Use of foreign asset beta comparators

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1 Executive summary

1. The analysis in this report is based on making no distinction between gas and electricity businesses. We have separately provided analysis of how the AER could use the foreign sample to arrive at an estimate of an asset beta for gas only businesses.[1]

2. There has only ever been a small sample of listed regulated Australian firms whose primary business is the operation of energy transport infrastructure. Since early 2017 there has been only 3 such firms (AST, APA and SKI) and, from July 2021, this number has fallen from three to one (APA). A sample of three implies inherently wide confidence intervals around the mean. With a sample of one it is impossible to even estimate a confidence interval around the mean.

3. We have identified 24 highly regulated foreign comparators from the US (20), Canada (2) and the UK and NZ (1 each). Table 1 reports the Australian and foreign sample mean asset betas and 95% confidence interval for the population mean across various estimation periods and methods.

Table 1: Average asset betas

	OLS (95% CI)		**LAD (95% CI)**	
	Australia	Foreign	Australia	Foreign
1 Jan 2006 to 30 June 2021	0.22 (±0.22)	0.38 (±0.03)	0.25 (±0.20)	0.34 (±0.03)
Post GFC*	0.25 (±0.18)	0.39 (±0.03)	0.28 (±0.14)	0.33 (±0.03)
5-years ending 30 June 2021	0.22 (±0.27)	0.47 (±0.05)	0.30 (±0.25)	0.32 (±0.03)

Source: Bloomberg, CEG analysis * From 1 Nov 2009 to 30 June 2021.

4. The LAD estimation method is robust to outliers. This is potentially an advantage when dealing with periods with very large shocks (such as the impact of COVID19 on equity markets in early 2020).[2] All the LAD estimates (for both Australian and foreign samples) are at or above the AER's estimate of a 0.24 asset beta. An asset beta of 0.24 is materially below the foreign OLS estimates but is within the range of Australian OLS estimates.

5. In this context, there are two extreme approaches to incorporating foreign observations:

[1] CEG, Asset beta for gas transport businesses, September 2021.

[2] See ENA's *"Response to AER's Pathway to 2022 Rate of Return Instrument: Draft Equity Omnibus Working Paper"*, section 6.4, 3 September 2021. (https://www.aer.gov.au/system/files/ENA%20-%20Submission%20-%20Equity%20-%203%20September%202021.pdf)

i. To act 'as if' we know the null-hypothesis is true with 100% certainty. In this case, all Australian and foreign beta estimates would be pooled giving 89% (=24/27) weight to foreign observations;

ii. To act 'as if' the null-hypothesis is false with 100% certainty and that 100% of the difference in estimated asset betas reflect true asset betas; in other words, we ignore the result of the statistical test altogether. In this case, zero weight would be given to foreign asset beta estimates.

6. A middle course between these extremes and proceeds on the basis of a prudent caution in respect of the truth of the null hypothesis.[3] Under this approach, there are competing explanations for the difference in estimated asset betas:

i. Sampling error associated with a very small Australian sample; and

ii. Lower true asset betas for Australian regulated utilities.

7. The first explanation is highly plausible given the small Australian sample. Nonetheless, it remains perfectly possible that some of the estimated difference reflects a difference in true asset betas. We attempt to shed light on the extent to which one of these possible explanations is more compelling and, in doing so, to choose an estimate appropriately located within the confidence intervals around our sample means.

8. The two most obvious reasons why Australian utilities might have lower beta risk are that:

i. Foreign utilities have a riskier operating environment. Specifically, differences in operating environment, in particular differences in regulation, lead to foreign equity returns being more susceptible to systemic shocks; and/or

ii. Foreign utilities are listed on a less risky market. A utility's beta is a measure of the riskiness of that utility relative to the riskiness of the equity market in which it is listed. So even if foreign utilities have the same operating environment as Australian utilities, then, other things equal, they will nonetheless have a higher beta if the foreign market is less risky than in Australia.

9. However, both of these hypotheses can be tested by looking at the volatility of the respective utility/market returns. Table 2 reports standard deviation of utility returns (SD_U) and standard deviation of market returns (SD_M).

3 Noting that a failure to reject the null hypothesis with confidence does not imply that the null hypothesis is actually true (or even that it is very likely to be true). See also discussion of type 1 and type 2 errors in the body of this report.

Table 2: Average utility and market standard deviation (SD_U and SD_M)

	SD_U		SD_M	
	Australia	Foreign	Australia	Foreign
1 Jan 2006 to 30 June 2021	3.1%	3.0%	2.2%	2.4%
Post GFC	2.8%	2.8%	2.0%	2.2%
5-years ending 30 June 2021	2.8%	3.3%	2.0%	2.5%

Source: Bloomberg, CEG analysis

10. It can be seen that over the longer periods foreign utilities have had very similar volatility to the Australian utilities. Moreover, foreign markets have had, if anything, slightly higher volatility than the Australian market.

11. These results are inconsistent with a hypothesis that differences in regulation (and operating environment more generally) cause foreign utilities' equity returns to be more sensitive to systemic shocks. If this was the case, we would expect to observe higher volatility of foreign utility stock returns (especially given foreign markets have higher volatility) but we do not see this. Higher volatility of foreign markets is also inconsistent with a hypothesis that foreign utilities have higher asset betas because their risk is measured relative to a low volatility market.

12. Based on this, and further analysis set out in sections four and five, we conclude that there is no basis for a prior belief that that the underlying asset beta for Australian utilities is lower than that for foreign utilities. This suggests sampling error, associated with a very small Australian sample, as a likely explanation for the difference in sample mean asset beta estimates. Nonetheless, we cannot rule out the possibility that the estimated difference reflects, at least in part, a true underlying difference in beta. Consequently, a balance between these competing explanations must be struck.

13. Consistent with this, we consider that a reasonable balance would be to adopt an estimate for asset beta that is within the 95% confidence interval for the Australian population mean asset beta (based on a sample of 3) and in the lower half of the 95% confidence interval derived from the foreign sample (sample of 24).

14. This is described visually in Figure 1-1 below which shows the overlapping confidence intervals for LAD and OLS estimates respectively and marks the bottom of the 95% confidence interval derived from the foreign sample.

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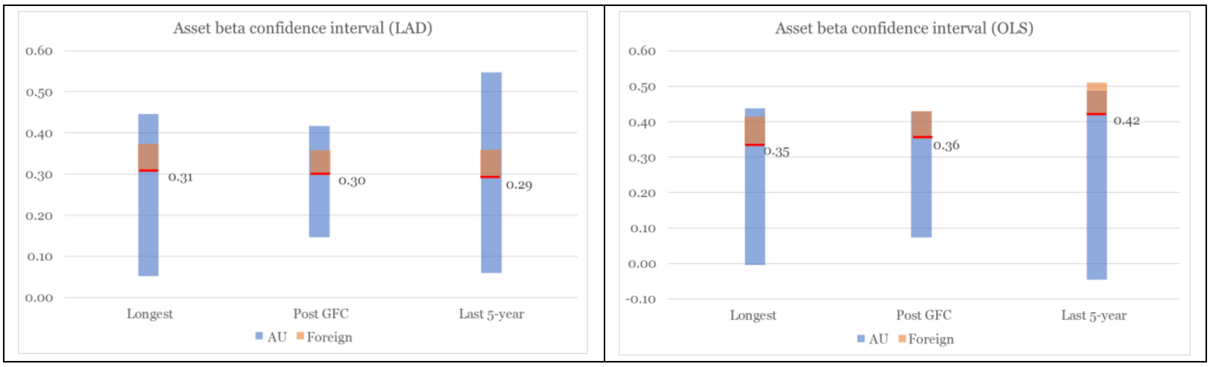
Figure 1-1: Overlapping confidence intervals for Australian and foreign asset betas (LAD and OLS)



Source: CEG analysis.

