IPART

Independent Pricing and Regulatory Tribunal
New South Wales

Review of our WACC method

Draft Report
Research

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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 on Friday 1 December 2017

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:

Review of our WACC method
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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 on the previous page.

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. IPART will then make every effort to protect that information, but 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 Executive summary

The Independent Pricing and Regulatory Tribunal of NSW (IPART) is reviewing the standard method we use to determine the weighted average cost of capital (WACC). The WACC is a key input for calculating the revenue requirements and setting prices for the businesses we regulate, and it is important that our determination is as accurate as possible. If we set the WACC too high, customers would pay too much and the regulated business could be encouraged to over-invest. If we set it too low, the business' financially viability could suffer, and it could be encouraged to under-invest. Neither outcome is in the long-term interest of customers.

Our aim in consulting on and publishing our WACC method is to improve the accuracy and predictability of our decisions. We last reviewed and updated our WACC method in December 2013.[1] Since then we have published further refinements to some elements of this method – including our approaches to estimating the debt margin, adjusting for inflation, and implementing the WACC decision rule.[2]

We consider our 2013 WACC method is working well. Stakeholders can replicate our calculations, and the method has increased the stability of the regulatory regime for our regulated businesses. Nevertheless, it is good practice to review the method periodically to make sure it is functioning as intended and to make incremental improvements.

This report outlines our draft decisions, explains how and why we made those decisions, and seeks submissions from stakeholders. We will consider all submissions before making our final decisions by February 2018. Our revised WACC method will apply to pricing decisions that take effect **on or after 1 July 2018**.[3]

1.1 What elements of our 2013 method we will broadly maintain

The feedback we have received from stakeholders confirms our view that, overall, our 2013 WACC method is working well.[4] The ARTC submitted that:

> Aside from the adoption of a forward looking aspect in the WACC calculation, ARTC has no other suggestions for IPART to change its WACC methodology given the significant value derived from its current approach in stability, logical consistency and transparency.[5]

1 IPART, *Review of WACC Methodology – Final Report*, December 2013.

2 IPART, *Fact Sheet - IPART's New Approach to Estimating the Cost of Debt*; April 2014; IPART, *Fact Sheet - New approach to forecasting the WACC inflation adjustment*, March 2015; IPART, *Fact Sheet - Guide to IPART's Uncertainty Index Model*, February 2016.

3 We would consult on applying our revised method in the course of future price reviews for such decisions. Our revised method **will not apply** to any determination currently in effect, or to our fare determinations for private ferries and rural and regional buses, both of which will apply from 1 January 2018.

4 WaterNSW submission to IPART Issues Paper, August 2017, p 4; ARTC submission to IPART Issues Paper, August 2017, p 3; Hunter Water submission to IPART Issues Paper, August 2017, p I; Sydney Water submission to IPART Issues Paper, August 2017, p 2; SDP submission to IPART Issues Paper, August 2017, p 1.

5 ARTC submission to IPART Issues Paper, August 2017, p 3.

Hunter Water stated that it:

> …considers that IPART's 2013 WACC methodology review resulted in a far better approach to the setting of financing costs. Hunter Water welcomed IPART's setting of decision rules in the WACC formula, the use of externally available information sources for each parameter, the inclusion of the uncertainty index and the publication of biannual WACC updates…IPART's current WACC methodology satisfies the test of replicability, stability and transparency.[6]

Therefore, we will broadly maintain the key elements of this method. We have made draft decisions to continue to use our 2013 method for:

- defining our benchmark firm
- constructing our uncertainty index and applying our WACC decision rule
- determining industry-specific parameters of gearing and beta, and
- using a real post-tax framework and accounting for imputation credits.

We consider maintaining the stability, certainty, replicability and predictability of our WACC method is important, as well as ensuring it produces reasonably accurate estimates. The stability and transparency of having a standard WACC method has been an important factor in supporting a strong credit rating for some of our regulated water businesses.

1.2 Overview of our proposed incremental changes

We have identified opportunities to make incremental changes to some elements of the 2013 method to improve its overall accuracy, transparency or predictability. In particular, we have made draft decisions to modify our approaches for sampling market observations, setting the cost of debt, measuring the current market risk premium (MRP), estimating the equity beta, and measuring inflation.

Our draft decisions reflect stakeholder feedback as much as possible. Where we found the case for change was not strong – that is, where it was not clear that a proposed change would produce a more accurate WACC estimate – we have opted to maintain our 2013 method, in line with our view on the importance of stability and certainty. On balance, we consider these decisions would result in a more accurate WACC without causing a significant adjustment for stakeholders.

1.2.1 Synchronising sampling dates and periods for selected current parameters

Because market observations tend to be volatile, the timing of the observations we use to measure the market-based parameters is important, particularly for current parameters. Our 2013 method is to use the most recent available data for each parameter, which means the sampling dates differ across parameters.

We have made draft decisions to synchronise the sampling dates for five current parameters – the risk-free rate, debt margin, current MRP, inflation and uncertainty index – and to adopt a consistent sampling period of two months for the risk-free rate and debt margin.

6 Hunter Water submission to IPART Issues Paper, August 2017, p i.

This would improve the accuracy in our resulting WACC calculations by recognising the interrelationships between parameters.

1.2.2 Adjusting the current cost of debt during the regulatory period

Our 2013 method is to set a cost of debt that gives equal weight to estimates of the current and historical cost of debt unless there is significant economic uncertainty. In our view, it is important to take account of the current cost as this provides incentives for efficient investment decisions.

Some stakeholders submitted that this approach creates a refinancing risk for regulated businesses that they can only partially offset through hedging strategies. They suggested that we should set the cost of debt based on historical data only, and use a trailing average approach to estimate this cost.[7] They commented that a trailing average approach would produce a regulatory cost of debt that matches the prudent debt financing strategy for firms with long-lived assets, and could reduce costs for firms and price volatility for consumers.

We agree with stakeholders' concerns that our 2013 method may create a refinancing risk. However, after considering stakeholders' submissions and conducting further analysis, we do not support a trailing average approach. Setting the regulatory cost of debt based on historical data only would not provide the same incentives for efficient investment as our 2013 method.

Instead we have made draft decisions to:

- adjust our estimate of the current cost of debt to reflect changes in the efficient cost of debt during the regulatory period, and
- make this adjustment at the beginning of the following regulatory period using a true-up mechanism.

We consider this would address the refinancing risk that stakeholders identified, as it would mean a regulated business is exposed (ex post) only to the average efficient cost of debt over the regulatory period. At the same time, it would maintain the incentives for efficient investment decisions during the regulatory period created by the current approach.

We have also made a draft decision to use an improved approach to measure the cost of debt by converting published bond yield data into annualised yields. We will continue to use RBA-published data on the spread between the yield of BBB rated bonds issued by Australian non-financial corporations to the 10-year Australian Government Bond yield.

As noted above, this change would apply only to decisions made on or after 1 July 2018. Determinations that are already in effect will be subject to our 2013 method. This means at the next regulatory review, there will be no true-up of the cost of debt in current determinations. Rather, the true-up will be calculated throughout the next regulatory period and prices adjusted at the subsequent period.

7 NSW Treasury submission to IPART Issues Paper, August 2017, p 1; WaterNSW submission to IPART Issues Paper, August 2017, p 9; Sydney Water submission to IPART Issues Paper, August 2017, pp 11-12; Hunter Water submission to IPART Issues Paper, August 2017, p 5.

1.2.3 Changes to our method for measuring the current MRP to reduce bias

Under our 2013 method, we estimate the current MRP using six different methods, five of which are variations of a dividend discount model (DDM) method and one is a market indicators method. We currently determine a point estimate by selecting the midpoint of the highest and lowest of these estimates in each month.

We considered several alternative methods, including selecting the median of all six estimates, and using a weighted average of the market indicators MRP estimate and the median of the DDM MRP estimates. We have made draft decisions to:

- combine the DDM MRP estimates into one estimate using a median approach that does not exclude outliers, and
- set the point estimate as the weighted average of the market indicators MRP and the median DDM MRP, with a one-third weight to the former and two-thirds weight to the latter.

Most stakeholders supported moving from a midpoint to a median approach, but did not comment specifically on using a weighted average of the results of the different methods.[8] We consider it is appropriate to place more weight on the DDM estimates as the DDM method has a longer history and wider acceptance than alternative methods. However, simply selecting the median of the six estimates could place too much emphasis on the DDM results.

While we decided not to change the way we apply the DDM methods, in line with stakeholder feedback, we made a draft decision to replace two of the indicators in our market indicator method (the dividend yield and the risk-free rate) with a single new indicator (earnings yield less the risk-free rate).

1.2.4 Re-estimating the equity beta at each price review to ensure it remains appropriate

In our 2013 method, we assess the equity beta each time we determine the WACC for a regulated business to check that it remains appropriate, in light of updated market data and having regard to other regulators' recent WACC decisions. We have made a draft decision to maintain this approach. However, we would only change the value we use in our WACC calculations where we consider there is sufficient evidence to support this.

We have also made draft decisions to broaden the sample of proxy firms we use in estimating the equity beta, to continue considering the Vasicek-adjusted beta and discontinue considering the Blume-adjusted beta.

Broadening the sample of proxy firms would yield more reliable estimates

One of the main weaknesses of our current approach for estimating the equity beta is that the selected proxy companies may not represent a benchmark firm well, leading to an inaccurate estimate. To address this weakness, we have made a draft decision to use the broadest possible selection, but exclude thinly traded stocks in line with feedback from

8 WaterNSW submission to IPART Issues Paper, August 2017, p 10; Hunter Water submission to IPART Issues Paper, August 2017, p A.4; Sydney Water submission to IPART Issues Paper, August 2017, p 13.

Frontier Economics (on behalf of Sydney Desalination Plant (SDP)).[9] We agree that a broad sample method is more objective, more likely to yield statistically reliable estimates, and more resistant to problems caused by companies dropping out of the sample over time (for example, because they become de-listed).

Discontinuing consideration of the Blume-adjusted beta would improve accuracy

Several studies have found equity betas obtained from ordinary least squares (OLS) regression analysis are likely to be subject to a high degree of estimation bias due to sampling error. Regulators commonly adjust for this bias using the Vasicek and Blume methods.

Our current practice is to make a judgement on the appropriate beta by considering the OLS beta with no adjustments, the Blume-adjusted beta and Vasicek-adjusted beta. We have decided to discontinue considering the Blume-adjusted beta because it is an automatic, formulaic and arbitrary adjustment. We consider that the Vasicek adjustment is preferable because it relies on firm-specific information to adjust the empirical results.

1.2.5 Using the expected rate of inflation over the regulatory period

Under our 2013 method we deflate our nominal WACC inputs by applying a single, forward-looking rate that is the expected rate of inflation over the next 10 years, regardless of the length of the regulatory period. We calculate expected inflation as the geometric average of the inflation rate.

Sydney Water stated that we should use a best estimate of expected inflation over the regulatory period rather than 10 years. It also noted our current approach might be problematic when long-term inflation expectations differ substantially from forecast inflation over the regulatory period.[10] We agree with Sydney Water's view, and have made a draft decision to use the expected rate of inflation over the regulatory period. We note that this could mean we use a slightly different inflation rate in two concurrent reviews, if we decide to set different regulatory periods for the businesses concerned.

We have made a draft decision to calculate the expected rate of inflation by first calculating the geometric average of the forecast **change in the level of prices** over the regulatory period, and then converting this average into an annual inflation rate separately. Most stakeholders supported this approach, which is consistent with the AER's approach.

To improve clarity, we have also decided to define the forecast we use in estimating inflation, as the inflation forecast in the RBA's most recently issued Statement of Monetary Policy that is closest to 12 months from the start the regulatory period.

Some stakeholders suggested that we should use a 'breakeven inflation' (BEI) method, which is estimated by comparing yields on nominal bonds to those on inflation-linked

9 Frontier Economics, *Review of WACC method: response to IPART Issues Paper: A Report Prepared for Sydney Desalination Plant*, August 2017, p 39.

10 Sydney Water submission to IPART Issues Paper, August 2017, p 18.

bonds.[11] On balance, we consider that our 2013 method would promote greater stability and predictability for stakeholders.

1.3 How you can have your say

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

- Released an Issues Paper in July 2017, which set out our approach, proposed principles for the review and key issues on which we sought feedback. We received seven submissions.
- Held a public hearing in August 2017 to provide stakeholders with an opportunity to discuss our Issues Paper, propose changes and raise further issues.
- Considered all submissions to the Issues Paper, feedback from the public hearing and conducted our own analysis and research to inform our draft decisions.

We are now seeking submissions on our draft decisions and invite comments from interested parties by **Friday 1 December**. You can find details of how to make a submission on page iii of this Draft Report. We have included a list of our draft decisions in section 1.5 below. We will take stakeholder submissions into account in making our final decisions in February 2018.

1.4 Structure of this report

The rest of this paper discusses the review in more detail and sets out our analysis and draft decisions:

- Chapter 2 provides contextual information about our WACC method and our principles for this review.
- Chapter 3 focuses on our approaches for measuring WACC inputs, including our definition of the benchmark firm and the timing of market observations.
- Chapters 4 and 5 discuss our approaches for determining the costs of debt and equity respectively.
- Chapter 6 discusses how we combine debt and equity measurements to derive a point estimate of the WACC, including how we implement the WACC decision rule.
- Chapter 7 focuses on our approaches for measuring inflation and gamma.

1.5 List of draft decisions

For convenience, a complete list of our draft decisions is provided below.

11 WaterNSW submission to IPART Issues Paper, August 2017, p 13; Hunter Water submission to IPART Issues Paper, August 2017, p 10; NSW submission to IPART Issues Paper, August 2017, p 6.

Measuring WACC inputs

Determining the cost of debt

Determining the cost of equity

2 Context and principles for this review

As Chapter 1 discussed, we consider that our 2013 WACC method is working well. We are satisfied that it has resulted in reasonably accurate decisions in the past. Stakeholders can replicate our calculations, and the method has increased the stability of the regulatory regime for our regulated businesses.

Therefore, our objective for this review is to identify whether there are opportunities to make incremental improvements to the method so our WACC decisions better reflect efficient financing costs. We have developed an approach for meeting this objective, including a set of principles to guide our decision making.

2.1 Who the review affects

Our WACC decisions have a major impact on the returns on assets for our regulated businesses and others affected by our building block calculations. These regulated businesses include:

- water utilities such as Sydney Water Corporation, WaterNSW, Hunter Water Corporation and the Sydney Desalination Plant, and
- public transport businesses such as Transport for NSW and private ferries.

Other affected businesses include those we review under section 9 of the *Independent Pricing and Regulatory Tribunal Act 1992* (IPART Act), such as the Port Authority of NSW, for which we recently recommended maximum fees and charges for cruise ships.

Our WACC decisions also have a major impact on the customers of our regulated businesses. The allowance for a return on assets within the revenue requirement significantly affects the prices these businesses can charge.

2.2 Scope of the review

The review focusses on how we measure and estimate the parameters we use to calculate the WACC. Its scope includes:

- our basis for measurement, including our definition of the benchmark firm and approach to sampling
- how we estimate the parameters for the cost of debt and the cost of equity
- how we bring these parameters together to select a single point estimate of the WACC, and
- how we measure inflation and gamma.

We have not considered broader policy issues related to how we apply the WACC. For example, the type of WACC we apply (ie, whether it is pre- or post-tax, real or nominal) and

matters associated with our building block method (such as financeability) are outside the scope.

We are satisfied that our current approach of applying a post-tax WACC more closely estimates tax than applying a pre-tax WACC using the statutory tax rate. We also consider that it is appropriate to maintain our approach of setting a real WACC and indexing the asset base for inflation. Moreover, moving away from a real post-tax WACC would add considerably to uncertainty and have the potential for large price changes.

2.3 Our principles for this review

In making our decisions for this review, we aim to balance the following four principles:

1. Our WACC method should produce reasonably accurate estimates of the cost of capital. This will ensure that customers do not pay more than necessary and that the regulated firms will be financially viable and have the incentive to invest in the efficient level of productive assets.
2. Our WACC method should be relatively stable over time to give stakeholders certainty.
3. Our WACC method should be predictable and replicable by stakeholders to provide transparency and reduce resources required in each review.
4. We should make incremental improvements where there is sufficient evidence that they increase the accuracy of the cost of capital faced by a benchmark firm.

We consider these principles take account of the impact of our WACC method on regulated business and their customers, and take account of the matters we are required to consider in making our determinations and recommendations under section 15 of the IPART Act (see Box 2.1).

Since our Issues Paper, we added the first principle listed above. We made this change in response to PIAC's submission to our Issues Paper, which suggested that we should:

> … emphasise the impact on consumers from any changes to the WACC method in this review. This should help to frame the debate to ensure that the WACC methodology is, indeed, working in the best interest of consumers.[12]

Each principle, and our rationale for including it, is discussed in more detail in this chapter.

12 PIAC submission to IPART Issues Paper, August 2017, pp 1-2.

Box 2.1 Matters we are required to consider under section 15 of the IPART Act

There are several matters we are required to consider in making our determinations and recommendations. Under section 15 of the *Independent Pricing and Regulatory Tribunal Act 1992* (IPART Act) we must have regard to a range of factors, including, but not limited to:

1. cost of providing the services concerned
2. protection of consumers from abuses of monopoly power
3. appropriate return on public sector assets and associated dividends to the Government for the benefit of the people of New South Wales
4. need for greater efficiency in the supply of services so as to reduce the costs for the benefit of consumers and taxpayers, and
5. impact on borrowing, capital and dividend requirements of the government agency concerned and, in particular, the impact of any need to renew, or increase relevant assets.

The cost of capital is a component of the costs of providing the services. Setting the WACC too high is arguably inconsistent with (2) and (4), while setting it too low may conflict with (3) and (5). The requirement to consider efficiency influences our definition of the benchmark entity and how we measure the WACC parameters.

Source: *Independent Pricing and Regulatory Tribunal Act 1992,* section 15.

2.3.1 Our WACC method should produce reasonably accurate estimates

Our overarching objective in setting the WACC is to produce a reasonably accurate estimate. This is important because, if we set a WACC that is too high, then customers would pay too much for the services and we risk encouraging too much investment in that business. If we set the WACC too low, then we risk the financial viability of the firm and encouraging too little investment. Neither of these outcomes is in the long term interest of consumers.

2.3.2 Our WACC method should be stable over time to provide stakeholder certainty

Having a stable WACC method within and between regulatory periods provides certainty to regulated businesses and their customers. Increased certainty translates to reduced risk, stable revenues for businesses and stable prices for customers.

For example, regulatory stability is an important influence on the credit ratings of Australian water utilities. Moody's rating agency's 'Regulated Water Utilities' methodology assigns a 15% weight to 'stability and predictability of regulatory environment'.[13]

Following the implementation of our 2013 WACC method, in March 2015, Moody's upgraded Sydney Water Corporation's (Sydney Water) issuer rating from A1 to Aa3. It attributed this upgrade to Sydney Water's "expectation of improved transparency in the regulatory framework". Moody's commented that:

> IPART has been demonstrating increased predictability and transparency in its regulatory decisions. Although it does not have the track record of the Australian Energy Regulator which regulates transmission and distribution electricity and gas networks in the eastern and southern

13 Moody's Investor Service, *Rating Methodology – Regulated Water Utilities*, December 2015, p 6.

states, it has shown a philosophy that has become increasingly transparent, and supportive of the credit profiles of regulated entities, including Sydney Water.[14]

Similarly, Moody's March 2015 rating report for Hunter Water Corporation (Hunter Water) stated that IPART has "a stable and mature regulatory framework…"[15] and "we believe that IPART will continue to exhibit consistency in its decision translating into increased stability in revenue outcomes for Hunter Water."[16]

In October 2016, Moody's changed its outlook for Sydney Water to stable, stating:

> The change in outlook to stable reflects Moody's belief that Sydney Water's shareholder, the New South Wales state government (New South Wales Treasury Corporation (TCorp), Aaa stable), will implement countermeasures to maintain the company's metrics within its rating tolerance level.
>
> …the rating recognizes that the transparent regulatory framework which governs Sydney Water's regulated tariffs provides visibility into likely future revenue reductions and space to implement the required countermeasures to protect its credit profile.[17]

In our Draft Report, we have not proposed broad changes to our WACC method to ensure its ongoing stability.

2.3.3 The WACC should be predictable and replicable by stakeholders for increased transparency

In our 2013 WACC review, we decided to publish financial market updates biannually in February and August.[18] We publish these updates to allow our stakeholders to better replicate and anticipate our WACC decisions. In conjunction with the updates, we also release a WACC spreadsheet with a working copy of our WACC model.

This enables stakeholders to understand how our WACC decisions are made. It reduces the resources and effort required by stakeholders in each regulatory review. This has been beneficial for both IPART and the regulated businesses. As discussed above, it has also had a positive impact on the ratings outlook for water utilities, with Moody's specifically referencing IPART's improvement of "the transparency and predictability of its revenue decisions" in its reasoning for changing the Sydney Water rating outlook from stable to positive.[19] It stated that:

> The improvement in IPART's transparency is reflected in a number of measures that the regulator has taken in the last 1-2 years, including the bi-annual publication of its financial market updates, following a review of its weighted average cost of capital ("WACC") methodology. As a result, the improvement in the transparency of the regulatory framework is enhancing Sydney Water's credit profile, which also factors in our expectation for continued stability in its financial metrics.[20]

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14 Moody's Investor Service, *Rating Action: Moody's upgrades Sydney Water's rating to Aa3; outlook stable*, March 2015, p 1.

15 Moody's Investor Service, *Rating Action: Moody's assigns first-time A1 issuer rating to Hunter Water Corporation; Outlook Stable,* March 2015, p 1.

16 Ibid.

17 Moody's Investor Service, *Rating Action: Moody's changes outlook for Sydney Water Corp's Aa3 rating to Stable*, October 2016, p 1.

18 IPART, *Review of WACC Methodology – Final Report*, December 2013, p 29.

19 Moody's Investor Service, *Moody's revises Sydney Water's rating outlook to positive from stable*, December 2014, p 1.

20 Ibid.

In making our draft decisions for this review, we have sought to maintain or improve our current transparency, predictability and replicability.

2.3.4 We should make incremental improvements where there are convincing reasons

While our WACC method has generally performed well over time, there may be scope to improve it incrementally. In our Draft Report, we have considered the merits of potential improvements relative to the benefits of a stable, predictable method over time. We have proposed improvements only where we have found that there are convincing reasons for change to increase accuracy, or enhance stability and certainty.

There are many differences between the approaches individual regulators take to calculating the WACC. This makes it difficult to be consistent with other regulators when making our WACC decisions. However, as part of this review we considered recent changes that other Australian and New Zealand regulators have made to their WACC approach, and the evidence and reasons for these changes.

Appendix A compares selected Australian and New Zealand regulators' approaches to the WACC.

While stakeholders considered that a consistent approach across regulators would be beneficial, we consider that we should pursue it only where it leads to an improvement. Sydney Water stated:

> Sydney Water believes that generally harmonising positions across regulators is beneficial, in so far as harmonisation brings about improvements to IPART's WACC method. That is, change towards regulatory best practice.[21]

Hunter Water stated:

> Regulators should continually review and benchmark their methodologies against peers to encourage robust outcomes in their respective jurisdictions. A common position across regulators when it occurs should indicate a best practice position, however should not be promoted for the sake of consistency.[22]

Water NSW stated:

> We think that there should be a race to best-in-class, and that it is better to have a regulatory environment that is 'better-and-different', than the 'same-and-worse'.[23]

We agree with these views and have proposed changes only where they would improve the accuracy of our WACC estimate.

21 Sydney Water submission to IPART Issues Paper, August 2017, p 8
22 Hunter Water submission to IPART Issues Paper, August 2017, p A.2
23 WaterNSW submission to IPART Issues Paper, August 2017, p 5

3 Measuring WACC inputs

We use two types of inputs for our WACC calculation: industry-specific parameters, and market-based parameters. The industry-specific parameters include the gearing ratio and the equity beta. We measure these parameters by studying a benchmark entity, rather than the actual regulated firm. The market-based parameters include the risk-free rate, debt margin, market risk premium (MRP) and inflation forecast. We base these parameters on a sample of market observations or forecasts.

As part of this review, we have considered:

- our definition of the benchmark entity, particularly whether we should assume that it operates in a competitive or regulated market, and
- our approach to sampling the market observations, including whether the sampling dates for all parameters should be synchronised, and whether these dates should be disclosed to regulated businesses in advance.

The sections below outline our draft decisions, and then discuss them in detail.

3.1 Overview of draft decisions

We have decided to maintain our definition of the benchmark entity. We consider this definition is consistent with our price setting objective, and stakeholders expressed strong support for maintaining it.

We have also decided to:

- synchronise the sampling dates for the risk-free rate, debt margin, current MRP, inflation and the uncertainty index, and
- adopt a consistent sampling period of two months from the sampling date for the risk-free rate and debt margin.

We consider these modifications would improve the accuracy of our WACC decisions by recognising the co-relationships between parameters.

In addition, we will continue to provide regulated businesses with advance notice of the sampling dates we will use, but not make this information public until we release our determinations. We consider this would allow businesses to manage their debt portfolios without exposing them to undue financing risk.

3.2 Our definition of the efficient benchmark entity

Our 2013 method estimates the WACC with reference to an efficient benchmark entity, which we define as 'a firm operating in a competitive market and facing similar risks to the regulated business'. The cost of capital for this firm may be different to the regulated

business' actual cost. This is consistent with our price setting objective, which is to attempt to replicate the disciplines of a competitive market. A competitive market would limit prices to the level of efficient and prudent costs. This could differ from the costs incurred by the actual business.

Because the benchmark entity is a hypothetical firm, its cost of capital cannot be observed directly. Therefore, we rely on information on a sample of proxy firms to determine the industry-specific WACC parameters. How we define the benchmark efficient entity is important, as it guides our selection of these proxy firms.

