NERA
ECONOMIC CONSULTING

Cost of Capital for SPT in RIIO-T2

Report for Scottish Power Transmission plc
[REDACTED]

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Executive Summary

SP Transmission (SPT) commissioned NERA Economic Consulting (NERA) to estimate the cost of equity, and consider the optimal design for the cost of debt indexation mechanism, for the forthcoming electricity transmission price control (RIIO-2).

This is a redacted report to comply with conditions on the publication of data. Redactions are indicated by [✂].

Cost of Equity

We set out our estimate of the cost of equity for SPT in RIIO-2, as well as respond to Ofgem's RIIO-2 consultations and decisions. Overall, we estimate a cost of equity of 6.03 to 7.56 per cent (real CPIH), higher than Ofgem's CAPM-range of 3.87 to 5.63 per cent (real CPIH). If taking into account the latest available data for the RFR (i.e. October 2019), we estimate a slightly lower cost of equity of 5.97 to 7.55 per cent. This is an update of our earlier report for SPT on the cost of equity at RIIO-T2.[1]

We summarise the derivation of individual cost of equity parameters below.

We estimate a TMR of 6.9 to 7.8 per cent (real, CPIH), drawing on long-run historical data

We estimate the TMR based on long-run realised market returns for UK from the 2019 Dimson, Marsh and Staunton (DMS) database, which provides long time series data on returns going back to 1900 and is the standard reference point for UK regulators and the CMA.

As a first step, we estimate updated historical returns for the UK market in RPI-real deflated terms, as RPI is the only available and reliable measure of UK historical inflation going back to 1900. We estimate historical RPI-deflated TMR using established estimators which provide an unbiased measure of expected returns for different investment horizons, developed by Blume and JKM. We use two alternative sources of historical RPI inflation: i) DMS/ONS RPI data and ii) Bank of England Millennium RPI data.

Table 1: Long-run TMR estimates (real, RPI deflated)

RPI index based on DMS (up to 1949) and ONS (1950 onwards) data

	Simple	Overlapping	Blume	JKM
1Y Holding	7.0	7.0	7.0	7.0
2Y Holding	7.3	6.9	6.9	6.9
5Y Holding	6.5	6.8	6.9	6.8
10Y Holding	7.1	6.7	6.8	6.6
20Y Holding	7.4	6.7	6.7	6.1

Source: NERA calculations using DMS (February 2019), Credit Suisse Global Investment Returns Yearbook 2019 (DMS data since 1949 converted to real RPI-deflated figures using ONS data).

[1] NERA (April 2019), Cost of Equity for SPT in RIIO-2.

RPI index based on Bank of England Millennium dataset

	Simple	Overlapping	Blume	JKM
1Y Holding	6.6	6.6	6.6	6.6
2Y Holding	6.9	6.6	6.6	6.6
5Y Holding	6.2	6.5	6.5	6.4
10Y Holding	6.8	6.4	6.5	6.2
20Y Holding	7.0	6.4	6.3	5.8

Source: NERA calculations using DMS (February 2019), Credit Suisse Global Investment Returns Yearbook 2019 (DMS nominal data converted to real RPI-deflated figures using BoE RPI Millennium data).

Assuming holding periods of up to 5 years, in line with evidence on typical investor holding periods, we estimate a historical real TMR (RPI deflated) of 6.4 to 7 per cent.[2]

As a second step, we convert the historical RPI-deflated returns to a CPI equivalent using the historical RPI-CPI wedge of 45 to 71 bps, measured over the period where historical CPI data (actual or back-casted) are available. This supports a real CPI-deflated TMR of between 6.9 and 7.8 per cent. This approach addresses the concern around structural changes to RPI in 2010, which is corrected for by adjusting the historical real RPI returns to a CPI equivalent, which is unaffected by the 2010 ONS change in methodology for calculating RPI.

We continue to have concerns with Ofgem's reliance on the UKRN report estimates of real CPI returns and on CEPA's DGM

In its May 2019 Sector Specific Decision, Ofgem confirmed its TMR estimate of 6.25 to 6.75 per cent (real, CPIH), drawing principally on the estimate of the TMR presented in the 2018 UKRN report of 6 to 7 per cent (real, CPIH).

As explained in our April 2019 report for SPT, the UKRN's TMR estimate is understated in real CPI terms for two reasons. First, the UKRN report deflates historical nominal equity returns using an inflation series which combines historical RPI and CPI inflation for different periods. This hybrid RPI/CPI index overstates historical CPI inflation, given that RPI has historically been higher than CPI, and understates historical CPI-deflated returns as a result. Second, the UKRN report applies an excessive 1 per cent downward adjustment to historical simple arithmetic returns for alleged predictability of returns at long horizons. Evidence on returns predictability is highly contentious and the 2018 UKRN report approach ignores more established methods developed by Blume and JKM for estimating unbiased estimators of the TMR for long investment horizons and which were also used by the CMA at recent reviews. These methods support a relatively more modest adjustment to simple arithmetic averages of at most 40 bps for the UKRN preferred 10-year investment horizon.[3]

Correcting for the above issues, we estimate a real CPIH TMR of 6.9 to 7.8 per cent, higher than Ofgem's assumed range of 6.25 to 6.75 (real, CPIH).

[2] We do not place weight on the simple average method, as the number of observations is relatively limited for holding periods of 2 to 5 years and the estimates are not stable over time as a result.

[3] Or stated differently, the UKRN 1 per cent uplift to geometric returns is understated relative to established estimators from Blume and JKM.

In our April 2019 report for SPT, we also explained our concerns with Ofgem's reliance on CEPA's DGM estimate of the TMR for the UK FTSE, due to CEPA understating dividend growth by relying on UK GDP forecasts as a basis of short and long-run dividend forecasts. We explained that CEPA's dividend forecasts are understated, given FTSE companies derive more than 70 per cent of their earnings from outside of the UK and hence the long-run assumption should reflect a global not UK GDP growth, while short-run analyst forecast of dividend growth also support higher values than UK (or global) GDP growth. We also presented estimates of the DGM from the Bank of England, which rely on analyst forecasts of dividend growth in the short-run and global GDP growth forecasts in the long-run, and which support TMR estimates which are higher than historical realised returns estimate.

We therefore conclude that forward-looking evidence shows that the historical returns data is conservative, but we recommend that this evidence is only used as a cross-check, due to the uncertainty around dividend forecasts.

We estimate an RFR of -0.21 (real CPIH), drawing on nominal 20-year gilts deflated with OBR CPI inflation forecasts

We estimate the RFR based on short-run data, in line with Ofgem's proposal to index the RFR parameter during the RIIO-2 period. We forecast an average RFR of -0.21 (real, CPIH) over the RIIO-2 period, for comparability with Ofgem's (forecast) estimate. Our forecast RFR is calculated based on current evidence on yields on 20-year nominal government bonds, increased by the expected increase in yields implied from forward rates on UK gilts and deflated into real (CPIH) terms using long-term forecast of CPI inflation from the OBR.

Ofgem estimates a mid-point notional equity beta range of 0.75, at 60 per cent gearing

In its sector decision, Ofgem draws on OLS statistical techniques, estimation timeframes of 5 to 17.5 year periods and high frequency daily data to estimate beta. It also proposes a debt beta range of 0.1 to 0.15. It adjusts observed gearing levels for evidence on MAR and, additionally, proposes to adjust book values of debt for a market-to-book value of 1.03 to 1.06. Based on such an approach, it estimates a mid-point notional equity beta range of 0.75.

We have a number of concerns with Ofgem's beta estimation in its SSMD

Primary among our concerns with Ofgem's approach, is its continued use of very long-term time horizons to estimate beta risk. As we have demonstrated in earlier reports, very long-term time horizons cannot be relied upon because of the change in the activities of the comparator networks, change in regulatory risk, as well as the change to the market portfolio.

We also disagree with Ofgem's continued use of an EV/RAV (or MAR) adjustment to the comparators' gearing, which has the effect of over-stating gearing and understating asset betas. This is conceptually incorrect, and appears to be a mis-conception of Indepen, Ofgem's advisers, proposed adjustment. Indepen apply a MAR adjustment to notional gearing in re-levering betas, not in de-levering' comparators' gearing. Ofgem has not addressed our concerns about the lack of any conceptual justification in its sector decision.

In the SSMD, Ofgem introduced a new adjustment to observed gearing: to apply a market value to book value factor (MVF) of debt of 1.03 to 1.06. We do not believe this adjustment is conceptually correct in the context of a regulated network where, unlike competitive

markets, the regulator allows for the recovery of embedded debt costs, albeit on a notional basis.

In its SSMD, Ofgem has adopted the use of a debt beta of 0.1 to 0.15. In our earlier report, we used a debt beta of zero in line with regulatory decisions for water and energy, but we also noted that the debt beta assumption has a negligible impact on the overall cost of equity if implemented correctly, as per CMA's conclusion. In this updated report, we adopt a value of 0.05 based on our review of the most recent market evidence.

Empirical asset betas have increased since RIIO-1 price control decision

The evolution of asset betas for listed UK networks comparators – National Grid, SSE, UU, Severn Trent and Pennon – shows that asset betas for the UK networks comparators have increased markedly since the height of the financial crisis in Europe (2011-2012) and the RIIO-T1 determination in 2013, although they have declined again as we approach the re-setting of the price control.

[✂]

We consider NG is the most natural comparator for SPT, for measuring beta risk

As we have previously shown and summarised in this report, energy networks face greater risks than water networks, because of the relative complexity of the investment programme, as acknowledged by Ofgem at previous reviews, competition risks from Ofgem's competition proxy (CPM) and special purpose vehicle (SPV) models, and uncertainty over the future role of TOs due to embedded generation. These factors suggest that NG provides the most natural comparator for SPT beta. SSE may also provide a useful comparator, although we acknowledge that its asset beta has been high and volatile over recent years, in part because of the impact of Brexit.

We do not focus on the most recent averaging periods, as these are unduly affected by political and regulatory events

[✂] we have estimated beta for NG (and other comparators) drawing on the estimation periods (2 and 5 year) and averaging periods (spot, 1, 2 and 5 years) employed by the CMA at BW 2015.

In interpreting the data for SPT, we do not focus on very short-term estimates, i.e. those estimates that are based on spot or an averaging period over the last year, as we show that increased political risk has depressed asset betas over the most recent time periods.

[✂]

The political risk surrounding networks will eventually be resolved, and the new price control will come into effect in April 2021. Therefore, we should not place undue emphasis on these transitory factors. [✂]

We also show that NG's plc composite asset beta is likely to understate beta risk, because it reflects lower risk US network operations.

[✂]

European comparator evidence supports an asset beta of 0.42 on average

We consider that European comparators provide a reasonable benchmark for a UK regulated network, provided we understand the relative risks faced by these comparators. Other UK regulators also draw on international comparators, notably CAA in its assessment of airport risk and for NERL.

[✂]

In conclusion, we propose an asset beta range of 0.38 to 0.42.

We propose an asset beta range of 0.38 to 0.42 where the lower case is informed by NG's asset beta for our preferred two-year and five-year estimation windows.

[✂]

We consider that SPT's beta should be at least as high as NG plc's beta, given that NG plc's beta is likely to understate UK energy network risk, as our decomposition analysis shows.

For our upper-case we determine a value of 0.42 which is based on the evidence from European comparators. Our relative risk analysis shows that SPT faces similar risks to Italian and Spanish networks.

[✂]

This is a conservative upper case estimate, in light of evidence from the decomposition of NG plc's beta which supports a higher range.

Overall, we estimate an updated cost of equity for SPT in RIIO-2 of between 6.03 and 7.56 (real CPIH)

Overall, we estimate a cost of equity of 6.03 to 7.56 (real CPIH), higher than Ofgem's CAPM-range of 3.87 to 5.63 per cent.[4]

[4] We have not allowed for (or addressed) in this report, Ofgem's reduction of 50 bps for expected outperformance. This issue is addressed in a separate consultancy report. See footnote 19

Table 2: We estimate a cost of equity of 6.03 to 7.56 per cent (real CPI)

	Ofgem SSMD			NERA (March 2019)	
Parameter	**Low**	**Mid**	**High**	**Low**	**High**
TMR	6.25%		6.75%	6.92%	7.76%
RfR	-0.75%		-0.75%	-0.21%	-0.21%
ERP	7.00%		7.50%	7.13%	7.97%
Asset Beta	0.35		0.40	0.38	0.42
Asset Beta (Zero Debt Beta)	0.26		0.34	0.35	0.39
Debt Beta	0.15		0.10	0.05	0.05
Gearing	60%		60%	60%	60%
Equity Beta	0.66		0.850	0.88	0.98
Cost of Equity (step 1)	**3.87%**		**5.63%**	**6.03%**	**7.56%**
Cost of Equity (step 2)	4.00%	4.8%	5.60%		
Expected outperformance		0.50%			
Allowed return on equity		4.3%			

Source: NERA calculations

We have also estimated an updated cost of equity range taking into account the latest available data for the RFR (i.e. as of our October 2019 cut-off date). Table 3 shows our updated cost of equity, ranging from 5.97 to 7.55 per cent, slightly lower than our estimated cost of equity for the March 2019 cut-off date from the slight decline in government yields.

Table 3*:* We estimate a cost of equity of 5.97 to 7.55 per cent (real CPI) as of October 2019

	Ofgem SSMD			NERA (October 2019)	
Parameter	**Low**	**Mid**	**High**	**Low**	**High**
TMR	6.25%		6.75%	6.92%	7.76%
RfR	-0.75%		-0.75%	-0.66%	-0.66%
ERP	7.00%		7.50%	7.58%	8.42%
Asset Beta	0.35		0.40	0.38	0.42
Asset Beta (Zero Debt Beta)	0.26		0.34	0.35	0.39
Debt Beta	0.15		0.10	0.05	0.05
Gearing	60%		60%	60%	60%
Equity Beta	0.66		0.850	0.8	0.98
Cost of Equity (step 1)	**3.87%**		**5.63%**	**5.97%**	**7.55%**
Cost of Equity (step 2)	4.00%	4.8%	5.60%		
Expected outperformance		0.50%			
Allowed return on equity		4.3%			

Source: NERA calculations.

Cost of Debt

For cost of debt, we consider the correct optimal trailing average to use in the indexation mechanism for RIIO-2 price control period, respond to Ofgem's estimate of the halo effect, and set out estimates of the additional costs of borrowing, drawing on a study for the Energy Networks Association (ENA).[5] We also discuss the options for inflation under indexation for cost of debt.

In its sector specific methodology decision, Ofgem proposed 11-15 year trombone for the cost of debt indexation mechanism

For SPT at RIIO-1, Ofgem adopted a cost of debt indexation mechanism based on an average of the A and BBB iBoxx indexes of the yields on GBP non-financial corporate debt of 10 years + remaining maturity, and a trailing average of 10 years. The nominal iBoxx index is deflated using the break-even inflation implied by the difference between nominal and index linked 10 year gilt yields for the relevant index date.

Ofgem intends to reconsider the specification of the index for RIIO-2. Overall, its states its intention to "broadly match debt allowances with sector expected efficient debt costs for RIIO-2 through the calibration of the index",[6] which could be achieved by adjusting the trailing average, index weights, or incorporating a wedge for expected out- or underperformance.

At its working assumption for TOs (and GDNs), Ofgem proposes a 11-15 year trombone mechanism, i.e. where the starting trailing average is 11 years and the first year in the mechanism is fixed such that the trailing average extends out to 15 years over RIIO-2.

Conceptually, the trailing average should be set equal to the efficient tenor, which is a minimum 15 years

In determining the trailing average of the cost of debt indexation mechanism, the trailing average should match the average tenor at issuance of network companies' debt. By doing so, an energy network that issues a bond in line with the average tenor of, say 20 years, will receive an allowance equal to the efficient cost of the bond in each year of the lifetime of the bond, thus creating a reasonable prospect of recovering its debt costs.

We show that the energy sector has an average tenor of 19 years, with a range of 17 (GDNs) to 24 years (GTs). Given that Ofgem's determination of a 10-year trailing average may have encouraged the sector to issue shorter tenor bonds, we also examined the water and energy sectors which have a tenor of around 25 and 20 years respectively. In its sector decision, Ofgem stated that the determination of the trailing average should take into account the 14 per cent or so variable debt that has an interest rate setting maturity of 6 months; however, we find that adjusting for this factor makes practically no difference to the industry tenor.

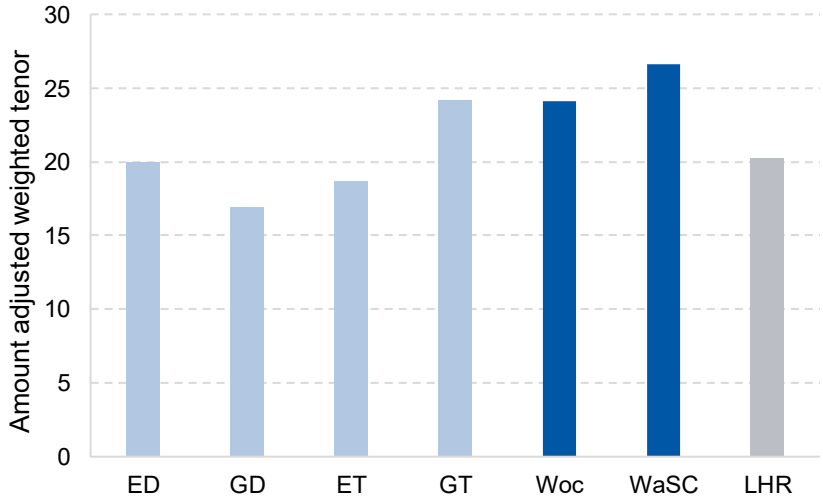
We conclude that market evidence supports an efficient tenor at issuance and therefore trailing average of at least 15 years, the (approximate) shortest tenor observed for any sector, and the evidence more strongly supports an efficient tenor of around 20 years. A 15 year or

[5] NERA (14 March 2019) Cost of debt at RIIO-2, A report for ENA

[6] Ofgem (24th May 2019) RIIO-2 Sector Specific Methodology Decision – Finance, p.18, para. 2.61.

20 year trailing average would also include 80 and up to 95 per cent of companies' historical debt issuance respectively, whereas a 11-year period excludes almost half of energy sector debt.

Figure 1: The average tenor at issuance for energy networks is 19 years (range 17 to 24), and longer for water and LHR



Source: NERA analysis

We find a negative halo when we draw on reliable measures of credit spreads, potentially reflecting companies' new issue premium (NIP)

Ofgem will consider companies' ability to outperform the benchmark index in setting the allowed cost of debt at RIIO-2 (referred to as the regulatory halo). Ofgem measures the halo as the difference between the *credit spread* of the iBoxx index, i.e. the difference in the iBoxx yield relative to the gilt yield of matching tenor, and the *credit spread* of companies' bonds. It considers that this approach more adequately controls for differences in tenor when identifying companies' performance; failure to control for tenor has provided for erroneous measures of the halo effect in previous studies. Ofgem estimates a halo effect of 7 bps when it compares network bond spreads to the index matching the rating at issue.

[✂]

We estimate additional costs of borrowing of 28-57 bps for transaction, liquidity and cost-of-carry, or 53-82 bps if we additionally include NIP and CPI switching costs

At RIIO-1, Ofgem considered that the additional costs of borrowing could be remunerated by company outperformance of the index (i.e. the halo effect), i.e., it implicitly assumed 20 bps additional costs. Given that there is no evidence of a halo effect for energy networks, Ofgem should provide an explicit allowance for the additional costs of borrowing. These include transaction costs, liquidity cots, cost-of-carry, new issue premium, and the costs arising from the switch to CPI indexation.

Drawing on company data and market evidence, we estimate transaction costs of 7 bps, drawing on company public bond issuance; liquidity cost of 4.5 bps assuming no draw-down

of the facility to avoid any potential double-count with cost-of-carry; and, cost-of-carry of 16 to 45 bps based on companies meeting sufficiency of resource and rating agency requirements to meet funding obligations for 12 to 24 month period. Overall, we estimate a range of 28 to 57 bps for transaction, liquidity costs and cost-of-carry.

In addition, we find evidence for a NIP of 13 bps, [✂], and in line with recent studies of the NIP associated with wider corporate debt issuance. We also estimate cost of 12 bps for companies to mitigate risk associated with notional RPI ILD, e.g. to swap RPI ILD to CPI, and thus to ensure that switch to CPI indexation is value neutral.

Overall, we estimate the additional costs of borrowing over RIIO-2 could be in the range of 53 to 82 bps, indicating that Ofgem's allowed (implicit) 20 bps at RIIO-1 is insufficient to fund companies' additional costs of debt over RIIO-2.

Table 4: We estimate the additional cost of borrowing to be between 53 to 82 bps over RIIO-2

Additional borrowing costs	bps
Transaction cost	7
Liquidity cost	4.5
Cost-of-carry	16 - 45
Sub-total	**28 – 57**
New issue premium	13
CPI indexation associated costs	12
Total	53 – 82

Source: NERA analysis

In deriving a real cost of debt allowance, Ofgem should use OBR CPI forecasts or outturn inflation

Ofgem has identified two methods to derive a real cost of debt allowance in CPI terms from a nominal iBoxx index. The first retains the RIIO-1 breakeven inflation – derived as the difference between nominal and index linked gilts – and additionally includes an expected RPI-CPIH wedge. The second method deflates the nominal iBoxx by the Office for Budget Responsibility's (OBR's) longest-term CPI forecast.

We show that break-even inflation overstates expected inflation which means that energy networks are unlikely to recover their actual nominal debt costs under this method. This is because breakeven inflation overstates inflation because of the "inflation risk premium" in the nominal gilt yield. The use of a 20-year breakeven inflation is even more problematic, given the structural imbalance in the demand for long-term indexed linked gilts from pension funds which depresses yields. The potential for 20-year breakeven inflation to overstate inflation is apparent when considering inflation forecasts published by the OBR and HMT. These measures support long-term forecast of 3.1 to 3.2 per cent whereas the current 20-year break-even supports a value of 3.4 per cent.

The retention of the current break-even measure would also require an adjustment for the expected RPI-CPI wedge, which adds further complexity. In its working assumptions for the cost of debt allowance, Ofgem draws on OBR 5yr forecast for CPI as a proxy for CPIH for

each date. We believe that it should adopt this approach of the two alternatives it sets out. However, we also consider that the use of outturn inflation, as used to index the asset base, is a viable alternative for determining the real allowed cost of debt. Such an approach has the advantage that it ensures investors recover their nominal cost of debt, and avoids forecast error.