15. Focussing on the longer periods, choosing an estimate from the lower end of the overlapping confidence intervals would result in a range of from 0.31 (LAD) to 0.35 (OLS). The range for the shorter five year period extends from 0.29 to 0.42.

16. The bottom end of all these ranges is very close to 0.30. In our view, this 0.30 estimate strikes a reasonable balance between the competing explanations for differences between Australian and foreign sample mean asset beta estimates.

17. As noted in paragraph 1 above, this approach assumes that there is no difference between gas and electricity betas. The use of international comparators would allow a gas specific estimate of asset beta as the sample size is sufficiently large that the need to pool electricity and gas as the AER does presently for domestic betas. If gas specific asset betas were to be estimated by including foreign firms in the sample set then we refer the AER to our September 2021 report for APGA.

2 Introduction

18. We have been engaged by the Australian Pipeline and Gas Association (APGA) to provide conceptual and empirical advice on the potential reasons for differences in measured asset betas for Australian versus foreign regulated energy utilities. This is in the context where:

- There is a small sample of Australian comparators; but
- The average statistically estimated asset beta for Australian comparators is lower than the average for foreign comparators.

19. In this context, it is a priori plausible that:

a. The difference is a statistical artefact driven by the small sample size for Australian betas; or

b. The difference reflects real differences in the systemic riskiness of Australian regulated utilities versus their counterparts in foreign jurisdictions; or

c. A mix of the above explanations.

20. Which of these explanations is most likely to be true will determine what reliance should be given to foreign comparators.

21. The analysis in this report is based on making no distinction between gas and electricity businesses. We have separately provided analysis of how the AER could use the foreign sample to arrive at an estimate of an asset beta for gas only businesses.[4]

22. The remainder of this report has the following structure:

- Section 3 surveys asset betas for Australian and foreign comparators and finds that the Australian sample mean is lower than the foreign sample mean;
- Section 4 examines whether sample average asset betas are statistically significantly different for Australian and foreign comparators. We find that the sample means are not statistically significantly different;
- Section 5 examines whether there is any evidence that would support a prior belief that the true Australian asset beta would be lower than for foreign comparators. We test a number of hypothesis and do not find evidence that supports an expectation of lower asset betas for Australian comparators;
- Section 6 concludes on what we regard as the most reasonable estimate of the true Australian asset beta taking into account the previous analysis.

4 CEG, Asset beta for gas transport businesses, September 2021.

3 Australian and foreign asset beta estimates

3.1 Samples and average asset betas

23. We have identified a sample of comparable foreign regulated utilities. The full list of these utilities is set out in Appendix A and it is comprised of:

- The US utilities identified by CEG in 2013 as "highly regulated" excluding those who have since stopped trading due to M&A activity and one that filed for bankruptcy.[5] This results in 20 US highly regulated utilities; plus
- Four highly regulated non-US regulated utilities selected from a wider list identified by the WA ERA. (Two Canadian utilities (EMA and FTS) and one utility from each of the UK (National Grid) and New Zealand (Vector)).

24. Our sample is considerably smaller than the NZCC sample[6] due to the application of a "highly regulated" threshold.

25. All of our comparators have data up to 30 June 2021.

26. There are three Australian comparators that have data up to 30 June 2021 (AST, SKI and APA). These three firms have data going back to January 2006. Therefore, our longest estimation period is January 2006 to June 2021. We also report shorter periods also ending in June 2021 but starting more recently than 2006.

27. This is broadly consistent with the AER method of reporting shorter and longer periods all ending in the most recent time period. In contrast to the AER method, we do not include firms who had data only available for a subset of these periods. This is because the analysis we perform in this report would be difficult to interpret, and arguably invalid, if results were not all estimated over a consistent time frame for each foreign and domestic firm.

28. The following tables set out the relative sample average asset beta estimates and gearing estimates. We report both OLS (ordinary least squares) and LAD (least

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5 PG&E sought bankruptcy protection in January 2019 after accumulating an estimated $30 billion in liability for fires started by its poorly maintained equipment.

6 A comparison between our full list and the NZCC list in 2016 is in Table 14. All except for 3 comparators (Portland General Electric, Emera and Fortis) in our list are in the NZCC list. The full NZCC list can also be found in the *"Input methodologies review decisions Topic paper 4 Cost of capital issues 20 December 2016"*, Table 28, p.229.

absolute deviation) estimates of asset beta in this report. We also set out the confidence interval for the population mean that sits around the sample mean.

Table 3: Full samples average asset betas

	OLS (95% CI)		LAD (95% CI)	
	Australia	Foreign	Australia	Foreign
1 Jan 2006 to 30 June 2021	0.22 (±0.22)	0.38 (±0.03)	0.25 (±0.20)	0.34 (±0.03)
Post GFC*	0.25 (±0.18)	0.39 (±0.03)	0.28 (±0.14)	0.33 (±0.03)
5-years ending 30 June 2021	0.22 (±0.27)	0.47 (±0.05)	0.30 (±0.25)	0.32 (±0.03)

Source: Bloomberg, CEG analysis. * From 1 Nov 2009 to 30 June 2021.

Table 4: Sample average gearing

	Australia	Foreign
1 Jan 2006 to 30 June 2021	55%	42%
Post GFC	53%	41%
5-years ending 30 June 2021	53%	40%

Source: Bloomberg, CEG analysis

29. In context of this analysis the LAD estimates are more robust in that they are less prone to being affected by outlier observations. This is potentially an advantage when dealing with periods with very large shocks (such as the impact of COVID19 on equity markets in early 2020).[7]

30. It can be seen that the sample average foreign asset beta is universally higher than the sample average asset beta for the Australian firms. However, the averages are much closer when using LAD – with the LAD estimates being both higher for the Australian sample and lower for the US sample. This result implies that most of the difference between Australian and foreign asset betas is driven by outlier observations – which, in the periods in question, happen to lower the OLS Australian asset beta estimates and raise the OLS foreign asset beta estimates.

[7] See ENA's Response to AER's Pathway to 2022 Rate of Return Instrument: Draft Equity Omnibus Working Paper, section 6.4, 3 September 2021. (https://www.aer.gov.au/system/files/ENA%20-%20Submission%20-%20Equity%20-%203%20September%202021.pdf)

4 Are differences statistically significant?

4.1 Uncertainty around the sample mean

31. An important distinction must be drawn between the sample mean and the population mean. When we estimate asset betas we are sampling only:

    a. A subset of regulated energy utilities (e.g., we are sampling only the listed subset of these); and

    b. A subset of the full set of all possible systemic market shocks that investors care about (we are sampling only the actual shocks that occurred in our estimation period).

