Risk premium on assets relative to debt

Benchmarking CAPM-implied equity returns

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Contents

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Figures and tables

Executive summary

In our February 2018 report for the ENA on setting the appropriate cost of equity for RIIO-2, we compared the output from a CAPM-based calculation of the cost of equity with evidence from debt markets.[1]

This report develops the evidence base to ensure that the allowed returns set by the regulator for equity are commensurate with the risk associated with operating and owning the associated assets. This is intended to help determine whether the building blocks of the capital asset pricing model (CAPM) add up to a realistic estimate of the cost of equity capital. While there is much discussion on the individual building blocks of the CAPM—including the risk-free rate, the asset and equity betas and the equity risk premium—there is little discussion on whether the resulting overall cost of equity capital provides a 'sensible market-based' result.

The proposed test is intended to fill that gap. It is based on the relationship between the asset risk premium (ARP) and debt risk premium (DRP) of a given company. Since the claim for interest and repayment of principal to the debt holders has priority over dividend payments to equity holders, the risk premium required by debt holders must be less than the risk premium required by equity holders. This rule must hold not only for the levered equity but also for the unlevered equity. In other words, the risk of the assets is always greater than the risk of the debt of the same company. This should be evident, since the debt beta will always be below the asset beta at levels of gearing below 100%.

To undertake the analysis, the following estimates must be made.

- **asset risk premium:** the expected excess return to holding risky assets compared to riskless assets.
- **debt risk premium:** the expected excess return to holding risky debt relative to riskless assets.

Results

We test the CPIH-deflated cost of equity of 4.5% based on the middle of the range of expected returns as estimated in the sector-specific methodology (i.e. step 2 of the methodology Ofgem has used to calculate the cost of equity).[2] We calculate the ARP–DRP differential implied by the 4.5% to be around 60bp (using a debt beta assumption of 0.05).[3] This is then compared with the distribution of the ARP–DRP differential based on evidence from three sources:

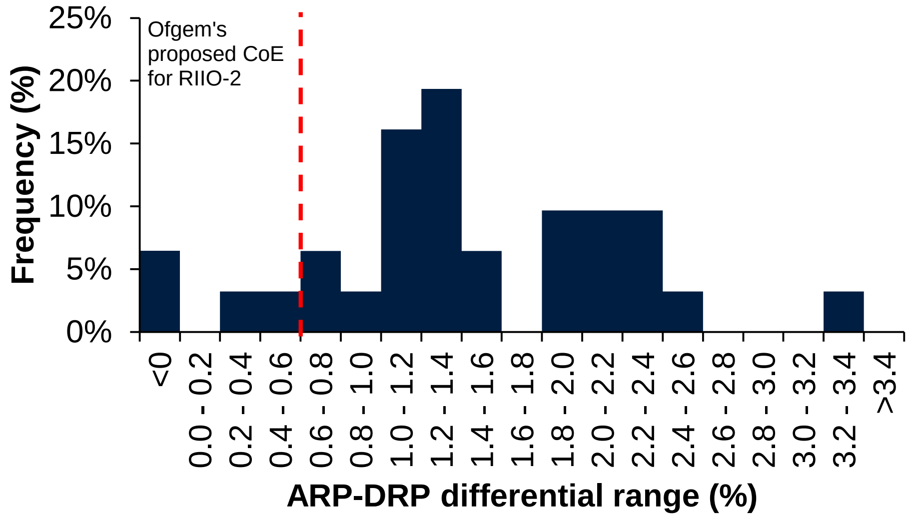
1. UK regulatory precedents;
2. bonds issued by UK utilities and regulated entities; and
3. bonds issued by US utilities.

The location of the 4.5% CPIH-deflated cost of equity in each of the three distributions is shown below. In each case, the 4.5% cost of equity proposed in the sector-specific methodology (based on expected returns) is well below what the empirical evidence suggests an investor would require as compensation for risk. The implied ARP–DRP differential is in the bottom 15%

[1] Oxera (2018), 'The cost of equity for RIIO-2', 28 February, p.49.
[2] Ofgem (2018), 'RIIO-2 Sector Specific Methodology Annex: Finance,' 18 December, Table 16.
[3] The findings are robust to a sensitivity analysis using a 0.10 debt beta. See Appendix A4.

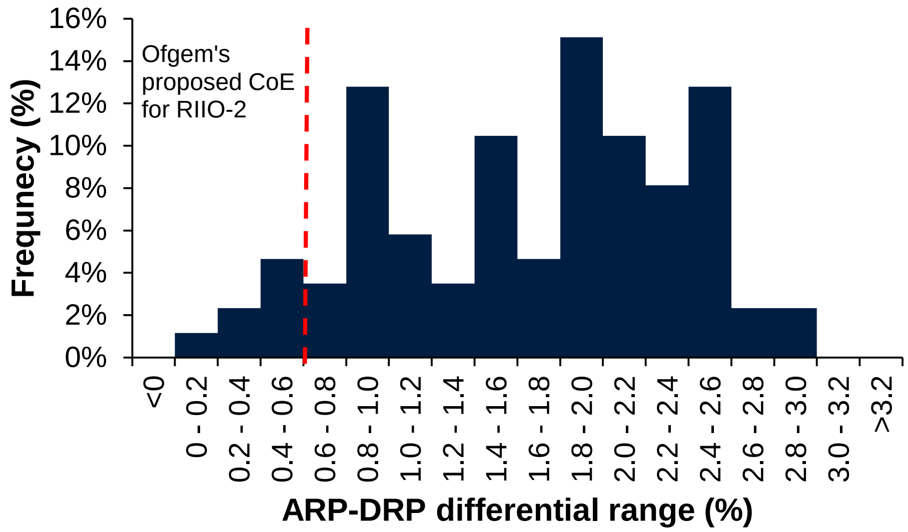
of all the distributions, and the bottom 10% for the evidence based on bonds issued by UK and US utilities. This indicates that the sector consultation estimates for the asset beta and/or the equity risk premium are too low relative to the market price of debt risk.

Distribution of ARP–DRP differential for UK regulatory precedents



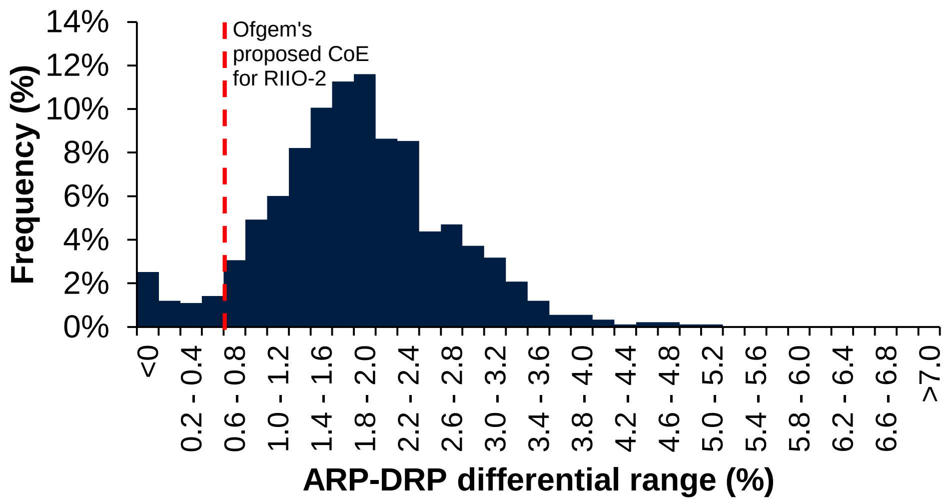
Source: Oxera analysis

Distribution of ARP–DRP differential for bonds issued by UK utilities



Source: Oxera analysis

Distribution of ARP–DRP differential for bonds issued by US utilities



Source: Oxera analysis.

The cost of equity range we proposed for RIIO-2 in February 2018 implies an ARP–DRP differential in the 30–45th percentile of our analysis of bonds issued by UK utilities, in the 30–50th percentile of our analysis of bonds issued by US utilities, and is at the 60-65th percentile of previous regulatory precedents. This is more in line with what investors require as compensation for risk.

Further indications of the size of adjustments that would bring the sector-specific proposals more in line with the benchmarks on the ARP–DRP differential are as follows. For example, for the cost of equity to be at the 40th percentile of the distribution of previous regulatory precedents, we would need to add around 60bp to the ARP implied by step 2 of the sector-specific methodology. As the notional gearing proposed for RIIO-2 is 60%, this implies that approximately 150bp would need to be added to the cost of equity.[4]

Alternatively, for the Ofgem proposals to be at the 60th percentile of the UK utilities distribution, we would need to add 80bp to the Ofgem midpoint ARP and approximately 200bp to the Ofgem cost of equity. We note that the market evidence suggests that a larger adjustment is required to Ofgem's proposed cost of equity for RIIO-2 than when using regulatory precedents as the benchmark.

Finally, we note that the headline cost of equity allowance proposed by Ofgem is 4.0%, not the 4.5% we have tested in this report. The 4.0% is based on the third step of the Ofgem methodology for setting the cost of equity allowance. This step makes a downward adjustment based on an assumption that investors will expect companies to out-perform regulatory targets during RIIO-2. This adjustment moves the headline cost of equity further away from what the evidence suggests equity investors require as a rate of return to compensate for the higher risk of equity relative to debt.

Conclusion

The evidence from the debt markets suggests that the allowance for the cost of equity in the sector-specific methodology is insufficient to compensate for the

[4] The asset risk premium is an unlevered equity risk premium. This can be converted to an approximate levered equity risk premium by dividing by the share of equity in the capital structure (i.e. dividing by 0.4). This adjustment assumes that only the asset beta is changing and that the other parameters such as the ERP and TMR are held constant. If one were to assume multiple changes, or if parameters other than the asset beta were to change, the change to the cost of equity would differ from that reported.

relative risk of holding equity rather than debt in the same asset. This suggests that the combination of assumptions used for the CAPM parameters is extreme, and that one or more of the parameters should be revised upwards to provide a sensible market-based result for the cost of equity.

1 Introduction

A fundamental principle of finance is that holders of assets with higher risk expect a higher return.[5] This principle underlines the financial models (e.g. the capital asset pricing model, CAPM) used by all UK regulators, and regulators in other countries. A breach of this principle would suggest that investors are willing to take on risk without adequate compensation, or even have an appetite for risk, rather than being risk-averse. This would conflict with both theory and empirical evidence that investors are risk-averse.[6]

A common measure that relates risk to return is the beta metric, as used in the CAPM. The asset beta of the company (β_a) is equal to the weighted average of its equity beta (β_e) and its debt beta (β_d). This is shown in the equation below.

