated when it is combined with conditions of low government bond rates and a high MRP. Those conditions were applicable at the time of the AER Final Decisions.[30]

49   That is, the Tribunal accepted the existence of evidence of a low-beta bias – that the SL-CAPM systematically understates the returns of low-beta stocks.

50   The Tribunal then determined that there is no reviewable error in:

   a.   Recognising the existence of evidence of a low-beta bias; or

   b.   Accounting for that evidence by selecting an allowed beta from the top end of the estimated range.

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[29] *PIAC-Ausgrid*, 2016, Paragraph 779.

[30] *PIAC-Ausgrid*, 2016, Paragraph 731.

4 Over-emphasis on regulation and market power when selecting comparators

4.1 Incenta's approach to comparator selection for Aurizon

51 Incenta considered four groups of listed companies in order to select a set of comparators with which to estimate Aurizon's equity beta:

    a. Regulated energy and water businesses;

    b. Toll roads;

    c. North American pipelines; and

    d. Class 1 railroads.

52 Incenta then conducted an essentially qualitative, "first principles" analysis to identify which of these groups of firms is likely to provide the best set of comparators to Aurizon, for the purpose of beta estimation. Incenta concluded that:

> …among the industries considered, regulated energy and water businesses provide the best comparator industry for Aurizon Network.[31]

53 Little or no weight seems to have been given to other important factors, such as industry characteristics, customer concentration and exposure to certain types of customer. For instance, no weight is given to Class 1 railroads, even though Aurizon operates a rail network. The implication is that Class 1 railroads contribute *no relevant information at all* to the task of estimating the systematic risk of Aurizon, an operator of a rail network. The implication is that Class 1 railroads contribute *no relevant information at all* to the task estimating the systematic risk of Aurizon, an operator of a rail network. In our view, it is unreasonable to conclude that no other railroad provides any relevant information at all.

54 The approach that Incenta has followed in Aurizon's case implies that the characteristics of the industry being regulated by the QCA matters not at all to the task of estimating beta. Rather, the only thing that matters is that the firm is subject to cost-based regulation and, in the absence of regulation, the firm would enjoy significant market power.

55 Table 1 below presents the key conclusions from Incenta's first principles analysis on the relevance of each industry group. The highlighted text demonstrates that Incenta's overriding considerations when selecting comparators were:

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[31] Incenta, Aurizon Network's WACC for the 2017 DAU, December 2017, p. 43.

    a.   The extent to which the firms were subject to cost-based regulation that buffered the cash flows of the business; and

    b.   The extent of market power the business enjoys / the competitive pressures the business faces.

Table 1: Incenta's key conclusions from its first principles analysis

Comparator group	Incenta's conclusions
Regulated energy and water businesses	Both Aurizon Network and regulated energy and water businesses are monopoly service providers, have a 'captured' customer base with resilient demand for the service, and are subject to cost-based regulation for pre-set periods that cushions cash flows. These factors result in low sensitivity of demand / revenue to GDP shocks. We would therefore expect Aurizon Network and regulated energy and water businesses to have similar levels of exposure to systematic risk.
Tollroads	Unlike Aurizon Network, these businesses do not possess a high degree of market power, and while traffic can be sensitive to GDP shocks, there is no cost-based regulatory mechanism to cushion such shocks, which leads us to expect higher systematic risk for tollroads relative to Aurizon Network.
North American pipelines	Oil and gas transmission pipelines are subject to competitive pressures from parallel pipelines and alternative transport modes. As such, in general North American pipelines lack market power and their customers are not 'captured' like the customers of Aurizon Network. Furthermore, their regulatory framework differs from those applying to Aurizon Network and regulated energy and water businesses. The light handed regulatory regime for United State oil and natural gas pipelines relies on the existence of varying degrees of competition within the relevant markets, and it is this competitive pressure, not regulation, that often constrains them. There is no pre-determined regulatory period, and while cost-based regulation is applied to mitigate the pipeline carriers' market power where it exists, regulatory tariffs are influenced by market conditions. Hence, regulatory buffering of the cash flows of North American pipelines is limited in comparison to that of Aurizon Network. Uncontracted pipeline capacity is vulnerable to changing market conditions, and contract roll-off is likely to be a significant issue for North American pipelines. We therefore expect North American pipelines to have higher systematic risk than Aurizon Network.
Class 1 railroads	Class 1 railroads are expected to have materially higher systematic risk than Aurizon Network. Class 1 railroads are subject to competitive pressure from parallel railroads and alternative transport modes; carry loads that are highly sensitivity to GDP shocks; have relatively higher operating leverage; and their cash flows are neither constrained nor buffered by regulation, which merely monitors the rate of return being earned.