32. Both of these introduce sampling error and uncertainty concerning how accurate our sample mean is as an estimate of the true "population mean" – where the "population mean" is the asset beta estimate we would observe if we sampled across the largest sample of hypothetically possible: a) regulated energy utilities; and b) all possible sets of systemic market shocks (weighted by investors' perceived probability of them occurring).[8] In this report we refer to the "true" Australian utility asset beta as short

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8 To clarify this distinction:

- Type "a" uncertainty exists because every individual asset beta estimate is affected by noise associated with non-systematic shocks. For example, bad news affecting a utility's stock price that results from a non-systematic shock (such as an adverse court finding about liability for a bushfire) might randomly fall in a week when the stock market has a strong positive/negative return. In which case, it will cause the estimated beta to be artificially lower/higher than it would otherwise. If we have a large number of comparators in out sample then this noise will more reliably "cancel out" in the sample mean than if we have only a small number of comparators;
- Type "b" uncertainty exists because what investors care about are all the possible prospective systemic shocks that might affect the equity in a firm and the market as a whole. However, when we estimate historical betas we are sampling only from the actual systemic shocks that occurred in that historical period. This will not include all of the shocks that investors perceive as possible and cannot be assumed to include shocks in proportion to investors' perceptions of the probability/severity of that type of shock occurring in the future. For example:
    - A war involving an expansionist superpower and Australia today is a possible systemic shock that is not represented in the historical period since 2000 used by the AER to estimate asset beta;
    - A once in a 100 year financial crisis could be included in the post 2000 historical period used by the AER but doing so may overweight this sort of shock if investors truly do not perceive such a shock is likely again in their investment horizon.

hand for the population mean of Australian utility asset betas (and similarly for the "true" asset beta for foreign utilities)

33. We can address sampling error/uncertainty of type "a" by using standard statistical methods to place a confidence interval around our sample average asset beta. However, this will be an underestimate of the true uncertainty surrounding the sample mean because it does not capture uncertainty of type "b" – which cannot easily be quantified.[9]

34. It is not possible to accurately account for type "b" uncertainty and reported confidence intervals for asset beta, including in this report, typically do not include this source of uncertainty. However, this means that the statistical tests that we present have a greater probability of Type I error (incorrectly rejecting the null-hypothesis of no difference in population means when it is, in fact, true) than Type II error (incorrectly failing to reject the null hypothesis of no difference in population means when it is, in fact, false).

4.2 Welch's t-test results

35. Table 5 applies Welch's t-test for a difference in population means. In all circumstances we find that we cannot reject the null hypothesis, at the standard 5% confidence level, that the underlying population means are the same for Australian and foreign asset betas. This is true for both OLS and LAD but the p-values for LAD are typically much higher than for OLS (noting that a high p-value implies less confidence in rejecting the null hypothesis (a higher level of confidence in the null hypothesis)).

Table 5: p-value for Welch's t-test for difference in population means

	OLS	LAD
1 Jan 2006 to 30 June 2021	9.2%	19.3%
Post GFC	8.0%	28.5%
5-years ending 30 June 2021	6.5%	73.7%

Source: Bloomberg, CEG analysis

In the concurrent evidence session 1 held on 10 February 2022 there was an analogy made by Dr Boyle to the effect that: relying on data for foreign asset betas to inform Australian asset betas; might be like relying on size data for great dane dogs to inform

9 It is difficult to gain data on investors' perceptions of the probability/severity of all possible types of shocks. Even if it that data existed, it would not be possible to accurately model how the market and individual utility stocks would respond.

an estimate of the size of cocker spaniel dogs.[10] If this analogy was actually accurate, we would certainly be able to reject the null-hypothesis of no difference.

4.3 Statistical tests are informative, but not determinative, of the weight to be given to foreign asset beta estimates

36. It is important to note that the inability to reject a null hypothesis does not imply that the null hypothesis must be true. In particular, we cannot rule out, at a 5% significance level, either of the following null-hypotheses:

- the Australian population mean is the same as the foreign population mean; or
- the Australian population mean is different to the foreign population mean.

37. The key "take away" of the statistical test is that the lower estimated asset betas for Australian utilities is not, on its own, strong evidence that the true (unobservable) population mean for Australian asset betas is actually lower. This does not mean, however, that the means are identical; absent infinite data, no test in statistics can show this.

38. In this context, there are two extreme approaches to incorporating foreign observations:

  i. To act 'as if' we know the null-hypothesis is true with 100% certainty. In this case, all Australian and foreign beta estimates would be pooled giving 89% (=24/27) weight to foreign observations;

  ii. To act 'as if' the null-hypothesis is false with 100% certainty and that 100% of the difference in estimated asset betas reflect true asset betas; in other words, we ignore the result of the statistical test altogether. In this case, zero weight would be given to foreign asset beta estimates.

39. A middle course between these extremes and proceeds on the basis of a prudent caution in respect of the truth of the null hypothesis.[11] Under this approach, there are competing explanations for the difference in estimated asset betas:

  i. Sampling error associated with a very small Australian sample; and

  ii. Lower true asset betas for Australian regulated utilities.

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10 Transcript, rate of return instruments concurrent evidence session 1, p56.

11 Noting that a failure to reject the null hypothesis with confidence does not imply that the null hypothesis is actually true (or even that it is very likely to be true). See also discussion of type 1 and type 2 errors in the body of this report.

40. The first explanation is highly plausible given the small Australian sample. Nonetheless, it remains perfectly possible that some of the estimated difference reflects a difference in true asset betas.

41. Exactly what balance between the foreign and Australian sample means is chosen will reflect the strength of other evidence to support a view that Australian utilities face different (and, specifically, lower) risk than foreign utilities.

4.4 Reasons why there may be a difference in true asset betas

42. Analysts, including the AER, have raised valid reasons why the true underlying foreign and domestic equity betas might be different. This means that relying on a larger sample including foreign asset betas may reduce the potential for sampling error due to small sample size but this might come at the expense of introducing bias into the sample.

43. The AER's concerns are summarised below. In particular, the AER notes:[12]

    i. Different forms of regulation may affect regulated utilities relative risk;

    ii. Differences in the domestic economy/business cycles and the composition of foreign stock markets may affect regulated utilities relative (beta) risk;

    iii. Some foreign comparators may operate outside the regulated energy network sector (e.g., in telecommunications) and this may alter their relative (beta) risk.

44. In relation to the third point, we consider that this is an issue with sample selection and is not an issue peculiar to foreign comparators. That is, if it is important to exclude firms with certain types of operations, this criterion can be applied equally to foreign and domestic firms – it is not a methodological issue peculiar to the use of foreign firms.

45. In relation to the first and second point, we agree with the AER that each of these are possible reasons why asset betas estimated for foreign firms against foreign equity markets may by systematically biased relative to the "true" asset beta for otherwise similar firms operating in Australia.

46. We note that the AER has not concluded, or presented any evidence, to the effect that these differences create an *a priori* expectation that Australian asset betas would be lower. For example, the AER has not attempted to identify differences in regulatory regimes that mean foreign comparators are more risky.

12 AER, Overall rate of return, equity and debt omnibus | Final working paper | November 2021, section 5.4.3.1

47. Rather, the AER is simply (and correctly) noting that, absent an exhaustive study to demonstrate the contrary, this could be the case. Equally, it is possible that the opposite is true and foreign firms may be lower risk.

48. In other words, we have no sound *a priori* evidence of the direction of a bias, or even if one exists at all. Nonetheless, when we observe a difference in sample means this raises the prospect that the difference might be due to underlying differences in the true asset betas. We cannot discount that possibility with certainty – just as we cannot discount the alternative explanation (sampling error associated with a small Australian sample) either.

49. For these reasons it is important to assess the potential for bias. In order to do so it is necessary to clearly set out:

    a. the reasons/mechanisms by which the true asset beta for foreign comparators might be higher/lower than the true asset beta for an Australian regulated utility; and

    b. gather evidence about the potential magnitude of each specific source of bias.

50. Both a. and b., will inform what sort of reliance is put on foreign vs Australian comparator estimates.

5 Informing the magnitude of potential differences in "true" beta

5.1 Theoretical sources of potential underlying differences in true beta

51. In order to clearly identify each of the reasons why bias might exist it is necessary to start with the mathematical formula for beta:

$\beta = \rho(r_M, r_U) \times \frac{SD_U}{SD_M}$; where

$\rho(r_M, r_U) =$ the correlation between the return on the market and the return on the individual utility equity;

$SD_{r_U} =$ the standard deviation of the return on individual utility equity; and

$SD_{r_M} =$ the standard deviation of the return on market.