1. Introduction

Scottish Power Transmission (SPT) commissioned NERA Economic Consulting (NERA) to assess the key aspects of cost of capital for RIIO-T2 price control, which is expected to run for the period April 2021 to March 2026.

This is a redacted report to comply with conditions on the publication of data. Redactions are indicated by [✂].

For cost of equity, we set out our estimate the cost of equity for RIIO-T2 price control period, as an update of our earlier report for SPT on the cost of equity at RIIO-T2.[7]

Our methodology for estimating the cost of equity for SPT relies on the application of the Capital Asset Pricing Model (CAPM). The CAPM sets out that the investor's required return on equity can be calculated from two components:

- A Risk-free Rate (RFR): which compensates investors for the time value of money, i.e. the fact that they commit capital today to an investment that is expected to pay off in the future; and
- An Equity Risk Premium (ERP): which is equal to the total market return (TMR) less the RFR. The ERP compensates investors for the fact that the future return on their equity investment is uncertain. Under the CAPM framework, the only risk that investors are compensated for is the company's non-diversifiable or systematic risk, referred to as beta risk. The premium for risk is calculated as beta times the equity risk premium, defined as the expected return on the market portfolio less the risk-free rate.

Algebraically, CAPM can be written as:

$$R_e = RFR + \beta * (TMR - RFR)$$

where R_e is the return on equity, RFR is the risk-free rate, β is the measure of the systematic risk of the company's equity and TMR is the total return on the market portfolio.

For cost of debt, we assess the optimal trailing average to use in the indexation mechanism for RIIO-2 price control period, and then respond to Ofgem's estimate of the halo effect. We also assess the additional costs of debt (i.e. halo effect and transaction and liquidity costs), with reference to our work for the ENA.[8] We then consider options for deflating the iBoxx index, and address Ofgem's suggestion that a long-term estimate of inflation expectations is more appropriate for deflating the index than outturn inflation data.

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[7] NERA (April 2019), Cost of Equity for SPT in RIIO-2. We make the following changes in estimating the cost of equity for SPT relative to our previous April 2019 report: i) We present cost of equity estimates in real CPIH deflated terms (as opposed to RPI-deflated terms used in our April 2019 report), ii) we have updated our TMR estimates using the latest returns data for the UK market reported in the 2019 DMS publication and considering two alternative measures of historical RPI inflation (from DMS/OBR and the Bank of England Millennium dataset), iii) for estimating the RFR, we use a cut-off date of 29 March 2019, in line with Ofgem's cut off for the May 2019 Sector Specific Decision, to ensure comparability of estimates (given the RFR will be updated prior to the start of RIIO-2), iv) we also present an average forecast RFR rather than a spot estimate, as per Ofgem's approach.

We have updated our beta estimates in line with latest market evidence (up to October 2019).

[8] NERA (September 2019) Halo Effect and Additional Cost of Borrowing at RIIO-2

1.1. Structure of the report

The remainder of this report is structured as follows:

- Section 2 sets out our estimate of the Total Market Return (TMR) and its constituent elements the RFR and the ERP;
- Section 3 sets out our estimate of the asset beta for SPT;
- Section 4 draws conclusions on the cost of equity for SPT during RIIO-T2;
- In Section 5, we assess the optimal trailing average to use under the RIIO-2 mechanism for SPT;
- In Section 6, we demonstrate that there is no halo which means transaction costs should be recognised in full;
- In Section 7, we present estimates of transaction, liquidity costs and cost-of-carry, drawing our study for ENA; and,
- In Section 8, we consider options for deriving a real cost of debt allowance from nominal iBoxx indices under a CPI framework.

There are also a number of appendices:

- Appendix A addresses issues with Ofgem's TMR as per its Sector Specific Methodology Decision (SSMD);
- Appendix B estimates the impact of Labour's nationalisation plans on asset betas;
- Appendix C provides evidence on the decomposition of National Grid plc's asset beta
- Appendix D provides a relative risk assessment for our European comparators; and,
- Appendix E sets out our analysis of the halo effect.

2. Total Market Return, Risk-free Rate and Equity Risk Premium

In this section, we set out our estimate of the total market return (TMR) for RIIO-T2 and its constituent elements the risk-free rate (RFR) and the equity risk premium (ERP).

We estimate a TMR of 6.9 to 7.8 per cent (real, CPIH), drawing on realised historical returns, cross-checked against forward looking evidence from the dividend growth model (DGM) published by the Bank of England. By contrast, Ofgem's estimates a TMR range of 6.25 to 6.75 per cent (real, CPIH) based principally on the 2018 report for the UKRN.[9]

2.1. Summary of Ofgem's RIIO-2 Sector Specific Consultation and Decision

2.1.1. December 2018 Sector Specific Consultation

In its December 2018 Sector Specific Consultation, Ofgem estimated the cost of equity parameters using the following three-step methodology.[10]

Step 1: CAPM evidence

Ofgem relied on the Capital Asset Pricing Model (CAPM) for estimating cost of equity. Ofgem proposed a TMR based on long-run realised returns of 6.25 to 6.75 per cent (real, CPIH), based on the TMR estimate presented in the 2018 UKRN report (6 to 7 per cent real CPI). UKRN's 2018 proposed TMR in RPI terms (5 to 6 per cent) is around 150 bps lower than the 2003 UKRN TMR estimate, according to Ofgem, because of the lower realised returns up to 2018 (c. 25 bps), lower upward adjustment from geometric to arithmetic mean (c. 25 bps) and a switch from RPI to CPI(H) inflation (c. 100 bps). [11]

Ofgem no longer relied on the CEPA estimated a TMR of 5 to 6.5 per cent (real RPI-deflated), which Ofgem used in its earlier February 2018 framework consultation.[12]

Ofgem proposed an RFR based on spot market evidence. It also proposed to update the equity allowance during the RIIO-2 period based on the change in the RFR multiplied by a (1-beta) factor plus the TMR multiplied by beta, but where the TMR and beta are held constant during the price control review ("RFR indexation"). Ofgem's proposal falls back to updating the equity allowance based on the change in the RFR*(1-beta), as a consequence of assuming the TMR and beta are constant.[13] Ofgem proposed to update the RFR using yields on 20-year RPI-linked bonds, adjusted for the difference between RPI and CPI forecasted by

[9] Wright, Burns, Mason, Pickford (2018), Estimating the cost of capital for implementation of price controls by UK Regulators, An update on Mason, Miles and Wright (2003).

[10] Ofgem (December 2018) RIIO-2 Sector Specific Methodology – Annex: Finance, p. 14

[11] Ofgem (December 2018) RIIO-2 Sector Specific Methodology – Annex: Finance, Annex 2, p.91

[12] CEPA (February 2018), Review of Cost of Capital Ranges for Ofgem's RIIO-2 for Onshore Networks, section 5.1.1. and 5.1.2.

[13] Ofgem (March 2018), RIIO-2 Framework Consultation, para. 7.64.

OBR. The resulting CPIH-based risk-free rate should be calculated as the average over the month of October preceding the relevant charging year.[14]

Step 2: Cross-checking of CAPM results

Ofgem cross-checked the CAPM-implied cost of equity against different measures, such as CEPA's DGM, Market-to-Asset Ratios (MAR), forecasts from investment managers and advisors, bids for Offshore Electricity Transmission assets ("OFTOs") and infrastructure fund discount rates.

Step 3: Expected versus allowed returns

Ofgem proposed to apply a distinction between Expected Return (ER) and Allowed Return (AR) for RIIO-2 in light of companies' outperformance in previous price controls, applying a 50 bps downward adjustment to its cost of equity estimate (resulting in the equity allowance lying towards the lower end of Ofgem's CAPM range).

2.1.2. May 2019 Sector Specific Decision

Step 1: CAPM evidence

In its May 2019 Sector Specific Decision, Ofgem confirmed its proposed TMR of 6.25 to 6.75 (real CPIH) from the December 2018 consultation, drawing on three key pieces of evidence: [15]

- The 2018 UKRN report which Ofgem believes provides a robust recommendation that the TMR is between 6 and 7 per cent (real CPIH).
- The DGM cross-check based on the analysis by CEPA, which supports an 8 per cent nominal (6 per cent real CPIH) TMR.
- The cross-check based on investment managers' forecasts, which support a TMR figure below Ofgem's estimated range, albeit higher than presented in the consultation (7.65 per cent nominal or 5.5 per cent real CPIH).

Ofgem also confirmed that it would apply RFR indexation, updating the cost of equity allowance based on the change in the RFR keeping the TMR and beta constant. However, Ofgem noted it would present an updated view of the exact methodology for how the updated RFR will be calculated (i.e. derivation real CPIH values, averaging period and tenor) at Draft Determinations.[16]

Ofgem's proposed CAPM-based cost of equity parameters for RIIO-2 presented in the May 2019 Sector Specific Decision are summarised in Table 2.1. (We discuss Ofgem's beta estimates in Section 3.)

[14] Ofgem (December 2018), RIIO-2 Sector Specific Methodology Annex: Finance, para 3.47.

[15] Ofgem (May 2019), RIIO-2 Sector Specific Methodology Decision – Finance, p.31-42.

[16] Ofgem (May 2019), RIIO-2 Sector Specific Methodology Decision – Finance, p.25-30.

Table 2.1: CAPM-implied cost of equity: GD2 and T2 average (CPIH-deflated)

	Low	High
Notional equity beta	0.66	0.85
Total Market Return (TMR)	6.25%	6.75%
Risk-free rate (RFR)	-0.75%	-0.75%
CAPM-implied cost of equity	**3.87%**	**5.63%**

Source: Ofgem (May 2019), RIIO-2 Sector Specific Methodology Decision – Finance, Table 9, p. 58.

Step 2: Cross-checking of CAPM results

Ofgem also confirmed that it will continue to use the cross-checks on the CAPM-based cost of equity estimates, including evidence from: i) OFTO IRRs, ii) investment managers, iii) infrastructure funds and iv) CAPM with investment managers' value for TMR. Ofgem noted that the cross-checks support its revised CAPM estimates, in particular around 5 per cent (real CPIH), ultimately concluding on a 4.8 per cent (real CPIH) cost of equity estimate as a mid-point.[17]

Step 3: Expected versus allowed returns

Ofgem also confirmed that it will include the last step in its methodology, setting the allowed return as the sum of i) Ofgem's estimate of the cost of equity and ii) expected out- (or under-) performance for RIIO-2, provided the allowed returns remains within Ofgem's estimated cost of equity range. Ofgem noted that it would consider the appropriate assumption of out-(under-)performance as part of calibrating the overall RIIO-2 package.[18]

2.1.3. Our Review of Ofgem's Approach to Estimating the TMR

We agree with Ofgem's proposed methodology to estimate the TMR based on long-run historical averages as the best available evidence on investors' future expectations, using forward-looking approaches as a cross-check. This is also the approach we use in estimating the TMR in this report (as discussed in the following sections).

However, we do not agree with Ofgem's specific TMR estimates, drawing on historical realised returns from the 2018 UKRN report and the DGM-based TMR estimates from CEPA. As explained in our April 2019 report for SPT,[19] there are two important issues which lead to the UKRN report understating real CPI returns, namely: i) the use of the Bank of England hybrid CPI/RPI index for deriving historical CPI-deflated returns and ii) the adjustment to historical data for alleged predictability of returns at long horizons which forms the basis of the UKRN's lower bound estimate. As also explained in our April 2019 report for SPT, [20] CEPA's DGM model understates the expected TMR due to implausibly low

[17] Ofgem (May 2019), RIIO-2 Sector Specific Methodology Decision – Finance, p.58-66.

[18] Ofgem (May 2019), RIIO-2 Sector Specific Methodology Decision – Finance, p.66-78.

[19] NERA (April 2019), Cost of Equity for SPT in RIIO-2, Appendix C.

[20] NERA (April 2019), Cost of Equity for SPT in RIIO-2, Appendix A3.

assumptions around dividend growth. Ofgem did not address the above issues in its proposed TMR for RIIO-2, as we explain in Appendix A.

In relation to step 2 of Ofgem's methodology, in our April 2019 report[21], we also explained that Ofgem's cross-checks do not support a lower cost of equity compared to the CAPM-based estimate and indeed in some cases support an upward adjustment to Ofgem's estimates (e.g. OFTOs winning bidders support a cost of equity of 5.2 per cent (real, CPIH), and infrastructure discount rates support a cost of equity of 5 to 8.2 per cent (real, CPIH)). We therefore conclude that the cross-checks do not provide evidence that the CAPM-based range overstates the cost of equity.

We do not address Ofgem's step 3 analysis as part of this report, as this is addressed in an earlier industry wide study.[22]

We also do not specifically address Ofgem's proposed RFR indexation in this report, which is addressed as a separate NERA study on behalf of the wider industry. [23]

2.2. We use a TMR approach to estimate the cost of equity in line with Ofgem and CMA precedent

As explained in detail in our April 2019 report for SPT,[24] we estimate the cost of equity using a TMR approach, which estimates the TMR and RFR directly and calculates the ERP as the difference between the TMR less the RFR. The reason for adopting a TMR approach is the inverse relationship between the RFR and ERP elements of the TMR, as documented in financial literature.

The use of a TMR approach is also consistent with UK regulatory precedent including the CMA's approach in its most recent reviews (NIE 2014 and Bristol Water 2015).[25] Ofgem is also proposing to use the TMR approach for RIIO 2, as we describe in Section 2.1.

2.3. Updated evidence on the TMR

In this section, we present updated evidence on the TMR, drawing on: i) long-run historical evidence, and ii) forward looking estimates based on dividend growth model, in line with our approach in the April 2019 report for SPT.

2.3.1. Long-run historical data support a TMR of 6.9 to 7.8 per cent (real CPIH)

We present long-run historical estimates of the TMR based on UK data from Dimson, Marsh and Staunton (DMS) database, which provides long-term time series data on returns on stocks, bonds, bills over the period since 1900 up to 2018, i.e. including 119 years of data in

21 NERA (April 2019), Cost of Equity for SPT in RIIO-2, Appendix B.

22 Frontier Economics (March 2019) Adjusting Baseline Returns for Anticipated Outperformance

23 NERA (March 2019), Cost of equity indexation using RFR, A report for the ENA.

24 NERA (April 2019), Cost of Equity for SPT in RIIO-2, Section 2.2.

25 CMA (March 2014), NIE Limited price determination; CMA (October 2015), Bristol Water price determination

the latest publication.[26] The DMS database is the standard reference point for UK regulators including the CMA as well as financial practitioners.[27]

There are two methodological issues associated with estimating the TMR based on historical data: i) the appropriate inflation to use when deflating historical returns into real terms, given recent changes in the measurement of RPI and ii) the appropriate averaging method (arithmetic versus geometric), as we discuss below.

Appropriate inflation index for estimating historical real returns

We deflate the historical realised returns into real terms using historical RPI inflation. We conclude this is appropriate, given RPI inflation series is the only historical series available as a measure of UK inflation going back to 1900 and indeed RPI inflation has been the official measure of inflation in the UK until 2003,[28] i.e. for most of the historical period since 1900.

Our approach of using RPI inflation as a basis of analysing historical real realised returns is consistent with the view presented in the ONS paper by O'Donoghue et. al. (2004), which concludes that RPI inflation series represents the appropriate historical inflation to be used for making *"long-run comparisons […] of consumer price inflation and the purchasing power of the pound"*.[29] In addition, the ONS recently published a "Long term indicator of prices of consumer goods and services" which also uses RPI data as a measure of historical inflation.[30]

However, there is an issue with using historical real RPI-deflated returns as a basis of determining the TMR for RIIO-2, given RPI is not considered as a reliable measure of inflation *going forward*. In 2010 the ONS modified the way certain clothing and footwear price indices were collected, which raised the variation of the indices, and resulted in the wedge between RPI and CPI attributed to differences in the formulae ("the formula effect") increasing by about 32 bps.[31] In 2013, the National Statistician de-designated RPI as a national statistic and the subsequent review by Paul Johnson published in 2015 concluded that *"Government and regulators should work towards ending the use of RPI as soon as practicable"*.[32] In line with the recommendation from the Johnson review, Ofgem is proposing to switch from RPI to CPIH indexation of allowed revenues at RIIO-2.

[26] DMS (February 2019), Credit Suisse Global Investment Returns Yearbook 2019.

[27] See e.g. CMA (March 2014), NIE Limited price determination, para 13.139.

[28] Until 2003, the Bank of England used RPI for the purpose of inflation targeting, replacing it with CPI from 2003 onwards. Since 2003, RPI has been replaced by CPI. From 2011, RPI has also been replaced by CPI for the purpose of indexation of pensions for public sector employees. (Sources: HM Treasury (10 December 2003), Remit for the Monetary Policy Committee of the Bank of England and the New Inflation Target; Department for Work and Pensions and the Rt Hon Steve Webb (12 July 2010), Statement on moving to CPI as the measure of price inflation.)

[29] O'Donoghue, Goulding, Allen (March 2004), Consumer price inflation since 1750, p.39.

[30] Available at ONS website: https://www.ons.gov.uk/economy/inflationandpriceindices/timeseries/cdko/mm23.

[31] ONS (December 2010), CPI and RPI: Increased impact of the formula effect in 2010, p. 1.

[32] Johnson, P. (2015), UK Consumer Price Statistics: A review.

Given the above issue with the unreliability of RPI as a measure of inflation going forward and given that Ofgem is proposing to index price controls relative to CPIH, we calculate historical real returns for the purpose of estimating the TMR for RIIO-2 as follows:

- We start with historical returns deflated with historical RPI inflation, as the only available and reliable measure of historical UK inflation going back to 1900.
- We then convert the historical real RPI returns into equivalent CPIH returns using the estimate of the historical RPI-CPI wedge (using CPI as a proxy for CPIH).

To calculate the historical RPI-CPI wedge we rely on available data on the historical difference between RPI and CPI inflation:

- The most reliable evidence on the historical RPI-CPI wedge is from the period 1989 onwards, when both the RPI and CPI data exists as official indices published by the ONS. Using evidence from this period shows a historical RPI-CPI wedge of 71 bps.[33]
- We also have *some* evidence on the historical RPI-CPI wedge over the period 1950 to 1988, drawing on the official RPI index and the back-casted CPI index from the ONS, although the value of the CPI index over this period is less certain given the ONS series reflects a back-cast estimate based on available RPI data rather than a bottom-up derived CPI series from the underlying data. Using evidence from this period shows a historical RPI-CPI wedge of 25 bps. [34]
- We have no evidence on the value of CPI inflation (actual or back-casted) prior to 1950 and therefore no evidence on the RPI-CPI wedge.

Based on the above evidence, we estimate a historical RPI-CPI wedge of between 45 bps (calculated over the full historical period since 1950 when *some* CPI data is available) and 71 bps (calculated over the most recent period since 1988 when official CPI data is available).

Applying the historical RPI-CPI wedge of 45 to 71 bps to historical returns deflated using the historical RPI index provides an estimate of CPI-deflated returns, which can be used as a basis of setting real TMR for RIIO-2 (based on CPIH indexation). This approach also addresses the concerns around structural changes to RPI in 2010, which is corrected for by effectively adjusting the historical real RPI returns to a CPI equivalent, which is unaffected by the ONS change in methodology for estimating RPI in 2010.

Arithmetic versus geometric averages

The second key question in estimating the TMR based on historical data is whether the expected return should be estimated based on arithmetic or geometric averages of historical realised returns.[35]

[33] NERA calculations based on ONS data.

[34] NERA calculations based on Bank of England (2017), A millennium of macroeconomic data for the UK, tab A47. Wages and prices.

[35] The arithmetic average is calculated as the sum of the historical annual returns divided by the number of years in the historical period, while the geometric average corresponds to a constant rate of return that an investor would receive each year to achieve the same asset value as generated by the variable annual returns by the end of the period.

As explained in our April 2019 report for SPT,[36] if we assume a single period or one year investment horizon, the correct estimate of the expected return is the simple arithmetic mean.[37] In case of investment horizons which are greater than one year, the simple arithmetic mean will be an upward biased estimate of the expected return. Alternative estimators which provide unbiased estimates of the TMR for investments horizons longer than a single period include:

- The "simple estimator" which is based on the arithmetic mean of returns for non-overlapping investment horizons or holding periods of N years.
- The "overlapping estimator" which is based on the arithmetic mean of returns for overlapping investment horizons or holding periods of N years.
- The "adjusted unbiased" (referred to by the CMA as "Blume") estimator, which is a weighted average of arithmetic and geometric means, based on the investment horizon (N) relative to the historical estimation period (T):

$$TMR = [\frac{T-n}{T-1}T * (1+AM)^n + \frac{n-1}{T-1} * (1+GM)^n]^{\frac{1}{n}} - 1$$

- The "Jacquier, Kane and Marcus (JKM)" estimator, which similarly to Blume calculates the TMR as the weighted average of the geometric and arithmetic means, with greater weight placed on the arithmetic mean the longer the historical period compared to the investment horizon.

In its 2014 NIE decision, the CMA presented historical TMR estimates based on the four estimators discussed above, for different investment horizons or holding periods.[38]

Estimates of real CPIH-deflated TMR for RIIO-2

In summary, we estimate a TMR based on DMS historical realised UK returns data:

- using the historical RPI index and the historical RPI-CPI wedge to calculate historical (and forward-looking) CPI-deflated returns; and
- applying the established methods (such as Blume and JKM) to estimating returns for long investment horizons /holding periods, in line with the CMA approach for NIE in 2014.

Table 2.2 below shows historical realised returns in RPI-deflated terms using the different methods which account for long-holding periods (such as Blume and JKM discussed above) using data over the period 1900-2019 from the latest DMS 2019 publication. We estimate historical returns in RPI-deflated terms using two alternative sources of historical RPI inflation[39]:

[36] NERA (April 2019), Cost of Equity for SPT in RIIO-2, Section 2.3.1.

[37] Jacquier, Kane, Marcus (2005), Optimal Estimation of the Risk Premium for the Long-run and Asset Allocation: A Case of Compounded Estimation Risk, Journal of Financial Econometrics, vol 3, no 1, pp 37-55.

