The cost of equity for RIIO-2

Q3 2020 update

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Executive summary

In November 2019, Oxera published a report (the 2019 Oxera report) that featured estimates of the cost of equity for RIIO-2, as commissioned by the Energy Networks Association (ENA). This report concluded that a reasonable cost of equity (CoE) falls in the range of 5.98-7.09% (CPIH-real). Ofgem released its RIIO-2 Draft Determinations on 9 July 2020, with a call for comments closing on 4 September 2020.[1]

Ofgem's Finance Annex[2] contains the regulator's responses to our 2019 report, as well as outlining its methodology for calculating an allowed return on equity. Ofgem uses a number of assumptions, market data, and cross-checks to arrive at an allowed return on equity of 3.70–3.95%. This range is based on a calculated cost of equity of 3.93–4.20%.[3]

This report serves as an update to the 2019 Oxera report. Our analysis suggests that Ofgem's proposed cost of equity range is materially lower than that suggested by current market evidence. We have examined financial market data through 31 July 2020 and updated our earlier analysis. We have also analysed Ofgem/CEPA's assumptions and cross-checks. In sum, our work supports a CoE in the range of 6.00–7.08%.

The difference in estimates primarily arises because Ofgem assumes a risk-free rate that is unreasonably low, an incorrect market return, and an asset beta calculated using comparator firms with dissimilar risk characteristics from regulated UK energy firms. The distinction between our CoE range and Ofgem's is important because setting the regulatory CoE too low can severely impair the financeability of energy network firms. Ofgem's statutory duties require it to enable networks to finance their functions, highlighting the importance of avoiding a regulatory CoE that is artificially low. Furthermore, an artificially low CoE is welfare-reducing for consumers in many cases, due to its effects on investment and subsequent societal welfare. Our report therefore aims to carefully balance these statutory duties with the most recent economic data and an analysis of Ofgem's cross-checks, as well as cross-checking our own estimates.

The following paragraphs detail our calculations and summarise the key differences between our new estimate, our 2019 estimate, and Ofgem's Draft Determinations.

Comparison with RIIO-1

We briefly summarise major changes to Ofgem's methodology from RIIO-1 to RIIO-2. We note that *all* of Ofgem's changes below would have the effect of lowering the allowed CoE:

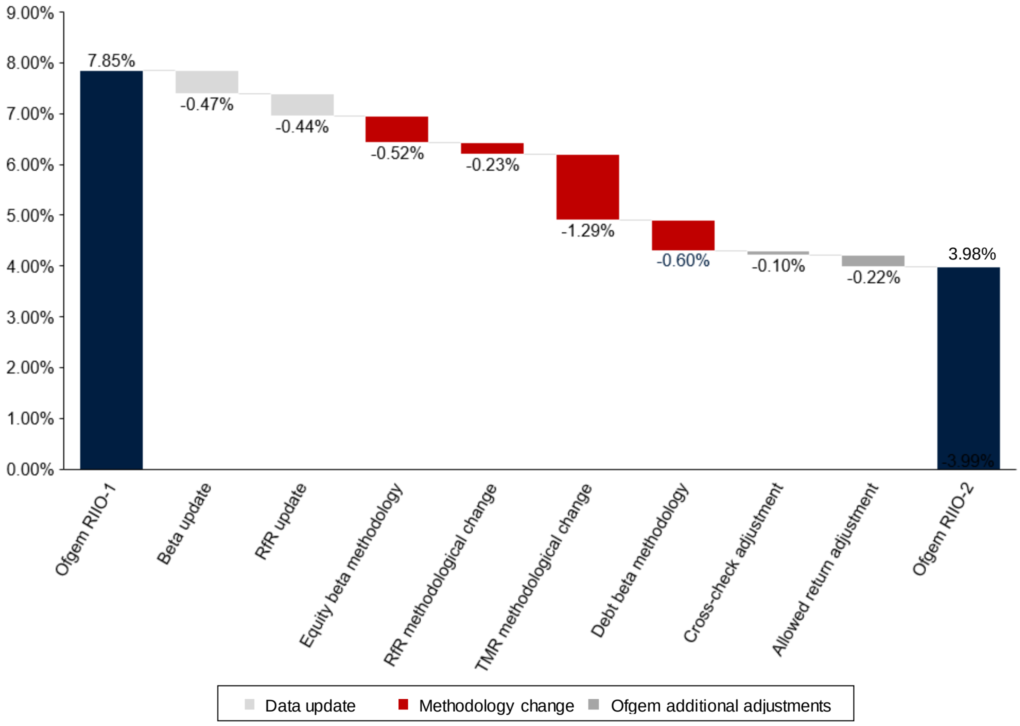
- restating the historical total market return (TMR) based on an experimental index for historical CPI, which results in a lower estimated TMR;

[1] Ofgem (2020), 'RIIO-2 Draft Determinations', 4 September, https://www.ofgem.gov.uk/publications-and-updates/riio-2-draft-determinations-transmission-gas-distribution-and-electricity-system-operator.
[2] Ofgem (2020), 'RIIO-2 Draft Determinations – Finance Annex', https://www.ofgem.gov.uk/system/files/docs/2020/07/draft_determinations_-_finance_annex.pdf.
[3] See Ofgem (2020), 'RIOO-2 Draft Determinations', Table 6, https://www.ofgem.gov.uk/publications-and-updates/riio-2-draft-determinations-transmission-gas-distribution-and-electricity-system-operator.

- increasing the weight on the geometric average historical return, thereby moving further away from the correct (Cooper) estimator, resulting in a lower TMR;
- moving to spot yields on government bonds, which lowers the estimated risk-free rate (RfR);
- using a debt beta of 0.125 where previously Ofgem used zero, which artificially deflates the notional equity beta;
- reducing the allowed return below the estimate of the CoE.

We present these changes graphically in Figure 1.1 below. This figure reconciles the allowed cost of equity for NG in RIIO-1[4] and Ofgem's allowed equity return in the Draft Determinations.

Figure 1.1 Cost of equity bridge between RIIO-1 and RIIO-2



Note: The Ofgem RIIO-1 CoE was adjusted to CPIH real terms using a 81bp RPI-CPIH wedge. The 3.98% figure is based on a 60% gearing and a 22bp outperformance adjustment–this equivalent to 3.95% using 25bp outperformance adjustments. The beta update is based on the two-year equity beta of NG. The risk-free rate update is based on the ten-year average of 10Y UK gilts. The equity beta methodological changed is based on the difference between NG's equity beta and the allowed equity beta. Differences are due to rounding.

Source: Oxera analysis based on Ofgem's methodology and parameters.

Note that only 23% of the change in CoE between RIIO-1 and RIIO-2 is due to changes in market data. In other words, *nearly 80% of the decrease* in the proposed regulatory CoE is due to changes from previous Ofgem methodology and the cumulative effect of these changes is a reduction in the CoE of 387bp.[5]

[4] Ofgem (2012), 'RIIO-T1: Final Proposals for National Grid Electricity Transmission and National Grid Gas', 17 December.
[5] The 3.98% figure is based on a 60% gearing and a 22bp outperformance adjustment–this equivalent to 3.95% using 25bp outperformance adjustments. Differences are due to rounding.

Risk-free rate

We have updated our methodology to estimate the RfR, given our recent work submitted to the Competition and Markets Authority (CMA) on whether sovereign yields are a good proxy for the rate of return on a zero-beta asset. Crucially, the capital asset pricing model (CAPM) defines the RfR as the rate of return on a zero-beta asset and assumes that investors borrow and lend at the RfR. That assumption is violated when considering Ofgem's estimate of -1.5% (CPIH-real), which is based on spot yields on government bonds. Historically, Ofgem estimated the RfR by adding a spread to spot government yields, implicitly converting the government bond yields into a useable RfR; they no longer add such a wedge.

We present two methods for calculating a RfR: either adding a wedge to the government bond yields, consistent with Ofgem's earlier methodology, and starting with high-grade corporate debt and netting out the small premium for default risk. Both methods yield similar estimates for the RfR. Once the value of the RfR is fixed at the start of RIIO-2 it can be subsequently be indexed for changes in government bond yields on an annual basis throughout RIIO-2.

Total market return

As in the 2019 Oxera report, we rely on historical evidence from DMS as the primary source of input, together with the forward-looking evidence derived from the Oxera implementation of the Bank of England dividend discount model (DDM) as a primary cross-check. Our estimates using historical data, the Bank of England dividend discount model, corrected estimates of inflation, academic surveys, and Ofgem's own cross-checks continue to support a TMR estimate of 7.0–7.5% (CPIH-real).

The TMR in the CAPM should represent the rate investors use to discount future cash flows–i.e. the arithmetic average or higher (Cooper (1996)) as opposed to the JKM estimator, which was noted in Oxera's 2019 report.[6] Our evidence continues to show that the Cooper (1996) estimator is the appropriate methodology to generate a TMR estimate for use in the CAPM, for the purposes of discounting, valuation, and setting the regulated rate of return. Ofgem's methodology conflates portfolio investment (compounding) with capital budgeting and valuation (discounting). The uncertainty about the true rate of return means that the arithmetic average has to be adjusted down to achieve an unbiased estimate of the future rate of return on an investment in a portfolio of securities, while the arithmetic average has to be adjusted up to achieve an unbiased estimate of the discounted value of future cash flows. The Ofgem approach embeds an assumption that the TMR is lower than the arithmetic average, which will contribute to the allowed return being lower than the discount rate being applied by investors to value the regulated companies and to make decisions about capital budgeting and investment appraisal.

The long-run geometric and arithmetic averages of the real UK equity market returns were 5.4% and 7.2%, respectively, in the 2019 DMS report. Based on the 2020 edition of DMS, which covers data from 1899 to 2019, the long-run geometric and arithmetic averages of the real UK equity market returns have

[6] Jacquier, E., Kane, A. and Marcus, A. (2005), 'Optimal Estimation of the Risk Premium for the Long Run and Asset Allocation: A Case of Compounded Estimation Risk', *Journal of Financial Econometrics*, **3**:1, pp. 37–55.

increased by 0.1%, to 5.5% and 7.3% respectively. Considering nominal returns, the long-run geometric and arithmetic averages have increased from 9.2% to 9.3% and from 11.0% to 11.1% respectively, compared to the 2019 Oxera report. This evidence indicates an increase in the TMR, suggesting that Oxera's estimate may be conservative.

Further, the use of long-term historical evidence requires reliable inflation data. Since the 2019 edition of DMS, the book has deflated the nominal returns with an inflation series that is a hybrid of RPI and CPI inflation. The hybrid inflation series creates problems when using long-term market data, which have been noted by the ONS. We therefore do not use the real returns directly from DMS.

For comparability of long-term market data, one must instead deflate the nominal returns by a consistent inflation series. There are two possible methods for doing so:

1. adding the forecast RPI–CPIH wedge to RPI-real historical returns restated using today's RPI methodology (which is Oxera's preferred approach);
2. deflating nominal returns by CPI inflation, adjusted for bias in the historical estimates of CPI.

The second approach is subject to a much higher degree of uncertainty because for periods prior to 1997 the CPI series has been estimated *ex post*. We consider it is more robust to start with the official RPI historical series and then to consider any adjustments to the RPI series

Ofgem instead uses unadjusted estimates of historical CPI from the ONS. As discussed below in the report, this creates a series of inflation data that is inconsistent across time.

Risk and beta

The 2019 Oxera report estimated an asset beta range of 0.38–0.41 based on a debt beta of 0.05.

In terms of debt beta, our estimates continue to point to a maximum debt beta of 0.05. In addition to mathematical errors made in their debt beta calculation, Ofgem/CEPA (citing an earlier NERA study) misrepresent the arguments in Fama and French (1993),[7] who actually estimate a debt beta of 0 (or even negative) for nearly all firms, rather than 0.22, as claimed by CEPA.[8]

In this report, we again estimate two-year and five-year asset betas. We continue to find that the market evidence on beta supports a clear differential between energy networks and water companies. Indeed, Ofgem/CEPA's own data suggest that energy companies are riskier than water companies. Ofgem/CEPA's new expanded sample of European comparators appears to suffer from downward bias due to the illiquidity of several stocks in the sample. In addition, our analysis, which uses data through 31 July 2020, suggests that asset betas have risen sharply.

The sharp increase in the two-year asset beta of the sample average is likely to be linked to the economic disruption caused by the shutdowns related to the COVID-19 pandemic. As it is not clear how long this disruption will persist, we

[7] Fama, E. F. and French, K. R (1993), 'Common risk factors in the returns on stocks and bonds', *Journal of Financial Economics*, **33**:1, 1993, pp. 3-56.
[8] CEPA (2019), 'Considerations for UK regulators setting the value of debt beta', report for the UK Regulators Network, 2 December, https://www.ukrn.org.uk/wp-content/uploads/2019/12/CEPAReport_UKRN_DebtBeta_Final.pdf.

therefore reduce the weight placed on shorter-term data for this report. We use National Grid’s five-year asset beta as the low end of our estimate, and the comparator average five-year asset beta as the high end. Our new report presents an asset beta range of 0.38–0.41. We separately consider multiple pieces of evidence suggesting that the CAPM systematically underestimates the cost of equity, such as recent academic research, quantifying the volatility created by political/regulatory risk, and linking this to risk associated with skewness in returns. In all, our evidence supports the view that our asset beta estimate of 0.38-0.41 is conservative, given that the CAPM likely ignores relevant risk exposures in practice. This results in an estimated CoE that does not adequately reward investors for the level of risk involved.

Adjusting the equity return down to offset assumed outperformance

Ofgem applies a 22–25bp reduction to its cost of equity on the assumption that network companies may expect a certain level of outperformance on incentive mechanisms, cost of debt and tax. We do not make this adjustment because outperformance is only achievable if companies beat the efficiency targets set by Ofgem. The possibility of outperformance encourages companies to make cost efficiency gains, which can subsequently be shared with consumers. Consumers already benefit from lower bills and better service when companies outperform, and ‘aiming off’ on the cost of equity is the wrong way to deliver these benefits.

Notwithstanding the above, if Ofgem believes that the level of outperformance should be reduced, the correct approach would be to identify and directly reduce the scope for such outperformance via the relevant mechanisms. For instance, if excessive outperformance is expected relative to cost allowances, this needs to be addressed through a higher efficiency challenge, not through a lower allowance for the equity return.

Cross-checks

Ofgem’s Draft Determinations report a number of cross-checks (step 2), which are used to adjust the CAPM-based CoE (step 1) down by 10bp.

An important check is to use the step 1 CoE inputs and test whether these model inputs fit the Modigliani–Miller (MM) model of a WACC that is invariant to gearing. Ofgem’s inputs for the RfR, debt beta, cost of debt, and TMR result in a WACC that differs from its proposed value. In other words, its model inputs appear to violate the MM model. This is one of the reasons that Ofgem reduces its step 1 estimate of the CoE by 10bp. However, there is an error in the Ofgem calculation, which uses the historical cost of debt rather than the current cost of debt that is assumed in the MM model. Correcting for this error, as well as the error in the RfR discussed above, produces a WACC that is not very sensitive to changes in gearing and therefore there is no basis for a 10bp reduction of the CoE.

Our review of the analysis of infrastructure funds and OFTO rates of return suggests that these cross-checks are unreliable data points.

We also considered Ofgem’s use of estimated premia over regulated asset value, or market-to-asset ratios (MAR), to appeal to the argument that the CoE was set ‘too high’ in the SSMD. We noted in our report submitted to the CMA in May 2020 that expected outperformance—along with other items, such as the non-regulated portion of the business, accrued dividends, and expected takeover premium—can more than explain the premia for Severn Trent and

United Utilities.[9] In other words, the premia can be explained without the argument that the allowed return on equity is too high. Current data continue to support this view.

We note that the above two companies are the only ‘pure play’ companies in CEPA’s analysis, as the others are also engaged in other business. CEPA itself criticises a decomposition approach in other parts of its analysis, indicating that it is incorrect to include NG, SSE, and PNN in its MAR analysis. We further show that one can generate RAB premia if the market expects a slight relaxation in regulatory pressures on the allowed cost of equity post-RIIO-2, and that Ofgem/CEPA’s use of spot dates rather than a longer-term average exacerbates the uncertainty in its analysis.

Nevertheless, in light of the uncertainty in apportioning components of equity market valuations to individual elements of the regulated settlement, there is no reason to depart from the position as stated in previous CMA assessments and the UKRN cost of capital study—evidence from traded market premia does not provide a reliable guide in practice to the cost of equity used by investors in regulated utilities.

In sum, the Ofgem cross-checks do not provide robust evidence to support the CoE proposed by Ofgem in the DD.

Moreover, none of these cross-checks is directly comparable with Ofgem’s CAPM analysis. In contrast, the comparison we have undertaken between the allowed return on assets and the pricing of risk within the debt market is a test of internal consistency between different elements of the capital structure for the same company. A cross-check that is directly comparable to the cost of equity for companies regulated under RIIO-2 should be given more weight.

The asset risk premium

As part of the ENA’s response to Ofgem’s RIIO-2 Sector Specific Methodology Consultation, in March 2019 Oxera submitted evidence to Ofgem on how its proposed allowance on the cost of equity compared with the pricing of risk for these companies in the debt markets (the ‘Oxera ARP−DRP report’).[10] We explained that the ARP−DRP differential can be used as a cross-check for the appropriate level of the allowed cost of equity.

In our updated report,[11] we show that:

- The benchmarks for ARP−DRP can be employed not only as a cross-check to cost of equity, but also to obtain **conservative estimates** of the allowed WACC, because of the downward bias in asset beta estimation.
- After adequately addressing Ofgem’s concerns set out in the RIIO−2 SSMD, our findings reveal more information to support the conclusion that Ofgem’s RIIO−2 cost of equity allowances in the Draft Determination **falls below** that implied by (i) contemporaneous market evidence for the cost of debt and the risk-free rate; and (ii) a mixture of contemporaneous market evidence and regulatory precedent on the asset beta and the TMR. This conclusion is based on the finding that the ARP−DRP differential implied by Ofgem’s allowances is low compared to those implied by the traded yields of energy bonds over the *six-month* period preceding the RIIO−2 Draft Determination.

[9] Oxera (2020), ‘What explains the equity market valuations of listed water companies?’ 20 May.
[10] Oxera (2019), ‘Risk premium on assets relative to debt’, 25 March.
[11] Oxera (2020), ‘Asset risk premium relative to debt risk premium’, 4 September.

- Our updated analysis, incorporating various methodological improvements, finds that the ARP−DRP differentials implied by past regulatory allowances for energy companies (i.e. RIIO−1, NIE RP5 and RP6) were **broadly in line** with those implied by contemporaneous market evidence around the corresponding determinations.

This is not surprising given that the cumulative impact of the major methodological changes introduced by Ofgem for estimating the CoE in RIIO-2 has been to reduce the estimate. The 50th percentile of the ARP-DRP differential implies a real CoE of 6.35%, supporting the CoE range in this report. The takeaway is that the evidence on asset risk premium suggests that Ofgem's CoE estimates are too low.

Required equity returns for RIIO-2

Our report presents multiple pieces of evidence that the CAPM-implied CoE systematically underestimates an appropriate return on equity for regulated energy companies in the UK. Even so, we note that this is currently the preferred regulatory approach. Therefore, based on the newly available evidence on the CAPM parameters, we recommend updating the cost of equity range to 6.00–7.08% CPIH-real. This information is summarised in Table 1.1.

Table 1.1 Summary of RIIO-2 cost of equity estimates

	Oxera 2019		Current evidence		Change	
	Low	High	Low	High	Low	High
Real TMR (%)	7.00	7.50	7.00	7.50	-	-
Real RfR (%)	-1.20	-0.79	-1.00	-1.00	0.20	-0.21
ERP (%)	8.20	8.29	8.00	8.50	-0.20	0.21
Asset beta	0.38	0.41	0.38	0.41	-	-
Debt beta	0.05	0.05	0.05	0.05	-	-
Equity beta at 60% gearing	0.88	0.95	0.88	0.95	-	-
Real cost of equity at 60% gearing (%)	**5.98**	**7.09**	**6.00**	**7.08**	**0.02**	**-0.02**
Equity beta at 55% gearing	0.78	0.85	0.78	0.85	-	-
Real cost of equity at 55% gearing (%)	**5.22**	**6.26**	**5.27**	**6.23**	**0.04**	**-0.03**

Note: All figures are presented in CPIH-real terms and do not include a 25bp downward adjustment for expected outperformance as advocated by Ofgem.

Source: Oxera analysis

1 Introduction

In November 2019, Oxera published a report (the 2019 Oxera report) that featured estimates of the cost of equity for RIIO-2, as commissioned by the ENA. This report serves as an update to the 2019 Oxera report and reflects new evidence from capital markets, as well as updates based on or in response to further thinking and evidence presented by Ofgem in its Draft Determinations. This report also incorporates analysis submitted to the CMA as part of the water PR19 appeals.

The report is structured as follows.

- Section 2 discusses the estimation of the market parameters, considering the evidence on the risk-free rate (RfR), total market return (TMR) and equity risk premium (ERP). We also consider a range of cross-checks to the TMR.
- Section 3 considers the latest evidence on equity betas, debt betas and gearing to derive an estimate of the asset beta for the energy networks affected by RIIO-2. It also considers other risks priced by investors in the energy sector that may not be properly reflected in an equity beta estimate, such as the impact of political and regulatory risk and resulting skewness in returns.
- Section 4 combines the evidence from the previous two sections to provide an updated CAPM-based cost of equity range for RIIO-2.
- Section 5 concludes with a discussion of how to select a point estimate for the cost of capital that maximises consumer welfare when there is uncertainty about the underlying parameters of the cost of capital.
- Appendix 1 provides a comparison between the estimates presented in this report and the RIIO-2 Draft Determinations as well as a comparison between the RIIO-2 Draft Determinations and RIIO-1.
- Appendix 2 responds to the cross-checks considered by Ofgem.

The analysis provided in this report is based on current data and may change by the time that RIIO-2 begins.

2 Market parameters: the risk-free rate, total market return, and equity risk premium

2.1 Risk-free rate

In the 2019 Oxera report, our estimate of the risk-free rate (RfR) used 10- and 20-year government bond yields. Oxera has subsequently published a report that investigates the relationship between sovereign yields and the capital asset pricing model (CAPM).[12] Because the CAPM requires firms and investors to borrow and lend at the RfR, we concluded that government bond yields significantly underestimate a practical estimate of the RfR for the CAPM.[13] In the context of RIIO-2, this underestimation creates a violation of the Modigliani–Miller (MM) proposition—that the vanilla WACC should be invariant with respect to the level of gearing. In this section, we summarise our findings and present an updated view of the most appropriate proxy of the RfR. In Appendix A4, we further discuss the implications of the RfR for the MM proposition.

Any selected proxy variable for the RfR should measure the expected real return on an investment free of default risk. Government bonds with high credit ratings are therefore often used as proxy variables for the RfR, given the low default risk for these securities. However, the academic literature suggests that unadjusted spot yields on government bonds cannot always be used as a proxy for the risk-free rate in the CAPM framework. Crucially, both investors and firms are assumed to borrow and lend at this rate. The CAPM itself requires only that the RfR be the expected return on a zero-beta asset, and does not specify that this asset is a government bond.[14] A recent report by Oxera summarised two reasons explaining why government bond yields are an underestimate of the risk-free rate (RfR) to use in the CAPM.[15]

1. **A substantial convenience premium for government bonds.** Empirical studies show that government bonds possess special safety and liquidity characteristics compared to other securities. This pushes the yields on government bonds below the required rate of return for a zero-beta asset. Therefore, to be used as a proxy for the risk-free rate, the yields on bonds issued by governments with a high sovereign credit rating would need to be adjusted upwards to remove the impact of the convenience premium. Krishnamurthy and Vissing-Jorgensen (2012) write:[16]

   > Treasury interest rates are not an appropriate benchmark for “riskless” rates. **Cost of capital computations using the capital asset pricing model should use a higher riskless rate than the Treasury rate**; a company with a beta of zero cannot raise funds at the Treasury rate. [Emphasis added]

   In essence, the convenience premium reflects the money-like convenience services offered by government bonds, which have special safety and

[12] Oxera (2020), ‘Are sovereign yields the risk-free rate for the CAPM?’, prepared for the Energy Networks Association, 20 May.
[13] Sharpe, W. (1964), ‘Capital asset prices: A theory of market equilibrium under conditions of risk’, *Journal of Finance*, **19**:3, pp. 425–442.
[14] Brennan, M. (1971), ‘Capital Market Equilibrium with Divergent Borrowing and Lending Rates’, *The Journal of Quantitative and Financial Analysis,* **6:**5, December, p. 1204.
[15] Oxera (2020), ‘Are sovereign yields the risk-free rate for the CAPM?’, prepared for the Energy Networks Association, 20 May.
[16] Krishnamurthy, A. and Vissing-Jorgensen, A (2012), ‘The Aggregate Demand for Treasury Debt’, *Journal of Political Economy*, **120**:2, April, pp. 233–67.

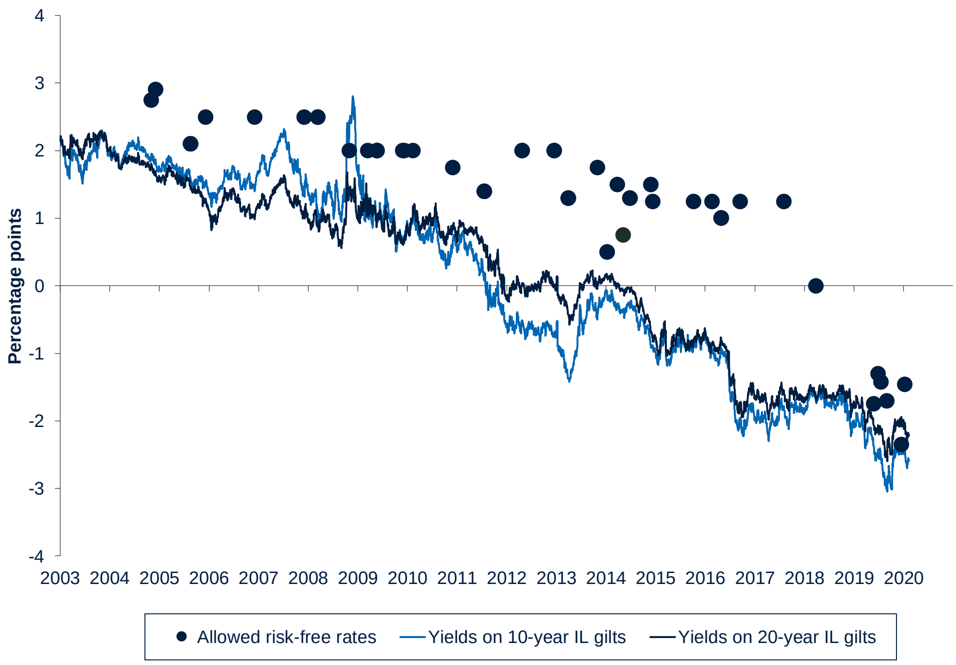
liquidity characteristics. This is currently not incorporated in Ofgem's CoE indexation methodology.[17]

2. **The gap between corporate and sovereign risk-free financing rates.** The CAPM assumes that all investors can borrow and lend at the same risk-free rate. However, in reality, non-sovereign investors with even the highest creditworthiness face higher borrowing rates than those faced by governments.

Berk and DeMarzo (2014) have observed that due to the issues above, '**practitioners sometimes use rates from the highest quality corporate bonds in place of Treasury rates in [the CAPM equation]**' [emphasis added].[18]

To understand why the issue of underestimation of the risk-free rate was not raised in the past, it is helpful to examine the difference between historical regulatory risk-free rate allowances in the UK and the spot yields on government bonds. We illustrate this in Figure 2.1.

Figure 2.1 Regulatory precedents on the risk-free rate



Source: Oxera analysis based on past regulatory determinations.