3.2.1 Other regulators use a different definition

Our definition of the benchmark firm differs from those used in some other Australian jurisdictions. For example, the AER adopts 'a conceptual definition of the benchmark efficient entity that is a pure play, regulated energy network business operating within Australia'.[24]

The AER's reasoning is that demand risk is mitigated by the regulatory regime through revenue or price setting mechanisms under a revenue cap. Energy network businesses can use higher fixed charges to offset demand volatility under a price cap and have the ability to propose the form of control they employ (eg, revenue cap or price cap). By virtue of being regulated, these businesses effectively face a very limited increase in risk due to competition.[25]

The Queensland Competition Authority (QCA) uses similar guidance in choosing proxy firms for benchmarking, being 'pure play', 'regulated' and 'standalone' firms.[26]

The Essential Services Commission of South Australia (ESCOSA) applies a set of operational principles for setting a rate of return, which include that 'The rate of return should reflect the prudent and efficient financing strategy of an incumbent large water utility which minimises expected costs in the long-term, on a risk-adjusted basis'.[27] Further, ESCOSA's operational principles state that 'The assumed prudent financing strategy should not depend on the ownership of the regulated business (ie, the approach is indifferent to whether the entity is in Government or private ownership).'[28]

24 AER, *Better Regulation, Explanatory Statement - Rate of Return Guideline*, December 2013, p 32.
25 Ibid, p 33.
26 Queensland Competition Authority, *Final decision, Trailing average cost of debt*, April 2015, p 6.
27 Essential Services Commission of South Australia, *SA Water Regulatory Rate of Return 2016 – 2020, Final Report to the Treasurer*, March 2015, p 21.
28 Ibid, p 22.

3.2.2 Stakeholders supported our current definition

There was support from stakeholders for retaining our current definition.[29] For example, Sydney Water stated:

> We believe that the benchmark entity definition aligns with the IPART's guiding principles and objectives, broadly the promotion of efficient investment in, and efficient operation and use of regulated infrastructure for the long-term interests of consumers. Consistent with these guiding principles, and setting the cost of capital with reference to a benchmark entity, will ensure the allowed return for a firm is in line with efficient financing costs.[30]

Hunter Water stated:

> Hunter Water agrees with the preliminary view that the benchmark firm should continue to be a firm operating in a competitive market facing similar risks to the regulated business. As a regulator, IPART's role is to impose proxy conditions that imitate a hypothetical unregulated market, such that regulated entities do not abuse their monopoly powers. Hunter Water believes the benchmark utility defined supports IPART's role.[31]

PIAC considered that our preliminary view was 'not inappropriate'.[32]

3.2.3 Our draft decision is to maintain our current definition

We maintain our view that our current definition is appropriate. The underlying rationale for this definition is that, if the regulated utility was subject to competition instead of regulation, then it would be able to pass only efficient capital costs through to customers.

We note that IPART operates under different legislation to that of the AER, QCA and ESCOSA in regulating energy utilities and we regulate a broader cross-section of businesses. In setting prices, we can aim to replicate the outcomes of a competitive market and choose proxy companies that reflect similar risks to those established under our regulatory framework.

We prefer our definition for two reasons:

1. It is consistent with our price setting objective, which is to replicate the outcomes of a competitive market. Our definition aims to ensure that a regulated firm faces similar investment incentives to a competitive firm facing similar risks. This approach replicates the outcomes of a competitive market and avoids creating possible distortions between the regulated and competitive sectors of the economy. This encourages an efficient allocation of capital across the economy.
2. There are more listed businesses in the competitive sector than in the regulated sector. This means that analysis of firms in the competitive sector benefits from a larger set of observations of the cost of capital and financing strategies.

29 WaterNSW submission to IPART Issues Paper, August 2017, p 7; SDP submission to IPART Issues Paper, August 2017, p 13; PIAC submission to IPART Issues Paper. August 2017, p 2; Sydney Water, submission to IPART Issues Paper, August 2017, p 9; Hunter Water submission to IPART Issues Paper, August 2017, p A.2.
30 Sydney Water submission to IPART Issues Paper, August 2017, p 9.
31 Hunter Water submission to IPART Issues Paper, August 2017, p A.2.
32 PIAC submission to IPART Issues Paper, August 2017, p 2.

We consider that it is appropriate to include non-regulated firms (those operating in a competitive market) and relevant regulated firms in the set of proxy firms. This is because:

- Our price setting objective aims to replicate the outcomes of a competitive market and therefore firms should be compensated for that level of risk.
- Some other regulators, such as ESCOSA, aim to replicate the outcomes of a competitive market, potentially making those regulated firms appropriate proxies. Businesses that are not regulated under this objective would be less suitable proxies.
- For some industries, there are few proxy firms. Therefore, we include some regulated firms as a practical necessity.

Draft Decision

1 Maintain our definition of the efficient benchmark firm as 'a firm operating in a competitive market and facing similar risks to the regulated business'.

3.3 Synchronising sampling dates and aligning sampling periods

Because market observations tend to be volatile, the timing of the observations we use to measure the market-based parameters is important, particularly for the current parameters. Sampling at different times would yield different WACC values.

Data on some current parameters is generally published on the last workday of each month. The exceptions are the risk-free rate, which is published daily, and inflation, which is a forecast. This means we have two main options. We can either sample data:

- on the closest possible day to the date we make our WACC decision for each parameter (the latest available data method), or
- on a common day for all parameters (the synchronised method).

Under our 2013 method, we use the latest available data method.[33] In practice, this means we use the latest month's data for most parameters, and the latest day's data for the risk-free rate (published the day we make our WACC decision). In addition, we use end-of-month values for the MRP and debt margin calculations, but use a 40-day average of daily values to calculate the risk-free rate estimate.

While our 2013 method ensures we use the most recent information available for all parameters, it also means we use information sampled on different dates. This could result in errors when parameters co-vary over time, such as the risk-free rate and the MRP. In our Issues Paper, we expressed the preliminary view that we should synchronise our sampling dates and consider adopting a similar sampling period across all market parameters.

3.3.1 Stakeholders supported our preliminary view

Stakeholders generally agreed that synchronising sampling dates across parameters would be an incremental improvement to our current approach. For example, Sydney Water submitted that:

33 In the instance where we have more than one determination or decision starting from the same (or very near) date, we use the same sample dates for all determinations/decisions.

> …synchronising and aligning sampling dates would be beneficial by removing measurement error and/or biases, with little to no additional administrative costs.[34]

Hunter Water stated that:

> …synchronised sampling of parameters represents an incremental improvement that will improve accuracy in the cost of capital.[35]

3.3.2 Our draft decisions are to synchronise sampling dates and use a 2-month sampling period

We have decided to synchronise sampling dates, so that we use the latest month's data for debt margin, current MRP, inflation and the uncertainty index, and the risk-free rate published on the same day as that monthly data. This method would minimise any errors that may arise from sampling variables on different dates. However, it would also mean that the risk-free rate sample would normally not be the most recent available, unless the WACC decision is made very close to the beginning of a month.

The synchronised method improves the accuracy of our WACC decisions because it recognises co-relationships. Combining WACC inputs that were sampled on different dates does not necessarily cause a problem if those inputs are uncorrelated. But when two inputs are correlated, they should be sampled on the same date. Otherwise, the date inconsistency could lead to systematic bias in the WACC estimate, as illustrated by the three examples presented in our Issues Paper.[36]

While moving to the synchronised method would reduce any potential bias in the estimates that may result from a mismatch in our sampling periods, it may not completely eliminate it unless we adopt a similar length sampling period. Therefore, we have decided to adopt a consistent sampling period of two months for the risk-free rate and debt margin. We consider this would further improve the accuracy of our WACC method.

Draft Decisions

2 Synchronise the sampling dates for the risk-free rate, debt margin, current MRP, inflation and the uncertainty index.

3 Adopt a sampling period of two months from the sampling date for the risk-free rate and debt margin.

3.4 Notifying regulated businesses of sampling dates

We currently provide regulated businesses with advance notice of the sampling period we will use to measure the current market-based parameters. However, we do not publish this information until we release our price determination.

Providing businesses with advance notice of the sampling dates allows them to manage some of the regulatory risk associated with our WACC decision (ie, the risk that movements in interest rates and borrowing costs over the regulatory period result in a significant

34 Sydney Water submission to IPART Issues Paper, August 2017, p 10.
35 Hunter Water submission to IPART Issues Paper, August 2017, p A.3.
36 IPART, *Review of our WACC method – Issues Paper*, July 2017, pp 16-17.

divergence between our decision on the cost of debt and the actual cost of debt over the period). In particular, it allows them to hedge their debt portfolios in line with our decision on the cost of debt.

3.4.1 Stakeholders supported continuing our current approach

Stakeholders generally agreed that we should continue to provide notice to the regulated business of our sampling dates. For example, SDP submitted we should provide at least three months' advance notice.[37] Hunter Water stated that:

> This will allow regulated entities to replicate and proper plan for upcoming cost of capital outcomes and to prudently manage debt requirements.[38]

Stakeholders also considered we should continue keeping this information confidential, because making it public may have a negative impact on a firm's financing risk. For example, Sydney Water submitted:

> …we believe that IPART ought to maintain their practice of publicly releasing sampling dates once price determinations are finalised, maintaining the neutral impact on a businesses' financing risk.[39]

Water NSW stated:

> Publishing this information or providing it to financial institutions could allow market participants to attempt to drive up the cost of debt during the sampling period. This would ultimately result in customers unfairly bearing higher water bills for no additional benefit.[40]

3.4.2 Our draft decision is to continue to provide advance, confidential notice

We agree with stakeholders' comments. If financial market participants knew the sampling dates we proposed to use in advance, they would know when businesses were likely to raise debt or execute hedges and could raise their borrowing or hedging costs accordingly.

We consider that waiting until our determination is finalised to publish sampling periods ensures there is no impact on the businesses' financing risk.

Draft Decision

4 Continue to provide the regulated business with confidential, advance notice of the sampling dates.

37 SDP submission to IPART Issues Paper, August 2017, p 13.
38 Hunter Water submission to IPART Issues Paper, August 2017, p A.3.
39 Sydney Water submission to IPART Issues Paper, August 2017, p 10.
40 WaterNSW submission to IPART Issues Paper, August 2017, p 7.

4 Determining the cost of debt

Under the 2013 method, we calculate the regulatory cost of debt by estimating the current cost of debt and the historical cost of debt, and selecting the midpoint value.[41] This places equal weight on the current cost and the historical cost. We set this value at the start of the regulatory period, and do not adjust it during the period.

For both cost estimates, we add the **risk-free rate** of return (using data on 10-year Australian Government Bond (AGS) yields) and the **debt margin** (using data published by the RBA on the spread between 10-year BBB-rated corporate bond yields and the 10-year AGS yields).[42] For the current cost estimate, we use averaged data for a recent 40-day period. For the historical cost, we use averaged data for the previous 10 years.

In this review, we considered a range of potential improvements to our approach and data for the cost of debt. The sections below outline our draft decisions and then discuss each decision in detail.

4.1 Overview of draft decisions

We have decided to continue to calculate the cost of debt as the midpoint of the current cost of debt and the historical cost of debt at the start of the regulatory period unless there is significant economic uncertainty. It is difficult to set a cost of debt that precisely replicates the cost for a benchmark firm operating in a competitive market and facing similar risks to the regulated business. On balance, we consider a midpoint approach creates the right balance of incentives for efficient investment and for prudent debt management. However, we have also decided to:

- adjust our estimate of the current cost of debt to reflect changes in the actual cost of debt during the regulatory period, and
- make this adjustment at the beginning of the following regulatory period using a true-up mechanism.

We consider this adjustment to our 2013 method would be an incremental improvement that would address stakeholders' concerns that the current approach creates refinancing risk. Under our draft decision, the current estimate of the cost of debt would expose a regulated business to the average cost of debt over the regulatory period. At the same time, it would enhance investment incentives over time because the regulatory cost of debt would reflect the marginal cost of raising debt **at all points during** this period, albeit through an adjustment in the following period.

41 We select the midpoint when the uncertainty index is at, or within, one standard deviation of the long-term average.

42 There is also small allowance (12.5 basis points) for debt raising costs added to both the current and historical estimates.

We will also continue to use RBA data on the spread between corporate and government bond yields to measure the debt margin, data on coupon-paying AGS yields to measure the risk-free rate, and continue to adopt a 10-year term to maturity to measure the cost of debt for businesses in all industries that we regulate. However, where bond yield data is derived from semi-annual rates of return we have decided we will convert it to annualised yields.

4.2 Weighting the current and historical cost of debt

In our Issues Paper, we expressed the preliminary view that we should continue to place equal weight on estimates of the current and historical cost of debt.[43] We also questioned whether we should update this value during the period, given the potential for significant shifts in interest rates.[44]

Most stakeholders disagreed with our preliminary view that we should continue to place equal weight on estimates of the current and historical cost of debt. To replicate our current methodology, a firm would need to refinance at least half its debt portfolio for a 10-year period just prior to the start of a regulatory period. Stakeholders suggested such an approach was not likely nor a prudent debt management strategy. For example, Hunter Water submitted that our 2013 method "…does not emulate operations of a competitive benchmark firm completely. Some refinancing risk will remain due to updates only at the start of the regulatory reset period".[45] At our public hearing, Mr Jeff Graham of Sydney Water commented that "…refinancing 50 per cent of their debt every four years or using some products to do that. I do not think a benchmark entity would do that…it has a refinancing risk that is quite significant if we were to refinance 50 per cent of our debt every four years."[46]

Although a business could partly offset the refinancing risk by using interest rate swaps to hedge changes in the risk-free rate, it would not be able to hedge changes in the debt margin. The NSW Treasury submitted that this "forces extreme refinancing risk on the business".[47]

To address this issue, most stakeholders submitted we should set the cost of debt based on the historical cost of debt only and supported moving to a trailing average approach.[48] We agree that our current approach may expose a business to refinancing risk, but we do not support a trailing average approach.

Instead, in our view, we should continue to place weight on both the current and historical cost of debt, as this provides the correct balance of incentives for efficient investment and prudent debt management. To reduce refinancing risk, we should adjust our estimate of the current cost of debt to reflect monthly changes in the actual cost of debt during the regulatory period. We should make these adjustments through a true-up at the beginning of the following regulatory period. Box 4.1 explains how we propose to implement this true-

43 IPART, *Review of our WACC method - Issues Paper*, July 2017, p 24.
44 Ibid, p 23.
45 Hunter Water submission to IPART Issues Paper, August 2017, p 5.
46 IPART public hearing transcript, August 2017, p 5.
47 NSW Treasury submission to IPART Issues Paper, August 2017, p 3.
48 NSW Treasury submission to IPART Issues Paper, August 2017, p 1; WaterNSW submission to IPART Issues Paper, August 2017, p 9; Sydney Water submission to IPART Issues Paper, August 2017, pp 11-12; Hunter Water submission to IPART Issues Paper, August 2017, p 5.

up. We consider we can implement this change at the beginning of the next regulatory period, with no need for transitional arrangements.

Under our draft decision, there would be no impact on customer prices initially when we set the WACC. Instead, prices would either increase (or decrease) over the following period, depending on the actual change in the cost of debt. The increase (or decrease) would be added (subtracted) from the notional revenue requirement for the subsequent period before we decided on the price path for that period.

Box 4.1 Our proposed approach for adjusting our estimate of the cost of debt

Provided the uncertainty index is equal to or less than one standard deviation from its long-term average when we set the WACC, we would use the following approach to set and adjust the regulatory cost of debt:

1. Prior to the start of the regulatory period, we would calculate the cost of debt as the midpoint between our estimates of the current cost of debt and the historical cost of debt.
2. At the end of each month during the period, we would calculate the difference between (1) the actual cost of debt for that month, and (2) our estimate of the current cost of debt, and multiply this figure by the share of debt that is assumed to be financed using the current cost of debt.[a] This figure is the monthly *difference* in the cost of debt.
3. At the end of the period, we would sum the monthly differences, and compound each monthly difference by the cost of debt for the time remaining before the end of the regulatory period.[b] This figure is the *true-up amount*, expressed in percentage terms.
4. In making our determination for the next regulatory period, we would include the true-up amount in the notional revenue requirement (NRR) for that period.

In practice, if the cost of debt falls (rises) during a regulatory period, the true up would be negative (positive). Prices would be lower (higher) in the following period reflecting reduced (increased) financing costs.

Steps 1 to 3 are expressed more formally in the equations below.

Step 1. In period 0, prior to the commencement of the regulatory period, we set the WACC using our 2013 method,[c] expressed in the formula below:

(1) $$WACC_0 = \alpha\left(\frac{CoD_0^{current} + CoD_0^{historical}}{2}\right) + (1-\alpha)\left(CoE_0\right)$$

where:

- α is the gearing ratio
- $CoD_0^{current}$ is our current cost of debt estimate
- $CoD_0^{historical}$ is our historical estimate of the cost of debt, and
- CoE_0 is our estimate of the cost of equity.

The WACC applies for periods 1 to *T*, where *T* is the length of the determination in months.

Step 2. At the end of periods 1 to *T*, we first calculate:

(2) $$Diff_i = \left(\frac{\alpha}{2\times T}\right) \times \left(CoD_i^{actual} - CoD_0^{current}\right)$$

where:

- $\left(\frac{\alpha}{2\times T}\right)$ is the share of debt that we assume is refinanced in each month, and
- CoD_i^{actual} is the actual average cost of debt realised over periods *i=1,2,…,T*.

$Diff_i$ is the monthly difference in debt costs, expressed in percentage terms, which would be used to estimate the true-up at the end of the period.

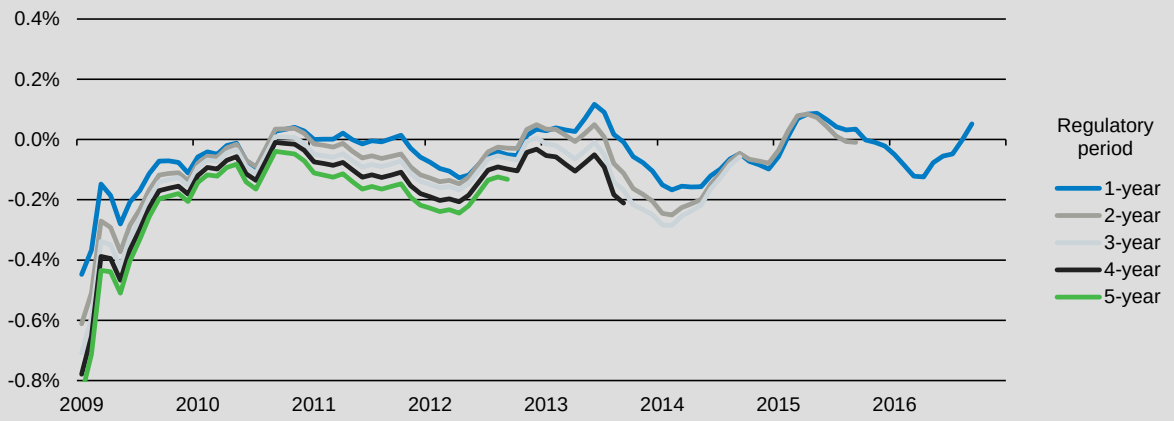
Step 3. At the end of the final month in the regulatory period, *T*, we calculate:

(3) $$TU_T = \sum_{i=1}^{T} Diff_i \times \left(1 + \frac{CoD_i^{actual}}{12}\right)^{T-i}$$

where TU_T is the true-up amount, expressed in percentage terms. This equation compounds the difference calculated in Step 2 by the cost of debt for time remaining before the end of the regulatory period. This reflects the difference in actual financing costs over the regulatory period compared to the estimate we made in period 0, and accounts for the time value of money for the true-up value.

We estimated the true-up amount that would have been required had we set prices using our proposed approach (ie, TU_T), for 1- to 5-year regulatory periods between 2009 and 2017 for illustrative purposes only.[d] Each point calculates the size of the true up in percentage terms (TU_T) and plots this adjustment at the beginning of the regulatory period (ie, in period 0).[e] A negative number (say -0.1%) indicates in hindsight that we over-estimated the WACC by 0.1%, per year, and that we would reduce prices in the next period to adjust for this. It shows that our proposed approach would have generally resulted in a small adjustment to prices in the following period.

Figure 4.1 What would the true-up have been historically?



Data source: Bloomberg; RBA; IPART calculations

A firm could replicate our proposed approach by refinancing half of its debt over the entire length of the regulatory period (typically three to five years). Under our current approach, a firm would need to do this over a 2-month period prior to the beginning of the regulatory period to coincide with the timing of us making our decision on the WACC.

a That is, the gearing ratio divided by two, reflecting the 50% weight on the current cost of debt estimate.

b This is because the firm would need to finance the difference between current interest rates, and the assumed cost of debt at the beginning of the period, until the next regulatory period.

c In this example the uncertainty index is at, or within one standard deviation of, zero.

d We cannot calculate the exact true-up amount, as it would depend on the size of the firm.

e This is why we can only calculate a true-up for a 5-year regulatory period beginning before September 2013.

4.2.1 Most stakeholders support a trailing average approach

As Table 4.1 indicates, most stakeholders considered we should estimate the cost of debt using a trailing average approach. Under this approach, the regulator calculates the

historical cost of debt at the start of the regulatory period, and recalculates it annually during the period.

In effect, under a trailing average, 10% of the business's debt portfolio is assumed to be refinanced every year. When the historical cost of debt is updated annually, the cost of debt over the past 12 months is added to the cost of debt, while debt raising costs from 10 to 11 years' ago are removed from the historical estimate.

Table 4.1 Summary of stakeholder views on approach for calculating cost of debt

	How should the cost of debt be calculated?	Adjustment annually or at next determination?
ARTC	Broadly supports current IPART approach, but should adjust current cost of debt estimate for interest rate expectations	N/A
Hunter Water	Full trailing average	Next determination
PIAC	N/A	No specific preference, but prefers gradual, consistent incremental changes
SDP	The risk-free rate should be: ▼ 50% current estimate, and ▼ 50% trailing average The debt margin should be 100% trailing average	Annual update, ie, no true-up at the next regulatory period
Sydney Water	Full trailing average	Next determination
Treasury	Full trailing average	Next determination
WaterNSW	Full trailing average	Annual update

Source: NSW Treasury submission to IPART Issues Paper, August 2017, p 1; WaterNSW submission to IPART Issues Paper, August 2017, p 9; Sydney Water submission to IPART Issues Paper, August 2017, pp 11-12; Hunter Water submission to IPART Issues Paper, August 2017, p 5; SDP submission to IPART Issues Paper, p 2; ARTC submission to IPART Issues Paper, August 2017, pp 2-3; PIAC submission to IPART Issues Paper, August 2017, p 2.

The reasons stakeholders gave in support of using a trailing average approach were generally consistent across submissions. The most common reasons were that:

- **A trailing average would match a firm's prudent debt financing strategy.** It is prudent for firms with long-lived assets to issue long-term debt on a staggered maturity basis. This allows them to manage the risk that they would be unable to refinance a large proportion of their debt at a given time at a reasonable cost. NSW Treasury submitted that using a trailing average approach could result in a regulatory cost of debt that matches this strategy, if the averaging period matched the assumed tenor of the debt.[49]
- **A trailing average may reduce price volatility to consumers.** As noted above, under a trailing average approach, when the regulator recalculates the cost of debt each year, only one tenth of the debt portfolio is assumed to be refinanced. WaterNSW noted that this would mean the cost of debt is unlikely to change materially each year, and thus would be unlikely to lead to a significant change in prices.[50]

49 NSW Treasury submission to IPART Issues Paper, August 2017, p 2.
50 WaterNSW submission to IPART Issues Paper, August 2017, p 8.

- **A trailing average would reduce a firm's costs**. NSW Treasury stated that a trailing average approach would allow a business to replicate the regulated cost of debt without the additional costs of derivatives.[51]

The ARTC was more supportive of IPART's midpoint approach. Furthermore, the ARTC commented that our 2013 method could be improved if the current cost of debt estimate was adjusted "with a forward looking estimate of the rate based on available data" as "incorporating a forward looking dimension into the WACC calculation would improve its robustness and accuracy".[52]

In our Issues Paper, we suggested that forward rates could be used to allow the WACC to capture expected changes in the cost of debt during a regulatory period. NSW Treasury stated that forward rates would not be an accurate predictor of future movements in interest rates.[53] In response, our draft decision is instead to adjust our estimate of the current cost of debt to reflect changes in the actual cost of debt as they occur during the regulatory period, and to make this adjustment at the beginning of the following period using a true-up.

4.2.2 Our draft decision is to continue giving 50% weight to the current cost of debt and update it during the period

After considering stakeholders' submissions, we maintain our preference for setting the regulatory cost of debt as the midpoint between estimates of the current and historical cost of debt, as giving equal weight to the current cost of debt provides firms with incentives to make efficient investment decisions.[54] The current cost of debt reflects the marginal cost of raising debt for a firm near the start of the regulatory period. As the AER has noted, a regulatory cost of debt that reflects this marginal cost is "likely to more closely imitate the outcomes of a competitive market" (than an approach using historical averages).[55]

In addition, we consider that updating our estimate of the cost of debt to reflect changes in the actual cost during the regulatory period (as outlined in Box 4.1) would potentially improve these incentives. This would ensure the regulatory cost of debt reflects the marginal cost of raising debt **at all points during** this period, albeit through an adjustment in the following period. Firms making investment decisions during the period could take changes in the actual cost of debt into account, knowing they would be reflected in the regulatory cost of debt in the following period.

Further, we consider this approach would reduce refinancing risk, because a firm would only be exposed (ex post) to the average cost of debt that occurs over the regulatory period, rather than the 'rate on the day' risk as currently. It would also reduce the need for a firm to use derivatives to hedge refinancing risk, which may reduce costs for the firm.

We do not support the use of a trailing average because our analysis suggests that:

51 NSW Treasury submission to IPART Issues Paper, August 2017, p 3.
52 ARTC submission to IPART Issues Paper, August 2017, pp 2-3.
53 NSW Treasury submission to IPART Issues Paper, August 2017, p 2.
54 We would give equal weight unless the uncertainty index was more than one standard deviation from its long term average.
55 AER, *Final Decision: Jemena distribution determination 2016 to 2020*, *Attachment 3 – Rate of return*, May 2016, pp 3–292.

- Under this approach, historical events such as the GFC could affect financing costs for around 10 years but affect customer prices for up to 20 years, causing investment distortions.
- Depending on where we are in the economic cycle, implementing this approach with an adjustment in the following regulatory period could initially over-compensate (under-compensate) firms, before reducing (increasing) prices to customers in future periods, potentially distorting investment signals over time. For instance, given where we are now in the economic cycle, we expect a trailing average to initially over-compensate firms, as relatively expensive debt is rolled-over.
- Implementing our draft decision could result in a similar cost of debt as a trailing average approach without causing investment distortions, or initially overcompensating firms.
- Our draft decision results in a method that is consistent with the pressures faced by firms operating in a competitive market, and it does not over-compensate firms for changes in the cost of debt.

