COST OF EQUITY ASSESSMENT FOR RIIO ED2

A report prepared for WPD

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Confidential

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EXECUTIVE SUMMARY

Frontier Economics has been commissioned by Western Power Distribution (WPD) to estimate a range for the cost of equity, which will feed into an overall cost of capital estimate. This report provides an explanation of the parameters required to estimate the cost of equity and our suggested approach for this. In addition, Ofgem's final determination for gas distribution and gas and electricity transmission for RIIO-2 have now been published; our estimates for each component therefore take into account the recent RIIO-2 determinations as well as other recent regulatory precedent, and up to date market data.

Risk free rate

For the risk free rate, we recommend to take an approach in line with the recent CMA PR19 redetermination. This considers both Bank of England index linked gilts and corporate bonds using the iBoxx AAA index to provide a lower and upper bound, both averaged over a 6-months period.

This provides a range from -1.61% to -0.88% in CPIH real terms.

Total market return

For the total market return, we rely on the historic ex post approach, considering a number of averaging methods, holding periods and two methods for deflating nominal historical returns. Considering all of the resulting estimates from these different approaches, we conclude a reasonable range would be 6.58% to 7.44% in CPIH real terms.

Beta

In estimating the unlevered beta, we consider three main elements – i) the set of publicly listed comparators, ii) the data frequency and iii) the estimation windows and averaging period. This can be summarised as follows:

- We first draw on GB utilities for our sample group of comparators which includes water companies as well as National Grid (the closest to GB pure play energy network). We note however that water companies tend to display lower risk exposure than energy networks (as per the consistently lower beta estimates). NG is the closest comparator to WPD but currently only operates in the transmission sectors (although historically it did own a gas distribution business prior to its disposal), compared to WPD which operates in the electricity distribution sector. Given the small sample size of the GB group, we expand our comparator sample to also include European regulated energy networks.
- With regards to data frequency, we consider that overall daily betas tend to be sufficiently reliable, do not suffer from reference day issues and tend not to produce a large amount of outliers. We therefore use daily estimates.

- We present estimates covering 2, 5 and 10 year windows, and averaging periods covering spot rates, 2 year averages, 5 year averages and 10 year averages, following recent CMA practice.

Based on the range of unlevered betas, we base the lower bound on the estimates for GB water networks which tend to be exposed to less risk than energy networks (as per the CMA PR19 redetermination). This gives a lower bound of 0.30.

To locate the upper bound, we then look at NG and other European comparators, which produce a beta range of 0.34 to 0.36.

We therefore retain a range of 0.30 to 0.36 for the unlevered beta. We adopt the debt beta assumptions as per the CMA PR19 decisions, 0.05 to 0.10. The resulting asset and equity betas based on these estimations are 0.35 to 0.38 and 0.72 to 0.88 respectively.

Aiming up

Regulators generally aim up when setting a point estimate for the WACC allowance, rather than selecting the mid-point of the range. This is due to the fact that estimating WACC involved a considerable amount of uncertainty, and costs associated with under- or over-estimating the WACC are asymmetric.

Given the CMA's latest precedent of aiming up for the water sector by 25 bps, we consider that for the electricity distribution networks, where both the need to attract investment and the harm from failure to invest are likely to be greater than in water, a minimum of 40 bps aiming up would be necessary.

Overall cost of equity

To summarise all of the parameters, we consider the appropriate range for the cost of equity over RIIO ED2 is 4.33% to 6.45%, with a mid-point of 5.39%. Due to the need to aim up, we consider that the appropriate allowed return on equity should be set at no lower than 5.8%. This is summarised in the table below.

Table 1 Summary of cost of equity

	Low		High
Gearing			
Notional gearing	60%		60%
Observed gearing	50%		45%
Risk-free-rate	-1.61%		-0.88%
Equity risk premium	8.19%		8.32%
Total market return	6.58%		7.44%
Debt beta	0.10		0.05
Asset beta	0.35		0.38
Equity beta	0.73		0.88
Post-tax cost of equity	4.33%		6.45%
Mid-point		5.39%	
Aiming up		>0.4%	
Point estimate		5.80%	

Source: Frontier analysis

While the top end of the range found by our analysis of CAPM supports a number well above 6.0%, in our view the balance of evidence at this time suggests that the true value is more likely to be below 6.0%. At this stage we therefore adopt a truncated working assumption of a range from 5.8% to 6.0%, and rely on a point estimate of 5.8%, at the bottom of this range. We will keep this range under review as evidence evolves.

1 INTRODUCTION AND BACKGROUND

Frontier Economics has been commissioned by Western Power Distribution (WPD) to estimate a range for the cost of equity, which will feed into an overall cost of capital estimate. In order to determine the cost of equity, consistent with UK regulators, we follow the capital asset pricing model (CAPM).

This report first provides an explanation of the parameters required to estimate the cost of equity. Each of these parameters is then addressed in turn, with an explanation on our proposed range provided for each component. Consistency across price control periods is important to ensure that investors' exposure to regulatory risk is minimised. However, Ofgem's final determination for gas distribution and gas and electricity transmission for RIIO-2 are materially different from RIIO-1 and are currently (as of the writing of this report) under CMA appeal. In this context, our estimates for each component therefore take into account the RIIO GD2/T2 determinations as well as the recent regulatory CMA precedent in particular the PR19 appeal and the ongoing RIIO2 appeal, and up to date market data.