[38] CMA (March 2014), NIE Limited price determination, p. 13-27, Table 13.7.

[39] The two alternative sources of historical RPI from the BoE and the DMS are both based on official RPI data from the ONS for the period after 1950, while for the period prior to 1950, they rely on different sources of historical RPI inflation. The BoE relies on the study: O'Donoghue, Goulding, Allen (March 2004), Consumer price inflation since

- The RPI inflation reported in the DMS publication for the period 1900-1949 and official ONS RPI historical data for the period 1950 onwards; and
- The RPI inflation included in the Bank of England's Millennium Dataset.

Table 2.2: Long-run TMR estimates (real, RPI deflated)

RPI index based on DMS (up to 1949) and ONS (1950 onwards) data

	Simple	Overlapping	Blume	JKM
1Y Holding	7.0	7.0	7.0	7.0
2Y Holding	7.3	6.9	6.9	6.9
5Y Holding	6.5	6.8	6.9	6.8
10Y Holding	7.1	6.7	6.8	6.6
20Y Holding	7.4	6.7	6.7	6.1

Source: NERA calculations using DMS (February 2019), Credit Suisse Global Investment Returns Yearbook 2019 (DMS data since 1949 converted to real RPI-deflated figures using ONS data).

RPI index based on Bank of England Millennium dataset

	Simple	Overlapping	Blume	JKM
1Y Holding	6.6	6.6	6.6	6.6
2Y Holding	6.9	6.6	6.6	6.6
5Y Holding	6.2	6.5	6.5	6.4
10Y Holding	6.8	6.4	6.5	6.2
20Y Holding	7.0	6.4	6.3	5.8

Source: NERA calculations using DMS (February 2019), Credit Suisse Global Investment Returns Yearbook 2019 (DMS nominal data converted to real RPI-deflated figures using BoE RPI Millennium data).

Table 2.2 shows that the assumed holding period is an important factor in estimating the historical TMR. As explained in our April 2019 report for SPT,[40] evidence from financial literature supports the use of relatively short holding periods of up to 5 years, which we use as a basis of estimating the TMR. However, we do not place weight on the simple averaging method, as the number of observations is relatively limited for holding periods of 2 to 5 years (e.g. for 5 years, the TMR is based on around 20 or so observations) and the estimates are not stable over time as a result.[41]

Taking into account the above considerations, we estimate a historical real TMR (RPI-deflated) of 6.4 to 7.0 per cent, as per the highlighted cells in Table 2.2.

1750. The DMS uses an index of retail prices prior to 1950, but the source for the specific inflation index is unclear from the publications.

40 NERA (April 2019), Cost of Equity for SPT in RIIO-2, Section 2.3.1.

41 For example, using the DMS 2018 dataset and DMS RPI inflation results in 2-year and 5-year simple average TMR estimates of 6.6 and 6.7 per cent (using data up to 2017), while the DMS 2019 dataset (using data up to 2018) shows estimates of 7.3 and 6.5 per cent respectively, a difference of 20-70 bps by adding just one year of data. We therefore conclude that these estimates are not reliable for estimating the TMR for RIIO-T2.

In Table 2.3 below, we convert the historical RPI-deflated range of 6.4 to 7.0 per cent to a CPI equivalent using our estimate of RPI-CPI wedge of 45 to 71 bps discussed above. This supports a historical CPI-deflated return of between 6.9 and 7.8 per cent.

Table 2.3: NERA estimate of historical real TMR (CPI)

	Lower bound	Upper bound
Historical RPI TMR	6.44%	6.99%
RPI-CPI historical wedge	0.45%	0.71%
Historical CPI TMR	**6.92%**	**7.76%**

Note: Inflation adjustments calculated using the Fisher equation
Source: NERA analysis.

Our estimate of the historical real TMR (CPI) of 6.9 to 7.8 per cent is higher than the equivalent range from the 2018 UKRN report of 6 to 7 per cent that Ofgem relies on, due to i) UKRN report understating the historical CPI returns by relying on a BoE hybrid CPI/RPI inflation series which overstates historical CPI and ii) UKRN report applying an excessive adjustment for long holding periods compared to established methods used by the CMA.

2.3.2. Bank of England estimates forward looking TMR of 8 to 9 per cent (CPIH-deflated)

In our April 2019 report for SPT, we presented forward-looking estimates based on the Bank of England's dividend growth model, published in 2017.

As there has been no update of the Bank of England's DGM, we continue to rely on the evidence presented in our earlier report. However, given we are presenting a cost of equity estimate for RIIO-2 in CPIH terms, we have converted the Bank of England's DGM results into CPI terms, as shown in Table 2.4 below.

Table 2.4: Bank of England DGM supports a real (CPI-deflated) TMR of 8.4 to 9.3 per cent

	Spot (Mar 2017)	1Y average (Mar 2017)	5Y Average (Mar 2017)
BoE TMR (average RfR)	8.5	8.4	8.6
BoE TMR (LT RfR)	8.7	8.5	9.3

Note: The Bank of England estimates the DGM using a time varying risk-free rate for all maturities (where available) and a long-run risk-free rate assumption. We calculate a TMR as the sum of the Bank of England's reported ERP and an i) average of the nominal risk-free rate for all available maturities and ii) the nominal risk-free rate at the longest maturity available, deflated with OBR long-run forecasts of CPI inflation.
Source: NERA analysis of Bank of England (2017), An improved model for understanding equity prices, Quarterly Bulletin 2017Q2, p.94 and Bank of England yield curve data using March 2017 as cut-off date (later data from BoE on the TMR not available).

Depending on the averaging period, the forward-looking estimates of the real TMR based on the Bank of England's DGM lie in a range between 8.4 and 9.3 per cent (real CPI-deflated). The forward-looking estimates are therefore higher compared to the historical estimates discussed in the previous section.

2.4. We conclude a TMR of 6.9 to 7.8 per cent (real CPIH)

In deriving the TMR for the RIIO-T2 period, we rely on long-run historical averages as the primary source of evidence, with forward looking estimates based on the DGM used only as a cross-check. We consider forward looking evidence should be treated with caution, given the relative sensitivity of the results to the long-term dividend growth assumption, for which there are no independent analyst forecasts. The use of historical evidence as a measure of the expected TMR is supported by the stability of the TMR over time as documented in financial literature.

We recommend a TMR in the range between 6.9 and 7.8 per cent real (CPIH-deflated) for RIIO-T2, in line with our estimates based on historical data, using CPI as a proxy for CPIH. Forward looking evidence supports a higher TMR estimate between 8.4 and 9.3 per cent (real CPIH-deflated).

2.5. Updated Evidence on the RFR

For RIIO-2, Ofgem is proposing to introduce RFR indexation, with the RFR and allowed equity return updated each year during the RIIO-2 period. We therefore estimate the RFR for RIIO-2 taking into account the context that the RFR will be indexed. We therefore draw on short-run estimates of the RFR and do not consider long-run estimates, which have been used by UK regulators in past determinations, which however did not include an update via RFR indexation.

We estimate the RFR based on current market evidence, using the same information date as Ofgem's May 2019 Sector Specific Decision (for comparability). [✂]

In deriving our short-run RFR estimate, we use nominal gilt yield with 20-year tenor deflated using CPI forecast, because long-term nominal gilts provide the most stable and objective measure of RfR.[42] Historically, longer term nominal gilt yields have been less volatile than yields of shorter maturity gilts, which suggests that it could provide the more stable measure of RFR going forward. In addition, nominal gilts provide a more objective measure than index-linked gilts, as ILD gilts, especially with long maturities, may provide a distorted measure because of the excess demand or "structural imbalances" driven by pension funds demand.[43] The CMA has considered this issue as relevant at previous reviews.[44]

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[42] More detailed evidence can be found in the NERA report commissioned by the ENA, source: NERA (March 2019) Cost of equity indexation using RFR, a report for ENA.

[43] See, e.g. Schroders (June 2016), Pension funds and index-linked gilts – A supply/demand mis-match made in hell, "UK private sector defined benefit schemes already own an estimated 80% of the long-dated index-linked gilt market and potential demand is almost five times the size of the market. Supply is expected to remain high, and is likely to increase the market by around a third over the next five years, but this will not come close to matching demand. Pension funds waiting for index-linked gilt yields to rise to "attractive" levels are fighting a losing battle. The imbalance is structural and yields are likely to remain depressed relative to economic fundamentals for the foreseeable future."

[44] CMA has drawn previous conclusions at airport reviews, e.g. "The main challenge that we faced when using this [real gilt] data was the segmentation in the gilt market caused by regulatory and accounting rules which encourage pension funds to purchase long-maturity government debt. A number of observers believe that strong demand from this one specific type of investor has pushed down the yields of long-dated ILGs (as shown in Figure 2) to the point where the returns that were on offer were attractive only to other pension funds. This is said to make the long-dated ILG yields an unreliable indicator of the risk-free rate for a typical equity investor and, in particular, for the marginal shareholder whose cost of capital we were trying to measure when estimating the rate of return that Stansted needs to earn." Source: CMA (November 2008) Stansted Airport Ltd Q5 price control review, Appendix L – Cost of Capital, para 51,

[✂]

We conclude on an RFR of -0.21 in real CPIH terms for RIIO-T2. This reflects our risk-free rate estimate based on the spot rate of the 20-year nominal government bonds on 29 March 2019, Ofgem's information date for the May 2019 Sector Specific Decision, plus the average forward curve uplift over RIIO-2, deflated with expected CPI from OBR forecasts.

We also updated the RFR evidence to the most recent data [✂]. Using a cut-off date of 11 October 2019, the average RFR would be -0.66 per cent in real CPIH terms for RIIO-T2, lower than the -0.21 per cent that we estimate using Ofgem's cut-off date.

[✂]

2.6. Conclusions on TMR and decomposition into RFR and ERP

Table 2.5 summarises our recommendations on the TMR and how this should be decomposed between the RFR and ERP components.

Table 2.5: We recommend a TMR of 6.9 to 7.8 per cent, with an RFR of -0.21 per cent and an implied ERP of 7.1 to 8.0 per cent for March 2019 information date (real, CPIH)

	Ofgem SSMD (Mar 2019)		NERA (Mar 2019)		NERA (Oct 2019)	
Parameter	Lower bound	Upper bound	Lower bound	Upper bound	Lower bound	Upper bound
TMR	6.25%	6.75%	6.92%	7.76%	6.92%	7.76%
RfR	-0.75%	-0.75%	-0.21%	-0.21%	-0.66%	-0.66%
ERP	7.0%	7.5%	7.13%	7.97%	7.58%	8.42%

Source: NERA calculations and Ofgem (May 2019), RIIO-2 Sector Specific methodology decision, Annex: Finance, p.78.

By contrast, Ofgem estimates a TMR range of 6.25 to 6.75 per cent, based principally on the 2018 UKRN report, which proposes a TMR of 6 to 7 per cent (CPI real). As we explain in our April 2019 report for SPT[45] and summarise in Appendix A we consider that the UKRN's TMR estimate is understated in real CPI terms, due to relying on historical RPI/CPI series which overstates historical CPI inflation and applying an excessive downward adjustment to historical returns data for alleged predictability at long horizons.

[45] NERA (April 2019) Cost of Equity for SPT in RIIO-2, Appendix C.

3. Beta

In this section, we set out updated estimate for beta risk of SPT at RIIO-T2. We first present a summary of Ofgem's sector consultation and decision before setting out our own evidence for beta risk.

We recommend an asset beta of 0.35 to 0.39 compared to Ofgem's 0.26 to 0.34 (both on zero debt beta basis, for comparison). Our range draws on up-to-date evidence for the set of UK network comparators, including NG, and European energy network betas.

3.1. Summary of Ofgem RIIO-2 Consultations on Beta

3.1.1. March Framework Consultation

In its Framework Consultation in March 2018, Ofgem proposed to estimate betas by looking at historical correlations between prices of regulated utilities and a reference index, while also making use of sophisticated (GARCH) econometric techniques mentioned in the UKRN report. It provided evidence from CEPA and the UKRN report.[46]

In July 2018, Ofgem published its Framework Decision, where it confirmed the approach set out in the March Consultation, namely that it would consider the estimation of beta for network companies, based on issues highlighted in the UKRN report.

We have previously set out our concerns with CEPA's and UKRN's beta evidence in our previous report for SPT. For UKRN report, our main concerns on its approach to beta estimation are: the use of low frequency (e.g. quarterly) data, the long estimation window (since 2000) and the absence of a discussion of the modelling choice (given the existence of several GARCH models). [47]

3.1.2. Sector Specific Methodology Consultation

In December 2018, Ofgem published its RIIO-2 sector specific methodology, which contains an updated notional equity beta range of 0.65 to 0.76.[48] To arrive at this range, Ofgem commissioned two further reports, from Dr Donald Robertson and Indepen. The first report, by Robertson, discusses issues around the use of GARCH and OLS, the use of different data frequencies and impact of using different estimation windows.

To arrive at an asset beta, Ofgem starts by de-leveraging a raw equity beta range of 0.6 to 0.7 (which it states is consistent with Indepen's recommended range) using an average of the gearing levels of the 5 comparators used by Indepen, but multiplying it by a Market-to-Asset ratio (MAR) of 1.1.[49] This adjustment appears to be based on Indepen's recommendation that the gearing used to de-leverage and the gearing used to re-leverage should both be on a

[46] Ofgem (March 2018), RIIO-2 Framework Consultation, Our approach to setting price controls for GB gas and electricity networks, p.84 and p.87-89.

[47] NERA (19 April 2019) Cost of Equity for SPT in RIIO-2 in T2, Appendix I.

[48] Ofgem (18 December 2018), RIIO-2 Sector Specific Methodology Annex: Finance, Section 3, pp.39-40.

[49] Market to Asset ratio is defined as Market Value of the company over the RAB.

consistent basis (i.e. it is not consistent to have actual gearing based on Debt/Enterprise Value to de-leverage and re-leverage using notional gearing based on Debt/RAB).[50]

Ofgem arrives at an asset beta range of 0.35 to 0.36, using debt betas of 0.10 to 0.15. It then re-leverages them using a notional gearing estimate of 60 per cent, calculating a notional equity beta range of 0.65 to 0.76.

As we set out in our previous report for SPT, we have a number of concerns with Indepen's approach.[51] Principally, Indepen's proposed adjustment to gearing has no precedent in UK regulation and, even if we were to accept the proposed adjustment, there is no strong evidence that adjusted MARs are significantly different from 1. Moreover, Ofgem fails to correctly apply Indepen's method, and instead applies an adjustment to actual gearing, leading to an understatement of asset betas and cost of equity.[52] Indepen also fails to take into account the evidence from the beta decomposition of National Grid, and evidence from international comparators. We also expressed concerns about the use of very long timeframes to estimate beta, given the likely change in company activities, regulatory framework, and market composition that all affect beta risk.[53]

In our April 2019 report, we concluded that Ofgem should estimate asset betas by de-leveraging individual equity betas based on the specific gearing of the firm over the relevant time period rather than the most recent market evidence, and neither Ofgem nor Indepen's adjustment for the MAR is justified.

3.1.3. Sector Specific Methodology Decision

In its sector decision, Ofgem determined that it will estimate raw equity betas focussing on outturn data of at least 5 years, primarily using OLS but with GARCH as a cross-check. Specifically, Ofgem high case beta is based on an estimation timeframe of 5 years, and its lower case beta value is based on a 17.5 year period. Ofgem uses high frequency daily data for its regression analysis which addresses our earlier concerns around use of low frequency quarterly data.[54] Ofgem has also decided that it will adjust for gearing by considering outturn market data over the relevant historical time period, as opposed to current market data. [55]

It confirms the use of a comparator set of five companies – SSE, NG, UU, SVT and PNN, but states that it will consider at draft determination the weighting attached to each, including an assessment of relative systematic risk for the different sectors. [56] It also provides further evidence which it considers supports its debt beta range of 0.1 to 0.15.[57]

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50 Indepen (December 2018), Ofgem Beta Study – RIIO-2 Final, Main Report, Section 4, pp.31-34.

51 NERA (19 April 2019) Cost of Equity for SPT in RIIO-2 in T2, Appendix H

52 NERA (19 April 2019) Cost of Equity for SPT in RIIO-2 in T2, Appendix I

53 NERA (19 April 2019) Cost of Equity for SPT in RIIO-2 in T2, section 3.2.1. See also NERA (2018) Review of UKRN recommendations on beta estimation,

54 Ofgem (May 2019) RIIO-2 Sector Specific Methodology Decision, Finance, p. 152

55 Ofgem (May 2019) RIIO-2 Sector Specific Methodology Decision, Finance, p. 55

56 Ofgem (May 2019) RIIO-2 Sector Specific Methodology Decision, Finance, p. 55

57 Ofgem (May 2019) RIIO-2 Sector Specific Methodology Decision, Finance, pp. 51-52

Ofgem continues to adjust observed gearing levels for evidence on MAR, and Ofgem provides further evidence to support its assumption of a MAR of 1.1 based time-series data from Barclay's on premium/discount to RAB over time.[58] Additionally, Ofgem propose to adjust book values of debt for a market-to-book value of 1.03 to 1.06.[59]

Based on such an approach, it estimates a mid-point notional equity beta range of 0.75 rather than 0.7 as per its consultation, with the principal change being its use of a comparator gearing level averaged over the estimation period as opposed to the use of the current estimate.[60]

We have the following substantive concerns with Ofgem's approach:

- The use of very long-term time horizons to estimate beta risk. As we have demonstrated in earlier reports in response to Ofgem's consultation, very long-term time horizons cannot be relied upon because of the change in risk of the comparators, change in regulatory risk, as well as the change to the market portfolio.[61]
- The continued use of an EV/RAV (or MAR) adjustment to the comparators' gearing, which has the effect of over-stating gearing and understating asset betas. This is conceptually incorrect, and appears to be a mis-conception of Indepen's proposed adjustment. Indepen apply a MAR adjustment to notional gearing in re-levering betas, not in de-levering' comparators' gearing. Ofgem has not addressed our concerns about the lack of any conceptual justification in its sector decision but simply presents data on the value of the adjustment.[62]
- The use of a market value to book value of debt of 1.03 to 1.06. We discuss this issue further in section 3.2.1
- The use of a debt beta of 0.1 to 0.15. In our earlier report, we used a debt beta of zero in line with regulatory decisions for water and energy, but we also noted that the debt beta assumption has a negligible impact on the overall cost of equity if implemented correctly, as per CMA's conclusion.[63] In this updated report, we adopt a value of 0.05 based on our review of the most recent market evidence (see section 3.2.2.)
- The failure to decompose NG's group beta to identify beta risk with its UK energy network businesses. Ofgem does not provide any reason for this but observes that we have not provided a similar decomposition for SSE.[64]

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58 Ofgem (May 2019) RIIO-2 Sector Specific Methodology Decision, Finance, p. 50

59 Ofgem (May 2019) RIIO-2 Sector Specific Methodology Decision, Finance, p. 57

60 In its consultation, Ofgem used a current market evidence of around 50 per cent, but in its sector decision uses a value of around 43 per cent based on the relevant estimation periods. Ofgem (May 2019) RIIO-2 Sector Specific Methodology Decision, Finance, p. 57. Table 8 and para. 3.177

61 NERA (April 2019) Cost of Equity for SPT in RIIO-2, Appendix I, Section 1.2, and NERA (2018), Review of UKRN report recommendations on beta estimation, a report for National Grid, chapter 3

62 We described our concerns in NERA (April 2019) Cost of Equity for SPT in RIIO-2, Appendix H2 and H3

63 NERA (April 2019) Cost of Equity for SPT in RIIO-2, section 3.2

64 Source: Ofgem (May 2019) RIIO-2 Sector Specific Methodology Decision, Finance, p. 152. We have not decomposed SSE's asset beta, as we lack pure play generation and retail businesses to robustly estimate the beta risk associated with these other business activities. However, we note that around 45 per cent of SSE's operating profits are expected to come from network activities and a further 35 per cent from relatively low risk renewable contracted generation.

In the following sections, we present our estimate for the asset beta of SPT. Section 3.2 briefly sets out our methodology, including our proposed approach to debt beta. In section 3.3. we present updated beta evidence on UK and European networks. In section 3.4 we present our conclusions.

3.2. Empirical beta analysis

3.2.1. Methodology

Our overall approach is to use ordinary least squares (OLS) statistical techniques, and to draw on relatively high frequency data (e.g. daily or weekly) and the estimation and averaging periods employed by CMA, namely 2 to 5 year estimation periods, and 1, 2 and 5 year averaging periods, as we describe in section 3.3.

We do not rely on very long timeframes, e.g. Ofgem's 17.5 years, for reasons described in our earlier report, namely that changes in regulatory risk, changes in the listed company activities; and changes to the composition of the market portfolio make long-run estimates unreliable as a measure of forward-looking risk. In addition, as we set out in 3.3, we show that we should not rely on the most recent 1 or 2 year period, given that this is unduly affected by political risks, namely the nationalisation debate, and regulatory risks around the price control, which have emerged as increasingly important risk factors since our earlier April 2019 report.

Along with time-frames, the main other methodological issue relates to de-leveraging and re-leveraging. As we have described above, Ofgem de-levers raw equity betas by adjusting the actual gearing of companies using Indepen's normal MAR adjustment, overstating the actual gearing level.[65] This is not consistent with Indepen's approach, as Indepen applies its adjustment to the notional gearing estimate, and not to the actual gearing levels. When de-leveraging betas, the objective is to remove the financing effects from the comparators to obtain a measure of business risk, which is accomplished by using the firm's actual capital structure, and not some measure adjusted to reflect a notional level. Ofgem's adjustment leads to an understatement of the asset betas and, consequently, the cost of equity.

Instead, in de-levering and re-levering the beta, we use (book) debt to market asset values, and the so-called Miller formula which is the standard approach in GB regulation, i.e. used by CMA.[66,67]

Therefore, we consider that its composite beta provides a reasonable estimate for beta risk for the network business. Source: JP Morgan Cazenove, 13 September 2019, SSE plc, p.5.

65 Ofgem (18 December 2018), RIIO-2 Sector Specific Methodology, Annex: Finance, Section 3, pp. 39 and 40.

66 CMA (2015), Bristol Water plc - A reference under section 12(3)(a) of the Water Industry Act 1991, p.333; CMA (2014), Northern Ireland Electricity Limited price determination - A reference under Article 15 of the Electricity (Northern Ireland) Order 1992, p.13-40.