A trailing average could result in historical events affecting prices for 20 years

Implementing a trailing average cost of debt could result consumer prices being affected for up to 20 years after an event such as the GFC.

Most stakeholders wanted us to implement a trailing average without annually updating the cost of debt during the regulatory period. To implement the trailing average, stakeholders suggested we continue to set a single WACC for each regulatory period. They proposed that we would calculate the change in the cost of debt each year during the period and cumulate these changes into an adjustment that we would gradually feed through to prices in the next period.

Under this approach, the cost of debt is initially set as the 10-year historical average cost of debt. Therefore, customer prices reflect the cost of debt issued up to 10 years' before the beginning of a regulatory period. Because the cost of debt is not updated during the regulatory period, debt issued 10 years before the beginning of the period will affect customer prices for the length of the current regulatory period (which could be up to five years). Furthermore, to the extent that the change in trailing average is gradually passed through to prices over the following period to avoid volatility, historic debt costs may affect customer prices in the following regulatory period.

The change we make to our WACC method as a result of this review will apply to pricing decisions that take effect on or after 1 July 2018. Consider a hypothetical scenario where we set a WACC for a firm:

- on 1 July 2018, for a 5-year period to 30 June 2023
- use a trailing average approach to set the cost of debt, and
- use a regulatory true-up to update this cost for changes in the trailing average between 1 July 2018 and 30 June 2023.

In this example, we would initially set the cost of debt as the average cost of debt over the period July-2008 to June 2018. We would gradually pass through the change in the trailing

average cost of debt over 2018 to 2023, from its level as at 1 July 2018, over the following regulatory period (2023 to 2028).

The GFC increased debt raising costs significantly (by around three percentage points, on average), over the late-2008 to early-2009 period. Over the period 2018-19, the impact of the GFC on the trailing average would dissipate, resulting in a lower cost of debt. The regulated firm would see costs increase over its financing horizon, say 10 years. However, the trailing average approach would see prices increase over 20 years – until the end of the next regulatory period (2028). This would mean that the firm received a WACC that was too high for the later 10 years, which would result in customer prices being too high over this period and could also distort investment incentives.

Given our draft decision to set a term-to-maturity of 10 years, it is appropriate for debt costs to affect customer prices for a 10 year period. However, if historical events only affect financing costs for 10 years, we don't consider that customer prices should be higher (or lower) as a result of these events for a significantly longer period of up to 20 years.

A trailing average with an adjustment in the following period may initially over-compensate firms

Our analysis suggests that, depending on where we are in the economic cycle, implementing a trailing average with an adjustment in the following period may initially over- or under-compensate firms, potentially distorting investment signals.

This is because the change in the trailing average will be affected by both a known change – the cost of debt maturing during the regulatory period – and an unknown change – the cost of issuing debt over the regulatory period. In a falling interest rate environment where the cost of debt issued up to 10 years prior is much higher than the historical average over the past 10 years, we would expect the trailing average to fall during the regulatory period and to initially over-compensate firms. Conversely, in a rising interest rate environment, we would not initially account for the fact relatively inexpensive debt would be maturing during the regulatory period, until the beginning of the following period.

Given where we are in the economic cycle, if we implemented a trailing average approach using an adjustment in the following regulatory period, it is likely prices would over-compensate firms initially, at the beginning of the regulatory period. We would then need to reduce prices in the following period.

This finding reflects the fact that the actual cost of debt has fallen over the past 10 years. In other words, the cost of debt in 2008 was higher than it is currently.[56] As the trailing average is updated over time, relatively expensive debt is replaced by lower cost debt. However, this reduction in debt costs would not be reflected in prices immediately, instead, it would be passed through gradually at the start of the following regulatory period.

For example, Figure 4.2 plots:

- The risk-free rate that would have initially been set at the start of a regulatory period under a trailing average (grey line). That is, the cost of debt would initially be set according to the 10-year historical average cost of debt:

56 The average cost of 10-year BBB corporate debt was about 10.4% in 2008, compared to an average of 4.6% over the first 9 months of 2017.

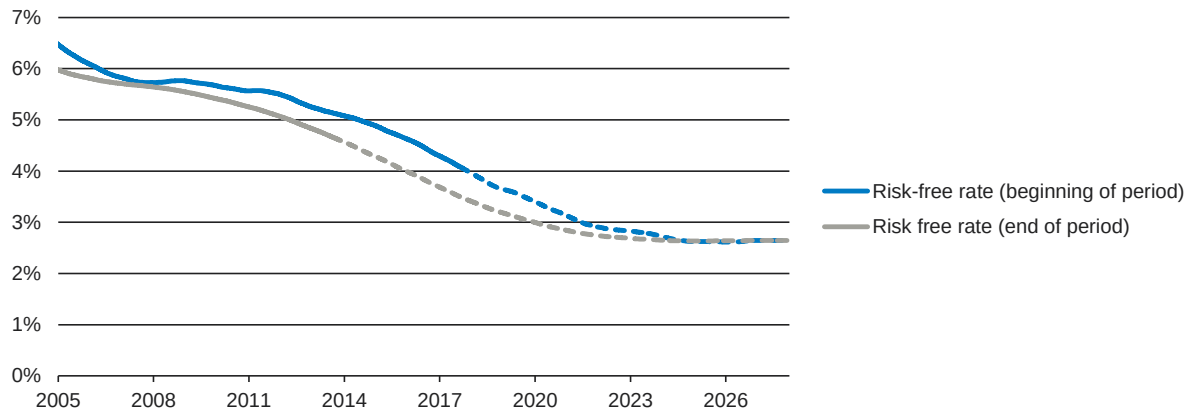
$RF_t^{Historical}$

- The risk-free rate that would be realised at the end of the period, once the change in the trailing average was calculated (black line). In notation:

(4) $$Trailing\ average_t = RF_t^{Historical} + \frac{\sum_{i=1}^{4}\left(RF_{t+i}^{Historical} - RF_t^{Historical}\right)}{5}$$

The dotted lines show that if risk-free rates remain at their current levels, we would expect the change in the trailing average (ie, the true-up) to be negative going forwards in this market. Moreover, because the risk-free rate is currently much lower than the risk-free rate 10 years ago, we would expect the true-up to be negative even if interest rates increase.[57]

Figure 4.2 The trailing average risk-free rate with a true-up (%)



Note: Dotted lines show risk-free rates at their current level going forward. The trailing average is calculated for a 5-year regulatory period.

Data source: Bloomberg; IPART analysis.

Figure 4.3 estimates the total impact on customer bills if we set the risk-free rate using a trailing average, as presented in Figure 4.2. That is, it calculates:

(5) $Impact_t = \sum_{i=1}^{2}\left(RF_{t+i}^{Historical} - RF_t^{Historical}\right)$ for a 3-year regulatory period, and

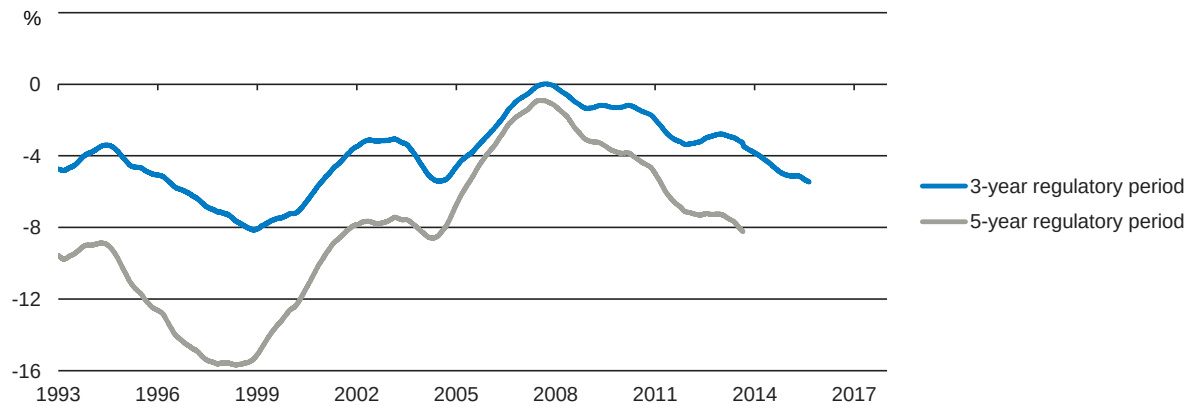
(6) $Impact_t = \sum_{i=1}^{4}\left(RF_{t+i}^{Historical} - RF_t^{Historical}\right)$ for a 5-year regulatory period.

A negative number denotes that the true-up would have resulted in higher prices during the first regulatory period and lower prices in the following period. Likewise, a positive number indicates that the true-up would have resulted in lower prices during the first regulatory period and higher prices in the following period. This would then be apportioned in the following regulatory period.

Given where we are in the economic cycle, Figure 4.3 suggests firms would be over-compensated initially if we implemented a trailing average with an adjustment to prices in the following period. Conversely, if the cost of debt increased gradually over an extended period, a trailing average could initially under-compensate firms.

57 Our analysis suggests the true-up would be negative with a moderate increase in risk-free rates. If risk-free rates increased by 2%, the true-up would initially be close to zero over 2018-2020, but would be positive in subsequent years (ie, we would initially undercompensate firms in this scenario).

Figure 4.3 Impact on the regulatory true-up on customer bills in the following period (%)



Note: We make the following WACC parameter assumptions in this figure: a constant debt margin of 3%, a constant market risk premium of 6%, a gearing ratio of 60%, an equity beta of 1 and a 2.5% inflation rate.

Data source: IPART calculations

To address this issue, we could implement a trailing average by updating our cost of debt estimates on an annual basis. Changes in the cost of debt would be reflected in consumer prices as they occur. However, stakeholders suggested that this approach:

- would increase the administrative costs,[58] and
- could increase price volatility, if a large increase in the cost of debt in one year is followed by a large decrease in the cost of debt the next year (or vice versa).[59]

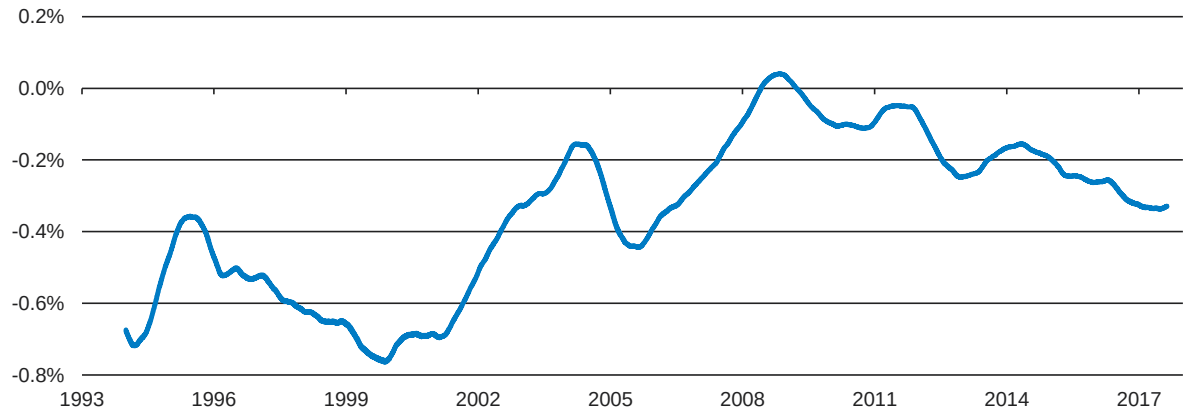
Our view is the risk of a large increase in volatility is fairly low with an annual update to the trailing average. Figure 4.4 plots the change in the risk-free rate that would occur with an annual update to the trailing average, over the past 20 years. In other words, it plots:

(7) $$Annual\ update_{t+1} = RF_{t+1}^{Historical} - RF_{t}^{Historical}$$

Figure 4.4 shows that changes in the trailing average are smooth over time. This reflects that risk-free rates have trended downwards in a fairly linear fashion over this period. It also reflects that the cost of debt would only be re-estimated for 10% of the debt portfolio each year under this approach.

58 Sydney Water submission to IPART Issues Paper, p 23.
59 Hunter Water submission to IPART Issues Paper, p 6.

Figure 4.4 Change in risk-free rate with a trailing average and annual update (%)



Data source: Bloomberg; IPART analysis

The overall cost of debt under a trailing average may be fairly similar to our midpoint estimate, over time. However:

- If we implemented a trailing average using a true up, we would be likely to initially over-compensate firms given where we are in the economic cycle.
- If we implemented the trailing average by updating the cost of debt annually, we would potentially increase the administrative burden for firms to implement our WACC method.

Our current approach approximates the trailing average approach

Our analysis suggests that had we used a trailing average approach implemented using a true-up in the following period to determine the risk-free rate during the past 20 years or so, the outcome would have been approximately the same as it was under our current approach, or if we had set prices according to our draft decision.

Figure 4.5 compares how the risk-free rate would have been estimated over the period 1993-2013, for a 5-year regulatory period, [60] using:

1. **IPART's current approach**, which is the midpoint of the current and historical estimates (green line). Using notation, the risk-free rate, at time t, can be expressed as follows:[61]

(8) $$Midpoint_t = \left(\frac{RF_t^{Current} + RF_t^{Historical}}{2}\right)$$

where:

- $RF_t^{Current}$ is the current estimate of risk-free rate made at time t, and
- $RF_t^{Historical}$ is the historical estimate of risk-free rate made at time t.

60 Because data on the debt margin is only available from 2005, we were unable to consider movements in the 10-year trailing average of the debt margin over a sufficiently long time period.

61 This assumes that the uncertainty index is at, or within one standard deviation of, zero.

2. **A trailing average approach** (black line). Specifically, it is the trailing average realised once the change in the trailing average during the regulatory period is added to the initial estimate of the risk-free rate under this approach, expressed as follows:

$$(9) \qquad Trailing\ average_t = RF_t^{Historical} + \frac{\sum_{i=1}^{4}(RF_{t+i}^{Historical} - RF_t^{Historical})}{5}$$

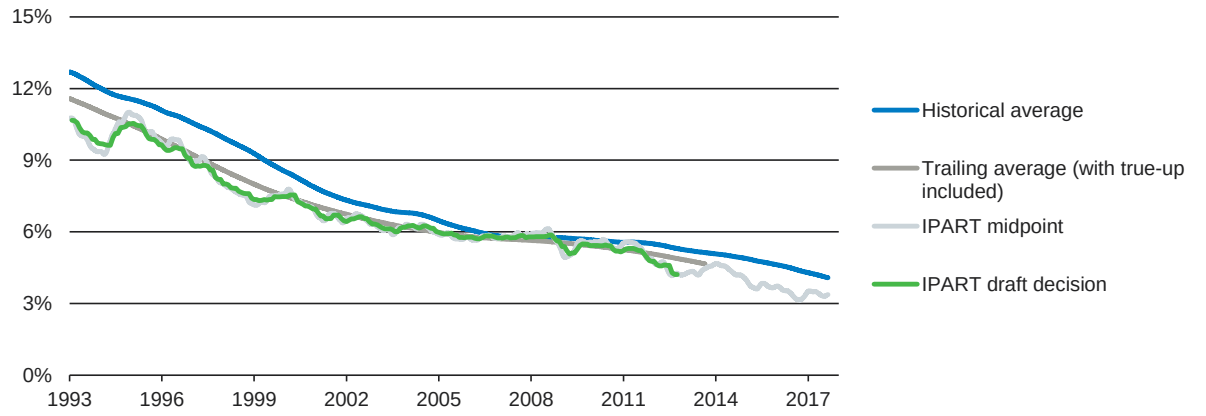
where

- $t+i$ is the historical estimate of the risk-free rate made in i years' time.

3. **Our draft decision**, which adjusts our current estimate of the cost of debt to reflect changes in the actual cost of debt during the regulatory period. See Box 4.1 for more information on how this adjustment is calculated.

Figure 4.5 shows that, over the period 1993 to 2013, the risk-free rate calculated using the trailing average approach would have closely replicated the rate calculated using IPART's current approach, or our draft decision.

Figure 4.5 The midpoint approach approximates the trailing average risk-free rate (%)



Note: The trailing average is calculated for a 5-year regulatory period.
Data source: Bloomberg; IPART analysis

There are two reasons why the midpoint of the current and historical risk-free rate could be a reasonable proxy for expected changes in the trailing average:

1. The trailing average is a 10-year moving average. Independent of future interest rate movements, the trailing average would tend to move towards the current cost of debt over time.
2. Current interest rates incorporate all known information, at that point in time. To that extent, it is a proxy for future interest rate movements.

Our methodology is more consistent with the pressures faced by firms in a competitive market

Under our draft decision, firms will either pay or be paid for changes in the cost of debt that occur during the regulatory period, over the next regulatory period. Because we propose to retain a midpoint approach, under normal market conditions half of the change in the cost of

debt that occurs during the regulatory period would be passed back through prices in the following period.

We have analysed whether our draft decision over-compensates firms for changes in the cost of debt that occur during the regulatory period. We consider that our draft decision results in a cost of debt methodology that is more consistent with the pressures faced by firms in a competitive market, and that it does not over-compensate for changes in the cost of debt.

The WACC serves two overlapping functions: first, it acts as a hurdle rate for investment, and second, it is used explicitly to set prices.

Our draft decision results in a more efficient hurdle rate for investment

Changes in the cost of debt that occur over time will affect the hurdle rate for investment for firms operating in a competitive market, and should also do so for regulated firms. Under our recommendation (but not under our 2013 method), changes in the cost of debt that occur in the regulatory would be correctly factored into firms' investment decisions as they are made. Therefore, we consider that a true-up to the current cost of debt provides an efficient investment signal consistent with the signal faced by firms in a competitive market.

Changes in the WACC are appropriately reflected in price changes

Because we explicitly use the WACC to set prices (and change prices at set intervals), regulated firms are different to unregulated firms operating in a competitive market, at least in the short term.

For competitive firm, the elasticity of demand affects the impact of a change in the cost of debt on the prices charged by a competitive firm in the short-term. For example, if the cost of debt increased, a competitive firm may not pass on the full cost increase immediately. For regulated firms, because we adopt a midpoint approach, under our draft decision, we will effectively pass through only half of the increase in the cost of debt,[62] which we consider more closely proxies the outcomes in a competitive market than our 2013 method. In addition, some of industries that we regulate (eg, water), are likely characterised by inelastic demand, which would mean that a large portion of costs increases could theoretically be passed through to consumer prices in the short-term.

In the long-term, a change in the cost of debt for a competitive firm fully flows through to customer prices. Our approach fully recoups changes in the cost of debt over the long-run: the current cost of debt recovers these changes as they occur, and the historical estimate recovers these changes over time.

4.2.3 We could introduce an adjustment to current cost of debt without transitional arrangements

Several stakeholders considered transitional arrangements may be appropriate if we implemented changes to our current approach (and in particular, if we adopted a trailing average approach).[63] They commented that a firm's efficient debt management strategy is

62 Under our draft decision we would compensate the firms for updated debt costs monthly, but we would pass these changes through into prices in the subsequent regulatory period.

63 SDP submission to IPART Issues Paper, August 2017, p 2.

influenced by the way we set the cost of debt, and if we changed our methodology, firms would need time to rebalance the composition of their debt portfolio, and any associated derivative transactions, in response to new arrangements.

We consider transitional arrangements would not be required if we implemented our draft decision, either to prices in the current regulatory period, nor in future regulatory periods where our new WACC methodology would apply.

In our view, introducing an adjustment to update our current cost of debt estimate is an incremental improvement that is more favourable to firms than our current approach. For example, it reduces their exposure to refinancing risk if there is a large and unexpected increase in interest rates during the period. It also reduces the need for them to enter into (potentially) costly derivative transactions to hedge such changes.

4.2.4 How would our draft decision interact with the uncertainty index?

IPART's decision rule is to set the cost of debt as the midpoint of current and historical estimates, provided that the uncertainty index is at, or within one standard deviation of, its historical average of zero when we set the WACC. Our draft decision would interact with our decision rule as follows:

- If the uncertainty index is at, or less than one standard deviation from, its historical average when we make the determination, we would set the cost of debt for the entire regulatory period, as outlined in Box 4.1. We would then not change the weighting between the current and historic debt costs if the uncertainty index moved outside the one standard deviation range during the regulatory period. In other words, we would hold everything constant with the determination except the estimate of the current cost of debt, which we would update.

  This approach is consistent with our 2013 method. In addition, if financial conditions deteriorated and the uncertainty index did move outside the one standard deviation range during the regulatory period, we would typically expect debt raising costs to increase in this environment. In this case, our draft decision is more favourable to firms than our current approach.

- If the uncertainty index is more than one standard deviation from its historical average when we make the determination, we would continue to use the weighting that we applied at the time of making the determination. Again, this reflects updating only the estimate of the current cost of debt – it does not revisit other elements of the original WACC decision and does not involve the exercise of discretion after we make the original decision.

Draft Decision

5 Continue to estimate the cost of debt as the midpoint between our estimates of the current and historical cost of debt when the uncertainty index is at, or within one standard deviation of, its long-term average.

6 Adjust our estimate of the current cost of debt to reflect the cumulative monthly change in the actual cost of debt during the regulatory period, and to make this adjustment through a regulatory true-up:

- at the beginning of the following regulatory period, and
- in the notional revenue requirement (NRR) for the next regulatory period.

4.3 Measuring the debt margin

To estimate the debt margin, we currently use estimates published by the RBA of the spread between the yield of BBB-rated bonds issued by Australian non-financial corporations to AGS yields.[64] They are an aggregate of spreads for bonds issued with BBB+, BBB, and BBB- credit ratings, with a residual maturity close to the target 10-year tenor.[65]

ESCOSA also uses the same data, but other regulators use different data. For example, the AER uses individual bond yield data from third-party data providers.[66] The NZCC uses the BBB+ credit rating to estimate the debt premium for electricity networks, and an A- rating for airports.[67]

In deciding how to estimate the debt margin, three issues need to be addressed:

1. Whether we adopt a single credit rating for all industries, or estimate a different credit rating in each industry for which we set prices.
2. If we continue to adopt a single credit rating across industries, whether the BBB rating is the most appropriate credit rating.
3. Whether we continue to calculate the debt margin using the RBA's measure of corporate debt spreads.

In our Issues Paper, we expressed our preliminary view that the BBB credit rating is the most appropriate measure of the debt margin for a benchmark firm operating in a competitive market, even if the firms we regulate might not be BBB rated.[68]

64 See: IPART, *Fact Sheet: New Approach to Estimating the Cost of Debt: Use of the RBA's Corporate Credit Spreads*, February 2014.

65 For further information about how bonds are chosen as part of the RBA's estimates, please see: Arsov, et al, *New Measures of Australian Corporate Credit Spreads*, RBA Bulletin Article, December Quarter 2013, pp 15-26.

66 Essential Services Commission of South Australia, *SA Water Regulatory Rate of Return 2016 – 2020, Final Report to the Treasurer*, March 2015; AER, *Better Regulation, Rate of Return Guideline*, December 2013.

67 Commerce Commission New Zealand, *Input methodologies review decisions: Topic paper 4: Cost of capital issues*, December 2016, p 57.

68 IPART, Review of our WACC method - Issues Paper, July 2017, p 25.

4.3.1 Stakeholders supported continued use of RBA data

In our Issues Paper, we also asked stakeholders if they agreed with our preliminary view that we should continue to use the 10-year corporate bond spread data published by the RBA.[69] All stakeholders who commented agreed that we should. SDP also suggested that we consider using additional data sources – such as Bloomberg or Thomson Reuters data – in conjunction with the RBA data. It noted that using other sources of data would allow us to calculate the debt margin if the RBA data become unavailable.[70]

4.3.2 Our draft decision is to maintain our 2013 method

We have decided we will continue to use only the RBA data. It is our preferred data source because we consider the estimates are reliable, it is publicly available, and the RBA has published its methodology for calculating the debt margin.[71] Alternative measures of the debt margin are currently available only with a paid subscription to these services.

If the RBA should stop publishing this series, we could consider these alternatives, or calculate the debt margin ourselves by applying the RBA's published methodology to current market data.

We have also decided to continue our existing approach and estimate the debt margin by adopting a BBB credit rating across all industries.

In principle, the credit rating we use to estimate the debt margin should vary, to some extent, by industry. For example, some industries operate in more stable markets than others, and therefore the risks of investing in those industries could be lower both for debt and equity investments.

In practice, it is not feasible to estimate a benchmark industry credit rating accurately. For example, to estimate an industry credit rating, we might look to use the firms that we select as proxy firms to estimate equity beta (and the gearing ratio). However there are at least two reasons why this is difficult to do in practice.

1. In many industries, only a small proportion of these proxy firms has received a credit rating from a ratings agency, and therefore may not be representative of an average across the industry.
2. Most of the proxy firms are foreign-based. The credit ratings for these firms are often not directly comparable to an equivalent firm operating in Australia. A BBB-rated proxy firm operating in a country where sovereign government debt has a BBB credit rating is unlikely to have the same risk profile as a BBB-rated firm operating in Australia (where sovereign debt is AAA-rated).

We consider that the BBB credit rating is most appropriate because we consider that the BBB rating will, on average, provide an efficient estimate of the WACC. This is because the

69 Ibid.
70 SDP submission to IPART Issues Paper, August 2017, p 6.
71 Arsov, Brooks and Kosev, *New Measures of Australian Corporate Credit Spreads*, RBA Bulletin Article, December Quarter 2013, pp 15-26.

gearing ratio and the credit rating are endogenous.[72,73] A credit rating higher than BBB would mean the benchmark firm would need to rely on a higher proportion of relatively expensive equity. Conversely, if the benchmark firm was sub-investment grade, the increase in the debt margin would likely more than offset the reduction in equity costs.

Draft Decision

7 Continue to use the 10-year BBB corporate bond spreads published by the RBA to measure the debt margin across all industries.

4.4 Converting published bond yield data into annualised yields

In Australia, government and corporate bond yields are typically derived from semi-annual rates of return.[74] In other words, risk-free rates are based on semi-annual rates of return, and we assume that the RBA data we use to estimate the debt margin is also based on semi-annual rates of return. We currently calculate the average annual rate of return for a 10-year government bond (the yield to maturity) by simply doubling the rate of return that an investor would earn over half a year.