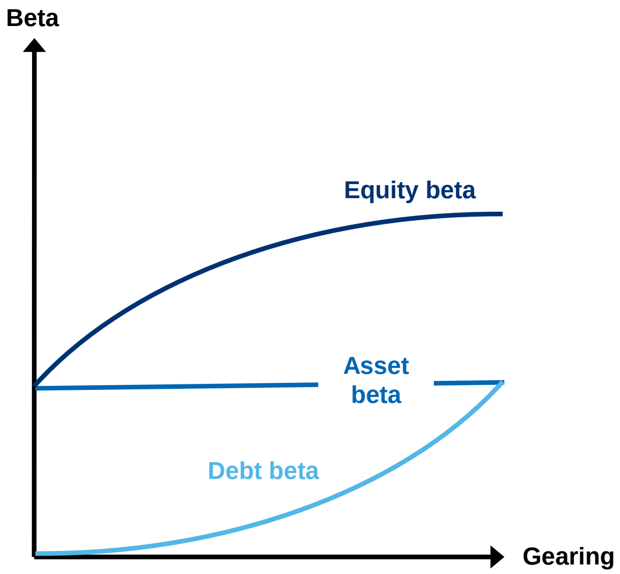
Decomposition of asset beta

$$\beta_a = \frac{E}{D+E}\beta_e + \frac{D}{D+E}\beta_d$$

$\boldsymbol{\beta_a}$ asset beta; $\boldsymbol{E}$ market-value of equity; $\boldsymbol{D}$ market-value of debt, $\boldsymbol{\beta_e}$ equity beta; $\boldsymbol{\beta_d}$ debt beta

According to the Modigliani–Miller (MM) theorem (Proposition I), the asset beta is constant irrespective of the company's gearing.[7] Debt is less risky than equity because it has higher priority in receiving both interest payments and repayment of principal in the event of bankruptcy. It follows that expected returns on debt will be lower than the expected return on assets, and that one would expect the debt beta of a company to be lower than its asset beta. This relationship is shown below.

Figure 1.1 Modigliani-Miller theorem, Proposition I (hypothetical example)



Source: Oxera analysis.

[5] Assuming that the investors are risk-averse.
[6] For a discussion on the empirical evidence, see Ghysels, E., Santa-Clara, P. and Valkanov, R., (2005), 'There is a risk-return trade-off after all', *Journal of Financial Economics*, **76**:3, pp. 509–48. Evidence of a risk-return trade-off suggests that investors are risk-averse.
[7] Proposition I states that when there are no transaction costs and no difference in the cost of borrowing across agents, a firm's cost of capital is constant regardless of the firm's capital structure. The theorem also applies to the asset beta (unlevered beta)—if a firm's weighted average cost of capital (WACC) is constant, the asset beta must also be constant.

In our report for the ENA on setting the appropriate cost of equity for RIIO-2, we described alternative sources of evidence to compare against our proposed cost of equity.[8] We described three alternative sources of evidence; the asset risk premium, individual stock DDM and regulatory precedent.[9] This report focuses on the first alternative source of evidence.

1.1 Asset risk premium

As noted earlier, higher risk should be commensurate with a higher expected return. Often, the returns on risky assets are compared with the returns on riskless assets. Typically, government debt is used as a proxy for a risk-less asset.[10]

The excess expected return over this benchmark is called the asset risk premium (ARP). Under the CAPM, the ARP is calculated as asset beta multiplied by the equity risk premium (ERP), in turn calculated as the excess of the expected total market return (TMR) over the risk-free rate. This is shown in the equation below.

Asset risk premium

$$ARP = \beta_a * ERP$$

$\boldsymbol{ARP}$ asset risk premium; $\boldsymbol{\beta_a}$ asset beta; $\boldsymbol{ERP}$ equity risk premium

The ARP requires an assumption to be made about the expected TMR. The other parameters can be estimated and obtained directly from publicly available data. As the asset becomes more risky (as measured by β_a), the ARP also increases.

1.2 Debt risk premium

The excess return expected by debt holders relative to riskless assets is called the debt risk premium (DRP). There are two ways of measuring the DRP.

Measuring the debt risk premium

Approach 1:

$$DRP = YTM - expected\ loss - RfR$$

Approach 2:

$$DRP = \beta_d * ERP$$

$\boldsymbol{DRP}$ debt risk premium; $\boldsymbol{YTM}$ yield to maturity; $\boldsymbol{RfR}$ risk-free rate; $\boldsymbol{\beta_d}$ debt beta; $\boldsymbol{ERP}$ equity risk premium

Conceptually, the difference between the two Approaches can be summarised as the following. Approach 1 is a top-down approach to disaggregate credit spreads into the proportion of the credit spread that is explained by systematic factors. Approach 2 is a bottom-up approach to directly estimate the compensation for bearing systematic risk.

The two approaches would be expected to generate different results because typically there is a residual component of the credit spread that cannot be explained by expected loss or the debt beta.[11] In other words, despite the

[8] Oxera (2018), 'The cost of equity for RIIIO-2', 28 February, p.49
[9] Oxera (2018), 'The cost of equity for RIIIO-2', 28 February, p.49
[10] No truly risk-less asset exists in the real world, therefore a proxy needs to be found.
[11] Webber, L. and Churm, R. (2007), 'Decomposing corporate bond spreads', *Bank of England Quarterly Bulletin Q4*, pp. 533–541.

theoretical support for Approach 2, credit spreads observed in the market can only be explained by assuming very high debt betas. We therefore provide detailed empirical analysis in this report using both of these approaches.

Under Approach 1, the calculation of the DRP requires an estimate of the expected loss from default. Our calculation is explained below.

Expected loss

$$Expected\ loss = ADR * LGD$$

$$LGD = 1 - RR$$

$\boldsymbol{ADR}$ annualised default rate; $\boldsymbol{LGD}$ loss given default; $\boldsymbol{RR}$ recovery rate

Annualised default rate is the chance of a borrower defaulting in a given year. For our analysis we take the cumulative default rates (**CDR**) from Table 8 of Feldhütter, P. and Schaefer, S.M., (2018), 'The myth of the credit spread puzzle', *The Review of Financial Studies*, **31**:8, pp.2897-2942. We then adjust these cumulative default rates using the formula:

$$ADR = 1 - (1 - CDR)^{(1 - length\ of\ bond)}$$

The recovery rate reflects the value of a security after default. This is positively correlated with seniority of debt. We take the recovery rates reported by Moody's as our source of recovery rates.[12]

We calculate the expected loss to be equal to 30bp for senior unsecured debt based on the evidence of loss given default on A and BBB bonds.[13] For senior secured bonds, such as those issued by Affinity Water, the loss given default is assumed to be lower (as the recovery rate is higher), and we calculate a lower expected loss equal to 20bp.[14]

Our expected loss calculation uses annualised default rates that are higher than those reported by Moody's. Using Moody's reported default rates would have produced a lower expected loss assumption of 10bp.[15]

In the Appendix to this report, we present the implied ARP–DRP differential expected by investors using Approach 2. We note the level of the ARP–DRP differential calculated under Approach 2 is higher than Approach 1. As noted earlier, this difference is driven by the component of the credit spread that cannot be explained by expected loss or debt beta.

1.3 ARP–DRP differential

From financial theory, we can make the following predictions about the ARP–DRP differential. First, the ARP–DRP differential will not be independent of gearing under Modigliani–Miller Proposition I (see Figure 1.2). This is due to two factors:

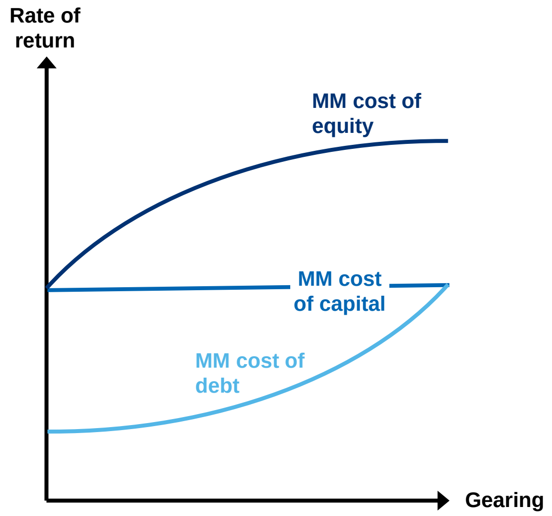
- the ARP is constant irrespective of gearing given the MM propositions,

[12] See Moody's (2019), 'Annual default study: Defaults will rise modestly in 2019 amid higher volatility', 1 February, Exhibit 9.
[13] We assume the loss given default is 60% based on the average recovery rates on senior unsecured bond recovery rates reported by Moody's for A & BBB rated debt. See Moody's (2019), 'Annual default study: Defaults will rise modestly in 2019 amid higher volatility', 1 February, Exhibit 28.
[14] Senior secured debt has a higher recovery rate due to the higher priority claim on a firm's cash flows in the event of default. We assume a loss given default of 40%, based on Moody's (2019), 'Annual default study: Defaults will rise modestly in 2019 amid higher volatility', 1 February, Exhibit 9, and the same annualised default rate as senior unsecured bonds.
[15] Based on the same 60% loss given default previously assumed and the average annual default rates taken from Moody's (2019), 'Annual default study: Defaults will rise modestly in 2019 amid higher volatility', 1 February, Exhibit 37.

- the cost of debt and the DRP will increase with gearing as default risk increases.

As gearing and the cost of debt increases the differential between the ARP and DRP narrows.

Figure 1.2 Modigliani-Miller theorem, Proposition I (hypothetical example)



Source: Oxera analysis.

The second prediction about the ARP–DRP differential relates to how the relationship changes according to a company’s exposure to systematic risk. An increase in exposure to systematic risk is shown by an increase in the asset beta of a company.

Given that debt is less risky than the assets, in absolute terms any changes in the premium for exposure to systematic risk will be greater for assets rather than for debt. Therefore, one would expect that the change in the ARP would be higher than the change in the debt risk premium. As a result, a higher asset beta is consistent with a higher ARP–DRP differential.

These theoretical predictions have helped us to provide controls in the construction of our sample to enable comparability of the ARP–DRP differential across different firms, bonds and regulatory precedents. Construction of the sample without these considerations could lead to biases in any estimates of the appropriate range for the ARP–DRP differential.

1.4 Debt beta

In determining the debt beta assumption for this report, we have consulted leading academics and experts on debt beta including Professor Stephen Schaefer, Professor of Finance at the London Business School. Our empirical analysis presented in our beta report suggests that a debt beta of 0.05 is appropriate for UK utilities.[16] We have assumed this debt beta throughout the remainder of this report.

In previous regulatory precedents, regulators have assumed debt betas typically ranging from 0 to 0.10. We have re-estimated all regulatory precedents assuming a debt beta of 0.05, to improve the comparability

[16] Oxera (2019), ‘Review of RIIO-2 finance issues: The estimation of beta and gearing’, March.

between previous regulatory precedents and our results. In the Appendix, we present a sensitivity on our debt beta assumption assuming a debt beta in line with the bottom of Ofgem's proposed range for RIIO-2, i.e. 0.10. We show that our conclusions are not sensitive to the debt beta assumed.

In re-estimating the asset beta for the regulatory precedents, we undertook the following steps:

1. we obtained the equity beta and gearing from the regulatory precedents as reported;
2. using our debt beta of 0.05, we re-estimated the asset beta for a given regulatory precedent taking the equity beta and gearing from step 1.

