Using international comparators to estimate the benchmark Australian equity beta

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1 Introduction

1. We have been engaged by the Australian Energy Networks Association (ENA) to provide advice on how international comparators for measuring equity beta can best be incorporated into an estimate of the weighted average cost of capital used in the Australian Energy Regulator's (AER's) rate of return instrument (RoRI).

2. This report has the following structure.

- Section 2 summarises our findings and conclusions;
- Section 3 describes how we arrive at our sample(s) of international comparators;
- Section 4 describes how we estimate equity beta for each comparator;
- Section 5 explains why we consider an international sample arrived at in the manner set out in section 3 has comparable average risk to regulated Australian energy business. In doing so we also explain that differences in measured asset betas using the AER leverage formula (with zero debt beta) tend to overstate the true difference between international and domestic estimates of regulated asset betas.

2 Summary and conclusions

3. Due to the lack of Australian listed regulated energy utilities, in order to update the AER's estimates of beta risk into the future it will be necessary to rely on a sample that includes international regulated comparators. This raises important questions that must be addressed:

   a. How should a sample of international comparators be formed?

   b. How should equity beta be estimated for these comparators?

   c. How should the AER test whether international comparators are of similar risk to an (unobserved) benchmark Australian regulated utility?

   d. Assuming that the international comparators are of similar risk, what methodology can most accurately accommodate the use of an equity beta derived from those comparators?

   e. How is this likely to affect the WACC estimated in the RoRI?

2.1 How should a sample of international comparators be formed?

4. We set out a five step process for arriving at, and updating, a sample of international comparators.

   a. Step 1: Identify a wide sample of international comparators.

      i. Step 1A: Generate wide sample using industry classifications developed by Bloomberg, MSCI/S&P and FTSE Russell.

      ii. Step 1B: Include missing comparators identified by the New Zealand Commerce Commission (NZCC).

   b. Step 2: Filter for comparable countries, we restrict the sample to OECD countries.

   c. Step 3: Filter based on the fraction of regulated assets (assessed manually).

   d. Step 4: Filter based on liquidity (bid-ask-spread) and gearing between 0% and 100%.

   e. Step 5: Form sample sets based on the above (we report results for a base sample and two other samples used for sensitivity and robustness checks).

2.2 How should equity beta be estimated for these comparators?

5. We use the NZCC estimation method which takes an average of 5 weekly and 20 four weekly sampling periods (i.e., uses of 25 asset betas for each firm's asset beta). For the purpose of this report, we adopt two estimation periods ending on 31 March 2024 (one long run period covering all data from 1990 onwards and the most recent 10 years).

2.3 How should the AER test whether international comparators are of similar risk to an (unobserved) benchmark Australian regulated utility?

2.3.1 Testing for difference in asset beta (assuming a zero debt beta)

6. A straightforward method in comparing the asset betas between Australian and foreign samples is to compare whether their sample means are statistically different or not. The table below compares the asset betas between Australian and the three foreign sample sets using OLS under both periods.

Table 2-1: Comparison of asset betas between Australian and foreign sample sets using OLS (Welch's t-test p-value)

	Longest period	Recent 10 year
OECD (90% regulated assets filter; max 0.5% bid-ask spread)	0.242 vs 0.305 (19.0%)	0.220 vs 0.331 (16.6%)
NZCC sample	0.242 vs 0.336 (6.2%)	0.220 vs 0.386 (9.0%)
NZCC (80% regulated assets filter)	0.242 vs 0.313 (13.8%)	0.220 vs 0.349 (12.9%)

Source: Bloomberg, CEG analysis.

7. We note that our OECD sample with a 90% regulated assets and 0.5% bid-ask spread filter consistently returns the lowest asset beta estimates across both periods. It is also the case that international average asset betas are consistently higher than the Australian asset beta estimates for all the periods and sample sets.

8. Notwithstanding the fact that the international sample averages are higher than the Australian sample averages, these differences are not statistically significantly different. This can be seen from the fact that application of the Welch's t-test always results in a p-value above 5% irrespective of the sample or period and is always above 10% relative to our preferred broad OECD samples. This means that one cannot be confident that the true "population" mean of the Australian observations is different to the true "population" mean of the foreign observations.

9. Nonetheless, on its own, the consistently historically lower Australian asset beta estimates could still be a cause for concern about the prospective adoption of an international sample – provided those historical differences are accurately estimated. That is, the absence of a statistically significant difference does not demonstrate that the sample means are the same. It only demonstrates that we cannot be highly confident that the sample means are different.

2.3.2 Accounting for the fact that debt betas may be positive

10. There are good reasons to believe that the lack of a debt beta in the AER de-leverage formula (Equation 2) causes the foreign sample asset betas to be overstated relative to the Australian observations (and *vice versa*). This is because the foreign samples tend to have average gearing of around 40%-45% compared to the Australian sample average gearing of around 55%. Consequently, assuming a zero debt beta tends to overstate the difference in asset betas given that, in reality, the debt beta is likely positive.

11. Correcting this will simultaneously:

    a. Lower the estimated difference between Australian and international sample means; and

    b. Lower the expected impact on the final equity beta (and WACC) associated with giving weight to the international sample.

12. We estimate that the average international sample WACC is only 0.20%/0.45% higher than the average Australian sample WACC in the long run/last 10 years. This provides a reasonable estimate of the impact of giving 100% weight to international comparators in a manner that ensures the results are not unduly affected by positive debt betas.

13. This raises the question of how the AER can ensure that results are not unduly affected by differences in gearing. The options available to the AER include:

a. Give the same weight to the international sample when setting both gearing and asset beta (this is consistent with the NZCC methodology and also with past AER practice);

b. Restrict the international comparator sample to those firms with similar gearing to the RoRI gearing (i.e., similar to 60%);

c. Adopt non-zero debt beta in its leverage formulae (at least for gearing above a certain threshold). This is common practice by UK regulators and the QCA;

d. Some combination of the above.

3 Methodology for sample selection

14. This section outlines the steps for forming the foreign comparators sample sets. In summary:

   a. Step 1: Identify a wide sample of international comparators.

      i. Step 1A: Generate wide sample using industry classifications published by Bloomberg.

      ii. Step 1B: Include missing comparators identified by the NZCC.

   b. Step 2: Filter for comparable countries.

   c. Step 3: Filter based on the fraction of regulated assets.

   d. Step 4: Filter based on liquidity (bid-ask-spread) and gearing between 0% and 100%.

   e. Step 5: Form sample sets based on the above.

15. In this report a total of three samples have been identified. These consist of a "base sample" and two alternative samples used to check for sensitivity/robustness.

   a. Base sample (OECD, 90% regulated assets filter; max 0.5% bid-ask spread): wide sample of international comparators filtered to only include OECD country of risk and at least 90% regulated assets and maximum bid-ask-spread of 0.5% this is also the **base sample** (n=41);

   b. NZCC sample: NZCC final decision sample (n=48), and;

   c. NZCC (80% regulated assets filter): NZCC sample but only firms with at least 80% regulated assets (n=35);

3.1 Step 1: Identify a wide sample of international comparators

16. In order to arrive at a comprehensive and non-arbitrary list of international comparators, it is important to start with a wide range of comparators. Step 1A and 1B below illustrate the details in forming an initial list of 236 international firms.

3.1.1 Step 1A: Generate wide sample from industry classifications

17. We performed an industry search on Bloomberg by combining three common industry classifications, which yielded 230 international firms from all around the world. All three industry classifications are published on Bloomberg. The exact industry filtering process in Bloomberg's EQS functions are:

   a. Global Industry Classification Standard (GICS): Electric Utilities, Multi-Utilities, Gas Utilities;

   b. Bloomberg Industry Classification System (BICS): Electric Transmission & Dist, Integrated Electric Utilities, Gas Utilities;

   c. Industry Classification Benchmark (ICB): Conventional Electricity, Multi-Utilities, Gas Distribution, Pipelines.

18. We also applied the following filters into Bloomberg's EQS:

   d. CY2023 Market Cap (USD) >= 100 million.

   e. Trading status: Active;

   f. Security attributes: Show primary Security of company only;

19. The below subsections explain the rationale for each filtering.

3.1.1.1 Combining three Industry classifications

20. In order to systematically select relevant companies in a non-arbitrary and repeatable way, we have combined three common industry classifications to filter for the companies that are likely to engage most of their operations in regulated electricity or gas activities.

