



Independent Pricing and Regulatory Tribunal
New South Wales

Estimating Equity Beta

for the Weighted Average Cost of Capital

Draft Report
Research

March 2020

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Tribunal Members

The Tribunal members for this review are:

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Invitation for submissions

IPART invites written comment on this document and encourages all interested parties to provide submissions addressing the matters discussed.

Submissions are due by 1 May 2020.

We would prefer to receive them electronically via our online submission form <www.ipart.nsw.gov.au/Home/Consumer_Information/Lodge_a_submission>.

You can also send comments by mail to:

Equity Beta method review

Independent Pricing and Regulatory Tribunal

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Late submissions may not be accepted at the discretion of the Tribunal. Our normal practice is to make submissions publicly available on our website <www.ipart.nsw.gov.au> as soon as possible after the closing date for submissions. If you wish to view copies of submissions but do not have access to the website, you can make alternative arrangements by telephoning one of the staff members listed above.

We may choose not to publish a submission - for example, if it contains confidential or commercially sensitive information. If your submission contains information that you do not wish to be publicly disclosed, please indicate this clearly at the time of making the submission. However, it could be disclosed under the *Government Information (Public Access) Act 2009* (NSW) or the *Independent Pricing and Regulatory Tribunal Act 1992* (NSW), or where otherwise required by law.

If you would like further information on making a submission, IPART's submission policy is available on our website.

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1 Overview

The Weighted Average Cost of Capital (WACC) is an important input for all our pricing reviews, in water, rail access and other industries where we set, recommend or arbitrate prices. We use it to determine the permitted return on assets. Many WACC inputs are sensitive to current observations of debt and equity markets, while other inputs are industry-specific and tend to vary more slowly.

Equity beta is one such industry-specific input. It reflects the level of systematic risk faced by a firm in a particular type of industry. That is, the extent to which a firm's returns co-vary with returns to the market as a whole. Equity beta is a key input to our determination of the cost of equity using the Capital Asset Pricing Model (CAPM). There are well-established econometric methods for estimating the equity beta of a particular listed firm.¹

The challenge is to determine a representative beta for a particular firm that we regulate, where it may not be listed on any stock exchange. To do this, we identify listed proxy firms that have a similar systematic risk profile to the regulated firm, and then estimate equity beta for those firms.

Our challenge is different to that faced by the Australian Energy Regulator (AER) in two ways. First, the majority of energy firms they regulate are listed entities, so there is no need to identify proxies in different industries. Second, the AER's focus is on the risk profile of **regulated entities**,² while our benchmark efficient entity is one operating in a **competitive** market.

This type of proxy company analysis is well established in financial economics and regulatory practice. The challenges in doing it well are twofold. First, some judgement is required in selecting suitable proxy firms. Second, it is necessary to ensure that the estimated equity beta values are statistically sound.

1.1 Draft decisions

We have made five draft decisions after conducting our own analysis and considering the matters raised in submissions. These decisions represent changes to our Fact Sheet method.

- 1 Use weekly returns rather than monthly returns and examine all five possible reference days (ie, weekly average Monday to Friday, Tuesday to Monday, Wednesday to Tuesday, Thursday to Wednesday, and Friday to Thursday) to estimate beta.

¹ The significance of listing is that stock markets provide daily information on stock prices and dividends for listed firms, which permit direct measurement of returns (ie, profits to shareholders).

² For example, the AER states that "Our regulatory task is to determine a rate of return that is commensurate with efficient financing costs. To this end, 'risk' must be considered in the context of a firm that is providing regulated energy network services." Australian Energy Regulator, *Discussion paper Equity Beta*, March 2018, p 7.
<https://www.aer.gov.au/system/files/AER%20-%20Equity%20Beta%20Discussion%20Paper%20-%20March%202018.pdf>

- 
- 2 Change the threshold for inclusion of a proxy firm to 60 months minimum available return data rather than 36 months.
 - 3 Use the market value of equity to calculate gearing and use the average gearing over the sample period to de-lever observed equity betas rather than gearing measured at the end of the estimation period.
 - 4 Use the Brealey-Myers de-levering formula, which omits the tax term, rather than the Hamada formula.
 - 5 Adopt the decision rule that before considering any revision to an established beta value for a price review:
 - The prior beta estimate is more than one standard deviation from mean of current sample, and
 - There is persistent evidence over long period (ie, a regulatory period or longer) of changed beta.

We consider that these five draft decisions provide for a more stable and statistically reliable method to estimate equity beta than our current method. These decisions assist with maintaining the stability, certainty, replicability and predictability of our WACC method, as well as ensuring it produces reasonably accurate estimates. Submissions emphasised the importance of stability of outcomes and otherwise were supportive of most of these recommendations.