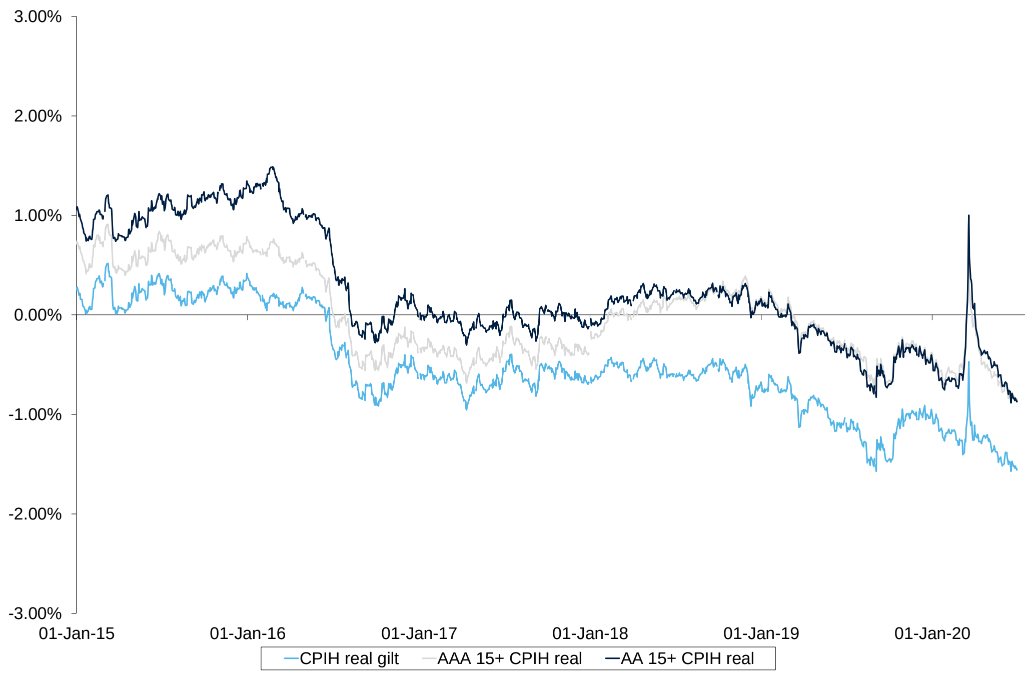
Note that prior to 2019, the regulatory allowance for the risk-free rate was set above the spot yields on government bonds. Therefore, the regulatory issue of an underestimated risk-free rate in the CAPM framework was less severe. The average gap was 149bp over 10Y ILGs and 131bp over 20Y ILGs. However, in the most recent Draft Determinations, the regulatory allowance for the risk-free rate was reduced to the same level of the spot yields on government bonds. This is further reflected in the estimated WACC exhibiting greater instability with reference to the gearing level—i.e. violation of the Modigliani–Miller theorem.[19]

[17] See 'WACC allowance model.xlsx' published alongside the 2020 Draft Determinations.
[18] Berk and DeMarzo (2014), *Corporate Finance. Third Edition*, p. 404.
[19] Modigliani, F. and Miller, M. H. (1958), 'The Cost of Capital, Corporation Finance and the Theory of Investment', *The American Economic Review*, **48**:3, June.

In line with the recommendation in Berk and DeMarzo (2014), the next part of this section focuses on the market evidence on the yields of 'highest quality corporate bonds'. In particular, we present the yields on AAA-rated corporate bonds, as well as their spreads over UK ILGs. We also consider the yields on AA-rated bonds as a cross-check.

Figure 2.2 presents yields on indices of sterling-denominated AAA and AA corporate bonds with 15+ years to maturity. These yields have consistently had a positive spread relative to government bonds of comparable maturity.

Figure 2.2 Real yields on corporate and government bonds



Note: The yields of iBoxx corporate bond indices are deflated using the average of 15-year and 20-year ILG-implied inflations from the Bank of England, adjusted for the RPI-CPIH wedge.

Source: Oxera analysis based on data from IHS Markit and Bank of England.

Table 2.1 indicates that the AAA spread has ranged between 70bp and 80bp in the last six months, suggesting that the RfR would be underestimated if it was set equal to spot or forward yields on government bonds.

Table 2.1 Spot and average yields with maturity of 15+ years

	Spot	Three-month average	Six-month average
20Y ILG average	-2.63%	-2.50%	-2.36%
20Y ILG average, CPIH real	-1.84%	-1.71%	-1.57%
iBoxx £ corp AAA 15+, real	-1.16%	-1.01%	-0.80%
Cross-check: iBoxx £ corp AA 15+, real	-1.21%	-0.99%	-0.78%
	Spread (bp)	Spread (bp)	Spread (bp)
15–20Y average ILG			
iBoxx £ corp AAA 15+, real	0.68%	0.70%	0.77%
Cross-check: iBoxx £ corp AA 15+, real	0.63%	0.72%	0.79%

Note: The yields of iBoxx corporate bond indices are deflated using the average of 15-year and 20-year ILG-implied inflations from the Bank of England. Based on the OBR's forecast, CPIH/RPI wedge of 81bp is assumed to derive the CPIH real values. A cut-off date of 31 July 2020 is assumed.

Source: Oxera analysis based on data from IHS Markit and Bank of England. Office for Budget Responsibility (2019), 'Historical official forecasts database', March.

We recognise that AAA corporate bonds yields reflect a non-zero probability of default. We therefore next consider how much of the observed AAA yield represents compensation for expected loss and a premium for systematic risk.

Elton *et al* (2001) consider actual default rates and bankruptcy recovery rates on corporate debt and show that a risk-neutral investor will require (at most) a 5bp default premium to invest in a 10-year AA-rated corporate bond.[20]

Berk and DeMarzo (2014) report data from Moody's that indicates an annual default rate of 0.0% for AAA corporate bonds over 1983–2011 based on a 10-year holding period.[21] The authors also report an average loss rate for unsecured debt of about 60%. These data are consistent with the expected loss component of the AAA corporate yield being close to zero over a 10-year horizon.

Feldhütter and Schaefer (2018) provide estimates of default probabilities using a structural model (Black–Cox) and a new approach for calibrating the model to historical default rates that leads to more precise estimates of investment-grade default probabilities. The authors present estimates of default probabilities and premiums up to a 20 year investment horizon.

The authors report actual cumulative default probabilities of 0.87% and 1.71% for AAA-rated corporate bonds over 10- and 20-year horizons.[22] The default probabilities implied by the Black–Cox model are reported as 0.54% and 1.18% for the 10- and 20-year horizons. The annualised default probabilities are obtained by dividing these figures by the investment horizon. Multiplying by an average loss rate of 60% gives the annualised default premiums, which are reported in Table 2.2.

[20] Elton, E., Gruber, M., Agrawal, D., and Mann, C. (2001), 'Explaining the Rate Spread on Corporate Bonds', *The Journal of Finance*, **56:**1, February, Table 6.
[21] Berk, J. and DeMarzo, P. (2014), *Corporate Finance: Third Edition*, Pearson, Table 12.2.
[22] Feldhütter, P. and Schaefer, S. (2018), 'The Myth of the Credit Spread Puzzle', *The Review of Financial Studies*, **31**:8, August, pp. 2897–2942, Table 8.

Table 2.2 Estimates of default premiums

Horizon	10-year	20-year
Actual	0.03%	0.04%
Black–Cox model	0.05%	0.05%

Source: Oxera analysis based on Feldhütter, P. and Schaefer, S. (2018), 'The Myth of the Credit Spread Puzzle', *The Review of Financial Studies*, **31**:8, August, pp. 2897–2942, Table 8.

In addition, Feldhütter and Schaefer (2018) account for the systematic risk premium in AAA corporate yields. Table 2.3 summarises the estimated spreads between AAA corporate yields and the underlying risk-free rate.

Table 2.3 Estimated spreads of AAA corporate bond yields to risk-free rate

Horizon	7–13 year	13–20 year
Actual	0.06%	0.22%
Black–Cox model	0.01%	0.02%

Source: Oxera analysis based on Feldhütter, P. and Schaefer, S. (2018), 'The Myth of the Credit Spread Puzzle', *The Review of Financial Studies*, **31**:8, August, pp. 2897–2942, Table 9.

In conclusion, at a 10-year horizon the yields on AAA corporate bonds minus up to 5bp to account for a default risk premium is a reasonable proxy for the risk-free rate to use in the CAPM.

As the investment horizon increases, the cumulative default probability increases. The uncertainty of the estimate also increases, particularly given that defaults of bonds originally rated AAA at issue are rare. At a 20-year investment horizon, AAA corporate bond yields with a downward adjustment of 5–20bp could be used as a reasonable proxy for the risk-free rate to use in the CAPM.

In order to provide a more informed view of the allowed RfR during RIIO-2, we apply an uplift to the current spot rate based on the difference between current spot rates and the average forward rates for RIIO-2. This approach is consistent with the framework put forward by Ofgem in the Draft Determinations. Table 2.4 summarises the estimation of the risk-free rate including the adjustment and the forward risk premium.

Table 2.4 Risk-free rate estimation (CPIH-real)

	2022	2023	2024	2025	2026	Average
iBoxx £ corp AAA 15+, real [a]	-1.16%	-1.16%	-1.16%	-1.16%	-1.16%	-1.16%
Forward Premium [b]	0.11%	0.15%	0.20%	0.23%	0.26%	0.19%
Adjustment [c]	-0.10%	-0.10%	-0.10%	-0.10%	-0.10%	-0.10%
RfR with adjustment [d = a+b+c]	**-1.15%**	**-1.10%**	**-1.06%**	**-1.02%**	**-1.00%**	**-1.07%**

Note: The table presents the spot figures of the iBoxx £ corp AAA 15+. The cut-off date is 31 July 2020.

Source: Oxera analysis based on data from IHS Markit and Bank of England.

In summary, the CPIH-real RfR is forecast to range from -1.15% to -1.00%. The RfR based on based on a three-month average is -1.00% and based on a six-month average is -0.79%.[23]

Although we noted earlier the problems using high-rated government bond yields as a RfR rate, especially in the current period, we recognise their historical popularity. As a cross-check, we build the RfR using a 'bottom-up' methodology by adding a premium to high-rated government bonds, such as UK gilts. Empirical analysis shows that between 1998 and 2005,[24] spreads of AAA-rated corporate bonds relative to government bonds range from 52–176bp. More recently, over the past three to six months, this spread averaged at 75bp and 86bp respectively.

Adding a premium on top of UK gilts is consistent with the approach taken by investment banking analysts. In particular, the majority of equity analysts covering the regulated utilities in the UK have assumed a risk-free rate that exceeds the spot yield on government bonds by 69–214bp, averaging at 102bp.[25]

Based on this evidence, we consider that an upward adjustment of 50–100bp on UK gilts would be appropriate to assess the RfR level. Table 2.5 presents the RfR estimate using UK gilts and an upward adjustment of 75bp. This cross-check generates an average RfR forecast of -0.90%.

Table 2.5 Risk-free rate estimation using UK gilts

	2022	2023	2024	2025	2026	Average
CPIH ILG [a]	-1.84%	-1.84%	-1.84%	-1.84%	-1.84%	-1.84%
Forward Premium [b]	0.11%	0.15%	0.20%	0.23%	0.26%	0.19%
Adjustment [c]	0.75%	0.75%	0.75%	0.75%	0.75%	0.75%
RfR with adjustment [d = a+b+c]	**-0.98%**	**-0.93%**	**-0.89%**	**-0.85%**	**-0.83%**	**-0.90%**

Note: The table presents the spot figures of UK gilts. The cut-off date is 31 July 2020.

Source: Oxera analysis based on data from IHS Markit and Bank of England.

On balance, based on the market evidence as of 31 July 2020, we consider that -1.00% is an appropriate assumption for the RfR. Overall, our preferred method to determine a rate that investors and firms can borrow/lend at uses the default-adjusted AAA rate, given the above-noted issues with government bond yields. However, our cross-check using a traditional 'bottom-up' approach also generates similar estimates of RfR.

To conclude, there are two methods for estimating the risk free rate: the first is to use AAA bond yields and adjust them downward after accounting for a default premium; the second is to use government bond yields and adjust them

[23] Based on AAA corporate bond yields deflated by RPI break-even inflation and a CPIH–RPI wedge of 81bp.
[24] Feldhütter and Lando (2008) covered the period of 1996 to 2005. However, the data for iBoxx GBP Corporate AAA 15+ index became available on 1 January 1998.
[25] Jefferies (2020), 'Utilities. When the Facts Change...Upgrade UU to Buy', 10 February; HSBC (2019), 'Pennon Group. Buy: Capital allocation – a point of inflection', 12 November; (2020), 'Pennon Group. Buy: FD accepted, waste purchasers queue up', 14 February; (2020), 'National Grid. Upgrade to Buy: A truly defensive play', 19 March; (2020), 'Pennon Group. Pure play company with Viridor sale', 20 March; (2020), 'SSE. Dividend disruption premium', 8 April; (2020), 'United Utilities. Upgrade to Buy: Financial prudence, high visibility', 8 April; Credit Suisse (2020), 'National Grid. Risk discount dissipating', 14 January; Barclays (2020), 'Pennon Group / Severn Trent. Happy Valentine's Day Ofwat – and could CMA referrals be a match for Ofgem?', 14 February; (2020), 'Severn Trent. Severn Trent in line for 2020 but 2021 may see some downgrades', 31 March; (2020), 'Severn Trent / United Utilities. Ofwat consults on providing temporary liquidity', 17 April.

upward for factors that reduce these yields relative to the expected return on a zero-beta asset. The two approaches should lead to similar results.

Once the value of the RfR is fixed at the start of RIIO-2 it can be subsequently be indexed for changes in government bond yields on an annual basis throughout RIIO-2.

Having determined an appropriate range for the RfR, the next step in determining the cost of equity via the CAPM is to assess an appropriate level for the total market return (TMR). The TMR is the sum of the RfR and a risk premium for investing in equity (the equity risk premium, or 'ERP'). When implementing the CAPM, the estimation of the RfR cannot be considered in isolation from the ERP.

2.2 TMR and ERP

This section sets out the updated evidence on the TMR. As in the 2019 Oxera report, we rely on historical evidence from DMS as the primary source of input, together with the forward-looking evidence derived from the Oxera implementation of the Bank of England DDM as a primary cross-check. We also present evidence from academic surveys by Fernandez et al.[26]

2.2.1 Historical evidence and inflation

The 2019 Oxera report presented the long-run average UK equity market returns based on the 2018 edition of the DMS book, which covered data from 1899 to 2017. At that time, the long-run geometric and arithmetic averages of the real UK equity market returns were 5.4% and 7.2% respectively. Based on the 2020 edition of DMS, which covers data from 1899 to 2019, the long-run geometric and arithmetic averages of the real UK equity market returns have increased by 0.1%, to 5.5% and 7.3% respectively.

Considering nominal returns, the long-run geometric and arithmetic averages have increased from 9.2% to 9.3% and from 11.0% to 11.1% respectively, compared to the 2019 Oxera report.[27]

As outlined in the 2019 Oxera report, recent academic studies have shown that averaging equity returns for the period 1899–2018 produces the lowest average relative to any other averaging period, either shorter or longer. This suggests that estimates of the long-term equity market return based on the period covered by the DMS dataset may be downward-biased.[28]

In addition, as noted in the 2019 Oxera report, since the 2019 edition of DMS, the book has deflated the nominal returns with an inflation series that is a hybrid of RPI and CPI inflation.[29] For comparability, one must obtain real returns that are consistent with RPI or CPI inflation over time. Therefore, we cannot directly rely on the DMS real estimates. Rather, the nominal returns shown in the 2020 edition of DMS need to be deflated by a different inflation

[26] Graham and Harvey have not updated their survey since the 2019 Oxera report.
[27] Dimson, E., Marsh, P., and Staunton, M. (2018), 'The 2019 Global Investment Returns Yearbook: 119 years of financial history and analysis.', p. 209.
[28] See for instance, Grossman, R. S. (2014), 'Bloody Foreigners! Overseas Equity on the London Stock Exchange, 1869 to 1928', January, Wesleyan University, Connecticut; Turner, J., Acheson, G., Hickson, C. and Ye, Q. (2008), 'Has equity always earned a premium? Evidence from nineteenth-century Britain', 10 May, https://voxeu.org/article/has-equity-always-earned-premium-evidence-nineteenth-century-britain, accessed 3 October 2019; NGET (2019), 'National Grid's response to Ofgem's RIIO-2 sector-specific methodology consultation – Finance', pp. 24–25.
[29] Dimson, E., Marsh, P. and Staunton, M. (2019), 'Credit Suisse Global Investment Returns Yearbook 2018', February.

series from the one presented therein. In the 2019 Oxera report, we outlined two possible methods for achieving this, namely:

1. adding the forecast RPI–CPIH wedge to RPI-real historical returns restated using today's RPI methodology (which is Oxera's preferred approach);
2. deflating nominal returns by CPI inflation, adjusted for bias in the historical estimates of CPI.

We note that Ofgem/UKRN perform neither of these adjustments, incorrectly using an unadjusted CPI measure. They instead note that '[the proposed adjustments] hinge on there being a consistent and perfect single measure of inflation for more than 100 years. The absence of this does not invalidate using the best available measure for each period of history, as implied by NG.'[30] We disagree. A regulator should not intentionally use an unreliable and inconsistent inflation measure. To the contrary, our goal is to generate a comparable, consistent inflation measure across the entire time series, otherwise any calculation of a historical real TMR will be inconsistent with the way that inflation is measured today.

To implement the first approach we created an adjusted RPI series as part of our work for Heathrow Airport. The intention was to build a hypothetical historical RPI series as if it were restated using today's RPI methodology. We have updated this data through 2019. Table 2.6 below compares the RPI inflation estimates of our previous report and the updated analysis.

Table 2.6 RPI Inflation

Index	Inflation rate—initial report	Inflation rate—including 2019
RPI All Items (ONS)	4.17%	4.14%
Adjusted RPI—Method 1	4.16%	4.14%
Adjusted RPI—Method 2	4.33%	4.30%
Adjusted RPI—Method 2, sensitivity 1	4.47%	4.46%
Adjusted RPI—Method 2, sensitivity 2	4.20%	4.14%

Note: This analysis covers the period 1899–2019.

As noted in the 2019 Oxera report, if the historical (1899–2019) RPI series was restated using today's RPI calculation methodology, the series could be up 30bp higher than if based on the official RPI series published by the ONS.[31] On this basis, the arithmetic average of the historical annual real equity market return for the period 1899–2019 would be between 6.5% and 6.8% (RPI-real). Adding the OBR's estimate of the forecast difference between RPI and CPI inflation of 81bp produces a range of 7.2–7.6% (CPIH-real).[32]

Oxera subsequently undertook further research on the historical RPI series, and in an updated report concluded that there are likely to have been significant methodological changes in the RPI series other than just the 2010 change related to the way the ONS collects clothing prices. Making a selective upward adjustment to the long-run average of RPI inflation based on just the 2010 change ignores these other changes and is therefore not robust and is likely to bias the estimate of long-run RPI upwards. If, for example, the

[30] Ofgem (2020), 'RIIO-2 Draft Determinations – Finance Annex', 09 July, p. 194.
[31] Oxera (2019), 'Estimating RPI-adjusted equity market returns', 2 August.
[32] Office for Budget Responsibility (2020), 'Economic and fiscal outlook', March, p. 59.

changes in the early 1990s are also accounted for, it would be appropriate to deflate the long-run average equity return using the published RPI data without making any further adjustments for the forecast wedge between RPI and CPI inflation.[33]

The second approach of adjusting the historical estimates of CPI to identify and remove biases is subject to a much higher degree of uncertainty because for periods prior to 1997 the CPI series has been estimated *ex post*. We consider it is more robust to start with the official RPI historical series and then to consider any adjustments to the RPI series, such as the analysis we described above or the analysis the CMA did in the NERL provisional findings, which was to replace the Cost of Living Index with the Consumption Expenditure Deflator.

The historical estimates of the CPI are essentially based on estimates of what the wedge between RPI and CPI inflation would have been in the past, in particular the ‘formula effect’. The empirical challenges of estimating the formula effect back to 1950 are underlined by the downward revision made by the OBR in December 2019 to estimates of how much the formula effect contributes to the wedge between RPI and CPI inflation. This revision suggests that the effect of the 2010 change to the way inflation data was collected had a lower impact on RPI inflation than we previously thought. This illustrates the risk that making adjustments to the historical RPI data could increase rather than decrease the accuracy of the real expected equity return.

We requested the data and code underlying the CPI backcast. The ONS was unable to locate the information used to construct the historical CPI estimates, and has been unable to replicate them. The ONS is currently revising the backcast of historical CPI. We consider that it would be inappropriate to switch to this estimated historical inflation series for setting a price control when the series is under revision and may be subject to error, given that the results cannot be reproduced.

In addition to concerns about the robustness of the historical estimates of CPI, we consider that the CPI estimates are likely to be materially upward-biased estimates of inflation and, therefore, downward-biased estimates of real return.

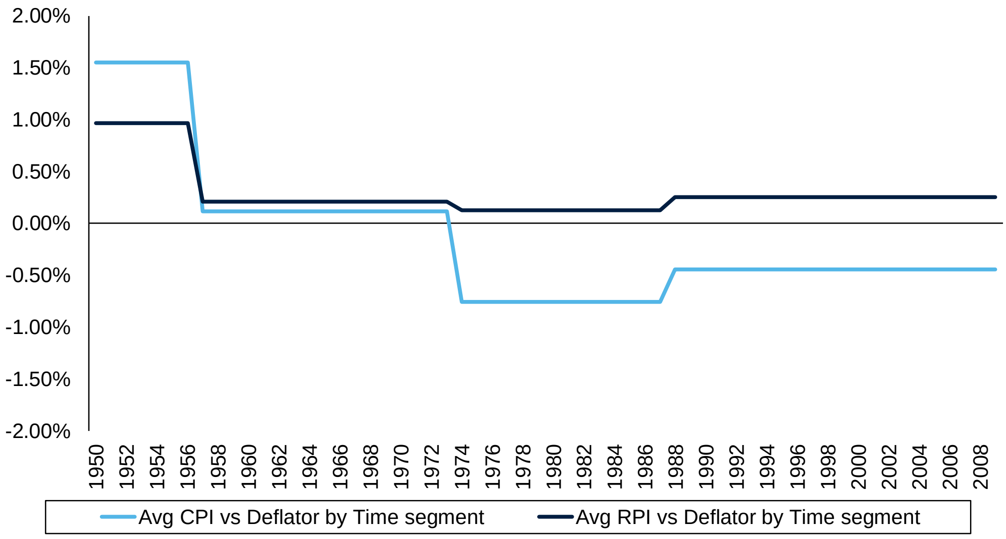
For the period 1900–1950, the CPI backcast is based on the consumption expenditure deflator (CED). These historical estimates of CED are from Feinstein (1972).[34] Hence, these estimates of CED predate the publication of CPI in 1997. Therefore, the construction of the CED is likely to be based on price series that are constructed in a similar way to the measure of inflation at that time, which was RPI. Specifically, it is likely the underlying price series in the CED estimates are using the Carli method of averaging and not the Jevons formula method of averaging. Therefore, the CED inflation is likely to include the same degree of upward formula effect bias as we get with the RPI. We have discussed this hypothesis with the ONS and they agree with this interpretation.

Analysis undertaken by National Grid, presented in Figure 2.3, shows that since 1956 the average differential between RPI and the CED is relatively stable at around 20bp. In comparison, the average differential between the CED and the backcast of CPI has changed significantly over time.

[33] Oxera (2020), 'Response to the CMA on estimating RPI-adjusted equity market returns', prepared for Heathrow Airport, 15 April
[34] Feinstein, C. H. (1972), ‘National Income, Expenditure and Output of the United Kingdom 1855-1965’.

This suggests that, prior to 1950, where the CPI backcast is using CED, this is both theoretically and empirically closer to RPI than CPI.

Figure 2.3 Average differential in each of several time segments, between each of CPI and RPI and the deflators from Sefton and Weale (1995) and the 2000 to 2010 Blue Book National Accounts



Source: National Grid (2020), 'Total Market Returns', 23 January, p. 11.

As such, the rest of this section will focus on the issue of converting the average returns obtained using the first method (adjusted RPI plus the forecast RPI-CPIH wedge) to an unbiased market discount rate that can be used to set the allowed TMR.

Converting from a historical average to an unbiased market discount rate

As explained in the 2019 Oxera report, an unbiased estimate of the market discount rate (i.e. TMR) will be closer to the arithmetic average than the geometric average. Cooper (1996) demonstrated that the discount rate investors should use to give an unbiased estimate of the present value of future cash flows will assume a TMR at least as high as the arithmetic average of historical returns.

The importance of distinguishing carefully between estimated expected returns used in calculations that require compounding rather than discounting is emphasised in Jacquier, Kane & Marcus (JKM, 2005).[35] As the TMR can be defined as the total expected return that investors require for investing in equities, the JKM estimator can be used to estimate this return. However, the relevant question for setting a price control is 'what rate do investors use to discount future cash flows?'. Using the JKM and Blume estimators to answer this question results in estimates that are more biased than simply using the arithmetic average, because the JKM and Blume estimators adjust in the wrong direction (i.e. down).

[35] 'Cooper (1996) analyses the bias in the context of discount factors for capital budgeting purposes. He concludes that the arithmetic mean is usually nearly appropriate even accounting for estimation error. However, because discount factors involve powers of the *reciprocal* of the rate of return, the biases he finds differ drastically from those considered here.' Jacquier, E., Kane, A. and Marcus, A. (2005), 'Optimal Estimation of the Risk Premium for the Long Run and Asset Allocation: A Case of Compounded Estimation Risk', *Journal of Financial Econometrics*, **3**:1, pp. 37–55.

To put it simply, the Cooper estimator is an unbiased estimator of the rate to use for discounting future cash flows and undertaking a valuation exercise, which is how the CoE is utilised by investors when making investment decisions. Conversely, the JKM estimator is an unbiased estimator of the growth rate to use to project the future value of a portfolio of securities—roughly equivalent to a buy-and-hold return. The Cooper estimator is therefore the appropriate measure to use in this regulatory context.

Consequently, for the purposes of setting the regulatory cost of capital, the arithmetic average is the most relevant data point for informing the estimate and certainly should not be excluded from the analysis. However, we note, as explained by Cooper (1996),[36] that both the geometric and arithmetic averages are likely to be downward-biased estimators of the discount rate.[37, 38] Therefore, one should expect the true discount rate to be higher than the arithmetic and geometric averages.

Applying the Cooper methodology to convert real TMR estimates described above to unbiased estimates of the market discount rate results in a range of c. 6.48–7.13% for the RPI-deflated market discount rate, depending on the investment horizon. Adding the OBR's estimate of the forecast difference between RPI and CPIH inflation of 81bp yields an unbiased estimate of the CPIH-deflated market discount rate of 7.29–7.94% (CPIH-real). These results are summarised in Table 2.7.

Table 2.7 Estimating RPI-deflated TMR

	Lower bound	Upper bound
Arithmetic average	6.46%	6.76%
Assumed forecast horizon		
1 year	6.48%	6.80%
5 years	6.55%	6.87%
10 years	6.64%	6.96%
20 years	6.81%	7.13%

Note: We have updated Cooper (1996) to reflect the volatility in UK equity market returns and the same time horizon used in the UKRN study. Note that this analysis covers the period 1899–2019.

Source: Oxera analysis based on Cooper (1996).

Conclusion on historical evidence

In conclusion, we maintain our recommendation of deflating historical nominal returns by the adjusted RPI inflation series. This is because the RPI series is more accurate than the CPI series, as the latter largely relies on backcasted estimates that appear to be subject to upward bias. The arithmetic average of the RPI-real estimate should then be converted to an unbiased estimate of the discount rate using the Cooper (1996) methodology. Finally, the RPI–CPIH

[36] Cooper, I. (1996), 'Arithmetic versus geometric mean estimators: Setting discount rates for capital budgeting', *European Financial Management*, **2**:2, 1996, pp. 156–67, http://faculty.london.edu/icooper/assets/documents/ArithmeticVersusGeometric.pdf.
[37] The analysis in Cooper (1996) focuses on discount factors, which are the reciprocal of discount rates. As such, an upward bias in discount factors is equivalent to a downward bias in discount rates. To maintain consistency with the rest of this report, we refer to discount rates rather than discount factors.
[38] The reason for this bias is the shape of the function (the function is convex, which results in the expected value of the function being higher than the true expected value, as shown by Jensen's inequality) used to estimate the arithmetic and geometric average discount factors. The reason why the bias is the opposite direction for the discount rate to the discount factor is due to the discount rate being the inverse of the discount factor. Therefore, the bias is inverted.