As outlined above, we follow the CAPM approach for estimating the cost of equity. This describes the relationship between the risk and expected return for an investment, and consists of three main components:

i) the risk free rate (RFR) which shows the rate of return an investor could expect to make from investing in risk-free assets;
ii) the total market return (TMR) which shows the return over the entire market portfolio; and
iii) the equity beta which represents the exposure to an asset's systematic risk relative to the overall market.

Together, the TMR minus the risk free rate provides the equity risk premium, which shows the premium an investor would expect to earn were they to hold a portfolio of shares across the market.

The relationship between these parameters can be formalised as follows:

$$r_e = RFR + \beta(TMR - RFR)$$

Where:

- r_e represents the cost of equity;
- RFR represents the risk free rate;
- β represents the equity beta; and
- TMR represents the total market return.

Whilst the RFR and TMR are a single estimated value, the equity beta is formed of both the asset beta and the debt beta. As highlighted, the equity beta reflects an investor's exposure to an asset's systematic risk relative to the overall market, and this is comprised of both the risk to shareholders (the asset beta), the risk to bondholders (the debt beta), and the company's gearing level. The Harris-Pringle formula is used to express the relationship between the equity, asset and debt beta:

$$\beta_E = \frac{\beta_A - g \times \beta_D}{1 - g}$$

Where:

- β_E is the cost of equity;
- β_A is the asset beta;
- β_D is the debt beta; and
- g is the notional gearing.

For companies which are publicly listed, the equity beta can be directly estimated by regressing the company specific return against the return from the overall market. To the extent that the observed market gearing differs from the notional gearing, we can use the Harris-Pringle formula to de-gear the estimated equity beta to infer an asset beta and then re-gear it back to the notional equity beta at the notional gearing level. However, for companies which are not publicly listed, such as WPD, we need to do this exercise using a sample of comparable companies which are listed.

Further explanation on how this has been done for WPD is provided in Section 4. The remainder of this report addresses each of the RFR, beta and TMR parameters, concluding with the resulting overall cost of equity estimate.

2 RISK FREE RATE

The RFR represents the rate of return an investor could expect from investing in a riskless asset. Whilst it is not possible to measure the RFR directly, government bonds or AAA-rated corporate bonds are generally considered to be the closest to a risk-free investment. The following section summarises recent regulatory precedent before setting out our proposed approach for the RFR.

2.1 Regulatory precedent

At RIIO GD2/T2 FD, Ofgem based the RFR on 20-year index linked gilts on the basis that government bonds "are very low risk"[1] and opted not to consider AAA-rated corporate bonds.[2] The RFR was therefore based on current yields across October 2020, converted into CPIH using a RPI/CPI wedge of 0.8%. The RFR will be updated throughout the price control period, however Ofgem's approach provided a value of -1.58% at the time the final determination was published. This decision is currently subject to a CMA appeal.

For PR19, Ofwat took a different approach, fixing the RFR for the PR19 period ex ante. Its determination was also based on index linked gilts though. Ofwat used one month average yields of 15-year index linked gilts, including an uplift to provide an implied RFR over the 2020-2025 period. This was converted into a CPIH real value using a 1% wedge reflecting, the long-term difference between the RPI and CPI inflation measures,[3] providing an estimate of -1.39%.

In its PR19 redetermination, the CMA included c AAA-rated corporate bonds in its estimate of the RFR. The CMA provided a range for the RFR with the lower bound based on the 6-month average of 20-year index linked gilts, and the upper bound based on the 6-month average of the iBoxx GBP non-gilt AAA 10+ and 10-15 indices.[4] Corporate bonds were included on the basis that they represent a rate that is close to risk-free but also a rate that "is available to all (relevant) market participants."[5] This gave a range of -1.63% to -1.05% with a mid-point of -1.34%. It should be noted that the CMA used an updated RPI CPI wedge estimate of 0.9% when converting the index linked gilts into a CPIH real estimate.

2.2 Estimating the RFR

We believe it is reasonable to include AAA-rated corporate bonds in the estimation of the RFR given the CMA's assessment that this reflects the lowest risk investment, which is available to all relevant market participants. We note the potential downward bias of the ILG yield as a proxy for estimating the RFR, due to the unique features of the government bond which could lead to convenience premium. We also recognise the potential upward bias of the AAA corporate bond

1 Ofgem, RIIO-2 Final Determinations – Finance Annex, paragraph 3.12.

2 Ofgem, *RIIO-2 Final Determinations – Finance Annex*, paragraph 3.14.

3 Ofwat, *PR19 Final Determinations – Allowed Return on Capital Technical Appendix,*p.40.

4 CMA, *Anglian Water Services Limited, Bristol Water plc, Northumbrian Water Limited and Yorkshire Water Services Limited price determinations: Final report,* paragraph 9.241.

5 CMA, *Anglian Water Services Limited, Bristol Water plc, Northumbrian Water Limited and Yorkshire Water Services Limited price determinations: Final report,* paragraph 9.149.

yield due to possible default risk premium, inflation premium and/or liquidity premium.

We therefore take an approach consistent with the CMA, estimating the lower bound using the 6-month average of 20-year Bank of England index linked gilts. As the Bank of England gilts are indexed to RPI inflation, we use the OBR's RPI CPI wedge of 0.8% to convert into CPI real terms. This gives a value of -1.61%.

For the upper bound, we update the CMA's approach of using the average of the iBoxx GBP non-gilt AAA 10+ and 10-15 indices. The average for these across the past six months is 1.16% and 0.90% respectively in nominal terms. Converting to CPI and taking an average of these values provides an upper bound estimate of -0.88%.