67 An alternative is to use the so-called Modigliani-Miller: $\beta_e = \beta_a * (1 + \{1\text{-Tax Rate}\}*D/E)$. The Miller formula assumes that the capital structure of the firm is constant, or in other words the firm pursues a target capital structure and it rebalances its debt and equity constantly towards its target. By contrast, the Modigliani-Miller formula assumes that the debt *level* of the firm is constant, whilst the capital structure can change. See: Brealey and Myers (2011), Principles of Corporate Finance, 10th edition, p.484-486.

Ofgem also implements a market-to-book value adjustment of 1.03 to 1.06. On the face of it, this adjustment may be appealing: the prior claim by debtholders on free cash-flows is represented by the market value not book value and the market value of debt increases as a proportion of total financing where interest rates decline. However, the adjustment is not conceptually correct in the context of a regulated entity: the prior claim by debtholders does not increase proportionately where debt interest costs decline as Ofgem continues to allow companies to recover historical debt coupon costs (on average) in their allowed revenues. We also note that asset beta is relatively insensitive to the MVF adjustment.[68]

Finally, relative to our earlier report, we adopt a debt beta of 0.05 rather than zero, although below Ofgem's range of 0.1 to 0.15, for the reasons we explain below.

3.2.2. Debt beta

In its sector decision, Ofgem determines a debt beta of 0.1 to 0.15, and cites evidence from us presented in a report to Ofcom for telecoms regulation.[69] We do not consider the academic evidence and regulatory decisions replicated by Ofgem supports its determination of a debt beta of 0.1 to 0.15.

The evidence cited by Ofgem shows debt beta regulatory determinations in the range of zero to 0.15, although most determinations are towards the lower end of this range with the exception of (higher risk) telecoms sector. Ofgem also presents a review of evidence from academic literature and practitioners, which shows a debt beta range of 0 to 0.2, but it is clear that the most recent estimates are towards the lower end of this range. For these reasons it is not reasonable for Ofgem to determine a range that lies above the mid-point of the range of 0 to 0.2.

The estimation of debt betas is prone to statistical error, likely explained by the low trading frequency for bonds leads to illiquidity issues that make the estimation of a debt beta particularly difficult and subject to distortions that do not provide robust estimates. In addition, the proportionate beta risk borne by debtholders will be related to the business risk of the sector. Our recommendation of 0.1 debt beta, cited by Ofgem, related to the higher risk telecommunications sector. Since debt beta measures the systematic risk of debt, the industries with more exposure to business risk and market risk should have higher debt betas.[70] This is recognised in finance literature, for example, Berk and DeMarzo consider debt betas to be higher for industries that are more exposed to market risk. Berk and

[68] Application of the MVF has the effect of reducing the value by around 0.01. In assessing the magnitude of the MVF adjustment, we multiply the gearing ratio measured with book value of debt i.e. book value of net debt / (book value of net debt + market capitalisation) by the average of Ofgem's MVF lower and upper range, i.e. average of 1.03 and 1.06, and unlever the re-lever the equity betas of all comparators using the MVF-adjusted gearing ratio, assuming a debt beta of 0.05. For NG, the MVF-adjusted asset betas decline by around 0.01 relative to the asset beta calculated using the gearing ratio measured with book value of debt.

[69] Ofgem (May 2019) RIIO-2 Sector Specific Methodology Decision, Finance, pp. 51-52.

[70] For example, higher business risks would reflect greater competition intensity, industry cyclicality, and price/income elasticity of demand. See categorisation of business risks in S&P Rating Services (April 2014), Corporate Ratings Methodology, p.2.

DeMarzo recommend that debt betas should be proportionate to market risk, which implies a 0.05 debt beta for energy markets assuming a debt beta of 0.1 for telecoms. [71]

The CMA has taken varying approaches to the debt beta assumptions, estimating a debt beta of 0.1 for Heathrow at Q5, a 0.05 debt beta for NIE in 2014 and a zero debt beta in its most recent determination for Bristol in 2015.[72] At BW 2010, it assumed a debt beta of zero but also modelled a debt beta of 0.1.[73] However, as noted by the CMA, the assumed debt beta has a negligible impact on the equity beta and cost of capital, assuming de-leveraging and leveraging is undertaken correctly.[74,75]

For our analysis, we assume a debt beta of 0.05, in line with the most recent CMA NIE decision.

3.3. Updated empirical evidence from UK and European networks

We examine the evolution of asset betas for listed UK networks comparators – National Grid, SSE, UU, Severn Trent and Pennon – over the past 10 years [✂].

[✂]

We find that SSE's regulated network currently accounts for a significant portion of its group's business, up to three-quarters by operating profit, following the intended sale of its GB household retail business.[76] Therefore, we consider SSE as a relevant comparator, consistent with the CMA's approach in the 2014 NIE determination.[77]

[✂]

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71 Berk and DeMarzo further propose that one can scale the debt betas by the relative asset beta for the industry. Given that BT's current asset beta is 0.64 (with zero debt beta) and taking Ofgem's mid-point proposed asset beta range of 0.30 (with zero debt beta) for illustrative purposes, we can scale Ofcom's 0.1 debt beta with the asset beta ratio of 0.30/0.64, which gives a debt beta of 0.05. Berk, J. and DeMarzo, P. (2014), Corporate Finance, Third Edition, Chapter 12, p.413, footnote 15; Ofcom (28 June 2019) 2019 PIMR and BCMR Statement: Annexes 1-25 of 26, p.319, Table A21.1.

72 Competition Commission (2007), BAA airports market investigation, Appendix F – Cost of capital, F-26; Competition Commission (26 March 2014), Northern Ireland Electricity Limited price determination A reference under Article 15 of the Electricity (Northern Ireland) Order 1992 Final determination, page 13-36; CMA (6 October 2015), Bristol Water plc A reference under section 12(3)(a) of the Water Industry Act 1991 Report, page 325.

73 CC (2010) Bristol Water price determination, Appendices, N6, footnote 13.

74 The assumed debt beta affects the notional cost of equity only to the extent that leverage for the comparators differs from the notional assumption. If empirical leverage is the same as notional and consistent debt betas are used for un-levering and re-levering, there is no impact on the re-levered cost of equity.

75 For example, at the BW 2015 appeal, the CMA assumed a debt beta of zero, noting that debt beta has very little impact on the overall cost of capital as BW's notional gearing level was similar to the comparators.

76 SSE's 2019 annual account shows the network business account for 73 per cent of the adjusted operating profit and 58 per cent of adjusted EBITDA in FY2019, excluding discontinued activities (namely, sale of retail activities). Equity analysts estimate that SSE's regulated network business represents around 45 per cent of the group's enterprise value. Source: SSE (2019) Annual report, segmental accounts, p. 156: JP Morgan Cazenove, 13 September 2019, SSE plc, p.7; SSE plc 2019 Annual report, p.38-39, https://sse.com/investors/reportsandresults/media/0zva4vg0/sse-31464-annual-report-2019-web.pdf.

77 CMA (26 March 2014) Northern Ireland Electricity Limited price determination, A reference under Article 15 of the Electricity (Northern Ireland) Order 1992, Final determination, p 13-36.

We updated beta estimates using the CMA approach from the Bristol Water appeal,[78] where the betas are estimated based for various data frequencies and estimation windows, with the CMA taking an average of the regression results over different periods. In addition to the CMA, we also include an additional regression: 5 year daily estimates of betas, in order to provide a more complete view of the CMA's different combinations of estimation periods and data frequency.

The CMA determined a beta range based on the 25th and 75th percentiles (interquartile range) based on the different approaches.

[✂]

3.3.1. Relevant estimation periods and data frequency

In interpreting the data for SPT, we do not focus on very short-term estimates (i.e. those estimates that are based on spot or an averaging period over the last year, as there is evidence that increased political and regulatory risk has depressed asset betas over the most recent time periods. Investor returns in sectors facing heightened political and regulatory risks are less correlated with the market, because those returns are affected by government and regulatory events rather than market movements, and these political and regulatory events do not typically co-vary with the market. Therefore, increased political and regulatory risk tends to decrease beta estimate. In Appendix B, we show that recent beta estimates could be depressed [✂] from political risk, although the effect is uncertain because of the difficulty in identifying the dates when the market's perception of political risk changed.

We expect these events to be relatively short-lived, i.e. the political risk surrounding networks will eventually be resolved, and the new price control will come into effect in April 2021. Therefore, we should not place undue emphasis on these transitory factors. Rather than explicitly control for the effect of political risk (e.g. through use of dummy variables as per Appendix B), our preference is to place less weight on these most recent periods. Analyst reports make it clear that there is a material risk of nationalisation priced into networks' valuations. It would therefore be perverse to determine the cost of capital on periods when beta estimates were depressed, as investors' cost of capital must have increased.[79]

We also focus on estimates using high frequency data, i.e. estimated using daily data, as these provide estimates with the lowest standard errors.

Therefore, of the set of regressions [✂], we therefore propose to focus on 2 and 5-year daily estimates (i.e. high frequency) based on 2 year and 5 year averaging periods to avoid placing undue weight on periods affected by political and regulatory events.

[✂]

[78] CMA (October 2015), Bristol Water price determination.

[79] For example, equity analysts include a "nationalisation scenario" within their discounted cash-flow (DCF) analysis. See for example, JP Morgan Cazenove (13 September 2019) SSE plc, Sale of retail to OVO a means to an end, p. 6

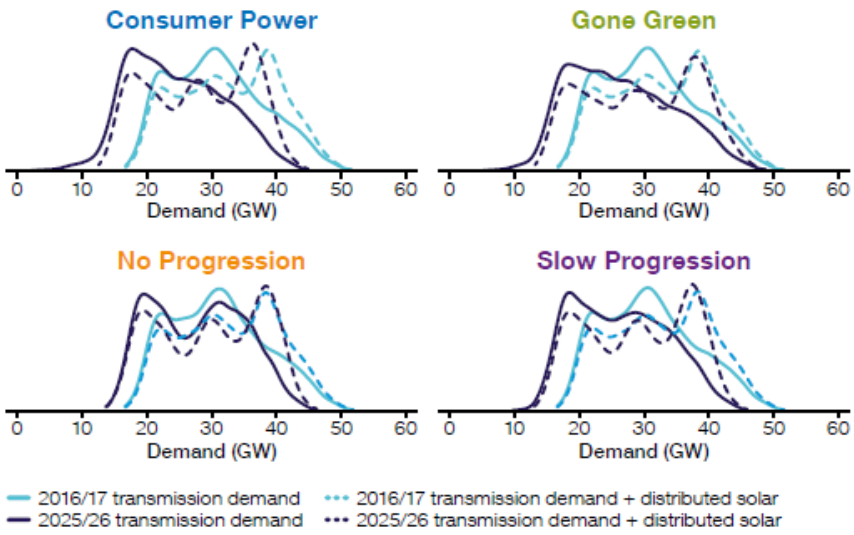
3.3.2. Relevance of the set of comparators

As we described in our earlier report for SPT, in general, the regulatory regimes in energy and water are closely aligned. However, our earlier comparative risk analysis suggests that investors in SPT face higher risk than investors in water networks for the following reasons:

- Greater system operability risks associated with TOs;
- Greater exposure to stranding risk due to uncertainty over the future role of SPT in a decarbonised energy sector with prospects for decentralised generation

In relation to the latter, the government's decarbonisation agenda is driving significant changes in the energy supply market with traditional sources of energy supply replaced with divergent mix, with material yet uncertain implications for TOs. The potential for increased levels of embedded generation and storage at the distribution level may lead to changes in the use of transmission networks at T2 and beyond. FES modelling shows that due to the potential for embedded generation there is the prospect for a reduction in peak demand, and prolonged periods of low demand on electricity TO networks, shown by growth in left hand tail of the relevant distributions (see Figure 3.1). For example, according to Future Energy Scenarios (FES) 2017, under the scenario "Consumer Power", as many as 33 GW of solar panels could be connected to electricity system, with a majority connected at distribution level, including "behind the meter".[80]

Figure 3.1: Change in demand profile, and increase in left side tail of distribution as demand declines on electricity TOs from embedded generation



Source: National Grid (2016) System Operability Framework, p21.

We also considered that TOs face greater risk from the complexity of investment. At RIIO-T1, Ofgem considered both the scale and complexity of investment as risk factors. Ofgem took into account factors such as the size of the project, the number of projects, interlinkages

[80] NG (2017), FES. Link: http://fes.nationalgrid.com/media/1253/final-fes-2017-updated-interactive-pdf-44-amended.pdf.

with other projects and the projects' bespoke nature when assessing the complexity of networks' investments.[81]

We also noted that TO faces greater competition risks, given DECC's (now BEIS) proposal "extending competitive tendering in the GB electricity transmission network" (CATO), which is intended to follow a similar framework to the Offshore Transmission Owner (OFTO) regime.[82] Ofgem has also published proposals to introduce a competition proxy model (CPM) and a special purpose vehicle (SPV) model, which can proceed ahead of CATO[83], and has identified a number of projects which it expects to subject to CPM or SPV approach. These models are likely to expose TOs to greater risk, given the greater construction[84] and operational risks.[85]

For these reasons, we consider that water networks are likely to understate SPT's beta risk, and SPT is likely to have a similar level of beta risk to NG.

3.3.3. NG group beta decomposition

As per our earlier report for SPT, we have also considered how NG's non-UK regulated businesses affect its asset beta. In our April 2019 report[86], we explained that NG's US business is less risky than its UK business for the following reasons:

- Shorter regulatory periods for National Grid's US business (mostly 3-4 years, except gas businesses in Massachusetts), reducing within-period volatility of returns with more frequent updating of revenues in line with costs;
- Greater use of cost pass-through or true ups, e.g. for commodity prices and mandated capex; and
- Greater objectivity in setting allowed costs, in most cases set based on outturn costs for a base year and projected forward, without explicit efficiency factors that reduce allowances over time. By contrast, RIIO draws on more subjective comparative efficiency analysis and technical review of costs.

In addition, US regulatory regimes are determined with reference to case law which has been tested in the courts. The nature of the proceedings offers greater investor security relative to the more subjective approach, and weaker appeals mechanisms, associated with GB price

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81 Ofgem (2012), RIIO-T1: Final proposals for National Grid Electricity Transmission and National Grid Gas – Finance support document, Table 3.3

82 DECC (January 2016), Extending competitive tendering in the GB electricity transmission network, IA No: DECC 3088(1)

83 Ofgem (2018), Impact Assessment on applying the PSV and CPM to future new, separable and high value projects, p. 14

84 Ofgem states that construction and delivery risk will remain largely with the TO but with "*sharing factor for underspend and efficient overspend*". Thus, Ofgem intends to subject over-spends to efficiency test, which increases regulatory risk relative to the RIIO counterfactual where there is no such qualification. Ofgem (July 2018) Hinkley-Seabank project: decision on delivery model, Appendix 3.

85 TO is exposed to a higher level as operational and maintenance cost allowance set over the contract period as opposed to subject to periodic review. The CPM/SPV approach thereby exposes the TO greater risk from asset failure that increase cost, and unexpected increases in the cost itself. Ofgem (July 2018) Hinkley-Seabank project: decision on delivery model, Appendix 3

86 NERA (April 2019) Cost of Equity for SPT in RIIO-2, Appendix G.4.

controls. For example, the rate cases have enshrined principles in relation to the protection of property rights, and notions of prudency standards in relation to permissible costs.

In order to obtain a measure of the systematic riskiness of National Grid's UK regulated business, we update National Grid's asset beta decomposition into a UK and US asset beta from our April 2019 report.

The decomposition of NG plc's beta is done through the following equation:

$$\beta_{National\ Grid} = \frac{Regulated\ assets\ in\ UK}{Total\ regulated\ assets} * \beta_{UK} + \frac{Regulated\ assets\ in\ US}{Total\ regulated\ assets} * \beta_{US}$$

$$\beta_{National\ Grid} = 53\% * \beta_{UK} + 47\% * \beta_{US}$$

As we explained in our earlier report, to estimate the US beta, we rely on a set of 20 US network comparators, who mainly engage in regulatory energy network, retail, or generation activities. Furthermore, we consider that 3 of these comparators provide a more accurate representation of the risk to which NG's US assets are exposed, given that they operate in the same states and hence are exposed to similar regulatory regimes. These companies are Consolidated Edison, Unitil Corp and Eversource Energy. We estimated the implied NG UK energy network asset betas based on the reduced comparator set (we show the results using our full comparator set in Appendix C**Error! Reference source not found.**). [✂]

3.3.4. Empirical evidence from European energy networks

In this section, we present updated empirical beta evidence for listed European networks in Italy and Spain. In Appendix D, we also present updated comparator risk assessment which shows that SPT faces broadly similar risks to Italian and Spanish networks.

In its sector specific decision, Ofgem has not provided evidence on European comparators. In response to our report, Ofgem argues that the European comparators' beta range is wide and taking the average European asset betas is not suitable for the purposes of estimating the riskiness of RIIO-2, and could introduce "international risk, political risk and tax differences".[87] We consider that European comparators provide a reasonable benchmark for a UK regulated network, provided we understand the relative risks faced by these comparators. Moreover, we note that there is UK regulatory precedent in using betas from other countries in determinations. For example, the CAA in its 2014 price review for Heathrow and Gatwick estimated an asset beta by reviewing evidence from airports from countries such as Germany (Fraport) and France (ADP).[88]

We updated the most recent asset beta estimates for these comparators following the CMA approach of calculating asset betas for two- to five-year estimation windows and averaging them over different time periods. [✂] Of the set of regressions, we prefer those that draw on high frequency daily data as these have lower standard errors, and as per our approach to UK network betas (see section 3.3.1).

[87] Ofgem (May 2019), RIIO-2 Sector Specific Methodology Decision – Finance, p.135-136.

[88] CAA (2014), Estimating the cost of capital: technical appendix for the economic regulation of Heathrow and Gatwick from April 2014: Notices granting the licenses, pp.39-43

[✂]

3.4. Conclusions on Beta

In this section, we summarise our findings on the asset beta evidence.

We propose to draw on 2 and 5 year estimation periods using high frequency daily data (for lower standard errors) and 2 to 5 year averaging periods to ensure that the impact of nationalisation and the regulatory cycle does not have undue weighting on the beta estimates.

Drawing on our relative risk analysis, we conclude that SPT's beta should lie above the water betas. We also consider that SPT faces greater risks than other energy networks, in relation to complexity of investment, competition, and asset stranding risks from uncertainty over future flows on transmission networks. Our analysis of risk suggests that NG is the most natural comparator for SPT.

[✂]

However, we also show that NG plc's composite beta understates the risks associated with its UK operations, as the composite beta in part reflects lower risk US operations. By decomposing NG's beta into a UK and a US component we obtain an asset beta range for NG's UK networks [✂] higher than our ranges mentioned above.

Taking into account the evidence above, we propose an asset beta range of 0.38 to 0.42 where the lower case is informed by NG's asset beta for our preferred 2 year and five year estimation windows [✂].

We consider that SPT's beta should be at least as high as NG plc's beta, given that NG plc's beta is likely to understate UK energy network risk, as our decomposition analysis shows.

For our upper-case we determine a value of 0.42 which is based on the evidence from European comparators, again focusing on regressions using high frequency daily data. Our relative risk analysis shows that SPT faces similar risks to Italian and Spanish networks [✂]. Evidence from decomposition of NG plc's beta supports a NG UK asset beta [✂] higher than our upper case.

4. Updated Estimates for Cost of Equity

Table 4.1 sets out our updated estimates for SPT's cost of equity in RIIO-2 of 6.03 to 7.56 per cent (CPIH deflated). This is higher than Ofgem's CAPM range of 3.87 to 5.63 per cent, at step 1.

Our estimates for the individual cost of equity parameters are as follows:

- **TMR**: We estimate a TMR of 6.92 to 7.76 per cent (real CPIH) based on UK long-run historical realised returns, deflated with historical RPI inflation (DMS/ONS and BoE) and converted to CPI returns using an estimate of the historical RPI-CPI wedge from available data.
- **RFR**: We estimate an RFR of -0.21 (real CPIH) based on current yields on 20-year nominal government bonds, adjusted by an expected increase in yields over the RIIO-2 period and deflated to CPI using OBR's forecasts of long-run CPI inflation (average forecast for RIIO-2, for comparability with Ofgem's assumption).
- **Beta**: We estimate an asset beta of 0.38 to 0.42 (0.05 debt beta). Our lower bound is informed by NG's asset beta for our preferred two-year and five-year estimation windows [✂]. Our upper bound is based on empirical betas for European networks, which is conservative in light of evidence from the decomposition of NG plc's beta which supports a higher value.
- **Gearing**: We assume a notional gearing of 60 per cent, in line with Ofgem's proposal and consistent with empirical data and precedent reviewed in our April 2019 report for SPT.[89]

Table 4.1: We estimate a cost of equity of 6.03 to 7.56 per cent (real CPI)

	Ofgem SSMD			NERA (March 2019)	
Parameter	**Low**	**Mid**	**High**	**Low**	**High**
TMR	6.25%		6.75%	6.92%	7.76%
RfR	-0.75%		-0.75%	-0.21%	-0.21%
ERP	7.00%		7.50%	7.13%	7.97%
Asset Beta	0.35		0.40	0.38	0.42
Asset Beta (Zero Debt Beta)	0.26		0.34	0.35	0.39
Debt Beta	0.15		0.10	0.05	0.05
Gearing	60%		60%	60%	60%
Equity Beta	0.66		0.850	0.88	0.98
Cost of Equity (step 1)	**3.87%**		**5.63%**	**6.03%**	**7.56%**
Cost of Equity (step 2)	4.00%	4.8%	5.60%		
Expected outperformance		0.50%			
Allowed return on equity		4.3%			

Source: NERA calculations

We have also estimated an updated cost of equity range taking into account the latest available data for the RFR (i.e. as of our October 2019 cut-off date). Table 4.2 shows our

[89] NERA (April 2019), Cost of Equity for SPT in RIIO-2, Section 4.

updated cost of equity, ranging from 5.97 to 7.55 per cent, slightly lower than our estimated cost of equity for the March 2019 cut-off date.

