REVIEW OF COST OF CAPITAL RANGES FOR OFGEM'S RIIO-2 FOR ONSHORE NETWORKS

OFGEM

FEBRUARY 2018

FINAL REPORT

Submitted by:

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IMPORTANT NOTICE

1. INTRODUCTION

Cambridge Economic Policy Associates (CEPA) has been appointed by Ofgem to provide support in reviewing the component parts of the cost of capital used in revenue allocations by its Networks Division. This report focuses on cost of capital estimates pertaining to network operator price controls currently regulated under RIIO-1 (covering RIIO GD1, T1 and ED1). We refer to the upcoming determinations as the RIIO-2 price controls and set out our recommendations for Ofgem.

In a related report published in January 2018, we also advised Ofgem on an approach to assessing the appropriate cost of capital for new assets, such as Offshore Transmission Owner (OFTO) assets, interconnectors, and new, separable and high value onshore electricity transmission projects such as Hinkley Sea-Bank (HSB) connection.[1] Our approach to the RIIO-2 price controls set out in this report is designed to be consistent with the approach for new assets. However, a consistent approach does not necessarily imply an identical cost of capital should be set; a feature of a robust regime is that the cost of capital reflects the specific characteristics of the investments under consideration.

1.1. Objectives and scope

The main objective of this report is to provide an overall approach to cost of capital estimation for network operator price controls that are currently regulated under RIIO-1. Based on this proposed estimation approach, this report then sets out recommended ranges to be applied in RIIO-2. These ranges reflect our view of the cost of capital based on currently available evidence – consequently, the estimates will need to be updated when further market evidence becomes available. While providing point estimates of the cost of capital is beyond the scope of this report, we do provide discussion of how point estimates might be reached. This report also provides guidance on how the proposed ranges could be updated for future decisions.

We consider that it remains appropriate to continue using the Capital Asset Pricing Model (CAPM) for estimating the cost of equity. While its suitability has been subject to extensive debate, the CAPM is well-understood and the basis for regulatory determinations in the UK. It is introduced more fully in Section 3. We do, however, make use of alternative sources of evidence, both as cross-checks to ensure overall rate of return estimates are appropriate, and where evidence on individual CAPM parameters is not available.

This report is part of a framework study covering cost of capital estimation across Ofgem's Networks Division. The analysis and approaches discussed relate only to network operator price

[1] CEPA (2018) 'Review of cost of capital ranges for new assets for Ofgem's networks division', January 2018, available at: https://www.ofgem.gov.uk/system/files/docs/2018/01/cepareport_newassets_23jan2018.pdf

controls, and not new asset investments. Our recommended cost of capital ranges cover both electricity and gas, and both transmission and distribution. We consider that the recommended framework and overarching approach are sufficiently flexible to deal with differences between price control determinations and as such, we present one range rather than focus upon individual sectors or companies separately.

In 2017, Ofgem, through the UK Regulators Network, jointly commissioned a study on the cost of capital from a team of academics and practitioners led by Professor Stephen Wright.[2] We have used this report as a reference. The UKRN report makes ten recommendations, which we have discussed where relevant in this report. Since it was being developed in parallel to our own, we have made use of drafts of the UKRN report, and so references in this document refer to the "UKRN draft report".

1.2. Report structure

Following this introductory section, the report is structured as follows:

- Section 2 provides context for setting an appropriate cost of capital for the RIIO-2 price controls.
- Section 3 sets out the framework we have used for estimating the cost of capital.
- Section 4 discusses various approaches to estimating the cost of debt.
- Section 5 discusses various approaches to estimating the cost of equity.
- Section 6 presents capital structure and financeability analysis.
- Section 7 summarises our proposed range and discusses how Ofgem could proceed from here.

The report is also supported by multiple annexes. Annexes A and B cover indexation and inflation respectively, while Annexes C and D discuss the approach to estimating beta. Annexes E and F relate to setting equity market returns, including use of a Dividend Growth Model (DGM).

[2] "Estimating the cost of capital for implementation of price controls by UK regulators".