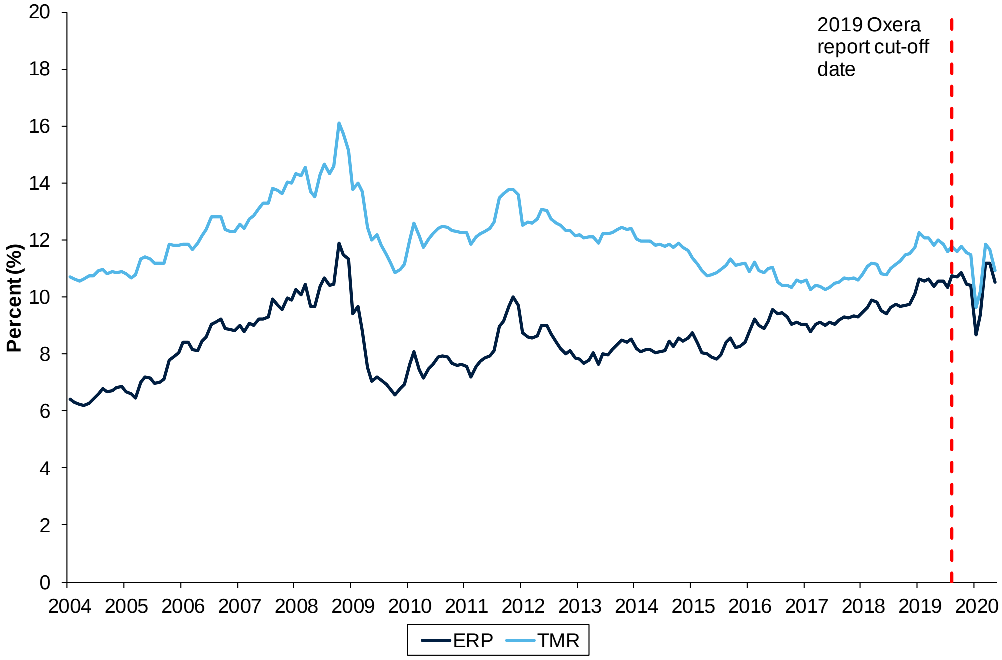
wedge of 81bp should be added to the resulting figures in order to obtain an unbiased estimate of the CPIH-real market discount rate. We showed that following this method leads to a range of 7.29–7.94%.

2.2.2 Dividend discount models

As part of the analysis conducted for our previous report on the RIIO-2 cost of equity, we constructed a dividend discount model (DDM) following the Bank of England's methodology. We observed that the ERP derived from our DDM was much more volatile than the equity market discount rate derived from the same model.[39] We also observed that the equity market discount rate had not followed the same downward trend as observed in the yields on government bonds, implying relative stability of the TMR.[40]

We have now updated our DDM to account for the passage of time since our first report. This is shown in Figure 2.4.

Figure 2.4 Nominal equity market discount rate and ERP based on a DDM for the FTSE All-Share Index



Note: The red dotted line is the cut-off date for our previous analysis. ERP estimates take account of the full profile of the nominal yield curve. Due to the instability caused by the COVID crisis, the growth rate from April 2020 is assumed to be equal to the long term GDP growth rate using IMF and Bloomberg data.

Source: Oxera analysis based on Bloomberg, Refinitiv Datastream, and the IMF World Economic Outlook.

Figure 2.4 shows that if we look at the time series since 2004, the TMR has changed less than the ERP, supporting the view that the TMR is a largely stable parameter over time.

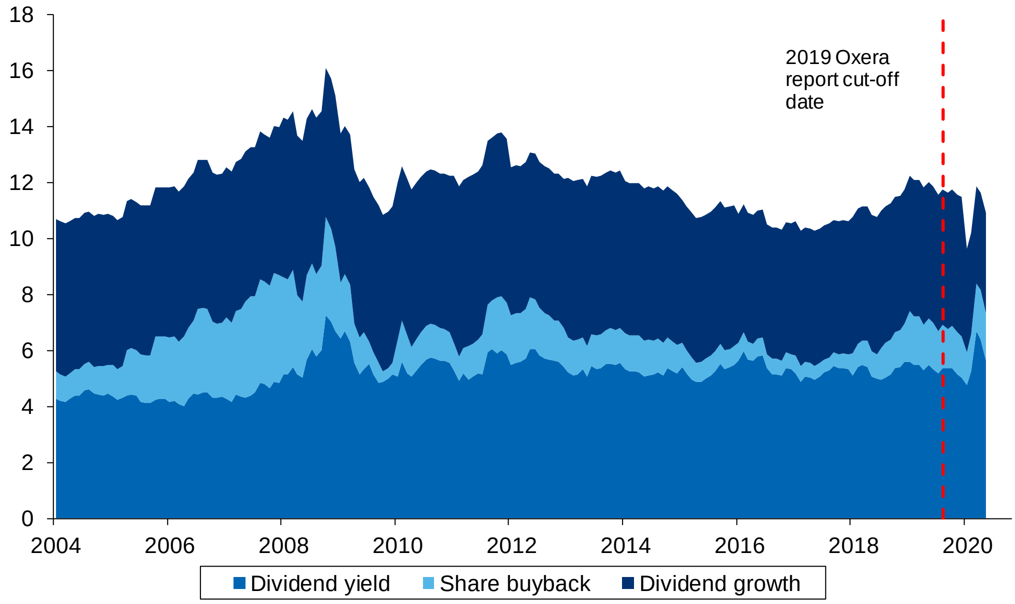
As in our original report, to examine the drivers of the current estimates, we have disaggregated the equity market discount rate estimate in Oxera's DDM model into the following three components:

[39] Oxera (2018), 'The cost of equity for RIIO-2,' 28 February, p. 27.
[40] Oxera (2018), 'The cost of equity for RIIO-2,' 28 February, p. 27.

1. the dividend yield;
2. the share buy-back yield;
3. dividend growth rates.

Figure 2.5 shows that since the publication of the 2019 Oxera report, the equity market discount rate implied by the DDM has been volatile.

Figure 2.5 Components of the equity market discount rate (nominal)



Note: Due to the instability caused by the COVID crisis, the growth rate from April 2020 is assumed to be equal to the long term GDP growth rates using data from the IMF and Bloomberg.

Source: Oxera analysis based on Bloomberg, Refinitiv Datastream, and the IMF World Economic Outlook.

As of July 2020, the spot value for the nominal equity market discount rate was 10.28%,[41] while the 10-year average was 11.62%. Deflating these estimates by 2.02% expected CPIH inflation implies a CPIH-real equity market discount rate of 8.09% (based on the spot value) and 9.41% (based on the 10-year average).[42] Note from Figure 2.5 that a reduction in dividend growth assumptions is the main driver of the change, alleviating concerns that this could artificially inflate our estimate. This information is summarised in Table 2. below:

[41] We have assumed the short term growth rate from April 2020 to be equal to the long term GDP growth rate using data from the IMF and Bloomberg. The avoids introducing upward bias by introducing the high short-term growth rates related to the forecast recovery from the COVID shock.
[42] Using a CPIH assumption of 2.02%.

Table 2.7 Equity market discount rate estimates implied by DDM

Nominal		CPIH-real[1]	
Spot value as of July 2020	10-year average to July 2020	Spot value as of July 2020	10-year average to July 2020
10.28%	11.62%	8.09%	9.41%

Note: [1] CPIH inflation of 2.02% is assumed. The revenue breakdown per country is based on Bloomberg data.

Source: Oxera analysis based on Bloomberg, Refinitiv Datastream, and the IMF World Economic Outlook

DDMs are typically highly sensitive to the dividend growth rate assumptions, in particular to the long-term growth rate. The Bank of England model links the long-term dividend growth rate to forecasts of the long-term growth rates of gross domestic product (GDP) for a weighted sample of countries. This is because the UK-listed companies in the index used in the DDM operate internationally and derive a significant proportion of their revenues from outside the UK. As such, the growth and risk of their dividends will be affected by international economic developments and not only by the UK economy. This risk will be reflected in the equity betas obtained by regressing company equity returns against the FTSE All-Share Index, and therefore consistency requires that these growth forecasts are used to infer the equity market discount rate from the DDM.

We rely on the GDP estimates of the IMF to estimate the long-term growth rate. In July 2020, the IMF had not yet published the usual five-year GDP forecasts, instead publishing a one-year forecast that presents a high degree of volatility as a result of the uncertainty of the economic outlook given the COVID-19 pandemic. Therefore, we adopted last year's five-year forecast as a proxy of long-term growth.

To illustrate this sensitivity of the DDM to long-term growth, a single-stage DDM was estimated using forecast GDP growth for the UK as opposed to a weighted sample of countries. This resulted in a CPIH-real equity market discount rate of around 6.9%.[43] This approach is conservative in comparison to the multi-stage DDM because:

- it does not incorporate analyst forecasts of dividend growth over the short term, which are generally higher than long-term GDP growth rates;
- the long-term growth assumption considers only UK GDP growth. This assumption is conservative, as companies listed on the London Stock Exchange are generally exposed to international markets, which on average have higher GDP growth rates than the UK.

In 2018, companies in the FTSE All-Share Index generated only 20% of revenues in the UK, with the rest coming from international activities.[44] As such, we consider it to be incorrect to use UK GDP growth forecasts in a DDM analysis of the FTSE All-Share, as it is unreasonable to assume that earnings growth outside of the UK will be on average the same as the GDP growth of the UK.

[43] A 2% nominal GDP short-term growth rate and 3.56% long-term growth rate is used for the UK.
[44] Oxera analysis based on Bloomberg data.

2.2.3 Survey evidence

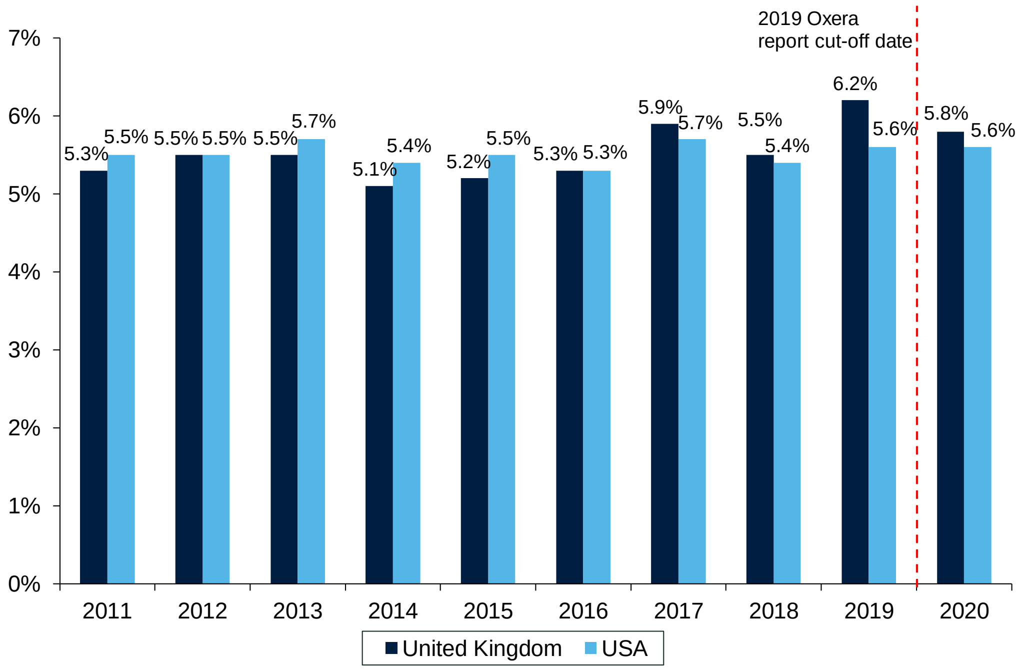
As described in our first report, while surveys could be viewed as another source of evidence for the ERP and TMR, their results need to be interpreted with caution. Issues with interpretation of survey evidence include the following:

- respondents' answers may be influenced by the way questions are phrased—for example, whether the question asks about required returns to equity or expected returns on a specified stock market index;
- there is a tendency for respondents to extrapolate from recent realised returns, making the estimates less forward-looking and prone to be anchored on recent short-term market performance;
- the results are based purely on judgement, which may also be influenced by the respondent's own position or biases, and are less reliable than estimates based more on market evidence on pricing.

Notwithstanding the need to interpret the survey evidence with caution, this sub-section presents up-to-date evidence in relation to respondents' expectations about ERP and TMR.

Survey evidence from Fernandez et al. for the UK suggests some year-to-year variation in responses.[45] This is presented in Figure 2.6, which shows the evolution for the average ERP from annual surveys of finance and economics professors, analysts and company managers in the UK and USA over time. In both countries, the expected ERP has stayed within a range of around 5–6%.

Figure 2.6 ERP survey data from Fernandez et al. for the UK and USA



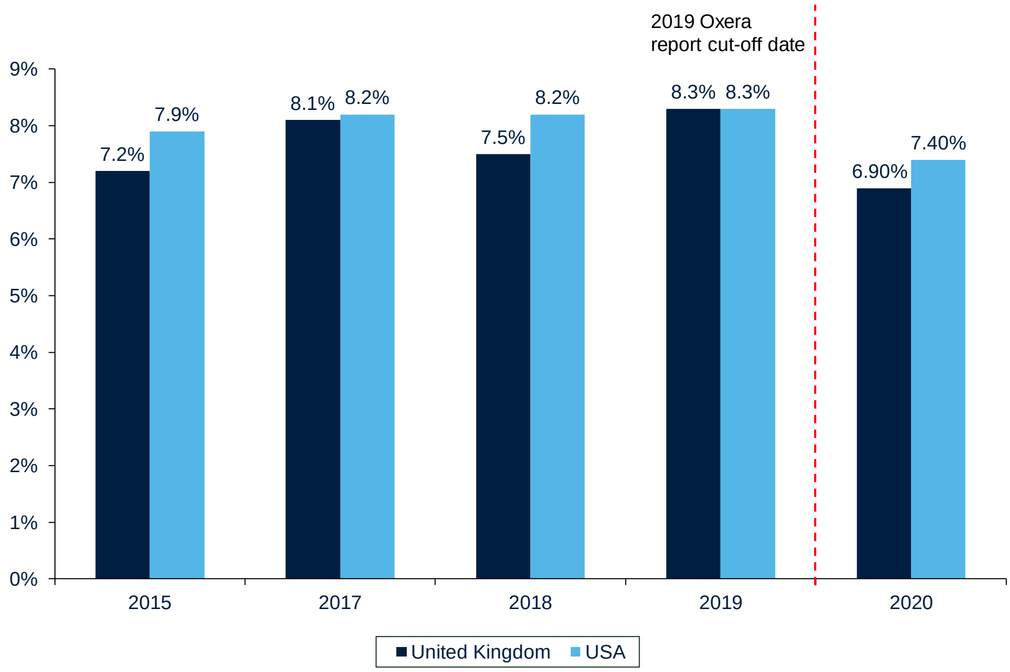
Note: The red dotted line represents the cut-off date from our first report.

[45] Fernandez, P., Pershin, V. and Acín, J. F. (2017), 'Discount Rate (Risk-Free Rate and Market Risk Premium) used for 41 countries: a survey', 17 April; (2016), 'Market Risk Premium used in 71 countries in 2016: a survey with 6,932 answers', 9 May. Fernandez, P., Pershin, V. and Acín, J. F. (2019), 'Market Risk Premium Used in 69 Countries in 2019: A Survey', 26 May. Fernandez, P., Apellaniz, E. and Acín, J. F. (2020), 'Survey: Market Risk Premium and Risk-Free Rate used for 81 countries in 2020', 25 March.

Source: Oxera analysis based on Fernandez, P., Pershin, V. and Acín, J. F. (2017), 'Discount Rate (Risk-Free Rate and Market Risk Premium) used for 41 countries: a survey', 17 April; (2016), 'Market Risk Premium used in 71 countries in 2016: a survey with 6,932 answers', 9 May. Fernandez, P., Pershin, V. and Acín, J. F. (2019), 'Market Risk Premium Used in 69 Countries in 2019: A Survey', 26 May; Fernandez, P., Apellaniz, E. and Acín, J. F. (2020), 'Survey: Market Risk Premium and Risk-Free Rate used for 81 countries in 2020', 25 March.

In the 2020 version of Fernandez et al, the authors have also presented estimates of the nominal TMR for 2015, 2017, 2018, 2019 and 2020. We present this information in Figure 2.7 below.

Figure 2.7 TMR survey data from Fernandez et al. for the UK and USA



Note: The red dotted line represents the cut-off date from our first report.

Source: Fernandez, P., Apellaniz, E. and Acín, J. F. (2020), 'Survey: Market Risk Premium and Risk-Free Rate used for 81 countries in 2020', 25 March.

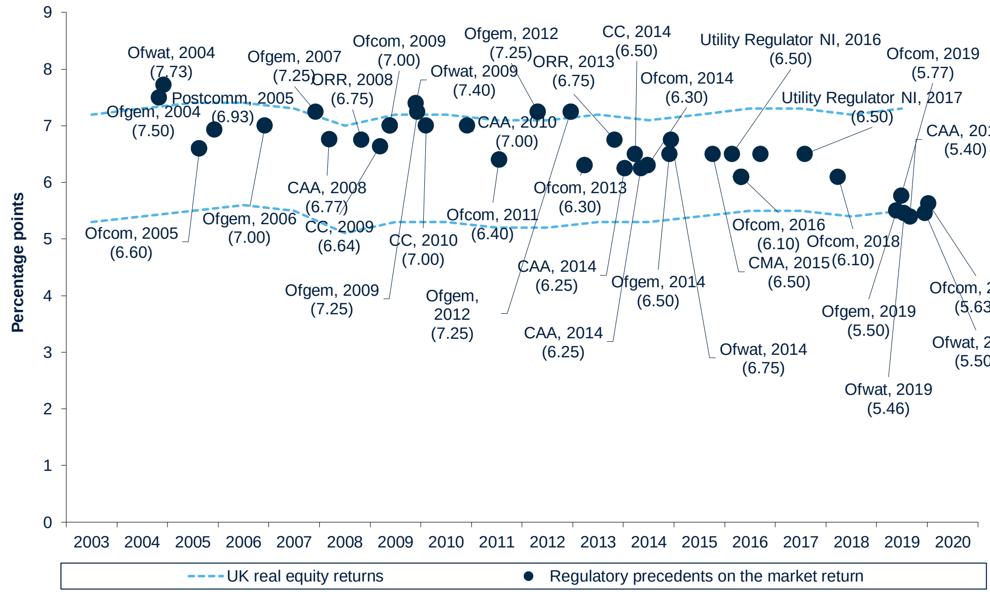
As shown in Figure 2.7, the expected nominal TMR has historically been in the range of 7–8%.

Note that Fernandez et al attempt to poll academics globally, but the respondents are not necessarily the same academics each year and it is not clear how this affects trends. As such, we do not place weight on year-to-year changes in this survey, and we did not adjust our number upward in 2019 even considering the upward movement in the survey data. We also note that the upward adjustment to generate a Cooper estimate should imply a TMR range similar to Oxera's, as these represent expected returns and not a discount rate.

2.2.4 Regulatory announcements on TMR

UK regulatory precedent and recent announcements on the TMR are shown in Figure 2.8, together with the evolution of the long-run average real equity returns for the UK since 2003. This includes the most recent announcements in the UK. These announcements feature an RPI-real allowed TMR of 5.40 to 5.63, which is materially lower than the TMR precedents observed historically.

Figure 2.8 Historical averages and UK regulatory precedent on the RPI-real TMR



Note: The top UK line represents arithmetic averages; the bottom UK line represents geometric averages. DMS calculation methodology is not constant over time.

Source: Oxera analysis based Dimson, E., Marsh, P., and Staunton, M. (2020), 'Summary Edition Credit Suisse Global', p. 23 and regulatory decisions.

It is important to note several important characteristics of the latest regulatory announcements. First, in contrast to Ofgem, Ofcom does not have a financing duty.[46] This allows Ofcom to attribute less weight to financeability constraints, thus allowing, all else being equal, a lower cost of equity to be assumed. Second, four water companies have appealed to the CMA, with the allowed equity return being a common ground of appeal across all appellants. Finally, in the NATS appeal, the CMA has not taken into consideration the responses to its provisional findings. Hence, the TMR evidence could be revised once the merits of the points raised by the respondents are addressed.[47]

The recent UK regulatory announcements also rely heavily on a number of recommendations made in the UKRN study.[48] The similarity of approach and assumptions across different regulators means that these cannot be regarded as independent data points, which undermines their value as cross-checks.

In sum, while the most recent regulatory publications have used a TMR below the historically observed level, these cannot be relied on for determining the TMR assumption for RIIO-2.

2.3 Conclusion

The updated historical data on average equity market returns yields an unbiased estimate of the CPIH-deflated market discount rate of 7.29–7.94%

[46] Ofgem (2013), 'Joint Regulators Group (JRG) Cost of Capital and Financeability', March, https://www.ofgem.gov.uk/ofgem-publications/37070/jrg-report-cost-capital-and-financeability-final-march-2013-pdf.
[47] CMA (2020), 'NATS (En-route) Plc/CAA Regulatory Appeal', 13 August, para. 61.
[48] UK Regulators Network (2018), 'Estimating the cost of capital for implementation of price controls by UK Regulators'.

(CPIH-real) depending on the investment horizon assumed for the Cooper adjustment.

Evidence from our primary cross-check, the DDM, is volatile but points towards a higher TMR estimate than the historical average equity market returns. The survey evidence points to a nominal TMR in the range of 7.0–8.0%. The downward inflation adjustment and upward (Cooper) adjustment to convert the expected return into a discount rate should result in a TMR consistent with our range. We further note that the recent regulatory publications present a TMR below the historically observed level. However, the similarity of approach and assumptions across different regulators means that these cannot be regarded as independent data points, which undermines their value as a benchmark.

On balance, we maintain our position that the evidence is supportive of the assumption that the TMR is more stable over time than the ERP. As such, we consider that the updated historical data remains supportive of the 7–7.5% CPIH-real (6.0–6.5% RPI-real) TMR range presented in the 2019 Oxera report.

3 Risk and beta

The equity beta in the CAPM is a measure of how risky an equity investment is compared with a diversified market portfolio. An equity beta of 1 means that the stock return perfectly covaries with the market return. An equity beta of less than 1 means that it tends to move in the same direction as the market return, but to a lesser magnitude (and vice versa for an equity beta of more than 1).

The CAPM is a one-factor model that assumes that risk is measured by the volatility (standard deviation) of an asset's systematic risk, relative to the volatility (standard deviation) of the market as a whole. The equity beta in the CAPM is a measure of how risky an equity investment is compared with a diversified market portfolio.

The CAPM therefore does not consider any company-specific risks, nor does it incorporate other potential sources of systematic risk. Importantly, the use of standard deviations to calculate beta assumes that returns are symmetric and normally distributed. For regulated firms, it ignores any unique risks potentially resulting from regulatory and/or political decisions. Relatedly, recent academic research finds that for low-beta firms, the CAPM systematically generates a required return on equity that is ‘too low’ (Dessaint et al, 2020).[49]

The equity beta is also affected by the level of gearing. As a result, the equity beta captures both financial risk (which depends on the company’s capital structure) and business risk. The calculation of an asset beta removes the financial risk component embedded in the equity beta. Since it represents the hypothetical risk of the firm with zero debt, the asset beta is independent of the choice of capital structure. It is therefore a more relevant measure for assessing business risk and comparing it across companies.

For a company listed on the stock market, estimating the equity beta using simple regression analysis is straightforward because all required market data is publicly available. For companies that are not listed, listed comparator companies need to be identified that can be used as a proxy. Observable equity betas for these companies need to be adjusted to the level of gearing in the company in question in order to be comparable.

Similarly, when assessing the riskiness of an industry, a sample of companies present in that sector should be used and the asset betas of those companies should indicate the overall risk of the business. Ideally, the sample would be formed by ‘pure-play’ comparators–i.e. companies that operate exclusively in the sector of interest. However, depending on the industry, there may be few ‘pure-play’ comparators; in this case, the sample of comparators would include companies that have a significant part of their operations in the industry of interest.

This section looks at:

- choice of comparators (section 3.1);
- technical estimation issues for equity beta (section 3.2);
- gearing and the relationship between equity beta and asset beta (section 3.2.1)

[49] Dessaint, O., Olivier, J., Otto, C. and Thesmar, D. (2020), ‘CAPM-based company (mis)valuations’, *Review of Financial Studies*, forthcoming.

- debt beta (section 3.2.2);
- asset beta estimation results (section 3.3);
- the impact of political and regulatory risk (section 3.4);
- negative co-skewness and political and regulatory risk (section 3.5).

3.1 Choice of comparators

To enable a robust estimation of the beta, it is important to ensure that reliable data is available and that the stocks being analysed are sufficiently liquid. In particular, when estimating the beta for a given economic activity, the main challenge is finding publicly-listed companies that are largely involved in the specific activity of interest. For example, in a regulatory context, the majority of profits or revenues should come from the regulated part of the business operating in the sector under consideration.

For the estimation of the asset beta range, this report considers two comparator samples: a UK sample, comprising listed UK energy and water companies, and a European sample of comparable energy networks. Our analysis suggests that a UK sample of energy networks is insufficient to appropriately estimate the asset beta of a notional company in the sector. In addition, we conclude that water companies and energy companies present different risk profiles, which is reflected in the historical series of the betas. Therefore, our final sample of comparators consists solely of energy networks in the UK and Europe. The choice of comparators for each sample is described in turn below.

3.1.1 UK comparators

When selecting comparators, it is important to choose companies that are similar in their exposure to systematic risk. The most important characteristics are the sector, the company's business mix and the regulatory framework under which it operates.

In the UK, there are only two listed companies that own energy networks subject to the RIIO price controls: National Grid and Scottish & Southern Energy (SSE). It is important to note that both also have significant activities outside of GB regulated networks, which reduces the robustness of inferences about the beta of GB regulated activities based on group-level beta estimates.[50]

For the purposes of determining the asset beta range, we had originally in our 2018 report excluded SSE from the sample on the basis that 'a significant portion of its business stems from generation and supply, which is not directly comparable to the business profile of an energy network'.[51] Similarly, we showed that:[52]

> […] the divergence of SSE's beta from the rest of the UK utilities in the last two years suggests that its sharp increase in beta may not be wholly attributable to the perceived risk of its network business.

[50] SSE has historically generated income from unregulated activities such as generation and supply, and National Grid operates gas and electricity network assets in the USA that are subject to a different regulatory framework to that in the UK.
[51] Oxera (2018), 'The cost of equity for RIIO-2', 28 February, Section 3.
[52] Oxera (2018), 'The cost of equity for RIIO-2', 28 February, Section 3.

In the 2019 report, we included SSE in the UK energy sample because, since the publication of the 2018 Oxera report, SSE had taken a series of steps to dispose of its energy supply and services business,[53] which would make its revenue mix more similar to that of the UK regulated energy networks. Following these developments, SSE's two-year beta converged with those of the other networks. However, since the beginning of 2020, SSE's beta diverged from the other networks, suggesting that part of the risk profile is not yet aligned with that of the other networks. Therefore, we decided to exclude SSE from the sample of UK energy companies.

The resulting UK sample of energy networks is too small to be considered a representative sample that accurately captures all the systematic risks faced by UK energy networks. It is for this reason that we recommend broadening the sample to consider European energy networks.

We have also considered water networks as comparator companies because they are utilities and subject to a similar regulatory regime, although they face a different set of business risks than energy networks. As a result, our UK sample includes four listed comparator companies: National Grid, United Utilities, Severn Trent and Pennon.

3.1.2 European comparators

Given the lack of listed energy networks comparators in the UK, it is necessary to include European comparators to generate an adequately-sized representative sample. We further note that the goal of an asset beta is to capture an *asset risk*. We argue that the asset risk between UK and European energy networks should be more similar than two different industries inside the same country. It is therefore not immediately obvious why water companies in England and Wales would better reflect asset risk for GB energy networks than European energy networks.

In the previous report, we used the following four listed energy networks comparators in our sample:

- Enagas;
- Red Eléctrica;
- Snam;
- Terna.

As explained in our 2018 report,[54] this sample is the result of a filtering process that excludes companies based on a range of factors, such as percentage of regulated activities, data availability and liquidity. The sample used by Ofgem/CEPA[55] includes these comparators, in addition to REN and Elia.