1.5 RIIO-2

In the sector-specific methodology consultation, Ofgem provided initial proposals for the cost of equity, the cost of debt and the cost of capital for the gas distribution, gas transmission and electricity transmission companies in Great Britain. The CAPM range implied by Ofgem's analysis and expressed in nominal terms is shown in Table 1.1.

Table 1.1 Ofgem's nominal CAPM-implied cost of equity range

	Ref	Low	High
Notional equity beta	[A]	0.646	0.762
Total market return	[B]	8.42%	8.93%
Risk-free rate	[C]	1.34%	1.34%
CAPM-implied cost of equity	**[D] = [C] + [A]*([B] – [C])**	**5.91%**	**7.12%**

Source: Ofgem (2018), 'RIIO-2 Sector Specific Methodology Annex: Finance,' 18 December, p. 41.

From these proposals, it is also possible to calculate an ARP and DRP differential—see Table 1.2.

Table 1.2 Asset risk premium and debt risk premium differential using Ofgem's nominal CAPM-implied cost of equity range

	Ref	Low	High
Asset beta	[A]	0.35	0.36
Total market return	[B]	8.42%	8.93%
Risk-free rate	[C]	1.34%	1.34%
Equity risk premium	[D] = [B] – [C]	7.08%	7.59%
Asset risk premium	**[E] = [A]*[D]**	**2.47%**	**2.77%**
Spot A/BBB cost of debt[1]	[F]	3.35%	3.35%
Expected loss	[G]	0.30%	0.30%
Debt risk premium	**[H] = [F] – [C] – [G]**	**1.71%**	**1.71%**
ARP–DRP differential	**[I] = [E] – [H]**	**0.76%**	**1.06%**

Note: [1] Taking the yields on the iBoxx A and BBB 10-year+ indices on the same day as Ofgem for its risk-free rate (26 October 2018) and averaging the two in line with Ofgem's methodology for setting the allowed cost of debt for RIIO.

Source: Ofgem (2018), 'RIIO-2 Sector Specific Methodology Annex: Finance,' 18 December, pp. 39–40 and Oxera analysis.

We note that the ARP–DRP differential from Ofgem's proposals is lower than the range implied by our report for the ENA on the RIIO-2 cost of equity. Table 1.3 shows that our recommended range for the ENA had an ARP–DRP differential of 1.43–1.80%.[17] This is higher than that implied by Ofgem's proposals: 0.76–1.06%.

Table 1.3 ARP–DRP differential using our proposed range for RIIO-2

	Ref	**Low**	**High**
Asset beta	[A]	0.40	0.42
Total market return	[B]	9.18%	9.70%
Risk-free rate[1]	[C]	1.34%	1.34%
Equity risk premium	[D] = [B] – [C]	7.84%	8.36%
Asset risk premium	**[E] = [A]*[D]**	**3.14%**	**3.51%**
Spot A/BBB cost of debt[2]	[F]	3.35%	3.35%
Expected loss	[G]	0.30%	0.30%
Debt risk premium	**[H] = [F] – [C] – [G]**	**1.71%**	**1.71%**
ARP–DRP differential	**[I] = [E] – [H]**	**1.43%**	**1.80%**

Note: [1] In our original ENA report, we suggested for RIIO-2 a risk-free rate of -0.5 to 0.0% RPI-deflated (2.49–3.0% nominal, with a 3% RPI inflation). We have adopted Ofgem's methodology for setting the risk-free rate, in order to be consistent with Ofgem's proposals to index the cost of equity. [2] Taking the yield on the iBoxx A and BBB 10-year+ indices on the same day as Ofgem for its risk-free rate (26 October 2018) and blending the two in line with Ofgem's methodology for setting the allowed cost of debt for RIIO.

Source: Oxera (2018), 'The cost of equity for RIIO-2,' 28 February, p. 6, and Oxera analysis.

Ofgem's proposed estimate for the real (CPIH-deflated) RIIO-2 cost of equity (before Ofgem makes a deduction for assumed outperformance expectations) is 4.5%, which is equivalent to 6.63% nominal.[18] Ofgem has not presented the CAPM parameters that underpin its final estimate. It is therefore not possible to know for certain the ARP for its proposed cost of equity. However, based on data presented by Ofgem, we estimate the ARP–DRP differential for its proposed cost of equity to be equal to around 90bp (using Ofgem's debt beta assumption).

Relevant to the above, we note that the debt beta range assumed by Ofgem for RIIO-2 is higher than that supported by our estimates based on bonds issued by UK utilities. Ofgem assumes a range for debt beta of 0.10-0.15 based on regulatory precedents, while the analysis in our beta report suggests a debt beta of around 0.05.[19] We restate in Table 1.4 below the ARP–DRP range estimated from Ofgem's proposals for RIIO-2 using our proposed debt beta.

[17] This is assuming the market risk-free rate and not our proposed risk-free rate of -0.5 to 0.0% RPI-deflated (2.49–3.0% nominal with a 3% RPI inflation assumption). If we assume the same risk-free rate as in our report, the ARP–DRP differential range falls to 0.67–0.80%, taking the same DRP as in Table 1.3. However, this is likely to be an underestimate, as one should use the same risk-free rate for both calculations. Our risk-free rate assumption was based on forward-curve evidence and an uplift, to allow for uncertainty, assuming that the regulator would fix the cost of equity allowance for the duration of the price control.
[18] Based on adjusting Ofgem's RIIO-2 cost of equity with Ofgem's CPIH working assumption of 2.04% using the Fisher equation ($nominal\ interest\ rate = (1 + inflation\ rate) * (1 + real\ interest\ rate) - 1$).
[19] Oxera (2019), 'Review of RIIO-2 finance issues: The estimation of beta and gearing', March.

Table 1.4 Ofgem's nominal CAPM-implied cost of equity range assuming a debt beta of 0.05

	Ref	Low	High
Raw equity beta	[A]	0.6	0.7
Debt beta	[B]	0.05	0.05
Gearing (net debt/EV)	[C]	50.8%	50.8%
EV/RAV	[D]	1.1	1.1
Adjusted gearing	[E] = [C]*[D]	56%	56%
Asset beta	[F] = [E]*[B] + (1 – [E])*[A]	0.29	0.34
Notional gearing	[G]	60%	60%
Notional equity beta	[H] = ([F] – [G]*[B])/(1 – [G])	0.66	0.77
TMR	[I]	8.42%	8.93%
Risk-free rate	[J]	1.34%	1.34%
ERP	[K] = [I] – [J]	7.08%	7.59%
ARP	**[L] = [F]*[K]**	**2.07%**	**2.56%**
Spot blended cost of debt (26/10/18)	[M]	3.35%	3.35%
Expected loss	[N]	0.30%	0.30%
DRP	**[O] = [M] – [J] – [N]**	**1.71%**	**1.71%**
ARP–DRP differential	**[P] = [L] – [O]**	**0.36%**	**0.85%**
Cost of equity	**[Q] = [J] + [H]*[K]**	**5.99%**	**7.16%**

Note: We take Ofgem's parameters as given, other than the debt beta parameter, which we have changed. This does not mean that we agree with Ofgem's other assumptions and parameters implicitly, but rather that the other parameters are not the focus of our analysis.

Source: Oxera analysis of Ofgem (2018), 'RIIO-2 Sector Specific Methodology Annex: Finance', 18 December, pp. 39–41.

Table 1.4 shows that, when assuming a debt beta of 0.05, the ARP–DRP differential is now in the range 0.36–0.85%. We note that a lower debt beta assumption translates into a lower asset beta, reducing the ARP–DRP differential (holding other coefficients constant). We estimate the ARP–DRP differential implied by Ofgem's proposed cost of equity to be equal to around 60bp with a debt beta of 0.05 compared with around 90bp with a debt beta of 0.10–0.15.

1.6 Indepen analysis

In a report commissioned by Ofgem, Indepen put forward two arguments about the ARP and DRP, and the usefulness of applying this test. First, Indepen states that the DRP that should be used to compare against the ARP is the unlevered debt risk premium—i.e. what the cost of debt would be if the company had zero leverage.[20] Second, the report suggests that there are issues with how to measure the expected return on debt—i.e. one should include the expected loss when calculating the DRP.[21] We address these two comments in turn.

First, we agree with Indepen that the cost of debt and hence the DRP are affected by the gearing of the company (see Figure 1.2) and the company's exposure to systematic risk. Therefore, it is important to control for these characteristics in the sample selection.

[20] Indepen (2018), 'Ofgem Beta Study – RIIO-2,' December, pp. 21–23.
[21] Ibid.

In particular, as explained in section 1.3, the ARP–DRP differential will be positively related to gearing. It is therefore important that any empirical analysis controls for gearing. In this report the sample is based on utility companies with similar levels of gearing to that proposed by Ofgem for RIIO-2. If the recommendation of Indepen to calculate the ARP relative to the unlevered DRP were followed, the sample of companies used to benchmark the ARP–DRP would need to be amended to include companies with lower gearing. As explained in section 1.3, this would be expected to result in a higher benchmark for the ARP–DRP differential.

Second, we acknowledge that the expected loss on bonds should be subtracted from the reported yield to maturity to reach the expected cost of debt. This has been reflected in our analysis. Even after accounting for expected loss, we show that Ofgem's proposals are not in line with the evidence from market data and previous regulatory precedents.

1.7 Hinkley Seabank

In our submission to Ofgem during the Hinkley-Seabank consultation, we raised our concerns about Ofgem breaching the principle that the difference between the ARP and DRP should be commensurate with the difference in the underlying risk between the two.[22] In our submission, we showed that CEPA's proposals suggested that the risk to assets was less than the risks to debt during the operations phase.[23]

In response to our criticism, Ofgem replied by saying

> While debt does have greater priority claims on cash flows, there are also other differences that can affect relative pricing of debt and equity – for example, equity returns factor in a control premium and upside potential. We do not think that small differences in the premia suggest the approach needs to be changed.
>
> The underlying calculation used by the respondent involves an adjustment from 80-85% gearing to 0% gearing – this is a material change in gearing that could test the limits of the theoretical relationship posed between required returns and gearing. We have used real-world, competitive data from the OFTO regime, which has been shown to be consistent with debt costs used in the analysis. This provides us comfort that our approach is appropriate.[24]

We disagree with Ofgem, Figure 1.2 shows that the relationship between the ARP and the DRP should always result in a positive differential.[25,26]

The cross-check proposed in this report is calibrated to a dataset not appropriate to be used as a comparison for the operations phase of the competition proxy model (CPM) due to the difference in characteristics between our sample of comparators and the operations phase. The evidence used in this report is based on companies, not a particular subset of the cash flows of a project.[27] As explained in section 1.3 the sample companies should be comparable in terms of gearing and asset risk.

[22] Oxera (2018), 'Response to Ofgem's minded-to WACC position for the Hinkley-Seabank project', March.
[23] Ibid.
[24] Ofgem (2018), 'Hinkley-Seabank project: decision on delivery model ', July, paras 2.61–2.63.
[25] The size of the differential can be affected by various factors, such as seniority of debt, asset beta and gearing.
[26] We disagree with CEPA's inputs into setting the cost of capital for the operations phase for the CPM, however this aspect is outside the scope of this report, and we therefore do not elaborate here on our reasons.
[27] Companies are a mixture of projects at different phases of their project lifecycle, i.e. construction and operations.