However, this ignores the impact of compounding on investment returns. Figure 4.6 illustrates the impact that adjusting annual rates of return for compounding would have on our cost of debt estimates. For example, if the cost of debt was 6% using semi-annual rates, the annualised rate of return would be 6.09%. Other regulators, including the AER, ERAWA and QCA, convert published yields into an effective annual rate.[75]

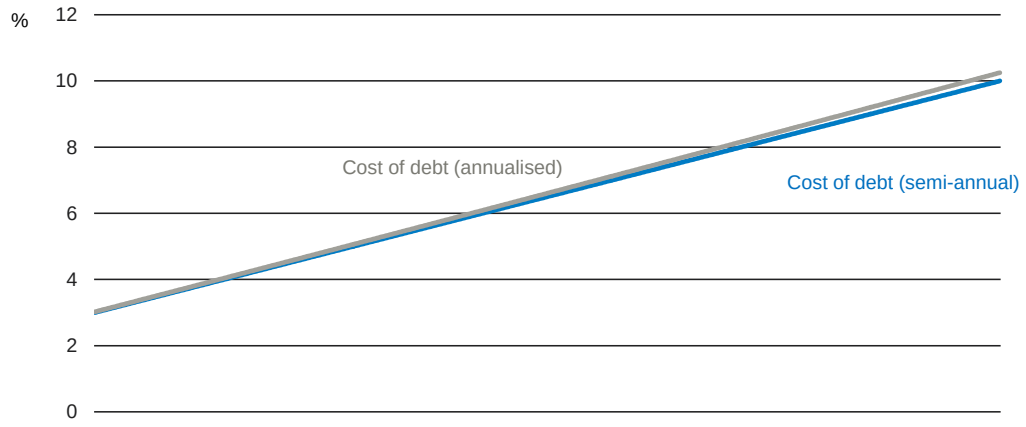
72 For example, if a water utility has a credit rating of A or AA, then it is probably under-geared. It could borrow more, reducing its rating as far as BBB while remaining investment grade. Doing so could reduce its cost of capital, since it would need to rely on a smaller proportion of relatively expensive equity in its capital structure.

73 Setting a higher credit rating also affects the financeability test. If we were to set a lower WACC based on a higher credit rating, the regulated business might not generate sufficient funds from its operations to meet the FFO/interest and FFF/debt metrics in the financeability test.

74 Quoting the yield to maturity based on semi-annual rates of return is standard bond market convention in Australia. This is because AGS bonds typically pay interest every six months. For more details, see AFMA, *Long Term Government Debt Securities Conventions*, January 2017, p 4.

75 AER, *Better Regulation, Rate of Return Guideline*, December 2013; Economic Regulation Authority, *Determination on the 2016 Weighted Average Cost of Capital for the Freight and Urban Railway Networks, and for the Pilbara railways*, October 2016; Queensland Competition Authority, *Final decision, Trailing average cost of debt, April 2015; Queensland Competition Authority, Cost of capital: market parameters*, August 2014.

Figure 4.6 Effect of converting semi-annual yields to annualised yields (%)



4.4.1 Stakeholders support annualising bond yield data

In the Issues Paper we asked stakeholders whether they agreed with our preliminary view that we should also convert the bond yield data we use into annualise yields.[76] All stakeholders who commented on this question agreed with our preliminary view.[77] SDP considered we should "…also extrapolate the effective tenor of debt of the RBA yields to the target tenor of 10 years".[78] The residual maturity of the bonds included in the RBA's sample of bonds tends to slightly below 10 years, on average.

4.4.2 Our draft decision is to annualise bond yield data

We have decided to start converting published bond yield data into annualised yields, using the proposed method in Box 4.2. However, we don't consider it necessary to extrapolate the debt spreads to a target tenor of exactly 10 years. First, this adjustment would increase complexity and reduce the transparency of our approach, and would still only approximate the 10-year debt margin. Second, we consider that this adjustment would have a minimal impact on our WACC estimates. Third, the term-to-maturity of the risk-free rate is not exactly 10 years at all points in time. Our view is that our proposed approach closely reflects a 10-year borrowing cost.

76 IPART, *Review of our WACC Method – Issues Paper*, July 2017, p 26.

77 WaterNSW submission to IPART Issues Paper, August 2017, p 9; SDP submission to IPART Issues Paper, August 2017, p 13; Hunter Water submission to IPART Issues Paper, August 2017, p A.4; Sydney Water submission to IPART Issues Paper, August 2017, p 5.

78 SDP submission to IPART Issues Paper, August 2017, p 13.

Box 4.2 Proposed method for annualising bond yield data

As outlined above, government and corporate bond yields are typically derived from semi-annual rates of return.

If the rate of return based on semi-annual yields is y_s, then the annualised rate of return, y_a, would be calculated as follows in equation (1) below:

(10) $$y_a = \left(1 + \frac{y_s}{2}\right)^2 - 1$$

We propose to adjust our cost of debt by the following factor, Δ_d

(11) $$\Delta_d = \left(1 + \frac{(y_{RF} + y_{DRP})}{2}\right)^2 - (1 + y_{RF} + y_{DRP})$$

where y_{RF} and y_{DRP} are the published risk-free rate and debt margin.

The risk-free rate also enters into the calculation of the cost of equity, which we propose to adjust by the factor Δ_e

(12) $$\Delta_e = \left(1 + \frac{y_{RF}}{2}\right)^2 - (1 + y_{RF})$$

Draft Decision

8 Convert published bond yield data into annualised yields.

4.5 Using 10-year coupon-paying bond yields

In the Issues Paper we asked stakeholders whether they agreed with our preliminary view that we should continue to use coupon-paying bond yield data to estimate the cost of debt.[79] All stakeholders who commented on this question agreed with our preliminary view.[80]

Our current approach to estimating the risk-free rate of return is to use the yield of an Australian Government bond, maturing in approximately 10 years' time, which pays interest every six months (ie, semi-annual coupons). We consider that this approach sufficiently approximates the historical risk-free rate of return, although it is not conceptually equivalent to the true cost of borrowing for 10 years.

This is because an investor who purchases this bond receives a series of cash payments every six months over a 10-year period. Thus the interest rate risk associated with a 10-year government bond is a combination of the 10-year interest rate, which applies to the principal payment and final coupon payment, and the rates of return applying to the other coupons paid over the life of the bond.[81]

79 IPART, *Review of our WACC Method* – Issues Paper, July 2017, p 27.

80 WaterNSW submission to IPART Issues Paper, August 2017, p 9; SDP submission to IPART Issues Paper, August 2017, p 13; Hunter Water submission to IPART Issues Paper, August 2017, p A.4; Sydney Water submission to IPART Issues Paper, August 2017, p 5.

81 RBA, *Extracting Information from Financial Market Instruments,* RBA Bulletin, March Quarter 2012.

To estimate the interest rate risk of borrowing over a 10-year period, we could calculate a 'zero-coupon' bond yield using bond market data.[82] The RBA publishes risk-free rates based on zero-coupon yields on a daily frequency on the second business day of each month. However, to do this, the RBA uses coupon-bearing bonds to estimate zero-coupon bond prices using a modified Merrill Lynch Exponential Spline methodology.[83]

While our current approach is not identical to the true cost of borrowing for 10 years, it is important for our approach to be transparent, replicable and result in an accurate proxy of borrowing costs. We consider that our current approach, which uses published coupon-paying bond yield data, meets these objectives.

Draft Decision

9 Continue to use the 10-year coupon-paying bond yield data to estimate the cost of debt.

4.6 Using a 10-year term to maturity to set the cost of debt

To estimate the cost of debt we add the 10-year risk-free rate and the spread between 10-year BBB-rated corporate bond yields and the 10-year risk-free rate (the debt margin). We settled on this approach in our 2013 WACC review, after we initially considered measuring the cost of debt using 5-year bond yields.[84]

Our draft decision is to continue to set the cost of debt using 10-year debt costs (ie, a 10-year term to maturity), for all industries we regulate. Our analysis suggests:

- a 10-year term to maturity (TTM) is more appropriate than a 5-year TTM, as an average across industries, and
- there are benefits to using a single TTM rather than use different TTM across industries.

4.6.1 A 10-year TTM is more appropriate than a 5-year TTM

We consider that using 10-year bond yields to estimate the cost of debt is more appropriate than using short-term bond yields because almost all regulated firms that we set a WACC for operate assets with long lives. As a result, using a 5-year TTM to estimate the cost of debt for these firms may increase firms' exposure to refinancing risk, because it may encourage these firms to issue short-term debt to fund long-term assets. In our Issues Paper, we noted to the extent that regulated firms operate assets with long lives, they would be exposed to refinancing risk if they did not issue long-term debt.[85]

In addition, it is inefficient if the TTM we assume does not match the life of the firms' assets. The efficient cost of finance for an asset is the cost of financing the asset over its life. As we noted in our 2013 review:

82 Nominal yields for Australian Government Bonds are adjusted for coupon payments to derive their zero coupon yields. See RBA, *Extracting Information from Financial Market Instruments*, RBA Bulletin, March Quarter 2012.

83 For more details, see Finlay and Chambers, *A Term Structure Decomposition of the Australian Yield Curve*, RBA Research Discussion Paper, December 2008.

84 IPART, *Review of WACC Methodology - Final Report*, December 2013, pp 12-13.

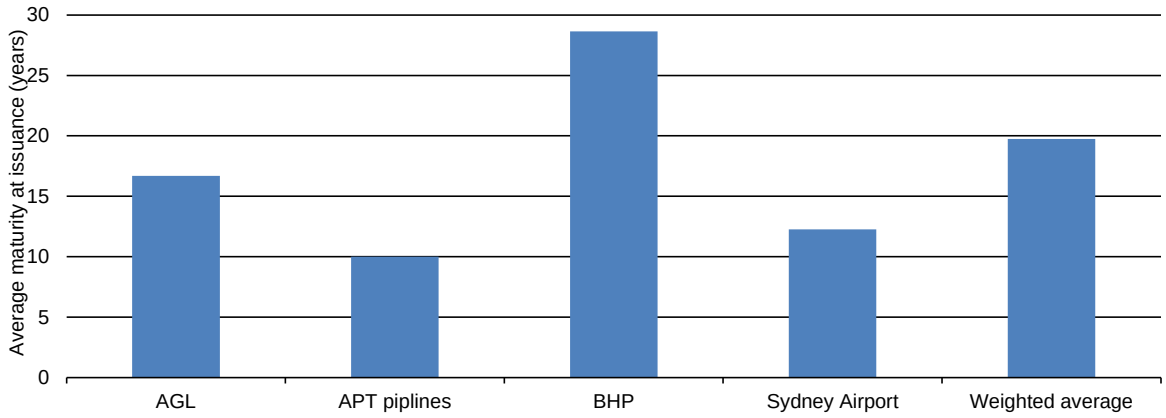
85 IPART, Review of our WACC Method – Issues Paper, July 2017, p 25.

> The real asset is the underlying physical assets, which generate the cash flow over their expected economic lives…Investors seeking to invest in a utility, whether regulated or unregulated, would value the business based on the expected cash flow that would be generated by the business over the expected life of its assets.[86]

Therefore, the TTM we assume for the firm should as closely as possible reflect the average life of its assets. Using a 5-year TTM may be inefficient relative to a 10-year TTM for assets with long lives.[87]

There is also broad evidence that firms operating long-lived assets seek to raise debt with a maturity of 10 years or longer. Figure 4.7 shows a sample of domestic businesses investing in long-lived assets issue bonds with a maturity of 10 years or longer.

Figure 4.7 Bond maturity profile for a sample of domestic businesses (years)



Note: This figure presents the average maturity of bonds on an 'original maturity' basis (the maturity of the bond at issue).
Data source: Bloomberg.

4.6.2 There are practical benefits in setting a single TTM for all industries

In principle, the TTM we use to set the WACC for a business should reflect an average asset life for the industry. That is, if we set a WACC for a firm operating in an industry which invested in short-lived assets, then it would be more efficient to set the WACC based on short-term bond yields. This would suggest the TTM should vary by industry.

In practice, we consider that using a 10-year TTM for all industries is more appropriate than determining industry-specific TTMs:

- Almost all regulated firms that we set a WACC for operate assets with long lives, of at least 10-years on average.
- The 10-year cost of debt can be measured reliably over time.
- A single TTM results in a simpler, more consistent approach, and reduces parameter uncertainty for the businesses that we regulate.

86 Ibid, p 11.
87 Ideally we would match the TTM to the asset lives. However, in practice the debt market does not offer products to exactly match the asset lives for long-lived infrastructure assets.

Draft Decision

10 Continue to use a 10-year term to maturity to estimate the cost of debt.

5 Determining the cost of equity

Under our 2013 WACC method, we use a Capital Asset Pricing Model (CAPM) to estimate the cost of equity. Under this model, the cost of equity equals the sum of the risk-free rate of return and the product of the market risk premium (MRP) and the equity beta.

Like most regulators in Australia and overseas, we use the Sharpe-Lintner CAPM (SL-CAPM). In applying this model, we estimate the current cost of equity and the historical cost of equity and select the midpoint value. This involves:

- estimating a historical and a current risk-free rate (as discussed in Chapter 4)
- estimating a historical and a current MRP, and
- estimating equity beta and gearing levels using a selection of proxy companies when we first estimate a benchmark WACC for a regulated industry, and reviewing this value in subsequent reviews.

As part of the review, we considered a range of refinements to this approach and the measures we use. The sections below provide an overview of our draft decisions and then discuss them in detail.

5.1 Overview of draft decisions

We have decided to continue to use the SL-CAPM, as there is not a sufficient case to replace it with an alternative model. However, we will monitor the impact that moving to the Fama-French model would have on our WACC decisions over the next five years.

We have also decided to continue estimating both a current and historical cost of equity, and giving equal weight to each of these estimates. In addition, we will continue to measure the historical MRP as a range with a midpoint of 6%. However, we will modify our approach and measures for estimating the current MRP and equity beta.

For the current MRP, we will continue estimating this value using six different methods and then selecting a single point estimate. However, we will modify the market indicator method by replacing two of the indicators we currently use (the dividend yield and the risk-free rate) with a single new indicator (earnings yield less the risk-free rate).

We will also modify the way we select a single point estimate for the current MRP. We will:

- combine the estimates derived by the five different dividend discount model (DDM) methods into a single DDM MRP by calculating the median estimate
- calculate the weighted average of this median DDM MRP and the market indicator MRP, giving a two-third weight to the former and a one-third weight to the latter.

For the equity beta, we have decided to re-estimate this value at each price review but only change the value we use in our WACC calculations where we consider there is sufficient

evidence to support this. To improve our selection of proxy companies we will use the broadest possible selection but exclude thinly traded stocks. To mitigate estimation bias in raw OLS beta estimates, we will continue to use the Vasicek adjustment but no longer use the Blume adjustment, as the former is more objective.

5.2 Using the Sharpe-Lintner CAPM

We use the SL-CAPM to calculate the cost of equity. According to this model, only systematic risk affects the expected return required by the marginal equity investor (who determines the price of equity). This is because the marginal investor would hold a well-diversified portfolio of equities, and a diversification strategy can remove firm-specific risk.

The average cost of equity across the entire market comprises a risk-free rate (representing the rate an investor would receive for zero risk to their capital) plus a premium that reflects the additional systematic risk a marginal equity investor bears (representing the average premium the investor would be willing to accept for a less-than-certain return). This is premium is known as the MRP.

Movements in the stock market affect some firms more than others. For example, utility firms that offer essential services tend to maintain a fairly steady profit margin through market upturns and downturns because there is a relatively steady demand for these services. On the other hand, firms that offer discretionary consumer products, especially luxury items, tend to be highly exposed to market dynamics.

We capture this varying sensitivity to the state of the market through a firm-specific parameter called the equity beta (β_e):

- An equity beta of one implies that the firm's rate of return (ie, after-tax profits divided by the value of equity) is the same as for the market as a whole at each point in time. That does not mean that the firm's rate of return is constant – rather it varies at the same time and in the same way as the overall market rate of return.
- An equity beta below one implies that the firm's rate of return is less sensitive to upturns and downturns than the market overall.
- An equity beta above one implies that the firm's rate of return is more sensitive to upturns and downturns than the market overall.

Given these points, the SL-CAPM states that:

(13) Expected rate of return on equity = risk-free rate + MRP x βe

5.2.1 One stakeholder submitted that we should use an alternative model

Notwithstanding regulators' widespread use of the SL-CAPM, academic research indicates that it tends to underestimate the cost of equity for low-equity beta stocks (such as regulated natural monopoly firms).

Sydney Water submitted that we use an alternative model to the SL-CAPM to address this downward bias.[88] It stated:

> In its 2013 Draft Determination, IPART expressed a view that the Sharpe CAPM used may exhibit a degree of downward bias and agreed corrective measures are required. This view is in line with views expressed by the Australian Energy Regulator (AER) on this issue and was supported by Sydney Water.
>
> However, from our observations of IPART's historical WACC estimates since 2014, it is unclear if IPART has applied any corrective remedies discussed in its 2013 Draft Determination. As a basic principle Sydney Water seeks ongoing commitment from IPART to use alternative CAPMs such the Fama French, Black or Sharpe-Lintner models to address the acknowledged downward bias of the Sharpe CAPM.[89]

5.2.2 Our draft decision is to continue using the SL-CAPM as there is not a sufficient case to replace it

It is prudent to periodically assess whether the SL-CAPM is the most appropriate pricing model for our WACC method. We agree that other models may exhibit less bias than the SL-CAPM. However, there may be theoretical or practical reasons not to use them. In our view, we should only change the asset pricing model we use in estimating the cost of equity where:

- the alternative model more accurately estimates the cost of capital
- the alternative model produces results that are stable over time to give stakeholders certainty
- the alternative model produces results that are predictable, transparent and reduce resources required for each review, and
- we receive sufficient evidence that changing to the alternative model would increase the accuracy of our WACC estimates.

Based on our analysis and Sydney Water's comments, we do not consider that there is sufficient evidence to suggest either alternative would be superior to the SL-CAPM (with adjustments for bias in the equity beta estimation) for our purposes. However, over the next five years, we will monitor the results that the Fama-French model would produce if we had adopted it in place of the SL-CAPM in our WACC method. This will help inform future periodical assessments of the most appropriate pricing model for our WACC method.

In response to Sydney Water's question about whether we have applied any corrective remedies to address the downward bias of the SL-CAPM since 2014, we have used the Vasicek and Blume adjustments for this purpose. We discuss this issue further in the remainder of this section and in section 5.3.

88 Sydney Water submission to IPART Issues Paper, August 2017, p 13.
89 Ibid.

We consider the Black CAPM would produce similar results to SL-CAPM with adjustments for bias in the equity beta estimation

Both the SL-CAPM and Black CAPM predict the expected return of an asset is a function of its covariance with systematic (undiversifiable) risk. The main difference between these models is the interpretation of the intercept term. The SL-CAPM uses the contemporaneous risk-free rate of return, while the Black CAPM adopts the return of the minimum-variance zero-beta portfolio of assets. The return of the zero-beta portfolio is greater than the risk-free rate, but lower than the return of the market portfolio.[90]

In an abridged form, the expected return of an asset under the SL-CAPM (S) and Black CAPM (B) are:

(14) $$(S)\ r_i = r_f + \beta(r_M - r_f)$$

(15) $$(B)\ r_i = r_Z + \beta(r_M - r_Z)$$

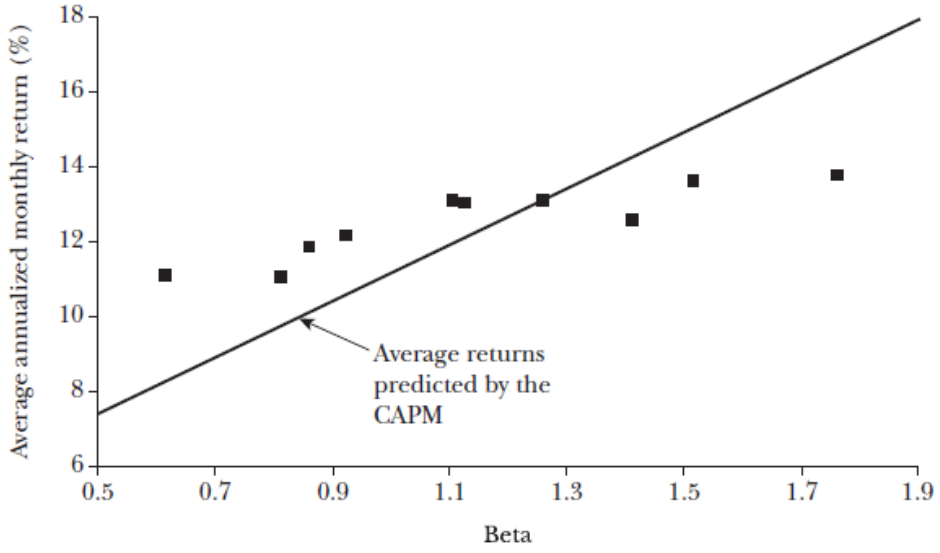
where r_i is the return on asset i, r_f is the risk-free rate of return, r_M is the return on the market portfolio, and r_Z is the return on the zero-beta portfolio. In essence, the SL-CAPM predicts a lower intercept (as $r_f < r_Z$) and a higher slope (β) than the Black CAPM.

The observed relationship between the equity beta and subsequent return is much 'flatter' under the Black CAPM than predicted by the SL-CAPM.[91] For stocks with estimated equity betas below (above) one, realised returns tend to be higher (lower) than predicted under the Black CAPM. Figure 5.1 demonstrates that observed results more closely reflect the estimates of the Black CAPM than the SL CAPM, with a lower slope parameter and a higher intercept.

90 Sharpe, W, *Capital Asset Prices: A Theory of Market Equilibrium under Conditions of Risk*, The Journal of Finance, Vol 19, No. 3, September 1964, pp 425-442; Lintner, J, *The Valuation of Risk Assets and the Selection of Risky Investments in Stock Portfolios and Capital Budgets*, The Review of Economics and Statistics, Vol. 47, No. 1, February 1965, pp 13-37; Black, F, *Capital Market Equilibrium with Restricted Borrowing*, The Journal of Business, Vol. 45, No. 3, July 1972, pp 444-455.

91 Fama, E, and K French, *The capital asset pricing model: Theory and evidence*, *Journal of Economic Perspectives*, Vol. 18(3), 2004, p 32.

Figure 5.1 Average annualised monthly return versus equity beta, 1928 to 2003



Note: Data points represent the annualised average value-weighted monthly returns of US equity portfolios decile-sorted on prior-year beta. The furthest left observation therefore represents the average return on the lowest-decile beta stocks, with the furthest right observation representing returns for the highest-decile beta stocks.

Data source: Fama, E, and K French, *The capital asset pricing model: Theory and evidence*, *Journal of Economic Perspectives*, Vol 18(3), 2004, p 33.

At face value, the evidence suggests that the Black CAPM addresses the downward bias of the SL-CAPM. This is especially relevant for regulated entities, as they typically exhibit equity betas of less than one.

However, our current approach implements an adjustment to our estimated equity betas to correct this potential bias. Empirical evidence suggests that equity betas obtained from ordinary least squares (OLS) estimation are likely to be subject to a high degree of estimation bias due to sampling error. To correct for this bias, we implement the Vasicek adjustment.[92] This adjusts OLS equity beta estimates towards the best prior equity beta estimate, with the degree of adjustment based on estimated standard errors. In essence, the Vasicek adjustment gives a higher weight to more precisely estimated equity betas, and a lower weight to estimated equity betas with higher standard errors.

Although the Vasicek adjustment is not explicitly designed to address the downward bias of the SL-CAPM, in practice, it can partly compensate for this bias. This is because very low or very high beta estimates are relatively more likely to be to be affected by estimation error.[93] For example, using a recent sample of proxy firms,[94] we compared estimated OLS equity betas to the change in equity beta due to the Vasicek adjustment. As Figure 5.2 shows, the Vasicek adjustment increases the estimates of low-beta firms, and decreases the estimates of high-beta firms.

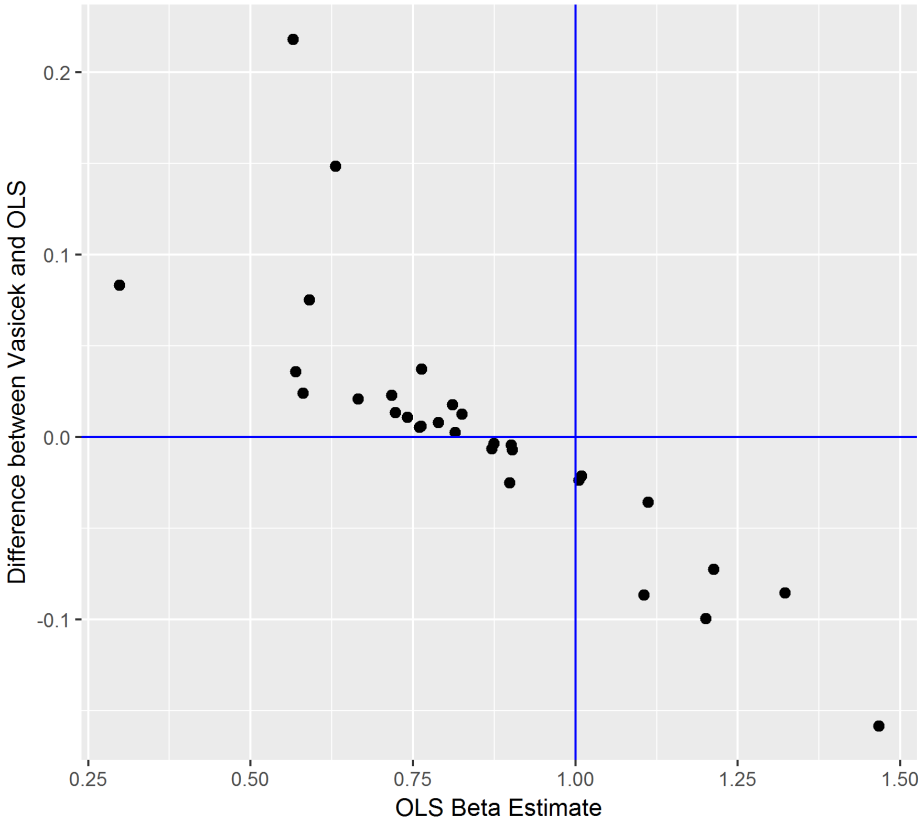
92 Vasicek, O, *A Note on Using Cross-Sectional Information in Bayesian Estimation of Security Betas*, The Journal of Finance, Vol. 28, No. 5, December 1973, pp 1233-1239.