We have analysed the liquidity of the comparators in our sample and in CEPA's sample in order to form a more robust view of the set. As liquidity is a difficult concept to define and is subject to interpretation, it is useful to look at a wide range of measures. In particular, the following liquidity measures were considered.

[53] Thomas, N. (2019), 'SSE aims to offload retail energy business by second half of 2020', *Financial Times*, 22 May, https://www.ft.com/content/268b55b0-7c5e-11e9-81d2-f785092ab560.
[54] Oxera (2018), 'The cost of equity for RIIO-2', 28 February, Section 3.1.2.
[55] CEPA (2020), 'RIIO-2: Beta estimation issues', 9 July.

- **Bid–ask spread as a percentage of closing price**—the difference between the lowest price at which an asset is offered for sale in a market and the highest price that is offered for the purchase of the asset. The lower the bid–ask spread, the more liquid the stock. A relatively narrow bid–ask spread could be a sign that there are a large number of buyers and sellers in the market.
- **Share turnover**—a measure of stock liquidity calculated by dividing the total value of shares traded over a period of time by the average market capitalisation of the stock for the period. The higher the share turnover, the more liquid a stock. For example, a high trading volume would indicate that a stock can be bought and sold easily.
- **Free float**—the proportion of shares that can be publicly traded. A small proportion of shares floated would create an impediment to active trading. Stocks with a low free float could therefore be considered less liquid.

The results from applying these liquidity filters to the set of potential comparators are summarised in Table 3.1.

Table 3.1 Potential comparators after liquidity filters

Name	Average bid–ask spread (% of closing price)	Average share turnover (%)	Average free float as a percentage of total outstanding shares
Elia Group SA/NV	0.23%	0.10%	46%
Red Eléctrica Corp SA	0.07%	0.43%	79%
Terna Rete Elettrica Nazionale	0.06%	0.32%	70%
REN—Redes Energéticas Nacionais SGPS SA	0.26%	0.13%	53%
Enagas SA	0.09%	0.61%	93%
Snam S.p.A.	0.06%	0.33%	58%
Average	**0.13%**	**0.32%**	**67%**

Source: Oxera analysis based on Bloomberg data as of July 2020.

A degree of judgement is required when interpreting the outputs of the liquidity filters. For example, at 0.13%, the average share turnover for REN is considerably lower than that of the most liquid comparators, which have an average share turnover in the range 0.32–0.61%. Elia also presents a low share turnover and has less than 50% of its shares publicly traded. Furthermore, both REN and Elia present high bid–ask spread compared to the sample, 0.26% and 0.23% respectively.

Based on the liquidity filters, we still consider that REN and Elia should be excluded from the sample of European energy networks. We note that while CEPA's liquidity analysis compares a broad sample of European energy companies, most of those companies appear to be illiquid; hence, the benchmark for the liquidity filters is affected by the sample choice. We consider that the correct approach would be to compare REN and Elia to liquid comparators, which would then lead to the exclusion of those companies from the final European sample.

Ofgem implies that CEPA's comparator set is the most appropriate, while directing readers to CEPA's report.[56] CEPA appears to use liquidity as a characteristic that can be 'traded off' against other characteristics in order to find suitable comparators.[57] CEPA's methodology uses a broad range of characteristics to create a comparator sample, selecting firms on a multivariate-based graphical 'green/yellow/red' light analysis of various attributes. In contrast, Oxera's methodology was specifically designed to screen out illiquid firms because the market data for these firms do not match in terms of generating a market beta. Conversely, we consider that that liquidity has a direct effect on equity betas and apply strict filters to eliminate unsuitable comparators. In other words, CEPA has performed a kind of 'screening-in' methodology, where they match on a broad set of characteristics and risk including illiquid firms. In contrast, our 'screening-out' methodology is aimed at avoiding illiquid firms because this creates estimation problems with beta.

3.2 Technical estimation issues for equity beta

In our previous report, we measured the comparators' equity betas using daily data over two- and five-year periods. Since then, a range of different evidence was considered for the data frequency and the estimation window for equity betas. On balance, none of the new evidence has led us consider that we should deviate from our chosen methodology. Therefore, we continue to rely on two- and five-year daily betas as our primary sources of evidence.

Nonetheless, in order to provide a comprehensive overview of evidence, this report also presents additional cross-checks, namely: (i) daily betas estimated over a 10-year period; (ii) weekly betas estimated over a two-year, a five-year, and a 10-year period; and (iii) monthly betas estimated over a five-year and a 10-year period.[58]

The rest of this section considers the other two main technical estimation issues, namely gearing and debt betas.

3.2.1 Gearing and the relationship between equity beta and asset beta

Assuming a combination of debt and equity financing, the asset beta is a weighted average of the equity beta and the debt beta, as described by the following equation (the 'Harris–Pringle formula'):[59]

$$\beta_a = \beta_e \cdot (1 - g) + \beta_d \cdot g$$

where g = the gearing ratio defined as $\frac{net\ debt}{debt+equity.}$

As explained in the Oxera 2019 report, there are two options that avoid creating an inconsistency between the definition of debt used in de-gearing comparator asset betas and the definition of debt used in calculating the gearing used to re-gear for the purpose of setting revenue allowances. The choice is between using market values or book values of debt in both steps of the calculation. Using book values for debt is the standard approach followed

[56] Ofgem (2020), 'RIIO-2 Draft Determinations – Finance Annex', 09 July, p. 47.
[57] See the Draft Determinations – Beta Estimation Issues (CEPA), p. 40.
[58] We note that this approach is broadly consistent with the one adopted by Ofgem in the SSMD, where raw equity betas were analysed over a longer time horizon of up to 17.5 years. Additionally, the SSMD also reported that 'most network companies explicitly agreed with the Indepen approach of using: high frequency data (daily or weekly)'.
[59] The Harris–Pringle formula assumes that the firm maintains a constant level of gearing, and therefore that the same WACC can be used to discount the cash flows in each period. The appeal of the Harris–Pringle formula in a regulatory context is that it is consistent with the notion of a regulator assuming a constant gearing ratio throughout the price control period.

in regulatory price controls, and for the purpose of this report we calculate the level of historical gearing using the book value of net debt, consistent with the Oxera 2019 report.

For a fully equity-financed firm, the asset beta is the same as the equity beta. However, for a firm with significant amounts of debt financing, the asset beta and the equity beta may be very different.

The process of converting estimated equity betas to asset betas is especially important when using evidence from a selection of firms in the market with different levels of gearing. In the provisional findings for the NATS/CAA regulatory appeal, the CMA states that it has 'some concerns with the consequences of the standard regulatory approach to 're-gearing''.[60] Specifically, the CMA is concerned with the violation of the Modigliani–Miller theorem.[61]

According to Modigliani and Miller (1958), the WACC should theoretically remain constant at all levels of gearing under the assumption of perfect capital markets and the absence of corporate and personal taxation.[62]

The rationale is that as a company gears up, the WACC is subjected to two opposing effects that offset each other:

- all else equal, an increased proportion of debt financing decreases the WACC, as debt is cheaper than equity;
- however, as gearing increases, the firm's equity and debt become riskier, which in turn increases the required return on debt and equity.

MM Proposition II predicts that the two effects above will always offset each other. In other words, the savings in WACC made from increasing the proportion of debt financing will be exactly offset by an increase in the required return on debt and equity.

In sections 2.1 and A2.6, we discuss why the MM theorem appears to be violated in the case of the NATS/CAA appeal and show that with the correct specification of the RfR and debt beta, the MM theorem is not violated.

3.2.2 Debt beta

In June 2020, Oxera prepared a report[63] addressing the report on debt beta authored by CEPA for the UKRN.[64] In that report, we showed that methods based on regressions (the direct and indirect methods) and structural models have the advantage of measuring the systematic exposure of debt to market risk. In contrast, the spread decomposition method lacks robust theoretical support and depends on multiple uncertain parameters. The degree of uncertainty over the assumptions required by the spread decomposition approach suggest that it provides little or no incremental evidential value relative to the other approaches. Therefore, regulators should rely on

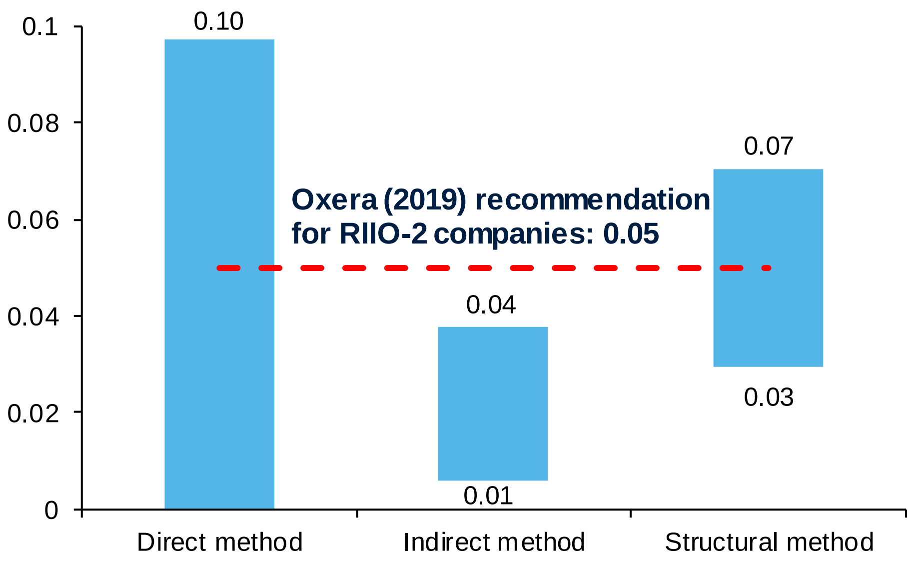
[60] Competition and Markets Authority (2020) 'Provisional Findings Report', Appendix D, para. 4.
[61] Modigliani, F. and Miller, M. H. (1958), 'The Cost of Capital, Corporation Finance and the Theory of Investment', *The American Economic Review*, **48**:3, June.
[62] Modigliani, F. and Miller, M. H. (1958), 'The Cost of Capital, Corporation Finance and the Theory of Investment', *The American Economic Review*, **48**:3, June, pp. 261–97.
[63] Oxera (2020), 'Estimating debt beta for regulated utilities', 4 June.
[64] CEPA (2019), 'Considerations for UK regulators setting the value of debt beta', report for the UK Regulators Network, 2 December, https://www.ukrn.org.uk/wp-content/uploads/2019/12/CEPAReport_UKRN_DebtBeta_Final.pdf.

regression-based and structural methods when setting debt beta for a price control.

Further, controlling for interest rate risk is important when estimating debt beta using a regression-based method. Otherwise, the resulting debt beta estimate will capture risks over and above credit risk, resulting in a biased estimate. This was not reflected by CEPA when it compared the methodology used by Schaefer and Strebulaev (2008) (i.e. the indirect regression-based approach) to the direct regression-based methodology used by PwC and Europe Economics.[65]

Estimates of debt beta using the direct and indirect regression-based methods, as well as the structural method are summarised in Figure 3.1.[66]

Figure 3.1 Evidence on debt beta



Note: The ranges of estimates for the direct method and the indirect method are set out in Figure 3.2 and Figure 3.3. Those for the structural method are set out in Figure 3.4, the range is derived using a sensitivity analysis on the key parameter. The red dashed line represents our estimate of the appropriate debt beta assumption for RIIO-2 (0.05), which was set out in our 2019 reports on (i) asset risk premium, debt risk premium and debt betas dated 23 January 2019 and (ii) beta and gearing dated 20 March 2019. The lower bound of the direct method is set to 0, excluding one marginally negative estimate from United Utilities. For completeness, see Figure 3.2.

Source: Oxera analysis.

Consistent with our 2019 report, our findings suggest that a debt beta level of 0.05 would be appropriate.

We note that Ofgem has quoted Oxera in support of its 0.125 debt beta assumption:[67]

> After considering Business Plan submissions, supporting consultancy reports, the UKRN study and the evidence we presented at SSMD, we remain of the view that a debt beta between 0.1 and 0.15 is reasonable. **Oxera's analysis supports our view that a reasonable value for debt beta can lie above**

[65] CEPA (2019), 'Considerations for UK regulators setting the value of debt beta', 2 December, pp.7–10.
[66] The direct method involves regressing bond returns on market returns, but this can be extended to include government bond returns. The indirect method involves regressing an issuer's bond returns on (i) the respective issuer's equity returns and (ii) the returns on government bonds. The coefficient on equity returns is subsequently multiplied by the issuer's equity beta to obtain the debt beta estimate. The structural method involves using option-pricing models to estimate a debt beta consistent with the market data.
[67] Ofgem (2020), 'RIIO-2 Draft Determinations–Finance Annex', 9 July, para. 3.39.

zero, given the statistically significant debt beta of 0.2 which Oxera report for National Grid. [Emphasis added]

We emphasise that our findings suggest that a debt beta no greater than 0.05 is an appropriate assumption in the context of UK Utilities. Further, the 0.2 statistically significant debt beta for National Grid is the result of the direct method, which, if not specified correctly, is subject to omitted variable biases and high standard errors. We discuss the implications of the use of direct method in the next section and respond further to the misrepresentation of our evidence later in this section.

The remainder of this section summarises the methodological findings of the Oxera (2020) report on debt betas.[68]

Methodology overview

In its report, CEPA outlines four methods for estimating debt beta:

- the direct method;
- the indirect method;
- structural methods;
- decomposition methods;

In this subsection, we discuss each method in turn, along with our response to it.

Direct method

The direct method, as described by CEPA, involves regressing bond returns directly on equity market returns to obtain the debt beta estimate. This method has been mentioned in the determination of allowed debt beta for H7 and RP3 by the CAA and for PR19 by Ofwat.[69]

CEPA claims that debt beta estimates obtained from the direct method have poor statistical properties, which include low statistical significance, volatility over time, implausible values, and/or low explanatory power of the underlying regression model.[70]

Low statistical significance and/or low explanatory power of the underlying model, as we found in some observations within our sample under the direct method, implies that the standard errors of the estimates are so high that the estimates are not statistically distinguishable from zero. While there is a risk that the regression model has been incorrectly specified or that the underlying data contains some noise, this lack of statistical significance could also result from true debt betas of zero. In other words, a lack of statistical significance means that one cannot reject the null hypothesis that the debt beta is zero, not that the estimation method is flawed because it does not generate a statistically significant result. Indeed, the direct method could be used productively in combination with the other estimation approaches.

Moreover, volatility by itself is not a reason for discarding an estimation method, as the true values of debt betas may be volatile over time. It is unclear

[68] Oxera (2020), 'Estimating debt beta for regulated utilities' 4 June.
[69] Europe Economics (2019), 'The Cost of Capital for the Water Sector at PR19', 17 July; PwC (2019), 'Estimating the cost of capital for H7 and RP3 – Response to stakeholder views on total market return and debt beta', August.
[70] CEPA (2019), 'Considerations for UK regulators setting the value of debt beta', 2 December, p. 7.

if CEPA is of the view that the firm-level debt beta should be stable over time, which is inconsistent with the way that Ofgem/CEPA estimate other time-varying betas.

Finally, with respect to the allegedly 'implausible' estimates produced by the direct method, it is unclear which criteria were used to reach such conclusions. If the criteria were dictated by past regulatory decisions, it is important to examine the robustness of the underlying methods and evidence base.

Indirect method

The indirect method described by CEPA is the two-step approach derived from Schaefer and Strebulaev (2008).[71] This is the same method as the one adopted in Oxera's earlier report for the ENA on estimating the appropriate equity and debt betas for the forthcoming RIIO-2 price control.[72]

The first step in this approach is to regress the returns of a company's bond (or portfolio of bonds) against the returns on an index of government bonds (a duration similar to the bond or the portfolio of bonds should be chosen) and the returns on the shares of the same company.[73] The second step is to multiply the coefficient on the company's equity returns (this is the elasticity of debt with respect to equity) obtained from the regression in the first step by the company's equity beta. This provides an estimate of the debt beta for the company in question.[74]

CEPA appears to have misunderstood the Schaefer and Strebulaev (2008) paper, as illustrated by two inaccurate statements.

First, CEPA claims that the authors used simulations of structural models,[75] while in fact the authors calculated the theoretical sensitivities directly using structural methods.

Second, CEPA claims that the authors used bond indices in their regressions.[76] This is incorrect. The authors used a large sample of bonds, and reported the average level of the estimated debt betas grouped by credit rating.

The second statement conceals an important difference between the indirect and direct methods. The regressors used in the indirect method include the equity returns and equity beta of the bond issuer, which will differ across issuers. The indirect method therefore always controls for differences in systematic risk across issuers. In contrast, the direct method, when using the returns on bond indices as the dependent variable, implicitly assumes that all issuers have the same systematic risk. The CEPA report in effect claims that there is no benefit to applying the indirect method instead of the simpler direct method. This is not necessarily correct, as the simpler direct method that uses returns on bond indices (instead of individual bonds) as the dependent variable makes more restrictive assumptions relative to the indirect method, where the

[71] CEPA (2019), 'Considerations for UK regulators setting the value of debt beta', 2 December, p.10 and Schaefer, S. M. and Strebulaev, I. A. (2008), 'Structural models of credit risk are useful: Evidence from hedge ratios on corporate bonds', *Journal of Financial Economics*, **90**:1, pp.1–19.
[72] Oxera (2019), 'Review of RIIO-2 finance issues: The estimation of beta and gearing', 20 March.
[73] Note that if a company is privately held i.e. it does not have listed shares, then the indirect method cannot be used.
[74] The coefficient on equity returns obtained in the first regression is the elasticity of debt with respect to equity. This is not a debt beta and has to be scaled by the equity beta in order to obtain the debt beta.
[75] CEPA (2019), 'Considerations for UK regulators setting the value of debt beta', 2 December, p. 8.
[76] CEPA (2019), 'Considerations for UK regulators setting the value of debt beta', 2 December, p. 10.

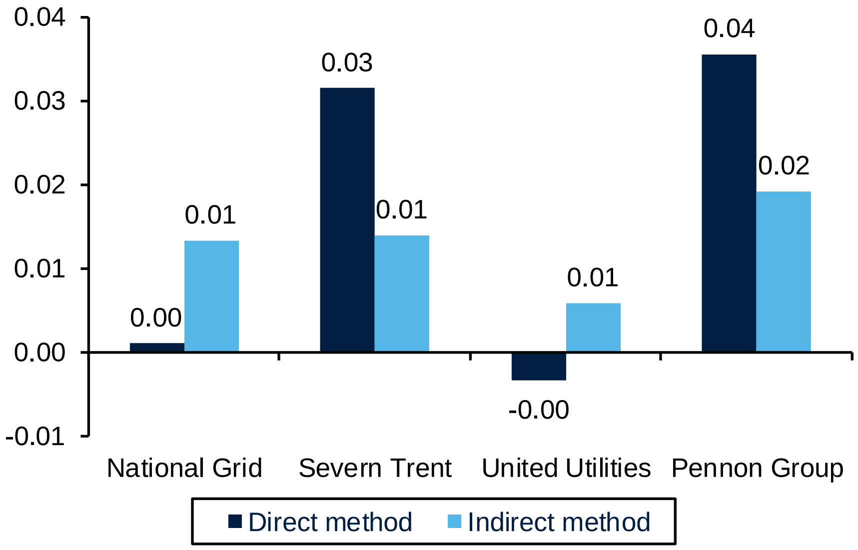
debt beta can vary across issuers. This claim belies a fundamental misunderstanding of the indirect method.

A further difference between the indirect and direct method is controlling for interest rate risk in the estimation of debt beta.[77] The absence of control for interest rate risk is an important limitation of the single variable regression specification assumed by CEPA. Failing to control for interest rate risk in the context of debt beta estimation can lead to omitted variable bias. However, this does not have to be a fundamental difference between the two methods, since the direct method can be modified to include government bond returns as an additional regressor.

With the assistance of Professor Stephen Schaefer, we used the indirect method (replicating the approach from Schaefer and Strebulaev (2008)) when estimating the debt beta for the upcoming RIIO-2 price controls.[78] We estimated the debt beta using bonds from National Grid, United Utilities, Severn Trent and Pennon Group.[79] We concluded that the evidence supported a debt beta assumption no higher than 0.05 for RIIO-2.

We have expanded our original analysis for the ENA by presenting a sensitivity using the direct method, where we do not control for interest rate risk. We have compared this new sensitivity against the results that we presented previously using the indirect method, which controls for interest rate risk.[80] We present the results of our analysis in Figure 3.2.

Figure 3.2 Comparison of direct and indirect methods for debt beta estimates



Note: The estimates presented above correspond to averages of debt betas for individual bonds. The analysis is based on 38 bonds, namely 22 for National Grid, nine for Severn Trent, six for United Utilities and one for Pennon Group. Refer to section 4.2 of the Oxera report dated 23 January 2019 for detailed results.

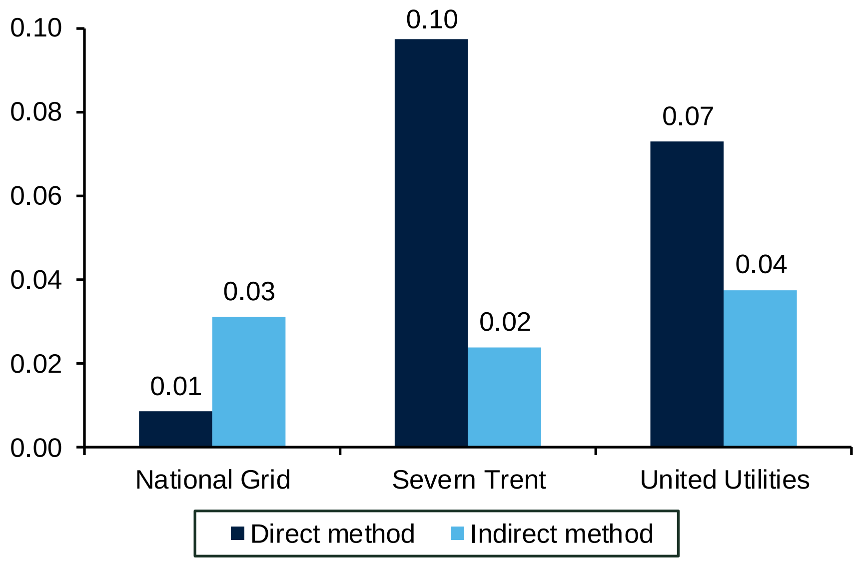
Source: Oxera analysis, based on Oxera (2019), 'Review of RIIO-2 finance issues: Asset risk premium, debt risk premium and debt betas', 23 January.

[77] When estimating debt beta, one is looking to isolate the credit risk of the debt instrument from the interest rate risk.
[78] Oxera (2019), 'Review of RIIO-2 finance issues: The estimation of beta and gearing', March.
[79] Oxera (2019), 'Review of RIIO-2 finance issues: The estimation of beta and gearing', March.
[80] We analysed the returns on 38 corporate bonds issued by National Grid (22), Severn Trent (9), United Utilities (6) and Pennon Group (1), from 1998 to 2018. For more details, see Oxera (2019), 'Review of RIIO-2 finance issues: Asset risk premium, debt risk premium and debt betas', 23 January.

It can be seen that the estimates obtained under the direct method can be either higher or lower than those obtained under the indirect method, depending on the underlying company. However, in all cases, the average debt beta estimate across different bonds remains below 0.05, i.e. Oxera's recommended estimate.

Further, as highlighted in our previous analysis, a material number of debt beta estimates are statistically indistinguishable from zero.[81] In order to understand the magnitude of debt betas in cases where they are statistically different from zero, we also present the results exclusively for the bonds that exhibit positive and statistically significant debt betas. This is illustrated in Figure 3.3.

Figure 3.3 Comparison of direct and indirect methods for debt beta estimates, statistically significant observations only



Note: The estimates presented above correspond to averages of debt betas for individual bonds. The analysis is based on 24 bonds with statistically significant debt betas, namely 13 for National Grid, nine for Severn Trent and two for United Utilities. Refer to 4.2 section of Oxera report on debt beta dated 23 January 2019 for detailed results.
Source: Oxera analysis, based on Oxera (2019), 'Review of RIIO-2 finance issues: Asset risk premium, debt risk premium and debt betas', 23 January.

It can be seen that even within the sample of statistically significant debt betas, the average beta remains below 0.05. Similarly, just as for the whole sample, controlling for interest rate risk makes a non-negligible impact on the debt beta estimates. This implies that regardless of whether a debt beta appears to be statistically significant or not, it is prudent to control for interest rate risk in the regression. Therefore, as discussed above, the direct method should be modified to include government bond returns as an additional regressor.

Structural methods

CEPA also discusses structural methods.[82] The structural methods rely on the theoretical option pricing models derived by Merton (1974) and Black and Cox (1976). These models can be used to calculate a debt beta based on assumptions about parameters such as gearing, equity volatility and equity beta.

[81] In particular, out of a total sample size of 38, 14 bonds exhibit a statistically insignificant debt beta.
[82] CEPA (2019), 'Considerations for UK regulators setting the value of debt beta', 2 December, section 2.1.3.

As described by CEPA, there are two advantages of using structural methods to estimate the debt beta. First, the model has strong theoretical foundations.[83] Second, the model allows for the consistent de-levering and re-levering of debt beta as it specifies the relationship between gearing and debt beta.[84]

CEPA cites three disadvantages of using structural methods. First, CEPA states that regulators are unfamiliar with using the method.[85] However, regulators have not been averse to introducing new methods and data, and through their actions they have demonstrated that unfamiliarity is not a barrier in practice.

Second, according to CEPA, structural methods do not offer a complete account of credit spreads.[86] However, a complete account of credit spreads is not directly relevant to the evaluation of structural methods for the purpose of estimating debt betas. Instead, CEPA should be assessing whether structural methods capture debt betas well. This was the purpose of the paper by Schaefer and Strebulaev (2008), cited by CEPA.[87] Schaefer and Strebulaev (2008) found that structural models, on average, capture debt betas well.[88] Therefore, this criticism from CEPA is not directed at the issue at hand (i.e. the estimation of debt beta).

The final disadvantage cited by CEPA is that structural methods require several assumptions. This is true; however, one can measure directly most of the parameters required to estimate debt beta using structural methods. Additionally, another method cited by CEPA, the decomposition approach, requires just as many assumptions as the structural method but has weaker theoretical underpinnings, for the reasons set out below. Therefore, it would appear that the structural method is a more robust approach to estimating debt beta than the decomposition approach.

With regard to CEPA's application of the structural method, we have identified two errors in its calculation.

First, as a proxy for the volatility parameter, CEPA has used the volatility of equity returns, not that of asset returns. However, since the model proxies equity as a call on the company's assets, the volatility parameter needs to be set to that of asset returns. Correcting this error decreases CEPA's estimate of debt beta from 0.16 to 0.11.

Second, CEPA has not applied the conversion from asset beta to debt beta correctly. According to Berk and DeMarzo (2014), the asset beta is converted to debt beta using the following equation:[89]

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83 CEPA (2019), 'Considerations for UK regulators setting the value of debt beta', 2 December, p. 11.

84 Debt beta and equity beta are both positively correlated with gearing. However, when de-levering and re-levering equity beta for differences in gearing between the target company and comparators used to estimate asset beta, debt beta is typically held constant. This can result in the use of the incorrect debt beta when undertaking this process. CEPA (2019), 'Considerations for UK regulators setting the value of debt beta', 2 December, p. 11.

85 CEPA (2019), 'Considerations for UK regulators setting the value of debt beta', 2 December, p. 11.

86 CEPA (2019), 'Considerations for UK regulators setting the value of debt beta', 2 December, p. 11.

87 Schaefer, S. M. and Strebulaev, I. A. (2008), 'Structural models of credit risk are useful: Evidence from hedge ratios on corporate bonds', *Journal of Financial Economics*, **90**:1, pp. 1–19.