1.8 Scope of this report

To assess the distribution of the expected differential between the ARP and the DRP, this report analyses a variety of sources, including regulatory precedents, publicly traded bonds issued by UK regulated entities and utilities, and publicly traded bonds issued by listed US utilities. These companies and regulatory precedents provide an appropriate cross-check, as they control for the companies' underlying characteristics.

2 Evidence from regulatory precedents

In determining the appropriate differential between the ARP and DRP, we have analysed evidence from UK regulatory precedents across the telecoms, transport, water and energy sectors—see Table 2.1.

Table 2.1 Regulatory precedents considered in the analysis

Ofgem	Ofwat	Ofcom
DPCR4 (2004)	PR04 (2004)	Copper access (2005)
TPCR4 (2006)	PR09 (2009)	LLU (Openreach) (2009)
GDPCR (2007)	PR14 (2014)	WBA (Openreach) (2011)
DPCR5 (2009)	PR19 Final methodology (2017)*	BCMR (Openreach) (2013)
RIIO-T1 (NGET) (2012)		FAMR (Openreach) (2014)
RIIO-GD1 (2012)		BCMR (Openreach) (2016)
RIIO-ED1 (2014)		WLA (Openreach) – 2018)*
ORR	**CAA**	**CMA**
PR08 (2008)	Gatwick (2008)	Stansted (2009)
PR13 (2013)	Heathrow (2008)	Bristol Water (2010)
	NATS (2010)	NIE (2014)
	Heathrow (2014)	Bristol Water (2015)
	Gatwick (2014)	
	NATS (2014)	
	Heathrow (2017)	

Note: Regulatory proposals are denoted by an asterisk (*).

Source: Regulatory determinations.

2.1 Methodology

The ARP and DRP, and associated spread between the two, can be calculated in a number of ways

In regulatory determinations, it is common for the regulator to include some allowance for transaction costs. We have therefore subtracted 10bp for transaction costs from the allowed cost of debt, in line with the proposals by Ofwat for PR19.[28]

We also subtract the expected loss reported in section 1.2 when calculating the DRP.

We make two further adjustments to the ARP–DRP reported in the regulatory precedents detailed below:

- **regulatory precedents**: first, we derive the difference based on the regulatory allowed ARP and the regulatory allowed DRP. The regulatory allowed DRP is calculated using the regulatory allowed debt premium less transaction costs and expected loss;[29]

[28] Ofwat (2017), 'Delivering Water 2020: Our methodology for the 2019 price review Appendix 12: Aligning risk and return', December, p. 58.
[29] Where possible, we use the allowance for newly issued debt and not the overall cost of debt allowance, as the cost of embedded debt can affect the allowed cost of debt under regulatory precedents.

- **regulatory ARP and market debt premium**: our first adjustment is to replace the regulatory allowed debt premium with the market debt premium. This is to remove the impact of allowances for embedded debt;[30]
- **adjusted ARP and market debt premium**: our second adjustment is to the risk-free rate used to calculate the ARP. The regulatory adjusted ARP is based on the regulatory allowed asset beta and the total market return (TMR). The ERP for the calculation is then derived as a residual between the allowed TMR and the market risk-free rate.[31] The market DRP is calculated using the market debt premium.[32]

The impact of embedded debt is an important consideration for the calculation of the DRP, as this results in the DRP being backward- not forward-looking and therefore inconsistent with the ARP and ERP. As the cost of embedded debt has been higher than the cost of newly issued debt over the past decade, if this is not adjusted for there will be an overestimate of the DRP, understating the level of the ARP–DRP differential.

In the regulatory precedents, the assumed risk-free rates are typically higher than the contemporaneous market risk-free rate. For example, the 1-month average of the market risk-free rate is around 150bp lower than the risk-free rate in regulatory precedents on average. This results in the ARP and the DRP being higher when using the market risk free rate instead of the risk-free rate assumed in the regulatory precedent. Therefore, one should rely on a consistent risk-free rate assumption when calculating the ARP and the DRP. Additionally, by restating the TMR, we make the ERP of the regulatory precedent more consistent with market evidence on the ERP.

2.2 Results

The average results from our analysis are presented in Table 2.2 below. Our preferred methodology using the adjusted ARP and market DRP produces an estimate of 1.32–1.39% for the average ARP–DRP differential. This is lower than the differential implied by market evidence.

Table 2.2 Results of regulatory precedents analysis

	Regulatory precedents	Regulatory ARP and market DRP	Adjusted ARP and market DRP
Mean ARP–DRP differential	1.19%	0.86%	**1.39%**
Median ARP–DRP differential	1.14%	0.90%	**1.32%**

Note: Figures may be rounded up or down.

Source: Oxera analysis.

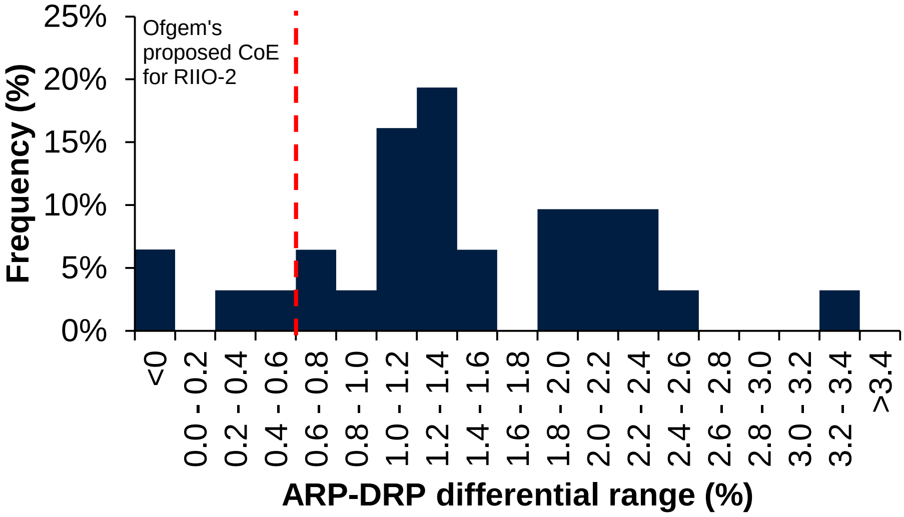
From the regulatory precedents analysed, we note there are two cases that breache the principle that the ARP should be greater than the DRP; namely, ORR's PR08 determination for Network Rail and Ofcom's 2009 determination for the BT (Openreach) Wholesale Local Access markets. These precedents

[30] Based on the spreads between yields on iBoxx £ A and BBB 10+ non-financial indices and yields on the UK government bonds with matching duration, averaged over one month prior to the relevant final regulatory determination.
[31] The market risk-free rate is based on the yields on 10-year UK government bonds, averaged over one month prior to the relevant final regulatory determination.
[32] Based on the spreads between yields on iBoxx £ A and BBB 10+ non-financial indices and yields on the UK government bonds with matching duration, averaged over one month prior to the relevant final regulatory determination.

may have been affected by the uncertainty generated by the developing financial crisis.

If one plots the distribution of the ARP–DRP differential under previous regulatory precedents, we see that Ofgem's proposals for RIIO-2 lie in the bottom 15% of the distribution.

Figure 2.1 Distribution of ARP-DRP differential for regulatory precedents



Source: Oxera analysis.

2.3 Conclusion

Using the approach in Table 2.2 that is most linked to market data (adjusted ARP and market DRP) leads to an estimate of around 130-140bp for the ARP–DRP differential on average.

3 Evidence from UK and US utilities

In addition to the regulatory precedents, we have analysed the bonds issued by UK and US regulated entities and utilities. This includes companies in the water, energy and transport sectors. We estimate the DRP and ARP for each company at the issue date of each bond, calculating the difference between the two.

To improve the relevance of our sample, it contains bonds issued after 2010. This is because bonds issued during and before the financial crisis may not be appropriate for today's market conditions.

3.1 Methodology

The methodology used is as follows.

1. Select the appropriate bonds. We look at bonds issued in public markets from 2010 onwards.

2. Take the relevant risk-free rate on the issue date, based on the length of the bond from Bank of England data.[33] Subtract this from the yield to maturity on the issue date in order to obtain the credit spread.[34]

3. After we obtained the credit spread for each bond, we subtract our expected loss assumption from the credit spread to obtain the DRP.[35]

4. Obtain the relevant asset beta for the company. For listed companies, we use market data to estimate the five-year daily asset beta.[36] For companies without listed equity, we use the asset beta assumed by the regulator for the company during the most recent regulatory precedent to the issue date for a given bond.[37,38]

5. Assume a risk-free rate based on the average length of the bond in the sample (18 years for UK utilities), the asset beta from step 3, and the TMR from the closest regulatory precedent to estimate the ARP.[39] In Appendix 1, we present a sensitivity, assuming a constant TMR based on the midpoint of the range suggested by our report for the ENA on the cost of equity to estimate the ARP.[40] We note that this sensitivity is likely to be conservative

[33] Due to quantitative easing, the UK yield curve is now downward-sloping at the long end. Thus, for bonds with a term longer than where the yield curve peaks, the DRP would be higher for longer-term bonds than shorter-term bonds all else being equal. We believe this to be an overestimate of the DRP for these bonds, as a longer time to maturity for a bond usually results in a higher cost of debt due to a higher maturity premium. We therefore take the top of the yield curve as the risk-free rate in order to reduce any overestimation of the DRP.
[34] Yield to maturity on issue date is extracted from Dealogic. We adjust the yield to maturity for inflation-linked debt using the Fisher equation. We assume that expected RPI inflation equals 3% and expected CPI inflation equals 2%. We adjust the yield to maturity as Dealogic reports the nominal yield on issue date without accounting for inflation.
[35] We use the same expected loss assumption as described in section 1.
[36] We estimate the equity beta using the FTSE All-share index as the proxy for the market. We assume a debt beta of 0.05. We obtain the asset beta using the five-year average gearing, where gearing is estimated using the following equation:

$$Gearing = \frac{Net\ debt}{Net\ debt + Market\ capitalisation}$$

[37] For bonds issued at a NGET and NGGT level, we take the asset beta from the regulatory precedent (adjusted for our debt beta assumption of 0.05). This is because we assume that the claim that bond holders have is on the assets for these subsidiaries, and that there is no recourse to the parent company.
[38] Private companies represent 74 out of 86 observations in our analysis.
[39] We inflated the TMR using the inflation rate assumed in the regulatory precedent. If not specified, we inflate the TMR using an RPI assumption of 3%.
[40] For estimates of the TMR, see Oxera (2018), 'The cost of equity for RIIO-2', 28 February, p. 6. We inflate the RPI-deflated TMR using an RPI inflation assumption equal to 3%.

since investors are likely to have expected a higher TMR at the time when the earlier bonds were issued.[41]

6. Finally, we compare our calculated ARP to DRP for each bond, and summarise our results.

3.2 Sample used

Some descriptive statistics of the sample of bonds used are shown below.