Table 4.2: We estimate a cost of equity of 5.97 to 7.55 per cent (real CPI) as of October 2019

	Ofgem SSMD			NERA (October 2019)	
Parameter	**Low**	**Mid**	**High**	**Low**	**High**
TMR	6.25%		6.75%	6.92%	7.76%
RfR	-0.75%		-0.75%	-0.66%	-0.66%
ERP	7.00%		7.50%	7.58%	8.42%
Asset Beta	0.35		0.40	0.38	0.42
Asset Beta (Zero Debt Beta)	0.26		0.34	0.35	0.39
Debt Beta	0.15		0.10	0.05	0.05
Gearing	60%		60%	60%	60%
Equity Beta	0.66		0.850	0.88	0.98
Cost of Equity (step 1)	**3.87%**		**5.63%**	**5.97%**	**7.55%**
Cost of Equity (step 2)	4.00%	4.8%	5.60%		
Expected outperformance		0.50%			
Allowed return on equity		4.3%			

Source: NERA calculations

5. Evaluation of Options for Cost of Debt Indexation Mechanism

In this chapter, we first briefly describe Ofgem's approach to the cost of debt indexation at RIIO-1, and then summarise the options it will consider as part of the RIIO-2 framework. We then describe the conceptually correct approach to the design of the cost of debt indexation mechanism and assess the optimal trailing average based on average tenor at issue and profile of debt issuance.

5.1. Ofgem Implemented Three Separate Mechanisms at RIIO-1

At RIIO-1, Ofgem introduced cost of debt indexation for energy networks, designing three separate mechanisms. For RIIO-T1 and GD1, Ofgem adopted a cost of debt indexation mechanism based on average of the A and BBB iBoxx indexes of the yields on GBP non-financial corporate debt of 10 years + remaining maturity, and a trailing average of 10 years. The nominal iBoxx index is deflated using the break-even inflation implied by the difference between nominal and index linked 10 year gilt yields for the relevant index date.[90]

For Scottish Hydro Electric Transmission (SHETL), Ofgem developed a bespoke cost of debt index with a weighting based on the company's investment profile (proxied by change in RAV). In its decision, Ofgem stated that the expected atypical investment and debt profile as the reason to adopt a bespoke approach: "*we acknowledged that a simple trailing average index may not fully reflect the cost of debt of a company with a rapidly-growing RAV if interest rates change sharply*."[91]

For ED1, Ofgem adopted a trailing average that started at 10 years but extends by one year each year of the price control until the trailing average is 20 years, referred to as the trombone.

In all cases, Ofgem estimated debt transaction costs at 20 bps but does not provide for explicit funding of these costs and instead assumes that on average companies outperform the index by an equivalent amount.

5.2. Ofgem Has Consulted on Changes to the RIIO-1 Mechanism

In its 2018 March framework consultation, Ofgem invited views on its approach to compensating companies for efficient debt costs.[92] It consulted on three options for setting the cost of debt:

- Option A: to recalibrate the RIIO-1 indexation policy
- Option B: A fixed allowance for existing debt plus indexation for new debt only

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[90] Ofgem (2014) RIIO-ED1: Draft determinations for the slow-track electricity distribution companies Financial Issues, p. 11. Link: https://www.ofgem.gov.uk/sites/default/files/docs/2014/07/riio-ed1_draft_determination_financial_issues.pdf

[91] Ofgem (February 2012), RIIO T1: Initial Proposals for SP Transmission Ltd and Scottish Hydro Electric Transmission Ltd, para. 5.44

[92] Ofgem (March 2018) op. cit., p. 78

- Option C: pass-through allowance for debt

Within option A, Ofgem invited views on the following design aspects:[93]

- Moving to a shorter or longer trailing average, e.g. 20 years as per ED1 "trombone"
- Using an A rated benchmark
- Weighting the index for individual companies according to RAV growth to better reflect timing of debt issuance
- Taking into account the alleged ability of companies to issue at lower rates than the benchmark indices

In its July decision document, Ofgem confirmed that it would not proceed with option C, but it will continue to appraise options A and B.[94]

5.2.1. Sector Specific Decision

5.2.1.1. Cost of debt indexation

In the December 2018 sector specific methodology, Ofgem proposed to continue with full indexation (i.e. Option A) for setting cost of debt allowances and determined this approach in its May decision.[95] Ofgem states that it will consider further calibration of cost of debt indexation mechanism.[96]

In its sector specific methodology decision, Ofgem questions the idea that a 20-year trailing average is the conceptually correct trailing average, to match average tenor at issuance with iBoxx benchmarking remaining tenor, given the proportion of floating rate debt. Ofgem calculates that companies issuance includes around 14 per cent floating debt, which effectively has an interest rate resetting maturity of 6 months and reduces the overall debt book tenor from a rate fixing perspective in its view.[97]

However, Ofgem acknowledges that 40-50 per cent of the non-floating rate embedded debt outstanding in 2020 will have been issued prior to FYE 2011 when rates were significantly higher. Ofgem will therefore consider a longer trailing average than 10 year to better align the mechanism with the historical debt issuance profile.

Ofgem revised the cost of debt indexation working assumption for GDNs and TOs from a 10-year trailing average to a 11-15 year trombone. Overall, its states its intention to "broadly match debt allowances with sector expected efficient debt costs for RIIO-2 through the calibration of the index",[98] which could be achieved by:

- adjusting the trailing average,

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93 Ofgem (March 2018) op. cit., p. 80

94 Ofgem (2018) RIIO-2 Framework decision, chapter 6. Link: https://www.ofgem.gov.uk/system/files/docs/2018/07/riio-2_july_decision_document_final_300718.pdf

95 Ofgem (24th May 2019) RIIO-2 Sector Specific Methodology Decision – Finance, p.13, para 2.27.

96 Ofgem (24th May 2019) RIIO-2 Sector Specific Methodology Decision – Finance, p.19, para 2.61-2.66.

97 Ofgem (24th May 2019) RIIO-2 Sector Specific Methodology Decision – Finance, p.17, para 2.55.

98 Ofgem (24th May 2019) RIIO-2 Sector Specific Methodology Decision – Finance, p.18, para. 2.61.

- changing weightings of the indices used, or
- providing a "wedge" for expected sector embedded debt cost differential to the index.

Ofgem suggests that it is likely to be appropriate to make an adjustment for Cadent's refinancing, either through factoring in the market yield of any such buyback or excluding Cadent's debt costs.[99]

Ofgem also considers that its revised analysis of the so-called regulatory halo effect supports outperformance by networks of around 10 bps. It also concluded that a long-term estimate of inflation expectations is more appropriate for deflating an index based on long-term debt rates: either drawing on breakeven inflation or official forecasts.[100]

5.3. Conceptually Correct Approach: Match Trailing Average to Average Tenor at Issuance

In determining the trailing average of the cost of debt indexation mechanism, the trailing average should match the average tenor at issuance of network companies' debt. By doing so, an energy network that issues a bond in line with the average tenor of, say 20 years, will receive an allowance equal to the efficient cost of the bond in each year of the lifetime of the bond, thus creating a reasonable prospect of recovering its debt costs.

5.3.1. Average tenor at issuance is a minimum 15 years, and on average closer to 20 years

Our analysis shows that all energy network bonds have an average tenor at issuance of around 19 years, with the different sectors falling in the range of around 17 (GDNs) to 24 (GT) years. (See Figure 5.1.)

In its sector decision, Ofgem notes that the average proportion of floating rate debt is approximately 14 per cent, and that this floating rate debt effectively has an interest rate resetting maturity of 6 months, which reduces the overall debt book tenor from a rate fixing perspective.[101]

We have calculated energy networks' debt average tenor taking into account the 14 per cent or so debt that is floating rate, and our analysis suggests that the average tenor remains largely unaffected, e.g. the average tenor declines to around 18 years (range of 15 to 24 years) if we assume a tenor of 0.5 years for such debt (irrespective of the actual tenor of the debt). Moreover, we do not agree that Ofgem should adjust the average tenor for the proportion of floating rate debt. Rather, the decision to issue floating or fixed rate debt should be a risk borne by the company rather than customers as part of a company's wider credit risk management.

As well as energy sector debt, we also consider evidence from outside of the energy sector given the potential impact of the regulatory framework on companies' debt issuance. For

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99 Ofgem (24th May 2019) RIIO-2 Sector Specific Methodology Decision – Finance, para 2.52, p.16. Ofgem states that: "We therefore believe it is likely to be appropriate to either: (a) factor in the market yield movement element of any such buyback; or (b) exclude Cadent's debt costs for the purposes of calibrating the sector index."

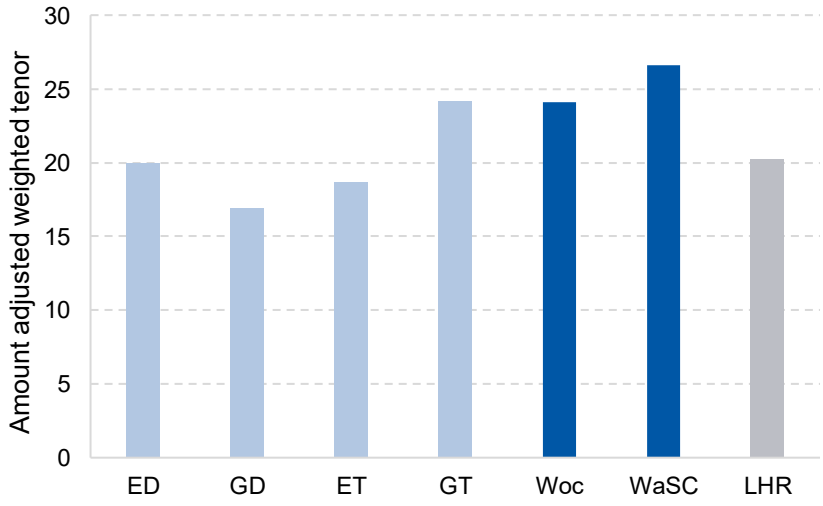
100 Ofgem (24th May 2019) RIIO-2 Sector Specific Methodology Decision – Finance, p.23, para. 2.85.

101 Ofgem (May 2019) Decision - RIIO-2 Sector Specific Methodology Decision – Finance, para. 2.55.p. 17

example, at GD1 and T1, Ofgem determined a 10 year trailing average as the relevant iBoxx indices were only available from 1998-99[102], which placed a limit on the trailing average at that time.[103] There is a risk that companies sought to match the index trailing average used by Ofgem which may have led to a shorter tenor for energy networks than the efficient tenor.

We have examined evidence from both the water and aviation sector, where regulatory rules have not provided incentives to issue shorter 10-year debt instruments.[104] We find that average tenor at issuance is around 25 years for water companies and 20 years for London Heathrow Airport (LHR).

Figure 5.1: The average tenor at issuance for energy networks is 19 years, and longer for water and LHR



Source: NERA analysis

5.3.2. The profile of issuance supports least 15 year trailing average

Ofgem also notes that the profile of sector debt issuance should inform the length of trailing index. In the case of the energy sector: around 45 per cent of debt issuance is pre-2011, meaning that a trailing average starting at 11 years in 2021 would exclude almost half of the sector current outstanding debt. On the other hand, a 15-year trailing average would cover

[102] The iBoxx GBP Benchmark Index was published on 1997/12/31, and the yield on the index start on 1998/1/1. See IHS Markit iBoxx GBP benchmark documentation, p.18.

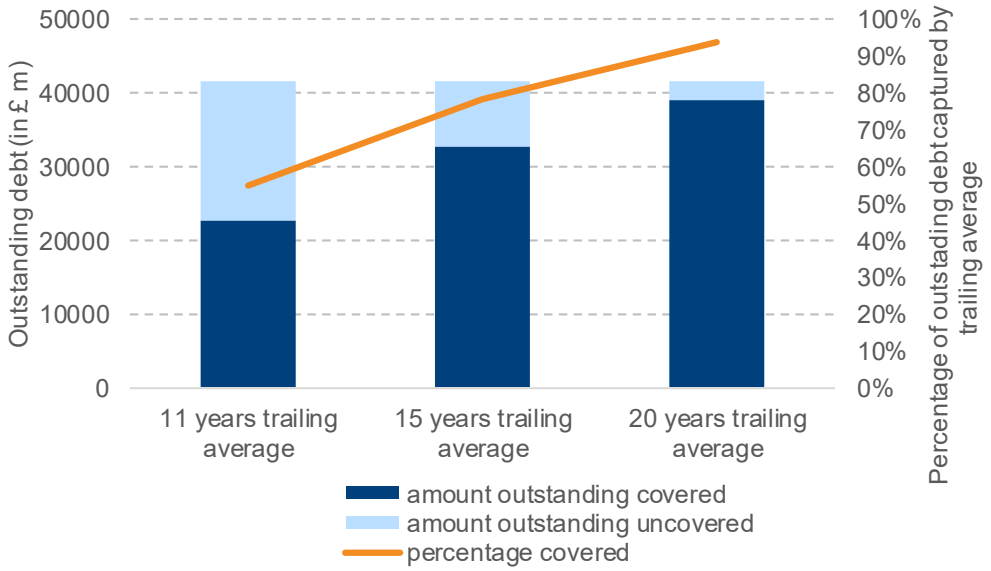
[103] In addition, for GDNs, a substantive element of industry debt was issued post distribution network (DN) sales in 2005, and therefore the then 10Y trailing average captured the period of debt GDN debt issuance.

[104] In both its 2009 and 2014 determinations, Ofwat did not index its cost of debt to any benchmark (Source: Ofwat (2009), Future water and sewerage charges 2010-2015: Final determinations, section 5.4.4, pp.130-131; Ofwat (December 2014), Setting price controls for 2015-20: Final price control determination notice: policy chapter A7 – risk and reward, section A7.4, pp.36-40). The Civil Aviation Authority (CAA) also did not index the cost of debt in either the Q5 or Q6 reviews (Source: CAA (11 March 2018), Economic Regulation of Heathrow and Gatwick Airports 2008-2013, section 10, para 10.18 to 10.32; CAA (2013), Estimating the cost of capital: a technical appendix to the CAA's Final Proposal for economic regulation of Heathrow and Gatwick after April 2014, CAP1115, section 6, paras 6.12 to 6.82).

around 80 per cent of the sector current outstanding debt, while a 20-year trailing average would cover close to 95 per cent.

Ofwat also considered the profile of issuance in its PR19 draft determination, in the context of choosing the appropriate trailing average length. Ofwat concluded that the choice of a 10 year trailing average did not capture the true issuance profile of the sectors bonds, as it would exclude close to half of the sectors outstanding borrowings.[105] In contrast, Ofwat considered that the 15-year trailing average has the merit of providing greater coverage of years when the water sector was actively issuing debt – with around 80 per cent of outstanding listed bonds issued over the period 2004-2018. It also considered that a 20 year trailing average would be feasible. [106]

Figure 5.2: A trailing average of 11 years excludes half of all debt; 15 years includes ca 80 per cent of debt (energy sector debt)



Source: NERA analysis

5.4. Conclusions

Our analysis shows that energy networks' average tenor at issuance is around 19 years, with a range of 17 to 24 years depending on the sector. We also examine evidence from other sectors, namely water and transport, which suggests an average tenor at issuance of at least 20 years. The trailing average should also be informed by an analysis of the profile of historical debt issuance. Our analysis shows a 15 year trailing average includes 80 per cent of company debt, and 20 year trailing average up to 95 per cent.

We therefore conclude that the cost of debt indexation should be based on a starting trailing average of *a minimum* 15 years, and more reasonably 20 years.

[105] Ofwat (July 2019), PR19 draft determinations, Cost of capital technical appendix, section 4, pp.76-77.

[106] Ofwat (July 2019), PR19 draft determinations, Cost of capital technical appendix, section 4, p.77.

6. There is No Evidence of a Halo Effect

Ofgem states that it will take into account companies' alleged ability to issue debt at rates lower than the benchmark index.

In this section, we review Ofgem's approach to estimating the regulatory halo of 7 bps, as set out in its May sector decision.

[✂]

6.1. Background

In our May 2019 study for the ENA on the regulatory halo effect[107], we demonstrated that network companies do not systematically outperform the iBoxx benchmark, once we control for differences in rating (network companies have historically enjoyed stronger rating than A/BBB) and tenor. Our conclusions are consistent with CMA in BGT2015 appeal, and is based on comparing yield-to-issuances relative to the benchmark over time, in order to replicate (and correct) Ofgem's consultant's approach (CEPA).

In its May decision, Ofgem stated that our approach was valid[108], but has also identified an alternative approach – comparing network company spreads to iBoxx credit spreads rather than yields which it considers better controls for differences in tenor between company bonds and the index. Ofgem considers that its revised analysis supports a halo effect of 7 bps when controlling for rating differences.

In its July draft determinations[109], Ofwat states that it disagrees that network companies' cost of debt performance relative to the benchmark index should control for differences in credit rating or tenor, and concludes an "outperformance wedge" of 25 bps.[110] Ofwat's 25 bps "outperformance wedge" is based on the estimates by Europe Economics, its consultant, who calculates the difference between water sector bonds' nominal yield-at-issuance relative to the nominal yield of the iBoxx A/BBB index. [111]

6.1.1. CEPA 2018 report for Ofgem

In its February 2018 report for Ofgem, CEPA carried out an assessment of the halo effect based on a sample of GB regulated energy networks' bonds.[112] Based on a comparison between the coupons of energy networks bonds and the iBoxx A/BBB index, CEPA estimates an average halo effect of 38 bps for nominal bonds, and 49 bps for indexed-linked debt

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107 NERA (14 March 2019) Cost of debt at RIIO-2, A report for ENA

108 Ofgem (24th May 2019) RIIO-2 Sector Specific Methodology Decision – Finance, p.20, para 2.72.

109 Ofwat (July 2019) PR19 draft determinations: Cost of capital technical appendix, p.66, link: https://www.ofwat.gov.uk/wp-content/uploads/2019/07/PR19-draft-determinations-Cost-of-capital-technical-appendix.pdf

110 Ofwat (July 2019) PR19 draft determinations: Cost of capital technical appendix, p.69, Table 4.3.

111 Europe Economics (17 July 2019) The Cost of Capital for the Water Sector at PR19, p.72. link: https://www.ofwat.gov.uk/wp-content/uploads/2019/07/Europe-Economics-The-Cost-of-Capital-for-the-Water-Sector-at-PR19.pdf

112 CEPA (February 2018) : Review of cost of capital ranges for Ofgem's RIIO, p.29-p.32.

(ILD).[113] CEPA then proposed a 25 bps downward adjustment of the iBoxx index value in its low case, and assumes that outperformance would offset its estimate of 10 bps transaction cost in the high case[114].

In our earlier report for the ENA,[115] we identified two flaws that, if corrected, eliminate the supposed "halo effect":

- CEPA incorrectly uses (higher) coupon rates as its measure of the cost of debt instead of yield at issue, which accounts for non-par issuance
- CEPA fails to recognise that energy networks' bonds were predominantly A rated *at issuance*, especially during the pre-2010 period where around 80 per cent of the energy networks' bonds were A rated.[116] Unsurprisingly, a comparison of predominantly A rated bonds at issuance to the average of A and BBB rated iBoxx indices will show "outperformance"; by contrast, comparing A rated bond issuance with the A rated iBoxx and BBB rated bonds with BBB rated iBoxx substantively reduces the halo.

Overall, we showed that correcting for these two errors in CEPA's analysis reduces the so-called halo effect to practically zero.[117]

6.1.2. Ofgem sector specific decision

In its sector specific methodology decision, Ofgem again claims that there is a halo effect. In this case, Ofgem measures the halo as the difference between the *credit spread* of the iBoxx index and the *credit spread* of companies' bond, i.e. Halo effect = iBoxx index spread – company's bond spread.

According to Ofgem's analysis, the estimated size of halo effect is 14 bps when all network bonds were compared to the average A/BBB index spread, or 7 bps when network bonds were compared to the index matching the rating at issue.[118]

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113 For nominal bonds, CEPA compares the nominal coupons for bonds with at least 10 year tenor to the average A/BBB rated iBoxx non-financial corporates 10 year+ indices. For index-linked bonds, CEPA compares the real coupon with the "real" iBoxx indices deflated with 20-year breakeven inflation.

114 CEPA (February 2018) op, cit., p.36.

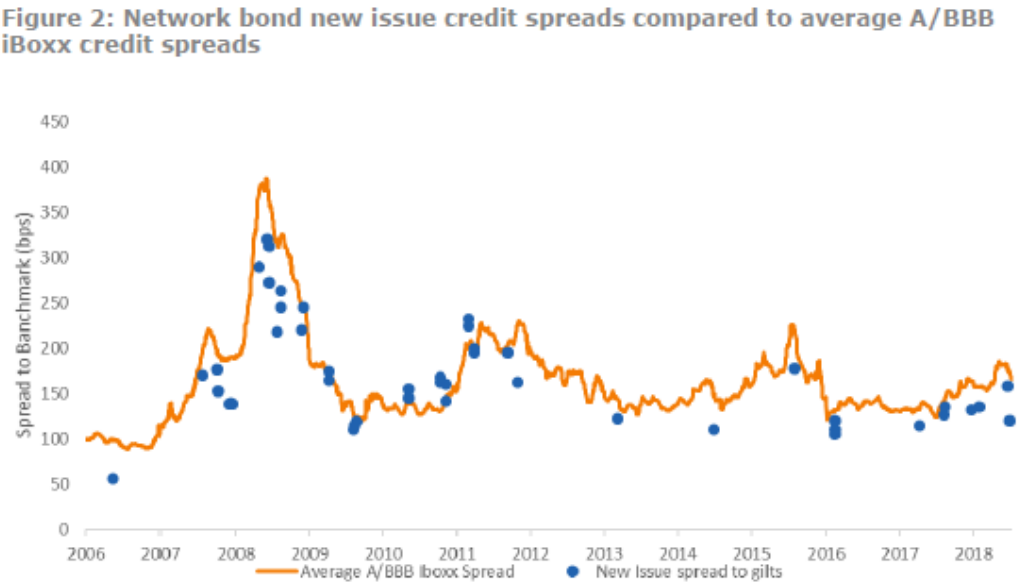
115 NERA (14 March 2019), Cost of debt at RIIO-2, A report for ENA slide 18

116 CEPA states that for nominal bonds "13% of shown coupons, or 25% by value, were issued at a rate higher than the average of the A and BBB values". However, using rating at issue, we have calculated that around two-thirds of bonds were issued at a rate higher than the average of the A and BBB values, materially higher than CEPA's estimates. One possible explanation for the difference is that CEPA has mistakenly used current rating instead of the rating at issue in its analysis.