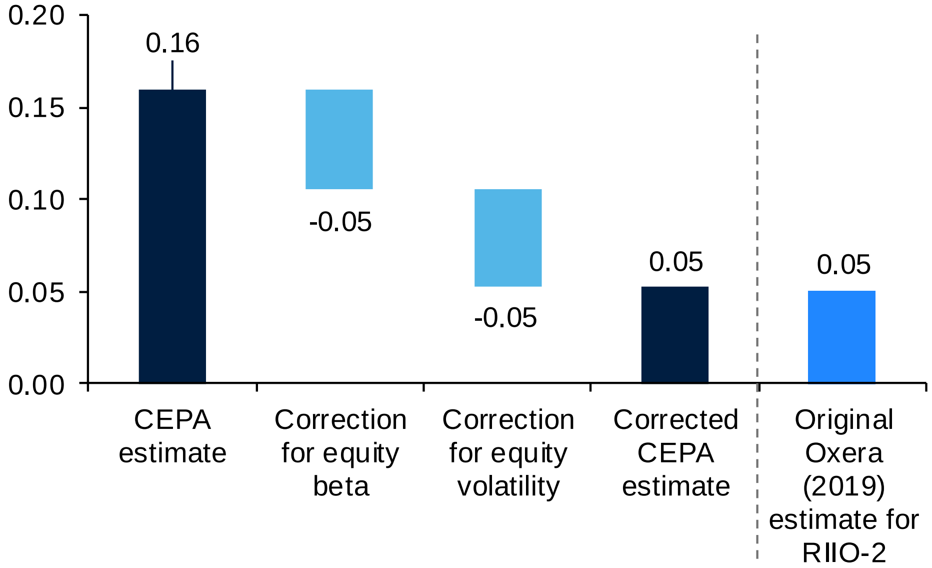
88 Schaefer and Strebulaev (2008) analysed the precision of structural methods by comparing the debt beta obtained by structural methods for various credit ratings and maturities to those obtained using empirical methods. They found that, on average, structural methods did approximate the debt beta obtained empirically through regressions.

89 Berk, J. and DeMarzo, P. (2014), *Corporate finance. Third edition*, p. 768, equation 21.20.

$$\beta_d = \frac{(1 - N(d_1))}{g} \beta_a$$

However, as can be seen from Appendix A of the CEPA report, instead of using the asset beta in the last term, CEPA has used an equity beta estimate.[90] Correcting this mistake further reduces CEPA's debt beta estimate from 0.11 to 0.05, which is in line with Oxera's recommendation for RIIO-2. This is illustrated in Figure 3.4.

Figure 3.4 Correcting CEPA's structural debt beta estimate



Note: CEPA's original and corrected estimate both assume a gearing of 40%, yield spread of 1%, a time horizon of 10 years, equity volatility of 30% and equity beta of 0.7. We note that CEPA does not disclose how it arrived at the yield spread of 1%.

Source: Oxera analysis based on CEPA (2019), 'Considerations for UK regulators setting the value of debt beta', 2 December, Appendix A, p. 26.

In sum, the corrected estimates of the structural method point to a 0.05 debt beta.

Decomposition method

CEPA's final approach is the decomposition approach. This method was used in the Competition Commission's (CC's) review of the Heathrow Q5 price control in 2007.[91] The method involves decomposing the debt spread (i.e. the spread between yields on corporate and government bonds) into three components—default premium, default risk premium and liquidity premium. The decomposition method was the main method relied on to derive the debt beta for the recent price controls for PR19 and RP3.[92]

CEPA quotes several advantages of the decomposition method. First, CEPA notes when the CC introduced the debt beta to UK regulation in 2007, the CC

[90] Oxera analysis based on CEPA (2019), 'Considerations for UK regulators setting the value of debt beta', 2 December, Appendix A, p. 26.
[91] Competition Commission (2007), 'Reference of Heathrow Airport to the Competition Commission', 3 October, Appendix F, p. 24.
[92] Ofwat (2019), 'PR19 final determinations: Allow return on capital appendix', 16 December, p. 55; Europe Economics (2019), 'Comments on NERA/NERL critiques of Europe Economics' WACC analysis', 6 June, pp.16–20.

observed that the decomposition approach was used by leading academic researchers and recommended by Berk and DeMarzo (2007).[93] However, Berk and DeMarzo have since updated their textbook and no longer recommend this method for estimating debt beta. Instead, the authors refer to structural method for estimating company-specific betas and to a mapping between a credit rating and debt beta,[94] as estimated by Schaefer and Strebulaev (2009).[95]

The second advantage cited by CEPA is that the estimates produced by the decomposition approach are less volatile.[96] However, having less volatile estimates is not necessarily an advantage. First, the reduced volatility could be driven by the misspecification of inputs when decomposing the credit spreads. Second, less volatility does not necessarily imply a better estimate, as the underlying debt beta may be changing over time. Therefore, whether stability is a sign of a good approach should be considered when evaluating the merits of the decomposition approach.

CEPA cites three disadvantages with the decomposition approach.

First, CEPA acknowledges that it can be hard to calibrate the parameters.[97] This is not surprising given the number of parameters that need to be estimated, and particularly given the uncertainty associated with measuring these parameters.[98]

The uncertainty associated with the decomposition approach was noted by the CMA in its preliminary decision in the NATS appeal:[99]

> We [CMA] considered that the evidence to support the debt beta was largely speculative. The CAA's analysis was based on regulatory precedent, and an attempt to deconstruct the debt premium [i.e. the decomposition approach]. The reasons for [the] current level of the debt premium, in particular why it is much higher than the premia implied by the debt beta and risk of default, are largely unexplained. NERL's evidence, in our view, illustrated that there was **significant uncertainty over the ability to measure debt betas using the CAA's approach**. [Emphasis added]

This led to the CMA putting more weight on the regression estimates provided by NATS's advisors in reaching its draft decision.[100]

The second disadvantage noted by CEPA is that there are conceptual challenges associated with the decomposition approach.[101] This relates to the fact that some of the components used in the decomposition approach may be both systematic and idiosyncratic in nature and the components may be correlated with each other.[102]

The third disadvantage noted by CEPA is that the decomposition approach does not allow one to assess the statistical significance of the debt betas

[93] Competition Commission (2007), 'Reference of Heathrow Airport to the Competition Commission', 3 October, Appendix F, p. 24.
[94] Berk, J. and DeMarzo, P. (2014), 'Corporate finance. Third edition', p. 413 and p. 765, example 21.10.
[95] Schaefer, S. M. and Strebulaev, I. A. (2009), 'Risk in capital structure arbitrage. Stanford GSB working paper', as referenced by Berk and DeMarzo.
[96] CEPA (2019), 'Considerations for UK regulators setting the value of debt beta', 2 December, p. 12.
[97] CEPA (2019), 'Considerations for UK regulators setting the value of debt beta', 2 December, p. 12–13.
[98] For example, the liquidity premium estimates reported by CEPA ranges from 0.01bps to 250bps. CEPA (2019), 'Considerations for UK regulators setting the value of debt beta', 2 December, p. 13.
[99] CMA (2020), NATS (En Route) Plc/CAA Regulatory Appeal: Provisional findings report, para 12.115.
[100] CMA (2020), NATS (En Route) Plc/CAA Regulatory Appeal: Provisional findings report, para 12.116.
[101] CEPA (2019), 'Considerations for UK regulators setting the value of debt beta', 2 December, p. 13.
[102] CEPA (2019), 'Considerations for UK regulators setting the value of debt beta', 2 December, p. 13.

obtained.[103] This criticism applies to any approach that does not use statistical methods (i.e. regression analysis) for estimating the debt beta.

Another disadvantage that could be added to those noted by CEPA is that there is no agreement between market practitioners on how to implement the decomposition approach. For example, the formula cited by CEPA that is used by Europe Economics differs from the formula used by the CC in 2007 and by the CC in 2010.[104]

As a result of these disadvantages, the decomposition approach could be viewed as an inferior version of the structural methods cited by CEPA. This is because unlike the decomposition method, structural methods have strong theoretical foundations, have been shown to approximate the regression estimates correctly, and can account for the relationship between gearing and debt beta. Additionally, both approaches require a similar number of parameters to be specified. Therefore, we would recommend that regulators place more weight on the structural method and the regression-based methods than the decomposition approach.

Debt beta and gearing

CEPA notes that the debt beta may not be stable through time and may change with gearing. We consider both of these arguments. First, CEPA's report on debt beta cites (via a NERA report) empirical evidence in Fama and French (1993) as support for a debt beta as high as 0.22.[105, 106] However, Fama and French make no such claim. The text referred to in the CEPA report was an example showing how one can estimate erroneously high debt betas if one omits important factors. Fama and French actually conclude that the debt beta is negative or zero for all but the lowest-grade bonds. Our upper bound of 0.05 is therefore conservative, based on academic evidence introduced as supporting evidence by CEPA.

We further note that the incorrectly cited Fama and French evidence is the clear outlier in Table 4.2 of the aforementioned NERA report, where they also cite support for debt betas of 0.05 for AAA to A- bonds by the Brattle Group, and 0.04 for Schaefer and Strebulaev (2008). In contrast, Ofgem cites studies that selectively choose data points from NERA's report supporting a much higher debt beta, some of which appears to be based on a misrepresentation of the academic evidence as discussed above.

Second, CEPA mentions that debt beta may change with gearing, stating: 'The evidence we have seen indicates that a ten percentage point change in gearing might be expected to result in a 0.06 change in debt beta (at least over some range)'.[107] Although we agree that there is a theoretical relationship between debt beta and gearing, depending on the theoretical assumptions, one cannot solve for the debt beta and simultaneously for either the asset beta and equity beta. For example, without tax effects, Modigliani and Miller (1963) implies the following relationship[108]:

[103] CEPA (2019), 'Considerations for UK regulators setting the value of debt beta', 2 December, p. 13.
[104] The two approaches differ with how one treats the liquidity premium. See CEPA (2019), 'Considerations for UK regulators setting the value of debt beta', 2 December, p. 1 and CC F24.
[105] Fama, Eugene F., and Kenneth R. French. 'Common risk factors in the returns on stocks and bonds.' *Journal of Financial Economics*, **33**:1, 1993, pp. 3–56.
[106] CEPA (2019), 'Consideration for UK regulators setting the value of debt beta', report for UK Regulators Networks, 2 December.
[107] Draft Determinations – Beta Estimation Issues (CEPA), p. 53.
[108] Modigliani, F and M. Miller, 1963, 'Corporate income taxes and the cost of capital: a correction' *American Economic Review*.

$$\beta_e = \beta_a + \frac{D}{E}\,(\beta_a - \beta_d)$$

Without the use of structural methods, one can solve for a relationship between the debt beta and gearing *only* if one already knows *both* the asset beta and the equity beta. Further, any effect is likely to be minor, given the low levels for debt beta estimated in our 2019 study.

Misrepresentation of Oxera's previous evidence

CEPA claims that Oxera's evidence supports a National Grid debt beta of 0.20.[109] This is a misrepresentation based on one regression model, similar to the earlier-discussed misrepresentation of Fama and French (1993). In our earlier report, we make the point that:

> If […] we simply regress returns on a portfolio of National Grid debt against the FTSE we obtain a coefficient of 0.20 (t = 2.48) while a regression of returns on riskless debt (the Barclays 7-10 year gilt index) against the FTSE gives a coefficient of 0.13. Including the Barclays gilt index in the regression along with NG equity reduces the coefficient on NG equity to 0.08 (t=2.23) and it is this figure, multiplied by the equity beta of NG, that reflects the credit risk of NG rather than the estimate of 0.20 that we obtain by regressing simply on the FTSE.
>
> […] many of the estimates of debt beta are not statistically significantly different from zero, and the average estimate across the full sample is 0.01. If the sample is censored by removing estimates that are not statistically significantly different from zero, then the average estimate increases to 0.03, and the estimate for National Grid is also 0.03.[110]

In summary, our evidence supports that of Fama and French, who find a low or non-existent debt beta after controlling for debt characteristics.

Conclusion

As described in the Oxera report published in June 2020,[111] based on the estimates from the direct and indirect regressions with the corrected version of CEPA's structural method, a debt beta assumption of 0.05 for regulated industries would be appropriate.

Further, we recommend that regulators focus on using regression-based methods and structural methods for estimating the debt beta for regulated entities, and that it is important to control for interest rate risk when applying regression-based methods. Otherwise, the resulting debt beta estimate would capture risks over and above credit risk, resulting in a biased estimate.

3.3 Asset beta estimation results

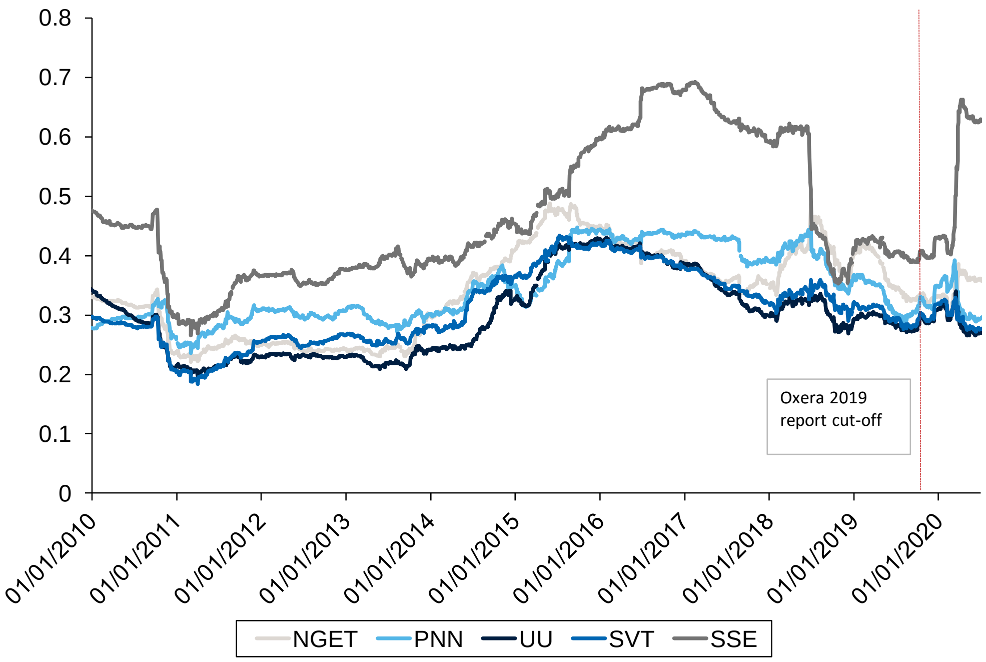
As discussed above, the asset beta strips out the financial risk from the equity beta; hence it is independent of the choice of capital structure and provides an appropriate measure of the risk a specific asset.

Figure 3.5 shows the two-year daily asset betas for each of the companies in our UK comparator sample. We show two-year daily asset betas as an illustrative way to assess the evolution of the data over time. However, when

[109] CEPA (2020), 'Considerations for UK regulators setting the value of debt beta', report for the UK Regulators Network, 2 December.
[110] Oxera (2019), 'Review of RIIO-2 finance issues: The estimation of beta and gearing', 20 March.
[111] Oxera (2020), 'Estimating debt beta for regulated utilities', 4 June.

constructing a range for the asset beta for RIIO-2, we consider both two- and five-year daily estimates.

Figure 3.5 Two-year daily asset betas for listed UK comparator companies



Note: Equity betas were estimated relative to the FTSE All-Share Index. A debt beta of 0.05 is assumed. The cut-off date is 31 July 2020.

Source: Oxera analysis based on Bloomberg data.

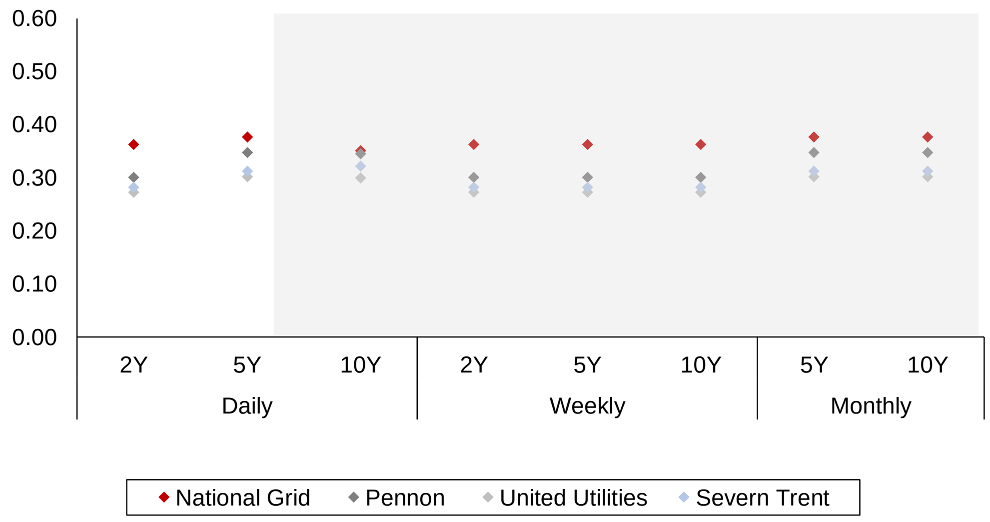
As shown in Figure 3.5, since our last report, SSE's two-year daily asset beta has increased significantly in comparison to other UK regulated utilities. Ofgem attributed the divergence of SSE's beta to its generation and retail services.[112] However, SSE divested its main retail activities in January 2020.[113]

Some of the increase in beta may be related to the GB regulated networks, however as SSE still carries some exposure to electricity prices we consider that it is prudent to exclude SSE from the sample of comparators at this stage, while recognising that the effect of excluding SSE is to lower the estimated asset beta range.

National Grid's asset beta remains above the water companies for all frequencies and time periods (Figure 3.6).

[112] Ofgem (2020), 'RIIO-2 Draft Determinations – Finance Annex', 09 July, para 3.31.
[113] City A.M. (2020), 'Ovo completes purchase of SSE's retail business', 15 January, https://www.cityam.com/ovo-completes-purchase-of-sses-retail-business/.

Figure 3.6 Asset betas for listed UK comparator companies under different frequencies and estimation windows



Note: The cut-off date is 31 July 2020. The area to the right of the five-year daily asset betas has been shaded to reflect the notion that our range is derived from the two-year and five-year daily estimates, while the rest of the data points are only used as cross-checks.

Source: Oxera analysis based on Bloomberg data.

Figure 3.6 shows that when considering the whole UK comparator sample, the results suggest a range of 0.27–0.38 under our proposed method of relying on two- and five-year daily estimates as the primary inputs. However, as mentioned in section 3.1, we do not consider that it would be appropriate to rely solely on this range, as doing so would likely underestimate the true beta for UK energy networks.

The selected sample of UK comparators has only one energy network company, National Grid, and the asset beta estimated for National Grid is likely to be an underestimate of the true asset beta of National Grid's UK regulated business. This is because the estimate presented in this report reflects elements of lower risk faced by National Grid's US business.

The notion that US betas tend to be lower than UK betas has been illustrated in a study by Mayer et al. (1996).[114] We report the relevant findings from the study in Table 3.2 below.

Table 3.2 Comparison of UK and US asset betas

Country	Electricity	Gas
UK	0.60	0.84
US	0.30	0.20

Source: Mayer et al. (1996).

As shown in the table, the US betas for electricity and gas companies are on average 0.30 and 0.64 lower than their UK counterparts. The authors of the study note the existence of 'a clear disparity between the beta values of utility

[114] Mayer, C., Alexander, I. and Weeds, H. (1996), 'Regulatory Structure and Risk and Infrastructure Firms: An International Comparison', p. 27.

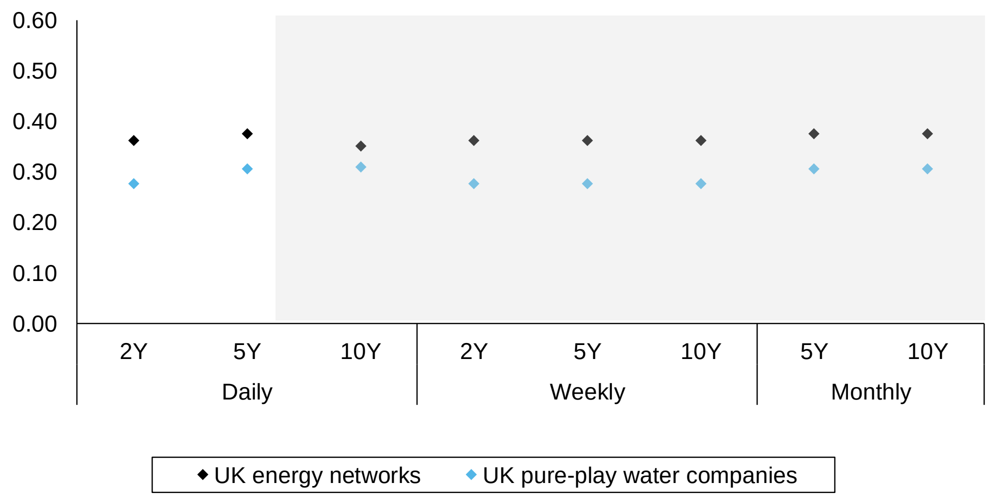
companies in the United States and the UK, which is usually attributed to the relatively safe operating environment in the United States'.[115]

This difference between the UK and the US asset betas suggests that the asset beta of National Grid's UK regulated business is likely to be higher than that of the National Grid Group.

In addition, we note that a preliminary analysis of this issue was presented in the Indepen Report. The preliminary analysis in that report found that National Grid's US betas are 0.15 to 0.19 lower than National Grid's UK betas.[116]

Second, as shown in Figure 3.7, the average asset beta for the energy networks (i.e. National Grid) has been consistently higher than the average asset beta of the two pure-play water comparators—United Utilities and Severn Trent.[117]

Figure 3.7 Comparison of asset betas for UK energy networks and UK pure-play water companies



Note: The cut-off date is 31 July 2020.

Source: Oxera analysis based on Bloomberg data.

As explained in the 2018 Oxera report, rapid technological change and an increased focus on decarbonisation suggest that the fundamental risk of energy networks is greater than that faced by water networks. For example, in July 2018, National Grid introduced a new scenario for meeting carbon targets—'Community Renewables'.[118] This scenario differs in that it assumes that the carbon targets are met under a system with a high degree of decentralisation.[119] The large roll-out of decentralised intermittent generation

[115] Mayer, C., Alexander, I. and Weeds, H. (1996), 'Regulatory Structure and Risk and Infrastructure Firms: An International Comparison', p. 30.
[116] Indepen. (2018), 'Ofgem Beta Study – RIIO-2 Main report', pp. 38–9, https://www.ukrn.org.uk/wp-content/uploads/2019/01/final_beta_project_riio_2_report_december_17_2018_0.pdf.
[117] Unregulated activities have until recently comprised a large proportion of Pennon Group's business. This is due to a waste management business relating to 'the recycling, energy recovery and waste management services provided by Viridor'. Waste management accounted for 59% of revenues and 23% of operating profits in 2017. See Pennon (2017), 'Annual Report and Accounts 2017', p. 120.
[118] National Grid (2018), 'Future Energy scenarios', July, p. 15, Figure 2.1 Scenario matrix, http://fes.nationalgrid.com/media/1363/fes-interactive-version-final.pdf. For comparison, see the previous year's version: National Grid (2017), 'Future Energy scenarios', July, pp. 14–17, 'Scenario descriptions', http://fes.nationalgrid.com/media/1253/final-fes-2017-updated-interactive-pdf-44-amended.pdf.
[119] See 2017 FES Workbook, tab 'ES3', and 2018 FES Workbook, tab 'ES2'.

may require significant adaptation from the grid. In March 2019, the UK government banned gas heating for new houses, with the aim of decarbonising domestic heating.[120] This raises the question of what utilisation gas networks will be able to achieve throughout the RIIO-2 period and beyond, and it is another example of heightened risk for energy networks compared to water networks.

We also note that demand for electricity fell and is expected to remain at 20% below historical levels due to the COVID-19 shutdown.[121] This will test the regulatory regime as regulatory protection against volume risk is only effective if companies can recoup their lost revenues via future increases in prices.

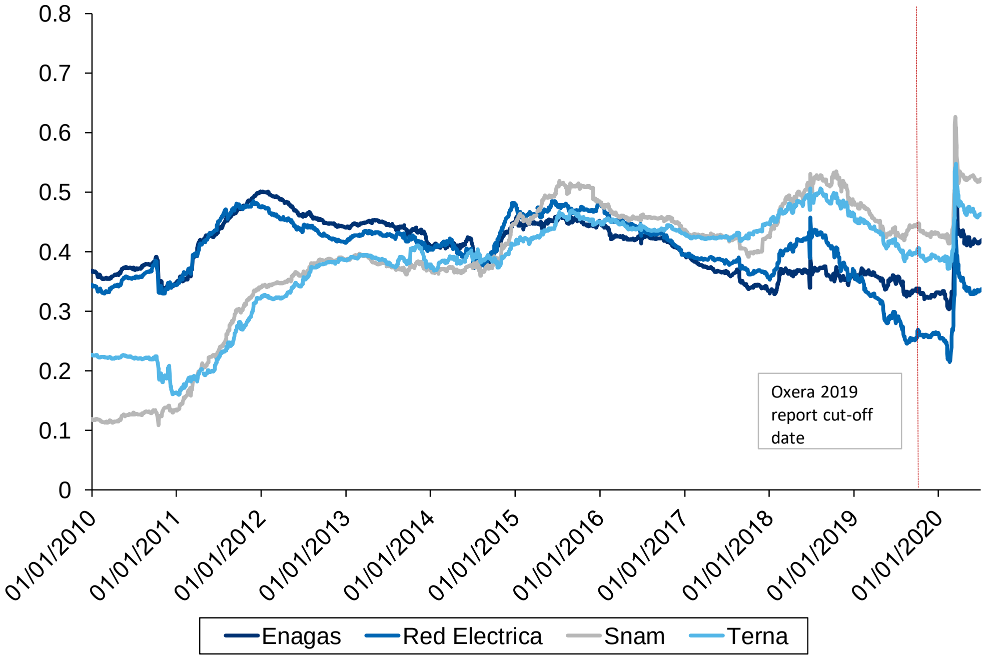
Finally, we note that although ultimately concluding that water and energy companies are similar in terms of regulatory exposures, Ofgem mentions that energy networks may be riskier than water companies,[122] and its own beta analysis consistently suggests that National Grid is riskier than the two pure-play water companies. CEPA writes that '[it recognises] that GB energy networks may be judged riskier than water networks – or at least that the sources of systematic risk are sufficiently different that water networks are an imperfect investment substitute for a pure play energy network in RIIO-2' and differ due to exposure to the 'Net Zero' initiative.[123] The CEPA report also mentions that placing heavier weights on water companies as comparators will mechanically lower the estimated asset beta for energy companies, implying that water companies are relatively less risky than energy companies.[124] CEPA notes in Table 2.3 of its report that energy companies are likely riskier than water companies in terms of demand, competition, and investment cyclicality.[125] They do not find a difference in political/regulatory risk. CEPA's Table 2.3 therefore identifies multiple dimensions on which energy companies may be riskier than water companies and no cases where the opposite is true. Table 18 of Ofgem's report summarising the similarities in energy and water risk is much stronger than the actual claims in CEPA's report.[126]

In combination, the issues outlined above suggest that there is a need to expand the comparator sample beyond the UK, as the UK comparator sample is unlikely to accurately reflect the risk profile for the energy networks in RIIO-2. Consistent with our approach in previous reports, we see merit in also considering a sample of regulated European energy networks. Indeed, we consider that the assessment by investors of the underlying business risk may be more closely aligned to that of UK energy networks, as all of the companies in the European sample derive the majority of their revenues largely from European regulated activities.[127]

[120] Harrabin, R. (2019), 'Gas heating ban for new homes from 2025', BBC News, 13 March, https://www.bbc.co.uk/news/science-environment-47559920, accessed 3 October 2019.
[121] nationalgridESO (2020), 'Summer: Outlook', April https://www.nationalgrideso.com/document/167541/download.
[122] Ofgem (2020), 'RIIO-2 Draft Determinations – Finance Annex', 09 July,p. 46.
[123] CEPA, 'RIIO-2: Beta estimation issues', p. 5.
[124] CEPA, 'RIIO-2: Beta estimation issues', p. 5. quotes 'A slightly lower range might be considered appropriate the more emphasis is placed on the similarities in the water sector regulatory frameworks and the price control building blocks in the two sectors'.
[125] CEPA, 'RIIO-2: Beta estimation issues', p.25.
[126] Ofgem (2020), 'RIIO-2 Draft Determinations – Finance Annex', 09 July, p. 51
[127] Enagas (2019), '1H2019 Results', 30 July, p. 3, https://www.enagas.es/stfls/ENAGAS/Relaci%C3%B3n%20con%20inversores/Documentos/CNMV%201H2019.pdf; Red Elétrica (2018), 'Red Eléctrica Corporación, S.A.: Consolidated Annual Accounts', 31 December, p. 13, https://www.ree.es/sites/default/files/downloadable/CCAA_ingles.pdf, accessed 3 October 2019; Snam (2019), '2019 Half Year Report', 30 June, p. 23, https://www.snam.it/export/sites/snam-rp/repository/ENG_file/investor_relations/reports/interim_reports/2019/SNAM_2019_Half_Year_Report.pdf; Terna (2019), 'Energy Is Our Responsibility: 2019 Half-Year Report', 30 June, p. 57, https://download.terna.it/terna/TERNA%20RELAZ_SEM%20ENG_8d715c21e8c2880.pdf.