Source: Incenta, Aurizon Network's WACC for the 2017 DAU, December 2017, p. 43.

56   If this proposition is true, then irrespective of what industry the QCA were to regulate, the best set of comparators that Incenta would recommend would always be regulated energy and water businesses, because these are the best example of listed regulated monopolies that are readily available—to the exclusion of non-regulated listed firms operating in the industry in question.

57   By way of example, suppose the QCA were responsible for regulating airports in Queensland. There are at least 26 listed airports around the world that could be

Over-emphasis on regulation and market power when selecting comparators

Final

used as potential comparators for the purpose of beta estimation.[32] However, since most of these airports are not subject to formal cost-based regulation, Incenta's approach would rule these airports out as relevant comparators and would instead identify regulated energy and water businesses as the most relevant comparators.

58   Such an approach would be unreasonable because non-regulated airports clearly have *some* (perhaps even significant) useful information to contribute about the systematic risk of a regulated airport.

4.2   Incenta's approach to comparator selection for Seqwater

59   We also note that there seems to be an internal inconsistency in the way Incenta has conducted its first principles analysis for Aurizon, vis-à-vis other businesses regulated by the QCA. For example, Incenta recently advised the QCA on, amongst other issues, the appropriate set of comparators to use when estimating Seqwater's equity beta. In that instance, Incenta advised the QCA that "regulated water businesses" were the most appropriate comparators to Seqwater.[33]

60   Incenta did not recommend the use of regulated energy networks, noting that:

> While there are no water businesses listed on the Australian stock market, there is a small number of regulated Australian energy businesses, and a much larger number of international regulated energy businesses, which would be likely to exhibit similar systematic risk characteristics to Seqwater. However, we considered that if an adequate number of regulated water businesses could be found, this would provide a reasonable estimate of the asset beta of Seqwater.[34]

61   In other words, Incenta excluded regulated energy businesses from the comparator sample used to estimate Seqwater's beta—presumably on the basis that these firms operate in a different industry and are therefore face industry-specific factors that drive their systematic risk—even though these energy firms, like Seqwater, are regulated.

62   That is, out of a sample of firms that have the same form of regulation, Incenta and the QCA have adopted a sub-sample of water firms, eliminating energy firms. The only reason to do this if the industry in which the firm operates (water in that case) is relevant to the estimation of beta.   It seems internally inconsistent that

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[32] The New Zealand Commerce Commission uses a sample of 26 listed airports to estimate the beta of the three major airports in New Zealand that it is responsible for regulating. Commerce Commission, Input Methodologies Review Decisions, Topic 4 – Cost of capital issues, Attachment C, Table 32, pp. 242-244.

[33] Incenta, Estimating Seqwater's firm-specific WACC parameters for the 2018-21 bulk water price investigation, November 2017, p. 20.

[34] Incenta, Estimating Seqwater's firm-specific WACC parameters for the 2018-21 bulk water price investigation, November 2017, p. 20.

Over-emphasis on regulation and market power when selecting comparators

industry is a relevant consideration when estimating beta for water firms, but not when estimating beta for rail firms.

4.3   Conclusion on selection of comparator firms

63   My view is that regulation and market power could be relevant factors that drive systematic risk, but they are not the *only* relevant factors. However, by using only regulated energy and water businesses to estimate Aurizon's beta, the QCA places exclusive weight on these considerations alone.