We have confirmed the feasibility of modifying our beta estimation tools to implement these recommendations.

1.2 We reviewed our WACC method in 2017-18

In our review of the WACC method during 2017-18 we undertook extensive consultation. Our final decisions on equity beta from our 2017-18 review are shown in Box 1.1. During that review, stakeholders requested more specific detail on how we proposed to select proxy firms and estimate their equity betas.

This report explains our draft decisions to modify our equity beta method including our response to stakeholder submissions.

Box 1.1 Final Decisions on Equity Beta from our 2018 Final Report on WACC

We made four final decisions on the calculation of equity beta:

25. Continue to re-estimate equity betas at each price review to inform our assessment of whether the existing estimates remain appropriate.
26. Use the broadest possible selection of proxy companies to estimate equity beta, but exclude thinly traded stocks.
27. Adopt a proxy selection process that includes:
 - a) publishing our criteria for proxy selection, and our list of comparator companies that meet our criteria at the start of the relevant review, and
 - b) giving stakeholders the opportunity to propose additional comparable industries that meet our criteria.
28. Determine the appropriate equity beta having regard to equity betas calculated using the OLS method with the Vasicek adjustment.

Source: IPART, *Review of our WACC method, Final Report*, February 2018, pp 61-65.

1.3 Have your say on our draft recommendations

For this review, we are conducting public consultation as well as detailed analysis. To date, we have:

- ▼ Released a **Fact Sheet** in April 2019 outlining our proposed approach to the review and invited comment. To allow stakeholders to replicate our calculations, we also published our source code³ in the R programming language, subject to a disclaimer.⁴
- ▼ Considered all submissions to our **Fact Sheet** and undertaken analysis to develop our Draft Report.

We are now inviting submissions on the decisions and analysis in this Draft Report. Submissions are due by **1 May 2020**. Information on how to make a submission is provided on page iii at the front of this report.

We will consider submissions to our Draft Report in preparing our Final Report. We intend to publish a final report in **June 2020**. We would apply the new equity beta method for reviews that commence from 1 July 2020.

³ Source code: <https://www.ipart.nsw.gov.au/files/sharedassets/website/shared-files/investigation-administrative-legislative-requirements-sea-wacc-methodology-2017/equity-beta-r-model-source-code.pdf>

⁴ Disclaimer: <https://www.ipart.nsw.gov.au/files/sharedassets/website/shared-files/investigation-administrative-legislative-requirements-sea-wacc-methodology-2017/beta-equity-disclaimer.pdf>

2 Matters raised in submissions

We received three submissions on our equity beta method:

- ▼ Hunter Water⁵
- ▼ Sydney Desalination Plant (SDP)⁶
- ▼ Sydney Water.⁷

We also received comments from WaterNSW that were contained in its 2020 Pricing Proposal for Greater Sydney.⁸

All of the submissions supported our general approach to WACC and equity beta. Recommendations in the submissions were mainly on matters of detail.

A critical part of our equity beta method is the selection of proxy companies. The selection rules on which we consulted are summarised in Table 2.1 below.

⁵ Hunter Water, Submission to IPART Fact Sheet – Estimating Equity Beta, July 2019 (Hunter Water submission) <https://www.ipart.nsw.gov.au/files/sharedassets/website/shared-files/investigation-submissions-sea-wacc-methodology-2017-estimate-equity-beta/online-submission-hunter-water-p.-shields-5-jul-2019-164535596.pdf>

⁶ Sydney Desalination Plant, Submission to IPART Fact Sheet – Estimating Equity Beta, July 2019 (SDP submission) <https://www.ipart.nsw.gov.au/files/sharedassets/website/shared-files/investigation-submissions-sea-wacc-methodology-2017-estimate-equity-beta/online-submission-sydney-desalination-plant-j.-de-lorenzo-4-jul-2019-111008625.pdf>

⁷ Sydney Water, Submission to IPART Fact Sheet – Estimating Equity Beta, July 2019 (Sydney Water submission) <https://www.ipart.nsw.gov.au/files/sharedassets/website/shared-files/investigation-submissions-sea-wacc-methodology-2017-estimate-equity-beta/online-submission-sydney-water-l.-harloe-1-jul-2019-221658407.pdf>

⁸ WaterNSW, *WaterNSW Pricing Proposal to the Independent Pricing and Regulatory Tribunal - Regulated prices for Greater Sydney 2020 to 2024*, July 2019 (WaterNSW proposal) <https://www.ipart.nsw.gov.au/files/sharedassets/website/shared-files/pricing-reviews-water-services-metro-water-review-of-prices-for-waternsw-greater-sydney-from-1-july-2020/legislative-requirements-review-of-prices-for-waternsw-greater-sydney-from-1-july-2020/waternsw-pricing-proposal-for-regulated-prices-for-greater-sydney-2020-to-2024.pdf> (pp 142-148)