21. Different organisations that create industry classifications can have slight differences in categorising companies into the appropriate industry categories. Combining three of the most commonly used industry classifications provides a comprehensive starting point for us to then apply other filters to.

22. The three industry classifications are:

    a. Global Industry Classification Standard (GICS), which is developed and is maintained by both MSCI and S&P Dow Jones Indices;[1]

        i. Electric Utilities;

        ii. Multi-Utilities, and;

        iii. Gas Utilities.

    b. Bloomberg Industry Classification System (BICS), which is developed and is maintained by Bloomberg, and;[2]

        i. Electric Transmission & Distribution;

        ii. Integrated Electric Utilities, and;

        iii. Gas Utilities.

    c. Industry Classification Benchmark (ICB), which is maintained by FTSE Russell.[3]

        i. Conventional Electricity;

        ii. Multi-Utilities;

        iii. Gas Distribution, and;

        iv. Pipelines.

23. In order to be included in our starting sample a firm needs to be identified by the above filters for each of GICS, BICS and ICB. That is, a firm that is only identified as being in a relevant sector by 2 or fewer of the industry classifications is not included.

3.1.1.2 Minimum market capitalisation

24. A minimum market capitalisation of USD$100 million for the most recent calendar year is set to remove small cap companies that are usually less liquid and their estimated asset beta less reliable.

3.1.1.3 Active and primary companies only

25. One of the key reasons why this report is commissioned is that all but one relevant Australian firm (APA) is delisted. The potential concern with using delisted firms is that as the markets evolve and transform over time, delisted firms become less and less relevant in reflecting the prevailing risks of an industry. As we noted in our previous report, "*The past is a foreign country: they do things*

[1] https://www.spglobal.com/spdji/en/landing/topic/gics/.

[2] https://data.bloomberglp.com/professional/sites/10/131915_CDS_REF_Classification_SFCT_180315_DIG.pdf.

[3] https://www.lseg.com/en/ftse-russell/industry-classification-benchmark-icb.

differently there".[4] Relying on data from delisted Australian companies is, in a meaningful sense, already relying on data from a country that is "foreign" to present day Australia.

26. In this context, it would be equally problematic, and arguably mores so, to rely on data from delisted foreign firms. For this reason, we restrict our sample to include only currently active companies. That said, a reasonable future update of this methodology might reasonably apply a slightly different filter (such as companies active for within the last 2 or 3 years).

27. Secondly, only primary companies are included to avoid giving more weight (or double counting) companies with multiple subsidiaries.

3.1.2 Step 1B: Include missing comparators identified by the NZCC

28. The next step is to include potential comparators that are identified by other foreign energy regulators but are not identified in the previous filtering process. Specifically, we consider the international firms identified by the NZCC in their recent final decision published in December 2023.[5]

29. The NZCC final decision includes 48 non-Australian firms from the United States (44), Britain (3) and New Zealand (1).[6] Amongst which, six of them are not identified in Step 1A.

30. Table 3-1 below summarises the six foreign firms added to the wider sample and their respective reason for not being identified in Step 1A.

Table 3-1: Foreign firms added to the wider sample from NZCC final decision sample

Ticker	Country	Reasons not identified in Step 1A
AES US Equity	United States	Identified as power producer in GICS
CNA LN Equity	Britain	Identified as electricity and gas marketing/trading in BICS
KMI US Equity	United States	Identified as oil and gas storage/transportation in GICS and BICS
OKE US Equity	United States	Identified as oil and gas storage/transportation in GICS and BICS
SJI US Equity	United States	Delisted, with acquisition proposal date in Feb 2022
SSE LN Equity	Britain	Identified as power generation in BICS

Source: NZCC final decision, Bloomberg and CEG analysis.

31. Combining both Step 1A and 1B, we arrive at an initial wide sample of 236 international firms.

4 The opening line of JP Hartley's novel "The Go-Between".

5 We have also considered Ofgem's RIIO-2 Final Determinations published in December 2020. However, amongst the four companies Ofgem identified in paragraph 3.71 of the determination, three of them are water providers. NG is the only utilities provider that is included in our wider list. https://www.ofgem.gov.uk/sites/default/files/docs/2021/02/final_determinations_-_finance_annex_revised_002.pdf.

6 NZCC (2023), Cost of capital topic paper Part 4 Input Methodologies Review 2023 – Final decision, https://comcom.govt.nz/__data/assets/pdf_file/0022/337612/Part-4-IM-Review-2023-Final-decision-Cost-of-capital-topic-paper-13-December-2023.pdf.

3.2 Step 2: Filter for comparable countries

32. To restrict the wide sample set to a more comparable sample, we apply a country filter to select countries that are more similar. We used Organisation for Economic Co-operation and Development (OECD) member countries as a criterion for comparable countries. [7]

33. For countries to be part of the OECD, they need to adhere to the fundamental values, which is described in the below (emphasis added):[8]

> *These fundamental values include a commitment to pluralist democracy based on the **rule of law** and the respect of human rights, adherence to **open and transparent market economy principles** and a shared goal of sustainable development.*

34. Filtering the list of 236 firms by country using OECD member countries reduces the list to 135 firms. Appendix A contains the full list of 135 firms.

3.3 Step 3: Filter for the amount of regulatory assets

35. In CEG 2013[9], we performed analysis in determining the amount of regulatory assets for each potential US comparator. In this report, we update and extend the analysis to all 135 firms described in the previous step.

36. Asset data in dollar value with breakdown by business segment is obtained from Bloomberg.[10] Every line of the business segments from each firm was then reviewed and coded as regulated, not regulated or omitted (such as eliminations and reconciliations) as per our methodology in CEG 2013. Generally, regulated segments include energy related activities such as distribution and transmission but exclude power generation (unless specifically identified as regulated) and renewables.

37. We then calculated the percentage of regulated assets by dividing the sum of all regulated business segments with the total of regulated and non-regulated business segments. The latest available year is used as the final number for each firm. If segment asset values are not available, we use segment revenues.

38. This filter can then be applied to only include firms that have a regulated assets (revenues) percentage above a given threshold.

3.4 Step 4: Filter for gearing and bid-ask-spread

39. We have only included companies with average gearing between 0% to 100% to remove firms from our sample which may have "unique" properties which are not representative of typical regulated energy utilities. It is unusual for regulated energy businesses, which are generally regarded as safe businesses with stable cash-flows to have negative debt. Having negative debt (cash greater than debt) might, therefore, be a signal that the regulated energy business is developing liquidity to invest in another riskier industry (e.g., renewables) and, therefore, that the business is not comparable to a pure regulated energy utility.

[7] OECD (n.d), List of OECD Member countries - Ratification of the Convention on the OECD, accessed on 8 April 2024, available at https://www.oecd.org/about/document/ratification-oecd-convention.htm.

[8] https://one.oecd.org/document/C(2013)110/FINAL/en/pdf, paragraph 4.

[9] CEG 2013, Information on equity beta from US companies, June 2013 (https://www.aer.gov.au/system/files/Essential%20Energy%20-%20Attachment%207.20_CEG_Information%20on%20equity%20beta%20from%20US%20companies%20-%202014.pdf).

[10] The relevant Bloomberg field is PG_ASSETS. For firms without segment breakdown on asset, revenue is used as a proxy, the relevant Bloomberg field is PG_REVENUE.

40. Additionally, a filter on the maximum bid-ask-spread to filter for liquidity is also considered as a sensitivity check when forming the samples. Firms with poor liquidity have less reliable estimates of equity beta because market shocks are not as quickly reflected in equity prices and equity prices are more susceptible to relatively small changes in flows (e.g., shareholders deciding to sell or buy into the company).

3.5 Step 5: Forming the sample sets

3.5.1 Different international sample sets with the application of different filters and threshold

41. In this report we work with three different samples:

    a. OECD (90% regulated assets filter; max 0.5% bid-ask spread) (n=41);

    b. NZCC sample: NZCC final decision sample (n=48); and

    c. NZCC (80% regulated assets filter): NZCC sample but only firms with at least 80% regulated assets (n=35).

42. The international sample set developed by the NZCC is dominated by firms from the US (92% of sample (b) and 91% of sample (c)) and limited to English speaking countries only.[11] Therefore, the sample set is highly exposed to country risks specific to the US.