117 NERA (14 March 2019), Cost of debt at RIIO-2, A report for ENA slide 18

118 Ofgem (May 2019) RIIO-2 Sector Specific Methodology Decision – Finance, Decision, p.21, https://www.ofgem.gov.uk/system/files/docs/2019/05/riio-2_sector_specific_methodology_decision_-_finance.pdf

Figure 6.1: Ofgem estimates a halo effect of 7 bps based on an analysis of relative credit spreads



Source: Ofgem (May 2019) RIIO-2 Sector Specific Methodology Decision – Finance, Decision, p.21

6.2. Our Analysis of Ofgem's Halo Effect

[✂]

6.2.1.

[✂]

6.2.2. Other studies demonstrate that there is no halo effect, including CMA

We also consider evidence for the halo drawing on other studies that have different sample sizes and different (yet valid) approaches to measuring the halo effect. These studies all show zero (or indeed negative) halo effects. The studies include:

- At ED1, Ofgem analysed the *yield at issue* of utility bonds with iBoxx A/BBB index and concluded that utilities can issue debt at a lower yield than the index. [119] In response, our analysis showed that the so-called "halo effect" was almost entirely explained by ILD and rating differences.[120]

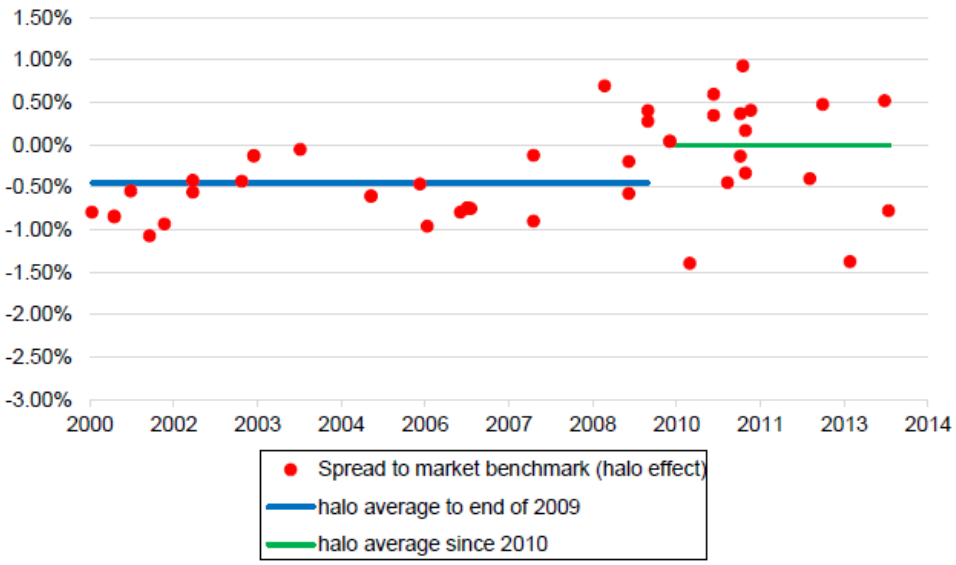
[119] Ofgem (March 2013), RIIO-ED1 Strategy decision, p.12

[120] See for example reports commissioned by WPD, SPED and Energy Networks Association from NERA Economic Consulting over the course of RIIO-ED1. Links: http://www.westernpower.co.uk/docs/About-us/Stakeholder-information/Our-future-business-plan/Supporting-Financing-plan/NERA-Analysis-of-Ofgem-s-Halo-Effect.aspx

- Ofgem then analysed the *relative spreads to maturity* for the iBoxx index and a set of DNO bonds[121]. Again, our analysis showed that there was no halo effect once we corrected for differences in tenor.[122]

The CMA also considered evidence on the halo effect as part of the appeal of Ofgem's RIIO-ED1 decision by British Gas Trading (BGT).[123] The CMA undertook its own analysis of the existence of the halo effect based on utility *yield at issue*. Although it found some evidence for the halo effect before 2009 (as shown by the blue line in Figure 6.2), the CMA noted that there was no evidence of a halo effect since 2009 (as shown by green line in Figure 6.2), and that any historical halo effect had diminished over time.[124]

Figure 6.2: CMA found no evidence for halo for the period from 2010



Source: CMA (September 2015), CMA BGT vs GEMA Final determination, p.150

6.2.3. Conclusion

[✂]

We also show that many previous studies, that draw on different sampling periods and techniques, demonstrate that there is no halo effect. We therefore conclude that there is no evidence to support any halo effect for energy networks.

6.3. Ofwat's Approach is Inconsistent with CMA

Ofwat proposes to base the cost of new debt on the average of A and BBB rated iBoxx Corporate non-financial indices with 10 years or more remaining maturity less a 25 basis

[121] Ofgem (December 2014) Final Determinations – Overview, Appendix 8, para. 1.4; https://www.ofgem.gov.uk/ofgem-publications/92249/riio-ed1finaldeterminationoverview-updatedfrontcover.pdf

[122] NERA (September 2014) A Response to Ofgem's proposals on the cost of equity and debt for ED1. Section 3.3. Link: https://www.spenergynetworks.co.uk/userfiles/file/App13_201409_NERA_ResponseToOfgemProposalsCoECoD.pdf

[123] CMA (2015) British Gas Trading Limited v The Gas and Electricity Markets Authority, Figure 15, p.137, para 8.8 (c)

[124] CMA (2015) British Gas Trading Limited v The Gas and Electricity Markets Authority, Figure 15, p.150

"outperformance wedge". We disagree with Ofwat's cost of debt indexation mechanism for determining the cost of new debt.

First, we find that there is no evidence to support a downward adjustment of 25 bps to the benchmark iBoxx indices for supposed company outperformance (or "regulatory halo"), as Ofwat proposes. As we have shown in successive studies, there is no empirical evidence to support the halo effect.

In its draft determination, Ofwat has stated that there is no requirement to adjust for tenor and differences in rating.[125] We disagree. Ofwat (like Ofgem) intends to set the cost of new debt allowance for a notional company and therefore, for consistency, it must assume that companies issue debt at the notional rating (average of A and BBB, as per its benchmark index) and for a tenor consistent with this benchmark index (at around 20 years). By contrast, Ofwat's outperformance wedge assumes that companies issue debt at a stronger rating and short tenor, on average. Ofwat's failure to account for differences in rating and tenor is also at odds with the CMA which did make such adjustments in its consideration of the outperformance wedge (or regulatory halo) at the BGT 2015 appeal. The CMA also concluded at the BGT 2015 appeal that there was no evidence to support a halo effect over the most recent period, as we explain below. [126]

6.4. Conclusions

Conceptually, there is no reason to believe that regulated companies can outperform the benchmark index because of the quality (or otherwise) of the regulatory regime. The rating agencies take into account the credit support offered by the regulatory framework in their assessment of the issuers' bond rating, and therefore any halo will be fully reflected in the rating (in other words, the effect of the framework is "fully priced in"). A comparison of the yield-at-issuance or spread for an A-rated energy network company bond should equal the yield-at-issuance or spread for an A-rated non-energy corporate bond, all other things equal (such as tenor).

[✂]

Our findings are also supported by previous studies, including the findings of the CMA BGT 2015 price control. In the absence of any empirical evidence on companies' ability to outperform the index, Ofgem should allow the additional costs of borrowing (transaction costs, liquidity and cost of carry) in full.

[125] Ofwat (July 2019), PR19 draft determinations, p. 66

[126] CMA (2015), British Gas Trading Limited v The Gas and Electricity Markets Authority, p.150.

7. Estimating Additional Costs of Borrowing

At RIIO-1, Ofgem did not provide for companies' debt transaction costs at it considered that these could be remunerated by company outperformance of the index (the so-called halo).

Given that there is no evidence of a halo effect for energy networks, Ofgem should provide an explicit allowance for the additional costs of borrowing. These include transaction costs, liquidity cots, cost-of-carry, new issue premium, and the costs arising from the switch to CPI indexation.

We set out estimates for these costs in this Chapter drawing on our study for ENA.[127]

7.1. Transaction Costs

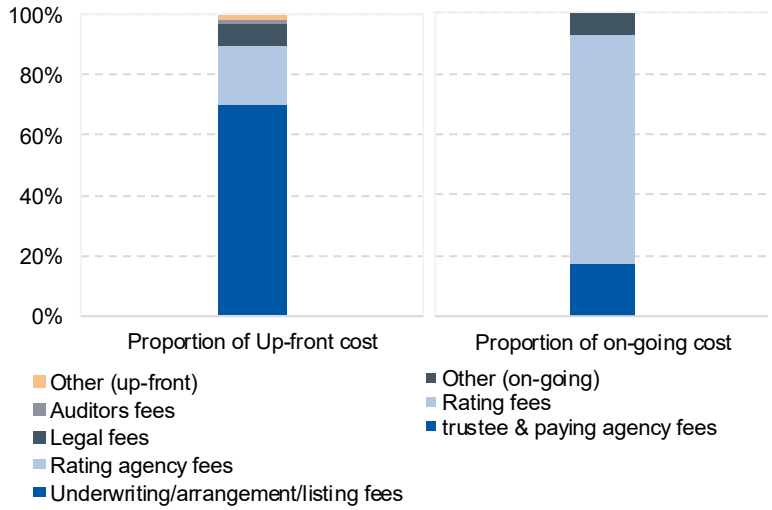
We collected evidence on transaction costs associated with public bond issuance distinguishing between underwriting fees, bond advisory fees, arrangement fees, rating agency fees, legal fees, auditors fees, listing fees etc. Our analysis also distinguished between up-front costs and on-going/annual costs. Taking into account amounts issued and tenors, we calculate the up-front transaction cost to be recovered as an annuity over the life of the bond, using the following formula:

Transaction cost = (Upfront fees / Tenor of the debt instrument + Per annum costs) / debt amount issued + total annualized common costs / notional debt

Our estimate shows that networks' debt transaction costs are 7 bps of notional debt costs on average. Companies' report that around 50 per cent of annualised costs are up-front costs rather than on-going. Of these up-front fees, underwriting fees and/or arrangement fees make up around 70 per cent of up-front costs, and rating agency fees and legal fees providing the other material components. The on-going costs are mainly rating fees, followed by trustee and paying agency fees.

[127] NERA (September 2019) Halo effect and additional costs of Borrowing at RIIO-2, A report for ENA.

Figure 7.1: Break-down of up-front and on-going transaction costs



Source: NERA Analysis

7.2. Liquidity Costs

Networks also bear the cost of maintaining liquidity facilities, driven by the requirement to manage day-to-day cash flow operations, and separate to cost-of-carry, which relates to pre-financing costs.

Ofgem cites Europe Economics (EE) estimate of liquidity cost of 3.5-4.5 bps, based on the costs associated with commitment fees on revolving credit facilities of 35-45 bps, and assuming facilities cover 10 per cent of companies' debt.[128] However, such an approach ignores other potential costs, although these additional costs are smaller, including i) upfront arrangement fees of, say, 30 bps of facility size (annuitised over 5 years = 0.6 bps of notional debt[129]), and ii) upfront legal fees and annual (agency) fees.

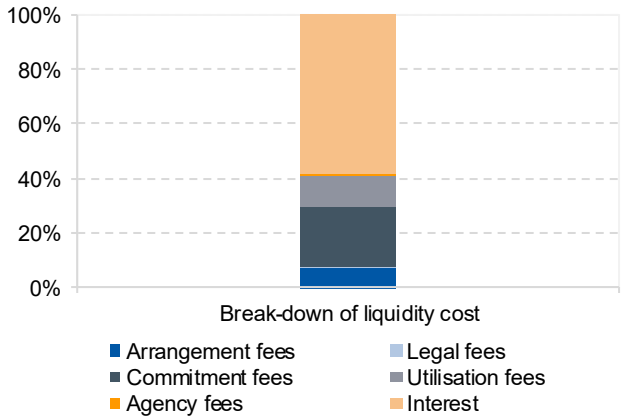
Of greater importance, Ofgem ignores potential draw-down costs. Companies will in practice draw down facilities to manage volatility in cash-flow requirements. Drawing on company evidence, we estimate the average liquidity cost to be at 9 bps of notional debt based on these further assumptions (in addition to EE's commitment fee and assumed facility size of 10 per cent of notional debt).[130]

[128] EE (2017) PR19 – Initial Assessment of the Cost of Capital p.72 Link: http://www.europe-economics.com/publications/europe-economics-final-report.pdf

[129] Calculated as 30 bps divided by 5 (based on tenor of facility) and further divided by 10, assuming facility is 10 per cent of notional debt.

[130] These include: i) Annual utilisation fee: 20 bps of drawn credit facility amount, ii) Interest on the liquidity facility: LIBOR + 35 bps, and iii) Assume facilities are on average half drawn.

Figure 7.2: Break-down of NERA estimate of 9 bps liquidity cost, assuming facility half-drawn



Source: NERA Analysis

7.3. Cost-of-Carry

Cost-of-carry is defined as the requirement to issue debt ahead of maturity to meet sufficiency of resources requirement, rating agency and debt covenant requirements etc. License requirement and credit rating agency liquidity methodology require companies to have sufficient liquidity over a period of 12 to 24 months. For example, Ofgem licence requirement Standard Special Condition A37 (Availability of Resources) requires network companies to ensure that they have sufficient financial resources and financial facilities available to carry out business for a period of 12 months, and credit rating agencies, such as S&P, require corporate issuers to achieve "adequate" or "strong" assessment on liquidity to receive a credit rating of BBB- and above.[131]

We calculate cost-of-carry range from 16 to 45 bps, assuming:

- pre-financing period to be between 12 to 24 months in line with license requirement and rating criteria;
- debt tenor to be between 15 and 20 years (refinancing 1/15 or 1/20 of debt each year); and,
- Net carry cost [✂] based on 5-year average interest rate differentials (calculated as new debt cost less cash-deposit interest received on pre-financed cash).

We note that costs would be higher if assumed tenor is aligned to a trailing average that is shorter than 15/20 years, e.g. costs lie in range 33 to 74 bps for 10 year tenor.

[✂]

[131] S&P requires that to achieve "adequate", sources of liquidity must be at least 1.2x the uses of liquidity over the next 12 month period, and to achieve "strong", sources of liquidity least 1.5x the uses of liquidity over the next 12 months with at least 1.0x for the subsequent 12 months (i.e.12 to 24 months)

7.4. Costs associated with CPI indexation

In RIIO-2, the RAV will be indexed by CPI, hence companies will need to consider switching from RPI ILD to CPI ILD issuance. In our view, CPI(H) corporate ILD market is unlikely to develop absent a decision by the Treasury's Debt Management Office (DMO) to develop a CPI(H) ILD gilt market based on the following observations: i) the Treasury has not set out any firm plans to issue any CPI (or CPIH)-linked sovereign debt, ii) the existing stock in RPI-linked gilts will not fully mature until 2068, so CPI-linked debt would have to compete with the alternative RPI-linked investment vehicles for decades, and iii) development of CPI-linked assets would fragment the ILD market, creating potential illiquidity in both CPI and RPI markets and increase costs. Furthermore, in September 2019, the UK government announced it would continue to issue RPI index linked gilts until at least 2025.[132]

We estimate it could take 20 years for CPI gilt market to fully develop, as DMO data shows that the weighted average maturity of existing RPI-linked gilt is around 20 years, implying that if CPI IL gilts were issued from now on to refinance maturing RPI IL gilts, it will take around 20 years to reach 50 per cent share of the overall IL gilt market, assuming no incremental issue or buy-back of RPI debt. In addition, it could take 20 years for CPI IL gilts to achieve the level of liquidity observed in RPI IL gilt market, as it took RPI IL gilt as long as 17 years to reach a high level of liquidity.[133]

Evidence from the RPI ILD market shows that the illiquidity premium increased to around 80 bps during the financial crisis (when market liquidity declined), which may be reflective of a premium for an illiquid CPI(H) ILD market. Bank of England estimated the historical evolution of liquidity premium of RPI-linked gilts relative to nominal gilts, and estimated that the ILD premium was around 20-30 bps post-2009, but increased to 80 bps (10-year maturity) during the financial crisis when market liquidity declined, which may be reflective of a premium for a nascent CPI-linked debt market.

The evidence on RPI and CPI inflation swaps suggests a premium of around 15 bps for CPI, based on the relatively higher bid-ask spreads for CPI products. A 2011 report by Pension Insurance Corporation stated that liquidity in the CPI swap market is low suggesting high transaction costs. The bid-ask spreads quoted by banks on 20 and 30-year CPI swaps tend to be around 20 bps, compared to just 5 bps for RPI swaps of the same maturities, which implies a 15 bps liquidity premium for CPI swaps over RPI swaps.

We estimate a cost of 12 bps to issue new CPI ILD and to mitigate basis risk of remaining RPI ILD, based on the assumption that companies maintain ILD of around 25 per cent of notional debt as assumed in Ofgem's Sector Methodology, and companies issue CPI ILD (or swap existing RPI ILD into CPI) at an additional cost of around 50 bps, the mid-point of 15 to 80 bps premium for CPI products. This implies an additional cost of around 12 bps on notional debt, calculated as 25 per cent of 50 bps.

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[132] Letters between the Chair of the UK Statistics Authority and the Chancellor on proposed reforms to RPI

[133] The illiquidity premium for RPI gilts stabilised over 20-year period (1981 to 1998), as measured by break-even to outturn inflation spread.

7.5. Conclusion on additional cost of borrowing

In conclusion, drawing on company data and market evidence, we estimate the transaction costs of 7 bps, drawing on company public bond issuance; liquidity cost of 4.5 bps assuming no draw-down to avoid any potential double-count with cost-of-carry; and, cost-of-carry of 16 to 45 bps based on companies meeting sufficiency of resource and rating agency requirements to meet obligations for 12 to 24 month period. Overall, we estimate 28 to 57 bps for transaction, liquidity costs and cost-of-carry.

In addition, we find evidence for a NIP of 13bps, in line with recent studies. We also estimate cost of 12 bps for companies to mitigate risk associated with notional RPI ILD, and to ensure that switch to CPI indexation is value neutral. Overall, additional costs of borrowing over RIIO-2 could be in the range of 53 to 82 bps. This indicates that Ofgem's allowed (implicit) 20 bps at RIIO-1 is insufficient to cover companies' additional costs of borrowing over RIIO-2.

As shown in Table 7.1, we estimate the additional cost of borrowing to range from 53 to 82 bps, with a central estimate of 68 bps.

Table 7.1: We estimate the additional cost of borrowing to be between 53 to 82 bps over RIIO-2

Additional borrowing costs	bps
Transaction cost	7
Liquidity cost	4.5
Cost-of-carry	16 - 45
Sub-total	**28 – 57**
New issue premium	13
CPI indexation associated costs	12
Total	**53 – 82**

Source: NERA analysis

8. Options for Inflation Under Indexation

Ofgem is consulting on its calculation of the inflation rate to derive the real cost of debt allowance from observed nominal values.

In its December 2018 consultation, Ofgem identified two methods to derive a real cost of debt allowance in CPI terms from a nominal iBoxx index. The first retains the RIIO-1 breakeven approach but includes an expected RPI-CPIH wedge when deflating the nominal iBoxx yields. The second deflates the nominal iBoxx by an expected value for CPIH directly and uses the Office for Budget Responsibility's (OBR's) longest-term CPI forecast as a proxy.[134]

Ofgem also states that companies raised the option of using outturn inflation to deflate the nominal indices. In its sector specific methodology decision, Ofgem states that it does not believe that outturn inflation data is a good indicator of the long-term future inflation expectations that are embedded in the long-term debt constituents of the iBoxx indices used. Instead, it believes that a long-term estimate of inflation expectations is more appropriate for deflating an index based on long-term debt rates: either breakeven inflation or official forecasts.[135]

In its working assumptions for the cost of debt allowance, Ofgem draws on nominal combined iBoxx yields deflated to CPIH real using the Fisher equation and the OBR 5yr forecast for CPI as a proxy for CPIH for each date.[136]

In this section, we show that break-even inflation is likely to overstate outturn inflation, and that of Ofgem's two options, it should draw on forecasts of CPI. We also consider that the use of outturn inflation, as used index the asset base, is a viable alternative for determining the real allowed cost of debt.

8.1. Break-Even Inflation Does Not Allow for Cost-Recovery

Ofgem currently deflates the nominal benchmark by break-even inflation, as derived from 10-year gilts as determined for the same time period as the determination of the nominal benchmark.

Break-even inflation overstates expected inflation which means that energy networks are unlikely to recover their actual nominal debt costs. Breakeven inflation overstates inflation because of the "inflation risk premium" in the nominal gilt yield. [137] In theory, the spread between the nominal gilt yield and index-linked gilt yield includes both the expected inflation for the remaining life of the nominal gilt as well as the inflation risk premium, which

[134] Ofgem (December 2018) Consultation - RIIO-2 Sector Specific Methodology, p. 101, para. 10.24

[135] Ofgem (24th May 2019) RIIO-2 Sector Specific Methodology Decision – Finance, p.23, para. 2.85.

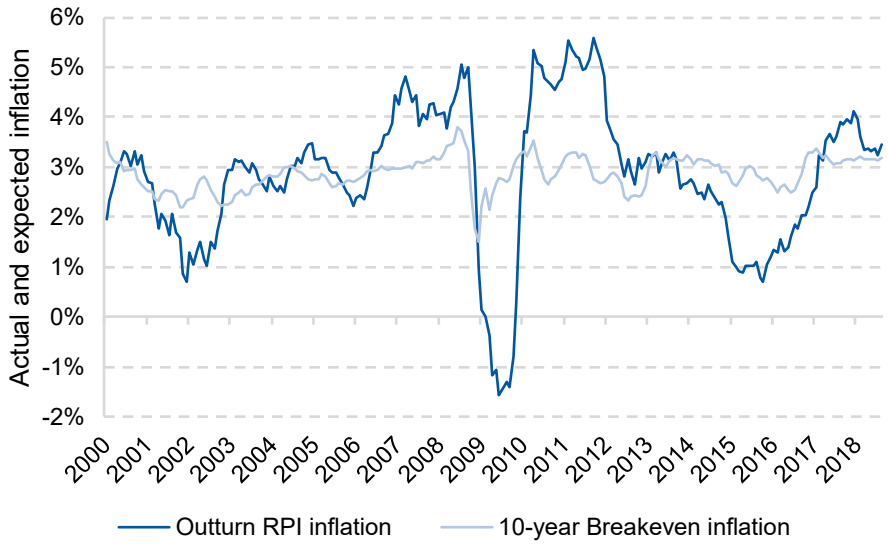
[136] Ofgem (24th May 2019) RIIO-2 Sector Specific Methodology Decision – Finance, p.19, footnote 16.