64   All of the groups of firms considered by Incenta—regulated energy and water businesses, toll roads, pipelines and Class 1 railroads—have some useful information to contribute to the task of estimating Aurizon's beta.

65   Therefore, the QCA should assign some weight to each of these four groups, rather than attributing 100% weight to one of these groups, and 0% weight to the remaining three. The QCA's approach of using only beta estimates derived from regulated energy and water businesses discards potentially relevant information contributed by comparators from other industries—notably rail networks—that would improve the QCA's estimate of Aurizon's beta.

66   The approach of having regard to industry characteristics when estimating beta for water companies, but not having regard to industry characteristics when estimating beta for rail companies, is internally inconsistent.

5   Appendix: Empirical evidence on low-beta bias

67   Soon after the publication of the Sharpe-Lintner Capital Asset Pricing Model (SL-CAPM),[35] researchers began testing whether the predictions (or, more precisely, the empirical implications) of the model were supported in real-world data. The conclusion from this evidence is that the empirical implementation of the SL-CAPM provides a poor fit to the observed data. That is, when the SL-CAPM parameters are estimated empirically and inserted into the SL-CAPM formula, the resulting estimate of the required return on equity bears little resemblance to observed stock returns.

68   A key finding in this literature is that the SL-CAPM systematically:

   a.   Underestimates the beta of stocks with a beta estimate lower than 1 (referred to as low-beta bias); and

   b.   Overestimates the beta of stocks with a beta estimate greater than 1.

69   This Appendix summarises some of the relevant evidence.

Black, Jensen and Scholes (1972)[36]

70   A number of empirical tests are based on the following rearranged version of the SL-CAPM equation:

$$r_e - r_f = (r_m - r_f)\beta_e .$$

71   For example, Black, Jensen and Scholes (1972) construct tests of the model in the form of the following regression specification:[37]

$$r_{e,j} - r_{f,j} = \gamma_0 + \gamma_1 \beta_{e,j} + u_j .$$

72   The SL-CAPM implies that $\gamma_0 = 0$ and $\gamma_1 = r_m - r_f$. However, a series of studies including Black, Jensen and Scholes (1972) report that the intercept of this regression model is higher than the SL-CAPM would suggest ($\gamma_0 > 0$) and the

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[35] The SL-CAPM was derived independently by Sharpe (1964) and Lintner (1965). Sharpe, W., 1964, "Capital asset prices: A theory of market equilibrium under conditions of risk," *Journal of Finance,* 19, 425-442; and Lintner, J., 1965, "The valuation of risk assets and the selection of risky investments in stock portfolios and capital budgets," *Review of Economics and Statistics,* 13-37.

[36] Black, F., M.C. Jensen, and M. Scholes, 1972, "The Capital Asset Pricing Model: Some empirical tests," in *Studies in the Theory of Capital Markets,* Michael C. Jensen, ed., New York: Praeger, 79–121.
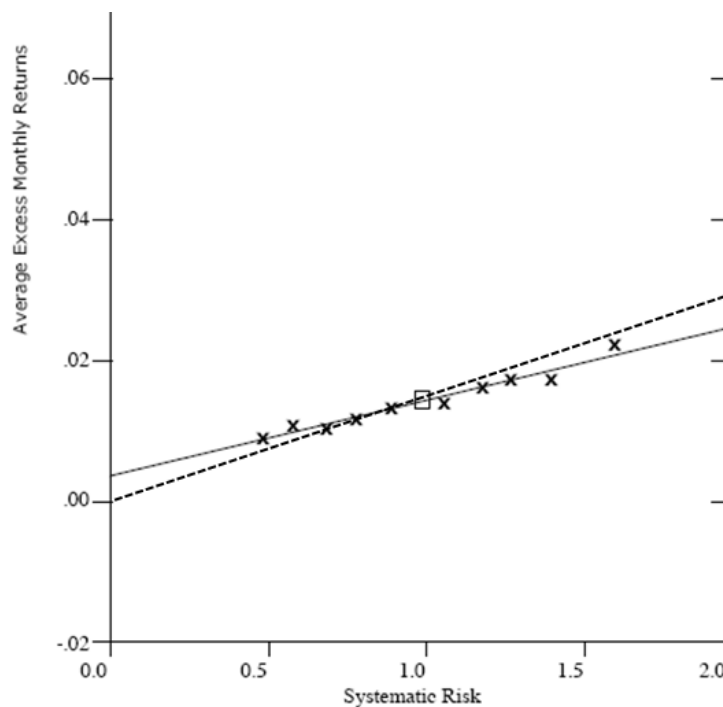
[37] See, for example, Black, Jensen and Scholes (1972), p. 3.