43. A breakdown by country with counts and percentages is presented in the table below.

[11] It is unclear why the NZCC sample does not include non-English speaking countries such as Japan.

Table 3-2: International sample sets breakdown by country (counts and percentages)

	OECD (90% regulated assets filter; max 0.5% bid-ask spread)	NZCC sample	NZCC (80% regulated assets filter)
Belgium	1 (2%)	-	-
Britain	-	3 (6%)	2 (6%)
Canada	4 (10%)	-	-
Italy	1 (2%)	-	-
Japan	4 (10%)	-	-
New Zealand	1 (2%)	1 (2%)	1 (3%)
South Korea	3 (7%)	-	-
Spain	1 (2%)	-	-
United States	26 (63%)	44 (92%)	32 (91%)
Total	**41 (100%)**	**48 (100%)**	**35 (100%)**

Source: CEG analysis.

3.5.2 Australian sample

44. In CEG 2022[12], for consistency on data availability, only three Australian firms (APA, AST and SKI) were included in the analysis. In this report, we have updated to use all nine Australian firms (eight of which are now delisted) included in the AER's 2022 RORI analysis.

45. For companies that are delisted, instead of using data until the very last date of the delisting, we have manually applied a cutoff date on the acquisition announcement date obtained from Bloomberg. This is because any price movements subsequent to the announcement would be heavily influenced by acquisition-related news and would bias the beta estimation.

46. The nine Australian firms with their respective Bloomberg ticker, first pricing date and acquisition proposal dates are in the table below.

[12] CEG 2022, Use of foreign asset beta comparators, March 2022 (https://www.aer.gov.au/system/files/APGA%20-%20Submission%20-%20Attachment%20-%20CEG%20report_Use%20of%20foreign%20asset%20beta%20comparators_Final.pdf).

Table 3-3: Profile of Australian firms

Bloomberg ticker	Current name (old name)	First pricing date	Acquisition proposal date
AST AU Equity	Ausnet Services Ltd	13/12/2005	20/09/2021
DUE AU Equity	DUET	12/08/2004	4/12/2016
SKI AU Equity	Spark Infrastructure Group	15/12/2005	14/07/2021
APA AU Equity	Apa Group	12/06/2000	n.a.
1803385D AU Equity	Australian Gas Networks Ltd (Envestra)	29/08/1997	8/05/2014
1535943D AU Equity	Gasnet Australia Trust	14/12/2001	22/08/2006
HDF AU Equity	Apa Sub Group (HDF)	10/12/2004	14/12/2011
1168921D AU Equity	Jemena Limited (Old AGL)	28/06/1968	26/04/2006
AAN AU Equity	Westnet Wa Infrastructure Ho (Old Alinta)	17/10/2000	30/03/2007

Source: Bloomberg.

47. Note that, except for the minimum year criteria set out in section 4.1, other filters described in section 3 only apply to the foreign sample sets. That is, in the longest period, all of the AER's Australian sample are always included in the analysis when we compare the AER's Australian sample to our international sample.

4 Suggested estimation methodology

4.1 Estimation periods

48. In the AER's 2022 RORI analysis, the AER estimates asset betas for mainly three periods:[13]

a. Longest available period;

b. Post tech boom & excl. GFC, and;

c. Recent 5 years.

49. We have adopted similar time periods except we replace "Post tech boom & excl. GFC" with the recent 10-year period (i.e., 2014 to 2024). We do so because we believe this is less arbitrary in defining certain event start and end dates, and that it is sufficient to serve as a medium length period (for comparison). The exact start and end date of the two periods are:

a. Longest period (1/1/1990 to 31/03/2024)

b. Last 10 years (1/04/2014 to 31/03/2024)

50. We note that the reported asset betas for the longest period utilise the most data that is available over the entire period. For example, an asset beta estimate for Jemena (old AGL), which was delisted in 2006, is included alongside an asset beta estimate for Ausnet, which was listed only in late 2005 and delisted in 2021. Similarly, a foreign firm with data from 2005 to 2024 will be included alongside a firm with data from 2015 to 2024. The rationale for comparing observations across different time periods is that the AER considers the long run estimate to be stable:[14]

> *We consider that the equity beta for a benchmark regulated energy network business is likely to be stable over the long term. Longer periods offer more observations and, hence, more statistically robust estimates.*

51. That is, if the long run average asset beta is stable then it is reasonable to assume that adding data from different firms estimated over different periods will still result in a sample average that is a reasonable proxy for the long run average asset beta.

52. For the longest period, we set a 10% minimum number of years required in our samples. This 10% filter requires a firm to have 3.4 years of data in the 34.2 years of data covered by the longest period (January 1990 to March 2024). Whereas for the 5 and 10 year samples, the threshold is to have data in one-third of the period (i.e., 1.67 and 3.33 years respectively). This criterion aims to exclude firms that were just listed in the end of a period or delisted in the beginning of a period. It is to safeguard against very short periods within the sample that might turn out to be outliers.

4.2 Estimation model

53. We have adopted the NZCC methodology to estimating asset betas. This method involves taking the average of weekly (5 iterations) and four-weekly (20 iterations) betas (i.e., an average of 25 asset betas for each firm's asset beta). [15] The AER used a weekly (Friday) estimate only.[16]

[13] AER (2022), Draft Rate of Return Instrument Explanatory Statement, June 2022 (AER 2022 RORI), https://www.aer.gov.au/system/files/Draft%202022%20Rate%20of%20Return%20Instrument%20-%20Explanatory%20Statement%20-%2016%20June%202022.pdf, table 8.4.

[14] AER 2022 RORI, pp. 163.

[15] For clarity, we have adopted the R model published by the NZCC in its final decision.

[16] AER 2022 RORI, pp. 174.

54. We consider that the NZCC methodology to estimating asset betas is more robust than simply a last-day-of-week weekly or last-day-of-month monthly estimates, as it considers price movement of every single day and also the weekly/four-weekly frequency.

55. For foreign firms, we have updated the NZCC's gearing formula to the following, noting that instead of "net debt" in the denominator, "total debt" should be used. We believe the cash equivalent component is already captured in the market valuation represented in the market cap.

$$\text{Gearing} = \frac{\text{Total debt} - \text{cash equivalent}}{\text{Market cap} + \text{Total debt}} = \frac{\text{Net debt}}{\text{Market cap} + \text{Total debt}}$$

56. However, for the Australian firms, we have adopted AER's estimate on the gearing.[17] For firms that are not available in the AER's gearing calculations, we adopted Olan Henry's longest sample estimate of the gearing.[18]

[17] https://www.aer.gov.au/documents/aer-gearing-calculations-16-june-2022.

[18] Olan Henry, Estimating Beta, An Update, April 2014.

5 Comparing Australian and foreign asset betas

57. This section asks whether asset beta estimates from international samples are statistically different to the asset betas estimated using only Australian firms. This section examines this question as follow:

   a. Section 5.1 performs a direct comparison of asset betas between Australian and foreign samples similar to the method in CEG 2022. We continue to find that:

      i. the sample mean of Australian asset betas is consistently lower than for foreign asset beta samples; but

      ii. these differences are not statistically significantly different; and

      iii. Australian and foreign comparators have similar equity market environments. Specifically,

         1. they have similar equity return volatility for utilities; and

         2. the relatively higher return volatility for the foreign stock markets is offset by a lower correlation between utility and market returns.

   b. Notwithstanding the lack of statistically significant differences, section 5.2 examines potential reasons why international asset betas might, nonetheless, be different. This section explains that:

      i. the determinants of equity beta (stock and market volatilities and correlations) are very similar for the international and Australian sample (such that sample average equity betas are essentially the same); but

      ii. it is differences in average gearing that drives differences in measured asset betas (the same measured equity beta at a lower gearing implies a higher asset beta).

   c. Section 5.3 explains:

      i. that the failure to include a debt beta in the leverage formula results in a material overstatement of the true difference in asset betas between international and Australian samples; and

      ii. the options available to regulators to deal with the "debt beta issue" when interpretating observations from comparators with materially different gearing.

5.1 Direct comparison of asset betas

58. A straightforward method in comparing the asset betas between Australian and foreign samples is to compare whether their sample means are statistically different or not.