Table 2.1 Sample selection rule summary

Criteria
Pre-estimation screening rules
Industry
What industry, or industries, should be used to identify proxy firms?
Firm characteristics
Does the firm operate in the nominated industry?
Does the firm undertake its activities in capital markets that are sufficiently similar to Australia?
Does the firm have a similar operating profile to the benchmark efficient firm?
Market
Is the sovereign's government bond market sufficiently deep and liquid?
Is the sovereign's equity market sufficiently deep and liquid?
Is the firm's international headquarters consistent with its actual operating market?
Operating profile
Is the firm's revenue predominately in the nominated industry?
Liquidity filters & data quality
Remove a monthly observation for a given stock if there is less than 10 days of trading data available
Remove a monthly observation for a given stock if the calculated Amihud measure exceeds the threshold of 25.
Remove the firm if it has less than 36 months of trading data available.
Post-estimation screening rules
Is the sample size sufficiently large?
Are the estimates consistent (no extreme outliers)?
Are there obvious biases in the results?

Source: IPART analysis

2.1 Submissions were unanimous on changes to sampling rules

All submissions requested that we increase the threshold for inclusion of a proxy firm from 36 months trading data to 60 months. This suggestion is based on improving statistical reliability and we support it.

All submissions also requested that we sample returns weekly rather than monthly and that we consider every possible reference day used to calculate returns (ie, weekly average Monday to Friday, Tuesday to Monday, Wednesday to Tuesday, Thursday to Wednesday, and Friday to Thursday). This is because weekly beta estimates can be sensitive to the choice of reference day.⁹ These suggestions are also based on improving the statistical reliability of beta estimates and we support them.

We note that adopting this suggestion increases the amount of data we need to download and process. We have modified our beta estimation R scripts and our data interface to accommodate these changes. We have confirmed that our modified scripts can implement them correctly.

⁹ The risk of estimation error due to the choice of reference day is known in the empirical finance literature as reference day risk.

2.2 Frontier Economics noted some departures from finance theory

Sydney Desalination Plant engaged Frontier Economics to review our beta method, and attached Frontier's report to its submission. Among other observations, Frontier Economics noted that two aspects of our equity beta method were inconsistent with finance theory:¹⁰

- ▼ We calculated gearing of a proxy firm based on the gearing in the **last month** of the sample period, and used the book value of equity to calculate gearing.
- ▼ In de-levering equity betas estimated for proxy firms, we used the Hamada formula, which applies when the total amount of debt remains constant (even though market capitalisation, hence value of equity, may change).

We have reflected on these comments and agree with Frontier. As a result, we now propose to:

1. Calculate gearing of a proxy firm based on the market value of equity and use the average gearing over the **sample period**.
2. In de-levering equity betas for proxy firms, use the Brealey-Myers formula, which applies when the **gearing ratio** remains constant (ie, the amount of debt is increased as market capitalisation increases to maintain the gearing ratio).

2.3 All submissions proposed expanding sample size

All submissions suggested we consider expanding the set of proxy firms we examine. Frontier Economics made a specific suggestion about the use of alternative industry classification schemes to identify suitable new firms,¹¹ and we have looked into that suggestion. Sydney Water and some other submitters suggested that we consider including Australian non-water infrastructure firms in the sample.¹²

We agree with Frontier's submission that it is important to recognise that the reliability of an estimate depends on both its statistical precision and the comparability of the firms used to derive that estimate. However, there is usually a trade-off between achieving statistical precision and comparability. Generally, the larger the sample, the greater the statistical precision of estimates.

However, if the size of a comparator sample is expanded beyond a certain point, the comparability of the firms within the sample may diminish. This, in turn, may reduce the reliability of the resulting beta estimate, notwithstanding the improvement in precision from a purely statistical point of view. Conversely, if the sample size is narrowed to permit only the most comparable firms, then the resulting sample is likely to be very small and come at the cost of greater statistical imprecision and variability in estimates over time.¹³

We expect that this trade-off would be explicitly considered in each price review. Depending on the characteristics of each regulated firm a future Tribunal could opt for a small, closely

¹⁰ SDP submission, pp 11, 27.

¹¹ SDP submission, p 10.

¹² Sydney Water submission, p 9. Hunter Water submission, p 3. WaterNSW proposal, p 146.

¹³ SDP submission, p 24.

matched proxy set in one review and a broader set in another. The decision on which industries to include in each proxy set would be made in the relevant price review, with opportunities for stakeholders to make submissions.