93 Gray, S and J Hall, SFG Consulting and Diamond, N and R Brooks, Monash University, *The Vasicek adjustment to beta estimates in the Capital Asset Pricing Model*, June 2013, p 4.

94 Airport proxy firms as cited in: IPART, *Maximum fees and charges for cruise ships Sydney Harbour – Final Report*, November 2016, p 99.

Cost of equity estimates under the Black CAPM may still be higher than under our adjusted SL-CAPM due to the use of r_Z as the intercept. However, in our view, the adjusted equity beta estimates sufficiently account for the known downward bias of the SL-CAPM.

Figure 5.2 OLS versus Vasicek-adjusted equity beta estimates, IPART airport proxy firms



Note: Difference is defined as Vasicek beta minus OLS beta. Positive differences indicate the Vasicek adjustment increased the OLS estimate, while negative differences indicate the adjustment lowered the OLS estimate. The adjusted R^2 value is 0.7

Data source: Airport proxy firms as cited in: IPART, *Maximum fees and charges for cruise ships Sydney Harbour – Final Report*, November 2016, p 99.

We will monitor the results produced by the Fama-French Model over the next 5 years

The Fama-French three-factor model[95] (FFM) follows empirical evidence that factors in addition to systematic and firm risks affect stock returns. In addition to a systematic (market) risk factor, the FFM also calculates a firm's expected return as a function of pricing factors that proxy firm size and book-to-market effects. The expected return of an asset under the FFM is:

(16) $$R_i - R_f = \beta_{mkt}(R_M - R_f) + \beta_{size}SMB + \beta_{value}HML$$

where r_i is the return on asset i, r_f is the risk-free rate of return, r_M is the return on the market portfolio, SMB and HML are factors capturing the excess return of small and high book-to-market ratios (B/M-ratio) firms respectively, and β are factor sensitivities.

95 Fama, E and K French, *Common Risk Factors in the Returns on Stocks and Bonds*, Journal of Financial Economics, Volume 33, No. 1, February1993, pp 3-56.

Both Australian[96] and international[97] evidence suggests that small firms earn higher excess returns on average than their larger counterparts, while high B/M-ratio firms earn higher excess returns on average than low B/M-ratio firms. This is why the FFM results in greater explanatory power in the cross-section of equity returns when compared to other versions of the CAPM.

A potential shortcoming of the FFM is that the model relies on ex-post statistical power that does not necessarily relate to ex-ante rational risk.[98] That said, the additional pricing factors in the FFM may not be an undiversifiable risk, but rather, factors which contribute to an underlying multidimensional risk framework.[99]

Some regulated firms contend that the FFM should be included in cost of equity estimations, stating that the increased explanatory power sufficiently outweighs any theoretical concerns or costs of implementation.[100]

In our view, this argument is sufficient to warrant estimation and comparison of FFM estimates, but is not sufficient reason to replace the SL-CAPM as our model at this stage. The FFM may provide a better statistical fit to historical returns data, but this statistical power varies significantly over time. In particular, there is empirical evidence that the impact of firm size on equity returns is not stable over time in Australia.[101]

In addition, the FFM would require estimates of size and B/M ratios for regulated entities. A government-owned regulated firm would have an undefined market value, since its equity is not traded. This would leave the B/M ratio undefined for such a firm. Potentially, we could estimate the FFM using the B/M ratio for a proxy firm, but doing so would introduce a greater subjectivity.

We intend to monitor the FFM over the next five years to examine how it would perform if we adopted it instead of the SL CAPM in our WACC method.

Draft Decision

11 Continue to use the Sharpe-Lintner CAPM to estimate the cost of equity, and monitor the impact that the FFM would have if we adopted it at a future review.

5.3 Weighting the current and historical cost of equity

As with the cost of debt, under our 2013 method, we estimate the current and the historical cost of equity, and then select the midpoint value. In our Issues Paper, we expressed a preliminary view that we should continue to give equal weight to the current and historical

96 Tim Brailsford, Clive Gaunt and Michael O'Brien, *Size and book-to-market factors in Australia* Australian Journal of Management, Volume 37, issue 2, April 2012, pp 261-281.

97 Eugene F. Fama and Kenneth R. French, *Size, value, and momentum in international stock returns*, Journal of Financial Economics, Volume105, May 2012, pp 457-472.

98 Josef Lakonishok, Andrei Shleifer and Robert Vishny, Contrarian Investment, Extrapolation, and Risk, The Journal of Finance, Volume 49, Issues 5, December 1994, pp 1541-1578.

99 Eugene F. Fama and Kenneth R. French, *Multifactor Explanations of Asset Pricing Anomalies*, Journal of Finance, Volume 51, Issue 1, March 1996, pp 55-84.

100 See SFG Consulting, *The Fama-French model*: Report for Jemena Gas Networks, ActewAGL, Ergon, Transend, TransGrid, and SA PowerNetworks, May 2014.

101 Tim Brailsford, Clive Gaunt and Michael O'Brien, *Size and book-to-market factors in Australia* Australian Journal of Management, Volume 37, issue 2, April 2012, pp 261-281.

cost of equity in normal circumstances (ie, unless the uncertainty index is greater than one standard deviation from zero).[102] We consider that this is appropriate because investors take account of both long- and short-term values when making their investment decisions. We also expressed a preliminary view that we should continue to use a range with a midpoint of 6% as the historical MRP because, over long time periods (eg, many decades), the average MRP value is fairly steady at about 6%.[103]

Other regulators, notably the AER and ACCC, only give weight to the historical average MRP in estimating the cost of equity (see Appendix A). In our view, the case for this approach would be strongest if deviations from the historical average were short-lived and mean-reverting. If so, the historical average would be a reasonable indicator of the actual cost of equity a regulated firm would face during the regulatory period. However, if deviations were persistent over a period of several years, then the case for using the historical average MRP only would be weaker.

In the past decade, deviations from the historical average MRP have been persistent. As Figure 5.3 illustrates, the current MRP has been mostly above 6% since 2008, and above 8% for most of the time since 2011. We consider some weight needs to be given to this fact, so we calculate both a historical and a current MRP.

In our view, it would be invalid to combine a current risk-free rate with a historical MRP, because the result of that calculation would not represent the state of the equity market at any point of time. By combining a current estimate of the risk-free rate with a current MRP estimate, we can approximate the current market price of equity. Likewise, by combining a historical estimate of the risk-free rate with a historical MRP estimate, we can approximate the historical average market price of equity. Either of these benchmarks would be a valid point of reference. When we combine the risk-free rates and MRP estimates in this time-consistent way, the current cost of equity is closer to the historical average cost of equity than either of them is to the time-inconsistent sum.

5.3.1 Stakeholders generally agreed with our preliminary views

Sydney Water, Hunter Water, WaterNSW and SDP all agreed that we should continue placing equal weight on the estimated current and historical cost of equity, and using the historical MRP estimate of 6%.[104] ARTC also supported this practice, noting:

> The underpinning methodology which IPART utilizes in developing its parameter assumptions removes significant volatility in the WACC calculation. For instance, its balance between short and long term assessments of market based parameters ensures short term market fluctuation. This ensures the WACC calculation applied is not the outcome of a temporal lottery, but more reasonably reflects changes in the parameters over time.[105]

102 IPART, *Review of our WACC Method - Issues Paper*, July 2017, p 31.
103 Ibid, p 30.
104 WaterNSW submission to IPART Issues Paper, August 2017, p 10; Hunter Water submission to IPART Issues Paper, August 2017, p A.4; Sydney Water submission to IPART Issues Paper, August 2017, p 13 SDP submission to IPART Issues Paper, August 2017, p 5.
105 ARTC submission to IPART Issues Paper, August 2017, p 1.

5.3.2 Our draft decisions are in line with our preliminary views

Given stakeholders' support for our preliminary views, we will continue to give equal weight to the current and historical cost of equity, and use a range with a midpoint of 6% as the historical MRP.

Draft Decisions

12 Continue to estimate the cost of equity as the midpoint between our estimates of the current cost of equity and the historical cost of equity when the uncertainty index is at, or within one standard deviation of, its long-term average.

13 Continue to use a range with a midpoint of 6% as the estimate of historical MRP.

5.4 Modifying our approach for measuring the current MRP

Unlike the historical MRP, the current MRP is difficult to measure reliably. Typically, estimates of this value rely on dividend discount models (DDMs). These models require assumptions about future growth rates and some other inputs. Different analysts adopt different assumptions, so there is a dispersion of views. Nevertheless, factors that cause the current MRP to rise or fall tend to affect all these estimation methods in a similar way. By taking an average or median of these different estimates, we can observe trends in changes to the current MRP.

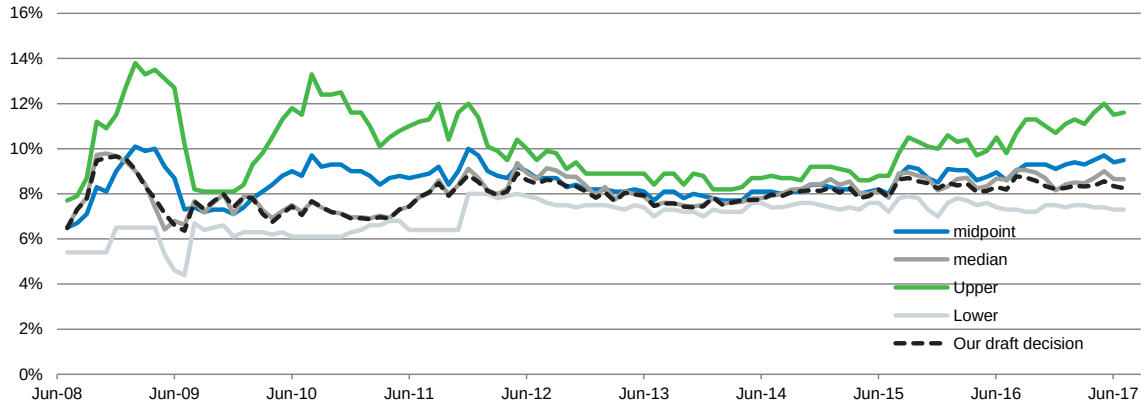
Under our 2013 method, we measure the current MRP using six different methods and then determine a single point estimate:

1. Damodaran 2013 method
2. Bank of England 2002 method
3. Bank of England 2010 method
4. Bloomberg method
5. SFG (now Frontier Economics) analysts forecast method
6. SFG market indicator method.

The first four of these methods are variations of the DDM. They differ in detail, but all infer a forward-looking market average return on equity based on expected dividends. The fifth is another variation of the DDM, which uses the forecasts of stock market analysts for individual stocks and a DDM. The sixth method uses five economic indicators to derive an indirect estimate of the MRP.

Figure 5.3 compares the minimum, maximum, median and midpoint of the MRP produced by these different methods since June 2008. It also plots the MRP forecasts under our draft decision to set the MRP as a weighted-average of the market indicators MRP and the median of the five DDM MRP estimates, with one-third weight to the market indicators MRP and a two-third weight to the median of the DDM MRP estimates (see Section 5.5 for more detail on why we have made this draft decision). Figure 5.3 shows the median method and our draft decision would have produced very similar estimates over 2008 to 2017.

Figure 5.3 Comparison of MRP forecasts, 2008 to 2017 (%)



Data source: IPART and SFG analysis of Bloomberg and Thomson Reuters data.

In our Issues Paper, we expressed a preliminary view that we should continue to use the same six methods to measure the current MRP.[106] However, we outlined potential modifications to the data used in applying first four methods. In addendum circulated with the agenda for our public hearing, we also outlined potential modifications to the indicators used in applying the sixth method.[107]

We note that the observed equity returns we use to estimate the current MRP are taken after corporate tax. However, they do not take account of the franking credit benefits that Australian investors receive. To take account of this benefit, our current MRP estimates make an adjustment for dividend imputation. This adjustment currently assumes a dividend imputation credit factor (gamma) of 0.25, in line with our 2013 WACC method. We discuss the derivation of this gamma in Chapter 7.)

5.4.1 Most stakeholders did not support changing the data used in applying the DDM methods

To apply four methods for measuring the current MRP (the Damodaran and Bloomberg methods and the two Bank of England methods), we currently use the ASX 200 share price index and consensus earnings per share (EPS) forecasts. However, it would be possible to use analyst **price targets** instead of **share prices,** and to use **individual analyst EPS forecasts** instead of **consensus forests.**

Like their EPS forecasts, analysts' price targets are likely to reflect their optimism. This means they are likely to be higher than the actual market prices. If we used price targets instead of share prices, we could avoid or mitigate the risk of a mismatch in the optimism between analysts making earnings forecasts and investors trading shares.

Individual analyst EPS forecasts contain more up-to-date data than consensus forecasts. In addition, using these individual forecasts would allow us to aggregate them to a market-based EPS forecast ourselves, using a method suited to our purpose. It would also allow us to match the date that the individual analyst EPS forecast was released to the market with

106 IPART, Review of our WACC Method: Issues Paper, July 2017, p 33.
107 IPART, Addendum: Estimating the market risk premium, August 2017.

the target price of the analyst from approximately the same date (we can also match the share price from the same date). This would improve the accuracy of our estimates.

There can be a delay in analysts updating their forecasts, so when consensus forecasts are used in the analysis and there is a large share price change, the DDM would incorrectly attribute this to a change in the cost of capital. If the market rises by 20% this month or falls by 20%, this change could be partly because of a change in discount rates but could be largely due to changes in the market's expectations for earnings. The consensus forecast lags share price changes due to delays in analysis updating their forecasts.

We consider that the use of consensus forecasts (rather than matching the individual analyst forecasts with prices from the same date) would produce the same cost of capital on average, but it would be more volatile over time. The volatility is due to stale information in the consensus forecasts.

Compared to our 2013 method for calculating these four MRP estimates, the use of analyst price targets and individual analyst EPS forecasts would yield MRP estimates that are lower (due to the use of price targets) and less variable over time (due to matching of earnings forecasts with prices at the same point in time).

WaterNSW agreed with the continued use of the six current MRP measures, but disagreed with the proposal to use analyst price targets in place of share prices. It noted that:

> …analyst price targets are factored into share prices upon their release, with the market (actual prices) reflecting more comprehensive information than analyst forecasts alone. Accordingly, we support the current approach of using an average (median - per response to Question 14 below) of the existing six methods to calculate the current MRP.[108]

Sydney Water expressed a similar view, also supporting the six current MRP measures, but not supporting the move to analyst price targets:

> We agree that there has been volatility in the in the short-term market risk premium (MRP) and that, maintaining stability in short-WACC parameters is an appropriate goal. However, we do not believe that the evidence presented by IPART sufficiently address the probable cause of the volatility, and so it is unclear if the proposed remedy is appropriate. We believe that more work ought to be conducted by IPART to establish the cause of the volatility and impact on the WACC of any proposed remedy.[109]

5.4.2 No stakeholder commented on modifying the indicators used in the market indicator method

In our addendum, we suggested there may be benefits to refining our approach for measuring the current MRP using the market indicator method. In particular, we proposed using a new indicator – the earnings yield less the risk-free rate – instead of two existing indicators – the dividend yield and the risk-free rate.[110] We considered that:

108 WaterNSW submission to IPART Issues Paper, August 2017, p 10.
109 Sydney Water submission to IPART Issues Paper, August 2017, p 5.
110 IPART, Addendum: Estimating the market risk premium, August 2017.

- the earnings yield is a better indicator than the dividend yield of changes in the MRP over time because the earnings yield is less affected by corporate regime changes (eg, the dividend yield is affected by corporate policy on whether to issue dividends or repurchase shares and invest in real assets), and
- comparing the earnings yield to the risk-free rate, rather than using the risk-free rate as a separate indicator, avoids double counting the impact of common factors that affect both equity and bond returns (eg, lower inflation expectations would lead to lower earnings yields and government bond yields even if the MRP did not change).[111]

Stakeholders did not comment on this proposed change to the market indicators method.

5.4.3 Our draft decisions are to make no change to the DDM methods and modify the market indicator method

We consider that using analyst price targets instead of market prices has theoretical merit. However, given the strongly expressed views of some stakeholders and the risk that the process by which individual analysts derive their price targets may not be transparent, we have decided we will make no change to the way we estimate the current MRP using the first four DDM methods.

We consider that modifying the indicators we use in applying the market indicators method would improve the accuracy and robustness of this method. For this reason, we have decided to make this modification. Nevertheless, we would welcome further stakeholder comments.

Draft Decisions

14 Continue to use our existing six methods to measure the current MRP.

15 Continue to use the ASX 200 share price index and consensus earnings per share forecasts to measure the current MRP using the Damodaran and Bloomberg methods and the two Bank of England methods.

16 Modify the indicators we use to measure the current MRP using the market indicator method by replacing two of our existing indicators – the dividend yield and the risk-free rate – with one new indicator – the earnings yield less the risk-free rate.

5.5 Modifying our approach for determining the current MRP

To select a single value for the current MRP from the six estimates discussed above, we currently use the midpoint of the highest and lowest current MRP estimate in each month. However, an alternative approach would be to use the median of the six indicators.

For most of the years shown in Figure 5.3 above, the midpoint and median would have produced a similar estimate. However, throughout 2010:

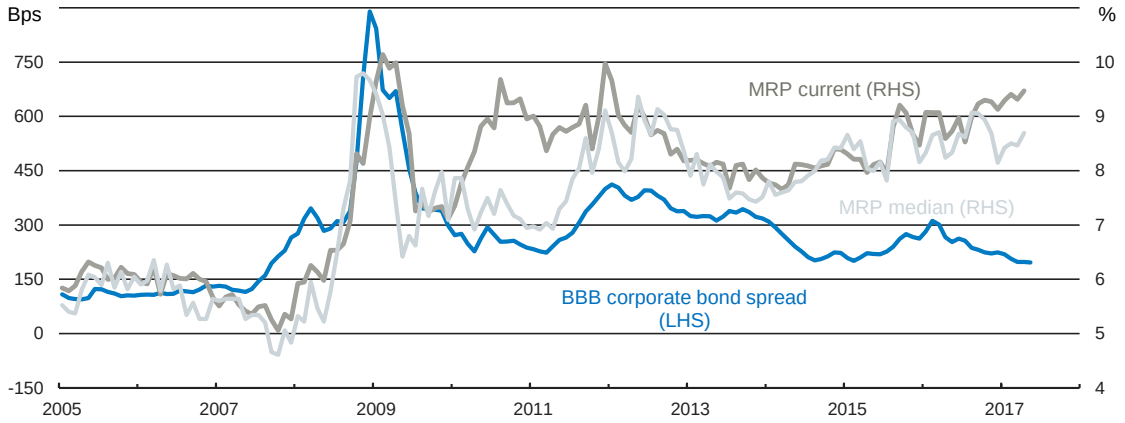
- the midpoint estimate was higher than five of the six indicators, indicating it is affected by extreme outliers, and

111 Ibid.

- the median estimate closely matched three of the six indicators, indicating it is less influenced by the high values in the Bloomberg indicator.

To consider which approach is preferable, we assessed how well each approach tracks the BBB corporate bond spread, which also measures the risk premium. Figure 5.4 compares the midpoint of the highest and lowest MRP indicator and the median of the six indicators, to the BBB corporate bond spread. It shows that the median measure of the MRP appears to move more closely with changes in the corporate bond spread than the midpoint measure. This provides some evidence that the median approach might be less affected by outliers than the midpoint approach.

Figure 5.4 MRP estimates and debt margin (bps, %)



Data source: IPART and SFG analysis of RBA, Bloomberg and Thomson Reuters data

In addition, from time to time, one of the six current MRP estimates may be unavailable. In those instances, the median approach provides a more accurate estimate than the current midpoint approach. For these reasons, we expressed the preliminary view that we should change our method of combining the six (or as many as are available) MRP estimates from the midpoint rule to a median rule.[112]

5.5.1 Most stakeholders supported using a median and retaining outliers

Sydney Water supported moving to a median approach, as it agreed that the median is less affected by outliers than the mid-point. It noted that "outliers should not be removed as this can become either an arbitrary approach or may overly rely on mechanistic outlier detection."[113] WaterNSW also supported the use of the median and the retention of outliers.[114] Hunter Water agreed with the use of the median.[115]

112 IPART, Review of our WACC Method: Issues Paper, July 2017, p 34.
113 Sydney Water submission to IPART Issues Paper, August 2017, p 14.
114 WaterNSW submission to IPART Issues Paper, August 2017, p 10.
115 Hunter Water submission to IPART Issues Paper, August 2017, p A.4.

SDP submitted that we should use the mean of the six MRP estimates rather than the median.[116] Frontier Economics, on behalf of SDP, contended that:

> We agree that when confronted with genuine outliers, a median approach would be appropriate. This is a standard statistical approach.
>
> However, the fact that a single estimate of the current MRP happens to be very high or very low does not necessarily make it a genuine outlier. It could be that this high or low estimate provides some useful information about the true MRP, which the remaining estimates fail to do. Discarding this estimate (by application of the median estimate) would, under such circumstances, result in a worse (rather than better) estimate of the current MRP.[117]

Frontier also contended that the mean of the six values would tend to give less weight to extreme values, while preserving—to some extent—the information content that they might have.[118]

Our addendum also discussed estimating the current MRP as a weighted average of the market indicators MRP estimate and the median of all available dividend discount model MRP estimates.[119] Stakeholders did not comment on this suggestion.

5.5.2 Our draft decision is to use a median approach to select a single estimate of the DDM MRP and give this estimate a weight of two-thirds

On balance, we are inclined to move to the median of the DDM MRP estimates. During and after the GFC, the Bloomberg MRP estimate was consistently the high estimate, sitting significantly higher than the others in the group. As such, we consider that it was a genuine outlier and the mean approach would have given it too much weight.

However, we calculate five different DDM estimates and only one estimate using the market indicators method. In combining these estimates, we could give excessive emphasis to the DDM methodology to the detriment of alternative methodologies. To overcome this potential source of bias, we have decided to combine the median DDM estimate with the market indicators estimate using a weighted average, rather than finding a central estimate of all six MRP estimates.

This draft decision acknowledges the point made by Frontier Economics that MRP estimates should not be excluded (or given virtually no weight) simply because they are different from the other estimates.[120] The fact that they are different may indicate that they contain useful information about the true MRP. This is especially likely to be the case when virtually all of the other MRP estimates use the same alternative methodology.

We consider that placing equal weight on the market indicators MRP and the median DDM MRP would not be appropriate because the DDM method has a longer history and wider acceptance. On the other hand, giving the market indicators MRP less than 20% weight would tend to reduce its impact below the impact it would have under a straight average of five estimates. While acknowledging the impreciseness of the weighting decision, we have

116 SDP submission to IPART Issues Paper, August 2017, p 5.
117 Frontier Economics, *Review of WACC method: response to IPART Issues Paper: A Report Prepared for Sydney Desalination Plant, August 2017, p 30.*
118 Ibid, p 31.
119 IPART, Addendum: Estimating the market risk premium, August 2017.
120 Frontier Economics, ibid, p 31.

made the draft decision to give the market indicators MRP a weight of one-third and the median DDM MRP a weight of two-thirds in the weighted average. The one-third weight to market indicators MRP is roughly in the middle of the 20% to 50% range.

Draft Decisions

17 In combining different DDM MRP estimates, move from the midpoint to a median approach, but do not exclude outliers.

18 Determine the point estimate of current MRP as the weighted average of the market indicators MRP and the median DDM MRP, with a one-third weight to the market indicators MRP and two-thirds weight to the median DDM MRP.

5.6 Re-estimating equity betas at each price review

For a listed firm, it is possible to measure the equity beta directly, by calculating the historical correlation between the firm's returns and the returns to the stock market overall. However, most of the businesses we regulate are not listed. In addition, our approach is to determine the WACC for a benchmark firm, not the actual regulated firm, because the actual firm might have an inefficient capital structure or borrowing arrangements (see Chapter 3). The benchmark firm operates in a competitive market but otherwise faces similar risks to the firm that we regulate.

Therefore, to estimate the equity beta, we select a group of listed companies that face similar risks to the regulated firm (or industry) as proxies. For each company in this group, we estimate the equity beta using market model regression and derive an asset beta (ie, de-levered beta) using its gearing ratio.

After considering the asset betas across the set of proxy firms, we then decide on an appropriate asset beta for the regulated business and use our benchmark gearing level to re-lever the asset beta to the final equity beta.

Currently, we review the equity beta each time we estimate a WACC for a business. For utilities that we periodically set prices for, we consider whether our existing estimates remain appropriate, in light of updated market data and having regard to other regulators' recent WACC decisions. We review the market evidence on gearing levels for proxy firms at the same time that we review the equity beta, as we need both to estimate asset betas and these form part of our analysis of systematic risk.

5.6.1 Stakeholder expressed mixed views on re-estimating equity betas

SDP agreed we should re-estimate equity beta at each price review, but suggested that we:

> Should use the broadest sample of comparators and longest estimation period possible; and
>
> Should change its beta estimate only if there is compelling evidence to do so – in view of the significant challenges in estimating betas precisely.[121]

WaterNSW submitted that we should review the appropriate equity beta outside of price reviews. It suggested that this would provide regulated utilities "with more certainty on

121 SDP submission to IPART Issues Paper, August 2017, p 14.

these parameters ahead of price-review submissions, and enhance the predictability and transparency of the IPART regulatory process".[122] Nevertheless, it also considered that:

> … both IPART and the regulated entity should still be able to submit a case for different parameters at the time of an individual price review, if there are strong grounds. This is important to ensure there is an opportunity for re-estimation in the event of significant market changes between the prior review and the time of the price submission.[123]

Hunter Water submitted that it would prefer us to provide regulated utilities with advance notice of the equity beta estimate prior to the commencement of each price review:

> Early notice would enable the utility to more accurately model likely revenue requirements, assess customer bill impacts and conduct financeability assessments. This would improve the robustness of price submissions and pricing proposals. Alternatively, a review or a sense check of the equity beta could occur on a periodic basis or in response to significant economic events.[124]

Sydney Water did not support re-estimation of betas at each price review, suggesting that re-estimation should occur "only after a significant structural change in financial markets" such as the GFC.[125] It put the view that "re-estimation of the equity beta at each price review may increase the volatility in IPART's regulatory WACC estimates unnecessarily".[126]

5.6.2 Our draft decision is to re-estimate equity betas at each review but not necessarily change the equity beta in our WACC calculations

We consider that, at each price review, we should take the opportunity to employ new market data on equity beta, if it becomes available. That is not to say that we would automatically change the equity beta that we use in WACC calculations. We are mindful of the estimation difficulties noted by SDP, and agree with its suggestion only to change the equity beta estimate if there is sufficient evidence. We consider that this approach is compatible with Sydney Water's view that the equity beta should only be revisited after a significant change.