Figure 3.8 shows the asset betas of the companies in the European comparator sample.

Figure 3.8 Two-year daily asset betas for listed European comparator companies



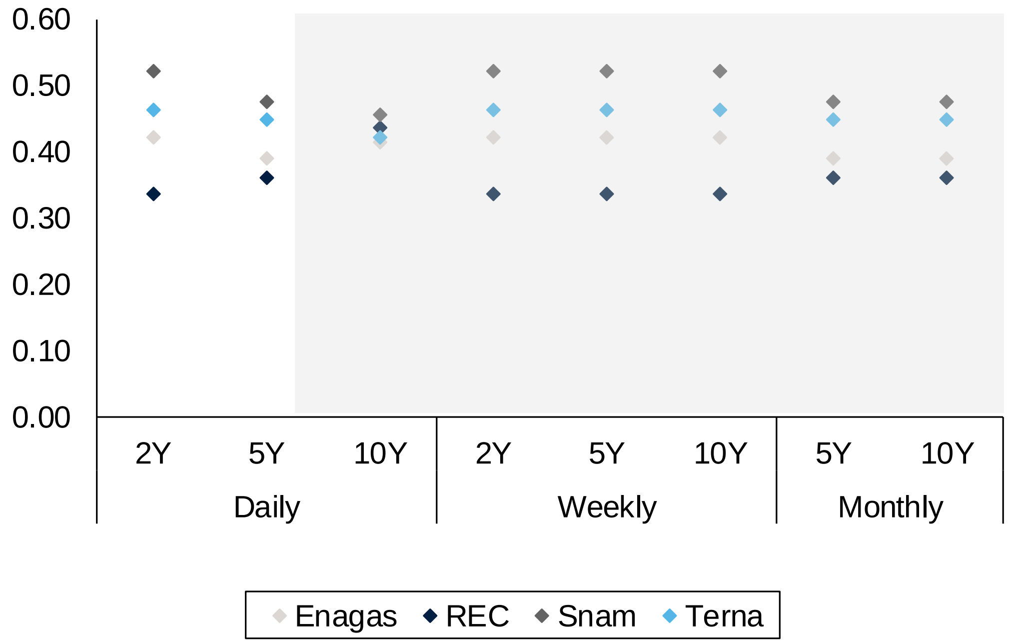
Note: Equity betas were estimated relative to the Eurostoxx TMI index. A debt beta of 0.05 is assumed. The cut-off date is 31 July 2020.

Source: Oxera analysis based on Bloomberg data.

We observe that the betas of the European comparators have increased significantly in 2020 since the beginning of the COVID-19 pandemic. The current market data points to a range of 0.34–0.52.

Figure 3.9 demonstrates asset beta estimates for the European comparator sample for a range of frequencies and estimation windows.

Figure 3.9 Asset betas for listed European comparator companies under different frequencies and estimation windows



Note: The cut-off date is 31 July 2020.

Source: Oxera analysis based on Bloomberg data.

The European evidence for two- and five-year daily data suggests a wider and higher asset beta range of 0.34–0.52 compared to the UK evidence (0.27–0.36). This is consistent with the asset beta for energy networks being higher than for water companies.

Table 3.3 presents the two- and five-year betas for our sample of comparators. We note that the two-year betas have increased, likely due to the economic uncertainty created by the COVID-19 pandemic. The five-year asset beta average has remained broadly stable at 0.40.

Table 3.3 Derivation of the preliminary asset beta range

	Jun 2020		Nov 2019	
	2-year	**5-year**	**2-year**	**5-year**
National Grid	0.36	**0.38**	0.33	0.38
Enagas	0.42	0.39	0.33	0.36
REC	0.34	0.36	0.26	0.38
Snam	0.52	0.48	0.43	0.45
Terna	0.46	0.45	0.39	0.44
Average	0.42	**0.41**	0.35	0.40

Note: Daily frequency.

Source: Oxera analysis based on Bloomberg data.

On balance, we propose a conservative asset beta range that uses National Grid’s five-year asset beta as the low end and the comparator average five-year asset beta as the high end, which translates into a range of 0.38–0.41. This is based on a debt beta of 0.05. If the asset beta range is restated using the debt beta of 0.125 assumed by Ofgem in the Draft Determination then the range would be 0.41-0.44. The latter range is presented to aid comparison with the Draft Determination but is not the recommendation of this report, because as demonstrated earlier, the evidence does not support a debt beta of 0.125.

We further note that Ofgem claims that CEPA's work supports an asset beta in the range of 0.34 to 0.39.[128] However, CEPA's report is much more cautious. It notes that 'We have not been asked to produce an overall asset beta range and so we do not provide one. We have, however, considered whether the balance of relevant evidence that we consider within the scope of this report is consistent with Ofgem's estimates of the asset beta range.'[129] One concludes that the limited evidence considered could support a wide range of asset betas, not only that proposed by Ofgem.

In the next subsection, we explain that the CAPM beta does not necessarily capture all of the systematic risk faced by regulated networks. We build on our previous reports and present new evidence. Ofgem notes in its draft determinations that it is unconvinced by arguments reflecting alleged CAPM failings or alleged risks that are not captured. In response, we note that we no longer aim at the top end of a range for beta based on market data. Second, the CAPM failings are not alleged, they are well-known in the academic literature (i.e., Dessaint et al (2020))[130], including in papers cited by CEPA (i.e., Fama and French (1993)).[131] Although our analysis uses the CAPM due to regulatory precedent, we take the view that multiple risk factors are uncaptured by this methodology and we explore one of them in this report (political/regulatory risk and associated skewness).

3.4 The impact of political and regulatory risk

In March 2019, we published a report on behalf of National Grid that examined the political and regulatory risks that regulated utilities currently face ('the March 2019 report').[132] CEPA's report agrees that these risks are prevalent for regulated utilities. The findings from that report, as summarised below, provide evidence that the beta in the CAPM equation is unlikely to reflect the full level of risk faced by UK energy networks.

In the March 2019 report, we noted that an increase in political and regulatory risk for UK energy network is evident from:

- more frequent political and regulatory news triggering share price falls (i.e. sharp declines in reaction to news);
- an increase in share price volatility since 2016—a period during which the UK Labour party asserted its policy of renationalising utilities if it were to come to power;
- a decline in the status of National Grid and other regulated utilities as 'defensive stocks';
- an increased focus on regulatory and political risk as a valuation driver in analyst assessments.

Figure 3.10 presents the value of the value of the networks' equity at the time of a growing/stable wider equity market. As noted above, 2016 represents the

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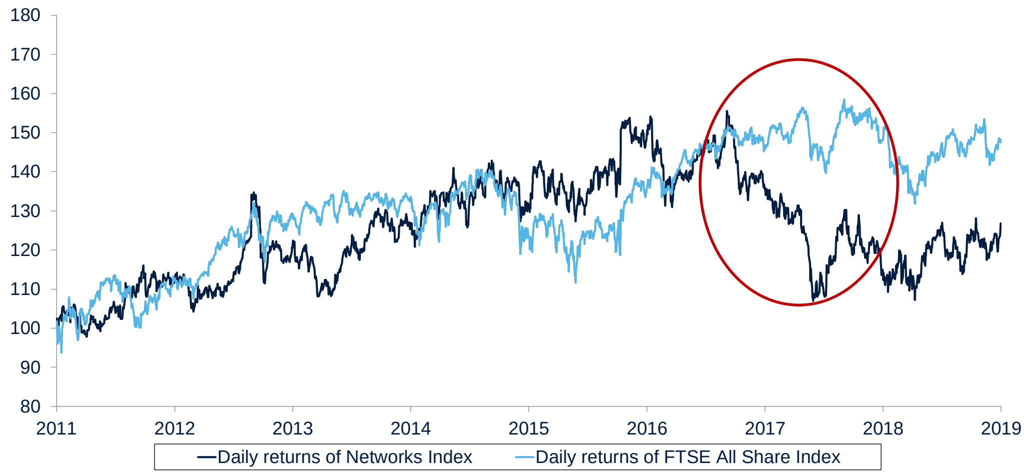
[128] Ofgem (2020), 'RIIO-2 Draft Determinations – Finance Annex', 09 July, p. 46.
[129] CEPA, 'RIIO-2: Beta estimation issues', p. 4.
[130] Dessaint, O., Olivier, J., Otto, C. and Thesmar, D. (2020), 'CAPM-based company (mis)valuations', *Review of Financial Studies*, forthcoming.
[131] Fama, E. F. and French, K. R (1993), 'Common risk factors in the returns on stocks and bonds', *Journal of Financial Economics*, **33**:1, 1993, pp. 3-56.
[132] Oxera (2019), 'Assessment of political and regulatory risk', prepared for National Grid Group, 4 March.

time when the UK Labour party asserted its policy of renationalising utilities if it were to come to power. As such, we consider that the fall in the networks' value versus the FTSE All-Share Index over the same period is a further demonstration that in recent times, UK network companies have been exposed to heightened regulatory and political uncertainty.

Figure 3.10 Total equity returns of the UK networks and the FTSE All-Share indices (2011=100)



Source: Oxera analysis based on Datastream data.

The premium that investors require for exposure to political and regulatory risk factors would in principle be best estimated using multifactor models. However, given the preference of UK regulators to use the CAPM, we have instead compared the CAPM beta for the entire sample period with the CAPM beta excluding the two days before and after major political and regulatory announcements. Table 3.4 compares the two-year equity betas for regulated utilities in the UK.

Table 3.4 Equity betas and political / regulatory risk

	2-year betas	2-year betas controlling for political and reg. announcements	Difference
National Grid	0.74	0.72	-0.01
Pennon Group	0.75	0.69	-0.06
United Utilities	0.67	0.64	-0.02
Severn Trent	0.63	0.61	-0.02

Note: We have excluded observations dating two days pre- and post-announcement.

The beta of regulated utilities eliminating regulatory and political announcements is, on average, 0.03 lower. This suggests that there is a higher risk associated with the dates where political and regulatory announcements were made. As a cross-check, and to confirm the hypothesis that those dates present a higher risk, we have estimated the beta of National Grid using the returns of the five days before and after major political and regulatory announcements. [133] In other words, we quantify the beta only for the dates around the political and regulatory announcements. Table 3.5 shows the results.

[133] In order to render calculations possible, we have used a five-day window around the announcement day. This ensures that the sample is sufficiently large to run a regression.

Table 3.5 National Grid equity beta and political / regulatory risk

	2Y betas full sample	Betas -5/+5 window around the announcement day	Difference
National Grid	0.74	0.79	+0.05

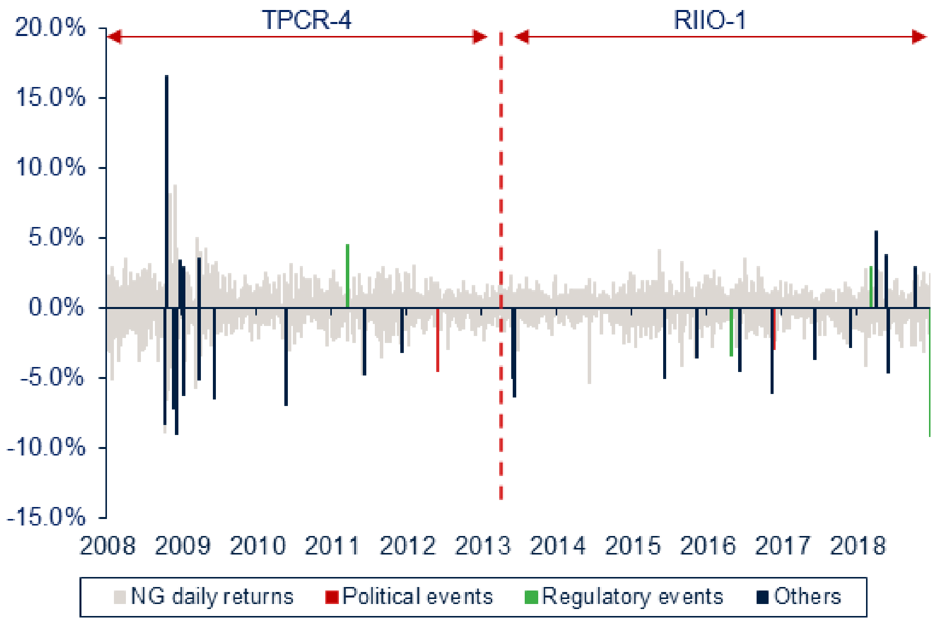
Source: Oxera analysis based on Bloomberg data.

Consistent with our previous findings, the beta of National Grid is 0.05 higher on the dates where political and regulatory announcements were made. These results indicate lower levels of undiversifiable risk in periods free of regulatory announcements. Such time-series variation suggests that risk increases during regulatory periods. We acknowledge that the above evidence does not quantify the potential risk premium over and above the CAPM beta.[134] We consider this question in the next section.

3.5 Negative co-skewness and political and regulatory risk

Another striking feature of political and regulatory announcements is their effects on the stock prices of regulated energy companies. From Figure 3.11, it is clear that the majority of regulatory announcements cause sharp declines in energy firms' stock prices relative to the market as a whole.

Figure 3.11 NG's share price reaction (a sharp increase or decrease in price relative to the FTSE All-Share), 2008–18



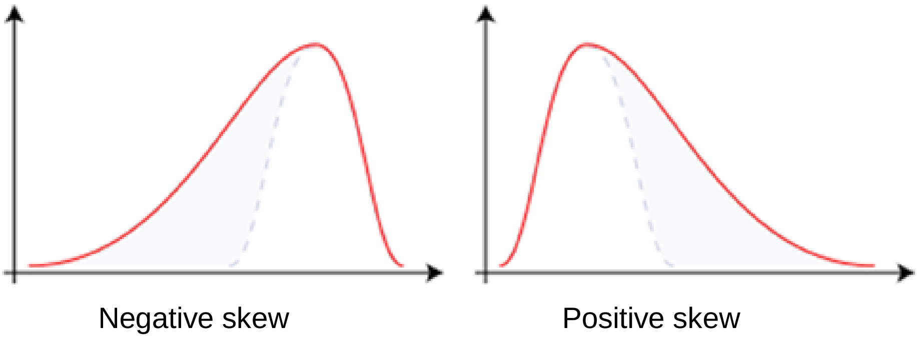
Note: The highlighted statistically significant observations (two standard deviations away from the long-run historical average) represent extreme movements in NG's share price, where its share price deviated substantially from that of the FTSE All-Share. Events are categorised based on a qualitative assessment of the news content. 'Others' includes systematic, company-specific and safe haven events.

Source: Oxera analysis based on Thomson Reuters data.

[134] A reader may wonder whether our evidence implies that the CAPM captures political and regulatory risk. As shown in the following section on skewness, it does not, because the CAPM is capturing longer-term averages and not sudden negative shocks.

Such rapid declines in stock prices is a concept known as negative skew. Skewness measures the potential upside or downside of an investment, and examples of negative and positive skewness can be seen in Figure 3.12.

Figure 3.12 Positive and negative skewness



Source: Hermans, R. (2008), open source

Positive skew investments tend to feature low-probability events with high payoffs. These sorts of investments are appealing to investors and have payoff structures similar to the national lottery. Negative skew events present limited upside but some probability of a large downside. Investors are averse to negative-skew investments and require a premium for holding such stocks. The academic literature demonstrates that investors require a premium potentially exceeding 3% for holding stocks with negative co-skewness with the market index, holding beta constant.[135]

Regulated energy companies in the UK seem like intuitive candidates for stocks serving as left-skew investments that 'present limited upside but some probability of a significant downside'. As noted collectively in the Ofgem and CEPA reports, regulated energy companies bear a number of potential serious downside risks, such as nationalisation, cybersecurity risk, and technological changes. Conversely, any outperformance has the potential to be capped by regulators, seemly removing any offsetting upside for a rational investor.

We test this intuition in Table 3.6 by estimating the co-skewness for National Grid relative to the market using the Harvey and Siddique (2000) methodology.[136] As noted by Harvey and Siddique, assets with negative co-skewness must have higher expected returns than assets with identical risk-characteristics but zero co-skewness. Therefore, investors require a risk premium to invest in such stocks, raising the cost of equity above the CAPM-implied cost of equity. Consistent with the above intuition, energy companies demonstrate negative co-skewness, with an average of -0.50%. This suggests that equity investors should require a premium above the CAPM-implied CoE (even compared to another company with a similar beta) in order to be fairly compensated for risk.

Table 3.6 Co-skewness

	Skewness	Coskewness NG-FTSE
NGET	-1.13%	-0.68

Source: Oxera analysis based on Bloomberg data. The cut-off date is July 2020.

[135] Harvey, C. and Siddique, A. (2000), 'Conditional Skewness in Asset Pricing Tests', *Journal of Finance*, **55**, pp. 1263–1296.
[136] Harvey, C. and Siddique, A. (2000), 'Conditional Skewness in Asset Pricing Tests', *Journal of Finance*, **55**, pp. 1263–1296.

To summarise, the data strongly suggests that political and regulatory risk manifests in stock returns. Upon the announcement of the average regulatory event, the stock prices of regulated energy companies demonstrate sharply negative movements. Such behaviour is consistent with negative skewness, and this is considered riskier by equity investors, even holding beta constant, as discussed in Harvey and Siddique (2000). As such, a rational equity investor would require a higher return that implied by the CAPM beta. Such evidence, combined with recent academic evidence documenting that the CAPM underestimates the CoE for low-beta firms, suggests that using the CAPM beta alone ignores important risk factors faced by regulated energy firms.

We further note that Ofgem may believe that its Return Adjustment Mechanisms (RAMs) protect consumers from overperformance and companies from underperformance. We agree with Ofgem that upside performance is limited. Although a separate issue may be that the RAM adjustment punishes efficiency and innovation and rewards poor performance, we want to distinguish between skewness driven by political risk versus simple financial underperformance. Left co-skewness is a sudden and dramatic downside event, such a nationalisation or a punitive regulatory decision, not a bad quarterly or annual ROE result.

3.6 Conclusion

Based on the evidence provided above, we conclude that the higher volatility around political and regulatory announcements, in combination with a persistently negative skewness and co-skewness, shows that investors' risk expectations are not fully captured using a one-factor CAPM model. Therefore, an appropriate risk-return remuneration should consider the downward bias implied by the simplified CAPM framework when determining the point estimate.

4 CAPM-based required equity returns for RIIO-2

Table 4.1 summarises the updated cost of equity parameters for the CAPM. In light of the updated evidence presented in section 2 and section 3, we recommend updating the cost of equity range to 6.00–7.08% CPIH-real at 60% gearing.

Table 4.1 Summary of RIIO-2 cost of equity estimates

	Oxera 2019		Current evidence		Change	
	Low	High	Low	High	Low	High
Real TMR (%)	7.00	7.50	7.00	7.50	-	-
Real RfR (%)	-1.20	-0.79	-1.00	-1.00	0.20	-0.21
ERP (%)	8.20	8.29	8.00	8.50	-0.20	0.21
Asset beta	0.38	0.41	0.38	0.41	-	-
Debt beta	0.05	0.05	0.05	0.05	-	-
Equity beta at 60% gearing	0.88	0.95	0.88	0.95	-	-
Real cost of equity at 60% gearing (%)	**5.98**	**7.09**	**6.00**	**7.08**	**0.02**	**-0.02**
Equity beta at 55% gearing	0.78	0.85	0.78	0.85	-	-
Real cost of equity at 55% gearing (%)	**5.22**	**6.26**	**5.27**	**6.23**	**0.04**	**-0.03**

Note: All figures are presented in CPIH-real terms and do not include a 25bp downward adjustment for expected outperformance as advocated by Ofgem.

Source: Oxera analysis.

As shown in Table 4.1, the net impact of changes in the capital market evidence and changes in methodology (i.e. the approach to the risk-free rate, and the method for weighting the evidence on asset betas)[137] is that the cost of equity range is similar to the 2019 Oxera report. For completeness, we report the bridge between the above CoE range and Ofgem's proposed CoE in Appendix A1.

We also note that Oxera submitted evidence as part of the ENA's response to Ofgem's RIIO-2 SSMD in March 2019 on how its proposed allowance on the cost of equity compared with the pricing of risk for these companies in the debt markets (the 'Oxera ARP−DRP report').[138] We explained that the ARP−DRP differential can be used as a cross-check for the appropriate level of the allowed cost of equity.

In our updated report, we show that:

- The benchmarks for ARP−DRP can be employed not only as a cross-check to cost of equity, but also to obtain **conservative estimates** of the allowed WACC, because of the downward bias in asset beta estimation.
- After adequately addressing Ofgem's concerns set out in the RIIO−2 SSMD, our findings reveal more information to support the conclusion that Ofgem's RIIO−2 cost of equity allowances in the Draft Determination **falls below** that implied by (i) contemporaneous market evidence for the cost of debt and the

[137] We discuss these changes in more detail in sections 2 and 3.
[138] Oxera (2019), 'Risk premium on assets relative to debt', 25 March.

risk-free rate; and (ii) a mixture of contemporaneous market evidence and regulatory precedent on the asset beta and the TMR. This conclusion is based on the finding that the ARP−DRP differential implied by Ofgem's allowances is low compared to those implied by the traded yields of energy bonds over the *six-month* period preceding the RIIO−2 Draft Determination.

- Our updated analysis, incorporating various methodological improvements, finds that the ARP−DRP differentials implied by past regulatory allowances for energy companies (i.e. RIIO−1, NIE RP5 and RP6) were **broadly in line** with those implied by contemporaneous market evidence around the corresponding determinations.

This is not surprising given that the cumulative impact of the major methodological changes introduced by Ofgem for estimating the CoE in RIIO-2 has been to reduce the estimate. The 50th percentile of the ARP-DRP differential implies a real CoE of 6.35%, supporting the CoE range in this report. The takeaway is that the evidence on asset risk premium suggests that Ofgem's CoE estimates are too low.

Finally, we note that Ofgem's Draft Determinations contain a large number of cross-checks meant to support a lower CoE estimated by Oxera in this report. Notwithstanding our concerns with the robustness of these cross-checks, which we set out in Appendix A2, none of these cross-checks is directly comparable with Ofgem's CAPM analysis. In contrast, the comparison we have undertaken between the allowed return on assets and the pricing of risk within the debt market is a test of internal consistency between different elements of the capital structure for the same company. A cross-check that is directly comparable to the cost of equity for companies regulated under RIIO-2 should be given more weight.

5 Conclusions

5.1 Regulatory cost of capital and consumer welfare

Ofgem's Draft Determinations draw a connection between reducing the regulatory cost of capital and increased consumer welfare.[139] Although the reduction in the level of consumer bills is readily quantifiable, it is neither the only nor even the most important consideration for consumer welfare.

As noted in the UKRN Cost of Capital study[140] and in both past and recent Oxera analysis,[141] regulators are trying to balance the risk of potentially overcharging customers on the one hand, and the risk of the company not being able to carry out its investment programme on the other. In the latter case, customers will not be able to enjoy the benefits that are delivered by the investment. The regulator's objective is to choose the WACC point estimate to balance the potential loss in welfare from underinvestment against the loss in welfare from setting prices higher than necessary to incentivise investment. The regulator has to take this decision in the context of uncertainty about the underlying WACC and cost of equity. The CMA notes that 'If there were positive externalities and longer-term benefits to consumers from identifying and investing in new capital projects, then we agreed that there could be a case for a long-term premium on the cost of capital.'[142]

In our 2020 report for Heathrow Airport on this topic,[143] we revisited the conclusion of the UKRN study that:

> […] the optimal choice of the RAR [regulatory allowed return] […] is high, in terms of the percentile within the range of distribution of the true WACC'.[144]

In reaching this conclusion, the author assumed that 'the consequence of setting too low a RAR [regulatory allowed return] is a complete loss of investment',[145] which is arguably an extreme assumption. We relaxed this assumption and found that for realistic values of the price elasticity, customer welfare is maximised by setting the allowed return at or above the 96th percentile of the WACC distribution.

Our quantitative analysis focused on potential future investment. UKRN's analysis suggested that in the case of investment that has already been carried out, it is optimal 'to ensure the lowest possible regulated price and therefore highest possible customer surplus'.[146] Given the financeability requirements, UKRN concludes that 'the optimal RAR [regulatory allowed return] [...] for old (sunk) investment is therefore the expected WACC'.[147]

This conclusion, however, assumes that no future investment is required.

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139 Ofgem (2020), 'RIIO-2 Draft Determinations – Finance Annex', 09 July, Section 1.10.
140 UKRN (2018), 'Estimating the cost of capital for implementation of price controls by UK regulators', 6 March.
141 Oxera (2014), 'Input Methodologies–Review of the '75th percentile' approach'', 23 June; (2020), 'Is aiming up on the WACC beneficial to customers?'.
142 CMA (2020), 'NATS (En Route) Plc/CAA Regulatory Appeal' p. 246, 23 July , https://assets.publishing.service.gov.uk/media/5f350e17e90e0732e0f31c2a/NATS_-_CAA_final_report_for_publication_August_2020_-----.pdf
143 Oxera (2020), 'Is aiming up on the WACC beneficial to customers?'.
144 Op. cit., p. 163.
145 Op. cit., p. 164.
146 Op. cit., p. 164.
147 Ibid.

However, in a world where companies are considering potential capacity expansions to their existing assets or construction of greenfield assets, regulatory treatment of sunk investment can affect future projects as well.

All else equal, if investors learn that the regulator intends to aim up during the first regulatory period only, they will expect lower cash flows over the lifetime of the project. This, in turn, decreases the attractiveness of the project and could in some cases jeopardise its economic viability. Investors would increase their required returns to offset the possibility that future regulators could reduce returns below the cost of capital that formed the basis of the investment decision.

5.2 Cost of equity range

As presented in section 4, the CAPM evidence suggests a 6.00–7.08% range for CPIH-real cost of equity. We note that the inputs used to calculate this range better represent true borrowing and lending rates as required by the CAPM and better capture the economic intuition behind asset risk and asset beta.

The revised cost of equity range therefore balances the sharp increases in volatility and beta appearing in 2020 with the reduction in yields on government bonds and bonds issued by UK utilities. As noted above, the estimate accomplishes this while retaining the theoretical underpinnings between the CAPM and MM models relied upon by regulators. The cost of equity presented in this report is consistent with the networks remaining financeable from the perspective of equity investors.

Oxera has carefully balanced and included multiple sources of market information, some reducing the CoE (i.e. changes in interest rates) and some increasing the CoE (i.e. increases in two-year betas). We consider that our estimate is conservative, particularly given that:

i) we omit SSE from our analysis;

ii) we currently ignore two-year beta estimates due to the market volatility driven by the economic conditions created by the COVID-19 pandemic; and,

iii) our recommended range does not include any adjustments to reflect the evidence that returns of regulated networks are subject to political and regulatory risk, and exhibit negative co-skewness.

Had we more heavily weighted these characteristics, our CoE range would have been higher.

In contrast, the cumulative impact of Ofgem’s changes in assumptions and methodologies since RIIO-1 is to lower the CoE. As shown in the appendix, Ofgem’s cross-checks supporting a lower cost of equity are often revised higher when using updated data or correcting outliers/errors. Its inputs to the cost of equity appear to fail the MM test. Many of its cross-checks use firms that are not true comparators based on risk and liquidity. This implies that Ofgem’s risk premium allowance for equity relative to debt is relatively low, and raises questions about whether the networks would be financeable from the perspective of equity investors. In terms of asset beta, Ofgem’s emphasis on including water companies as appropriate comparators is questionable, given the evidence in CEPA’s report, and inconsistent with the market evidence on the beta of National Grid compared with pure-play water companies.