Bringing these estimates together provides an overall range for the RFR of -1.61% to -0.88% in CPI real terms.

3 TMR

The total market return (TMR) represents the expected return over the entire market portfolio. Typically, regulators tend to place weight on long-run historic ex post equity market returns, which are considered to provide a reasonable indicator of current expectations on returns. These are usually taken from the Dimson, Marsh and Staunton (DMS) Credit Suisse Global Investment Returns Yearbook (DMS). This covers the period of 1900 to present day and can be used to calculate the average long-run return.

It is important to note that there are a number of methodological choices to be made when using this data, such as the averaging method used, the holding period (referring to how long an investor holds their assets for) and the measure of inflation used to deflate nominal historic returns. The combination of different approaches will impact the overall average long-run return estimate.

Additionally, there are additional supporting methods that can be used in conjunction with the historic ex post approach, such as considering investment manager forecasts, or using an ex ante rather than ex post approach, which tries to distinguish between historical realised returns and historical return expectations. We first set out recent regulatory precedent in this area before outlining our own approach for estimating the TMR.

3.1 Regulatory precedent

Prior to the RIIO-2 consultations, Ofgem stated that "a long-run average outturn market returns is the best single objective measure of investor expectations of the TMR".[6] For RIIO-T2 and RIIO-GD2, Ofgem looked at the historical long-run returns, using geometric returns with an uplift for arithmetic averaging,[7] but also considered additional sources as cross-checks, such as a Dividend Growth Model and investment manager forecasts.[8] This provided an estimate of 6.5% in CPIH real terms.

Similarly, Ofwat also considered multiple methods, looking at evidence from three approaches:[9]

1) The ex post approach – based on the 2019 DMS yearbook, Ofwat produced a range of TMR estimates using a variety of averaging methods and holding periods.
2) The ex ante approach – based on a decomposition method which looks at average returns using real dividend yields and the average real rate of dividend growth, combined with adjusting historical returns for one-off events which are unlikely to be experienced in future.
3) A forward-looking approach using forecast models which estimated future dividend growth rates.

[6] Ofgem, *RIIO-2 Sector Specific Methodology Annex: Finance,* paragraph 3.12.

[7] Ofgem, *RIIO-2 Final Determinations Finance Annex Revised,* paragraph 3.88.

[8] Ofgem, 2019, *RIIO-2 Sector Specific Methodology Decision: Finance Annex*, paragraph 3.103.

[9] Ofwat, *PR19 Final Determinations – Allowed Return on Capital Technical Appendix,* p 41-43.

Ofwat concluded on a point estimate, consistent with Ofgem, of 6.5% (CPIH real), which lay within the range obtained from each of its three approaches.[10]

In the CMA's PR19 Provisional Findings, the same three approaches Ofwat had used were also taken into account, however the overall TMR estimate was ultimately informed by the historic ex post approach. In the CMA's Final Report however, it deviated from this, setting the lower bound using the historic ex post approach, and the upper bound using the historic ex ante approach. This gave a range of 6.15% to 7.46% and point estimate of 6.81% (CPIH real).

3.2 Estimating the TMR

In line with the overwhelming UK regulatory precedent, our preferred approach is to place most weight on the historical ex post approach, which we believe is the least dependent on assumptions and therefore most objective and reliable. As outlined in section 3, there are a number of key choices which must be made when calculating the TMR based on average long run returns from the DMS yearbook data. These are

- the averaging method used,
- the assumed holding period, and
- the treatment of historic inflation.

Given numerous combinations of these assumptions could be used, which would all result in different estimates of the TMR, we consider a reasonable approach is to consider a wide variety of different methodologies. We can then infer a range from this evidence. We provide further explanation of each of the assumptions required, before presenting the resulting estimates.

The averaging method used

When averaging stock market returns over time, either an arithmetic average or a geometric average can be observed. Using an arithmetic average would assume that the historical return in each year is independent from all other years, and would therefore be in line with an investor who rebalances their portfolio each year. The geometric mean takes into account the compounding effect of investors holding their investments for multiple years, which would imply that investors buy and hold equity for the entirety of the relevant period.

Whilst the geometric mean is less susceptible to market volatility, the arithmetic mean has often been considered to be a better predictor of future returns in the context of the very long historic returns. A number of estimators have been developed which account for some of the issues associated with the arithmetic mean, including the Blume unbiased estimator, the JKM estimators and the Cooper estimator. Each one of these methods seeks to estimate an arithmetic mean from the geometric mean and the sample of the historic return data. As there is no academic consensus on which one is the most appropriate, and all of these produce different levels of estimates, we look into all of them in our analysis before taking a balanced view in the round to inform a reasonable range.

[10]

The assumed holding period

As outlined above, investors can hold shares over a number of years and the assumption around this impacts the average return. 10-year and 20-year holding periods are considered in the CMA's PR19 determination, and Ofwat considered 5 and 10 years holding period in its PR19 determinations.[11]

In our view, although we recognise the CMA's preferred holding period of 10 and 20 years, there is evidence to support the consideration of a 5-year holding period. Based on Bloomberg data. When looking at publicly listed UK utility companies, we observe that the average holding period is 4.4 years.

We therefore consider 5, 10 and 20 year holding periods in our analysis.

The treatment of inflation

The RPI inflation measure was introduced in 1947 and CPI in 1997. However the DMS yearbook data begins in 1900 and there is therefore no consistent measure of inflation which matches the period covered by the returns data.