Table 3.1 Summary of sample used for UK utilities analysis

	Energy	Water	Transport	Total
Number of bonds	41	40	5	86
Average term (years)	18	17	29	18
Average size (£m)	341	262	270	302

Source: Oxera analysis.

Table 3.1 shows that most of the bonds come from the energy and water sectors. This is not unexpected, given that the majority of UK utilities and regulated companies are in these sectors.

3.3 Results from UK analysis

Our results are summarised in Table 3.2. The evidence suggests an ARP–DRP differential of 1.66–1.83% on average.

Table 3.2 Summary of results of UK utilities analysis

		Length of bond		
	Full sample	≥5 years	≥10 years	≥15 years
Mean differential	1.66%	1.65%	1.63%	1.77%
Median differential	1.83%	1.83%	1.70%	1.91%
Sample size	81	80	67	42
Number of breaches of ARP>DRP	0	0	0	0

Note: We assume a debt beta of 0.05 throughout.

Source: Oxera analysis.

There are no breaches of the expected relationship (i.e. ARP>DRP) for our UK utilities analysis. In Table 3.3 below we present the average ARP, DRP, cost of debt, asset beta, ERP and risk-free rate across our sample.

[41] We assess that the TMR for the UK has declined slightly since the global financial crisis. See Oxera (2018), 'The cost of equity for RIIO-2', 28 February.

Table 3.3 Summary of parameters of UK utilities analysis

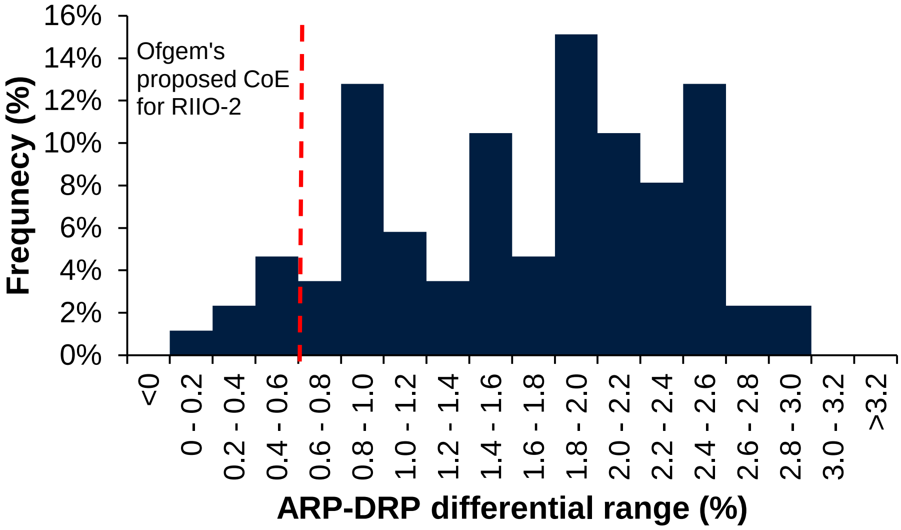
	Full sample	Length of bond ≥5 years	Length of bond ≥10 years	Length of bond ≥15 years
Asset beta	0.38	0.38	0.38	0.40
ERP	7.15%	7.14%	7.04%	6.94%
ARP	2.71%	2.71%	2.69%	2.77%
Cost of debt	4.00%	4.04%	4.27%	4.59%
Risk-free rate	2.66%	2.69%	2.93%	3.31%
Expected loss	0.28%	0.28%	0.28%	0.28%
DRP	1.06%	1.06%	1.06%	1.00%

Note: We assume a debt beta of 0.05.

Source: Oxera analysis.

Figure 3.1 shows that Ofgem's proposed cost of equity for RIIO-2 lies in the bottom ten percent of the distribution of our UK analysis. This suggests Ofgem would need to revise its cost of equity assumption to be in line with the evidence from UK utilities.

Figure 3.1 Distribution of ARP-DRP differential for bonds issued by UK utilities



Source: Oxera analysis

3.4 Results from US analysis

Table 3.4 Summary of results of US utilities analysis

	Full sample	Length of bond ≥5 years	Length of bond ≥10 years	Length of bond ≥15 years
Mean differential	1.82%	1.79%	1.74%	1.67%
Median differential	1.81%	1.77%	1.74%	1.67%
Sample size	914	845	717	401
Number of breaches of ARP>DRP	22	21	17	11

Source: Oxera analysis.

Table 3.4 shows the result of our analysis of US utilities. The analysis suggests that the ARP–DRP differential is slightly higher in the USA than the UK for utilities. This is not unexpected, given that on average the gearing of US utilities is lower than UK utilities.[42] This is consistent with the theory described in section 1.3.

We note there are breaches of the ARP being greater than the DRP, and consider these are likely to be largely due to an overestimate of the DRP for longer-dated bonds as the US yield curve ends at 30 years. Some of the bonds in our sample are issued with a maturity greater than 30 years. This leads to an overestimate of the term premium associated with these bonds.

Table 3.5 Summary of parameters of US utilities analysis

		Length of bond		
	Full sample	≥5 years	≥10 years	≥15 years
Asset beta	0.37	0.37	0.37	0.37
ERP	7.63%	7.62%	7.62%	7.63%
ARP	2.80%	2.81%	2.80%	2.79%
Cost of debt	3.76%	3.90%	4.10%	4.49%
Risk-free rate	2.48%	2.58%	2.74%	3.07%
Expected loss	0.30%	0.30%	0.30%	0.30%
DRP	0.98%	1.02%	1.06%	1.12%

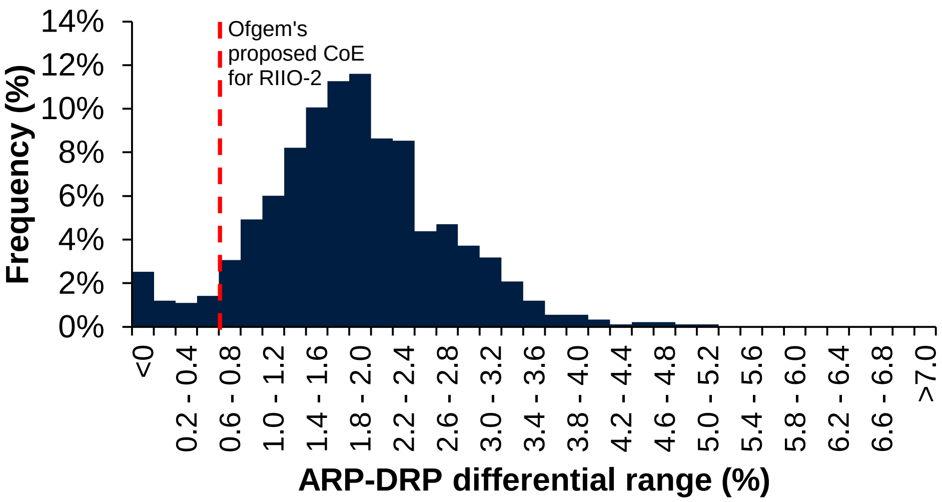
Note: We assume a debt beta of 0.05.

Source: Oxera analysis.

Table 3.5 is consistent with the theoretical framework we provided in section 1.3 on the relationship between the ARP and the DRP. For example, we observe that a longer maturity results in a higher DRP, thus reducing the ARP–DRP differential.

Figure 3.2 shows that Ofgem's proposed cost of equity for RIIO-2 lies in the bottom ten percent of the distribution of our US analysis, a similar finding to that based on our analysis of UK utility bonds.

Figure 3.2 Distribution of ARP–DRP differential for bonds issued by US utilities



Source: Oxera analysis.

[42] The average notional gearing of our UK sample is 60%, while for the US analysis the average gearing on issue date is 40%.

3.5 Conclusion

The results from Table 3.2 suggest an average ARP–DRP differential of around 1.66–1.83% for bonds issued by UK regulated entities since 2010. Table 3.4 suggests an average ARP–DRP differential of around 180bp based on bonds issued by US utilities since 2011. Both of these average differentials are considerably higher than the ARP–DRP differential implied by Ofgem’s current proposals for RIIO-2.

4 Conclusion

In this report, we have reviewed evidence on the risk premium on assets relative to debt from three sources: UK regulatory precedents, market data on bonds issued by UK utilities, and market data on bonds issued by US utilities. We now summarise our findings and the implication for the cost of equity proposed in the RIIO-2 sector-specific methodology consultation.

4.1 Summary of the evidence

Table 4.1 Estimates of the ARP–DRP differential

Average	Regulatory precedents	UK utilities and regulated entities	US utilities
Mean	1.32%	1.66%	1.82%
Median	1.39%	1.83%	1.81%

Source: Oxera analysis.

Our analysis of the evidence suggests that an ARP–DRP differential of around 130–140bp would be consistent with the average of previous regulatory precedents. Evidence from UK utilities bonds suggests that an average ARP–DRP differential of around 165-185bp would be acceptable to equity investors. Evidence from US utilities bonds suggests a differential of around 180bp.

4.2 Ofgem's proposals do not meet the criteria

We showed earlier, in Table 1.2, that the ARP–DRP differential from Ofgem's nominal CAPM-implied cost of equity range is 0.76–1.06%. This is below 85% of the empirical evidence analysed for this report assuming a debt beta of 0.1. We note that our proposed range for the ENA on the cost of equity for RIIO-2 (see Table 1.3) sits approximately between the 30th and 65th percentiles across all three pieces of evidence.

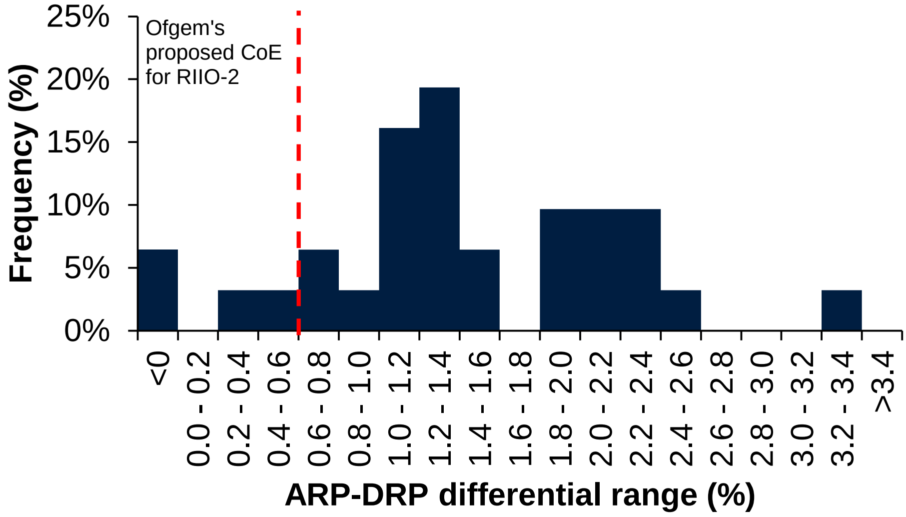
Additionally, we note that the debt beta range assumed by Ofgem for RIIO-2 is higher than that supported by our empirical evidence from bonds issued by UK utilities.[43] Ofgem assumes a range of 0.10-0.15 based on regulatory precedents, while the analysis in our beta report suggests a debt beta of around 0.05.