slope is flatter than the SL-CAPM would suggest $\left(\gamma_1 < r_m - r_f\right)$. For example, Black Jensen and Scholes (1972) state that:

> The tests indicate that the expected excess returns on high beta assets are lower than (1) [the Sharpe-Lintner CAPM equation] suggests and that the expected excess returns on low-beta assets are higher than (1) suggests.[38]

73   The main result of Black, Jensen and Scholes (1972) is summarised in Figure 2 below. In that figure, the dashed line represents the security market line[39] that is implied by the SL-CAPM and the solid line represents the best fit to the empirical data. The data suggests that the intercept is too high and the slope is too flat to be consistent with the SL-CAPM.

Figure 2: Results of Black, Jensen and Scholes (1972)

Source: Black, Jensen and Scholes (1972), Figure 1, p. 21. Dashed line for Sharpe-Linter CAPM has been added.

74   Black, Jensen and Scholes (1972) go on to define the intercept of the empirical regression line to be R_z, a quantity that has since become known as the "zero beta

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[38] Black, Jensen and Scholes (1972), p. 4.

[39] The term "security market line" refers to the linear relationship between beta and expected returns for individual assets or portfolios of assets. In empirical analysis this is typically measured as the line of best fit between beta estimates and realised returns for individual assets or portfolios of assets.

Appendix: Empirical evidence on low-beta bias

Final

premium."[40] They report that the zero beta premium over their sample period of 1931 to 1965 was approximately 4% per year.[41] They go on to conclude that:
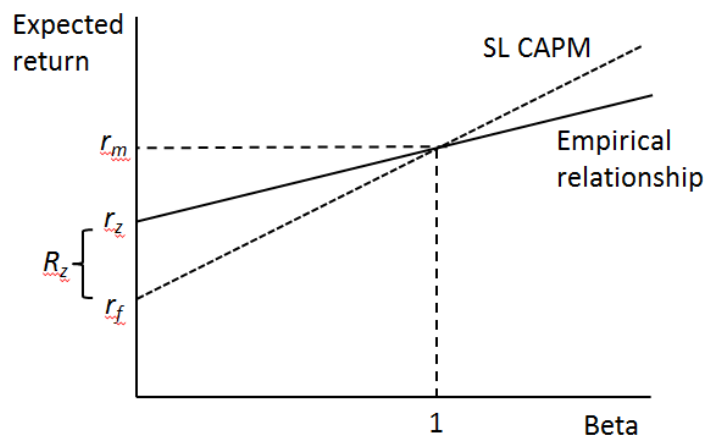
> These results seem to us to be strong evidence favoring rejection of the traditional form of the asset pricing model which says that Rz should be insignificantly different from zero.[42]

and that:

> These results indicate that the usual form of the asset pricing model as given by (1) [the SL-CAPM] does not provide an accurate description of the structure of security returns.[43]

75   The empirical relationship and the implications of the SL-CAPM are contrasted in Figure 3 below, which shows the SL-CAPM in its usual form. (Note that in Figure 2 Black, Jensen and Scholes (1972) show *excess* returns, after subtracting the risk-free rate.)

Figure 3: Sharpe-Lintner CAPM vs. empirical relationship.