Before the RPI measure was introduced, there were two other inflation measures – the cost of living index (COLI) and the consumption expenditure deflator (CED). Both the CMA and the Office for National Statistics note that the CED is the preferred measure on the basis of the greater coverage it provides.[12] This can be combined with the RPI or CPI measures to allow returns to be deflated over the entire period the DMS covers; we refer to these as CED/RPI and CED/CPI respectively.

It should be noted that given the CPI measure was only introduced in 1997, when using the CED/CPI measure, backward looking estimates are needed to cover the period 1947 to 1997. Therefore a "backcast" model is needed to estimate this.[13] This results in significant uncertainty around the CED/CPI approach. However the RPI measure has also received considerable criticism as there is an argument that the current RPI index is an unreliable index and diverges from historic RPI methodology and therefore using historic RPI average for forward looking real TMR might create bias. There is therefore no consistent view on either the CED/CPI or CED/RPI approach being the best for deflating historical nominal returns.

Our approach

In order to account for the different assumptions outlined above, we use the 2020 DMS yearbook and consider a range of averaging methods, holding periods and both the CED/RPI and CED/CPI inflation index.[14] Within averaging methods, we look at the results from using the Blume, JKM unbiased, JKM (MSE) and Cooper

[11] Ofwat, *PR19 Final Determinations – Allowed Return on Capital Technical Appendix,*p.41.

[12] CMA, *Anglian Water Services Limited, Bristol Water plc, Northumbrian Water Limited and Yorkshire Water Services Limited price determinations: Final Report,* paragraphs 9.293 to 9.294.

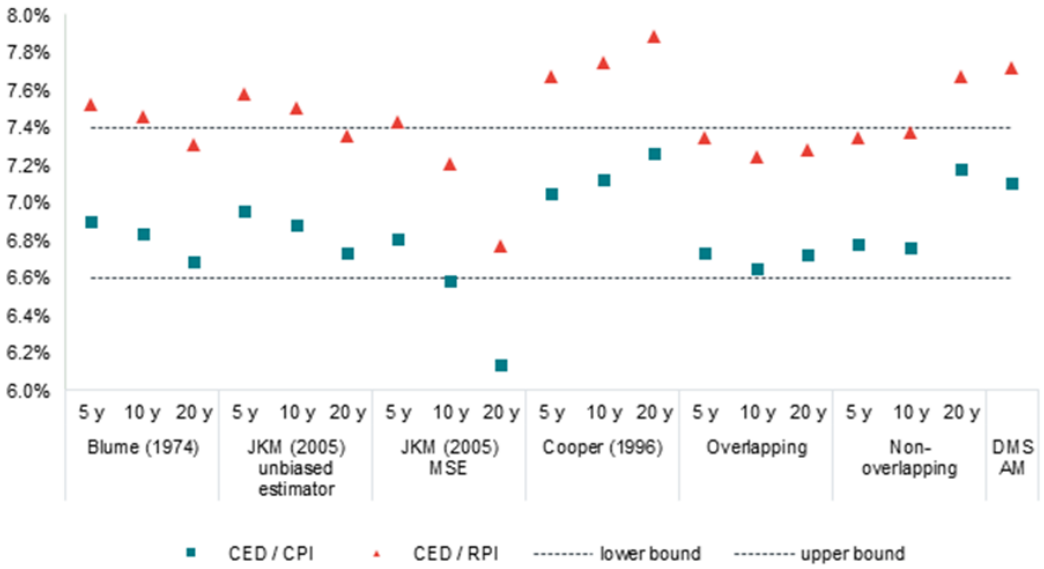
[13] CMA, *Anglian Water Services Limited, Bristol Water plc, Northumbrian Water Limited and Yorkshire Water Services Limited price determinations: Final Report,* paragraphs 9.295.

[14] We note that the 2021 DMS Yearbook has recently been published which includes data for 2020. However, the return in 2020 has been heavily influenced by the COVID crisis and is therefore likely to distort the result downward (e.g. the recent market recovering due to the re-opening was not included in the DMS 2021 data). We therefore caution against putting too much weight on this particular edition of the DMS data.

estimators, as well as overlapping and non-overlapping averages. With regards to holding periods, we look at 5, 10 and 20 years.

Figure 1 shows each of the resulting TMR estimates, and plots our recommended range. Considering all of the evidence presented, we note that the JKM (MSE) estimator assuming a 20-year holding period, appears to be an outlier. Additionally, the values obtained from the Cooper method at the upper end of the range could also be considered outliers. In deciding on an appropriate range, we therefore exclude the value obtained from the JKM (MSE) estimator assuming a 20-year holding period, and instead base our lower bound on the JKM (MSE) estimator for the 10-year holding period, and the 10-year overlapping average. Our upper bound takes a simple average across all CED/RPI estimates.

Figure 1 Evidence for TMR range



Source: Frontier Analysis of DMS Yearbook, 2020

When all of the above is taken into account, excluding obvious outliers, the evidence appears to support a range of 6.6% to 7.4% in CPI real terms. We note that we obtain the same average regardless of whether the Cooper estimates are included or excluded.

4 BETA

Since WPD is not a listed company, we cannot directly estimate its unlevered equity beta. Instead, we estimate an implied unlevered beta based on a set of comparators which is then used to inform the asset and equity beta for WPD. This is done using the following steps:

- We first calculate raw equity betas for a sample of listed companies which are comparable to WPD. This is done by regressing the return for each company against the overall stock market return;
- Secondly, we then remove the impact of the sample companies' gearing using the Harris-Pringle formula, obtaining the sample companies' unlevered betas. This provides a range of unlevered betas which we can use to inform our estimate of the level of unlevered beta most relevant for WPD;
- Finally, we use these inputs to compute the implied asset beta for WPD, which is then re-geared by the notional gearing levels to calculate WPD's notional equity beta.