We do not agree with WaterNSW's suggestion to undertake beta analysis outside of price reviews. As it noted, this would not remove the need to examine beta at each price review, so it may not provide certainty. There is also a risk that an equity beta analysis outside a price review may not achieve a sufficient level of stakeholder engagement since any application of that equity beta would be some time away.

Draft Decision

19 Continue to re-estimate equity betas at each price review to inform our assessment of whether the existing estimates remain appropriate.

122 WaterNSW submission to IPART Issues Paper, August 2017, p 10.
123 Ibid.
124 Hunter Water submission to IPART Issues Paper, August 2017, p 8.
125 Sydney Water submission to IPART Issues Paper, August 2017, p 6.
126 Ibid.

5.7 Using a broad selection of proxy companies to estimate the equity beta

One of the main weaknesses of our current approach for estimating the equity beta is that the selected proxy companies may not represent a benchmark firm well, leading to an inaccurate estimate. Often, the type of regulated industry will dictate the range of proxy firms available.

We also need to consider several statistical issues. To get valid estimates of beta, we need to have a sufficient number of market observations. We can increase the number of observations by including a larger number of proxy firms, or by examining a smaller number of firms over a longer period of time, or both. Each approach has drawbacks:

- To examine more firms, we may need to include firms that do not face sufficiently similar risks to the firm in question.
- To examine the same number of firms over a longer time period, we may need to not exclude periods where market behaviour was not sufficiently similar to the expected future market performance (for example, periods such as the GFC).

5.7.1 Stakeholders supported using a broader sample, but cautioned about the 'validity' of additional firms

Frontier Economics, on behalf of SDP, made specific suggestions on how to improve our selection of proxy firms. Frontier noted the trade-off between the comparability of proxy firms and the statistical reliability of the equity beta estimates. Of the two broad approaches (broadest possible sample or more selective sample), it preferred the broad sample method because it is:

- more objective
- more likely to yield statistically reliable estimates, and
- more resistant to problems caused by companies dropping out of the sample over time (for example, because they become de-listed).[127]

Frontier suggested that if we move to the broad sample method, we should exclude from the sample thinly traded stocks because their beta estimates are likely to be distorted by the small sample of trades.[128] It suggested the Amihud measure for testing the degree of illiquidity (hence thinness of trading in that stock).[129] In simple terms, this measure is the daily ratio of absolute stock return to its dollar volume, averaged over a relevant time period.

PIAC's submission stressed the importance of what they called 'validity', meaning relevant proxy firms, over and above statistical reliability, which refers to larger sample sizes.[130] PIAC submitted that:

> Simply adding more entities to the sample may make the data more statistically unreliable but may also make the comparison less valid.[131]

127 Frontier Economics, *Review of WACC method: response to IPART Issues Paper: A Report Prepared for Sydney Desalination Plant*, August 2017, p 39.
128 Ibid, p 39.
129 Ibid, pp 39-40.
130 PIAC submission to IPART Issue Paper, August 2017, p 2

5.7.2 Our draft decision is to use a broad selection of proxy companies, but exclude thinly traded stocks

We consider Frontier's suggestions are practical and useful and propose to adopt them. We note that the Amihud measure is a rough measure of the price impact of one dollar of trading volume. While there measures of illiquidity that are more precise in theory, such as the bid-ask spread, they require a lot of microstructure data that is often unavailable or difficult to obtain.[132] For our purpose, a simple measure such as the Amihud measure is appropriate.

We agree with PIAC that proxy firms should be relevant. It is usually difficult to find proxies that closely match the regulated firm's risk profile. Therefore, from a practical point of view it is usually necessary to select a broader sample of proxy firms and rely on statistical methods to separate the 'noise' from the relevant data.

There are additional difficulties to the empirical estimation of equity beta. The main data sources that regulators in Australia use for equity beta estimation are Bloomberg and Thomson Reuters. These sources provide raw data (stock prices and indices for the regression analysis) as well as published beta estimates. The published equity beta estimates reflect analyst-specific methodology choices, and can vary considerably. Some of these methodology choices are not always easy to replicate. For this reason, it is more common for regulators to do their own regression analysis using raw data.

Unless the regression analysis uses daily data, it is necessary to select weekly or monthly returns, which means we must choose a reference day (eg, Monday for weekly returns or the first day of the month). The chosen reference day can make a material difference to the estimate, so we must take care in selecting it.

Draft Decision

20 Use the broadest possible selection of proxy companies to estimate equity beta, but exclude thinly traded stocks.

5.8 Modifying our approach for adjusting equity betas

Several studies in finance literature have found equity betas obtained from ordinary least squares (OLS) regression analysis are likely to be subject to a high degree of estimation bias due to sampling error. To mitigate this bias, regulators commonly adjust for this bias using the Vasicek (1973) and Blume (1975) methods:

- The Blume technique adjusts for bias in individual securities by placing two-thirds of weight to the OLS equity beta and a third to an equity beta of one.[133]
- Vasicek adjusts the OLS equity betas towards the best prior beta estimate with the degree of adjustment based on the standard error of the OLS estimates. OLS estimates that have lower (higher) standard errors get more (less) weight.[134]

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131 Ibid.

132 Amihud, Y, *Illiquidity and stock returns: cross-section and time-series effects*, Journal of Financial Markets, Volume 5, 2002, pp 31-56.

133 Blume, M, *Betas and Their Regression Tendencies*, Journal of Finance, Vol. 30, No. 2, June 1972, pp 785-795.

In some of our recent WACC decisions we have made a judgement about the appropriate equity beta considering the OLS beta with no adjustments, the Blume-adjusted and Vasicek-adjusted equity betas.

5.8.1 Some stakeholders supported continuation of current approach, while others supported using the Vasicek method only

Frontier Economics, on behalf of SDP, agreed with the continued use of the three versions of beta: raw, Blume adjusted and Vasicek adjusted.[135]

Hunter Water expressed support for the 2013 method, but also saw merit in the Vasicek adjustment. It noted that this approach allows for transparent and objective adjustment of OLS estimates with a high standard error.[136]

Sydney Water supported the Vasicek adjustment.[137] In addition, at our public hearing, Dr Reddick from TCorp proposed that we move to using the Vasicek adjustment only, as TCorp considers "it has a little more science around it than the other adjustment".[138]

5.8.2 Our draft decision is to use the Vasicek adjustment only

We have decided to continue to use the Vasicek adjustment, but to discontinue the Blume adjustment. The reason for discontinuing the Blume adjustment is that it is an automatic, formulaic and arbitrary adjustment to an equity beta estimated from proxy company data. We also agree with stakeholders that the Vasicek adjustment is preferable because it relies on firm-specific information to make adjustments to the empirical results.

Draft Decision

21 Determine the appropriate equity beta having regard to equity betas calculated using the OLS method with the Vasicek adjustment.

134 Vasicek, O.A, *A Note on Using Cross-Sectional Information in Bayesian Estimation of Security Betas*, Journal of Finance, Vol. 28, No. 5, December 1973, pp 1233-1239.
135 Frontier Economics, *Review of WACC method: response to IPART Issues Paper: A Report Prepared for Sydney Desalination Plant*, August 2017, p 40.
136 Hunter Water submission to IPART Issues Paper, August 2017, p A.5.
137 Sydney Water submission to IPART Issues Paper, August 2017, p 15.
138 IPART public hearing transcript, August 2017, p 17.

6 Combining measurements to derive the WACC

Once we have estimated the cost of debt and equity (as outlined in Chapters 4 and 5), we have four measurements – our estimates of the:

- current and historical cost of debt, and
- current and historical cost of equity.

We currently calculate a single cost of debt by combining the current and historical costs, and then do the same for equity. We then combine our debt and equity costs according to the gearing ratio of the benchmark entity.

In normal market circumstances, we take a simple average of the current and historical measurements for both the cost of debt and the cost of equity. This is referred to as the midpoint approach. We consider that the market is in a normal state when our uncertainty index is at, or within one standard deviation of, its long run average value of zero:

- When the market is in a normal state, our decision rule is to apply the midpoint approach.
- When the market is not in a normal state, we use our discretion to decide how these data are combined.

We review the gearing ratio each time we estimate the WACC for a business, but do not necessarily change it.

For this review, we considered whether we should make incremental improvements to this approach – including: how we construct our uncertainty index and define our decision rule; what we do when our uncertainty index is outside the normal range; and, when and how we review the gearing ratio. The sections below outline our draft decisions then discuss each decision in detail.

6.1 Overview of draft decisions

We have decided to maintain our approach to how we construct our uncertainty index and apply our decision rule, in line with stakeholder feedback.

We have also decided that, when the uncertainty index is outside of the normal range, we will continue to use our discretion to decide how the current and historical data are combined, and consult with stakeholders before making our decision.

In addition, we have decided we will continue to review the gearing of the benchmark entity at each price review. However, as for the equity beta, we would only revisit the gearing we use in our WACC calculations where there is sufficient evidence to support this.

6.2 Maintaining our 2013 method of constructing the uncertainty index

Our uncertainty index aims to capture changes in the level of uncertainty about future economic conditions. We estimate the uncertainty index using principal component analysis (PCA), extracting a single time series variable which proxies the level of economic uncertainty in Australia from four financial variables. This approach closely follows the approach taken by the Bank of England.[139] It involves analysing data for the following four variables:

- implied volatility of annual ASX 200 returns
- dispersion in analysts' forecasts of ASX 200 returns
- the credit spread between investment-grade corporate bonds and Australian Government bonds, and
- the spread between 90-day bank bill swap rates and 3-month overnight index swaps (OIS).

We assume that changes in economic uncertainty in Australia are reflected in similar movements in these four variables. The PCA identifies common trends in data and expresses it in a way that highlights changes in these trends over time. Using this method we combine the four variables and extract a single variable that explains most of the variation in the original set of four proxy variables (this is known as the first principal component). This gives us a single time series that shows how the level of economic uncertainty has tracked against its historical average over time (see Appendix B).

Stakeholders generally supported our 2013 method of constructing the uncertainty index. For example, WaterNSW submitted:

> We consider the uncertainty index to be a transparent and logical approach to making adjustments to the WACC.[140]

Hunter Water noted that:

> …IPART's uncertainty index would act as a safety valve during extreme or unusual events that materially affect financial decisions.[141]

We have decided to maintain the 2013 method of constructing the index at this time as it is working well and promotes certainty.

Draft Decision

22 Maintain our 2013 method of constructing the uncertainty index.

6.3 Maintaining our current decision rule

As noted above, we currently consider that market circumstances are normal when our uncertainty index is at, or within one standard deviation of, its historical (since mid-2001) average of zero. In our Issues Paper, we raised two questions about this approach:

139 Bank of England, *Macroeconomic uncertainty: what is it, how can we measure it and why does it matter?*, Quarterly Bulletin, June 2013, vol. 53, issue 2, pp 103-104.
140 WaterNSW submission to IPART Issues Paper, August 2017, p 12.
141 Hunter Water submission to IPART Issues Paper, August 2017, p 9.

1. whether our current one standard deviation threshold is appropriate, and
2. whether the decision rule should be applied to a fixed period of time – such as the last 10 years of uncertainty index data.

Sydney Water considered our current one standard deviation threshold to be a transparent and logical approach.[142] Hunter Water acknowledged that:

> IPART's analysis of the uncertainty index in the issues paper shows the index exceeding the threshold during the global financial crisis and a seven month period in 2011, while going close to the threshold at other times. This appears reasonable with the benefit of hindsight. While supportive of the uncertainty index, Hunter Water is not convinced that there is a strong case for narrowing the current threshold.[143]

Our analysis also suggests the current sensitivity of the decision rule is appropriate. As Figure 6.1 below shows, the threshold of one standard deviation from the long-term (mid-2001) mean would have identified historic periods of heightened economic uncertainty. These periods include most of 2008-09 corresponding to the global financial crisis (GFC), as well as a seven-month period beginning in late-2011, corresponding to the Eurozone crisis. This indicates that it is functioning as intended. If we applied a tighter threshold, we would deviate from the midpoint more often. While it is difficult to determine exactly what periods are normal, a tighter threshold may pinpoint 'normal' periods of fluctuation as being abnormal conditions.

Likewise, while applying the decision rule to a fixed window could reflect periods with more similar structural conditions, the choice of time period is subjective and limiting it could reduce the amount of information used to apply the decision rule. We consider that the more information that is included in the calculation of the uncertainty index, the greater its ability to predict genuine out-of-range periods.

Draft Decision

23 Maintain our 2013 method decision rule.

6.4 Maintaining our discretion to consult on out-of-range situations

If the uncertainty index is more than one standard deviation from its historical average, our current approach is to exercise our discretion about whether to move from the midpoint. In exercising that discretion, we consider the value of the uncertainty index and financial market information including:

- debt and equity transaction data
- interest rate swap curves
- equity analyst reports, and
- independent expert reports.

We currently provide no formal guidance as to how we might exercise discretion when the uncertainty index indicates a period of high market volatility.

142 Sydney Water submission to IPART Issues Paper, August 2017, p 6.
143 Hunter Water submission to IPART Issues Paper, August 2017, p 9.

6.4.1 Stakeholders requested guidance on how we would apply discretion

WaterNSW stated that we should not retain discretion to adjust weightings of current and historical market data without providing sufficient transition opportunity for a regulated entity to replicate the debt maturity profile in response to the adjustment.[144] However, Sydney Water supported us maintaining discretion so long as we specify and apply a consultative, consistent and transparent framework for exercising such judgement.[145]

SDP requested that we explain what our response would have been in past instances where the uncertainty index moved outside the range of one standard deviation. It also contended that any movement in the index within a regulatory period should not lead to a reopening of an existing determination.[146]

6.4.2 We do not consider it is possible to provide general guidance

During periods of high market volatility, such as the GFC, important variables like the risk-free rate, the debt margin and the MRP can move far from historical average values. To capture the market conditions facing regulated firms, there is an argument that greater weight should be given to current measurements in such periods.

However, if market conditions change rapidly, there is also a risk that current estimates are more unreliable than historical average estimates. That consideration suggests giving greater weight to the historical measurements in volatile periods.

If a regulator was of the view that the conditions were likely to be transient, then the current estimates may not reflect the likely conditions over the regulatory period.

Box 6.1 discusses how we might have handled the GFC if our decision rule was in place. We consider this demonstrates the need to evaluate each episode of volatility on its particular features based on the information available at the time. Without knowing what is driving an out-of-range uncertainty index result, it is not possible to predict how a prudent utility would respond. For this reason, it is not possible to give general guidance on what we might do in such a situation.

Given the conflicting possibilities, we have decided to retain the discretion to modify the decision rule in light of market information at the time. In such a situation, we would consult with stakeholders at the time.

Draft Decision

24 Continue to use our discretion to determine the appropriate weighting of current and historical average market data when the market is in an abnormal state, and to consult with stakeholders before we make our decisions.

144 WaterNSW submission to IPART Issues Paper, August 2017, p 12.
145 Sydney Water submission to IPART Issues Paper, August 2017, pp 6-7.
146 SDP submission to IPART Issues Paper, August 2017, p 7.

Box 6.1 How would we have handled the GFC?

We now know that the GFC was a transient event for Australian financial markets. Had utilities known this, they may have refrained from refinancing, to the extent possible, while interest rates were high. Where they could not avoid refinancing tranches of debt, they may have rolled these over for the shortest tenor, to avoid locking in high rates for a long period.

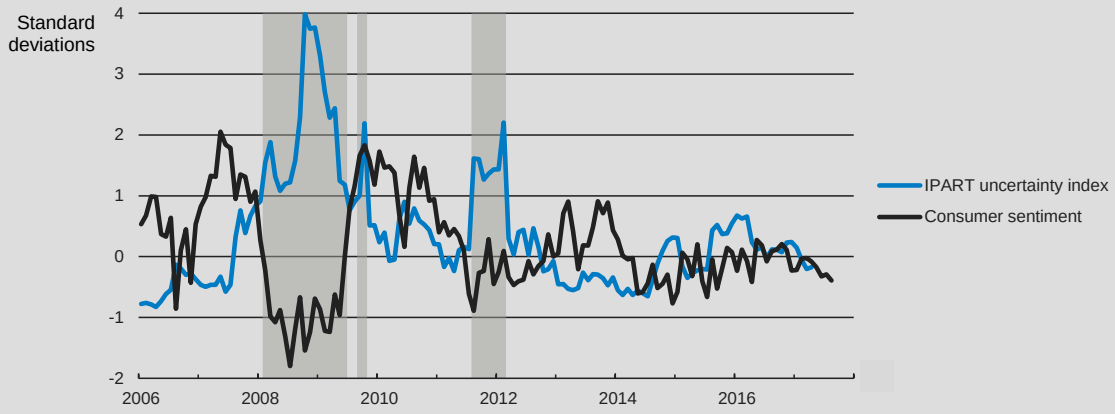
In that situation, it may have been appropriate to give more weight to the historic interest rate. However, the regulated businesses did not know that it was transient and neither did we.

An analysis of historical data suggests:

- an increase in the uncertainty index may be correlated with weak economic conditions
- when the uncertainty index is elevated, the current estimate of the WACC has been higher than the historical average, and
- if financial markets are relatively illiquid, current estimates may not reflect actual market conditions.

Figure 6.1 plots our uncertainty index and the Westpac Melbourne Institute measure of consumer sentiment over the period including the GFC. In the periods where the uncertainty index was more than one standard deviation above its long-term average (shaded grey), consumer sentiment was below its long-term average. In other words, when financial market volatility is high, consumers' confidence about the economy and their finances tends to be low.

Figure 6.1 IPART uncertainty index and consumer sentiment

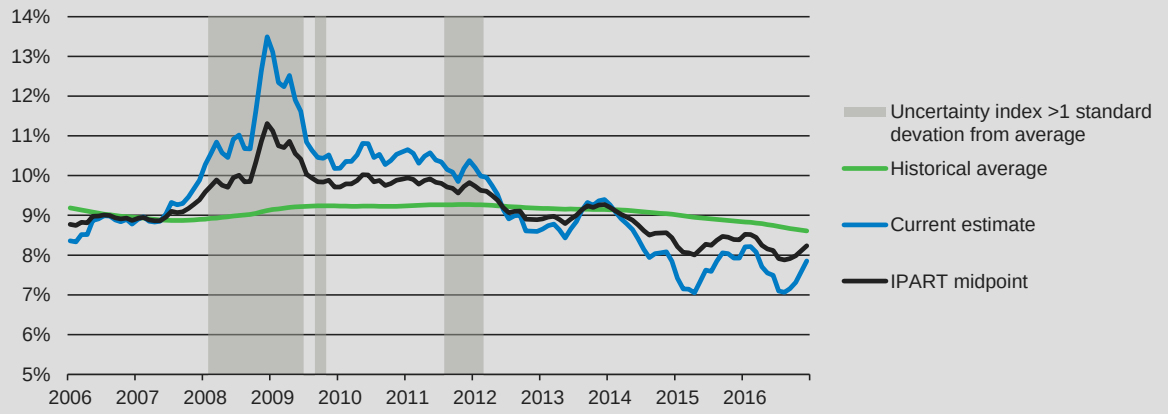


Note: Consumer sentiment is measured using "The Westpac Melbourne Institute Index of Consumer Sentiment" Index. We plotted the deviation in this index from its neutral sentiment. A higher number indicates more positive consumer sentiment.
Data source: Bloomberg; The Westpac Melbourne Institute Index of Consumer Sentiment; IPART analysis.

This suggests that we may have needed to be mindful of the impact of a higher WACC on consumers' ability to pay and the social impact of our decision. It also suggests that in periods of high volatility, investment opportunities may be scarce compared to when consumer sentiment is high.

Figure 6.2 shows that during the GFC, the current WACC estimate was 1-2 % above our midpoint.

Figure 6.2 Nominal vanilla WACC estimates and the uncertainty index (%)

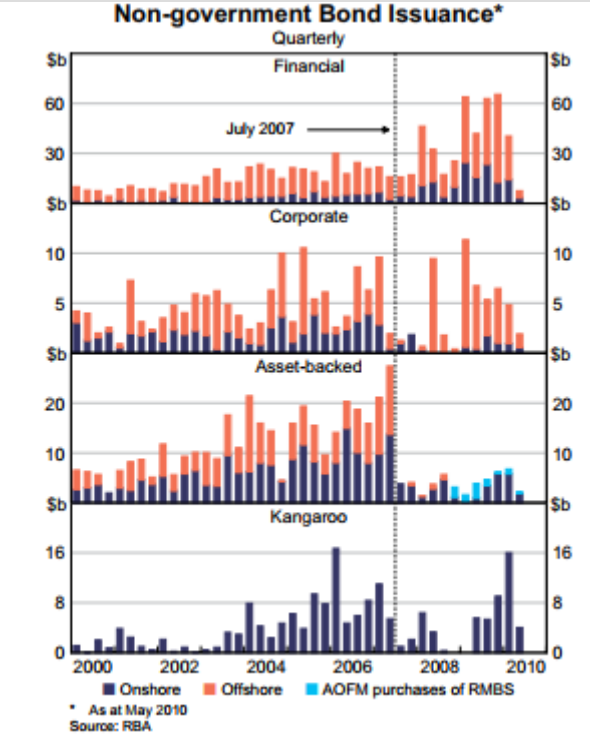


Note: The WACC estimates in this chart assume a 60% gearing ratio and an equity beta of 1.
Data source: IPART analysis.

When financial conditions are volatile, liquidity in debt and equity markets may fall, particularly in corporate bond markets. For example, we might be able to observe the debt margin, but a firm might not be able to issue debt at this time due to lack of investors.

Figure 6.3 plots non-government bond issuance during the GFC. It shows that while the average level of debt issuance remained fairly robust during the GFC period, issuance patterns were far more sporadic compared to pre-crisis conditions.

Figure 6.3 Non-government bond issuance during the GFC (A$b)



Data source: RBA.

This suggests:

- the current estimate of the WACC may not always reflect debt raising costs incurred by firms during periods of financial stress, and
- firms avoid issuing debt and equity when these costs are at their highest, which would tend to reduce their average cost of capital.

6.5 Reviewing the gearing ratio

Our current approach is to review the gearing ratio each time we estimate the WACC for a business, considering updated market data and decisions made by other regulators. In practice, the gearing ratio should be stable over time, particularly as most firms we regulate operate a stable base of historical assets. On the other hand, the efficient gearing ratio for a benchmark firm could change over time, for example, if there are changes in investor preferences, tax reforms or other policy changes.

6.5.1 Stakeholders had mixed views about how and when to review gearing

Sydney Water stated that "gearing should only be reviewed if there are obvious structural changes within Australia that would bring about the need to assess gearing".[147] It noted that if gearing was reviewed at each price review, because the review was largely based on proxy international firms, it may "import structural changes and unnecessary instability that may not be representative of the Australian experience".[148] However, it contended that if gearing were to be reviewed periodically, "it is critical that such reviews are conducted sufficiently prior to each firm's price review to enable timely utility modelling and sound business plans to be developed and submitted".[149]

WaterNSW stated that the appropriate time to review gearing would be between price reviews, following selection of appropriate proxy companies.[150]

SDP supported our preliminary view to maintain our current approach, but submitted that we should use: the capital structure of the benchmark firm; have regard to other regulatory decisions; and, only change our determination of the benchmark gearing if there is sufficient evidence to do so.[151]

6.5.2 Our draft decision is to continue to review gearing at each price review

Overall, we consider that a periodic review (every 3-5 years) of gearing is good practice and that we should review the gearing of the benchmark entity at the same time that we review the equity beta. Both of these reviews would rely on the same proxy firm analysis.

We consider that given the stakeholder administration and consultation involved, it would be pragmatic to do it within a price review (which generally occurs every 4-5 years).

147 Sydney Water submission to IPART Issues Paper, August 2017, p 16
148 Ibid, p 17.
149 Ibid, p 7.
150 WaterNSW submission to IPART Issues Paper, August 2017, p 12.
151 SDP submission to IPART Issues Paper, August 2017, p 6.

However, taking into account stakeholders' views, we propose to undertake this analysis earlier in the review process so that our proxy firm selection, gearing and beta analysis could be included at the issues paper stage. This would give stakeholders more time to consider our analysis and respond before we proceed with our draft decisions, which would be based on the results.

As for the equity beta, we would not automatically change the gearing we use in WACC calculations in line with the results of a periodic review. Rather, we would adjust it only if there were sufficient evidence.

Draft Decision

25 Continue to re-estimate the gearing of the benchmark entity at each price review to inform our assessment of whether the existing estimates remain appropriate.

7 Measuring inflation and gamma

Under our 2013 method for setting the WACC, we first measure the cost of debt and equity in nominal terms. Therefore, in line with our policy of setting and applying a real post-tax WACC, we need to adjust these nominal measurements by inflation to derive a real WACC.

Since December 2014, we have applied a single, forward-looking inflation forecast to both the current and historical costs. This forecast is the expected rate of inflation over the next 10 years, which we calculate as the geometric average of:

- a current 1-year forecast based on quarterly data from the RBA's Statement of Monetary Policy, and
- the middle of the RBA's target band for inflation (2.5%) for Years 2 to 10.

In this review, we have considered: what period over which we forecast inflation; whether we continue to estimate inflation using a geometric average method or use a breakeven inflation method; and whether we should change our approach for calculating the geometric average.

Another aspect of the impact of taxation on the WACC is the imputation credit factor, gamma. We current assume that gamma has a value of 0.25, and have consider whether this remains appropriate.