59. The table below, outlines both the OLS (ordinary least squares) and LAD (least absolute deviation) estimates of asset beta with the respective p-values from the Welch's t-test and the confidence interval for the population mean that sits around the sample mean. The table compares the Australian sample set and the foreign base sample set (c) described in section 0.

Table 5-1: Comparison of asset betas between Australian and foreign base sample

	OLS (95% CI)			LAD (95% CI)		
	Australia	**International**	**Welch's t-test p-value**	**Australia**	**International**	**Welch's t-test p-value**
Longest period	0.242 (±0.098)	0.305 (±0.029)	19.0%	0.210 (±0.071)	0.274 (±0.028)	8.3%
Recent 10-year	0.220 (±0.211)	0.331 (±0.035)	16.6%	0.243 (±0.168)	0.285 (±0.029)	41.9%

Source: Bloomberg, CEG analysis.

60. Under this base sample set, the asset betas estimated under both the OLS and LAD models both periods show that the Australian and international asset betas are not statistically different at the 5% level. The lowest p-value is 8.3% for the longest period using LAD.

61. Note that the longest period using OLS and the recent 10-year period using LAD have a sample average asset beta of 0.24 for Australian comparators, which is consistent with the 2022 RORI with a benchmark equity beta of 0.60 and leverage of 60% (0.24 = 0.60/(1-60%)).

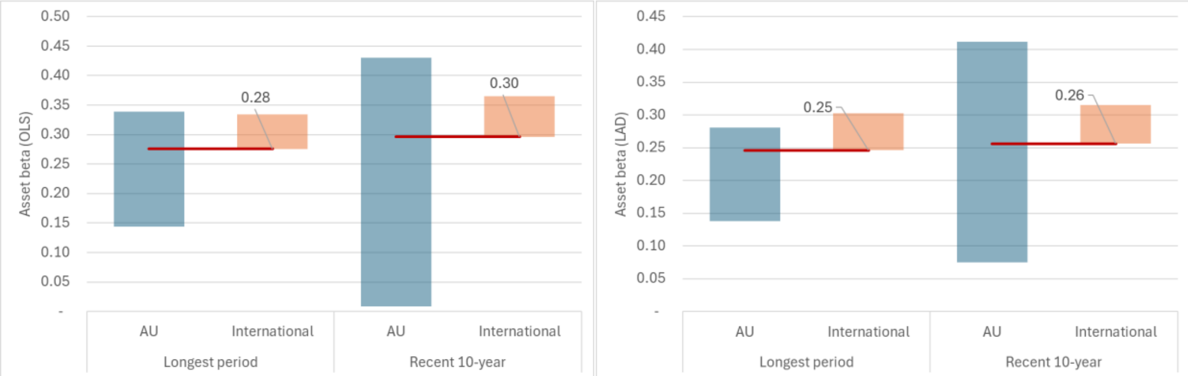
62. In CEG 2022, we suggested that the lower portion of the 95% confidence interval of the foreign asset beta could be a reasonable estimate that balances the fact that average Australian asset beta estimates appear lower than foreign estimates but that the small Australian sample size does not allow a definitive conclusion that the true Australian asset beta is lower:[19]

> *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).*
>
> *...*
>
> *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.*

63. The figure below is an update of the same analysis in figure 1-1 of CEG 2022.

[19] CEG 2022, paragraph 13 and 16.

Figure 5-1: Overlapping confidence intervals for Australian and foreign asset betas using the base sample (LAD and OLS)



Source: Bloomberg, CEG analysis.

64. In the above figure, the blue bars are the 95% confidence interval of the Australian asset beta estimate, while the orange bars are based on the foreign base sample set. The red line indicates the lower bound of the foreign asset beta estimate.

65. The significant difference in the range of 95% confidence interval between the blue and orange bars are driven by the difference in sample size and sample standard deviation. A lower sample size and higher sample standard deviation will lead to larger range.

66. Looking at this period by period, the lower end OLS estimates of the foreign asset beta is consistently 0.03 to 0.04 above the LAD estimates, with the lowest estimate at 0.28. The fact that most of the blue bars are able to wrap around the orange bars provides a visual representation of the high p-value when comparing the sample means between the Australian and foreign asset betas.

67. The table below compares the asset betas between Australian and the three foreign sample sets using OLS under both periods.

Table 5-2: Comparison of asset betas between Australian and foreign sample sets using OLS (Welch's t-test p-value)

	Longest period	Recent 10 year
OECD (90% regulated assets filter; max 0.5% bid-ask spread)	0.242 vs 0.305 (19.0%)	0.220 vs 0.331 (16.6%)
NZCC sample	0.242 vs 0.336 (6.2%)	0.220 vs 0.386 (9.0%)
NZCC (80% regulated assets filter)	0.242 vs 0.313 (13.8%)	0.220 vs 0.349 (12.9%)

Source: Bloomberg, CEG analysis.

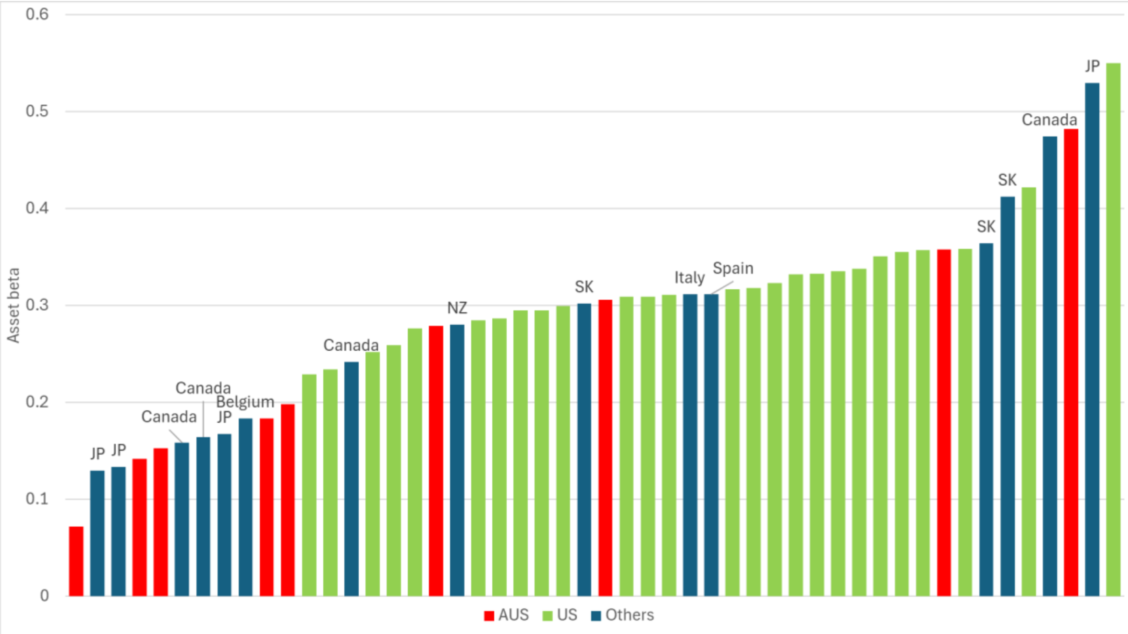
68. Foreign average asset betas are consistently higher than the Australian asset beta estimates for all the periods and sample sets. However, as we explain below. this is largely explained by the materially lower gearing observed in the foreign sample compared to the Australian sample and the fact that the asset beta we report is calculated using the AER de-leverage formula (which sets debt beta equal to zero).

69. Regardless, the Welch's t-test is always above 5% irrespective of the sample or period and is always above 10% relative to the OECD sample. This means that one cannot be confident that the true "population" mean of the Australian observations is different to the true "population" mean of the foreign observations.

70. In our view, the OECD sample is to be preferred. Relative to the NZCC sample, it is less dominated by US observations and, therefore, less likely to noise in response to US specific economic shocks.[20] It also excludes firms that were included by the NZCC but which have less than 90% regulated assets.

71. The variation in asset beta estimates in the longest time period is illustrated in Figure 5-2 below. It is noteworthy that the Australian observations are spread relatively evenly throughout the sample distribution – consistent with a p-value of 18.6% when testing whether the Australian mean is statistically significantly different to the foreign mean asset beta.

Figure 5-2: Asset beta estimate – longest period, OECD (90% regulated assets filter; max 0.5% bid-ask spread)



Source: Bloomberg, CEG analysis.