When calculating the raw equity and unlevered betas, we have to make a number of technical decisions. These are i) the choice of comparator sample, ii) the frequency of data to use, and iii) the estimating window and averaging periods to use. We can draw on finance text book best practice as well as recent regulatory precedent to help inform these methodological choices. Below, we set out the regulatory precedent on beta estimation, and outline our approach.

4.1 Regulatory precedent

Debt beta

In recent price control determinations, there has been relatively less focus on the debt beta, compared with the unlevered beta for example. The debt beta represents the relative risk of the return on debt relative to the market portfolio. The required return on equity is reduced if the debt beta is positive, as some of the risk absorbed by debt investors rather than equity shareholders.

In PR19, Ofwat commissioned Europe Economics (EE), who used a decomposition approach to provide an estimate of the debt beta. This resulted in a point estimate of 0.125. Although the CMA took account of this evidence, it noted that "the debt beta is difficult to measure and has a relatively small effect on the overall WACC".[15] Based on the evidence presented by both Ofwat and the disputing companies, the CMA set a range for the debt beta of 0.05 to 0.10, with a point estimate of 0.075. This represents a decrease from the CMA's provisional findings, where it originally proposed a range of 0.0 to 0.015. [16]

[15] CMA, *Anglian Water Services Limited, Bristol Water plc, Northumbrian Water Limited and Yorkshire Water Services Limited price determinations: Final report,* paragraph 9.517.

[16] CMA, *Anglian Water Services Limited, Bristol Water plc, Northumbrian Water Limited and Yorkshire Water Services Limited price determinations: Provisional findings,* paragraph 9.315

Ofgem also recognised the uncertainty with setting the debt beta, stating that "estimating the debt beta involves considerable regulatory judgement",[17] and considered evidence from the UKRN report, as well as company business plans and regulatory precedent.[18] Ofgem ultimately concluded on a point estimate of 0.075, noting that this was the midpoint of CMA's PR19 provisional findings range.

Unlevered beta

UK regulators have taken a broadly consistent approach with regards to estimating the unlevered beta for a notional company, with minor differences around comparator sample, data frequencies and averaging periods.

Ofwat and the CMA both limited their samples to Severn Trent and United Utilities, with Ofwat noting that including Pennon and other utilities would introduce "a component of non-water sector risk to returns".[19] Ofwat then used daily, weekly and monthly data frequencies with 1, 2 and 5-year estimation windows. In determining a point estimate, Ofwat relied on the 2-year daily estimate on the basis that this would provide sufficient data points and include recent data. It also noted that this approach had historically been a good indicator of betas in the succeeding 5 year period.[20]

Conversely, the CMA disagreed with using a 2-year estimation window on the grounds that this could be too short-term and subject to noise. [21] It therefore considered daily, weekly and monthly frequencies, using 2, 5 and 10-year estimation windows and 1, 2 and 5-year rolling averages. Both the CMA and Ofwat concluded on a point estimate for the unlevered beta of 0.29.

Ofgem considered a wider sample, looking at National Grid and Pennon, in addition to Severn Trent and United Utilities. It also presented unlevered beta estimates for SSE, but chose not to include these in the beta averages due to SSE's estimates also capturing the higher risk of its retail supply and generation businesses.[22] Consistent with the CMA, Ofgem also used 2, 5 and 10 year estimation windows and a range of averaging periods, deciding on a range of 0.285 to 0.335, with a point estimate of 0.311.

4.2 Estimation approach

Debt beta

Given the challenges of estimating the debt beta are widely recognised, we follow regulatory precedent to inform our range here. In its PR19 redetermination, the CMA used a range of 0.05 to 0.10, with a point estimate of 0.075, and as Ofgem also used this point estimate. Although in our view this is likely to be an over-estimate, in recognising the high level of uncertainty involved in debt beta

[17] Ofgem, *RIIO-2 Final Determinations Finance Annex Revised,* paragraph 3.67.

[18] Ofgem, *RIIO-2 Final Determinations Finance Annex Revised,* paragraph 3.64.

[19] Ofwat, *PR19 Final Determinations – Allowed Return on Capital Technical Appendix,* p.62.

[20] Ofwat, *PR19 Final Determinations – Allowed Return on Capital Technical Appendix,* p.65.

[21] CMA, *Anglian Water Services Limited, Bristol Water plc, Northumbrian Water Limited and Yorkshire Water Services Limited price determinations: Final report,* p.859.

[22] Ofgem, *RIIO-2 Final Determinations Finance Annex Revised,* p.42 to 43.

estimation and the relatively immaterial effect of debt assumption in the overall cost of equity calculation (as long as the assumption is consistently employed in both the de-gearing step and the re-gearing step), we elect to following the regulatory precedent.

Unlevered beta

As noted in Section 4, there are three main areas in which we have to make technical decisions when estimating the unlevered beta which cover the comparator set used, the data frequency and the estimation windows and averaging periods.

4.2.1 Selecting the comparator set

With regards to the comparator set, we aim to select comparators that are reasonably similar to WPD but still ensure a sufficient sample size. Given there are only two publicly listed energy companies in GB, Ofgem included the listed water companies in its sample for the recent RIIO-2 determinations.