In Table 1.4, we showed that when assuming a debt beta of 0.05, the ARP–DRP differential is now in the range 0.36–0.85%. This underlines the importance of the debt beta assumption for Ofgem's implied range to pass our proposed cross-check using Approach 1. We note that a lower debt beta assumption translates into a lower asset beta, reducing the ARP–DRP differential (holding other coefficients constant). We estimate the ARP–DRP differential implied by Ofgem's expected cost of equity for RIIO-2 to be around 60bp. This is below 85% of the empirical evidence analysed for this report.

For example, Figure 4.1 plots the distribution of the ARP–DRP differential using our sample from the regulatory precedents analysis and compares this to the differential implied by the 4.5% CPIH-real cost of equity proposed by Ofgem based on expected returns. We see that the proposed cost of equity is in the bottom 10% of the distribution and is not in line with previous regulatory precedents. Under the alternative approach of measuring the DRP,[44] the proposed cost of equity is still in the bottom 15% of the distribution.

[43] Oxera (2019), 'Review of RIIO-2 finance issues: The estimation of beta and gearing', March
[44] The results for Approach 2 are presented in Appendix 3.

Figure 4.1 ARP–DRP differential distribution for regulatory precedents



Source: Oxera analysis.

Our proposed cost of equity range for RIIO-2 implies an ARP–DRP differential in the 30 to 45 percentile of our UK utilities analysis and 60 to 65 percentile of previous regulatory precedents. This is more in line with what investors require as compensation for risk.

Our numbers being above the average for the regulatory precedents sample is driven by our ERP assumption, which is higher than what has been assumed in previous regulatory precedents. This is consistent with the view that changes in the ERP largely offset movements in the risk-free rate.[45]

4.3 Remedies

We propose that Ofgem reconsider its debt beta assumption for RIIO-2, such that it is in line with the empirical evidence. This would result in a lower ARP–DRP differential under Approach 1 and a higher ARP–DRP differential under Approach 2. Irrespective of Ofgem reconsidering the debt beta assumption, the evidence suggests that the combination of assumptions used for the CAPM parameters is extreme, and that one or more of the parameters should be revised upwards to provide a higher risk premium on assets and a sensible market-based result for the cost of equity.

For example, for the Ofgem proposals to be at the 40th percentile of the distribution of previous regulatory precedents, we would need to add around 60bp to the Ofgem ARP. As the notional gearing proposed for RIIO-2 is 60%, this implies that approximately 150bp would need to be added to the cost of equity.[46] Alternatively, for the Ofgem proposals to be at the 60th percentile of the UK utilities distribution, we would need to add 80bp to the Ofgem midpoint ARP and approximately 200bp to the Ofgem cost of equity. We note that the market evidence suggests that a larger adjustment is required to Ofgem's

[45] Oxera (2018), 'The cost of equity for RIIIO-2', 28 February
[46] The asset risk premium is an unlevered equity risk premium. This can be converted to an approximate levered equity risk premium by dividing by the share of equity in the capital structure (i.e. dividing by 0.4). This adjustment assumes that only the asset beta is changing and that the other parameters such as the ERP and TMR are held constant. If one were to assume multiple changes, or if parameters other than the asset beta were to change, the change to the cost of equity would differ from that reported.

proposed cost of equity for RIIO-2 than when using regulatory precedents as the benchmark.

Finally, we note that the headline cost of equity allowance proposed by Ofgem is 4.0%, based on the third step of the Ofgem methodology for setting the cost of equity allowance. This step makes a downward adjustment based on an assumption that investors will expect companies to out-perform regulatory targets during RIIO-2. This adjustment moves the headline cost of equity further away from what the evidence suggests equity investors require as a rate of return to compensate for the higher risk of equity relative to debt.

The combination of assumptions proposed in our report for the ENA on the cost of equity is more in line with the evidence presented in this report, and has asset beta and TMR assumptions that are higher than in the RIIO-2 sector consultation.[47]

[47] Oxera (2018), 'The cost of equity for RIIIO-2', 28 February, p. 6.

A1 UK utilities sensitivity analysis

This appendix provides a sensitivity on the analysis presented in section 3. In this sensitivity, we assume a constant TMR in line with the middle of the range suggested by our report for the ENA on the cost of equity.[48] The middle of our range corresponds to a nominal TMR of 9.44%.

A1.1 Results

The results of our analysis, shown in Table A1.1, suggest a mean differential of 1.40% and a median differential of 1.41%, based on the full sample of bonds used in our analysis. We note that the estimate is broadly consistent across length of bonds.

Table A1.1 Summary of results of UK utilities analysis

		Length of bond		
	Full sample	**>5 years**	**>10 years**	**>15 years**
Mean differential	1.40%	1.39%	1.36%	1.47%
Median differential	1.41%	1.41%	1.40%	1.52%
Sample size	86	85	72	47
Number of breaches of ARP>DRP	1	1	1	-

Source: Oxera analysis.

We note the DRP is higher than the ARP in one case when assuming a constant TMR. This breach is driven by a retail bond issued by Severn Trent in 2012, and is likely in part to reflect the fact our TMR assumption in this sensitivity is lower than assumed by regulatory determinations around 2012.

[48] See Oxera (2018), ‘The cost of equity for RIIO-2’, 28 February, p. 6.

A2 US utilities analysis: methodology and results

This appendix describes the methodology used for section 3.4.

A2.1 Methodology

The methodology used in our analysis is as follows.

1. Select the appropriate bonds. We look at bonds issued in public markets from 2011 onwards.[49]

2. Take the risk-free rate on the issue date based on the yield of the relevant US Treasury Bills taken from the U.S. Department of the Treasury.[50] Subtract this from the yield to maturity on the issue date to obtain the credit spread.[51]

3. After obtaining the credit spread for each bond, we subtract our expected loss assumption from the credit spread to obtain the DRP.[52]

4. Obtain the relevant asset beta for the company. Using market data, we estimate the five-year daily asset beta relative to the S&P 500.[53,54] For subsidiaries in our sample, we use the asset beta of the parent company.

5. Assume a risk-free rate based on the average length of the bond in the sample (20 years for US utilities), asset beta from step 3 and a TMR of 10.44%. This is based on two pieces of evidence: the midpoint of our suggested range for the ENA, which is equivalent to 9.44%;[55] and evidence from Dimson, Marsh and Staunton, which suggests that equity returns have been 1% higher on average in the USA than the UK.[56] Therefore, we consider this an appropriate adjustment to make to our TMR assumption for the UK market in order to reach an assumption for the TMR for the US market.

6. Finally, we compare our calculated ARP to DRP for each bond, and summarise our results.

[49] We do not go back further than 2011 due to constraints on the volume of data that could be processed for this analysis.
[50] The U.S. Department of the Treasury publishes yields on 1-, 2-, 3- and 6-month, 1-, 2-, 3-, 5-, 7-, 10-, 20- and 30-year Treasury Bills. We take the Treasury Bill closest to the of length of the bond being analysed.
[51] Yield to maturity on the issue date is extracted from Dealogic. We adjust the yield to maturity for inflation-linked debt using the Fisher equation. We assume that expected RPI inflation equals 3% and expected CPI inflation equals 2%. We adjust the yield to maturity since Dealogic reports the nominal yield on the issue date without accounting for inflation.
[52] We use the same expected loss assumption as described in section 1.
[53] We assume a debt beta of 0.05 as used earlier and use the depository receipt if available for companies listed outside of the USA, instead of the share price.
[54] In the USA there are two large stock exchanges—the NASDAQ and the New York Stock Exchange—and hence no equivalent to the FTSE All-share index. A commonly used proxy for the market in the USA when estimating the equity beta for a US company is the S&P 500, because this includes stocks listed on both exchanges.
[55] For estimates of the TMR, see Oxera (2018), 'The cost of equity for RIIO-2', 28 February, p. 6. We inflate the RPI-deflated TMR using an RPI inflation assumption equal to 3%.
[56] Dimson, E., Marsh, P. and Staunton, M. (2018), 'Credit Suisse Global Investment Returns Yearbook 2018'.

A2.2 Sample used

Table A2.1 Summary of sample used for US utilities analysis

	Energy	Water	Total
Number of bonds	901	13	914
Average length (years)	20	21	20
Average size ($m)	777	716	776

Source: Oxera analysis.

Table A2.1 shows that a large part of our sample comes from companies in the energy sector. This is understandable since the majority of water companies in the USA are owned by local authorities and so would rely less on external financing to finance their activities.

A3 Approach 2 for debt risk premium

This appendix provides an alternative approach for calculating the debt risk premium. We use 'Approach 2' for estimating the debt risk premium, as described in section 1.2. Approach 2 complements Approach 1 by using a different source of data—bond returns—to estimate debt beta.

ARP–DRP differential under Approach 2

$$ARP = \beta_a * ERP$$
$$DRP = \beta_d * ERP$$
$$ARP - DRP = (\beta_a - \beta_d) * ERP$$

$\boldsymbol{ARP}$ asset risk premium; $\boldsymbol{\beta_a}$ asset beta; $\boldsymbol{ERP}$ equity risk premium; $\boldsymbol{\beta_d}$ debt beta; $\boldsymbol{DRP}$ debt risk premium.

Therefore the differential under Approach 2 is the difference between the asset beta and debt beta of a company, multiplied by the ERP.

As noted in section 1.2, Approach 2 is a bottom-up approach to directly estimate the compensation for bearing systematic risk and is expected to generate different results to Approach 1 because typically there is a residual component of the credit spread that cannot be explained by expected loss or the debt beta.[57] In other words, despite the theoretical support for Approach 2, credit spreads observed in the market can only be explained by assuming very high debt betas.

We assume a debt beta of 0.05 for all three samples in line with our empirical results from our beta report for the ENA.[58] We re-estimate the asset beta for regulatory precedents using this debt beta of 0.05 in line with the methodology described in section 1.4.

A3.1 Results

Table A3.1 ARP–DRP differential using Approach 2 across the samples analysed

Average	Regulatory precedents	UK utilities and regulated entities	US utilities
Mean	2.58%	2.37%	2.42%
Median	2.54%	2.29%	2.34%

Note: We assume a debt beta of 0.05.

Source: Oxera analysis.

In the table above, we reproduce the results from Table 4.1 using Approach 2. These suggest that the appropriate differential based on Approach 2 would be around 230–260bp.

We have also re-analysed Ofgem's proposals for RIIO-2 using Approach 2—see Table A3.2 below.

[57] Webber, L. and Churm, R. (2007), 'Decomposing corporate bond spreads', *Bank of England Quarterly Bulletin Q4*, pp. 533–541.
[58] Oxera (2019), 'Review of RIIO-2 finance issues: The estimation of beta and gearing', March.