5.2 Potential sources of differences between Australian and foreign asset betas

72. The previous section established that the Australian and international asset beta sample averages are not statistically significantly different.

5.2.1 Further analysis is appropriate even though differences are not statistically significantly different

73. In section 4 of CEG 2022, we laid out why further analysis is necessary even though sample means are not statistically significantly different:[21]

[20] Refer to section 3.5.1 for detailed breakdown by country.

[21] CEG 2022 section 4.3.

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.

...

39. ...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.

74. In summarising and responding to AER's concerns, we stated that:[22]

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

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.

...

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.

5.2.2 Why could regulated utilities have different risk in different countries?

75. In section 5.1 of CEG 2022 we discussed the theoretical sources of potential underlying differences in true equity beta based on equation 1.

22 CEG 2022 section 4.4.

Equation 1: Beta formula

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

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

76. We explained that differences in regulatory regime and/or equity market characteristics can only persistently lower Australin utility equity beta risk relative to international comparators if:

    a. Differences in regulatory regime lower the volatility of Australian utility equity returns (SD_{r_U}) relative to international comparators. Specifically, if we observed persistently lower volatility of Australian utilities equity returns this might suggest that the Australian regulatory regime tended to produce more stable (lower risk) profit outcomes for Australian utilities;

    b. Differences in stock markets on which the utilities are listed raise the volatility of Australian market equity returns (SD_{r_M}) relative to international comparators. Specifically, a higher risk/more volatile Australian stock market might suggest Australian utilities have lower risk relative to their home market than international comparators (noting that "beta" is a measure of risk relative to the relevant market risk);

    c. Some other, less obvious, factors cause lower correlation between utility and market returns ($\rho(r_M, r_U)$) in Australia than in other countries. Specifically, holding the level of volatility in utility/market returns constant, if Australian utility returns are less correlated with the market then this will tend to lower Australian equity beta risk.

77. When we examined each of these potential sources of difference in beta risk we found that none provided a compelling case for why we might expect Australian utilities to have lower beta risk on average. Specifically:

    a. The volatility of Australian utility equity returns was very similar to international comparators. This suggested that the belief that the Australian regulatory regime delivered more stable (lower risk) profit outcomes for Australian utilities was not borne out by the equity market data. Table 7 of CEG 2022 showed that SD_{r_U} was very similar for Australian and foreign comparators over each of the three periods examined (since 2006, post GFC and most recent 5 years).

    b. The volatility of the Australian stock market (SD_{M_U}) was actually lower over each of the three periods examined – suggesting that equity beta should, if anything, be higher for Australian utilities (other things constant).

78. This left $\rho(r_M, r_U)$ as the only component of equation 1 that might justify a conclusion that Australian utilities have lower equity beta risk than their foreign comparators. Indeed, this has historically been the case. However, the theoretical problem this raises is that it is difficult to provide a compelling reason why Australian utilities equity returns should have lower correlation with market returns than international comparators – despite having similar or higher absolute utility volatility over periods when market volatility was higher internationally?

79. In order to rationalise this as a result of differences in regulatory regime we would need to have a cogent reason why the Australian regulatory regime causes Australian utilities to have more volatile equity returns relative to the market but, somehow, causes those returns to be less correlated with the market returns than international peers. While not impossible to develop a theoretical model in

which these facts co-exist, it is far from compelling that such a model describes reality (see section 5 and Appendix B of CEG 2022). Absent a compelling theoretical foundation, one should be uncomfortable strongly assuming that the historically lower correlation is reliable predictor of persistently lower future correlation (i.e., is not simply a statistical aberration).

80. Table 5-3 below shows updated comparisons of these factors using the CEG OECD 90% regulated sample and the longest period. The results are similar to those reported in Table 7 of CEG 2022.

Table 5-3: Illustration using the longest period of the CEG OECD 90% regulated sample

Parameter	Sample averages (Welch's t-test)	Effect on to equity beta
SD_{r_U}	5.3% vs 5.4% (85.4%)	Causes international to be **slightly higher** than Australia.
SD_{r_M}	3.2% vs 3.8% (2.6%)	Causes international to be **lower** than Australia.
$\rho(r_M, r_U)$	0.31 vs 0.39 (2.4%)	Causes international to be **higher** than Australia.
$\beta_{raw\ equity}$	**0.52 vs 0.56 (57.9%)**	**The three components offset each other, resulting in similar average raw equity beta.**

Source: Bloomberg, CEG analysis. Note that due to the sequence in calculating and averaging the betas, the numbers are not expected to fully add up, but should be close. Each of these parameters are the averages of weekly and four-weekly for the samples.

5.2.3 Differences in leverage drive differences in measured asset betas

81. The above table demonstrates that equity betas are actually very similar, on average, for the Australian and international base sample. That is, differences in SD_{r_U}, SD_{r_M}, and $\rho(r_M, r_U)$ cancel out leaving average equity beta essentially the same. It follows that the primary explanation for the difference in sample average asset betas is differences in gearing for Australian and international firms affecting the asset beta estimated using the AER de-levering formula:

Equation 2: AER de-levering formula

$\beta_A = \beta_E \times (1 - G)$; where

- β_A is asset beta;
- β_E is equity beta (defined in Equation 1)
- G is gearing defined as the market value of debt divided by the sum of the market value of debt plus equity.

Table 5-4: Differences in gearing and asset beta using the AER de-levering formula (longest period of the base sample)

Parameter	Sample averages (Welch's t-test)	Effect to asset beta
$\beta_{raw\ equity}$	0.52 vs 0.56 (57.9%)	The three components **offset each other**, resulting in similar average raw equity beta.
gearing	54% vs 45% (8.0%)	**Raises the international average asset beta** (estimated using AER leverage formula) relative to Australia.
β_{asset}	**0.24 vs 0.30 (19.0%)**	**It is the difference in gearing that drive the difference between international and Australian sample asset betas.**

Source: Bloomberg, CEG analysis. Note that due to the sequence in calculating and averaging the betas, the numbers are not expected to fully add up, but should be close. Each of these parameters are the averages of weekly and four-weekly for the samples.

82. The table below compares the average gearing of Australian and international samples across the two periods.

Table 5-5: Comparison of gearing for Australian and foreign sample sets (p-value)

	Longest period	Recent 10 year
OECD (90% regulated assets filter; max 0.5% bid-ask spread)	54% vs 45% (8.0%)	56% vs 44% (0.5%)
NZCC sample	54% vs 41% (1.8%)	56% vs 40% (0.7%)
NZCC (80% regulated assets filter)	54% vs 43% (3.5%)	56% vs 42% (2.7%)

Source: Bloomberg, CEG analysis.

83. It is observed that in all cases except the longest period of the more restricted OECD sample, gearing differences between Australian and international samples are statistically significantly different at the 10% level.

84. Moreover, gearing for international samples are consistently lower than for the Australian samples by 8% to 16%.

85. The following section delves deeper into analysis the impact of gearing to measured asset beta.

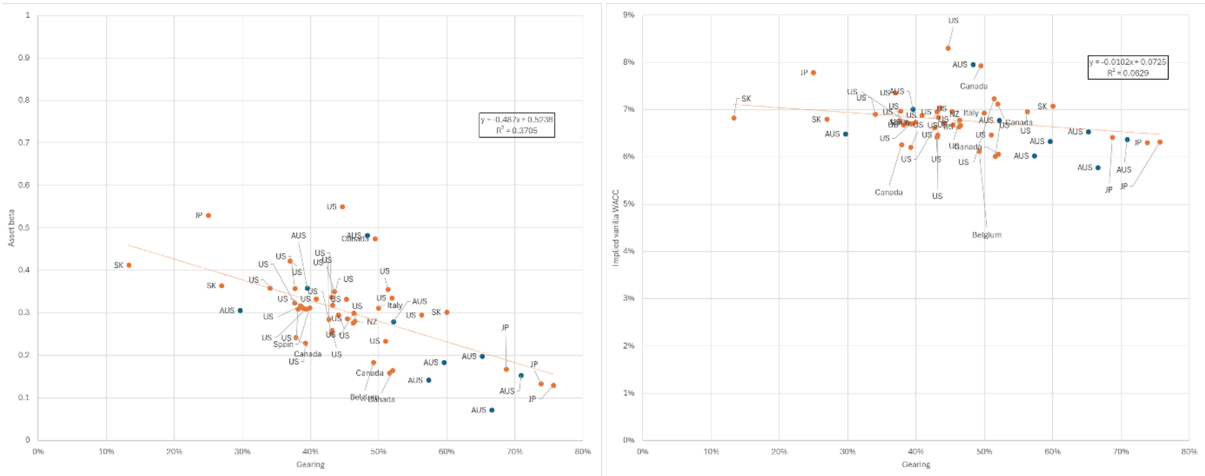
5.3 Imperfections in AER de-leverage formula tends to overstate the differences in sample average asset betas

86. When estimated using the AER de-leverage formula (Equation 2 set out below) there is a significant negative relationship between gearing and asset beta. Such a negative relationship should not exist because asset beta, by definition, should be independent of gearing. That is, if all firms had the same underlying risk and if the ideal (perfect) de-leverage formula were known and used, there should be no relationship between asset beta and gearing.