2.4 Some submissions queried our exclusion of Chinese, Russian exchanges

In our fact sheet on equity beta, we noted that we excluded proxy firms that were listed on stock exchanges in China, Russia and some African countries. Two stakeholders queried that decision. For example, Frontier Economics stated:¹⁴

IPART has excluded Chinese firms from its comparator sample. The Chinese stock market is considerably more liquid than the Australian stock market, and any illiquidity in the Chinese government bond market has no material impact on beta estimates. There are 12 Chinese firms within IPART's original long list of 228 Thomson Reuters comparators that pass all of IPART's data/liquidity filters. On IPART's own tests, there appears to be no reason to exclude these firms.

Our primary reason for excluding these stock exchanges was that the sovereign risk profile and governance arrangements there are different to the majority of stock exchanges in the sample. There was also an absence of transparency about some of the data from these countries. This could distort the relationship between quoted returns to individual firms and world equity market dynamics.

While liquidity is a relevant factor, the concern expressed in our fact sheet was based on governance and sovereign risk issues. Therefore, our draft decision is to continue excluding stocks listed on the exchanges of those countries.

2.5 Sydney Water proposed weighted beta estimates

Without making a specific suggestion about how this would be done, Sydney Water recommended that we assign explicit weights to beta samples taken from particular jurisdictions or industry sectors in deriving a central estimate.¹⁵ We have not adopted this suggestion because any weighting scheme would be arbitrary and our use of the median to find a central point does not require any weighting.

2.6 Several stakeholders recommended a status quo bias

Several stakeholders (SDP, Sydney Water, and WaterNSW) suggested imposing a threshold test before changing an existing beta estimate.¹⁶ Noting that beta estimates are imprecise and volatile, and that small changes in beta can lead to large changes in prices, stakeholders were concerned about the possibility that new analysis could result in spurious departures from the status quo beta.

¹⁴ SDP submission, p 10.

¹⁵ Sydney Water submission, p 11.

¹⁶ SDP submission, p 2. Sydney Water submission, p 6. WaterNSW proposal, p 146.

In order to guard against that possibility, Frontier Economics recommended that the following points be considered in any decision to depart from a prevailing beta estimate:¹⁷

- ▼ Departure from the status quo would only be contemplated if the prevailing estimate lies beyond 1 standard deviation either side of the sample mean of beta estimates across the comparator sample.
- ▼ Stakeholder submissions and preference for stability would be taken into account.
- ▼ Departure from the status quo would only be contemplated if the evidence supporting a different value was persistent over a long timeframe.

We consider that these suggestions are reasonable. We would consider stakeholder submissions in the normal course of any inquiry. Our draft decision is to adopt the other two Frontier recommendations.

Table 2.2 below summarises the recommendations made by submitters, our draft responses and reasons.

¹⁷ SDP submission, pp 11-32 (Frontier recommendation 9).

Table 2.2 Summary of submissions on equity beta consultation and IPART's response

Recommendation	Submitter(s)	IPART's response	Reasons
Compute beta using weekly returns rather than monthly returns, using all possible reference days (ie, Monday, Tuesday ... Friday)	SDP, Sydney Water, Hunter Water, WNSW	Agree	Improves statistical reliability
Exclude firms with fewer than 60 months of trading data (rather than 36 as currently)	SDP, Sydney Water, WNSW	Agree	Improves statistical reliability as long as 60 month requirement doesn't result in small sample size
Use market value of equity to calculate gearing and use average gearing over sample period to de-lever observed equity betas	SDP, WNSW	Agree	More consistent with finance theory than our current approach
Use the Brealey-Myers de-levering formula, which omits the tax term, rather than the Hamada formula	SDP, WNSW	Agree	More consistent with the assumption of constant gearing, rather than constant absolute amount of debt
Impose a high threshold before departing from established equity beta	SDP, Sydney Water, WNSW	Agree	Consistent with statements in our 2018 Final Report on WACC method
Consider widening pool of comparator firms	SDP, Sydney Water, Hunter Water, WNSW	Agree, subject to suitably objective rule for including new types of firms	Widening pool will usually improve statistical accuracy unless new firms are fundamentally dissimilar
Don't exclude Chinese and Russian firms or provide a better explanation of the reason	SDP, WNSW	Disagree. Accept the need for a better explanation, and we have provided that.	Sovereign risk and governance may distort market returns. Transparency concerns.
Assign explicit weightings to different groups of comparator firms and continue to include outliers	Sydney Water	Disagree with weightings. Agree about treatment of outliers, which is our current approach.	Choice of weightings likely to be arbitrary. Use of median makes weighting unnecessary. We would examine extreme outliers to understand the cause, but include them.