The sections below provide an overview of our draft decisions on inflation and gamma, and then discuss them in more detail.

7.1 Overview of draft decisions

We will continue to set a real post-tax WACC by adjusting our nominal cost estimates for inflation. However, we have decided to make some modifications to our current approach for this adjustment.

We will adjust both current and historical cost inputs by the expected rate of inflation over the regulatory period instead of the next 10 years. We consider this will reduce the risk under our current approach that, at different points in the economic cycle, we over- or under-estimate inflation.

We will continue to use a geometric average method to calculate this rate of inflation because, despite the in-principle benefits of using the break-even inflation method, as our analysis indicates that currently there is not a convincing case for change. However, we will make two small modifications to the way we apply the method:

- We will calculate expected inflation as the geometric average of the **change in the level of prices** (rather than the **inflation rate**).

- We will define the 1-year ahead RBA forecast as the inflation forecast in the RBA's most recently issued Statement of Monetary Policy that is closest to 12 months ahead of the start of the regulatory period.

We have also decided to continue to use 0.25 as the value of gamma.

7.2 Setting a real post-tax WACC

As Chapter 2 discussed, in this review we are not considering broader policy issues related to how we apply the WACC in this review. We will continue to apply a real post-tax WACC.

The post-tax framework avoids overcompensating firms who, in practice, tend to pay less than the statutory rate of tax. In many cases, the post-tax framework provides a more accurate estimate of the revenue that regulated businesses require to meet their tax obligations. This is consistent with the approach taken by many other Australian regulators, including the ACCC and AER (see Appendix A). We intend to review the way that we apply the post-tax framework in the building block model in 2018.

By applying a real WACC to a RAB that we index for inflation, we ensure that inflation is accounted for only once. Indexing the RAB for inflation affects the price path and hence, the business' cash flow, even though it is net present value (NPV) neutral over the life of the assets. That is because the decision to capitalise inflation alters the RAB and cash flow profile over time. Our financeability test allows us to examine whether the cash flows allow the business to remain financially viable.

7.3 Adjusting for expected inflation over the regulatory period

As noted above, we currently deflate our nominal WACC inputs by applying a single, forward-looking rate that is the expected rate of inflation over the next 10 years, regardless of the length of the regulatory period. In our Issues Paper, we expressed a preliminary view to continue to use a 10-year forward-looking inflation rate for this adjustment.

7.3.1 Stakeholders suggested alternative approaches

Stakeholders expressed a range of views on this question. For example, Sydney Water did not agree with our preliminary view, and stated that we should "use a best estimate of expected inflation over the regulatory period instead of using long-term inflation expectations".[152] It also noted our current approach, which is an estimate of long-term inflation expectations, might be "problematic when long-term inflation expectations differ substantially from forecast inflation over the regulatory period".[153]

In contrast, NSW Treasury proposed that we calculate inflation on the same basis that the risk-free rate is calculated.[154] For example, if we set the WACC as the midpoint of a current estimate and a historical average over the past 10 years, we should deflate the WACC by a

152 Sydney Water submission to IPART Issues Paper, August 2017, p 7.
153 Ibid.
154 NSW Treasury submission to IPART Issues Paper, August 2017, p 5.

midpoint of a current and a historical estimate of inflation. In particular, deflating the historical estimate of the WACC by a historical estimate of inflation, would reflect the real cost of finance at the time that debt, or equity, was issued.

7.3.2 Our draft decision is in line with Sydney Water's view

We agree with Sydney Water's view, including its concern about our current approach. A 10-year geometric average, with a 2.5% inflation rate for nine out of the 10 years, would produce an inflation estimate that is very close to 2.5%. Therefore, at different points in the economic cycle, there is a risk that our current approach would over- or under-estimate actual inflation.

We do not agree with Treasury's view. We consider a forward-looking inflation forecast over the regulatory period is the appropriate measure to deflate the nominal WACC. This is because the real WACC should reflect an efficient firm's expected real cost of capital over a regulatory period. Even though the nominal cost of capital might reflect a mix of current and historical debt and equity costs, it is the forward-looking inflation over the regulatory period that matters. It would determine how that nominal cost of capital is converted to real terms.

We note that our draft decision could mean we use a slightly different inflation rate in two concurrent reviews, if we decide to set a different regulatory period for the businesses concerned.

Draft Decision

26 In converting our nominal WACC inputs into real terms, adjust them by the expected rate of inflation over the regulatory period.

7.4 Using a geometric average method to calculate expected inflation

We currently calculate the expected inflation rate as the geometric average of the midpoint of the RBA's 1-year ahead inflation forecast and the midpoint of the RBA's target inflation band. However, we have previously used the break-even inflation method (BEI method).

The BEI method estimates inflation as the difference between the yield on an inflation linked bond and a nominal bond of equivalent maturity (implied by the Fisher equation below), to calculate expected inflation as the rate of inflation that would make an investor indifferent between the two bonds:

(17) $$(1 + i) \equiv (1 + r) \times (1 + \pi_e)$$

where:

- i is the yield on the nominal bond
- r is the yield on the inflation linked bond, and
- π_e is the expected inflation rate.

Rearranging, the inflation rate under the BEI method is:

(18) $$\pi_e = \left(\frac{1+i}{1+r}\right) - 1$$

In May 2009, we moved away from the BEI method, in part, due to concerns about the breadth of liquidity in the inflation-linked bond market.

The AER currently estimates inflation using a geometric average approach, forecasting inflation as the geometric average of:

- 1-year and 2-year forecasts based on quarterly data from the RBA's Statement of Monetary Policy, and
- the middle of the RBA's target (2.5%) for Years 3 to 10.

The AER is currently reviewing its approach to inflation. In its preliminary position paper, the AER expressed a preference to estimate inflation using a geometric average method over other methods including the BEI method because, in its view, it "has the greatest strengths and fewest weaknesses". [155]

7.4.1 Some stakeholders supported moving to the BEI method

Sydney Water and SDP expressed some support for continuing to use a geometric average method.[156] However, WaterNSW and Hunter Water encouraged us to consider the BEI method.[157] NSW Treasury strongly supported moving to the BEI method. NSW Treasury preferred the BEI method because, in its view:

- this method reflects the current market expectation of future inflation which feed directly into the price of debt at the time of the measurement
- RBA forecasts of inflation are only updated quarterly, and
- other regulators, including OFGEM and ORR in the UK, use BEI method.[158]

NSW Treasury also provided evidence that previous concerns with BEI method are no longer as acute:

- The depth and liquidity of inflation-linked bond markets have improved significantly in recent years, with investor demand, bond issuance and turnover data increasing significantly in recent years. In addition, the Australian Office of Financial Management (AOFM) – which is responsible for issuing inflation-linked bonds – has committed to maintaining an inflation-linked bond market.
- Inflation and liquidity premia are likely to have fallen in line with the increase in the size of the inflation-linked bond market.

155 AER, *Regulatory treatment of inflation*, *Preliminary position*, October 2017, p 12.
156 Sydney Water submission to IPART Issues Paper, August 2017, p 18 and SDP submission to IPART Issues Paper, August 2017, pp 42-43.
157 WaterNSW submission to IPART Issues Paper, August 2017, p 13 and Hunter Water submission to IPART Issues Paper, August 2017, p 10.
158 NSW Treasury submission to IPART Issues Paper, August 2017, p 6.

7.4.2 Results of our analysis of the two methods were not definitive

We have analysed the BEI method and the geometric average method to consider the points it raised. In particular, we compared two methods using four criteria:

- economic theory
- reliability of market data
- accuracy of historical forecasts, and
- simplicity, transparency and replicability.

We found that, overall, that there was not a sufficient case to change from a geometric average method to the BEI method.

Economic theory would suggest the BEI method is superior

In theory, the BEI method is superior to a geometric average approach, because it is the expected inflation rate that would make an investor indifferent between an inflation-linked bond and a nominal bond of the same maturity.

There is less reason to expect that the geometric average of RBA's 1-year ahead inflation forecast, and the midpoint of its inflation target, would be the best inflation forecast. The RBA's stated inflation target:

> …seeks to keep consumer price inflation in the economy to 2–3 per cent, on average, over the medium term.

While the RBA has found that its short-term forecasts of inflation have "substantial explanatory power", the RBA's inflation target is a range over the medium term.[159] It does not imply that an inflation forecast should be 2.5% after the first year of a specific regulatory period.

The BEI method may be affected by risk premia. Two potential risk premia are liquidity risk and inflation risk.

Liquidity risk reflects any additional yield investors require to hold an illiquid investment, over a more liquid investment. The size and depth of the nominal bond market is many times larger than the inflation-linked bond market in Australia. The yield on inflation-linked bonds may be upwardly biased relative to the yield on a nominal bond of the same maturity, reflecting the additional compensation investors require to hold inflation-linked bonds. Therefore, liquidity risk would tend to result in a downwards bias to the estimate of inflation under the BEI method.

Inflation risk is the compensation that investors require for bearing the risk of lower- or higher-than-expected inflation. This affects the yield of a nominal bond, as its real return is affected by inflation. In general, inflation risk would increase as uncertainty about future inflation increases, although recent evidence also suggests that the risk of deflation can

159 Peter Tulip and Stephanie Wallace, *Estimates of Uncertainty around the RBA's Forecasts*, RBA Research Discussion Paper, November 2012, p 2.

result in a negative inflation risk premium (as nominal bonds perform relatively well in a deflationary environment).[160]

A number of studies have found that inflation risk can vary over time, including research by the RBA,[161] updated in 2016,[162] which suggests inflation estimates using the BEI method may be affected by inflation risk. That said, the authors of the RBA research also emphasised caution over the results due to data limitations and model complexity.

The accuracy of the BEI method would be negatively affected to the extent that the risk premium embedded in the BEI method varies at different points in the economic cycle. In its ongoing review of inflation, the AER provided a full list of the risk premia that the BEI method may potentially be affected by.[163]

Current concerns about reliability of market data due to bond liquidity do not appear to be acute

Illiquidity in the inflation-linked bond market was a factor in our 2009 decision to move away from the BEI method. Illiquidity implies that market prices are not reliable. Our analysis for this review suggests that inflation-linked bond liquidity is currently lower than liquidity in the nominal bond market. However, we consider that bond market liquidity is currently:

- sufficient, if judgement is applied, to produce an estimate of inflation using the BEI method for 3-5 year regulatory period, and
- not appropriate for shorter regulatory windows.

Figure 7.1 suggests that although inflation-linked bond turnover has increased, it is around 5% of nominal bond turnover. This suggests that the BEI method may still be affected by liquidity premium, which all else equal, would mean the BEI method underestimates expected inflation.

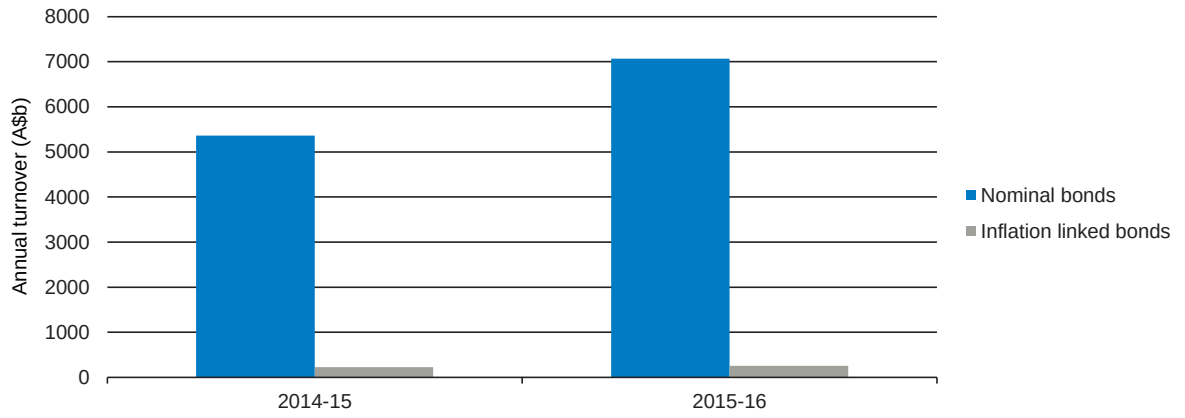
160 See, for example, Gonzalo Camba-Mendez and Thomas Werner, *The inflation risk premium in the post-Lehman period*, ECB Working Paper Series no. 2033, March 2017.

161 Richard Finlay and Sebastian Wende, *Estimating Inflation Expectations with a Limited Number of Inflation-indexed Bonds,* RBA Research Discussion Paper, March 2011.

162 Angus Moore, *Measures of Inflation Expectations in Australia,* RBA Bulletin, December Quarter 2016, pp 23-32.

163 AER, *Regulatory treatment of inflation, Preliminary position*, October 2017, Table 6, pp 55-57.

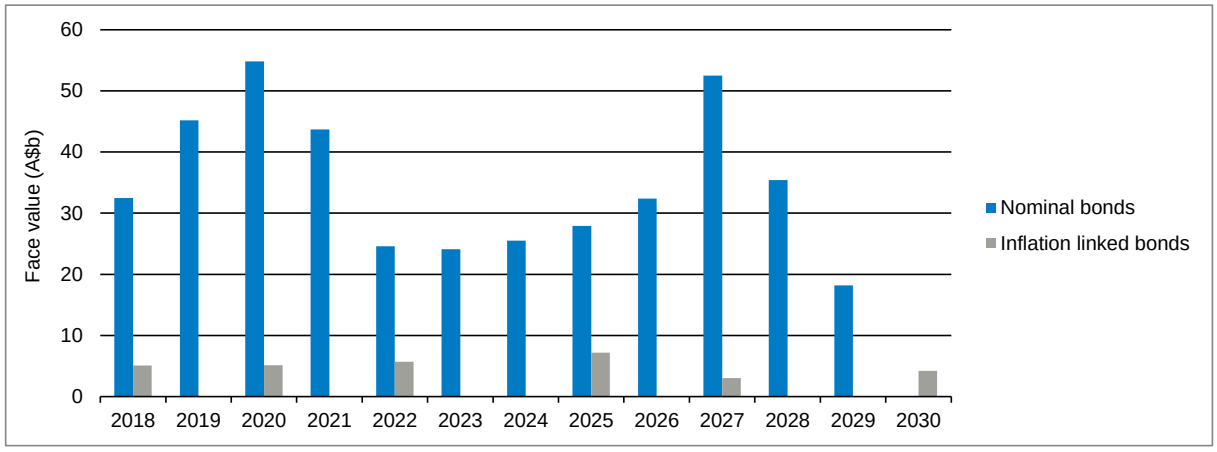
Figure 7.1 Annual turnover in Australian Government Bonds ($b)



Data source: Austraclear

While inflation-linked bond issuance has increased significantly, from around $6 billion in June 2009 to $30 billion as at June 2016, Figure 7.2 shows that the maturity dates of inflation-linked bonds are more sporadic than for nominal bonds. The AOFM has issued bonds so that a nominal bond matures in each year to 2029, and an inflation linked bond matures every 2-3 years.

Figure 7.2 Australian government bond maturities (A$b)



Data source: Australian Office of Financial Management, data as at 25 August 2017.

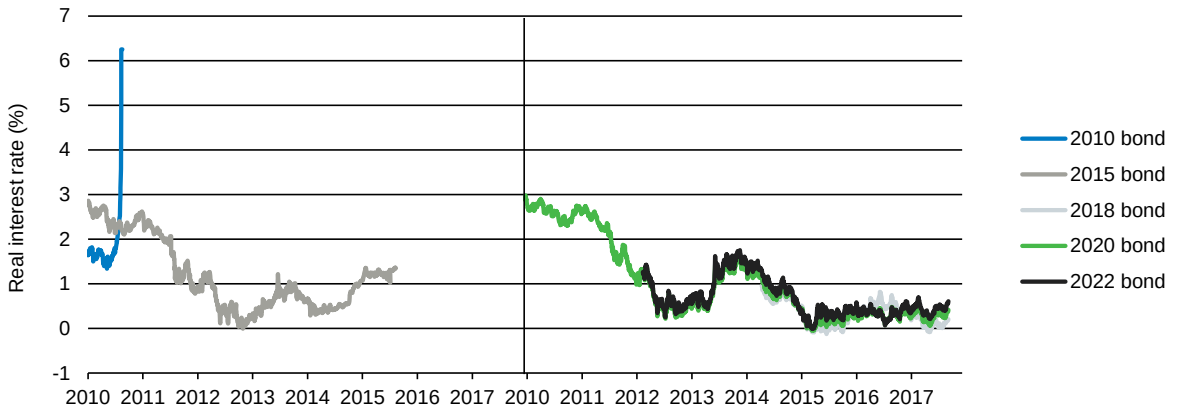
Because inflation-linked bond issuance is more sporadic, the maturity date of an inflation-linked bond maturity will not always align with the end of the regulatory period. When these dates do not align, we would need to interpolate an expected inflation rate consistent with the regulatory period. This increases the complexity of our approach.

Figure 7.3 plots the real interest rates for the various inflation linked bond securities, which we would be used to estimate inflation using the BEI method. It shows:

- The real interest rates for the inflation-linked bonds maturing in 2020 and 2022 indicate a reasonably liquid market (the right-hand panel of the figure). This suggests we could use these bonds to estimate inflation rates for 3- to 5-year periods.

- Real interest rates for the 2010 and 2015 bonds increased substantially in the 6 to 12 months before they matured (left-hand panel), likely reflecting bond illiquidity. For short regulatory periods, if we converted the real interest rate into an expected inflation rate using the Fisher equation, we could get an artificially low expected inflation rate using the BEI method.
- During periods in 2015 and 2017, real interest rates were occasionally negative. That is, investors were willing to buy and sell bonds with a negative real interest rate.

Figure 7.3 Real interest rates for inflation-linked bond securities (%)



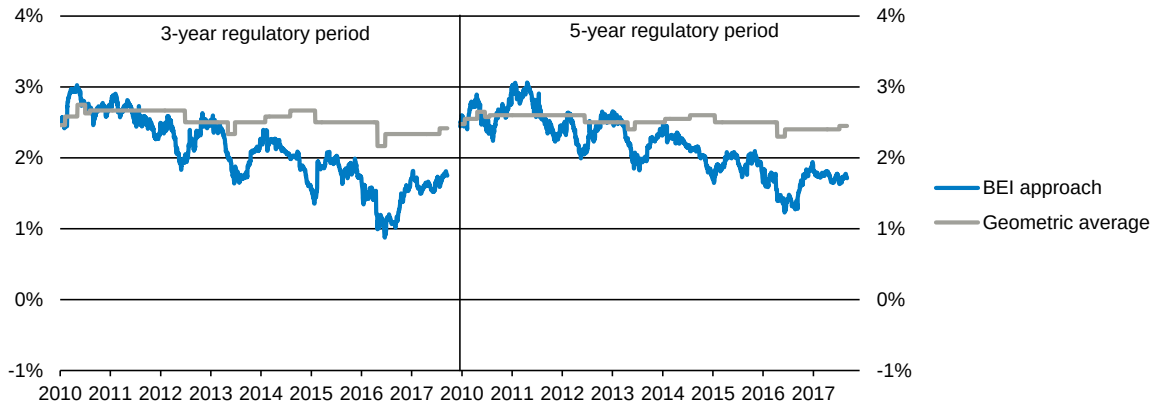
Data source: Bloomberg

Historical forecasts suggest the BEI method may be affected by changes in risk premia over time

We compared what our inflation estimates would have been over 2010-2017 using the BEI method, and the geometric average method, for 3- and 5-year regulatory periods (Figure 7.4):

- For the BEI method, where the maturity date of inflation-linked bonds did not align with the regulatory period, we used linear interpolation to estimate expected inflation.
- For the geometric average method, we calculated the geometric average according to the length of the regulatory period, as opposed to a 10-year average, in line with our draft decision.

Figure 7.4 Estimated annual inflation using the two methods (%)



Note: A positive number on the right-hand panel indicates that the model over-estimated inflation.
Data source: Bloomberg; IPART analysis

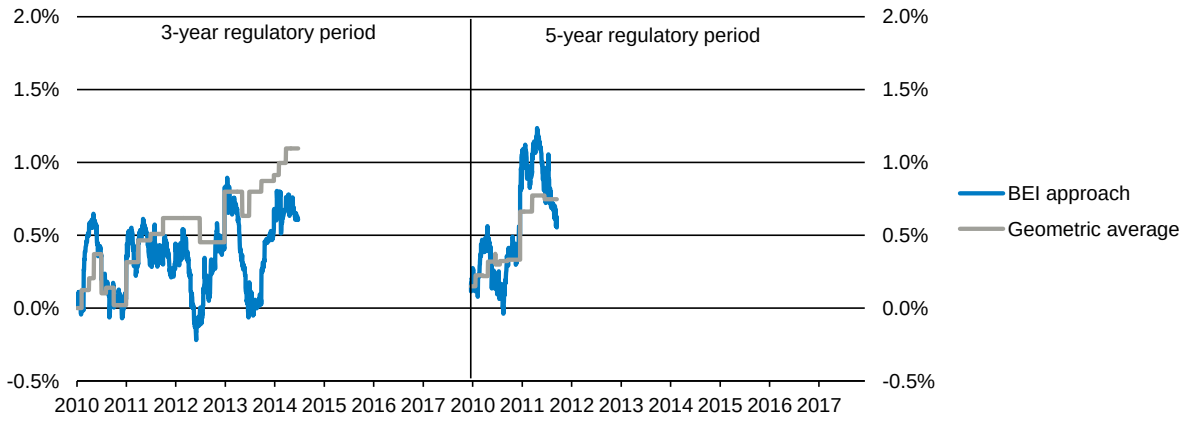
The comparison suggests that:

- The forecasts using the geometric average would have only fallen slightly over the 2010-2017 period (the grey lines). Inflation rates using this approach would have been between 2.3-2.4% in recent years.
- Expected inflation using the BEI method is currently around 1.7-1.8% for this period (the blue lines).
- The BEI method produced expected inflation rates in the middle of 2016 of around 1.0%. This reflects that real interest rates were around 0.4% in this period, and nominal interest rates were about 1.4%.

Figure 7.5 charts the difference between actual CPI inflation and the inflation estimates produce by each method over the period 2010 to 2017. A positive number indicates that the method would have over-estimated inflation:

- The data for 2010-2012 suggests neither the geometric average and the BEI method initially predicted the low inflation environment that we subsequently entered into, and therefore over-estimated inflation.
- Over a 3-year period (left-hand panel), the BEI method would have produced slightly smaller forecast errors than a geometric average method.
- Over a 5-year period (right-hand panel), there is less evidence the BEI method is more accurate than a geometric average method.

Figure 7.5 Realised forecast errors using the two methods (%)



Note: A positive number on the right-hand panel indicates that the model over-estimated inflation.
Data source: Bloomberg; IPART analysis

Based on the analysis summarised in Figures 7.1 to 7.5, our overall conclusion is that:

- The geometric average approach would over-estimate inflation in the current low inflation environment. However, to the extent that future inflation is uncertain, our method should gravitate towards an average expected inflation rate over the longer term. As outlined in our Issues Paper, our view is that long-term inflation expectations are anchored around the midpoint of the RBA's inflation target band (2.5%).[164] Therefore, we consider a geometric average method approximates the average inflation rate over time.
- The accuracy of the BEI method may be impacted over time to the extent that the risk premia affecting the yield on inflation-linked bonds, such as liquidity risk, vary at different points in the economic cycle.

The geometric average method is simpler, more transparent and replicable

The geometric average approach uses data that is publicly available and directly observable. The RBA currently produces semi-annual inflation forecasts in its quarterly Statement of Monetary Policy. The only drawback with this approach is that there is not an inflation forecast that is exactly 1-year ahead at all points in time. For example, stakeholders may be unclear whether we used a 9-month ahead, or 15-month ahead inflation forecast. Our draft decision would define our 1-year ahead inflation forecast more precisely.

The smaller amount of inflation-linked bond issuance results in data limitations. As a consequence, more judgement would be required to estimate inflation using the BEI method. To estimate inflation with the BEI method, we would need to:

1. Determine what time period we collect bond market data to estimate inflation.
2. Ascertain whether there is an inflation-linked bond with a maturity equal to the regulatory period.
3. If there is, calculate expected inflation directly using the fisher equation.

164 IPART, *Review of WACC methodology*, Issues Paper, July 2017, p 44.

4. If not, interpolate an expected inflation rate consistent with the regulatory period, using inflation linked bonds of similar maturity. This would involve:
   - deciding a method we would use to interpolate an expected inflation rate, and
   - potentially ignoring data from inflation linked bonds with a short maturity, which may be affected by illiquidity.

The bond yield data used to calculate inflation using the BEI method is publicly available through the RBA website. However, as judgement is required to estimate inflation using this method, we consider that the BEI method would be more difficult for stakeholders to replicate.

7.4.3 Our draft decision is to continue to use a geometric average method as there is not currently a sufficient case for change

We recognise the in-principle benefits of using the BEI method to calculate inflation. However, on-balance, we have decided to continue to use a geometric average approach as we consider that currently, there is not a sufficient case for change:

1. While our analysis suggests that liquidity in the inflation-linked bond market not currently an acute concern, we remain concerned that the market may not remain sufficiently liquid throughout the business cycle. Therefore, the accuracy of the BEI method may vary at different points in the economic cycle.
2. In part, due to data limitations, the BEI method is a slightly more complex, and less replicable, method compared to a geometric average.

However, we emphasise this is an on-balance draft decision. We particularly encourage any further feedback and analysis from stakeholders related to this draft decision.

Draft Decisions

27 Calculate the average expected inflation rate as the geometric average of:
   - the RBA's 1-year ahead inflation forecast in its most recently issued Statement of Monetary Policy for the first year of the regulatory period, and
   - the midpoint of the RBA's target inflation band (2.5%), for the remaining years in the regulatory period.

28 Reconsider whether we should move to a break-even inflation method to calculate the average expected inflation rate at the next review of our WACC method.

7.5 Refining our approach for calculating the geometric average

In applying the geometric average method, we currently calculate expected inflation as the geometric average of the **inflation rate**. This approach is expressed in equation (19) below:

$$(19) \qquad \pi_0^e = \sqrt[n]{(\pi_1^{RBA}) \times (\pi_2^{MP}) \times \ldots \times (\pi_n^{MP})}$$

where:

- π_0^e is the expected inflation rate
- π_1^{RBA} is the RBA's 1-year ahead inflation forecast, which applies in Year 1, and
- $\pi_2^{MP} \ldots \pi_{10}^{MP}$ are the midpoint of the RBA's target inflation band, which applies in Years two through 10.