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[40] We have not yet described the Black CAPM, but the term "zero beta premium" refers to the difference between the expected return on an asset with zero systematic risk (a zero beta) and the estimate of the risk-free rate (typically estimated as the yield on a government security).

[41] Table 5, p. 38 reports a monthly zero beta premium of 0.338% per month, which is approximately equivalent to 4% per year.

[42] Black, Jensen and Scholes (1972), p. 39.

[43] Black, Jensen and Scholes (1972), pp. 3–4.

Final   Appendix: Empirical evidence on low-beta bias
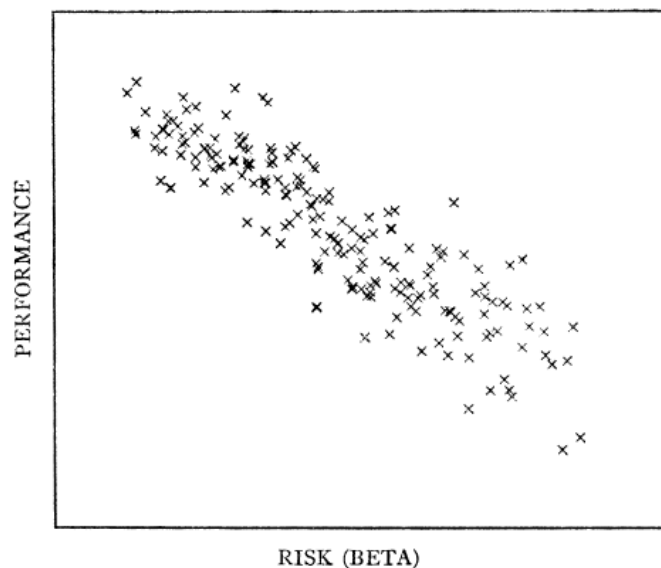
Friend and Blume (1970)[44]

76   Friend and Blume (1970) define the abnormal return (the Greek letter "eta" or η) to be the observed excess return of a stock (or portfolio) less the expected return from the SL-CAPM:[45]

$$\eta_i = (r_e - r_f) - (r_m - r_f)\beta_e .$$

77   Under the SL-CAPM, η_i should be zero on average and it should be independent of beta.   However, Friend and Blume (1970) report a systematic relationship between the abnormal return and beta – *low-beta* stocks generate *higher* returns than the SL-CAPM would suggest and *high-beta* stocks tend to generate *lower* returns than the SL-CAPM would suggest.   This relationship is shown clearly in Figure 4 below. Friend and Blume note that:

> The absolute values of the performance measures are in excess of market expectations for funds with Beta coefficients below one and below expectations for higher coefficients. [46]

Figure 4: The relationship between abnormal returns and beta

Source: Friend and Blume (1970), p. 567.

78   Friend and Blume (1970) go on to consider what it is about the SL-CAPM that results in it providing such a poor fit to the observed data.   They conclude that the

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[44] Friend, I., and M. Blume, 1970, "Measurement of portfolio performance under uncertainty," *American Economic Review*, 60, 561–75.

[45] Friend and Blume (1970), p. 563.

[46] Friend and Blume (1970), p. 569.

Appendix: Empirical evidence on low-beta bias

Final

most likely source of the problem is the assumption that all investors can borrow or lend as much as they like at the risk-free rate:

> Of the key assumptions underlying the market theory leading to one-parameter measures of performance, the one which most clearly introduces a bias against risky portfolios is the assumption that the borrowing and lending rates are equal and the same for all investors. Since the borrowing rate for an investor is typically higher than the lending rate, the assumption of equality might be expected to bias the one-parameter measures of performance against risky portfolios because, for such portfolios, investors do not have the same option of increasing their return for given risk by moving from an all stock portfolio to an investment with additional stock financed with borrowings at the lending rate.[47]

Fama and MacBeth (1973)[48]