87. The strong negative relationship between gearing and asset beta estimated using the AER de-leverage formula can be seen in the left hand panel of Figure 5-3 which plots each firm's estimated

asset beta against its gearing using the most recent 10-year period. By contrast, there is a much weaker relationship between vanilla WACC[23] and gearing as illustrated in the right hand panel.

Figure 5-3: Asset beta and vanilla WACC vs gearing for the recent 10-year period (OECD sample with 90% regulated assets filter and 0.5% bid-ask-spread filter)



Source: Bloomberg, CEG analysis.

88. The best-fit line in the left hand panel is drawn using the foreign sample (orange dots), showing that for every 10% increase in gearing, it implies a drop in asset beta by 0.049. The coefficient is also significantly different from zero, with a p-value of 0.0%. By contrast, there is no statistically significant relationship between gearing and WACC as shown in the right hand panel.

89. The WACC data (as reported in the right hand panel) can also be reported as sample averages. As can be seen from Table 5-6 the OECD sample average WACC is only 0.20%/0.45% higher than the Australian sample over the longest/last 10 year periods. The p-values for a test of difference in sample means are above 25% (reflecting a statistically insignificant difference).

Table 5-6: Comparison of implied vanilla WACC between Australian and foreign sample sets (p-value)

	Longest period	Recent 10 year
OECD (90% regulated assets filter; max 0.5% bid-ask spread)	6.59% vs 6.79% (38.1%)	6.49% vs 6.93% (25.5%)
NZCC sample	6.59% vs 6.90% (19.0%)	6.49% vs 7.19% (9.8%)
NZCC (80% regulated assets filter)	6.59% vs 6.80% (36.8%)	6.49% vs 7.00% (21.3%)

Source: Bloomberg, CEG analysis.

90. The ultimate explanation for the negative relationship between asset beta and gearing is the absence of a positive debt beta in the AER leverage formula. The absence of a debt beta means that the model assumes debt holders take on zero (none) of the asset risk as leverage rises. It is well understood that this assumption is inaccurate. When a firm issues debt, especially long term debt, the lenders do

[23] This has been estimated for each firm based on their observed gearing and equity beta and applying a common MRP of 6.2%, risk free rate of 4.0% and an average Debt risk premium of 2.0%.

take on some of the underlying asset risks. This is reflected in the Brealey and Myers leverage formula which is the same as the AER leverage formula when the debt beta is equal to zero.

Equation 3: Brealey Myers leverage formula

$$\beta_E = \frac{1}{1-gearing} \times (\beta_A - gearing \times \beta_D);$$

rearranged implies

$$\beta_A = (1 - \text{gearing}) \times \beta_E + \text{gearing} \times \beta_D;$$

- β_D = debt beta.
- β_A , β_E and gearing are as defined in Equation 2.

91. It can be seen that a positive debt beta will raise the estimated asset beta more for highly geared firms than for firms with lower gearing (this is especially true if debt beta increases with leverage as is likely (see discussion in Appendix B.1).

92. Assuming a zero debt beta is not problematic if the samples being compared have the same average gearing – because any bias in the de-levering process will be similar across samples. However, if the sample average gearing values are materially different this will not be true. This issue is described mathematically and graphically in Appendix B.

93. In this context, it is important to note that the average gearing in the OECD samples is around 45% which is materially lower than the Australian sample (around 55%) Thus, the failure to include a debt beta in the leverage formula will tend to overstate the OECD sample average asset beta relative to the more highly geared Australian sample asset beta.

94. It is important to note that this is not an issue created by using foreign estimated asset betas. This issue exists wherever the benchmark gearing assumption differs from the average gearing of the sample of firms from which the estimated asset beta has been derived. Historically, the AER has set RoRI gearing at a level that is very close to the sample average gearing from which asset beta has been estimated. Consequently, the failure to include a debt beta in the leverage formula has been unproblematic.

95. However, if the AER gives weight to international sample averages with materially lower gearing then this issue will need to be addressed. Potential options available to the AER to address this issue include:

a. Adopting a positive debt beta (or a formulae for debt beta). This practice is commonly adopted by UK regulators and also by the QCA in Australia (see Appendix B);

b. As more weight is given to international sample asset betas, the AER could consider giving more weight to international sample gearing. This would follow precedent from the New Zealand Commerce Commission (see Appendix B).

c. Restrict the foreign sample to have similar gearing to the RoRI benchmark (see illustration in Appendix B).

d. All of, or some mix of, the above.

Appendix A Descriptive information of firms in each sample

96. [In separate csv file]

Appendix B Gearing, debt beta and asset beta

97. The ultimate explanation for the negative relationship between asset beta and gearing in Figure 5-3 is the absence of a debt beta in the current asset beta formula. The absence of a debt beta means that the model assumes debt holders take on zero (none) of the asset risk as leverage rises. It is well understood that this assumption is inaccurate. When a firm issues debt, especially long term debt, the lenders do take on some of the underlying asset risks.

98. In order to capture this fact, theoretical asset beta formula, such as the Brealey-Myers levering formula include a debt beta.

Equation 3: Brealey Myers leverage formula

$$\beta_E = \frac{1}{1-gearing} \times (\beta_A - gearing \times \beta_D);$$

rearranged implies

$$\beta_A = (1 - \text{gearing}) \times \beta_E + \text{gearing} \times \beta_D;$$

- β_A = asset beta.
- β_E = equity beta.
- β_D = debt beta.
- $gearing = \frac{debt}{debt+equity}$

99. If the true debt beta is positive, then using a zero debt beta will create inaccuracies in the re-levered equity beta so long as the re-levered gearing is different to the original gearing (i.e., the gearing associated with the observed equity beta). Specifically, the re-levered equity beta has an observed relationship to gearing that is:

 a. When the assumed gearing is lower than the observed gearing, it will underestimate equity beta; and

 b. When the assumed gearing is higher than the observed gearing, it will overestimate equity beta.

100. This is because, assuming a zero debt beta causes a "too steep" leverage effect: because doing it incorrectly assumes that debt holders do not bear any risk. Consequently, it is assumed that, as gearing increases, 100% of asset risk is concentrated with equity holders without any transfer of risk to debt holders – causing the same absolute amount of asset risk to be concentrated amongst a smaller amount of equity investment. However, in reality, risk does get passed to debt holders (corporate debt is not a riskless asset) and, therefore, an increase in debt passes some risk to debt holders and concentrates the remaining risk amongst equity holders. The theoretically accurate asset beta formula captures the former effect – with the passing of some risk to debt holders causing a less steep relationship between equity beta and gearing.