52. The potential for bias exists whenever there is a reason to believe one of these three variables will be different for a regulated utility operating in Australia vis-à-vis a foreign regulated utility. The relevant question "how much of lower Australian estimates reflect underlying lower risk versus sampling error"? Consistent with this, the following table describes reasons why the true risk for foreign utilities (relative to their own equity market) might be higher than for Australian utilities relative to the Australian equity market.

Table 6: Mechanisms by which foreign utilities could have higher assets betas

Potential source of bias	How it affects: $\beta = \rho(r_M, r_U) \times \frac{SD_U}{SD_M}$
i. Differences in regulation (and/or other aspects of the operating environment) cause foreign utility equity returns to respond more vigorously to systemic shocks to the wider economy/market.	This potential source of bias should show up in higher standard deviation of foreign utilities' returns relative to standard deviation of Australian utilities returns.
ii. The foreign equity market is less risky than the Australian equity market. Thus, even if foreign and Australian utilities have the same absolute risk, foreign utilities will have lower risk relative to their own equity market (lower beta risk).	This potential source of bias should show up in lower standard deviation of foreign market returns relative to standard deviation of the Australian market returns.
iii. There is higher correlation between foreign utility returns and their home market than in Australia because:	
a) Different sets of systematic shocks hit the foreign economy/market and these include stronger/more of the types of systematic shocks that affect utilities; or	This will tend to show up in both higher $\rho(r_M, r_U)$ and higher SD_U. That is, if foreign economies are being hit by more frequent/stronger shocks of the kind that also affect utilities then we expect this to raise both $\rho(r_M, r_U)$ and SD_U in foreign markets.
b) The same sets of systematic shocks hit foreign/Australian markets but differences in the composition of those markets mean that the foreign market responds in a way that engenders greater correlation with utility returns than in Australia.	This will show up in higher $\rho(r_M, r_U)$ and will have an increasing effect on SD_M but no effect on SD_U

53. Appendix B provides the results of a formal stylised model that formally illustrates how the differences of the kind i) to iiib) above can raise asset beta and how this is associated with changes in the components of the asset beta estimate.

5.1 Empirically testing each source of potential bias

54. The first column of Table 6 sets out four different theoretically possible reasons why foreign comparators "true" beta may be higher than the "true" Australian beta. The second column sets out where we would expect to see those sources of bias "show up" in the three variables that are components of the estimated asset beta (volatility of utility returns, volatility of market returns and correlation between utility returns).

55. The first three out of the four sources of potential bias should be associated with higher volatility of foreign utility returns than Australian utility returns. However, this is not evident in the data. Table 7 shows that over the longer periods foreign

utilities have had the same or lower standard deviation of returns as Australian utilities. Similarly, the second of these sources of potential bias implies lower volatility in foreign equity markets but the opposite is actually observed.

Table 7: Average utility and market standard deviation (SD_U and SD_M)

	SD_U		SD_M	
	Australia	Foreign	Australia	Foreign
1 Jan 2006 to 30 June 2021	3.1%	3.0%	2.2%	2.4%
Post GFC	2.8%	2.8%	2.0%	2.2%
5-years ending 30 June 2021	2.8%	3.3%	2.0%	2.5%

Source: Bloomberg, CEG analysis

56. These results are inconsistent with a most obvious hypothesis for why foreign utilities would be higher underlying risk. Namely, that differences in regulation (and operating environment more generally) cause foreign utilities' equity returns to be more sensitive to systemic shocks. If this was the case, we would expect to observe higher volatility of foreign utility stock returns (especially given foreign markets have higher volatility) but we do not see this.

57. In addition, these results are also inconsistent with two out of the remaining three hypothetical sources of difference in true underlying risk. The only explanation for a difference in "true" betas that is consistent with the above facts is the last explanation iiib) in Table 6. Namely, that differences in composition of foreign and Australian equity markets lead foreign equity markets to have higher correlation with utility returns (but not higher volatility of utility returns).

58. This is mathematically possible (as illustrated in Appendix B) but it is not economically obvious why it would be the case. In any event, the maximum possible impact of this source of difference can be derived by estimating foreign utility betas relative to the Australian equity market.

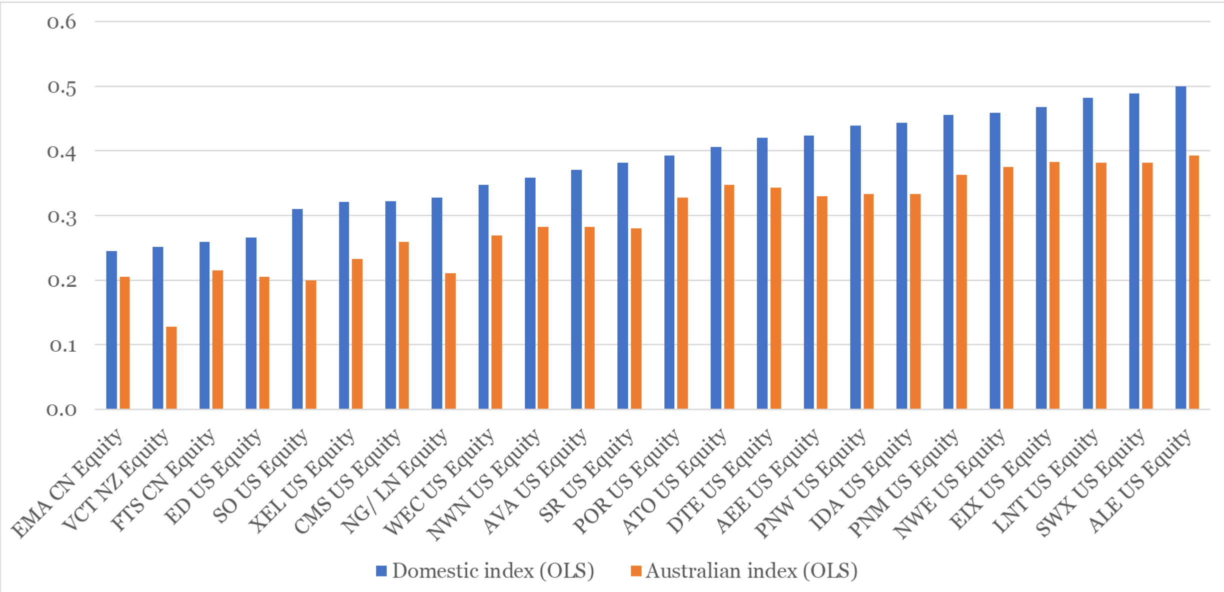
59. When this is done all differences between foreign and Australian equity market composition are fully accounted for. However, we also introduce a material downwards bias in the resulting asset beta estimate to the extent that the shocks hitting the foreign and Australian markets in the relevant return sampling period were different.[13] It follows that we can interpret reduction in foreign utility asset

13 That is, by using the Australian equity market returns we are fully accounting for any difference in composition/behavior of the Australian vs foreign equity market. However, we are also implicitly assuming that all of the systemic shocks that hit the Australian equity market in any given week are the same as those that hit the market in which the utility operates in that same week. This is clearly unlikely to be true and will materially lower the estimated asset beta for that utility below the level that would exist if it was truly operating in Australia.

betas estimated against the Australian equity market as a downward biased estimate of the asset beta they would have if they were operating in Australia.

60. When we do this, we see that foreign OLS asset betas do fall, although consistent with the bias described above, but they only fall by around 0.09 and average 0.29/0.30 in the longest/post GFC period[14] respectively. Therefore, even if we ascribed 100% of this reduction in foreign asset betas to effect iiib) from Table 6, we would still only arrive at an asset beta of around 0.30.