Table A3.2 ARP–DRP differential using Approach 2 for nominal CAPM-implied cost of equity range

	Ref	Low	High
Raw equity beta	[A]	0.6	0.7
Debt beta	[B]	0.15	0.1
Gearing (net debt/EV)	[C]	50.8%	50.8%
EV/RAV	[D]	1.1	1.1
Adjusted gearing	[E] = [C]*[D]	56%	56%
Asset beta	[F] = [E]*[B] + (1 – [E])*[A]	0.35	0.36
TMR	[G]	8.42%	8.93%
Risk-free rate	[H]	1.34%	1.34%
ERP	[I] = [G] – [H]	7.08%	7.59%
ARP–DRP differential	**[J] = ([F] – [B])*[I]**	**1.41%**	**2.01%**

Source: Oxera analysis of Ofgem (2018), 'RIIO-2 Sector Specific Methodology Annex: Finance,' 18 December, pp. 39–41.

Our results suggest that, using Approach 2, the cost of equity proposed in the sector-specific methodology is well below what the empirical evidence suggests an investor would expect on average. We note that restating Ofgem's range using a debt beta of 0.05 would result in a range for the ARP-DRP differential of 1.72–2.18% (see Table A3.3). This restated range is closer to, but still below, the average of the empirical evidence.

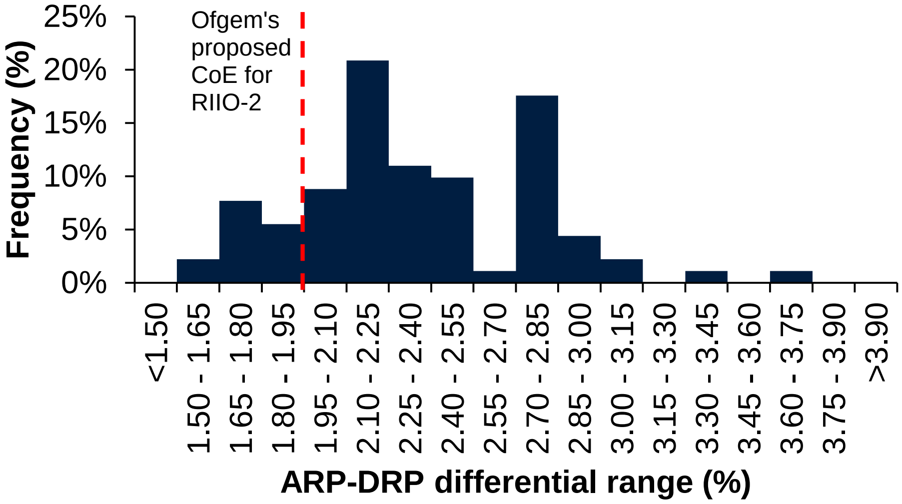
Table A3.3 ARP–DRP differential using Approach 2 for nominal CAPM-implied cost of equity range using debt beta of 0.05

	Ref	Low	High
Raw equity beta	[A]	0.6	0.7
Debt beta	[B]	0.05	0.05
Gearing (net debt/EV)	[C]	50.8%	50.8%
EV/RAV	[D]	1.1	1.1
Adjusted gearing	[E] = [C]*[D]	56%	56%
Asset beta	[F] = [E]*[B] + (1 – [E])*[A]	0.29	0.34
TMR	[G]	8.42%	8.93%
Risk-free rate	[H]	1.34%	1.34%
ERP	[I] = [G] – [H]	7.08%	7.59%
ARP–DRP differential	**[J] = ([F] – [B])*[I]**	**1.72%**	**2.18%**

Source: Oxera analysis of Ofgem (2018), 'RIIO-2 Sector Specific Methodology Annex: Finance,' 18 December, pp. 39–41.

The midpoint of the cost of equity proposed in the sector-specific methodology implies an ARP–DRP differential that is in the bottom 15% of the UK utilities distribution, assuming a debt beta of 0.05. This is shown in Figure A4.1 and is consistent with the finding under Approach 1.

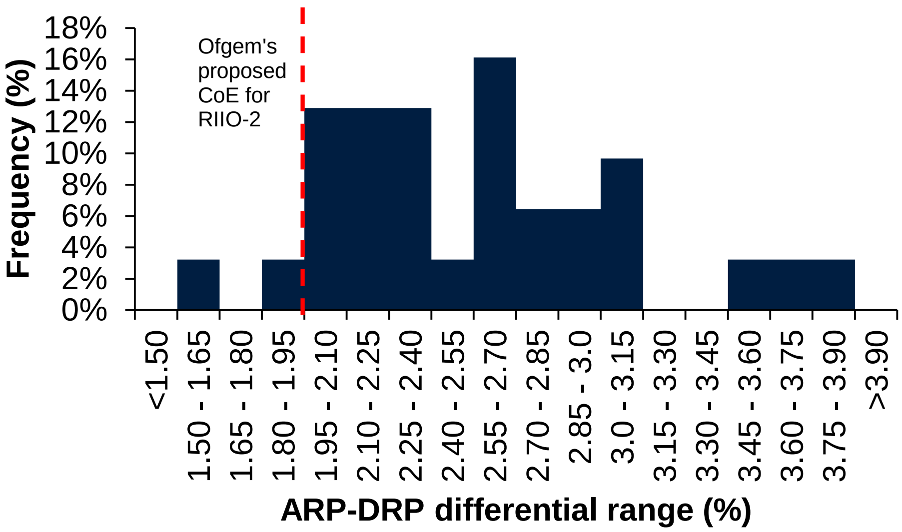
Figure A3.1 Distribution of ARP–DRP differential for UK utilities under Approach 2



Source: Oxera analysis.

Ofgem's proposed cost of equity lies in the bottom five percent of previous regulatory precedents, as shown in Figure A3.2.

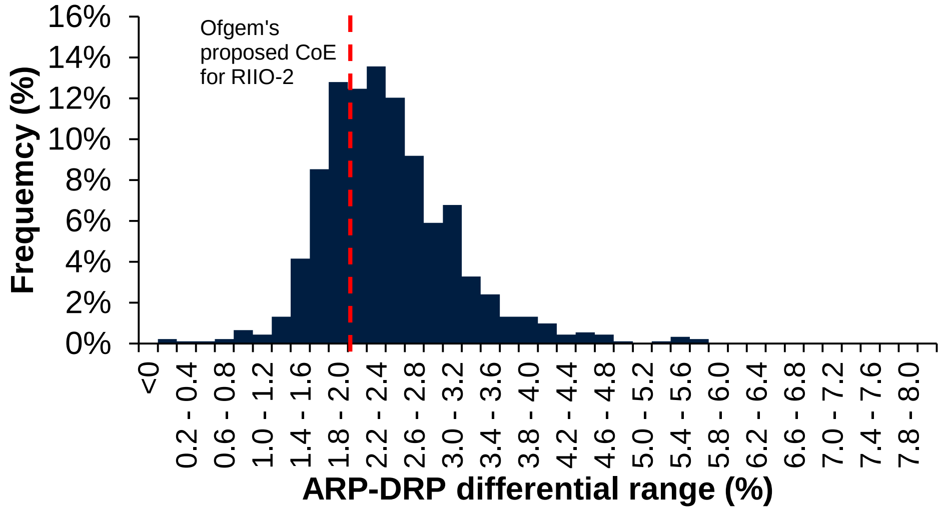
Figure A3.2 Distribution of ARP–DRP differential for regulatory precedents under Approach 2



Source: Oxera analysis.

While for the US utilities analysis we find that Ofgem's proposals lie in the bottom 30 percent of the distribution. This is inconsistent with the other pieces of analysis undertaken in this report. This suggests that for the US utilities analysis we may have incurred some measurement error in our parameters.

Figure A3.3 Distribution of ARP–DRP differential for US utilities analysis under Approach 2



Source: Oxera analysis.

The range we proposed for the cost of equity for RIIO-2 passes our proposed ARP-DRP cross-check. This is shown below. Our proposed cost of equity for RIIO-2 lies in the upper quartile of the UK utilities distribution because the ERP from our proposed range for the ENA is above the average ERP across our sample. As explained in our February (2018) report,[59] the theory and evidence point towards a higher ERP for RIIO-2 relative to the average of past regulatory determinations. If one assumes an ERP in line with the average ERP across our sample then our proposals for RIIO-2 would lie in the middle of the distribution.

Table A3.4 ARP–DRP differential under Approach 2 using our proposed range for RIIO-2

	Ref	Low	High
Asset beta	[A]	0.40	0.42
Total market return	[B]	9.18%	9.70%
Risk-free rate[1]	[C]	1.34%	1.34%
Equity risk premium	[D] = [B] – [C]	7.84%	8.36%
Debt beta	[E] = [A]*[D]	0.05	0.05
ARP–DRP differential	**[F] = ([E] – [A])*[D]**	**2.74%**	**3.09%**

Note: [1] In our original ENA report, we suggested for RIIO-2 a risk-free rate of -0.5 to 0.0% RPI-deflated (2.49–3.0% nominal, with a 3% RPI inflation). We have adopted Ofgem's methodology for setting the risk-free rate, in order to be consistent with Ofgem's proposals to index the cost of equity. [2] Taking the yield on the iBoxx A and BBB 10-year+ indices on the same day as Ofgem for its risk-free rate (26 October 2018) and averaging the two in line with Ofgem's methodology for setting the allowed cost of debt for RIIO.

Source: Oxera (2018), 'The cost of equity for RIIO-2,' 28 February, p. 6, and Oxera analysis.

A3.2 Conclusion

The conclusion from using Approach 2 is the same as the conclusion from Approach 1. The evidence from the debt markets suggests that the allowance for the cost of equity in the sector-specific methodology is insufficient to compensate for the relative risk of holding equity rather than debt in the same

[59] Oxera (2018), 'The cost of equity for RIIO-2,' 28 February.

asset. This suggests that the combination of assumptions used for the CAPM parameters is extreme, and that one or more of the parameters should be revised upwards to provide a sensible market-based result for the cost of equity.

A4 Sensitivity of results to debt beta assumption

This appendix provides a sensitivity on our analysis assuming a debt beta of 0.10 instead of 0.05. We show that the conclusions are not sensitive to the debt beta assumed.

Before presenting our results, one should note that the ARP–DRP differential implied by Ofgem's proposed cost of equity is equal to around 80bp under Approach 1 and around 180bp under Approach 2 when assuming a debt beta of 0.10.

A4.1 Results

Table A4.1 ARP–DRP differential using Approach 1 across the samples analysed

Average	Regulatory precedents	UK utilities and regulated entities	US utilities
Mean	1.56%	1.87%	1.98%
Median	1.51%	2.00%	1.97%

Note: We assume a debt beta of 0.10.

Source: Oxera analysis.