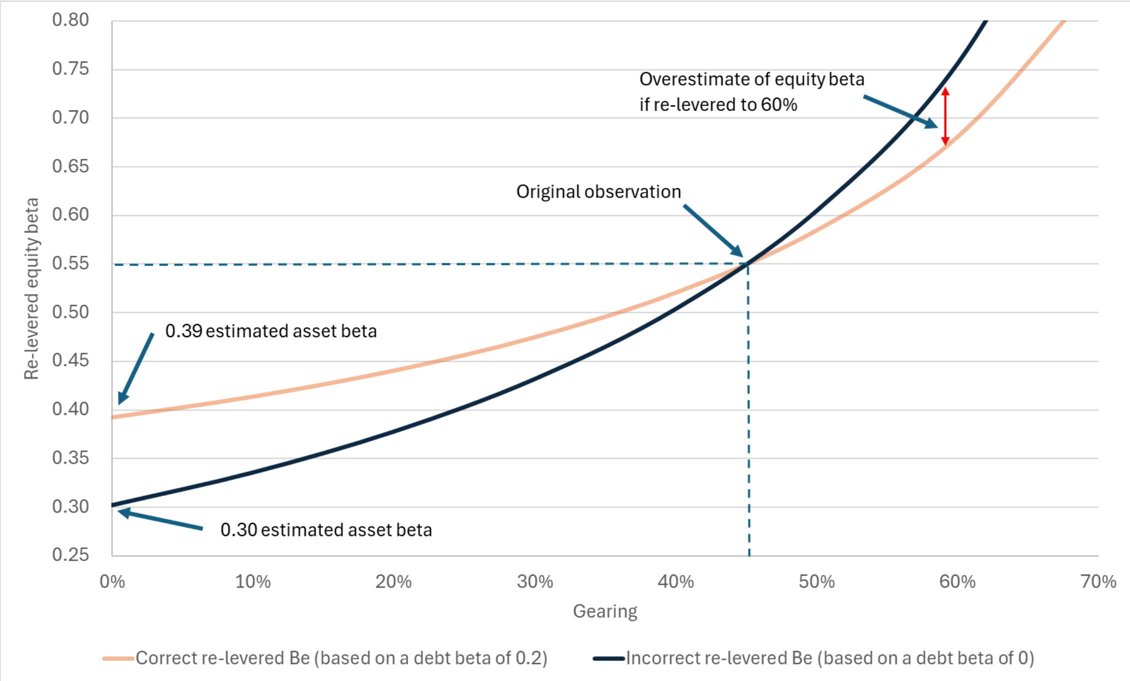
101. Consider an observed equity beta of 0.55 that is associated with an observed gearing of 45% and an actual (but unobservable) debt beta of 0.20. The estimated asset beta using the Brealey Myers

leverage formula with a zero debt beta will be 0.30 (=0.55*(1-45%)) while the correct asset beta will be 0.39 (=0.55×(1-45%)+0.20×45%).

102. This underestimated equity beta at zero debt ("asset beta") reflects the more general fact that all equity betas will be underestimated when assumed gearing of less than the original 45%. The flipside of this is that all equity betas will be overestimated if the assumed gearing is greater than the original 45% is used. This is also driven by the fact that the asset beta formula is "too steep".

103. The following chart illustrates the difference between the correct and the modelled equity beta in this scenario.

Figure B-1: Illustration of why re-levering away from the original gearing causes errors if the debt beta is incorrect



104. The simplified formula with a zero debt beta assumes that beta falls "too fast" with gearing. That is why it underestimates the asset beta (equity beta with zero debt). For precisely the same reason, re-levering to above the original gearing will overestimate equity beta. The overestimate of the equity beta assuming a 60% gearing is illustrated by the red vertical line in Figure B-1.

105. In this context, it is important to note that the average gearing in the OECD samples is around 45% which is materially lower than the RoRI current value of 60%. Thus, the graphical depiction of the overestimate in the equity beta from using the OECD sample asset beta in conjunction with a 60% gearing assumption (and a zero debt beta leverage formula) is indicative of the level of overestimation that would occur in this context (assuming a "true" debt beta of 0.20).

106. It is important to note that this is not an issue created by using foreign estimated asset betas. This issue exists wherever the RoRI gearing assumption differs from the average gearing of the sample of firms from which the estimated asset beta has been derived.

107. That said, we note that the RoRI gearing adopted by the AER (60%) has been consistent with the actual average gearing of Australian firms in the AER's asset beta sample. Consequently, this source of potential bias does not a material issue for the current RoRI assumptions. However, moving to the

OECD sample average asset beta would materially exacerbate this potential error if the AER did not make corresponding adjustments in its methodology. As discussed below, such changes could be to:

a. Adopt a positive debt beta;

b. Give more weight to international sample gearing when more weight is given to international sample asset betas;

c. Restrict the foreign sample to have similar gearing to the RoRI benchmark;

d. Some combination of the above.

Appendix B.1 QCA and UK regulators use of debt betas

108. The QCA uses the Brealey Myers leverage formula (Equation 3) with a debt beta of 0.12.[24]

> *For these reasons, we will retain a positive value for the debt beta. In recent reviews, we have used a value for the debt beta of 0.12. While Australian regulators tend to assume a debt beta of zero, two United Kingdom regulators, Ofgem and Ofwat, have applied values of 0.075 and 0.12 respectively for the debt beta in recent reviews.244 We are not aware of any further information that would provide a compelling reason for us to change our estimate of the debt beta. As such, our view is that a debt beta of 0.12 is appropriate.*

109. Partly because the QCA uses a positive debt beta they have decided that it is not necessary to also set gearing to be the same as for average gearing of the asset beta comparator set.[25]

> *Stakeholders had varying views about whether to use the same comparators for both beta and gearing. The DBCT User Group and Urban Utilities considered beta comparators would generally be appropriate for gearing comparators59, while the Gladstone Area Water Board (GAWB) said the comparators for gearing and beta do not need to be the same.60 While we consider that comparators we use to estimate beta provide an appropriate starting point for considering comparators for gearing, we are not limited to considering only those comparators. We may seek other comparators for gearing, as the risks that underlie the estimation of beta and gearing can differ.*

110. As noted in the first QCA quote above, UK regulators commonly use positive debt betas. However, as noted by Ofgem, the use of a debt beta is most important when setting benchmark (notional) gearing differently to the sample average (actual) gearing.[26]

> *We refer the CMA to the UKRN study on debt beta as published in December 2019, noting also that the CMA may wish to consider the MM [Modigliani and Miller] cross-check as per the NATS reference. If notional gearing and actual gearing are aligned then this could render debt beta moot.*

111. The UK Regulators Network asked CEPA to advise on estimating the debt beta in 2019. CEPA sets out the following table of UK regulatory precedent.[27]

[24] QCA, Rate of return review, Version 2, July 2023, p.80.

[25] QCA, Rate of return review, Version 2, July 2023, p.24.

[26] Ofgem (2020), 'Ofwat Price Determinations: Comments on the issues raised in the References', 11 May, p. 2.

[27] CEPA, Considerations for UK regulators setting the value of debt beta, Report for the UK Regulators Network, 2 December 2019, p.19

Table 3.1: Recent UK regulatory decisions on the debt beta

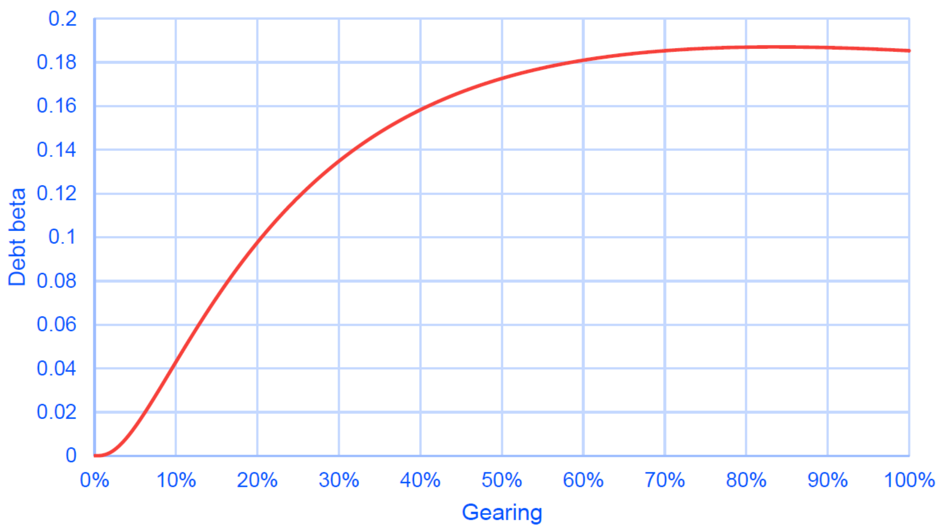
Regulatory review	Review stage	Year	Debt beta used
CMA (Bristol Water)	Decision	2015	0
Ofcom (MCT)	Decision	2015	0.10
Ofcom (BCMR)	Decision	2016	0.10
NI Utility Regulator (GD17)[23]	Decision	2016	0.10
NI Utility Regulator (RP6)	Decision	2017	0.10
Ofwat (PR19)	Methodology decision	2017	0.10
Ofcom (WLA)	Decision	2018	0.10
Ofgem (RIIO-2)	Methodology decision	2019	0.10-0.15
CAA (NERL)	Decision	2019	0.10
Ofwat (PR19)	Draft Decision	2019	0.125
Ofcom (LLCC)	Decision	2019	0.10