Figure 5-1: Foreign asset beta estimated against domestic vs Australian index (2006 to 2021)



Source: Bloomberg, CEG analysis

5.2 Differences in market composition exist when using historical estimates from the same jurisdiction

61. It is also important to keep in mind that today's Australian economy and equity market is also different to the Australian economy and equity market in the past. Therefore, an equivalent issue applies to historical estimates of Australian asset betas. These asset betas were estimated relative to an equity market that was different (and often materially so) to the current and/or prospective Australian equity market.

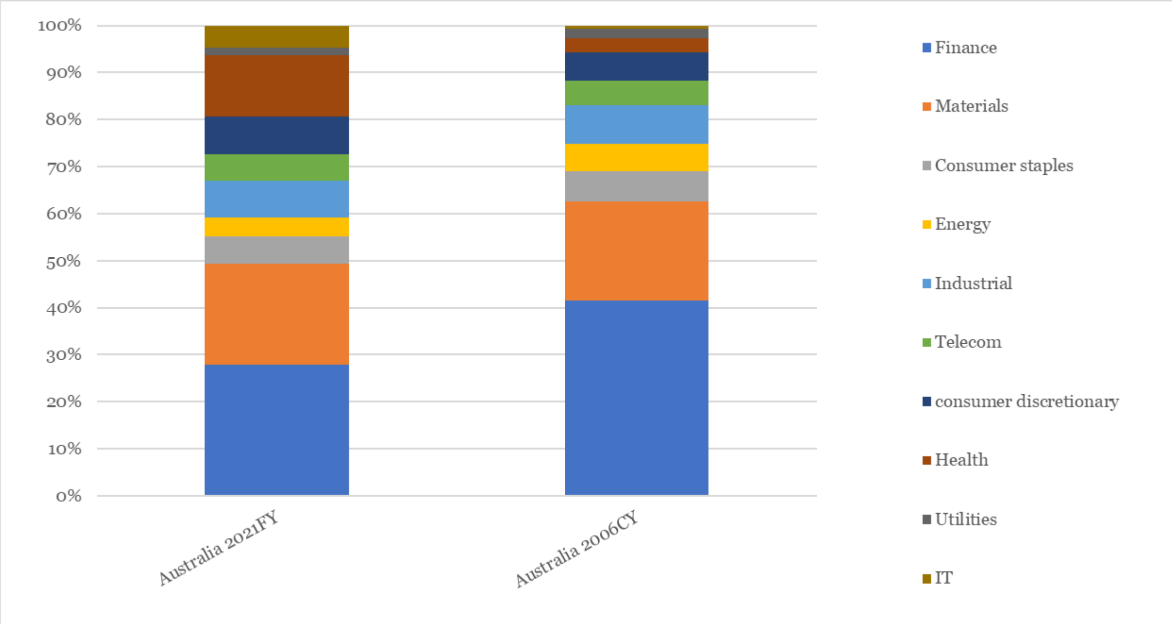
62. In this regard, the difference between historical estimates of asset beta from foreign and domestic data is a matter of degree, not of kind. Indeed, as the novelist JP Hartley famously states in the opening line of "The Go Between":

14 Longest is from 1 Jan 2006 to 30 June 2021. Post GFC is from 1 Nov 2009 to 30 June 2021.

"The past is a foreign country: they do things differently there"

63. One partial way to illustrate changes over time to compare sector weights in the ASX200. The following figure compares the composition of the Australian equity market from the first full year at beginning of our estimation period (CY2006) to the final year (FY2021).

Figure 5-2: Australian equity market: 2021 FY vs 2006 CY

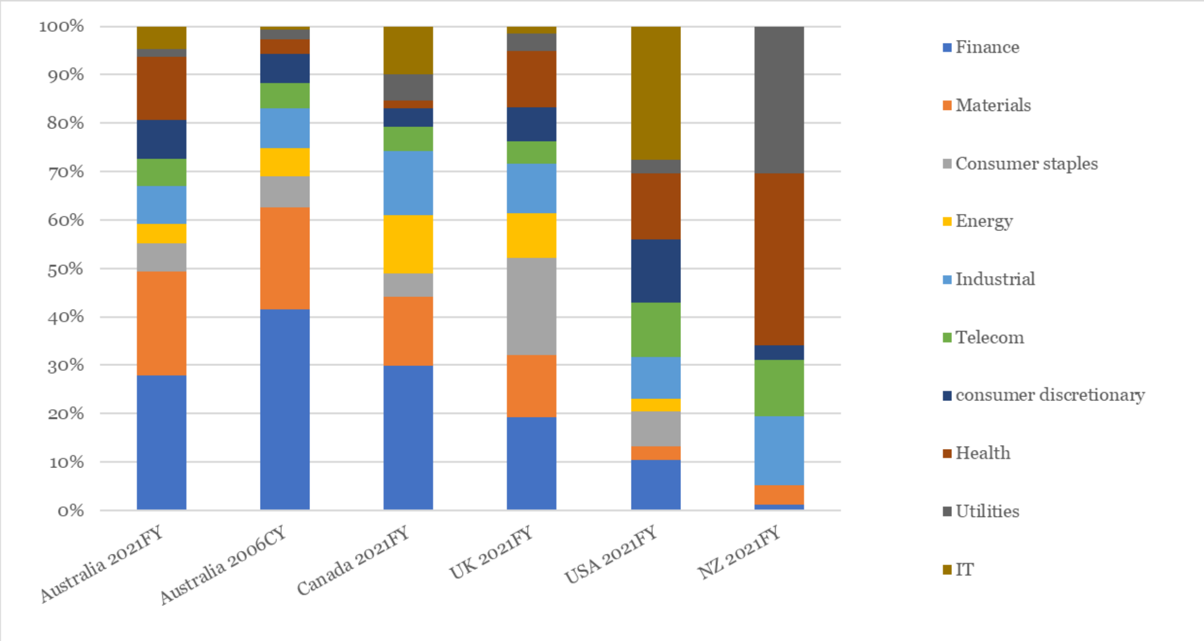


Source: Bloomberg and CEG analysis

64. It can be seen that between 2006 and 2021 the composition of the market shifted to have a materially higher weight to Health (from 3% to 13%) with lower weight to most other sectors and especially finance (down from 42% to 28%).

65. It is instructive to compare the difference in weights between Australia 2021 and Australia 2006 with the difference in weights between Australia 2021 and each of the relevant foreign markets in 2021. When we do so, we see that, while the sector weights are often different between Australia in 2021 and foreign markets in 2021, a similar magnitude of difference can be observed between Australia 2021 and Australia 2006.

Figure 5-3: Absolute differences in sector weights compared to the FY2021 Australian equity market



Source: Bloomberg and CEG analysis

66. Put simply, while the impact of differences in market composition are a legitimate issue, it is a concern that does not stop at geographical variation in equity markets but also applies to time series variation in the Australian equity markets. It is an issue that differs by degree, but not in kind, when considering the use of historical asset beta estimates – whether they be from Australia or foreign markets.

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6 Summary and conclusion

67. We only have a very small sample of three Australian comparators. We have estimated differences in sample averages for Australian and foreign highly regulated comparators. These differences are relatively larger when using the OLS estimation technique but are small when using the LAD estimation technique. However, for both OLS and LAD estimates we cannot reject the null-hypothesis that the underlying "true" asset beta is the same.

68. We identify, in Table 6, four possible theoretical reasons why the true asset beta for foreign utilities could be higher than for Australian utilities. Three of these (i, ii, and iiia)) are intuitive and have clear potential economic motivations. Namely, i) different foreign regulation/operating environment, ii) less risky local market and iiia) more systemic shocks of the kind that affect utilities. However, none of these are supported by the available data (they all predict higher standard deviation of foreign utility returns and/or lower standard deviation of foreign market returns and we do not observe this in the data).