In our Issues Paper, we expressed the preliminary view that we should modify our approach so we measure expected inflation as the geometric average of the **change in the level of prices**, with this average converted into an inflation rate separately.[165] This alternative is expressed in equation (20):

$$(20) \qquad \pi_0^e = \sqrt[n]{(1 + \pi_1^{RBA}) \times (1 + \pi_2^{MP}) \times \ldots \times (1 + \pi_n^{MP})} - 1$$

As stakeholders agreed with our preliminary view, we have decided to make this modification, and use equation (20). The CPI is a price index, and the average inflation rate between two points should be based on the change in the level of prices between those two points. This approach is consistent with the AER's current method.[166] In addition, our 2013 method would not work in the (unlikely) event that the 1-year inflation forecast is negative.

In addition, in comparing the BEI method and the geometric average method, we noted that it might not be clear to stakeholders how we use the RBA's inflation forecasts to calculate our 1-year ahead inflation forecast. To address this issue, we have decided to define our 1-year ahead inflation forecast more precisely, as the inflation forecast, in the RBA's most recently issued SMP, that is closest to 12 months ahead of the start the regulatory period.

Draft Decisions

29 Calculate expected inflation as the geometric average of the change in the level of prices.

30 Define the 1-year ahead RBA forecast we use to estimate inflation, as the inflation forecast:

- in the RBA's most recently issued Statement of Monetary Policy, and
- that is closest to 12 months ahead of the start of the regulatory period.

7.6 Using 0.25 as the value of gamma

Under the Australian imputation tax system, shareholders may receive dividends with imputation tax credits, which offset tax liabilities. Therefore, investors would accept a lower

165 IPART, Review of our WACC Method – Issues Paper, July 2017, p 47.

166 ACCC, *Best estimates of expected inflation: a comparative assessment of four methods*, ACCC/AER Working Paper Series No. 11, February 2017, p 109.

rate of return for an investment with imputation credits attached than if there were no imputation tax credits attached.

The imputation credit factor, gamma, is most relevant for converting a post-tax WACC to a pre-tax WACC. As we have adopted a post-tax WACC framework, we do not directly use gamma in our calculations. However, as noted in Chapter 5, gamma does have an influence over the current MRP estimates we use.

7.6.1 How we derived our point estimate of gamma used in our 2013 method

We have used a 0.25 value of gamma since our December 2011 pricing decision for the Sydney Desalination Plant (SDP). That decision took account of a dividend drop-off study by then SFG Consulting (SFG)[167] that was done for the Australian Competition Tribunal. This value was reconfirmed by a follow-up report by SFG that was done for Jemena Gas Networks in 2015.

SFG based its estimate primarily on implied market valuation methods, such as dividend drop-off studies. Such studies compare the value of equities in specific firms just before and just after a dividend is paid. While these estimates tend to be 'noisy', the underlying signal contains information about the value investors place on those dividends, taking full account of their tax position and ability to use imputation credits.

SFG also undertook another study, which took into account valuation information obtained from analysis of equity ownership and of Australian Taxation Office (ATO) taxation statistics. The equity ownership method uses data from the Australian Bureau of Statistics (ABS) to determine what proportion of Australian equity is held by domestic investors and what proportion by foreign investors. The main assumption of the method is that domestic investors take full advantage of imputation credits while foreign investors are unable to take any advantage of them. While providing a point of reference, this assumption is imprecise, and may tend to overestimate the use of imputation credits. Further, domestic ownership ratios fluctuate considerably over time, and are quite different for listed equities as compared to all (listed and non-listed) equities. All of these factors tend to make the equity ownership method imprecise.

The ATO taxation statistics approach uses aggregate data on the tax returns of payers of Australian tax. From this data it is possible to understand the extent to which taxpayers actually claim imputation credits. While this method also has its limitations, it tends to produce gamma estimates that are lower than those from the equity ownership method, because it does not make such imprecise assumptions about the behaviour of investors.

7.6.2 Most stakeholders supported gamma of 0.25

Most stakeholders supported gamma of 0.25. In its submission, SDP included a report from Frontier Economics that maintains that the best dividend drop-off (market value) estimate of gamma currently available is 0.25.[168] Frontier contends that there are two possible interpretations of gamma: a market value concept, under which gamma represents the price

167 SFG is now part of Frontier Economics.

168 Frontier Economics, *Review of WACC method: response to IPART Issues Paper: A report prepared for Sydney Desalination Plant*, August 2017, p 52.

that an investor would be willing to pay for an imputation credit; and, a redemption or utilisation concept, which represents the rate at which imputation tax credits are redeemed by taxpayers to reduce their personal tax liabilities. Under IPART's framework, gamma is the amount by which the total allowed return on equity is reduced to reflect the imputation credits that investors will receive. As such, it must reflect the market value of credits relative to dividends and capital gains. This suggests that the market value interpretation is appropriate.[169]

However, PIAC expressed concerns that this value is significantly lower than the gamma value used by other regulators. It noted that the "…Australian Competition Tribunal since found in favour of the AER's calculation of a gamma of 0.4 in its decision regarding SA Power Networks, as did the Full Federal Court with respect to the AER's decision regarding the NSW and ACT DNSPs [Distribution network service providers]".[170]

7.6.3 We consider there is not sufficient evidence to adopt a different value of gamma at this time

Unfortunately, because it is not possible to directly observe the after-tax returns that investors make, gamma is extremely difficult to establish empirically. We acknowledge that other regulators adopt different values for gamma (see Appendix A) and at times the selection of gamma has been controversial.

In recent years, some regulators have moved towards a higher value of gamma than 0.25.[171] In 2016, the SA Power Networks (SAPN) appealed the AER's final determination that the valued attributed to gamma should be 0.4 to the Australian Competition Tribunal (ACT). SAPN's proposal was a value of 0.25.[172] In its final decision, the ACT noted the difficulties in estimating gamma accurately from market data. It stated:

> Unfortunately, the available empirical evidence is inadequate to enable confident discrimination between these alternative perspectives. There are a range of studies, reviewed in the AER's Final Decision, using market prices which attempt to estimate the extent to which imputation credits are capitalised into stock prices and thus their market valuation. There are a range of results, and experts are divided on the merits of the various approaches and techniques

Ultimately, the ACT found in favour of the AER's value of gamma, its reasoning being:

> …the AER did not err, nor was unreasonable, in giving most weight to the "utilisation" approach. It considered the range of alternative approaches, recognised the diversity of views of experts on their merits (both theoretical and empirical), and made a judgement call. In doing so, it demonstrated responsiveness to the empirical evidence in lowering its estimate of gamma from 0.5 as proposed in its ROR Guidelines to a value of 0.4.[173]

However, while the ACT found that the AER's decision-making *process* for arriving at its value of gamma was not unreasonable in the circumstances, this does not necessarily infer that the ACT endorsed the AER's *decision*.

169 Ibid, p 45.
170 PIAC submission to IPART Issues Paper, August 2017, p 3.
171 See Appendix A – this includes the AER, ACCC and ERAWA which have adopted 0.4 and the QCA, which adopted 0.47.
172 Australian Competition Tribunal, *Final decision on application by SA Power Networks*, 2016, paragraph 125.
173 Ibid, pp 158-159.

We agree with Frontier that the value of gamma should be interpreted as the market value of dividends and capital gains that investors would be willing to forgo in exchange for imputation credits.[174] Further, we maintain our view that dividend drop-off studies are currently the best method to estimate the market value of gamma. Its advantage is that it measures the observed value of dividends and imputation credits by examining share price changes on ex-dividend days.

Since the 2011 SFG study we relied upon in our 2013 method, Frontier updated its analysis in 2013[175] and again in 2017[176]. The latter study employed a large sample and improved econometric techniques to estimate the value of both cash dividends and distributed imputation credits using dividend drop-off analysis. Both of these studies reconfirmed that the best estimate of the market value of gamma was 0.25.

7.6.4 Our draft decision is to continue to use 0.25

On balance, we consider that there is not sufficient evidence to suggest a more accurate method of determining gamma. Hence, to maintain stability and certainty for stakeholders, we propose to continue using our current value of gamma of 0.25.

We will continue to monitor developments in this area, and will consider whether we should change our approach to gamma at our next WACC review.

Draft Decision

31 Continue to use 0.25 as the value for gamma.

174 Frontier Economics, p 51.

175 Frontier Economics, *Updated dividend drop-off estimate of theta: Report for the Energy Networks Association*, June 2013.

176 Forthcoming paper by Damien Cannavan and Stephen Gray, *Dividend drop-off estimates of the value of dividend imputation tax credits*, 2017.

Appendices

A Comparison of other regulators' approaches to WACC

Table A.1 Comparison of IPART, AER, ACCC and ESC Victoria's recent approaches[177]

	IPART[a]	AER[b]	ACCC[c]	ESC[d]
Date updated	Dec 2013	Dec 2013	Apr 2017 (rail)	Oct 2016 (water)
Application				
Type of WACC	Real post-tax	Nominal vanilla post-tax	Real pre-tax WACC	Real post-tax
Definition of benchmark entity	"A benchmark firm operating in a competitive market and facing similar risks to the regulated business".	"A pure play, regulated energy network business operating within Australia".	-	-
Point estimate or range	Default is midpoint of estimate range for each parameter derived from long and current market data.	Point estimate	Point estimate	Point estimate based on weighting of 60:40 return on debt to return on equity. However, while a benchmark cost of debt applies, return on equity is determined over a range of values linked to tangible outcomes to customers according to 'PREMO' framework.
Adjustment mechanism	Uncertainty index constructed from four proxies for economic uncertainty in Australia. If UI outside one standard deviation from mean, we will consider	There are multiple reasonableness checks and adjustments before finalising cost of debt and equity components.	-	WACCs are adjusted based on level of ambition proposed by the business.

177 This comparison table is compiled from a combination of WACC statements of approach (where published) and recent regulatory decisions. It may not reflect the methodology that applies to all industries. We have noted the approach is specific to one industry.

	IPART[a]	AER[b]	ACCC[c]	ESC[d]
	moving from the midpoint.			
Fixed for period or intra-period adjustment	Fixed for period	Trailing average cost of debt	Fixed for period	Trailing average cost of debt
Cost of debt	Default is midpoint of short (40-day) and historical (10 year) average yields.	Start with an on-the-day rate for the first regulatory year using 10 or more consecutive business days averaging period as close as practicable to start of regulatory year. Gradually transition to a trailing average approach over 10 years, using benchmark with 10-year term to maturity and applying historical rates to new capex borrowings.	Sum of risk-free rate, debt margin and debt issuance (raising) cost.	10-year trailing average to estimate the benchmark cost of debt for water businesses, as it considers this better aligns actual cost of debt for an efficient business to regulated benchmark.
Risk-free rate	End of month estimates of AGS bond yields.	10-year AGS yield, 20 consecutive business days averaging period as close as practicably possible to the commencement of the regulatory period.	10-year Australian AGS and 20 day averaging period commencing as close as possible to the start of the period.	(Set out in each price review. Eg, for Melbourne Water 2016, cost of debt calculated as simple average of 10-year historical debt costs (risk-free rate plus debt premium) from RBA[e]
Debt margin	Measure monthly credit spreads of sample of Australian corporate bonds with term to maturity of 10 years from RBA.	Published yields from independent provider using benchmark credit rating and term to maturity of 10 years (extrapolated if shorter). Annualised if necessary. Confidential averaging period between 10 days to 12 months.	Takes an average of RBA and Bloomberg yield estimates. Adopts a BBB rated bond with a 10 year target tenor as the benchmark bond. Is a 20 business day average. Converted to an effective annual rate.	(Set out in each price review)
Credit rating	BBB (RBA BBB-/BBB/BBB+)	Closest approximate for BBB+	BBB (to represent BBB+)	BBB
Debt raising costs	12.5 basis points	Included in operating costs, based on efficient debt raising costs for benchmark firm.	9.5 basis points	15 basis points

	IPART[a]	AER[b]	ACCC[c]	ESC[d]
Cost of equity				Each business's return on equity is linked to tangible outcomes for customers. It varies according to level of ambition in price submission. A more ambitious submission will propose targeted services and outcomes at lower prices. This is achieved through better customer engagement, efficient management practices and rigorous self-examination. Ambition is assessed against five elements of PREMO – performance, risk, engagement, management and outcomes. 'Basic' submissions set at level where businesses recover interest costs of funding capital investment. 'Advanced' or 'Leading' price submissions would receive a higher return on equity.
Market risk premium	Default position is midpoint of short and historical averages of historical arithmetic average of excess market returns over risk-free rate. Current: average of six model parameter estimates (five based on DGMs)	Choose a point estimate (not necessarily the midpoint) from a range derived from theoretical and empirical evidence including historical excess returns, DGMs, survey evidence and conditioning variables.	Point estimate, taking into account historical estimates, market surveys and previous regulatory decisions. Most reliance placed on historical estimates.	
Imputation credits	0.25	0.4	0.4 (within range of 0.3–0.5)	
Equity beta	Determined as part of price determinations using proxy analysis.	Choose a point estimate from a range derived from empirical analysis of comparable firms. May be adjusted by international empirical analysis and theoretical principles.	Point estimate using the Monkhouse formula (eg, asset beta of 0.45 for ARTC). Analysis of comparable firms, adjusted for systematic risk mitigating factors. Takes into account previous betas and other regulatory decisions.	
Gearing	Determined as part of price determinations using proxy analysis.	0.6 based on historical precedent.	0.52 based on historical precedent and other regulatory decisions.	0.6
Inflation	Geometric mean of the 1-year RBA forecast and the middle of the RBA's target band of inflation (i.e. 2.5%) for the remaining nine years.	Geometric average of 1-year and 2-year ahead forecasts based on quarterly data from RBA's Statement of Monetary Policy; and, middle of RBA's target for years three to 10 (2.5%).	Weighted geometric average of RBA forecasts and mid-band inflation target over a 10-year period.	Latest market forecasts based on the Consumer Price Index – All Groups, Australia.

a IPART, *Review of WACC Methodology – Final Report*, December 2013.

b AER, *Better Regulation, Rate of Return Guideline*, December 2013; Federal Court of Australia, *Australian Energy Regulator v Australian Competition Tribunal (No 2),* 24 May 2017.

c ACCC, *Draft Decision – Australian Rail Track Corporation's 2017 Hunter Valley Access Undertaking*, 20 April 2017.

d Essential Services Commission, *Water Pricing Framework and Approach, Implementing PREMO from 2018*, October 2016. Essential Services Commission, *Melbourne Water 2016 Price Review – Guidance Paper*, April 2015.

Table A.2 Comparison of QCA, ERAWA, ESCOSA and NZCC's recent approaches

	QCA[a]	ERAWA[b]	ESCOSA[c]	NZCC[d]
Date updated	Aug 2014 (equity) Apr 2015 (debt)	Oct 2016 (rail)	Mar 2015 (water)	Dec 2016
Application				
Type of WACC	Nominal vanilla post-tax	Real pre-tax	Real post-tax	Vanilla post-tax
Definition of benchmark entity	Pure play, regulated, standalone.	-	"The regulatory return should be based on the expected behaviour of a benchmark efficient entity"	-
Point estimate or range	Point estimate	Point estimate	Point estimate	Percentile along a distribution, which is industry-specific.
Adjustment mechanism	-	-	-	Standard errors for asset beta, debt premium and MRP combined to determine WACC standard error. Based on industry, either midpoint or point along the distribution selected. Additional reasonableness checks apply to ensure WACC realistic in light of financial market conditions.
Fixed or intra-period adjustment	Fixed over period - rejected trailing average debt in 2015	Fixed over period	Trailing average cost of debt	Fixed over period - rejected trailing average debt in 2016
Cost of debt	'On the day' approach using benchmark cost of debt estimated just prior to start of regulatory cycle.	'On the day' observed rate for the next 10 years.	Weighted 10-year average approach – cost of debt updated each year of regulatory period.	Averages risk-free rate and debt premium over three calendar months just prior to start of regulatory period.
Risk-free rate	Based on Australian Government bond yields over 20-day averaging period and RBA data. Benchmark debt term of 10 years.	Observed yield of 10-year Australian Government Securities (AGS) from Treasury Indexed Bond markets, used as a proxy.	Observed yields from 10-year Commonwealth Government Bonds averaged over 20 business days. Observations taken close as possible to determination.	Government bond rates as using yield to maturity as an approximation of spot rates. Maturity term of risk-free rate five years.

	QCA[a]	ERAWA[b]	ESCOSA[c]	NZCC[d]
Debt margin	Econometric approach that measures the linear relationship between debt margin and term to maturity using 20-day averaging period.	5-year yield premiums (10-year rail) estimated from a sample of Australian and international bonds.	Weighted 10-year average approach, estimated directly from bond yields published by the RBA.	Maturity yields for pool of corporate bonds issued by similar companies. Estimate debt premium for term to maturity equal to regulatory period. Term credit spread differential allowance to compensate for additional debt premium and the interest rate swap execution costs from issuing longer term debt.
Credit rating	BBB+	BBB- to A (entity-specific)	BBB	BBB+(for electricity networks, A- for airports)
Debt raising costs	10.8 basis points	12.5 basis points	12.5 basis points	20 basis points
Inflation	-	Annually updated estimate implied from Treasury Bonds and Treasury Indexed Bonds using the Fisher equation.	Geometric mean of inflation over 10-year period using RBA inflation forecast for first and midpoint of RBA inflation target band for other years.	-
Cost of equity				
Market risk premium	Equally weighted average of four estimates (two historical and two current) (Ibbotson, Siegel, Cornell DGM, survey evidence), and conditional information and rounding to the nearest whole percentage point.	Calculated using Ibbotson, Wright and DGM methods - Wright estimate given most weight, Ibbotson estimate given less weight. The Authority then accounts for DGM estimate of MRP. In 2015 rail determination the Authority placed more weight on lower half of range of externally observed DGM estimates than upper half, in recognition of DGM estimates' inherent upward bias. The Authority determined a final MRP closer to	MRP of 6 per cent consistent with majority of regulatory decisions over the past 10 years, market surveys of academics and market practitioners and sits within the range provided by historical estimates.	Studies of historic returns on shares relative to risk-free rate leading to an MRP of 7%.

	QCA[a]	ERAWA[b]	ESCOSA[c]	NZCC[d]
		historic lower bound.		
Imputation credits	0.47	0.4	Allowance made in operating expenditure on an entity-specific basis.	0
Gearing	Analysis of benchmark capital structure using comparable firms.	0.2 to 0.5 based on business historical precedent.	60% based on Australian regulatory decisions.	Uses the average leverage of asset beta comparator samples.
Equity beta	Empirical analysis of equity returns of publicly listed 'comparator' companies.	Empirical analysis including a standard Ordinary Least Squares (OLS) approach and other robustness approaches such as the Least Absolute Deviations (LAD); maximum likelihood robust methodology (MM); and Theil Sen approaches.	0.7 based on recent empirical research and regulatory precedent.	Identify comparator sample and estimate equity beta for each firm. De-lever each equity beta to estimate asset beta for each firm. Calculate average asset beta for sample. Adjust for regulatory or systematic risk differences to average asset beta. Re-lever average asset beta for sample to equity beta estimate using notional leverage.

a Queensland Competition Authority, *Final decision, Trailing average cost of debt, April 2015; Queensland Competition Authority, Cost of capital: market parameters*, August 2014.

b Economic Regulation Authority, *Determination on the 2016 Weighted Average Cost of Capital for the Freight and Urban Railway Networks, and for the Pilbara railways*, October 2016.

c Essential Services Commission of South Australia, SA Water Regulatory Rate of Return 2016 – 2020, Final Report to the Treasurer, March 2015.

d Commerce Commission New Zealand, Input methodologies review decisions: Topic paper 4: Cost of capital issues, 20 December 2016.

B IPART's uncertainty index model

We publish our uncertainty index model and a guide to using the model on our website.[178] Stakeholders can use this to replicate our uncertainty index, which is used as a basis for determining an appropriate WACC in our various price reviews.

The rest of this appendix is structured as follows:

- Section B.1 explains IPART's uncertainty index
- Section B.2 provides a list of input data and data sources, and explains how we manipulate the input data in Excel to create necessary variables for the uncertainty index, and
- Section B.3 describes steps we use to run a principal component analysis (PCA) in SPSS to obtain the uncertainty index.

B.1 What is IPART's uncertainty index?

As part of our 2013 review, we developed a WACC decision-making framework to improve the transparency and predictability of our WACC decisions.[179] As part of this framework, we construct a monthly uncertainty index, which measures the level of economic uncertainty, and use it as a basis for determining an appropriate WACC in our price reviews. Our WACC decision making rule is that:

- If the uncertainty index is at, or within one standard deviation of, the long- term average of 0, we would select the midpoint WACC.
- If the uncertainty index is more than one standard deviation from the long- term average of 0, we would consider moving away from the midpoint WACC.

Our methodology for constructing the uncertainty index closely follows the approach taken by the Bank of England in its study of macroeconomic uncertainty.[180]

B.2 Creating proxy variables for economic uncertainty

Constructing the uncertainty index is a two-stage process. In the first stage, we download data and create variables in Excel. We then export these variables to SPSS, a software package used for statistical analysis, to run a PCA.

We use the following four variables, which are a proxy for economic uncertainty in Australia:

- implied volatility

178 IPART, *Fact Sheet: Guide to IPART's Uncertainty Index Model*, February 2016.
179 IPART, *Review of WACC Methodology - Final Report*, December 2013, pp 23-24.
180 Bank of England, 2013, pp 100-109

- dispersion in analysts' forecast
- credit spreads, and
- bills–overnight index swap (OIS) spread.

Table B.1 provides a full list of raw data and data sources.[181]

Table B.1 List of raw data and data sources

Proxy variable	Raw data	Data source	Series/Datatype
Implied volatility	S&P/ASX200 Volatility Index (post January 2008	Datastream	AXVIVOL/PI
	S&P/ASX 200 Index Total Return (prior to January 2008)	Datastream	ASX200I/RI
Dispersion in Analysts' forecast	Weighted average standard deviation of EPS forecasts for calendarised FY1 fiscal period	Datastream	@:AUSP200/ AF1SDC
Credit spread	UBS Credit Yield	Datastream (prior to September 2015)	ACBALLM/RY
	AusBond Credit Index Yield	Bloomberg (post September 2015	BACR0 Index/ YLD_YTM_MID
	UBS Treasury Yield	Datastream (prior to September 2015)*	AGBALLM/RY
	AusBond Treasury Index Yield	Bloomberg (post September 2015)	BATY0 Index/ YLD_YTM_MID
Bills-OIS spread	90-day Bank Accepted Bills	Datastream	AUBAB90D
	Australian 3-month Overnight Indexed Swaps	Datastream	AUGBILL3

B.2.1 Volatility Index

The S&P/ASX 200 VIX is a volatility index that reflects the market's expected volatility in the S&P/ASX 200. The level of the volatility index implies the market's expectations of volatility in the S&P/ASX 200 over the next 30 days. The index value is similar to rate of return volatility with the volatility index reported as an annualised standard deviation percentage.[182]

The variable, *Volatility Index,* is created in the '*IVOL*' tab in the Excel spreadsheet on a monthly basis. We download daily S&P/ASX 200 VIX from Datastream. The S&P/ASX 200 VIX is available only from January 2008. Prior to this period, we use the Total Return

181 Proprietary data from Thomson Reuters Datastream (Datastream) and Bloomberg has been removed and replaced with dummy data. Users need to source the data independently.

182 http://www.asx.com.au/products/sp-asx200-vix-index.htm accessed 23 June 2017.

Index (*TRI*) of the S&P/ASX 200 Index from Datastream and calculate the annualised standard deviation of daily returns over 90 days, where a daily return on day *t*, *r*, is calculated as:

$$r_t = \ln(\frac{TRI_t}{TRI_{t-1}})$$

We then calculate the standard deviation of the returns over the last 90 days and annualise it by multiplying it by the square root of 252.[183]

To obtain a monthly implied volatility value, we average daily volatility index values in each month.

B.2.2 Dispersion in Analysts' Forecast

The variable, *Dispersion in Analysts' Forecast*, is created in the '*DISP*' tab in the Excel spreadsheet. We download monthly dispersion in analysts' earnings forecasts for the companies in the S&P/ASX Index from Datastream. The dispersion in analysts' forecast is used as a proxy for the uncertainty about future earnings or the degree of consensus among analysts or market participants.

B.2.3 Credit Spread

The variable, *Credit Spread,* is created in the '*CS*' tab in the Excel spreadsheet on a monthly basis. Credit spreads refer to a difference in yields between different securities due to different credit quality. We calculate daily credit spreads as the difference between daily *Credit yield* and daily *Treasury yield*.

Previously, we used the daily UBS Australian all maturities credit yields and UBS Australian Treasury all maturities yield as *Credit yield* and *Treasury yield,* respectively, sourced from Datastream. However, since Thomson Reuters has ceased publishing these data series in September 2015, we have been using the AusBond Credit Index Yield and AusBond Treasury Index Yield. We note that data values from Datastream and Bloomberg are identical except that Bloomberg publishes weekend values.

To obtain a monthly credit spread, we average daily credit spreads in each month.

B.2.4 Bills-OIS Spread

The variable, *Bills-OIS Spread,* is created in '*BOS*' in the Excel spreadsheet. We download monthly 90-day bank bill swap rates and 3-month overnight indexed swaps (OIS) from Datastream, and calculate the Bills-OIS spread as the difference between these two data series.

[183] The annualisation assumes 252 trading days.

B.3 Running a Principal Component Analysis

A PCA is a way of identifying patterns in data and expressing the data in a way which highlights their similarities and differences.[184] Using this method, we can combine the four variables, which we identified as proxies for economic uncertainty, and extract a single variable, called a principal component, which explains most of the variation in the original set of the four proxy variables.

To replicate our PCA for the uncertainty index, users should download the MS Excel spreadsheet *IPART uncertainty index - Creating proxy variables - Public.xls* and accompanying Fact Sheet from our website.

[184] For more information on principal component analysis including derivation of principal components, see Jolliffe, I.T., *Principal Component Analysis Second Edition*, 2002.