Whilst it is useful to include the three water companies in the sample given that they are GB utility companies, water networks tend to be subject to lower risk than energy companies. This is evident from the lower water betas in Ofgem's estimates which persisted across all estimation approaches.[23] However, given the limited number of available companies, it is reasonable to with regards to using a sample of GB comparators which includes National Grid as the pure play energy network, and the three water companies, Severn Trent, Untitled Utilities and Pennon. However, we note that given water companies tend to be lower risk, this could result in underestimating the unlevered beta for WPD. Additionally, whilst NG is the closest comparator to WPD, it only operates in the transmission sectors, unlike WPD which operates in the electricity distribution sector. To reduce the risk of underestimating the beta for WPD, and to ensure sufficient similar comparators, we can expand the comparator sample to also include European companies.

When widening the sample to include European comparators, we need to ensure that the level of risk these companies are exposed to is comparable to the GB companies. In a report prepared for National Grid,[24] we identified a number of criteria that could be used to assess the suitability of the European networks for inclusion. This assessed each potential comparator on the basis of

- the comparability of its regulatory regime to GB,
- the liquidity of the company, and
- its share of regulated activities.

We draw on this assessment here to provide a final comparator sample consisting of the companies listed in Figure 2.

[23] Ofgem, *RIIO-2 Sector Specific Methodology Annex: Finance,* Table 10.

[24] https://www.nationalgrid.com/uk/electricity-transmission/document/134626/download

Figure 2 Unlevered beta comparator set

Comparator	Network type	Country
National Grid		Great-Britain
Severn Trent	Water	Great-Britain
United Utilities	Water	Great-Britain
Pennon Group	Water	Great-Britain
Elia	ET	Germany
Red Electrica	ET	Spain
Enagas	GT	Spain
Endesa	ED	Spain
REN	ET	Portugal
Terna Rete	ET	Italy
Snam	GT	Italy
Enel	ED	Italy

Source: Frontier analysis

When presenting our estimates we show the simple average of the unlevered beta estimates with the comparator set split into the following samples:

- the overall comparator set listed above;
- the sample of European energy networks only;
- the sample of GB water companies only; and
- the sample of the GB energy network only (i.e. National Grid).

Data frequency

The data used in the estimation can be based on different frequencies such as hourly, daily, weekly or monthly. It is important to ensure that the data provides a sufficient sample size and is not influenced by factors such as reference day issues. For example, using monthly data would result in a smaller sample size and there would be challenges with ensuring the same reference days are available in each month. We consider that daily betas tend to avoid these issues and this is consistent with what Ofgem uses.

Estimation windows and averaging periods

Selecting estimation windows (i.e. the time period over which data will be included for the regressions) and averaging periods (i.e. whether estimates coming out of the regression are then averaged over a certain period of time) also suffers from similar challenges as the data frequency decision. There is trade-off between capturing recent market conditions and having estimates that are subject to short-term market volatility, which may be unreflective of the market more generally. Spot estimates for example, vary between days and weeks so using a short term averaging period or estimation window, such as one year, can impact the beta estimations. Likewise, there are also limitations with using longer windows, such as 10 years. Long widows avoid the issue of short term volatility but may also be unreflective of the market today. Data impacted by the Global Financial Crisis (GFC) for example would be included in a 10-year estimation window. Given that

there are advantages and disadvantages associated with both short and long-term estimation windows and averaging periods, it is reasonable to consider a range of estimation approaches before coming to a conclusion. We therefore present 2, 5 and 10 year windows covering spot rates, 2, 5 and 10 year averages for the samples listed above.

Estimation results

Figure 3 below shows the resulting unlevered beta estimates using data up to 31st March 2021. The sample which only includes National Grid (NG), has an average of 0.33 across all estimation windows and averaging periods. This is marginally higher for the sample of EU energy networks at 0.34. Consistent with Ofgem's analysis, we find that the water companies exhibit evidence of being lower risk than the energy networks, with an average unlevered beta of 0.29 from a range of 0.27 to 0.33. Excluding the 10 year estimation windows or averaging periods suggests the GFC may influence estimates, with this resulting in slightly higher figures, such as new averages of 0.35 and 0.36 for NG and the EU networks respectively.

Figure 3 Unlevered beta estimates

Estimation window	Averaging period	Overall sample	EU networks	GB water networks	NG
2 years	Spot rate	0.36	0.39	0.27	0.34
2 years	2 years	0.34	0.36	0.27	0.33
2 years	5 years	0.34	0.35	0.32	0.35
2 years	10 years	0.32	0.33	0.30	0.32
5 years	Spot rate	0.34	0.36	0.28	0.35
5 years	2 years	0.34	0.35	0.31	0.35
5 years	5 years	0.34	0.34	0.33	0.36
5 years	10 years	0.31	0.31	0.30	0.32
10 years	Spot rate	0.33	0.34	0.29	0.33
10 years	2 years	0.32	0.33	0.29	0.31
10 years	5 years	0.30	0.31	0.29	0.32
10 years	10 years	0.30	0.31	0.29	0.32
Average		**0.33**	**0.34**	**0.29**	**0.33**
Average excl. 10Y windows or averaging periods		**0.34**	**0.36**	**0.30**	**0.35**

Source: Frontier analysis of Bloomberg data.

Note: Data is correct as of 31st March 2021. Spot rates are also based on 31st March data.

In addition to the data shown above, given that Covid-19 is likely to be a one-off event, unrepresentative of market data generally, we also perform our estimates using data up until the end of February 2020. This shows a broadly similar trend, with regards to water companies exhibiting lower risk than the other samples, however the water companies also provide lower betas when Covid-19 data is included, whereas the opposite is true for energy companies. The results are shown in Figure 4.