79   Fama and MacBeth (1973) use the following regression specification:[49]

$$r_{e,j} = \gamma_0 + \gamma_1 \beta_{e,j} + u_j.$$

80   Under this specification, the SL-CAPM implies that $\gamma_0 = r_f$ and $\gamma_1 = r_m - r_f$. Fama and Macbeth (1973) note that previous empirical work has demonstrated violations of both of these implications of the SL-CAPM:

> The work of Friend and Blume (1970) and Black, Jensen, and Scholes (1972) suggests that the S-L hypothesis is not upheld by the data. At least in the post-World War II period, estimates of $E[\tilde{\gamma}_{0t}]$ seem to be significantly greater than R_{ft}.[50]

81   Fama and Macbeth (1973) then test the hypothesis that $\gamma_0 - r_f = 0$ on average. They reject that hypothesis in their data and conclude that:

> Thus, the results in panel A, table 3, support the negative conclusions of Friend and Blume (1970) and Black, Jensen, and Scholes (1972) with respect to the S-L hypothesis.[51]

Fama and French (2004)[52]

82   The consistent results in the studies reviewed above are not unique to the data from the periods examined in those studies. Rather, the results have proven to be consistent through time – low-beta stocks generate higher returns than the SL-

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[47] Friend and Blume (1970), p. 569.

[48] Fama, E.F., and J.D. MacBeth, 1973, "Risk, return, and equilibrium: Empirical tests," *Journal of Political Economy*, 81, 607–636.

[49] See Fama and MacBeth (1973), p. 611.

[50] Fama and MacBeth (1973), p. 630.

[51] Fama and MacBeth (1973), p. 632.

[52] Fama, E.F., and K. French, 2004, "The Capital Asset Pricing Model: Theory and evidence," *Journal of Economic Perspectives*, 18, 25–46.
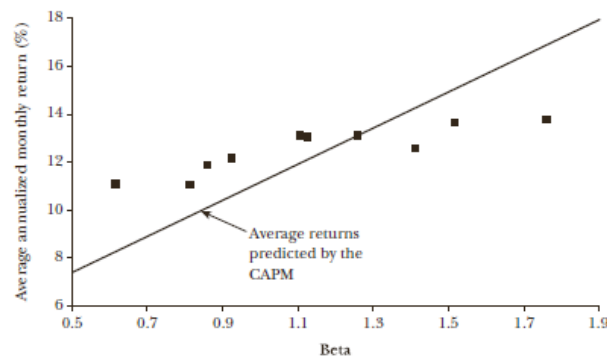
CAPM would imply and high-beta stocks earn lower returns than the SL-CAPM would imply. With respect to the early tests of the SL-CAPM, Fama and French (2004) summarise the state of play as:

> The early tests firmly reject the Sharpe-Lintner version of the CAPM. There is a positive relation between beta and average return, but it is too "flat."

83   Fama and French (2004) then provide an updated example of the evidence using monthly returns on U.S.-listed stocks over 76 years from 1928 to 2003. This analysis is summarised in Figure 5 below. Consistent with the early evidence, realised returns on low-beta stocks are higher than predicted by the SL-CAPM, and realised returns on high-beta stocks are lower than predicted by the SL-CAPM. Stocks with the lowest beta estimates (approximately 0.6) had average returns of 11.1% per year, whereas the SL-CAPM estimate of the expected return was only 8.3% per year. Stocks with the highest beta estimates (approximately 1.8) had average returns of 13.7% per year, whereas the SL-CAPM estimate of the expected return was 16.8% per year.