As explained in Oxera’s 2018 and 2019 reports, selecting the point estimate within the range requires striking the balance between higher consumer bills in the short term and providing adequate incentives to invest to deliver the consumer benefits of network resilience and enhancement. This trade-off is particularly important over the long term, as the rational response to an allowed return lower than the cost of capital would be to develop business plans that minimise investment, posing a risk to reliability and innovation in the sector.

The risk of underinvestment is closely connected to the issue of regulatory stability. Given that regulated networks make investment decisions that span multiple price control periods, limiting volatility in allowed returns from one price control period to the next facilitates the securing of long-term investment. This is particularly important for RIIO-2, when regulated utilities are exposed to heightened political uncertainty, which noticeably affects the perception of investors as to the risks of these businesses (see sections 3.4 and 3.5). To summarise this point, we note that the following changes from RIIO-1 have all had the effect of reducing the CoE:

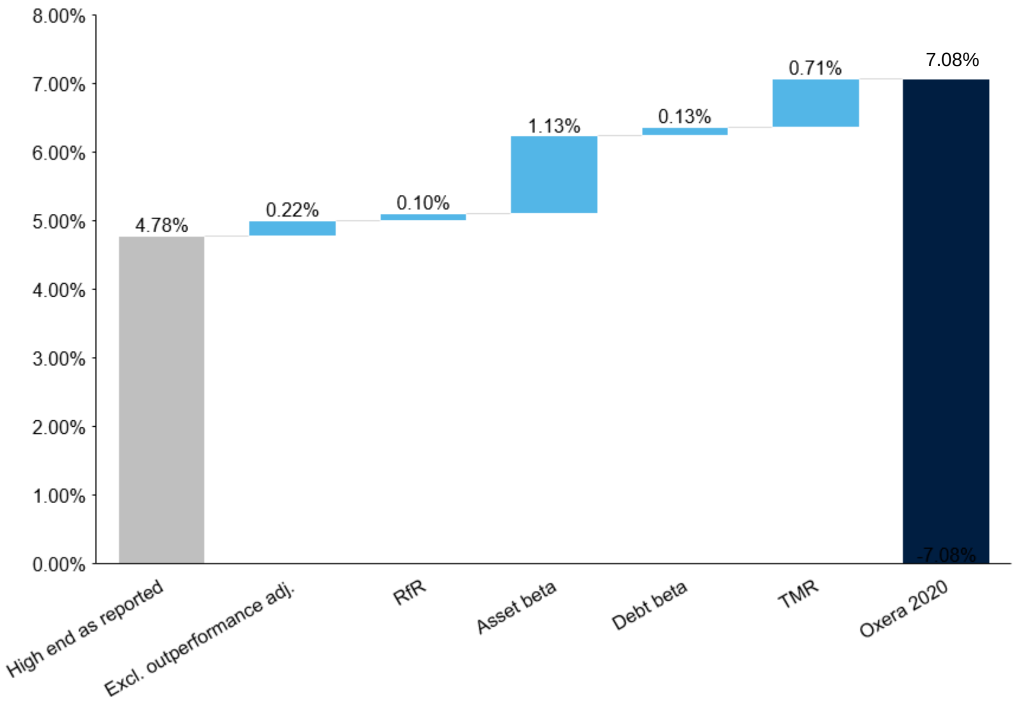
- restating the historical total market return (TMR) based on an experimental index for historical CPI, which results in a lower estimated TMR;
- increasing the weight on the geometric average historical return, thereby moving further away from the correct (Cooper) estimator, resulting in a lower TMR;
- moving to spot yields on government bonds, which lowers the estimated risk-free rate (RfR);
- using a debt beta of 0.125 where previously Ofgem used zero, which artificially deflates the notional equity beta;
- reducing the allowed return below the estimate of the CoE.

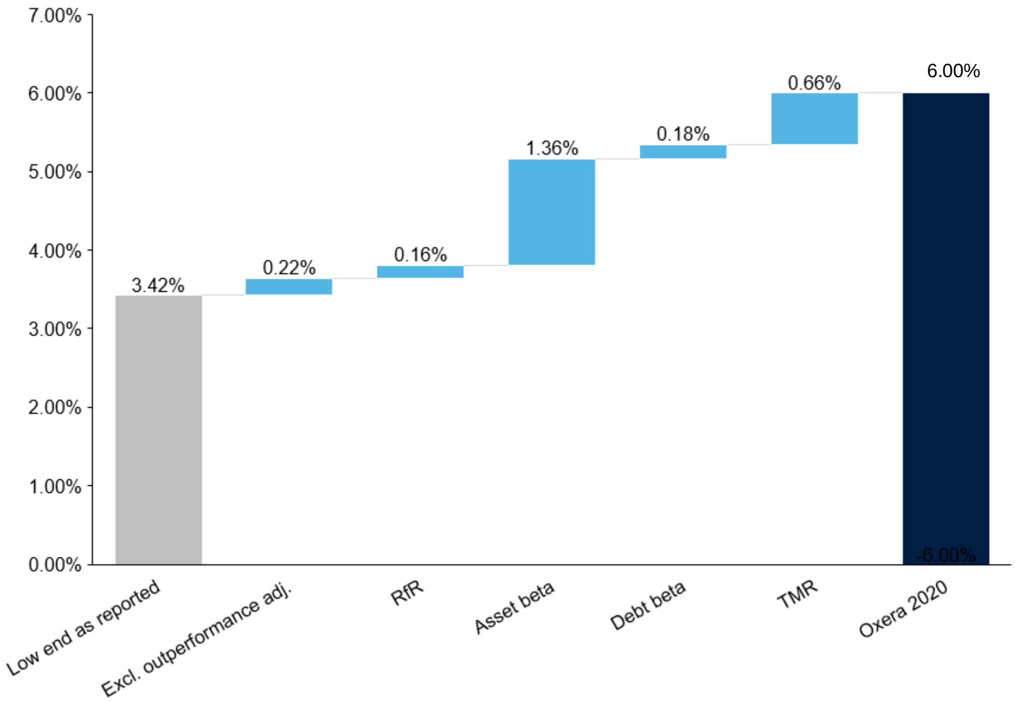
We restate our consideration that these changes in combination create the potential for underinvestment and under-innovation, especially in newer, riskier assets. Moderating the reduction in the allowed return on equity for the RIIO-2 controls compared with the RIIO-1 controls would support long-term investment.

A1 Comparison to Ofgem Draft Determinations and RIIO-1

Figure A1.1 illustrates the reconciliation bridges between the cost of equity range presented in in this report and the allowed equity return range in Ofgem's Draft Determinations.

Figure A1.1 Cost of equity bridge between Ofgem and Oxera's estimates



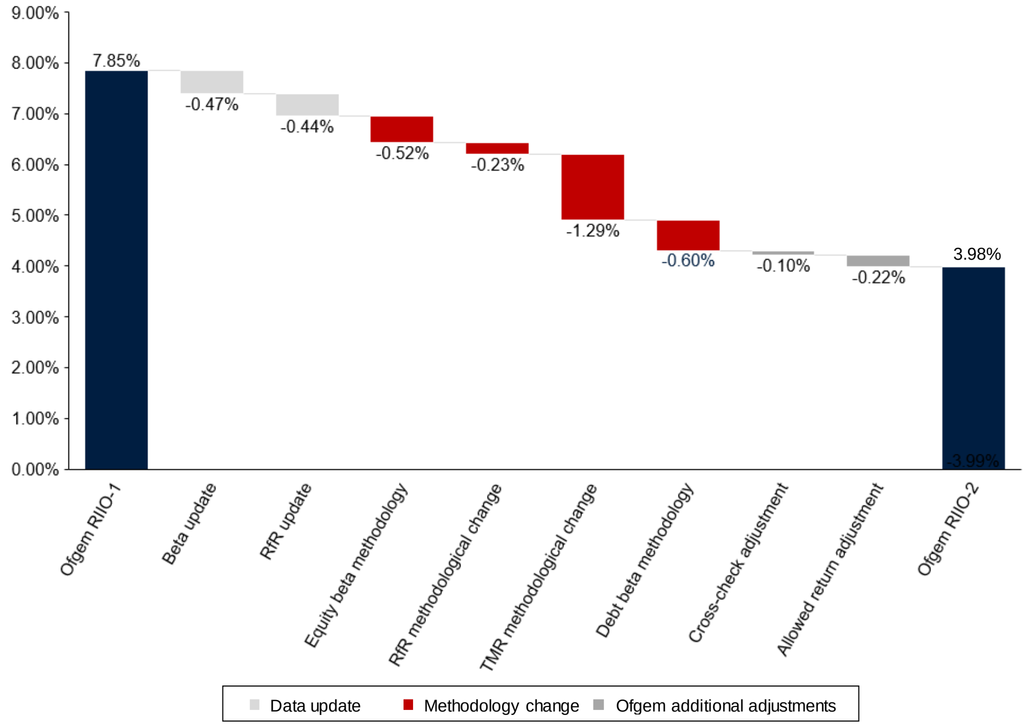


Note: All figures are presented in CPIH-real terms. The changes depicted in the chart are cumulative, as the labels indicate an incremental percentage change in cost of equity. The outperformance adjustment is 0.22–0.25%; we have assumed 0.22% in the chart.

Source: Oxera analysis.

Figure A1.2 illustrates the reconciliation bridges between the allowed cost of equity for NGET in RIIO-1[148] and Ofgem's allowed equity return in the Draft Determinations.

Figure A1.2 Cost of equity bridge between RIIO-1 and RIIO-2



Note: The Ofgem RIIO-1 CoE was adjusted to CPIH real terms using a 81bp RPI-CPIH wedge. The 3.98% figure is based on a 60% gearing and a 22bp outperformance adjustment–this equivalent to 3.95% using 25bp outperformance adjustments. The beta update is based on the two-year equity beta of NG. The risk-free rate update is based on the ten-year average of 10Y UK gilts. The equity beta methodological changed is based on the difference between NG's equity beta and the allowed equity beta. Differences are due to rounding.

Source: Oxera analysis based on Ofgem's methodology and parameters.

Ofgem's RIIO-2 allowed equity return is 387bp lower than the CPIH adjusted RIIO-1 allowance. The difference can be explained by looking at three categories of impact: market data update, methodological changes, and additional adjustments made by Ofgem. In total:

- 23% of the reduction can be attributed to the data update;
- 68% can be attributed to the methodological changes; and
- 8% can be attributed to the additional adjustments applied by Ofgem.

In sum, the majority of changes between RIIO-1 and RIIO-2 are due to methodological changes by Ofgem, and not changes in market data.

[148] Ofgem (2012), 'RIIO-T1: Final Proposals for National Grid Electricity Transmission and National Grid Gas', 17 December.

A2 Ofgem Cross-checks

This section considers Ofgem's cross-checks used to support its proposed CoE range in its Draft Determinations. We examine the following cross-checks:

- returns on winning OFTO bids (section A2.1);
- discount rates used by infrastructure funds (section A2.2);
- regulatory precedent (section A2.3);
- investor manager forecasts (section A2.4);
- market to asset ratio (MARs) (section A2.5);
- Modigliani-Miller beta re-levering (section A2.6).

A2.1 OFTO returns

As a cross-check to its cost of equity estimate, Ofgem considered the implied equity IRRs from winning OFTO bids.[149] Using the latest OFTO tender round bids, Ofgem arrived at a nominal equity IRR of 7.0% and a CPIH-real equity IRR of 4.9%.[150]

OFTO projects are operational assets with a very different risk profile compared to the onshore energy networks regulated by RIIO-2. In particular, the net cash flows are largely fixed in real terms over the duration of the OFTO tender revenue stream. As such, we consider that any comparison of asset risk is likely to significantly underestimate the cost of capital for a network that undertakes capital and replacement expenditure in addition to operational expenditure.

Furthermore, OFTOs are an asset class that have matured over the period that Ofgem has analysed, which could explain much of the reduction in the reported IRR from 10.2% in 2012 to 7.0% in 2019.

Finally, we note that we are unable to replicate this cross-check because the data has never been publicly released. However, conceptually, Ofgem assumes a terminal value of zero at the end of the expected project life. If the successful bidders assumed positive net cash flows after the end of the contracted revenue period, the implied IRR would be higher. Moreover, they also may have different tax structures and their bids may factor in expected outperformance, further underestimating the anticipated IRR. The inherent uncertainty of this data suggests that it is inappropriate for a cross-check for regulatory purposes. Therefore, we remain of the position that inferences made from OFTO bids should not be used to benchmark the CoE for onshore energy networks.

A2.2 Infrastructure fund discount rates

In March 2019, we submitted a report in which we assessed the appropriateness of using the discount rates used by the six listed infrastructure funds then identified by Ofgem as a cross-check for the cost of equity in RIIO-2. That report presented a comprehensive review of the infrastructure funds' risk and return characteristics. The conclusion of the review suggested that the funds' discount rates were not an appropriate cross-check for the CAPM cost

[149] Ofgem (2020), 'RIIO-2 Draft Determinations – Finance Annex', 09 July, paras 3.86–3.89.
[150] Ofgem (2020), 'RIIO-2 Draft Determinations – Finance Annex', 09 July, Figure 12 .

of equity range. This was mainly driven by the fact that the funds' asset composition makes them less risky than energy networks. Moreover, where funds' portfolio investments face greater revenue or volume risks than energy networks, these are generally hedged by long-term or availability-based contracts and/or government subsidies e.g. renewable obligation certificates (ROCs).

We have reviewed the portfolios of BBGI, JLIF, HCL, Gravis Capital, INPP, Greencoat, Platinum FSL, TRIG, Bluefield Solar, Next Energy, and JLEN. The results are summarised in Table A2.1.

Table A2.1 Portfolios of infrastructure funds

Company	Portfolio
BBGI	100% long-term availability-based public private partnership (PPP).
JLIF	Inactive since 25 May 2018. Before that 100% in infrastructure projects.
JLG	57.3% availability-based investment and 42.7% demand-based investments.
HICL	72% in PPP, 20% in demand based assets and 8% in regulated assets.
GCP	61% in renewable energy, 24% in PFI and 15% in social housing.
INPP	Schools, energy transmission, gas distribution, health facilities, judicial facilities, military housing, transport and waste water.
GRP	100% in operational renewable electricity generation assets within the Eurozone.
UKW	100% in operating UK wind farms.
FSFL	Equities, bonds, gold miners, properties, emerging markets, cash, absolute funds and infrastructure.
TRIG	69% in onshore wind, 19% in offshore wind, 11% in solar wind and 1% in batteries.
BSIF	100% in UK solar energy.
NESF	100% in solar photovoltaic assets.
JLEN	Wind, anaerobic digestion, solar, waste and wastewater.

Source: Oxera summary based on the funds' website.

We can observe that the asset classes and the risk of the diversified portfolios differ significantly to a 'pure-play' energy network business. Therefore, we continue to consider that the infrastructure funds' discount rates are not an appropriate benchmark for the cost of equity in RIIO-2 due to the fundamental differences in the risk profile.

In addition, we note that Ofgem's earlier use of infrastructure funds reported each fund's stated discount rate. In the new report, Ofgem uses each fund's discount rate and then deflates it using the market premium to the latest report net asset value. This 'implied IRR' was then used a cross-check to support Ofgem's CoE. The intuition provided by Ofgem is the same as for the MAR arguments (as discussed below in section A2.5). Specifically, Ofgem assumes that any premium above NAV means that the fund is overestimating its own cost of capital. As noted below in section A2.5, there are multiple explanations for a market premium that do not rely on the overestimation of cost of capital. In particular the NAV reported by each fund may take a more prudent view of future cash flows relative to market expectations. We further investigate the infrastructure funds' discount rates and whether they represent an appropriate cross-check for CoE.

Each fund uses these discount rates as its CoE measure. As they are publicly traded, each fund has an observable beta. Since we can observe each fund's CoE, beta, and RfR, we can estimate the implied TMR for each fund as a cross-check for the reasonableness of this data.

First, we note that these funds have very low or non-existent gearing in general.[151] Assuming the discount rate is equivalent to the funds' WACC/CoE, we can estimate the implied TMR using each fund's equity beta and CoE. As most of the funds report extremely low gearing, we have assumed gearing to be zero for all the funds. Consistent with our analysis, we have assumed a -1.0% real RfR and a 2.02 CPIH inflation. The results are summarised in Table A2.2.

Table A2.2 Implied TMR from funds' discount rates

	Discount rate	5-year equity beta	Implied TMR	Real TMR
JLG LN Equity	8.60%	0.56	14.12%	12.19%
HICL LN Equity	7.20%	0.33	18.77%	17.28%
INPP LN Equity	7.02%	0.33	18.51%	17.04%
GCP LN Equity	7.40%	0.34	18.72%	17.19%
BBGI LN Equity	7.07%	0.22	26.53%	25.51%
UKW LN Equity	7.50%	0.35	18.62%	17.06%
FSFL LN Equity	7.10%	0.32	18.94%	17.48%
TRIG LN Equity	7.25%	0.42	15.14%	13.45%
BSIF LN Equity	7.18%	0.20	29.54%	28.64%
NESF LN Equity	6.25%	0.34	15.51%	14.05%
JLEN LN Equity	7.40%	0.28	22.38%	21.03%

Note: Calculations are in nominal terms. TMR is deflated using a 2.02% CPIH. Gearing is assumed to be equal to zero. RfR is 1.44% in nominal terms.

Source: Oxera analysis based on the funds' annual reports and Bloomberg data.

We first note that the funds' five-year equity betas range from 0.20 to 0.56. Further, the betas do not correlate well with the stated discount rates; for example, BSIF has a beta of 0.20 and a CoE of 7.18%, whereas NESF reports a beta of 0.34 and a CoE of 6.25%. This could be because the funds have a variety of different risk exposures, including to different countries.

Next, we note an average implied real TMR of 17.30%, with high variation. This is so high as to be unreasonable. Although infrastructure funds may relay useful data in some cases, they are clearly inappropriate for a CoE cross-check for regulated UK energy firms. The implied TMR and lack of consistency between their own betas/CoE suggest that this data is unreliable for the type of

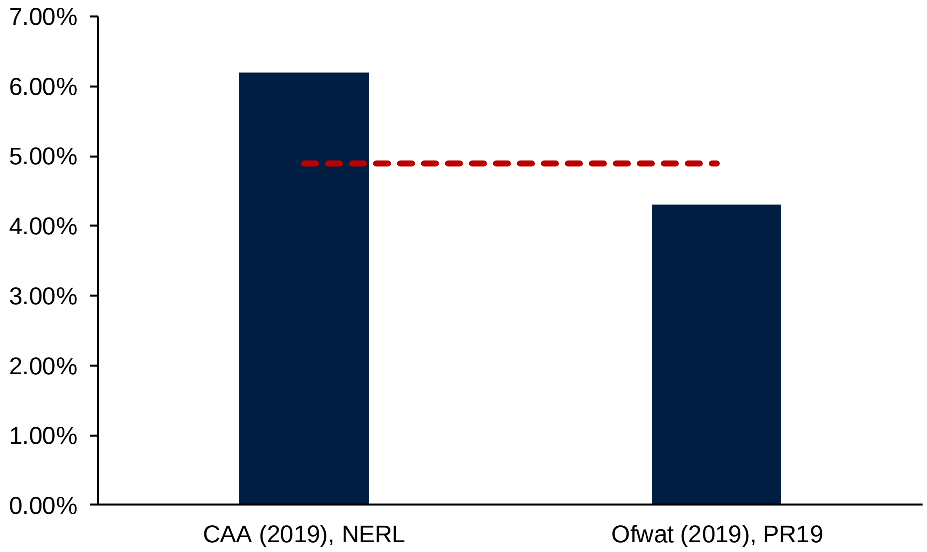
[151] Relaxing this assumption does not significantly change the analysis below.

cross-check attempted by Ofgem and that infrastructure funds' discount rates are not an appropriate benchmark for the cost of equity in RIIO-2.

A2.3 UK regulatory announcements

Figure A2.1 shows the allowed cost of equity adopted in the two regulatory announcements in the UK in the last two years that assumed gearing close to the 55% and 60% used by Ofgem in the Draft Determinations.

Figure A2.1 UK regulatory announcements for the allowed cost of equity (post-tax, CPIH real)



Note: We present CPIH real numbers to allow an easier comparison with the RIIO-2 range. We convert the RPI real precedents to CPIH real by adding our assumed wedge of 81bp.

Source: Oxera analysis based on regulatory determinations.

The Ofwat and CAA regulatory announcements were both appealed to the CMA, with the allowed equity return being a common ground of appeal across all appellants. We further note that the similarity of approach and assumptions across different regulators means that these cannot be regarded as independent data points, which undermines their value as cross-checks.

In the NATS appeal, the CMA has not taken into consideration all the responses to its provisional findings as it is considering these in more detail as part of the PR19 appeals. Hence, the CoE evidence could be revised once the merits of the points raised by the respondents are addressed.[152]

A2.4 Ofgem's investment manager cross-check

In deriving its TMR estimate, as a cross-check, Ofgem considered TMR estimates published by investment managers, as well as the rates of return prescribed by the FCA for the purposes of marketing retail financial products.[153] Ofgem used these projections in two ways—first as a cross-check on the TMR range, and second as a cross-check of the CAPM-implied cost of equity. We perform our own cross-check using updated investment manager forecasts and then examine Ofgem's analysis. First, we note:

[152] Competition and Markets Authority (2020), 'NATS (En-route) Plc/CAA Regulatory Appeal', 13 August, para. 61.
[153] Ofgem (2019), 'RIIO-2 Sector Specific Methodology Consultation – Finance,' 24 May, Table 10.

- The TMR estimates produced by investment managers have the primary purpose of providing prudent estimates of future returns to their clients, to ensure that clients are managing their finances prudently. This is mainly a function of the regulatory framework, namely the FCA Conduct of Business Sourcebook, section 13, which states the maximum rates of return that financial services companies must use in their calculations when providing retail customers with projections of future benefits:[154]

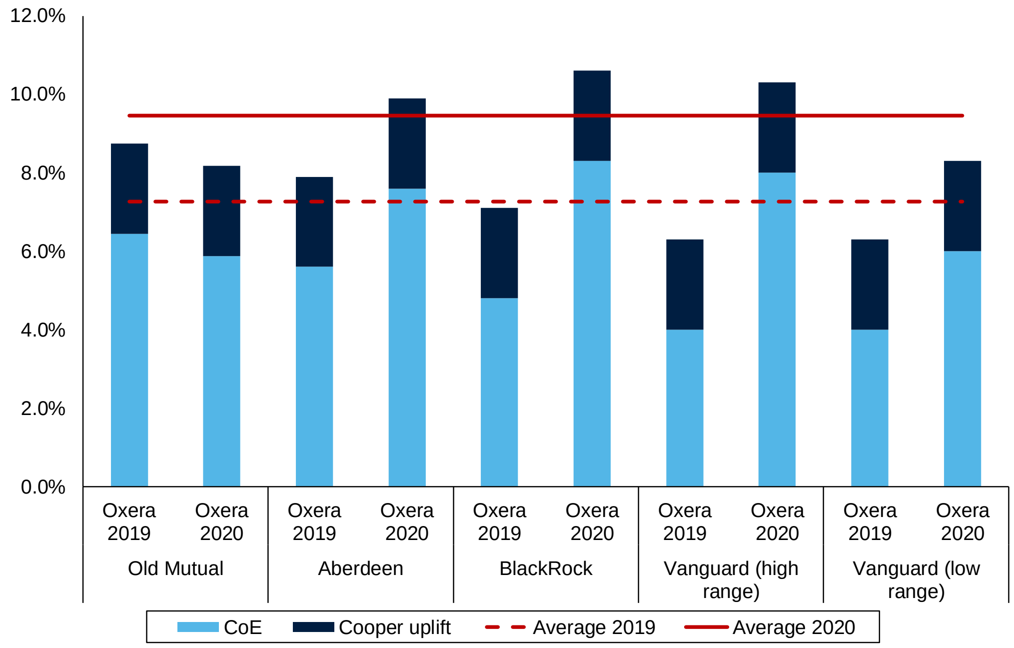
  Firms are required to use rates of return in their projections that reflect the performance of the underlying investments, but the ceilings imposed by the FCA aim to prevent consumers being misled by inappropriately high rates.

  This suggests that at best this evidence should be regarded as providing a lower bound on the expected compound rate of growth in the value of an investment in the equity market.

- If any weight is to be placed on this evidence in deriving the discount rate appropriate for setting the cost of equity allowance, an upward adjustment has to be made to correct for the downward bias arising due to geometric averaging. As explained by Cooper (1996), both the geometric and arithmetic averages are likely to be downward-biased estimators of the discount rate. Therefore, one must upwardly adjust these to generate a true market discount rate.

Figure A2.2 illustrates the change in the TMR estimates by investment managers between the time of writing the 2019 Oxera report and the present report (July 2020).

Figure A2.2 Evolution of evidence on TMR estimates by investment managers



Note: For an investment horizon between of 10-20 years, the Cooper adjustment to the geometric average is 225-240bps. In this figure, an adjustment of 230bp is used.

Source: BlackRock (2020), 'Capital Market Assumptions', May. Old Mutual (2020), 'Latest Asset Allocation Quarterly Review', June update. Aberdeen (2019), 'Long Term Investment Outlook',

[154] Financial Conduct Authority (2017), 'Rates of return for FCA prescribed projections', p. 5.

UK edition. Vanguard (2020), 'Beyond the pandemic: What to expect from shares and bonds', 3 June.

Although many investment managers under consideration have not issued an update to their forecasts, we present those that have in the chart above. As shown in Figure A2.2, the average projections increased from 7.3% to 9.5% nominal. Adjusting for inflation would result in a real discount rate consistent with our estimate for TMR. We note that the recent increase in these estimates are likely due to short-term market volatility. Consistent with the theme in our report, we focus on longer-term averages for this reason.

Ofgem's Draft Determinations also use investment manager reports to cross-check its TMR range, although some of their data and reports are older than ours. Oxera has conducted a review of each investment manager's report used in Ofgem's cross-check. Ofgem itself notes that many of the reports they use from the same investment manager are not comparable between the two periods. We agree, and further, these changes in the timing and/or market index appear to explain the perceived decline in TMR claimed by Ofgem's cross-check. We also note that Ofgem appears to double-weight this evidence, using it first to calculate the TMR and then as a cross-check.

First, we observe that nearly the entirety of the decline in Ofgem's estimated TMR is due to a change in the investment horizon for Schroders.[155] If the original horizon had been used for comparison, Ofgem would have reported a TMR of 7.90% rather than 4.90%.[156, 157] In addition to changing the investment horizon from 30 years to 10 years, Schroders also calculates its UK estimate using US data.[158] We understand that Ofgem has changed the investment horizon to match its other data points. However, we again note that this new value is an extreme outlier which is also based on a projection from US data. Given the obvious data outlier and the fact that this is not a direct UK estimate, we consider that this data point should be disregarded.

Secondly, the other data point that exhibited a strongly negative change is Blackrock's estimate. As noted by Ofgem, this is not a like-for-like comparison as Ofgem changes from an EU TMR in December 2018 to a UK TMR in December 2019. We were unable to find the December 2019 report, but Blackrock's current analysis suggests that it projects lower returns due to expected declines in corporate earnings and dividend yields, not because market risk has decreased.[159]

Both of these changes in data points selected by Ofgem have the effect of lowering the allowed CoE. In contrast, our evidence in Figure A2.2 shows investment manager forecasts moving in both directions. We note that without these two data points, the TMR estimated by investment manager reports remains unchanged, or even slightly higher. In light of the shortcomings of

[155] RIIO-2 Draft Determinations – Finance Annex, Table 23.
[156] Schroder (2019), '30-year return forecasts (2019–48)', January, https://www.schroders.com/en/sysglobalassets/digital/insights/2019/pdfs/2019_jan_long-run-return-forecasts-2019-2048-final.pdf.
[157] Schroder (2019), '30-year return forecasts (2019–48)', January, https://www.schroders.com/en/sysglobalassets/digital/insights/2019/pdfs/2019_jan_long-run-return-forecasts-2019-2048-final.pdf.
[158] The forecasts of Schroder are achieved by estimating the returns to all other countries/regions based off the US estimates. Specifically, they take the current US ERP estimate (relative to US bonds) and multiply it by the country/region's historical ERP beta to US ERP. The beta-adjusted country/region ERP estimate is then added to its nominal bond return estimate to come up with the equity return forecast.
[159] BlackRock (2020), 'Capital market assumptions: asset return expectations and uncertainty', https://www.blackrock.com/institutions/en-gb/insights/charts/capital-market-assumptions, accessed 27 August 2020.

using these estimates to inform cost of capital calculations, we cannot recommend placing any weight on this evidence.