Figure 4 Pre-Covid-19 unlevered beta estimates

Estimation window	Averaging period	Overall sample	EU networks	GB water networks	NG
2 years	Spot rate	0.31	0.32	0.29	0.29
2 years	2 years	0.34	0.35	0.30	0.35
2 years	5 years	0.34	0.34	0.34	0.37
2 years	10 years	0.31	0.31	0.29	0.32
5 years	Spot rate	0.34	0.33	0.34	0.35
5 years	2 years	0.34	0.34	0.35	0.37
5 years	5 years	0.33	0.33	0.33	0.34
5 years	10 years	0.30	0.30	0.30	0.32
10 years	Spot rate	0.31	0.32	0.30	0.31
10 years	2 years	0.30	0.31	0.28	0.31
10 years	5 years	0.30	0.30	0.29	0.32
10 years	10 years	0.30	0.30	0.29	0.32
Average		**0.32**	**0.32**	**0.31**	**0.33**
Average excl. 10Y windows or averaging periods		**0.33**	**0.34**	**0.32**	**0.35**

Source: Frontier analysis of Bloomberg data

Note: Data up to and including the 28th February 2020 is used.

With regards to setting an overall range based on the estimates presented, given the lower risk of the water sector, we think it is reasonable to use the water company betas to inform the lower bound of the range. The water sample itself has an average range of 0.29 to 0.32. Additionally, based on the CMA setting a range of 0.28 to 0.20 for PR19, we consider 0.30 as a reasonable lower bound. Given the potential market volatility driven by the GFC, which is captured in the longer windows and averaging periods, we exclude these from informing our upper bound. If we consider NG and the EU energy networks on this basis, we obtain values of 0.35, and 0.34 to 0.36 respectively. Given there is greater risk associated with underestimating the betas, we set 0.36 as the upper bound.

In addition, we note that the CMA has preferred the use of Eurostoxx index to estimate European comparators in its NATS redetermination.[25] We have tested our beta estimates against various Eurostoxx indices, and the resulting estimates are either similar or above our estimates obtained against national all share indices. This provides further headroom that our high end estimate of 0.36 can be considered conservative if European comparators are fully taken into account.

4.3 Overall beta estimate

Based on the inputs above, we can use the Harris-Pringle formula to estimate an overall equity beta range for WPD of 0.73 to 0.88. This is shown in Figure 5.

[25] NATS En-route Limited (NERL) Price Determination, November 2019.

Figure 5 Beta estimate

Parameter	Lower bound	Upper bound
Unlevered beta (A)	0.30	0.36
Debt beta (B)	0.1	0.05
Observed gearing across the sample (C)	50%	44.5%
*Asset beta (D = A + B*C)*	*0.35*	*0.38*
Notional gearing (E)	60%	60%
*Equity beta (F = [D – E*B] / [1-E]*	*0.73*	*0.88*

Source: Frontier analysis

5 AIMING UP

Regulators generally aim up when setting a point estimate for the WACC allowance, rather than selecting the mid-point of the range. This is due to the fact that estimating the WACC involves a considerable amount of uncertainty, and costs associated with under- or over-estimating the WACC are asymmetric. This is due to the consequences of setting the WACC too low, which is likely to cause under-investment in the network and ultimately disruption to service, are greater than the consequences of setting the WACC too high, which leads to marginally higher tariffs for consumers.

For the RIIO-T2 and RIIO-GD2, Ofgem chose not to explicitly include aiming up. It argued that the companies operating within RIIO-2 were not exposed to "perfectly asymmetric risks", and the design of RIIO-2 already includes uncertainty mechanisms to protect companies.[26] However, this decision is not consistent with the vast majority of GB regulatory precedent. For its PR19 determination, the CMA also published a working paper on aiming up. It outlined three main areas due to which aiming up is likely to be necessary. These covered the following:

- The level of investment in the water sector could be affected by the WACC point estimate.
  - It is important that there is a cautious approach to setting the cost of capital so that long-term investors in infrastructure are attracted to the sector, the WACC should therefore be set in a way that does not respond too quickly to fluctuating market conditions.
  - The right level of investment needs to be encouraged and if the WACC is set too low, the incentive for companies to identify new investment programmes is reduced.
- Uncertainty around the distribution of the different WACC parameters.
  - There may be asymmetry within the choice of parameters. The CMA noted that some parameters are subject to greater uncertainty around the correct estimation approach, such as the RFR or TMR, and there is judgement involved with where to set the range. The CMA considered each of the cost of equity parameters and whether the chosen range is likely to be symmetric. It concluded that "*outside of the TMR there may be a mild bias for the assumptions that indicate a higher cost of equity than suggested by the midpoint of our range*".[27]
- Financeability.
  - The CMA noted that the CAPM model could be used to provide a wide range of outcomes for the cost of equity which could result in obtaining a WACC which is too low to ensure investment-grade credit metrics, and that financeability should therefore remain a consideration.[28]

[26] Ofgem, *RIIO-2 Final Determinations Finance Annex Revised,* p.67 to 68.

[27] CMA, *Water redeterminations: Choosing a point estimate for the cost of capital – Working Paper,* paragraph 73.

[28] CMA, *Water redeterminations: Choosing a point estimate for the cost of capital – Working Paper,* paragraphs 95 to 98.

Taking all of the above into account, in its final PR19 decision, the CMA concluded that "there are a number of benefits from choosing a point estimate of the cost of equity above the middle of the range."[29] It concluded with aiming up 25bps above the mid-point of the range on the cost of equity.