Figure 5. Average returns versus beta over an extended time period

Figure 2
Average Annualized Monthly Return versus Beta for Value Weight Portfolios Formed on Prior Beta, 1928–2003
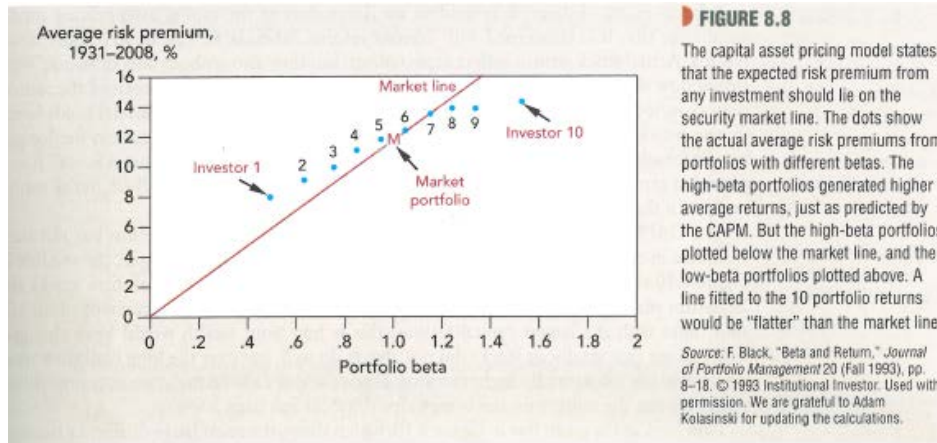
Source: Fama and French (2004), p. 33.

Brealey, Myers and Allen (2011)[53]

84   The evidence of low-beta bias has been so consistent and well-accepted that it is now discussed in standard finance courses and textbooks. For example, Brealey, Myers and Allen (2011), one of the leading finance textbooks, extend the previous analysis another four years to the end of 2008, and provide a similar chart to that presented by Fama and French (2004), but with excess returns on the vertical axis. This chart is presented below in Figure 6. The line represents the relationship between beta and excess return that is implied by the SL-CAPM and each dot represents the observed return for a particular portfolio. Consistent with all of the

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[53] Brealey, R.A., S.C. Myers, and F. Allen, 2011, *Principles of Corporate Finance,* 10th ed., McGraw-Hill Irwin.

Appendix: Empirical evidence on low-beta bias   Final

evidence set out above, the low-beta portfolios still earn higher returns than the SL-CAPM would imply.

Figure 6: The relationship between excess returns and beta

Source: Brealey, Myers, and Allen (2011), p. 197.

Berk and DeMarzo (2014)[54]

85   Another leading corporate finance textbook is Berk and DeMarzo (2014). They too consider violations of the SL-CAPM and also the explanations for those violations. They specifically note that if investors are unable to borrow unlimited amounts at the risk-free rate, the empirical relationship that has been documented in the data would be expected to occur. They also note that the result is a relationship between beta and expected returns that has a higher intercept (at r^*) and a flatter slope than the SL-CAPM would imply. They conclude that:

> Because our determination of the security market line depends only on the market portfolio being tangent for some interest rate, the SML still holds in the following form:
>
> $$E[R_i] = r^* + \beta_i \left(E[R_{Mkt}] - r^* \right)$$
>
> That is, the SML holds with some rate r^* in place of r_f.[55]

Summary of the empirical evidence

86   The analysis documented above, compiled over four decades of research and using 80 years of stock returns, all reaches the same conclusion. The researchers uniformly reject the SL-CAPM on the basis that, in the observable data, the relationship between estimated betas and observed stock returns:

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[54] Berk, J. and P. DeMarzo, 2014, *Corporate Finance,* 3rd global ed., Pearson.

[55] Berk and DeMarzo (2014), p. 399.

Appendix: Empirical evidence on low-beta bias

a. Has an intercept that is economically and statistically significantly greater than the intercept that is implied by the SL-CAPM; and

b. Has a slope that is economically and statistically significantly less than the slope that is implied by the SL-CAPM.

87   The evidence set out above suggests that the actual relationship between beta and stock returns has a flatter slope than the SL-CAPM predicts. This means that:

a. The SL-CAPM systematically underestimates the required return on low-beta stocks (i.e., those with a beta estimate less than 1);

b. The SL-CAPM systematically overestimates the required return on high-beta stocks (i.e., those with a beta estimate more than 1); and

c. The magnitude of the bias is greater when the beta estimate is further away from 1.

Appendix: Empirical evidence on low-beta bias