69. This is not to say we can be certain, but it does mean that there are grounds for *a priori* belief that these three reasons are not true (do not, in fact, raise underlying risk for foreign utilities).

70. The final reason (reason iiib)) for why an underlying difference in true betas may exist is that differences in composition of the equity markets somehow leads to stronger correlation between utility and market returns (but without leading to stronger volatility of utility return). There is no obvious economic reason to suspect that this might be the case and the maximum possible adjustment of this on asset beta is around 0.09 (although it is perfectly possible that the best adjustment is zero).

71. Based on this analysis we cannot rule out the possibility that the underlying asset beta for Australian utilities is lower than that for foreign utilities, but we can conclude that there is no basis for a prior belief that this is the case.

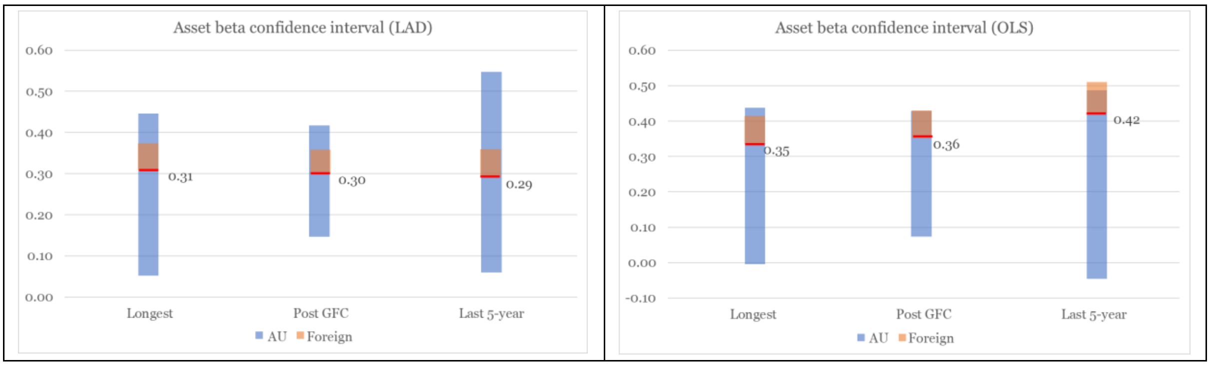
72. Consistent with this, we consider that it would be reasonable to adopt an estimate for asset beta that was within the 95% confidence interval for the Australian population mean asset beta (based on a sample of 3) and in the lower half of the 95% confidence interval derived from the foreign sample (sample of 24). A conservative approach would be to choose the very bottom of the confidence interval around the foreign sample mean. This is what we have done.

73. In doing so we give weight to the fact that both samples imply an overlapping range for the true asset beta. By choosing within that overlapping range we are not rejecting either source of evidence as relevant. However, by choosing a value at the lower end of the foreign asset beta confidence interval we are giving material weight to the potential that the lower estimated average asset betas for Australian comparators

(albeit from a sample of three) to at least partially be explained by lower true underlying beta risk for Australian utilities.

74. This is described visually in Figure 6-1 below which shows the overlapping confidence intervals for LAD and OLS estimates respectively and marks the bottom of the 95% confidence interval derived from the foreign sample.

Figure 6-1: Overlapping confidence intervals for Australian and foreign asset betas (LAD and OLS)



Source: CEG analysis.

75. Focussing on the longer periods, choosing an estimate from the lower end of the overlapping confidence intervals would result in a range of from 0.31 (LAD) to 0.35 (OLS). The range for the shorter five year period extends from 0.29 to 0.42.

76. The bottom end of all these ranges is very close to 0.30. In our view, this 0.30 estimate strikes a reasonable balance between the competing explanations for differences between Australian and foreign sample mean asset beta estimates.

77. Finally, the analysis in this report is based on the assumption that no distinction is being made between gas and electricity businesses (any such distinction would render the analysis impossible because there would be a sample of one Australian gas business). We have separately provided analysis of how the AER could use the foreign sample to arrive at an estimate of an asset beta for gas only businesses.[15]

15 CEG, Asset beta for gas transport businesses, September 2021.

Appendix A List of comparators asset beta and gearing and standard deviations

Table 8: Foreign comparators, longest period (weekly beta between 1 Jan 2006 & 30 Jun 2021)

Company (Ticker)	**Gearing**	**Standard deviation of return**	**Asset beta (OLS)**	**Asset beta (LAD)**
PNW US Equity	40%	0.031	0.439	0.379
XEL US Equity	43%	0.026	0.321	0.295
CMS US Equity	53%	0.030	0.322	0.266
NWE US Equity	43%	0.033	0.459	0.359
NG/ LN Equity	46%	0.028	0.328	0.296
VCT NZ Equity	48%	0.024	0.251	0.227
POR US Equity	43%	0.031	0.392	0.370
ATO US Equity	37%	0.028	0.406	0.400
ED US Equity	42%	0.025	0.266	0.238
DTE US Equity	45%	0.031	0.420	0.336
IDA US Equity	37%	0.030	0.444	0.417
AVA US Equity	45%	0.031	0.370	0.320
AEE US Equity	42%	0.031	0.424	0.375
ALE US Equity	30%	0.031	0.499	0.483
EIX US Equity	41%	0.034	0.468	0.424
LNT US Equity	34%	0.030	0.483	0.441
SO US Equity	41%	0.027	0.310	0.265
SWX US Equity	41%	0.034	0.489	0.449
WEC US Equity	38%	0.027	0.347	0.292
SR US Equity	38%	0.031	0.382	0.335
PNM US Equity	53%	0.044	0.456	0.369
EMA CN Equity	49%	0.023	0.245	0.241
NWN US Equity	36%	0.030	0.359	0.386
FTS CN Equity	53%	0.025	0.260	0.248
Average	**42%**	**0.030**	**0.381**	**0.342**

Source: Bloomberg, CEG Analysis

Table 9: Australian comparators, longest period (weekly beta between 1 Jan 2006 & 30 Jun 2021)

Company (Bloomberg Ticker)	Gearing	Standard deviation of return	Asset beta (OLS)	Asset beta (LAD)
APA AU Equity	50%	0.033	0.317	0.340
AST AU Equity	57%	0.029	0.148	0.208
SKI AU Equity	57%	0.032	0.180	0.195
Average	**55%**	**0.031**	**0.215**	**0.248**

Source: Bloomberg, CEG Analysis

Table 10: Foreign comparators, post GFC (weekly beta between 1 Nov 2009 & 30 Jun 2021)

Company (Bloomberg Ticker)	Gearing	Standard deviation of return	Asset beta (OLS)	Asset beta (LAD)
PNW US Equity	38%	0.030	0.469	0.355
XEL US Equity	42%	0.026	0.344	0.258
CMS US Equity	49%	0.028	0.336	0.267
NWE US Equity	43%	0.033	0.492	0.380
NG/ LN Equity	46%	0.025	0.289	0.299
VCT NZ Equity	45%	0.022	0.237	0.205
POR US Equity	42%	0.030	0.415	0.320
ATO US Equity	34%	0.027	0.433	0.401
ED US Equity	42%	0.024	0.255	0.219
DTE US Equity	42%	0.029	0.436	0.320
IDA US Equity	34%	0.029	0.508	0.422
AVA US Equity	43%	0.030	0.398	0.304
AEE US Equity	41%	0.027	0.376	0.350
ALE US Equity	33%	0.030	0.521	0.470
EIX US Equity	42%	0.032	0.420	0.363
LNT US Equity	36%	0.028	0.465	0.405
SO US Equity	41%	0.027	0.356	0.276
SWX US Equity	37%	0.033	0.506	0.413
WEC US Equity	36%	0.027	0.380	0.292
SR US Equity	38%	0.027	0.408	0.323
PNM US Equity	51%	0.036	0.439	0.316
EMA CN Equity	49%	0.022	0.291	0.267
NWN US Equity	37%	0.029	0.392	0.356
FTS CN Equity	52%	0.022	0.302	0.298
Average	**41%**	**0.028**	**0.394**	**0.328**