A2.5 Market to asset ratio (MARs)

Ofgem contends that market equity valuations of three listed water companies (SVT, UU, PNN) support Ofwat's allowed equity return for PR19. In particular, Ofgem relies on analysis from CEPA that indicates premia of about 20% to 40% at three spot dates, thereby suggesting that the allowed return on equity (i.e. 4.19% in CPIH-real terms) is more generous than market expectations.[160] Ofgem also presents some stylised modelling of the MAR-implied cost of equity under different levels of expected regulatory outperformance, and a time-series analysis of observed MARs since 2007. Together, Ofgem finds the evidence from MARs to be a 'persuasive' cross-check for the CAPM-derived cost of equity.[161]

In our May 2020 submission to the CMA as part of the water PR19 appeals, we concluded that uncertainty over the sources of value premia, and their respective valuations, makes it impossible in this case to infer the cost of equity with a meaningful confidence level to make such inference reliable and robust for regulatory purposes. We also presented analysis of SVT and UU showing that equity premia can be explained without any recourse to an assumption that the market cost of equity is lower than Ofwat's allowed return.[162] Our analysis used the average share prices from January to April 2020 and a range of analyst forecasts of expected outperformance over AMP7.

Based on Oxera's research, there are five key issues with Ofgem/CEPA's analysis of MARs.

Issue 1: Observed premia can be explained without recourse to an assumption that the market cost of equity is lower than Ofwat's allowed return

Figure A2.3 and Figure A2.4 below show the results of the decomposition of the premium to regulated equity for Severn Trent and United Utilities respectively.

Our analysis indicates that expected outperformance can explain the RCV premium for Severn Trent and United Utilities. The values of the non-regulated businesses, revenue adjustments due to PR14 reconciliations, accrued dividends and expected takeover premium also contribute to the RCV premium.

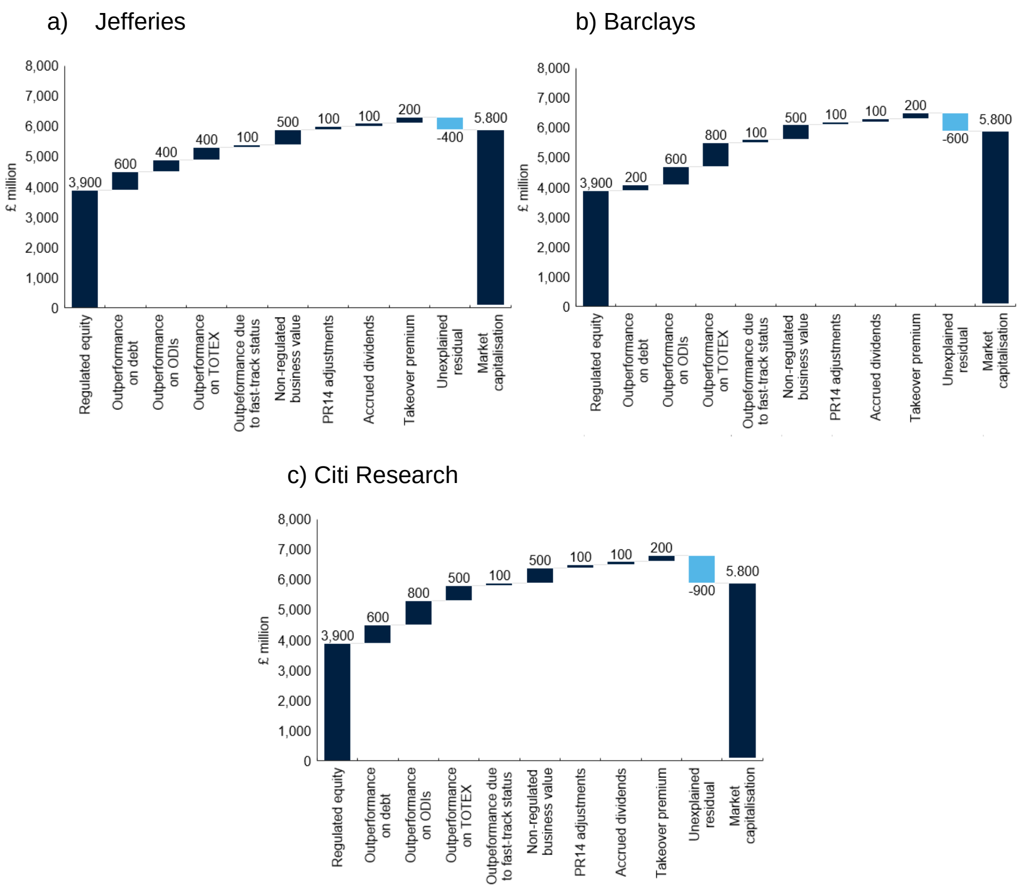
As explained in our May 2020 report, the unexplained residual may be due to pension adjustments, other provisions and market sentiment, among other factors. Negative values for the residual mean that the market value is lower than can be explained by expected outperformance, and would be consistent with investors discounting future cash flows using a higher cost of equity than the base equity return allowed in the PR19 Final Determinations.

It is important to note that just because Severn Trent and United Utilities are expected to outperform, this does not mean that the whole sector is systematically expected to outperform. In fact, Moody's has recently

[160] Ofwat (2019), 'PR19 final determinations, Allowed return on capital technical appendix', December, p. 5.
[161] Ofgem (2020), 'RIIO-2 Draft Determinations – Finance Annex', 9 July, para. 3.103, p. 66.
[162] Oxera (2020), 'What explains the equity market valuations of listed water companies?' 20 May.

downgraded many of the water companies, leaving the sector on negative watch.[163]

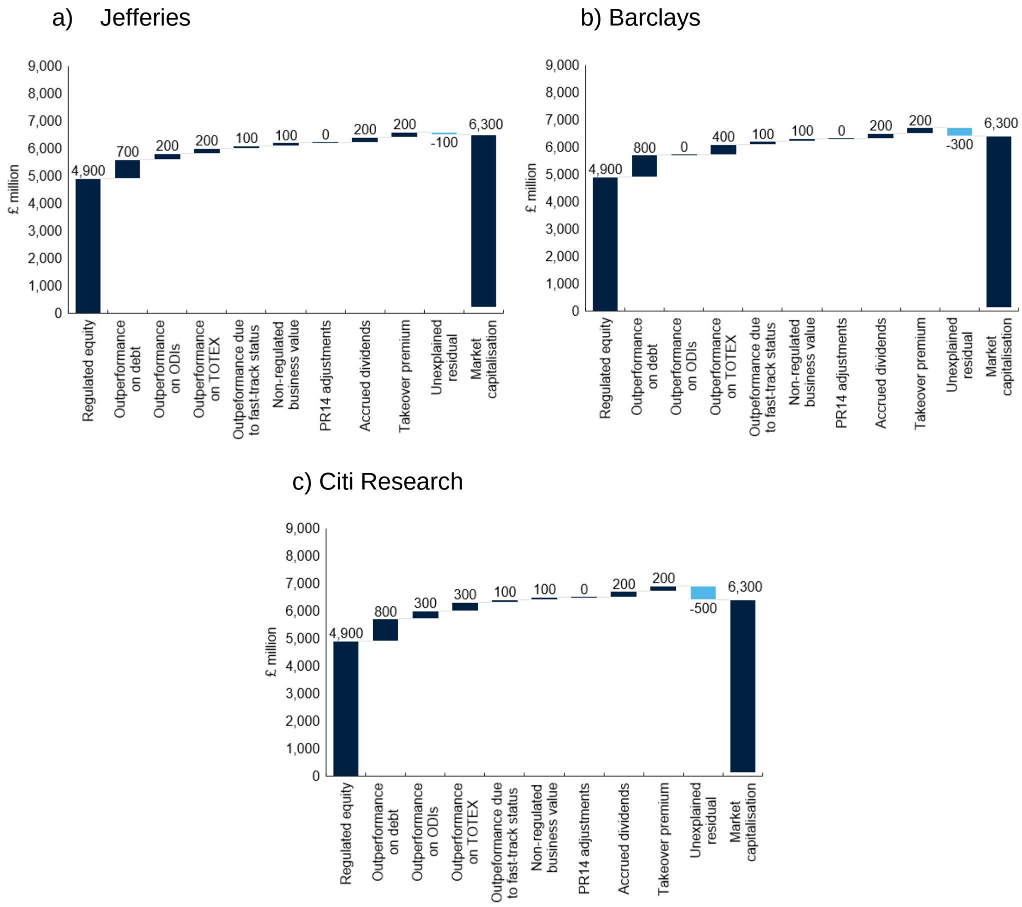
Figure A2.3 Decomposition of equity premia for SVT



Source: Oxera analysis.

[163] Moody's (2020), 'Regulated Water Utilities – UK: Outlook remains negative as price review leads to unprecedented number of appeals', 30 April.

Figure A2.4 Decomposition of equity premia for UU



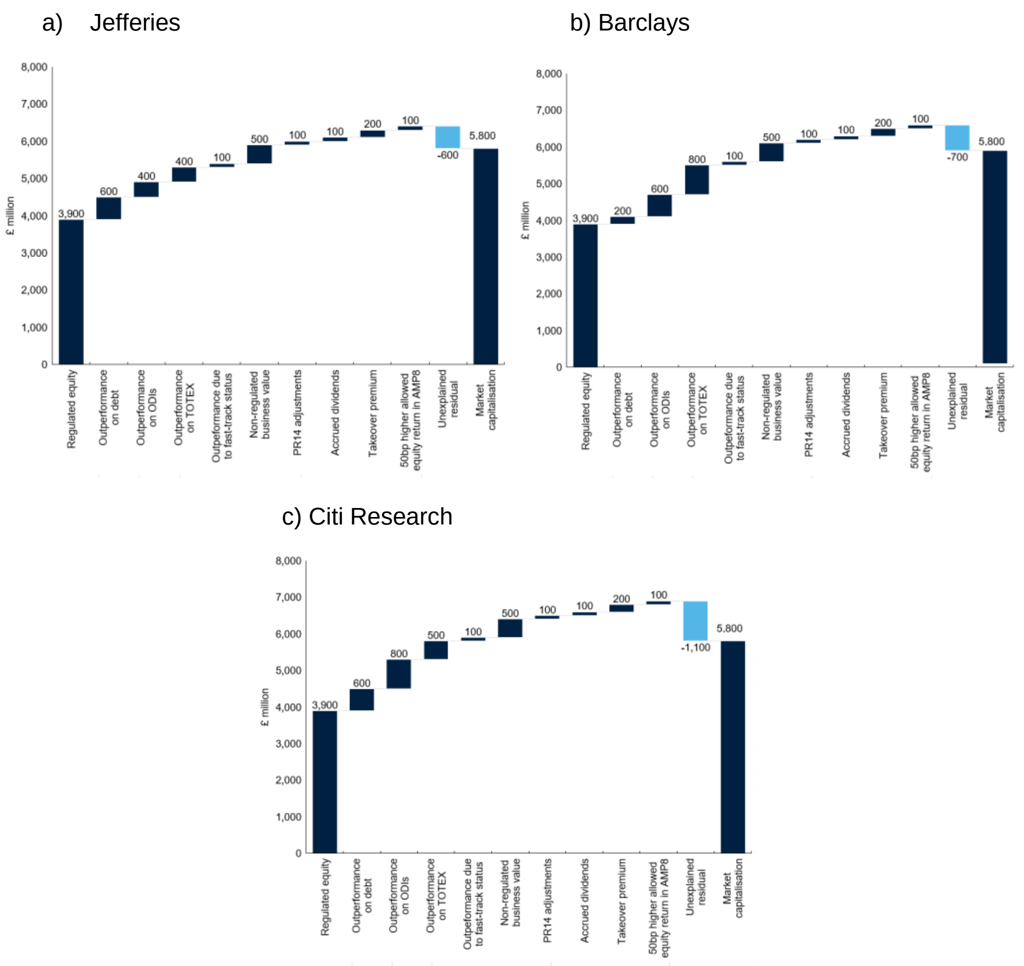
Source: Oxera analysis.

Issue 2: Market expectations of higher returns after AMP7 can help explain the premia we currently observe

Ofwat's allowed equity return for AMP7 (i.e. 4.19% in CPIH-real terms) is much lower than company proposals of 5.7% to 7.3% and 4.7% to 6.4%.[164] It is thus not inconceivable that investors rationally expect a somewhat higher allowed return in future price control periods. For example, we assume in Figure A2.5 that Ofwat's allowed equity return increases by 50bp to 4.69% (CPIH-real) after AMP7. We again find that this helps explain the observed premia for SVT and UU and further increases the negative residual in the decomposition.

[164] Ofwat (2019), 'PR19 final determinations, allowed return on capital technical appendix', December, p. 18.

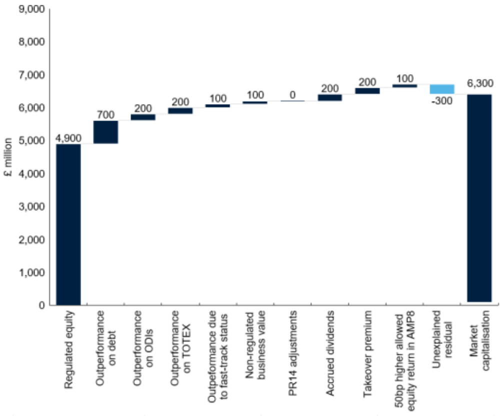
Figure A2.5 Decomposition of equity premia for SVT



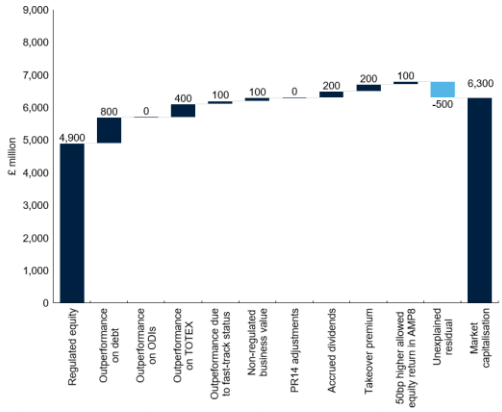
Source: Oxera analysis.

Figure A2.6 Decomposition of equity premia for UU

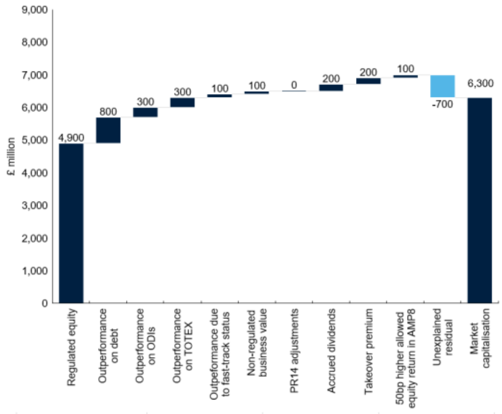
a) Jefferies



b) Barclays



c) Citi Research



Source: Oxera analysis.

Issue 3: CEPA estimate premia for two energy companies (National Grid and SSE) that are not 'pure-play'

CEPA observe positive premia for three water companies (SVT, UU, and PNN) and two energy companies (NG and SSE). However, CEPA notes that neither National Grid or SSE are 'pure-play' due to their material business activities outside their UK regulated energy networks.[165] This leads to what CEPA calls the 'decomposition problem'—the bias introduced to the observed premia due to the difficulties in accurately estimating the value of business activities outside their UK regulated energy networks. A bias in the observed premia could potentially lead to the incorrect inferences being drawn from CEPA's analysis. [166]

We disagree with CEPA that NG and SSE should be included in the analysis. This is because neither firm is 'pure-play', which further compounds the already high level of uncertainty in the MAR analysis. We further note that CEPA's analysis of PNN was undertaken before the disposal of Viridor was finalised, thus it is not clear if the disposal is fully captured in its market equity valuation. The remaining companies are SVT and UU. We show in Issue 1 and Issue 2 above that their observed premia can be explained without recourse to

[165] CEPA (2020), 'RIIO-2: Use of Market Evidence', 9 July, p. 14.
[166] Ibid, p. 14.

an assumption that the market cost of equity is lower than Ofwat's allowed return.

Issue 4: CEPA's time-series analysis of premia suffers from estimation issues

CEPA provide a time-series analysis of RCV premia for SVT, UU and PNN from 2007 until present. It shows an average RCV premium for SVT and UU of 10–15% and 1% for PNN over the period. However, a time-series type of analysis is not suitable for RCV premia as the frequency of the data used in the numerator and denominator is not consistent. Share prices in the numerator are updated regularly and can be easily observed on a day-to-day basis. Instead, the denominator is the RAB, which is updated annually.[167] The mismatch in the frequency of the numerator and denominator introduces estimation error to time-series observations of RCV premia.

It is not clear how to explain the negative RCV premia observed for PNN over multiple periods lasting several years. Estimation error inherent in this time-series analysis; the value of PNN's non-regulated business; and lower market expectations on future outperformance are potential explanations. Nonetheless, it is inconsistent to draw conclusions about the adequacy of Ofwat's allowed returns based solely on the positive RCV premia observed for SVT and UU over time and not give weight to PNN.

Issue 5: Ofgem/CEPA's stylised analysis disregards drivers of RCV premia other than outperformance and allowed returns

Ofgem/CEPA assume that observed premia are driven by two factors: outperformance and a market cost of equity that differs from Ofwat's allowed return. This analysis ignores several other drivers of listed RCV premia, including (but not limited to) the values of the non-regulated businesses, revenue adjustments due to PR14 reconciliations, investor expectations of future dividends, and expected takeover premium.[168] Ofgem/CEPA cite the UKRN study to support their rationale. However, the UKRN study looked at transaction premia of private companies who by definition do not have share prices that reflect daily market sentiments. The UKRN study argues that 'pure-play utilities are generally not subject to the issues of control premium and winners curse, though there remains the challenge of understanding the unobserved investor assumptions'.[169] Ofgem/CEPA have not given weight to the unobserved investor assumptions in their stylised analysis, which in the case of listed companies may well include some of the factors modelled in the Oxera analysis. Ofgem has also previously taken a more cautious position about drawing inferences from observed premia of listed companies:[170]

> We do exercise some caution when considering market-to-asset ratios. Firstly, there may be limited information in listed share prices as these stocks could, particularly in the short-run, be influenced heavily by wider market "noise"'. Second, as noted in the UKRN Study by Burns, any premium on corporate transactions could, at least in part, reflect (i) a control premium; or (ii) a winner's curse.

[167] The regulated asset base (RAB) is referred to as the RCV in the water sector and RAV in the energy sector. These are the same concepts and may be referred to interchangeably.
[168] Oxera (2020), 'What explains the equity market valuations of listed water companies?', 20 May.
[169] UKRN (2018), 'Estimating the cost of capital for implementation of price controls by UK Regulators', 6 March, p. 13.
[170] Ofgem (2012), 'RIIO-2 Sector Specific Methodology Annex: Finance', 18 December, p. 44, para. 3.127.

The inclusion of additional drivers of RCV premia, as in the Oxera analysis (see Figures A2.4-A2.6), can explain observed premia without requiring the assumption that the market cost of equity is lower than Ofwat's allowed return.

Conclusion

In light of the uncertainty in apportioning components of equity market valuations to individual elements of the regulated settlement, there is no reason to depart from the position as stated in previous CMA assessments and the UKRN cost of capital study—evidence from traded market premia does not provide a reliable guide in practice to the cost of equity used by investors in regulated utilities.

A2.6 Beta re-gearing and Modigliani–Miller cross-checks

In the Draft Determinations, Ofgem investigated the CoE implied from the Modigliani and Miller model as part of the cross-checks to the CoE. Ofgem follows a two-step procedure to cross-check the CoE estimated at the notional gearing value:

1. Ofgem estimates the WACC of UK utilities using observed gearing and 1.74% Cost of Debt.
2. It then uses the estimated WACC values to derive the cost of equity assuming a notional gearing level (60%).

The results of Ofgem analysis are presented in Table A2.3. Ofgem concludes that for companies with a gearing level close to 60%, UU and PNN, the CoE is similar to the observed CoE. Ofgem uses this analysis as part of the justification for reducing the CoE by 10bp in step 2 of the CoE calculation.

Table A2.3 CoE estimations based on a flat WACC

	SSE	NG	PNN	SVT	UU
Observed gearing					
5Y	6.26%	3.55%	3.23%	3.23%	3.39%
10Y	4.82%	3.23%	2.99%	3.07%	3.07%
Notional gearing (60%)					
5Y	9.00%	4.10%	3.80%	3.30%	3.50%
10Y	6.90%	3.70%	3.50%	3.20%	3.20%
Difference					
5Y	2.74%	0.55%	0.57%	0.07%	0.11%
10Y	2.08%	0.47%	0.51%	0.13%	0.13%

Source: Oxera representation of Ofgem (2020), 'RIIO-2 Draft Determinations – Finance Annex', 09 July, Table 20 and 21.

In the provisional findings for the NATS/CAA regulatory appeal, the CMA states that it has 'some concerns with the consequences of the standard regulatory approach to 're-gearing''. In particular, the CMA is concerned that:[171]

> […] the cost of capital increases by around 0.5% as a result of the assumed higher gearing of NERL (60%) relative to gearing assumption based on the gearing of comparators (30%), which is not consistent with either finance theory or with our [CMA's] understanding of how actual financing models work.

[171] Competition and Markets Authority (2020), 'Provisional Findings Report', Appendix D, para. 4.

In light of this concern, we investigate the implied CoE from the Modigliani–Miller model.

First, Ofgem assumes a 1.74% CoD for the estimation of the observed WACC. We note Ofgem's stated preference for forward-looking rates.[172] However, the 1.74% figure incorrectly uses a historical average, and not the forward-looking CoD that is assumed by Modigliani and Miller. Hence, a more appropriate figure would be the spot iBoxx AAA/B or the utilities 10+, c. 1.89% nominal and -0.13% real–assuming a 2.02% CPIH.

Second, as shown in a recent report by Oxera,[173] the violation of the MM model cited by the CMA is considerably mitigated if the risk-free rate is set at more plausible levels than the underestimates assumed in recent regulatory decisions. Specifically, we show that all else equal, the further the risk-free rate is below plausible levels, the more the WACC exhibits instability with reference to the level of gearing.

Further, Ofgem assumes a debt beta of 0.125, which helps to counteract the other errors–i.e. the overstated debt beta makes the WACC-gearing relationship flatter. As presented in section 3.2.2, this number is too high, and CEPA's corrected estimate corresponds to our upper bound of a debt beta for regulated networks of 0.05.

Table A2.4 presents our replication of Ofgem's analysis, where the MM theorem is violated and the 're-geared' estimations yield a higher WACC. The difference in WACC is considerably greater than zero, which implies a violation of the MM theorem.

Table A2.4 Violation of the MM theorem by Ofgem

	SSE	NG	PNN	SVT	UU
Observed gearing					
Equity β (5Y)	0.97	0.63	0.59	0.59	0.61
Equity β (10Y)	0.79	0.59	0.56	0.57	0.57
WACC (5Y)	4.63%	2.69%	2.57%	2.37%	2.43%
WACC (10Y)	3.80%	2.51%	2.45%	2.32%	2.31%
Notional gearing (60%)					
Equity β (5Y)*	1.48	0.79	0.78	0.62	0.63
Equity β (10Y)*	1.24	0.73	0.74	0.61	0.60
WACC (5Y)	5.16%	2.98%	2.92%	2.44%	2.47%
WACC (10Y)	4.40%	2.77%	2.82%	2.41%	2.37%
Difference WACC					
5Y	0.53%	0.29%	0.35%	0.07%	0.04%
10Y	0.60%	0.27%	0.38%	0.09%	0.07%

Note:*Assuming a 0.125 debt beta.

Source: Oxera analysis based on Ofgem data.

The next tables present the results correcting for the CoD and the RfR parameters.

[172] Draft Annex, i.e., p. 70, 87.
[173] Oxera (2020), 'Are sovereign yields the risk-free rate for the CAPM?', prepared for the Energy Networks Association, 20 May.

First, correcting the cost of debt on Ofgem's estimations would result in a reduction of the WACC difference to c. 0.05% for National Grid. Table A2.5 summarises the results when spot CoD of -0.13% is assumed.

Table A2.5 Correcting the CoD

	SSE	NG	PNN	SVT	UU
Observed gearing					
Equity β (5Y)	0.97	0.63	0.59	0.59	0.61
Equity β (10Y)	0.79	0.59	0.56	0.57	0.57
WACC (5Y)	3.96%	1.82%	1.75%	1.32%	1.35%
WACC (10Y)	3.19%	1.62%	1.65%	1.28%	1.25%
Notional gearing (60%)					
Equity β (5Y)*	1.48	0.79	0.78	0.62	0.63
Equity β (10Y)*	1.24	0.73	0.74	0.61	0.60
WACC (5Y)	4.05%	1.87%	1.81%	1.33%	1.36%
WACC (10Y)	3.29%	1.66%	1.71%	1.29%	1.26%
Difference WACC					
5Y	0.09%	0.05%	0.06%	0.01%	0.01%
10Y	0.10%	0.04%	0.06%	0.01%	0.01%

Note: * Assuming a 0.125 debt beta.

Source: Oxera analysis based on Ofgem data.

Second, correcting for the appropriate RfR would result in a further WACC difference reduction across the companies in the sample. Table A2.6 summarises the results when a -1.00% RfR is assumed.

Table A2.6 Correcting the RfR

	SSE	NG	PNN	SVT	UU
Observed gearing					
Equity β (5Y)	0.97	0.63	0.59	0.59	0.61
Equity β (10Y)	0.79	0.59	0.56	0.57	0.57
WACC (5Y)	3.98%	1.99%	1.95%	1.47%	1.49%
WACC (10Y)	3.31%	1.81%	1.87%	1.45%	1.41%
Notional gearing (60%)					
Equity β (5Y)*	1.52	0.82	0.81	0.63	0.64
Equity β (10Y)*	1.29	0.75	0.78	0.62	0.61
WACC (5Y)	3.95%	1.91%	1.85%	1.40%	1.48%
WACC (10Y)	3.24%	1.71%	1.76%	1.37%	1.40%
Difference WACC					
5Y	-0.02%	-0.01%	-0.01%	0.00%	-0.01%
10Y	-0.02%	-0.01%	-0.01%	0.00%	-0.01%

Source: Oxera analysis based on Ofgem data.

We observe that with the correct specifications the WACC is not very sensitive to gearing, while the equity betas have increased. This is consistent with the MM theorem that higher levels of gearing are translated into higher CoE but stable WACC.

Although the MM cross-check is an important component of Ofgem's analysis, their analysis is based on incorrect inputs. The RfR rate and CoD assumed by Ofgem violate the mechanical relationship between the CoE and gearing. Given these fundamental problems, we consider that Ofgem's MM cross-checks cannot support the CoE proposed in its Draft Determinations.

A2.7 Conclusion

Based on our analysis of Ofgem's cross-checks, we conclude that they cannot be used as robust cross-checks of the CoE. Specifically, infrastructure funds and OFTO bids have different risk profiles than those of UK energy firms. The investment manager evidence appears to support a TMR more in line with Oxera once obvious outliers are discarded. We also document that observed MARs can be explained without appealing to investors being overcompensated for risk and that evidence from traded market premia does not provide a reliable guide in practice to the cost of equity used by investors in regulated utilities. Finally, when examining Ofgem's MM cross-check, we note that correcting for input errors leads to a WACC that is not very sensitive to changes in gearing.

Above all, none of these cross-checks is directly comparable with Ofgem's CAPM analysis. In contrast, the comparison we have undertaken between the allowed return on assets and the pricing of risk within the debt market is a test of internal consistency between different elements of the capital structure for the same company. A cross-check that is directly comparable to the cost of equity for companies regulated under RIIO-2 should be given more weight.