In addition to the arguments put forward by the CMA above, there is strong evidence of previous GB regulatory decisions including an element of aiming up, either within the cost of equity, or the overall WACC range. Figure 6 provides a list of these previous determinations. It should also be noted that these decisions are supported by academic evidence. Two main papers have been published in this area which have studied when it is optimal to aim up. The papers by Wright, Mason and Miles (2003)[30] and Dobbs (2011)[31] both found that it is optimal to aim up when demand is inelastic, which is particularly relevant to utility companies.

Given the evidence available, the risks of setting the WACC too low combined with the uncertainty involved with setting the range for the cost of equity parameters suggest that an element of aiming up is appropriate. Follow the CMA's approach where it aimed up 25 bps above the mid-point of its cost of equity range for the water companies, we consider that a higher amount of aiming up, 40 bps, would be more appropriate for the electricity distribution networks given the investment at stake in the context of government's net zero agenda. Based on an overall cost of equity range of 4.33% to 6.45% obtained from the parameters outlined above, aiming up provides a point estimate of 5.80%.

[29] CMA, *Anglian Water Services Limited, Bristol Water plc, Northumbrian Water Limited and Yorkshire Water Services Limited price determinations: Final report,* paragraph 9.1402.

[30] Wright, Mason and Miles, 2003, *A study into certain aspects of the cost of capital for regulated utilities in the UK.*

[31] Dobbs, 2011, *Modelling welfare loss asymmetries arising from uncertainty in the regulatory cost of finance*.

Figure 6 Evidence of aiming up within previous GB decisions

Regulatory decision	COE range (point) %[1]	COE percentile	WACC range (point) %[2]	WACC percentile
CMA				
Bristol Water (Oct 2015)	5.45 – 6.01 (5.73)	50th[3]	3.63 – 3.93 (3.78)	50th[3]
NIE (Mar 2014)	3.4 – 5.0	-	3.3 – 4.1 (4.1)	100th
Bristol Water (Jun 2010)	3.6 – 6.6	-	3.8 – 5.0 (5.0)	100th
Stanstead (Oct 2008)	5.0 – 8.2	-	5.20 – 7.54 (7.1)	81st
Gatwick (Oct 2007)	5.0 – 8.4	-	4.9 – 6.8 (6.5)	84th
Heathrow (Oct 2007)	4.8 – 7.7	-	4.8 – 6.4 (6.2)	88th
Ofgem				
RIIO-ED1 (Nov 2014)	4.0 – 6.0 (6.0)	100th		
RIIO-GD1 (Dec 2012)	6.0 – 7.2 (6.7)	58th		
RIIO-T1 NGET (Dec 2012)	6.0 – 7.2 (7.0)	83rd		
RIIO-T1 NGG (Dec 2012)	6.0 – 7.2 (6.8)	67th		
DPCR5 (Dec 2009)	6.3 – 7.0 (6.7)	57th		
GDPCR (Dec 2007)	7.0 – 7.5 (7.25)	50th[4]		
TPCR4 (Dec 2006)			2.8 – 4.8 (4.4)	80th
Ofwat				
PR19 (Dec 2019)[5]	3.16 – 5.11 (4.19)	53rd		
PR14 (2014)	4.9 – 5.7 (5.65)	94th		
PR09 (2009)	3.5 – 7.2 (7.1)	97th		
CAA				
Q6 – HAL (2013)	5.68 – 7.61 (7.33)	85th		
Q6 – GAL (2013)	5.68 – 7.71 (7.43)	86th		

Source: Frontier Economics based on CMA, Ofgem, Ofwat and CAA decisions

Note: [1]COE range and point estimates are post-tax.

[2]WACC range and point estimates for Bristol Water and NIE are vanilla WACC, the airports are pre-tax WACC, and TPCR4 is post-tax WACC as reported in decision documents.

[3]Although the CMA did not aim up within the final range the CMA aimed up through its choice of the very top of the TMR range from the NIE (2014) decision

[4]Although Ofgem aimed straight within its Final Proposals range, it aimed up to the 75th percentile within its Initial Proposals range of 6.5%-7.5%.

[5]All figures are in RPI-real terms except for Ofwat's PR19 decision which is in CPIH-real terms.

6 OVERALL COST OF EQUITY

Figure 7 shows each of the parameters estimated above and the resulting estimate for the cost of equity. we consider the appropriate range for the cost of equity over RIIO ED2 is 4.33% to 6.45%, with a mid-point of 5.39%. As outlined, the need to aim up suggests that the appropriate allowed return on equity should be set at no lower than 5.8%.

While the top end of the range found by our analysis of CAPM supports a number well above 6.0%, in our view the balance of evidence at this time suggests that the true value is more likely to be below 6.0%. At this stage we therefore adopt a truncated working assumption of a range from 5.8% to 6.0%, and rely on a point estimate of 5.8%, at the bottom of this range. We will keep this range under review as evidence evolves.

Figure 7 Overall cost of equity

	Low	High
Gearing		
Notional gearing	60%	60%
Observed gearing	50%	45%
Risk-free-rate	-1.61%	-0.88%
Equity risk premium	8.19%	8.32%
Total market return	6.58%	7.44%
Debt beta	0.10	0.05
Asset beta	0.35	0.38
Equity beta	0.73	0.88
Post-tax cost of equity	4.33%	6.45%
Mid-point	5.39%	
Aiming up	>0.4%	
Point estimate	5.80%	

Source: Frontier analysis

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