Source: Bloomberg, CEG Analysis

Table 11: Australian comparators, post GFC (weekly beta between 1 Nov 2009 & 30 Jun 2021)

Company (Bloomberg Ticker)	Gearing	Standard deviation of return	Asset beta (OLS)	Asset beta (LAD)
APA AU Equity	47%	0.029	0.328	0.342
AST AU Equity	56%	0.026	0.212	0.253
SKI AU Equity	57%	0.029	0.196	0.240
Average	**53%**	**0.028**	**0.245**	**0.278**

Source: Bloomberg, CEG Analysis

Table 12: Foreign comparators, last 5-year (weekly beta between 1 Jul 2016 & 30 Jun 2021)

Company (Bloomberg Ticker)	Gearing	Standard deviation of return	Asset beta (OLS)	Asset beta (LAD)
PNW US Equity	37%	0.038	0.580	0.290
XEL US Equity	39%	0.032	0.461	0.307
CMS US Equity	43%	0.032	0.420	0.281
NWE US Equity	42%	0.041	0.621	0.443
NG/ LN Equity	45%	0.027	0.323	0.255
VCT NZ Equity	41%	0.021	0.280	0.247
POR US Equity	38%	0.036	0.516	0.314
ATO US Equity	26%	0.030	0.515	0.397
ED US Equity	42%	0.029	0.315	0.192
DTE US Equity	41%	0.035	0.542	0.303
IDA US Equity	26%	0.034	0.602	0.361
AVA US Equity	41%	0.036	0.449	0.211
AEE US Equity	36%	0.031	0.451	0.334
ALE US Equity	30%	0.036	0.618	0.511
EIX US Equity	42%	0.040	0.527	0.435
LNT US Equity	34%	0.032	0.535	0.389
SO US Equity	46%	0.035	0.464	0.322
SWX US Equity	36%	0.041	0.591	0.409
WEC US Equity	33%	0.034	0.495	0.337
SR US Equity	43%	0.034	0.439	0.290
PNM US Equity	47%	0.044	0.562	0.282
EMA CN Equity	56%	0.023	0.256	0.240
NWN US Equity	34%	0.035	0.437	0.347
FTS CN Equity	52%	0.022	0.295	0.287
Average	**40%**	**0.033**	**0.471**	**0.324**

Source: Bloomberg, CEG Analysis

Table 13: Australian comparators, last 5-year (weekly beta between 1 Jul 2016 & 30 Jun 2021)

Company (Bloomberg Ticker)	Gearing	Standard deviation of return	Asset beta (OLS)	Asset beta (LAD)
APA AU Equity	47%	0.032	0.342	0.417
AST AU Equity	54%	0.024	0.132	0.244
SKI AU Equity	57%	0.029	0.185	0.242
Average	**53%**	**0.028**	**0.220**	**0.301**

Source: Bloomberg, CEG Analysis

Table 14: Comparison between NZCC list and CEG (Foreign) list

Ticker	Company	NZCC list	CEG (Foreign) list
AEE US Equity	Ameren Corporation	In	In
AEP US Equity	American Electric Power	In	Out
AES US Equity	AES Corp	In	Out
ALE US Equity	Allete Inc	In	In
APA AU Equity	APA Group	In	Out
AST AU Equity	AusNet Services	In	Out
ATO US Equity	Atmos Energy Corp	In	In
AVA US Equity	Avista Corp	In	In
BKH US Equity	Black Hills Corp	In	Out
BWP US Equity	Boardwalk Pipeline Partners	In	Out
CMS US Equity	CMS Energy Corp	In	In
CNL US Equity	Cleco Corporate Holdings Llc	In	Out
CNP US Equity	Centerpoint Energy Inc	In	Out
CPK US Equity	Chesapeake Utilities Corp	In	Out
D US Equity	Dominion Energy Inc	In	Out
DGAS US Equity	Delta Natural Gas Co Inc	In	Out
DTE US Equity	DTE Energy Company	In	In
DUE AU Equity	Duet Group	In	Out
DUK US Equity	Duke Energy Corp	In	Out
ED US Equity	Consolidated Edison Inc	In	In
EDE US Equity	Empire District Electric Co	In	Out
EE US Equity	Excelerate Energy Inc	In	Out
EEP US Equity	Enbridge Energy Partners Lp	In	Out
EIX US Equity	Edison International	In	In
ES US Equity	Eversource Energy	In	Out
ETR US Equity	Entergy Corp	In	Out
EXC US Equity	Exelon Corp	In	Out
FE US Equity	Firstenergy Corp	In	Out
GAS US Equity	Southern Co Gas	In	Out

GXP US Equity	Great Plains Energy Inc	In	Out
HE US Equity	Hawaiian Electric Inds	In	Out
IDA US Equity	Idacorp Inc	In	In
ITC US Equity	ITC Holdings Corp	In	Out
JEL LN Equity	Jersey Electricity Plc	In	Out
KMI US Equity	Kinder Morgan Inc	In	Out
SR US Equity	Spire Inc	In	In
LNT US Equity	Alliant Energy Corp	In	In
MGEE US Equity	MGE Energy Inc	In	Out
NEE US Equity	Nextera Energy Inc	In	Out
NFG US Equity	National Fuel Gas Co	In	Out
NG/ LN Equity	National Grid Plc	In	In
NI US Equity	Nisource Inc	In	Out
NJR US Equity	New Jersey Resources Corp	In	Out
NWE US Equity	Northwestern Corp	In	In
NWN US Equity	Northwest Natural Holding Co	In	In
OGE US Equity	OGE Energy Corp	In	Out
OKE US Equity	Oneok Inc	In	Out
PCG US Equity	P G & E Corp	In	Out
PEG US Equity	Public Service Enterprise Gp	In	Out
PNM US Equity	PNM Resources Inc	In	In
PNW US Equity	Pinnacle West Capital	In	In
PNY US Equity	Piedmont Natural Gas Co	In	Out
POM US Equity	Pepco Holdings Llc	In	Out
PPL US Equity	PPL Corp	In	Out
SCG US Equity	Scana Corp	In	Out
SE US Equity	Sea Ltd-Adr	In	Out
SJI US Equity	South Jersey Industries	In	Out
SKI AU Equity	Spark Infrastructure Group	In	Out
SO US Equity	Southern Co/The	In	In
SRE US Equity	Sempra Energy	In	Out
SSE LN Equity	SSE Plc	In	Out
STR US Equity	Dominion Energy Questar Corp	In	Out
SWX US Equity	Southwest Gas Holdings Inc	In	In
TCP US Equity	TC Pipelines Lp	In	Out
TE US Equity	Tapstone Energy Inc	In	Out
UGI US Equity	UGI Corp	In	Out
UTL US Equity	Unitil Corp	In	Out
VCT NZ Equity	Vector Ltd	In	In
VVC US Equity	Vectren Corp	In	Out
WEC US Equity	WEC Energy Group Inc	In	In
WGL US Equity	WGL Holdings Inc	In	Out

WPZ US Equity	Williams Partners Lp	In	Out
WR US Equity	Evergy Kansas Central Inc	In	Out
XEL US Equity	Xcel Energy Inc	In	In
POR US Equity	Portland General Electric Co	Out	In
EMA CN Equity	Emera Inc	Out	In
FTS CN Equity	Fortis Inc	Out	In

Source: CEG Analysis

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Appendix B Monte Carlo simulation of sources of differences in asset beta

78. This section provides the results of a stylised model that formally illustrates how the differences of the potential biases discussed in Table 6 result in changes to the components of the asset beta estimate. Table 6 is reproduced below.