Source: CEPA review of regulatory determinations, supplemented by UKRN (2019) and NERA (2018)

112. CEPA also advised that, amongst other things: [28]

> *…debt betas should rise as gearing increases, as debt bears more non-diversifiable risk. The question is the extent of this effect. The structural approach described previously has the advantage that the dependence of the debt beta on gearing can be calculated explicitly. Figure 2.1 shows the outcome, using the same illustrative parameter values as in section 2.1.3.*

Figure 2.1: Illustration of the debt beta against gearing using the Cooper and Davydenko (2007) method



Appendix B.2 NZCC precedent and use sample average gearing with international comparators

113. The NZCC refers to the overly steep relationship between equity beta and leverage when using a zero debt beta as "the leverage anomaly". This is referred to as an anomaly because it causes WACC to rise with leverage when, consistent with the Modigliani Miller Theorem, the WACC should be independent of the leverage (i.e., the fundamental risk of a firm is unchanged by its financing

[28] CEPA, Considerations for UK regulators setting the value of debt beta, Report for the UK Regulators Network, 2 December 2019, p.15.

structure). This "leverage anomaly" would imply that the WACC is always minimised by issuing zero debt.[29]

> *This positive relationship between leverage and WACC is inconsistent with the behaviour of firms in workably competitive markets. Firms in those markets issue debt, providing debt levels are prudent, and are considered to be acting rationally when doing so.*
>
> *In 2010 we identified **two main options** to overcome this anomaly: use the average leverage of the sample of comparator companies used to estimate asset beta, or use non-zero debt betas. We noted that the use of non-zero debt betas is theoretically better than using notional leverage, but there are practical difficulties in accurately estimating debt betas. We also noted that most regulators do not use non-zero debt betas and that we had not used them in the past.*
>
> *Debt beta measures a firm's systematic risk associated with borrowing, and is measured by the sensitivity of the returns on corporate debt to movements in returns on the market portfolio of all assets. In 2010 PwC submitted that: If debt betas are to be excluded from the WACC analysis (which we concur with), then to be consistent the notional leverage used in the WACC estimation should be close to the average leverage of the comparator companies used to derive the (average) beta estimate. This is a fundamental requirement in order to be able to justify application of a "short cut" approach and thus ignore debt betas.*
>
> *We recognise that the greater the riskiness of debt, the more it resembles equity. Therefore, the greater the systematic risk of debt due to market conditions, the greater the debt beta.*
>
> *Consequently, in principle, debt betas should be included in the cost of capital calculation. The use of non-zero debt betas is theoretically sounder than using notional leverage as the use of non-zero debt betas would reduce the extent to which the post-tax WACC estimate for each service varies with leverage.*
>
> *However, we noted in 2010 that most submissions preferred the use of zero debt betas, that most regulators do not use debt betas (though a minority do), and that we had not used non-zero debt betas in the past. Further, there are practical difficulties in accurately estimating debt betas. Those challenges to the use of non-zero debt betas remain.* (Emphasis added)

114. The NZCC discusses in more detail all of the technical issues that would need to be dealt with if relying on an estimate of the debt beta in its 2010 decision. The NZCC's key conclusion was that, rather than estimating a debt beta the NZCC would align benchmark gearing with the average gearing of the comparators used to estimate equity and asset betas. [30]

> *With regard to estimating equity betas, the Commission noted that these would be inherently imprecise and involve a significant degree of judgement. Given the difficulty associated with obtaining reliable data for a portfolio of traded corporate bonds, the Commission considers that the estimation of debt betas would be even more imprecise and require an even greater degree of judgement.*

Appendix B.3 Restricting international comparators to have gearing close to the RORI benchmark gearing of 60%

115. Aligning benchmark gearing with the sample average gearing can be achieved in two ways:

[29] NZCC, Input methodologies review decisions, Topic paper 4: Cost of capital issues, 2016, pp. 142-143.

[30] Input Methodologies (electricity distribution and gas pipeline services) Reasons Paper, December 2010, pp. 428 to 431 and appendix H9 pp. 552 to 556.

a. Adjust the benchmark gearing to reflect the sample average gearing; and/or

b. Adjust the sample so that the sample average gearing matches the benchmark.

116. By way of illustration, we perform the latter approach (noting that this comes at a cost to sample size and, therefore, sample average reliability.

117. If we restrict comparators to those with gearing between 50% to 70%, this results in only 8 foreign firms in the longest period and 4 foreign firms in the recent 10-year.

Table B-1: Gearing for the restricted base sample (gearing 50% to 70%)

	Australia	International	T-test (p-value)
Longest period	54%	55%	84.5%
Recent 10-year	56%	52%	20.8%

Source: Bloomberg, CEG analysis.

118. After applying the gearing restriction, the restricted base sample has almost identical average gearing to the Australian sample (very high p-values, indicating that their sample means are very similar).

119. The average asset betas estimated using the foreign sample are very similar to the Australian sample compared to those in Table 5-1. Consistent with this, p-values testing for differences between the sample mean asset betas are 37%/85% for the recent 10 years/longest period.

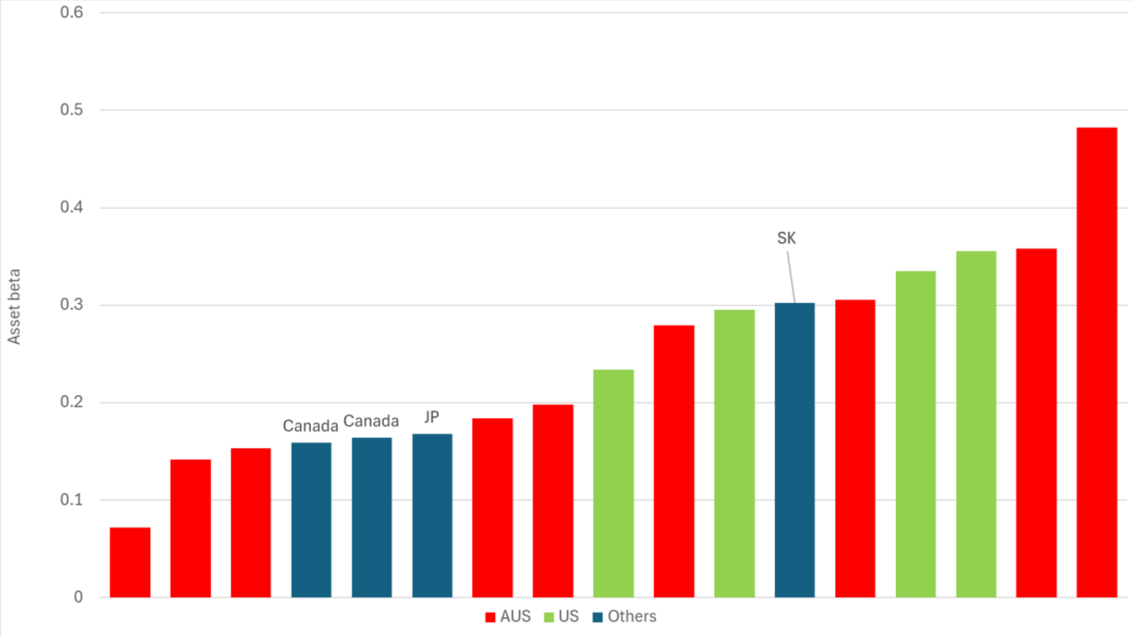
Table B-2: Comparison of asset betas between Australian and foreign samples

	OLS (95% Confidence Interval)		
	Australia	International	T-test
Longest period	0.242 (±0.098)	0.252 (±0.068)	84.7%
Recent 10-year	0.220 (±0.211)	0.301 (±0.205)	37.1%

Source: Bloomberg, CEG analysis.

120. A visual representation of this is provided in Figure B-2 below which shows the asset beta estimates for each firm under the longest period. Consistent with our observations in Figure 5-2, the Australian firms are quite evenly spread across the foreign sample.

Figure B-2: Asset beta estimate – longest period restricted base sample



Source: Bloomberg, CEG analysis.