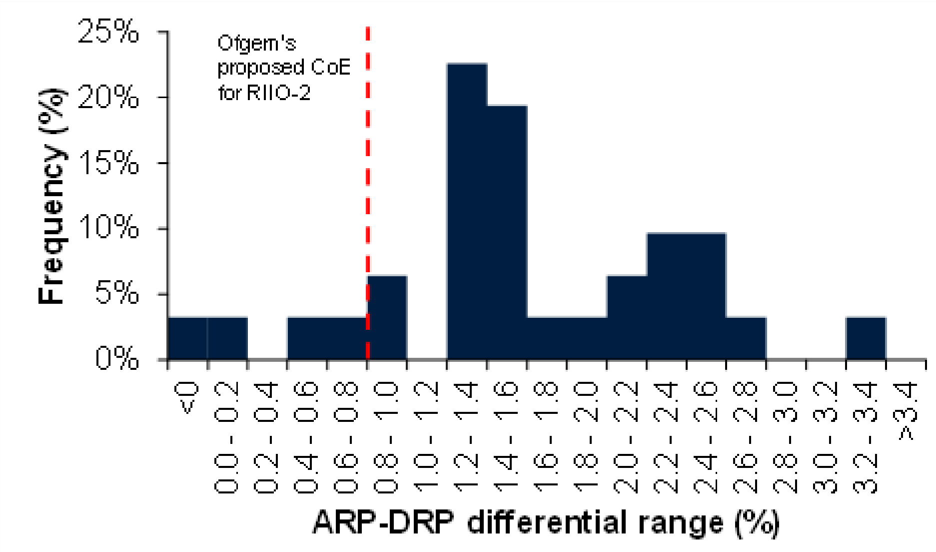
Table A4.2 ARP–DRP differential using Approach 2 across the samples analysed

Average	Regulatory precedents	UK utilities and regulated entities	US utilities
Mean	2.46%	2.25%	2.20%
Median	2.42%	2.15%	2.12%

Note: We assume a debt beta of 0.10.

Source: Oxera analysis.

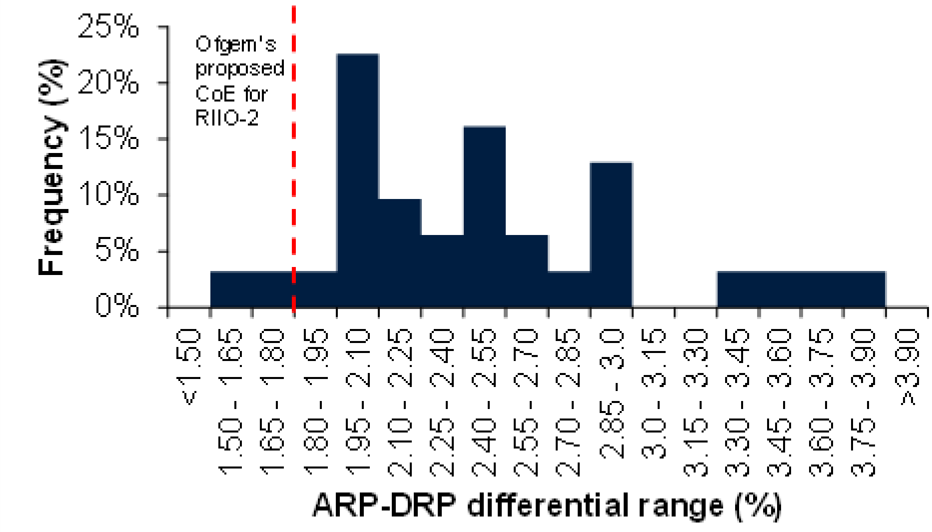
Figure A4.1 Distribution of ARP–DRP differential for regulatory precedents under Approach 1 (debt beta = 0.1)



Source: Oxera analysis.

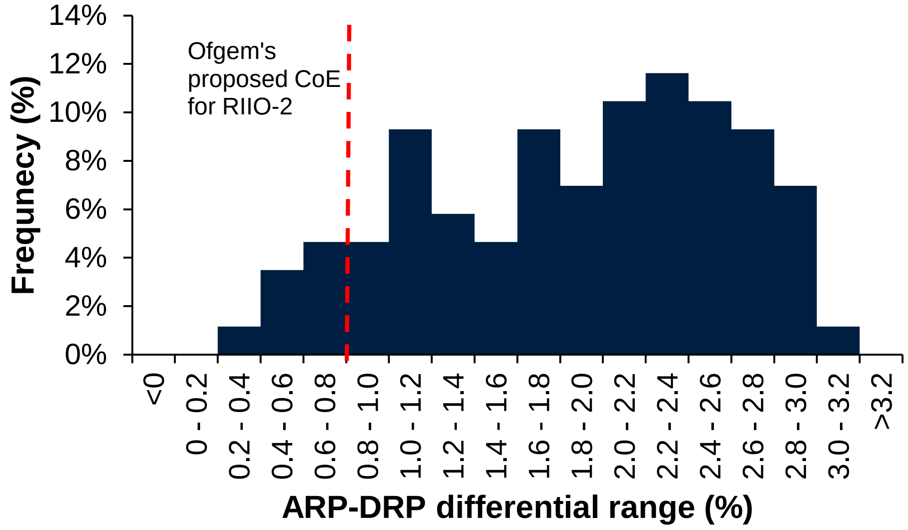
The conclusion from the regulatory precedents is the same when assuming a debt beta of 0.10 or 0.05. Under Approach 1, Ofgem's proposals for RIIO-2 still lie in the bottom ten percent. While for Approach 2, Ofgem's proposals are in the bottom fifteen percent.

Figure A4.2 Distribution of ARP–DRP differential for regulatory precedents under Approach 2 (debt beta = 0.1)



Source: Oxera analysis.

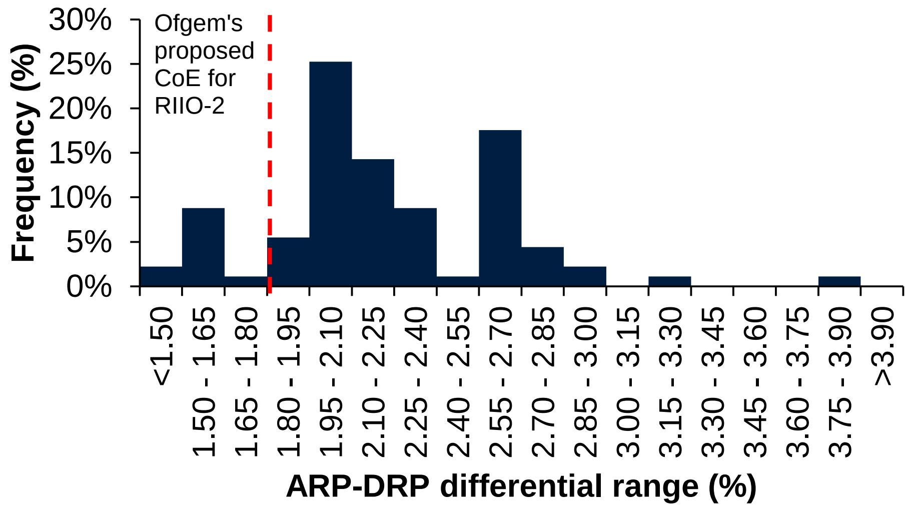
Figure A4.3 Distribution of ARP–DRP differential for UK utilities under Approach 1 (debt beta = 0.1)



Source: Oxera analysis.

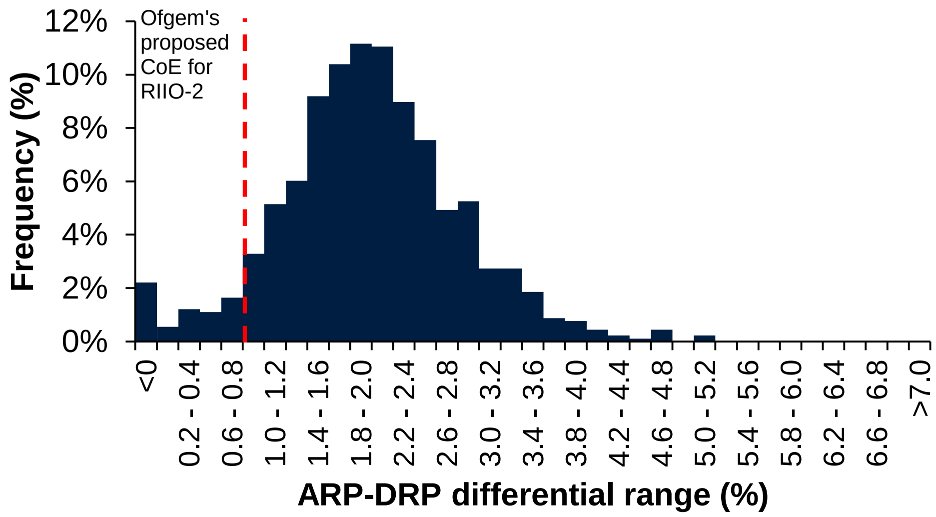
The conclusion from the UK utilities analysis is the same when assuming a debt beta of 0.10 or 0.05. Under Approach 1, Ofgem's proposals for RIIO-2 still lie in the bottom ten percent, while, for Approach 2, Ofgem's proposals are in the bottom ten percent.

Figure A4.4 Distribution of ARP–DRP differential for UK utilities under Approach 2 (debt beta = 0.1)



Source: Oxera analysis.

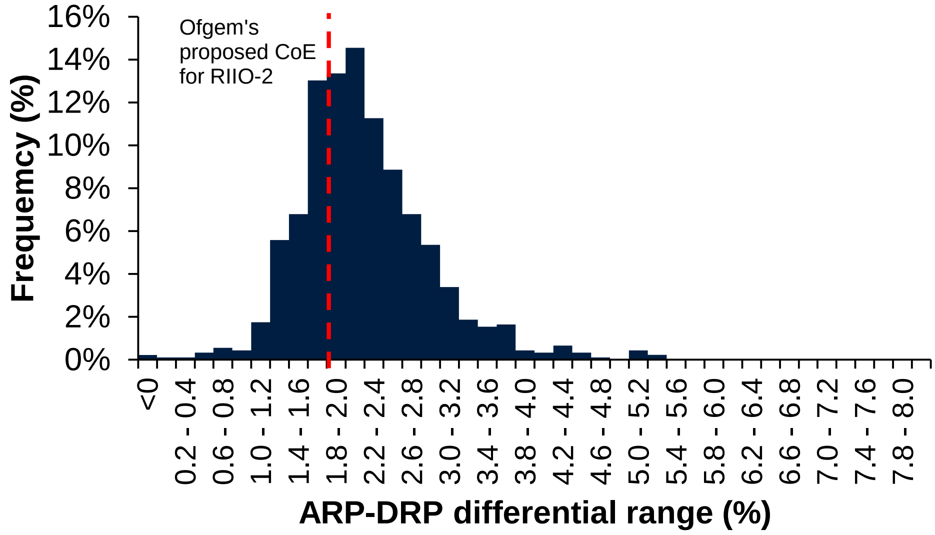
Figure A4.5 Distribution of ARP–DRP differential for US utilities under Approach 1 (debt beta = 0.1)



Source: Oxera analysis.

The conclusion from the US utilities analysis is the same when assuming a debt beta of 0.10 or 0.05. Under Approach 1, Ofgem's proposals for RIIO-2 lie in the bottom ten percent, while, for Approach 2, Ofgem's proposals are in the bottom 30 percent. We note that assuming a debt beta of 0.10 results in the ARP being greater than the DRP on some occasions. This is driven by the equity beta falling significantly for one US utility in particular: American Electric Power.

Figure A4.6 Distribution of ARP–DRP differential for US utilities under Approach 2 (debt beta = 0.1)



Source: Oxera analysis.

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