Table 15: Mechanisms by which foreign utilities could have higher assets betas

Potential source of bias	How it affects: $\beta = \rho(r_M, r_U) \times \frac{SD_U}{SD_M}$
i. Differences in regulation (and/or other aspects of the operating environment) cause foreign utility equity returns to respond more vigorously to systemic shocks to the wider economy/market.	This potential source of bias should show up in higher standard deviation of foreign utilities' returns relative to standard deviation of Australian utilities returns.
ii. The foreign equity market is less risk than the Australian equity market. Thus, even if foreign and Australian utilities have the same absolute risk, foreign utilities will have lower risk relative to their own equity market (lower beta risk).	This potential source of bias should show up in lower standard deviation of foreign market returns relative to standard deviation of the Australian market returns.
iii. There is higher correlation between foreign utility returns and their home market than in Australia because:	
a) Different sets of systematic shocks hit the foreign economy/market and these include stronger/more of the types of systematic shocks that affect utilities; or	This will tend to show up in both higher $\rho(r_M, r_U)$ and higher SD_U. That is, if a foreign economies are being hit by more frequent/stronger shocks of the kind that also affect utilities then we expect this to raise both $\rho(r_M, r_U)$ and SD_U in foreign markets.
b) The same sets of systematic shocks hit foreign/Australian markets but differences in the composition of those markets mean that the foreign market responds in a way that engenders greater correlation with utility returns than in Australia.	This will show up in higher $\rho(r_M, r_U)$ and will have an increasing effect on SD_M but no effect on SD_U

79. These four distinct potential sources of difference in underlying risk can be illustrated with a stylised model.

80. Let there be two types of shocks that affect equity markets. Call the first type of shock "u_t" and let it affect utility returns more than market returns. Call the other type of

shock "e_t" and let it affect the economy (and market) more strongly than the "u_t shock.

81. The model is formally laid out below:

- Utility specific shock – $u_t \sim Uniformly\ distributed\ between\ (-0.5\ , 0.5)$
- Systematic shock – $e_t \sim Uniformly\ distributed\ between\ (-0.5\ , 0.5)$
- Return of utility firms – $utility_t = u_t + ae_t$
- Return of market – $market_t = bu_t + e_t$

82. In this model, "a" is the sensitivity of utilities to the market wide shock (e_t)and "b" is the sensitivity of the market to the utility focussed shock (u)

83. Based on the model, we can calculate the theoretical result for the components of beta: standard error of return of utility firms, standard error of return on the market and their correlation.

- standard error of return of utility firms $sd_{utility} = \sqrt{\sigma_u^2 + a^2\sigma_e^2}$
- standard error of return of market $sd_{market} = \sqrt{b^2\sigma_u^2 + \sigma_e^2}$
- correlation $corr_{market,utility} = {(b\sigma_u^2 + a\sigma_e^2)} \big/ {sd_{utility} sd_{market}}$

84. In the base case we set a=0.5 and b=0.3. That is, utilities only experience half of the market wide shock and the market only experiences 30% of the utility focussed shock.

85. We then examine four variations from this base case that correspond to each of the four rows in Table 15.

- Row 1: we increase the sensitive of utility to market wide shocks by increasing a from 0.5 to 0.75.[16]

16 The theory predicts, an increase in a would result in an increase in the standard error of return of utility firms. The correlation would also increase. The numerator of the partial derivative of the correlation with respect to a is $\sigma_e^2 sd_{utility} sd_{market} - (b\sigma_u^2 + a\sigma_e^2) sd_{market} \frac{a\sigma_e^2}{sd_{utility}}$. The denominator is positive. The numerator is positive if $1 - ab > 0$. This condition holds based on the assumption that the return of utility firms are impacted mostly by the utility-specific shock and the return of market is mostly impacted by the systematic shock.

- Row 2: the magnitude of the market wide shock is made smaller (reduced from (-0.5 to 0.5) to (-0.25 to 0.25).[17]
- Row 3: the utility-specific shock is increased (from the range (-0.5 to 0.5) to (-0.75 to 0.75)).[18]
- Row 4. This row is implemented by making the market respond more strongly to utility specific shocks. We do this by increasing b from 0.3 to 0.45. The theory predicts that the volatility of the market and correlation would increase. These have opposite effects on beta. We have chosen parameters where the net impact on beta is positive – but this is not always true.

86. We simulated the baseline model, and the variations, on thousand time. The simulation results are presented in the table below.

Table 16: Simulation result on the impact of each mechanism

Driver of change	Theory prediction	Simulation result (% impact relative to the base case)			
		$sd_{utility}$	sd_{market}	$corr$	$Beta$
$a \uparrow$	$sd_{utility} \uparrow$ $sd_{market} \Leftrightarrow$ $corr \uparrow$	12.4%	0.0%	15.8%	30.1%
$\sigma_e^2 \downarrow$	$sd_{utility} \downarrow$ $sd_{market} \downarrow$ *by bigger margin*	-8.6%	-43.9%	2.5%	67.0%
$\sigma_u^2 \uparrow$	$sd_{utility} \uparrow$ $sd_{market} \uparrow$ *by a smaller margin*	40.7%	5.4%	-1.2%	31.9%
$b \uparrow$	$sd_{utility} \Leftrightarrow$ $sd_{market} \uparrow$ $corr \uparrow$	0.0%	5.4%	11.8%	6.1%

87. The simulation results demonstrate the expected results in relation to the first three potential sources of difference. The first two rows demonstrate that if utilities are more sensitive to market shocks, then beta will be higher – but so will volatility of

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17 The theory predicts that, decreasing σ_e^2, would decrease the volatility of the market by a bigger magnitude than the decrease in the volatility of utility firms. $\frac{\partial sd_{utility}}{\partial \sigma_e^2} = a$ and $\frac{\partial sd_{market}}{\partial \sigma_e^2} = 1$. Given $1 > a$, $\frac{\partial sd_{market}}{\partial \sigma_e^2} > \frac{\partial sd_{utility}}{\partial \sigma_e^2}$

18 Theory predicts that increase in the risk from utility specific shocks would increase the volatility in the return of utility firms and market. However the increase in the volatility of the return of utility firms will be greater than the increase in the volatility of the market $\frac{\partial sd_{utility}}{\partial \sigma_u^2} = 1$ and $\frac{\partial sd_{market}}{\partial \sigma_u^2} = b$. Given $1 > b$, $\frac{\partial sd_{utility}}{\partial \sigma_u^2} > \frac{\partial sd_{market}}{\partial \sigma_u^2}$

utility returns (which we do not observe in the foreign utility data). The second row shows that if market is itself less volatile then beta will be higher – but foreign markets are not less volatile. The third row shows that if the shocks that hit the utility sector in foreign markets are stronger then beta will be higher – but so will volatility of utility returns (which we do not observe in the foreign utility data).

88. The final row shows that it is possible that if the market responds more strongly to utility specific shocks then it is possible, but not guaranteed,[19] to generate a higher beta without a higher volatility in utility returns (or a lower volatility in market returns). That is, it is possible to generate the results we see in the data.

89. However, it is difficult to find a compelling economic case for why this outcome would reflect an underlying economic difference expected to persist overtime. In this context, the alternative explanation that the differences we observe in the data reflect sampling error, associated with a very small Australian sample, are more compelling. Of course, one cannot reach definitive conclusions with the data available.

[19] It is not guaranteed because market volatility also increases – which pulls beta in the opposite direction. Had we increased "b" to 0.6 (rather than 0.45) then beta would have fallen.