[137] See Bekaert, G., and Wang, X. (2010). Inflation risk and the inflation risk premium. Economic Policy, 25(64), 755-806. Campbell, J., & Viceira, L. (2009). Understanding inflation-indexed bond markets (No. orrc09-20). National Bureau of Economic Research.

compensates the investors for the risk of *unexpected* changes in inflation.[138,139] For example, in its PR14 Final Determination, Ofwat subtracted an inflation risk premium of 0.3 percentage points from breakeven inflation data when considering breakeven inflation as a cross-check on its "long-run" inflation estimate of 2.8 per cent.[140]

There is also a large difference between break-even inflation and outturn inflation in any one year, or review period. Setting aside our issues with break-even as a biased measure, this means that the inflation component of the return which is capitalised within the RCV may not equate to the real allowed cost of debt, and therefore companies may not recover their expected nominal debt costs in any one period.

Figure 8.1: Break-even and outturn Inflation vary, meaning SPT may under or over recover nominal debt costs in any one period



Source: NERA analysis of data from Bank of England and ONS

8.2. 20 year Break-Even Inflation Even More Problematic

The use of a 20-year breakeven inflation is even more problematic, given the well documented distortions in the index-linked gilt market for long maturities. For example, market reports note the structural imbalance in the supply and demand for long-dated index linked gilts which suppresses yields, and leads to biased break-even measures of inflation. For example, a recent report from Schroders' notes:[141]

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138 See Shen (2006), Liquidity Risk Premia and Breakeven Inflation Rates, Federal Reserve Bank of Kansas City, Economic Review, Second Quarter 2006.

139 This is also recognised by the Bank of England, which notes that care is required in interpreting the market data as a measure of inflation expectations because "*Illiquidity in the conventional and index-linked gilt markets could distort this measure, and in practice there will be an 'inflation risk premium' incorporated in the implied inflation rate."* See Bank of England "Notes on the Bank of England UK Yield Curves", page 5, footnote 8.

140 See Ofwat, December 2014, *"Setting price controls for 2015-20. Final price control determination notice: policy chapter A7 – risk and reward"* – page 36 and footnote 6.

141 *Source: Schroders (June 2016), Pension funds and index-linked gilts – A supply/demand mis-match made in hell*

"*UK private sector defined benefit schemes already own an estimated 80% of the long-dated index-linked gilt market and potential demand is almost five times the size of the market. Supply is expected to remain high, and is likely to increase the market by around a third over the next five years, but this will not come close to matching demand. Pension funds waiting for index-linked gilt yields to rise to "attractive" levels are fighting a losing battle. The imbalance is structural and yields are likely to remain depressed relative to economic fundamentals for the foreseeable future.*"

Similarly, the CMA has noted that a large portion of the long-dated ILD gilt is held by UK pension funds for asset-liability management, but the pension funds do not actively trade their bonds, because the liability matching portfolios are in generally rebalanced passively. Therefore, the majority of the long-dated ILD gilt market is infrequently traded and lacks liquidity.[142]

The potential for 20-year breakeven inflation to overstate inflation is apparent when considering alternative evidence from the OBR and HMT, commonly used by UK regulators including the CMA as a basis of forecasting inflation[143]. These measures support long-term forecast of 3.1 to 3.2 per cent (see Table 8.1 below), whereas the current 20-year break-even supports a value of 3.4 per cent.

Table 8.1 Forecasts from HMT and OBR support RPI inflation of 3.1 to 3.2 per cent below 20Y BE of 3.4 per cent

	2019	2020	2021	2022	2023
HMT (Feb 2018)	2.7	2.8	3.0	3.2	3.2
OBR (Mar 2019)	2.9	2.8	3.1	3.1	3.1

Source: HM Treasury (August 2019), Forecasts for the UK economy: a comparison of independent forecasts, p.18; and Office for Budget Responsibility (March 2019), Economic and fiscal outlook, p.65.

There are further problems with the use of break-even inflation. First, as Ofgem acknowledges the adoption of CPI indexation further complicates the use of break-even inflation given the absence of an equivalent market based CPI measure, i.e. Ofgem will need to make a further adjustment to the RPI break-even inflation estimates for the RPI-CPI wedge. Second, the use of break-even would retain the use of supposedly discredited RPI measures despite Ofgem's switch to a CPI framework.

8.3. Ofgem's Use of OBR Forecasts

In its sector decision, Ofgem also proposes to deflate iBoxx yields using the OBR 5yr forecast for CPI, as an estimate of CPI inflation expectations over the tenor of the bond.[144]

We have examined the performance of OBR 5 year forecast relative to the outturn for the period corresponding to the forecast. Our analysis shows that while OBR 5-year forecast has been practically identical to 2 per cent p.a. for every forecasting period since its publication in 2010, the outturn CPI for the corresponding period has varied between around 1.5 to 2.5

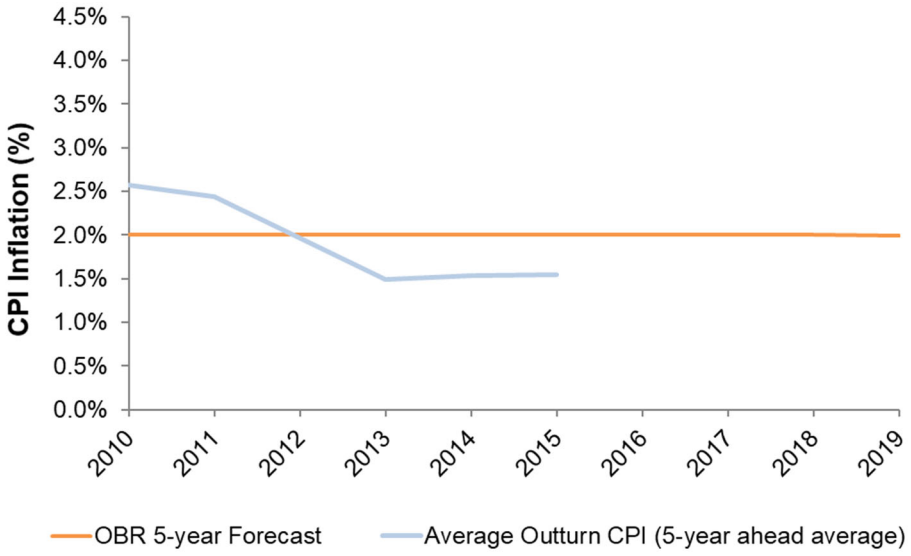
[142] See discussion e.g. in Competition Commission (March 2014), Northern Ireland Electricity Limited price determination, p.13-21.

[143] CMA (October 2015), Bristol Water plc, p.313

[144] Ofgem (24th May 2019) RIIO-2 Sector Specific Methodology Decision – Finance, p.19, footnote 16.

per cent. There is no systematic bias observable in the forecast method, although the period of comparison is relatively short.

Figure 8.2: Comparison of OBR 5-year forecast vs outturn

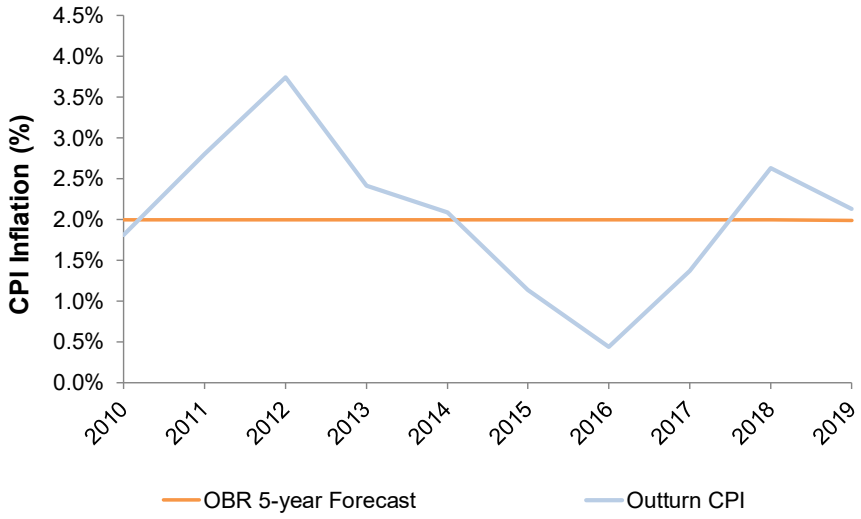


Notes: 2010 Average Outturn CPI corresponds to the average CPI over 2010-2014
Source: NERA analysis

8.4. Outturn Inflation Provides an Alternative Measure

An alternative potential approach is to derive real cost of debt allowance based on the inflation measure used to index energy networks' RAVs. The approach has the advantage that it ensures investors recover their nominal cost of debt: the inflation element of the cost of debt is recovered as a capital gain on the RAV, and the remaining real element is recovered as a return on the RAV. By contrast, Ofgem's proposed approach of using OBR forecast (effectively 2 per cent) means that investors may not recover their costs in any one year or indeed regulatory period.

Figure 8.3: OBR forecasts deviate from outturn inflation; Ofgem's approach may not allow for investor to recover nominal debt costs



Source: NERA analysis

There is a potential downside from using outturn inflation: in any one year outturn inflation may differ substantively from the implied inflation in nominal debt costs, which will reflect inflation expectations over the period of the debt. In this case, the real cost of debt allowance recovered in any year through allowed revenues may be low (or indeed high). The resulting volatility in the allowed real cost of debt component of revenues could potentially be avoided by using an average inflation measure, e.g. using an average inflation measure calculated over a number of years.

8.5. Conclusions

We show that break-even inflation is a biased estimate of inflation, as demonstrated by comparison with OBR inflation forecasts. The retention of the current break-even measure would also require an adjustment for the expected RPI-CPI wedge, which adds further complexity. In its working assumptions for the cost of debt allowance, Ofgem draws on OBR 5yr forecast for CPI as a proxy for CPIH for each date.[145] We believe that it should adopt this approach of the two alternatives it sets out. However, we also consider that the use of outturn inflation, as used to index the asset base, is a viable alternative for determining the real allowed cost of debt. The approach has the advantage that it ensures investors recover their nominal cost of debt, and avoids forecast error.

[145] Ofgem (24th May 2019) RIIO-2 Sector Specific Methodology Decision – Finance, p.19, footnote 16.

Appendix A. Summary of Issues with Ofgem's TMR Estimate in May 2019 Sector Specific Decision

In this appendix, we summarise the issues with the historical real (CPI) return estimate presented in the 2018 UKRN report and CEPA's DGM estimates of the TMR, and explain that these issues have not been addressed by Ofgem in its estimate of the TMR presented in the May 2019 Sector Specific Decision.

A.1. Issues with TMR Estimate from 2018 UKRN Report

As explained in our April 2019 report for SPT,[146] there are two issues issues which lead to the 2018 UKRN report understating historical real CPI-deflated returns, namely: i) the use of the Bank of England (BoE) hybrid CPI/RPI index for deriving historical CPI-deflated returns and ii) the downward adjustment to historical data for alleged predictability of returns at long horizons which forms the basis of the UKRN's lower bound estimate.

A.1.1. Use of BoE hybrid RPI/CPI historical index understates historical CPI deflated returns

The 2018 UKRN report recommends using the historical CPI inflation series from the BoE's Millennium dataset as a basis of calculating real (CPI deflated) historical TMR.

In our April 2019 report for SPT,[147] we explained that the data series from the BoE's Millennium dataset labelled as "CPI" does not represent a CPI index going back to 1900. Instead, it reflects a mix of an actual and back-casted CPI index for the period 1950-2016 and the RPI index for the earlier period 1915-1949 (as well as another cost of living index for the period 1900-1914). In other words, the alleged "CPI" index from the BoE does not measure historical CPI inflation going back to 1900 but instead reflects a hybrid CPI/RPI inflation since 1900. This hybrid index overstates historical CPI inflation, given that RPI has historically been higher than CPI, and understates historical real returns in CPI-deflated terms as a result.

In its May 2019 Sector Specific Decision, Ofgem stated that it was *"not persuaded that outturn inflation data from the Bank of England (BoE) is unreliable"*.[148] Ofgem further noted that the BoE approach is different from that taken by DMS, arguing that the DMS relied on inflation data based on out of date weightings for the period during WW2, which explains why the BoE inflation data is higher.[149] Ofgem also stated that investors today consider CPI or CPIH as the best proxy for inflation expectations, given changes in measurement of RPI since 2010.[150]

Ofgem's response does not address the fundamental concern regarding the BoE "CPI" inflation index being a hybrid index combining historical RPI and CPI inflation from different periods, therefore overstating historical CPI inflation and understating real returns in

[146] NERA (April 2019), Cost of Equity for SPT in RIIO-2, Appendix C.

[147] NERA (April 2019), Cost of Equity for SPT in RIIO-2, Appendix C.

[148] Ofgem (May 2019), RIIO-2 Sector Specific Methodology Decision – Finance, para 3.73.

[149] Ofgem (May 2019), RIIO-2 Sector Specific Methodology Decision – Finance, para 3.73-3.74.

[150] Ofgem (May 2019), RIIO-2 Sector Specific Methodology Decision – Finance, para 3.75.

CPI terms as a result. Ofgem's comment on the comparison of two alternative sources of historical *RPI inflation* data (from the BoE and the DMS) during WW2 period merely highlights differences between two alternative *RPI historical indices*, neither of which however measure historical CPI inflation. We agree with Ofgem that there are differences in the historical RPI indices used by the DMS and the BoE in the period prior to 1950. We have reflected both these alternative historical RPI indices in our updated estimate of the TMR in Section 2.3.1.

We agree that CPI/CPIH reflects the relevant measure of UK inflation *going forward*, especially given the structural change in RPI in 2010. However, in estimating historical realised returns since 1900, the relevant question is what is the appropriate measure of *historical inflation* over the historical period since 1900 as opposed to what is the relevant inflation measure going forward. As discussed in Section 2.3.1, RPI inflation i) is the only available historical series as a measure of UK inflation going back to 1900, ii) RPI has been the official measure of UK inflation until 2003 and iii) RPI represents the appropriate index to use for assessing historical UK inflation according to the ONS paper by O'Donoghue et. al. (2004).

In Section 2.3.1, we therefore derive a real (CPIH) TMR for RIIO-2 by: i) deflating historical returns in nominal terms using historical RPI inflation (the only available and reliable measure of historical UK inflation going back to 1900) and ii) converting the historical RPI deflated returns into a CPI equivalent using the historical RPI-CPI wedge, estimated based on available historical data on the difference between RPI and CPI inflation. Applying the historical RPI-CPI wedge to historical returns deflated using the RPI index provides an estimate of CPI-deflated real returns, which can be used as a basis of setting real TMR for RIIO-2 (based on CPIH indexation). This approach addresses the concerns around recent structural changes to RPI in 2010, which is corrected for by adjusting the historical real RPI returns to a CPI equivalent, which is unaffected by the 2010 ONS change in methodology for calculating RPI.

8.5.1. Evidence on predictability is contentious and established estimators support a lower downward adjustment to arithmetic mean to reflect long investment horizons

The 2018 UKRN report recommended that the TMR should be estimated based on a geometric return of 5 per cent (CPI-deflated, but based on an overstated measure of historical CPI, as we explain above), plus an adjustment of 1 to 2 per cent to calculate the arithmetic return, where the lower bound adjustment of one per cent is based on the authors' analysis of the expected decline in variances over a 5 to 10-year investment horizon.[151]

In our April 2019 report for SPT,[152] we explained that evidence on returns predictability is highly contentious and that the 2018 UKRN report approach ignores more established methods developed by Blume and JKM for estimating unbiased estimators of the TMR for long investment horizons which also consider serial dependence. We also showed that these established Blume and JKM estimators, which were also used by the CMA in 2014 NIE

[151] Wright, Burns, Mason, Pickford (2018), Estimating the cost of capital for implementation of price controls by UK Regulators, An update on Mason, Miles and Wright (2003), Appendix E.

[152] NERA (April 2019), Cost of Equity for SPT in RIIO-2, Appendix C.

decision, provide relatively modest downward adjustments to the simple arithmetic mean: e.g. assuming an investment horizon of up to 10 years, as per the 2018 UKRN report, implies a 10-40 bps downward adjustment to the arithmetic mean calculated for a 1-year holding period, which is far lower than the 1 per cent downward adjustment assumed in the 2018 UKRN report.[153]

In its May 2019 Sector Specific Decision, Ofgem stated that it was *"comfortable with the arithmetic uplift implied in the UKRN Study"* and that our report *"appeared to misinterpret the UKRN Study by assuming that an adjustment of 1% had been made to the simple arithmetic mean of realised returns to derive the lower bound 6% real TMR"*.[154]

Ofgem's response does not address the fundamental concern raised in our report. We agree that the 2018 UKRN study derived a TMR by adding 1-2 per cent to the geometric mean of historical realised returns to account for alleged returns predictability at long horizons. However, as we explained in our April 2019 report for SPT,[155] had UKRN used the established Blume and JKM estimators, it would have calculated a substantially higher TMR for its assumed investment horizon of 10 years compared to its bottom end TMR estimate of 6 per cent (real, CPI).

In our April 2019 report for SPT, we have presented this result as a *lower downward adjustment to the simple arithmetic return of 7 per cent than the 1 per cent assumed in the UKRN report*.[156] However, this result can equally be represented as a *higher upward adjustment to the geometric return of 5 per cent than the 1 per cent assumed in the UKRN report*. Indeed, the mathematical relationship between a geometric and arithmetic return is that the arithmetic return is equal to the geometric return plus half the variance. Given the historical standard deviation of annual realised returns in the UK has been around 20 per cent, the difference between the geometric and arithmetic mean is 2 per cent.[157] As a result, the lower bound TMR of 6 per cent calculated by the UKRN reflects both a 1 per cent upward adjustment to a geometric mean as well as a 1 per cent downward adjustment to the simple arithmetic mean. Either way, our conclusion is unchanged: had the UKRN report used the established Blume and JKM methods, it would have calculated a substantially higher TMR for its assumed 10-year investment horizon.

A.2. Issues with CEPA's DGM Model

A.2.1. DGM evidence presented by Ofgem in Framework Consultation and our response

In its February 2018 report for Ofgem, CEPA presented estimates of the TMR using its own constructed DGM model for the UK FTSE of between 7.5 and 8 per cent nominal (5.5 and 6

[153] Updated evidence in Table 2.2 shows the Blume and JKM estimators for a 10-year investment horizon show a 20-40 bps downward adjustment to the arithmetic mean calculated for a 1-year holding period.

[154] Ofgem (May 2019), RIIO-2 Sector Specific Methodology Decision – Finance, para 3.83.

[155] NERA (April 2019), Cost of Equity for SPT in RIIO-2, Appendix C.

[156] NERA (April 2019), Cost of Equity for SPT in RIIO-2, Appendix C, p.77.

[157] DMS (February 2019), Credit Suisse Global Investment Returns Yearbook 2019, p.

per cent real CPI).[158] Ofgem used CEPA's estimates it its subsequent March 2018 RIIO-2 Framework Consultation.[159]

In our report for another energy network,[160] we explained that CEPA's DGM-based TMR estimates were understated due to implausibly low assumptions around dividend growth rates, the key determinant of the DGM TMR. CEPA assumes that UK FTSE dividends would grow in line with the short term and long-term growth in UK GDP. The use of UK GDP growth as a basis of forecasting future FTSE dividends is incorrect, given that 70 per cent of earnings of FTSE companies come from countries outside of the UK, which have higher forecast GDP growth than the UK.[161] In addition, UK GDP growth forecasts are currently depressed (e.g. due to Brexit effects) and are substantially lower than independent analyst forecasts of dividend growth rates for FTSE stocks, which are used by the Bank of England as a basis of forecasting short-term dividend growth in its own DGM.[162]

As a result of understating dividend growth rates, CEPA's estimates of the DGM-based TMR are substantially lower than the DGM estimates from the Bank of England, which recognises that UK FTSE companies derive 70 per cent of their earnings from overseas in deriving long-run dividend growth rates and also uses available analyst forecasts of short-run dividend growth rates. As shown in section 2.3.2, the Bank of England's DGM estimates support a TMR of between 8 and 9 per cent (real CPI deflated), substantially higher than CEPA's estimates of around 5.5 to 6 per cent (real CPI deflated).

A.2.2. DGM evidence presented by Ofgem in December 2018 Sector Specific Consultation and our response

In the December 2018 Sector Specific Consultation, Ofgem presented a sensitivity of CEPA's DGM TMR estimates to alternative assumptions on short-run and long-run dividend growth rates, replicated in Figure A.1 below.

158 Based on figures presented in Figure E.7 and Table E.4 in CEPA (February 2018), Review of cost of capital ranges for Ofgem's RIIO-2 for onshore networks. Nominal values deflated into CPI terms using a 2 per cent CPI inflation forecast based on OBR.

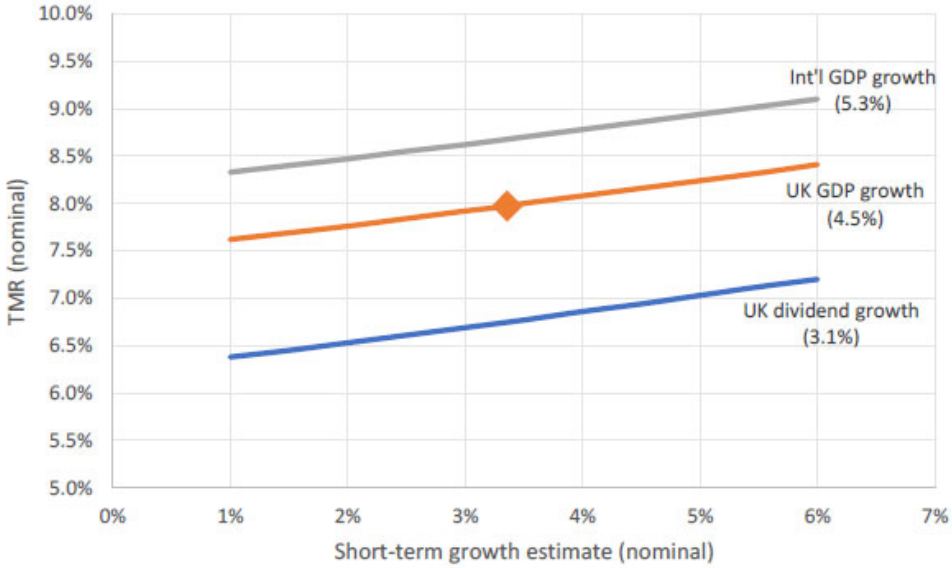
159 Ofgem (March 2018), RIIO-2 Framework Consultation, para 7.43.

160 NERA (May 2018), Cost of Equity for RIIO-2, A report for Western Power Distribution.

161 For example, the weighted average long-run GDP growth rate for the different regions from which FTSE companies derive their earnings as of October 2016 was around 5.9% (nominal), while the UK long-run GDP growth rate assumed by CEPA is 4.5 per cent (nominal). Source: Bank of England (2017), An improved model for understanding equity prices, Quarterly Bulletin 2017Q2, p.91, Chart 7; CEPA (February 2018), Review of cost of capital ranges for Ofgem's RIIO-2 for onshore networks, p. 117.

162 Bank of England (2017), An improved model for understanding equity prices, Quarterly Bulletin 2017Q2, p.90, Chart 3; CEPA (February 2018), Review of cost of capital ranges for Ofgem's RIIO-2 for onshore networks, p. 116.

Figure A.1: Sensitivity of CEPA's DGM to dividend growth assumptions



Source: Ofgem (December 2018), RIIO-2 Sector Specific Methodology Consultation, Finance, Figure 21, p. 94

For the short term dividend growth forecasts, Ofgem assumed values between 1 and 6 per cent (nominal) which according to Ofgem reflect a *"range of outturn and forecast nominal GDP growth rates over short time horizons over the past twenty years"*, noting that *"credible short term growth assumptions are currently closer to the middle of the illustrated range"* (i.e. around 3.5 per cent nominal).[163]

For long term dividend growth forecasts, which are the key driver of the DGM TMR as shown in Figure A.1, Ofgem presented three approaches:

- Using UK GDP growth forecasts of 4.5 per cent nominal (as per CEPA's original approach);
- Using historical UK dividend growth of 3.1 per cent nominal, which is lower than CEPA's UK GDP forecasts; and
- Using international GDP growth forecasts of 5.3 per cent nominal, which is higher than CEPA's UK GDP forecasts.

Based on the above sensitivities, Ofgem concluded on a revised DGM TMR range of 7.5 to 8.5 per cent nominal (5.5 to 6.5 per cent real CPI).[164]

In our April 2019 report for SPT,[165] we highlighted a number of issues with Ofgem's/CEPA's sensitivity analysis, which result in Ofgem's/CEPA's DGM understating the TMR. We briefly summarise these issues below.

First, we explained that the long-run growth rate assumption based on international GDP growth forecasts is the only appropriate assumption for estimating the TMR for the UK

[163] Ofgem (December 2018), RIIO-2 Sector Specific Methodology Consultation, Finance, p. 93.

[164] Ofgem (December 2018), RIIO-2 Sector Specific Methodology Consultation, Finance, p. 94.

[165] NERA (April 2019), Cost of Equity for SPT in RIIO-2, Appendix A.3.

FTSE, given that FTSE companies derive 70 per cent of their earnings from outside of the UK (i.e. only the top end of Ofgem's/CEPA's long-run forecasts is appropriate).

We also highlighted concerns with Ofgem's/CEPA's assumption on international GDP forecast growth rate of 5.3 per cent nominal. Ofgem/CEPA derived its long-run international GDP forecast by taking the difference between short-run GDP growth forecasts for the UK and "advanced economies" and added this difference to its own long-run forecast of UK GDP growth.[166] It is unclear why Ofgem/CEPA: i) did not use long-run forecasts of international GDP directly and ii) did not calculate a weighted average forecast GDP growth based on countries from which FTSE companies derive their earnings, as opposed to using a generic "advanced economies" figure which may not correctly represent the relevant countries/weights. In contrast, the Bank of England's DGM model uses long-run GDP forecasts for the relevant countries weighted by the sources of FTSE earnings, which supports higher growth (of 5.9 per cent nominal as of 2016), suggesting that Ofgem/CEPA are understating the TMR even when using the top end of its long-run dividend growth forecasts based on "international GDP growth".

Second, we explained that Ofgem's/CEPA's reliance on short-run UK GDP growth of around 3.5 per cent nominal understates short-run dividend growth for UK FTSE, given:

- short-run UK GDP growth data is depressed (e.g. due to Brexit) and indeed substantially lower than Ofgem's/CEPA's own estimate of the conceptually correct short-run international GDP growth of 4.5 per cent;[167]
- short-run GDP growth forecasts (for UK but also the conceptually correct international figure) are substantially lower compared to short-run analyst forecasts of FTSE dividend growth (of around 8 per cent nominal using BoE estimates from 2016[168]).

We also discussed several issues with Ofgem's/CEPA's assumptions on UK GDP growth rates and UK dividend growth rates, although we highlighted that using these growth rates is not appropriate for estimating the DGM-based TMR for the UK FTSE. [169]

A.2.3. DGM evidence presented by Ofgem in May 2019 Sector Specific Decision and our response

In its May 2019 Sector Specific Decision, Ofgem stated that it "*remain[s] sceptical of whether the BoE model is appropriate for informing price control decisions"*, given the BoE itself stated that *"investors' true dividend expectations cannot be observed, so any proxy for these used in a DDM, whether derived from analyst surveys or GDP forecasts, is necessarily only an approximation"* and given this uncertainty, the BoE's analysis is to *"focus less on the precise level of the ERP and more on changes in the ERP over time or on the level of the ERP*

[166] Ofgem states that CEPA calculated the long term international growth rate of 5.3 per cent based on "*difference between the IMF's short-term advanced economies GDP growth forecasts and the OBR's short-term GDP growth forecasts to the long-term UK GDP growth figure of 4.5%"*. Source: Ofgem (December 2018), RIIO-2 Sector Specific Consultation, Finance, p. 93.

[167] Ofgem (December 2018), RIIO-2 Sector Specific Consultation, Finance, p. 93, fn. 96.

[168] See NERA (April 2019), Cost of Equity for SPT in RIIO-2, Table A.1.

[169] See NERA (April 2019), Cost of Equity for SPT in RIIO-2, Appendix A.3 for details.

relative to historic averages".[170] In contrast, Ofgem argued that it *"asked CEPA to focus on the precise level, not the changes over time, to provide information on the TMR expectations"* and therefore it *"believes that the BoE DGM is less appropriate for our purposes than the CEPA approach"*. Ofgem also added that *"by relying on analyst forecasts for GDP growth the BoE model is liable to bias"*.[171]

Ofgem concluded on a TMR of 8 per cent nominal (6 per cent real CPI) based on CEPA's DGM evidence.[172] This corresponds to the estimate based on using UK short-run and long-run GDP growth as basis of FTSE dividend forecasts (highlighted in Figure A.1 above).

Ofgem's reasoning for dismissing the BoE's DGM model results equally applies to the CEPA model. The BoE stated that investor expectations of dividend growth are inherently unobservable, with any proxy of dividend growth only an approximation, and the BoE therefore tends to focus on changes in the ERP(TMR) rather than absolute levels. However, the issue that investor expectations of dividend growth are unobservable applies to any DGM model, including CEPA's. Ofgem cannot therefore on the one hand reject the BoE's model because expected dividends are unobservable and hence the model should be used for assessing trends and not levels, while at the same time argue that CEPA's model, despite the same uncertainty in dividend forecasts, is able to reliably estimate a TMR level.

As discussed above, FTSE companies derive over 70 per cent of their earnings from outside of the UK, where GDP growth forecasts are higher compared to UK GDP growth rates, and therefore using a proxy of future growth in dividends based on UK GDP forecast growth understates the TMR.[173]

As a minimum, Ofgem should use a forecast "international GDP" growth rate as a proxy for dividend growth rates when estimating the TMR for UK FTSE. Using Ofgem's own calculations replicated in Figure A.1 support a TMR of slightly below 9 per cent nominal (7 per cent real CPI) as a minimum, based on Ofgem's estimate of "international GDP growth" of 4.5 per cent nominal in the short-run and 5.3 per cent nominal in the long-run.[174]

Ofgem also dismisses the use of analyst forecasts as a basis of short-run dividend projections, given these may be liable to bias. Our review of recent literature reveals that any evidence of historical optimism bias is not relevant today:

- Much of the historical literature on optimism bias focussed on US companies prior to institutional reforms in 2003, when leading investment banks agreeing to reform analyst

[170] Ofgem (May 2019), RIIO-2 Sector Specific Methodology Decision – Finance, para 3.86.

[171] Ofgem (May 2019), RIIO-2 Sector Specific Methodology Decision – Finance, para 3.87.

[172] Ofgem (May 2019), RIIO-2 Sector Specific Methodology Decision – Finance, para 3.103.

[173] For example, the weighted average long-run GDP growth rate for the different regions from which FTSE companies derive their earnings as of October 2016 is around 5.9% (nominal), while the UK long-run GDP growth rate assumed by Ofgem/CEPA is 4.5 per cent (nominal). Source: Bank of England (2017), An improved model for understanding equity prices, Quarterly Bulletin 2017Q2, p.91, Chart 7; Ofgem (December 2018), RIIO-2 Sector Specific Consultation, Finance, p. 93 and fn. 96.

[174] Ofgem (December 2018), RIIO-2 Sector Specific Consultation, Finance, p. 93 and fn. 96.

pay structures and to rely more on external analyst input in order to mitigate bias in analyst forecasts.[175]

- As a result of the reforms, post-2003 US literature suggests that any bias has been substantively addressed: for example, Ashton et al. (2011) find that the bias in the long-run dividend growth rate due to analyst optimism is insignificant when a US dataset running up to 2006 is used.[176]
- Academic literature based on non-US market data also questions the existence of optimism bias. For example, for the UK, Ryan and Taffler (2006) find that the ratio of sell and buy recommendations is less distorted than in the US.[177] Galanti and Vaubourg (2017) find that optimism bias significantly reduced after the implementation of Commission Sharing Agreements (CSA), which unbundle brokerage and investment research fees, drawing on evidence from France.[178]

Based on our survey of these studies, we conclude there is no evidence that optimism bias in the UK is as prevalent as it may have been in the US in the past.

The use of analysts' forecasts as inputs in to the DGM has a long history in US rate of return testimonies and US court decisions consider it the most reliable way of applying a DGM. For example, in 2014, the Federal Energy Regulatory Commission (FERC) relied on security analyst forecasts published by the Institutional Brokers Estimate Systems, when estimating short-term growth rates in the first step of the model.[179]

The use of analyst forecasts also reflects the general approach in academic literature, for example:

- Chin, M. and Polk, C. (2015) use I/B/E/S survey data for calculating short-term dividend growth rates in a DDM model used for estimating expected UK returns;[180]
- Li et al (2013) also use I/B/E/S analyst forecasts as the basis for estimating growth rates that are then used for solving a DDM.[181]

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175 Sudarsanam, S. (2011), Cost of Equity for Regulated Companies: An International Comparison of Regulatory Practices, p.11.

176 Ashton, D.; Gregory, A. & Wang, P. (2011): Analysts' Optimism in Earnings Forecasts and Biases in Estimates of Implied Cost of Equity Capital and Long-run Growth Rate, University of Bristol Working Paper.

177 Ryan, P. and Taffler, R. (2006), Do Brokerage houses add value? The market impact of UK sell-side analyst recommendation changes, British Accounting Review, vol.38, no.4, pp.371-386.

178 Galanti, S., and Vaubourgm A.G. (May 2017), Optimism bias in financial analysts' earnings forecasts: Do commission sharing agreement rules reduce conflicts of interest?

179 Federal Energy Regulatory Commission, Docket No. EL11-66-001, Opinion No. 531 – Order on Initial Decision, Issued: June 19 2014, p.10, para 17.

180 Chin, M. and Polk, C. (January 2015), Bank of England Working Paper No 520, A forecast evaluation of expected equity return measures, pp.6-7

181 Li, Y., Ng, D. and Swaminathan, B. (2013), Predicting market returns using aggregate implied cost of capital, Journal of financial economics Volume 110 Issue 2, pp.419-436.

- Patterson, C. (1995) states that "*in valuation tests …. offered strong evidence that investors place the greatest weight on forecasts from Institutional Brokers of Analysts*"[182]

The use of analyst forecasts in the DGM model is also consistent with approaches by central banks including the BoE as well as the European Central Bank (ECB). While the ECB notes that the use of analyst forecasts may be problematic, it also points that:

> *"a better gauge for earnings and dividend expectations than analysts' expectations is hard to come by. (…) In fact,* ***these data constitute the most widely used source of forward-looking earnings expectations for practitioners****"*[183]

We therefore conclude that analyst forecasts should be used as best available evidence on the expected dividends in the short term, in line with approaches by academic literature, financial institutions including central banks and US regulatory precedent.

As discussed in Section 2.3.2, using analyst forecasts as a basis of short-run dividend growth and using the correct international GDP growth, weighted by the earnings sources for FTSE companies, as a basis of long-run dividend growth supports a TMR of around 8 to 9 per cent (real CPI), based on the BoE's estimates.

As a result, the plausible real CPI-deflated TMR range based on the application of the DGM model lies between 7 per cent (based on Ofgem's own, and potentially understated, international GDP growth forecasts) and 9 per cent (based on the BoE's short-run analyst forecasts and long-run international GDP growth weighted by earnings sources for FTSE companies).

As discussed in Section 2.4, DGM estimates should be treated with caution, notably given the relative sensitivity of the results to the long-term dividend growth assumption, for which there are no independent analyst forecasts. However, we conclude that the estimated TMR range of 7 to 9 per cent (real CPI) does not provide any basis to conclude that historical estimates of the TMR are overstated.

[182] Patterson, C. (1995), "The Cost of Capital", p.95

[183] ECB (2018), Measuring and interpreting the cost of equity in the euro area – Published as part of the ECB Economic Bulletin Issue 4/2018, Section 3. Available at: https://www.ecb.europa.eu/pub/economic-bulletin/articles/2018/html/ecb.ebart201804_02.en.html#toc1

Appendix B. Estimating the Impact of Political Risk on Beta

This Appendix sets out our quantification of the impact of Labour's nationalisation plans on GB's energy networks' betas.

In theory, political risk suppresses beta estimates as political interventions are generally uncorrelated with the market risk measured by the CAPM framework. One way to quantify the impact of Labour's nationalisation plan on beta risk is to construct a counterfactual beta that is unaffected by political risks, and only reflects the underlying business risks of the network utilities.

We can construct the counterfactual case by introducing time-specific dummies for the relevant dates when the network share prices are affected by heightened political risk. For example, utilities stocks' may have reacted adversely on the dates that Labour announced its plans to nationalise GB utilities and when Labour were going well in national opinion polls.

As a first step, we estimate the counterfactual betas for National Grid and SSE, excluding share price data for 16th May 2017 when Labour published its manifesto to nationalise the GB water companies[184], and 16th May 2019 when Labour proposed to nationalise energy networks.[185] In addition to these announcement dates, we would expect the market's perception of the likelihood of Labour winning the next election to have a material impact on networks' share prices and beta risk, i.e. those dates when Labour's plans became a potential reality. To take into account these dates, we also exclude those observations where Labour is leading in the election poll tracker, as a measure of the heightened risk that Labour implements its nationalisation plan.[186] There were two main periods where Labour was ahead in the polls: July to October 2017 and April to July 2019.

[✂]

[184] BBC news (16 May 2017), Labour manifesto at-a-glance: Summary of key points, https://www.bbc.com/news/election-2017-39933116. See full 2017 Labour Manifesto at p.19: https://labour.org.uk/wp-content/uploads/2017/10/labour-manifesto-2017.pdf

[185] Labour published the plan to renationalise the UK's entire electricity and gas system in its 16 May 2019 paper "Bring Energy Home", see: https://www.labour.org.uk/wp-content/uploads/2019/03/Bringing-Energy-Home-2019.pdf

[186] We draw on polling data from 2017 to 2019, and identify the dates when the Labour leads in the poll by greater or equal to 5 per cent.

Appendix C. National Grid's UK and US Asset Betas with Full US Comparator Set

In section 3.3.3 we presented National Grid's US and UK asset beta decomposition evidence based on the three most comparable companies for National Grid's US business (Consolidated Edison, Unitil Corp and Eversource Energy).

[✂]

Appendix D. Risk Assessment Relative to European Comparators

In section 3.3.4 we presented empirical evidence on betas from European (Italian and Spanish) comparator companies. In this appendix, we set out further details on comparing SPT to these listed European comparators, with regard to the systematic risk that investors face when investing in these companies.

Table D.1 summarises our risk assessment for these markets, relative to SPT. We find that in general, SPT faces similar risks as Italian and Spanish networks.

In Italy, networks are regulated under a hybrid of a price cap (on opex) and a rate of return regime (on capex). Due to a periodic true-up, only a very small share of opex is subject to volume risk (around 5 per cent).[187] Moreover, opex cost risk is partially mitigated through a 50 per cent sharing factor. Italian networks face very little capex risk given that capex is effectively passed through.

Whereas the Italian networks face relatively low risk based on volume and cost risk considerations, the regulator has announced its intention to introduce a RIIO-like incentive based framework. Given the expected change to the regime, we consider the Italian networks face a similar risk to SPT.

In Spain, transmission networks are regulated under revenue caps, as is SPT. On the cost side, they are subject to a 50 per cent sharing factor on capex, but bear the full cost risk on opex. Naturgy (GD) is subject to a revenue cap, based on opex and capex volume drivers. There is no sharing of opex and capex out or underperformance which indicates that it faces greater cost risk than UK networks, although this is mitigated by annual updates to the allowance in line with volume drivers and unit costs.[188] As with the Italian regime, we consider that investors in SPT face a similar degree of risk as investors in Spanish networks.

Based on our relative risk analysis, we consider that the Italian and Spanish networks face broadly similar risks to SPT.

[187] See for example Aeegsi, Decision 514/2013/R/gas (Tariff regulation for gas transport for RP4), Article 13.

[188] **Gas**: Ley 18/2014, https://www.boe.es/boe/dias/2014/10/17/pdfs/BOE-A-2014-10517.pdf; **Electricity**: Ley 24/2013 (https://www.boe.es/boe/dias/2013/12/27/pdfs/BOE-A-2013-13645.pdf), Royal Decree 1047/2013 (https://www.boe.es/boe/dias/2013/12/30/pdfs/BOE-A-2013-13766.pdf) and Royal Decree 1048/2013 (https://www.boe.es/boe/dias/2013/12/30/pdfs/BOE-A-2013-13767.pdf).

Table D.1: Relative risk assessment shows that SPT bears similar risks as listed European comparators

	GB	Italy	Spain	
	SPT	Snam (GT),Terna (ET), Acea (ED)	Enagas (GT), Red Electrica (ET)	Naturgy (GD)
Form / length of revenue period	• Revenue-cap • 8 years [5 years in RIIO-2]	• Hybrid of price cap (opex) and cost plus/pass through (capex), but virtually no volume risk on opex as a result of true up • 4 years (8 years under discussion)	• Revenue-cap • 6 years • Volume drivers for GT revenues based on outturn demand	• Revenue-cap (s.t. volume drivers) • Volume drivers/unit costs can be updated every 6 years
Setting cost allowances	• Expert review of totex • DB pension deficit recovery over 15yrs with 3Y re-valuation (but risk on post-2012 liabilities) • Re-openers for some costs • COD update = 10Y trailing average iBoxx	• Based on actual opex in base year, updated annually according to CPI-X formula.	• Allowances set based on "standard" costs for capex and opex (review of historical data & technical input) • Standard costs revised at the start of every regulatory period and every 3 years for GT	• Revenues not linked to RAB but based on base year costs (2002) rolled forward with volume drivers (demand and customer number growth)
Outturn cost risk & incentives	• TIM • Uncertainty/pass-through of non-controllables • Disapplication of price control	• Opex: 50% sharing factor, limited volume risk • Ex-post recognition of actual capex spent • Additional WACC for some investments (e.g. security of supply)	• Opex: no sharing factor • Capex: 50% sharing factor; profit from underspend capped at 12.5% of costs (ET only)	• No explicit sharing of out or underperformance
Quality of Service/Output incentives	• Performance incentives: +0.9/-1.4% of RORE	• Quality of service premiums/penalties (mainly technical, e.g. interruptions)	• ET: Availability incentive (of minor importance, capped)	
Other	• Uncertainty over future role of system from distributed generation	• Risks from prospective regulatory reforms (longer controls, outputs based regime)		• Higher remuneration for some assets

Note: In June and July 2019, the Spanish regulator opened a public consultation on the gas and electricity sectors for the regulatory periods of 2020-2025 (electricity) and 2021-2026 (gas). A final decision is expected before January 2020
Sources: Italy: Aeegsi, Decision 514/2013/R/gas (Tariff regulation for gas transport for RP4), Aeegsi, Decision 654/2015/R/EEL (Tariff regulation for electricity transmission); Spain: Gas: Ley 18/2014, https://www.boe.es/boe/dias/2014/10/17/pdfs/BOE-A-2014-10517.pdf; Electricity: Ley 24/2013 (https://www.boe.es/boe/dias/2013/12/27/pdfs/BOE-A-2013-13645.pdf), Royal Decree 1047/2013 (https://www.boe.es/boe/dias/2013/12/30/pdfs/BOE-A-2013-13766.pdf) and Royal Decree 1048/2013 (https://www.boe.es/boe/dias/2013/12/30/pdfs/BOE-A-2013-13767.pdf).

Appendix E. Halo Effect Supporting Analysis

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