2. CONTEXT

We set out below how the cost of capital is utilised in regulatory determinations and what are the key factors around determining the cost of capital for the RIIO-2 price controls. The subsequent sections cover:

- **The role of the cost of capital and RIIO-1 performance to date**: the allowed return represents one source of returns to shareholders, and understanding the risks and effective equity returns helps inform our assessment of the cost of capital.
- **Market Asset Ratios**: understanding market expectations of regulated companies (through both daily share price and transaction data) gives an indication of whether allowed returns have been suitable.
- **Competitive benchmarks**: having real-world benchmarks of required returns bid for regulated assets, such as OFTOs and the Thames Tideway Tunnel (TTT), provide a reference point for our assessment on onshore network returns.
- **Regulatory consistency**: a key consideration for a regulator is how any potential decision compares to other current estimates of the cost of capital by other regulators – Ofwat and the CAA have released details around the methodology for the cost of capital for the PR19 and H7 price controls respectively.

To conclude the section, we consider the key issues to be addressed in the remainder of the report.

2.1. Role of the cost of capital in price controls and RIIO-1 performance to date

Ofgem sets price control decisions for gas and electricity networks in Great Britain. This includes both distribution and transmission networks. There are three groups of price controls under the RIIO heading, each of which last eight years. The decisions fall under Ofgem's RIIO framework, introduced for the two price controls beginning in April 2013. The most recent onshore network decision is the RIIO ED1 price control, beginning in April 2015.

Table 2.1: Description of Ofgem RIIO price controls

Price Control	Years	Number of networks
Gas Distribution – RIIO GD1	Apr 2013 – Mar 2021	8
Gas and Electricity Transmission – RIIO T1	Apr 2013 – Mar 2021	4 (3 electricity, 1 gas)
Electricity Distribution – RIIO ED1	Apr 2015 – Mar 2023	14

The Weighted Average Cost of Capital (WACC) compensates regulated networks for an assessment of efficient financing costs. The allowed return building block is a function of the WACC itself and the Regulated Asset Value (RAV)[3].

The introduction of the RIIO framework saw Ofgem update several aspects of its approach to determining the cost of capital. One structural change was the introduction of indexation of the cost of debt. This meant that rather than set an ex-ante estimate for the cost of debt over the price control, the cost of debt allowance is updated based on outturn evidence from a benchmark index. Further information on the most recent Ofgem decisions and upcoming price control decisions by Ofwat and the CAA are discussed later within this section.

Sources of equity returns

Equity investors have two sources of returns from investment in a regulated company during a price control, i) the base return generated by the cost of capital and ii) excess returns from performance against other parts of the price control settlement. Ofgem presents a Return on Regulatory Equity (RoRE) measure in annual reporting to illustrate the effective returns to equity holders.

In the UKRN draft report, the authors discuss the distinction between the concepts of Regulatory Expected Return (RER) and the Regulatory Allowed Return (RAR). While these two concepts are related, they are not necessarily equal. The RER is an ex-ante expectation of total returns, including any systematic expectations of outperformance on costs and incentives. It therefore aligns with our description of RoRE, which is an ex-post measure of actual returns to equity holders. The RAR is the baseline return set by the regulator, and aligns to our discussion of the cost of capital in this report. The gap between RER and RAR represents the systematic outperformance (or underperformance) of the regulatory package expected to accrue to equity holders. Our approach aims to set a cost of capital that is commensurate with the regulatory regime – too low a cost of capital creates risks around financeability, while too high a cost of capital leads to higher customer bills and excessive returns.

The UKRN draft report discusses the importance of clear terminology around the cost of capital and we have sought to be transparent with our approach. We have used the UKRN draft report as a reference when undertaking this analysis and refer to its recommendations where relevant throughout this paper.

Evidence from RIIO-1

The base cost of equity is different across sectors and companies, with the allowed real (RPI) post-tax cost of equity captured in the below table. The figure below shows Ofgem regulated

[3] This is also referred to as Regulated Asset Base (RAB) and Regulatory Capital Value (RCV).

network companies' forecast real (RPI) post-tax RoRE over the eight-year price control – this is based on four years of outturn data for RIIO GD1 and T1, and two years of outturn data for RIIO ED1. This does not include financing outperformance on debt and is based on notional gearing[4].

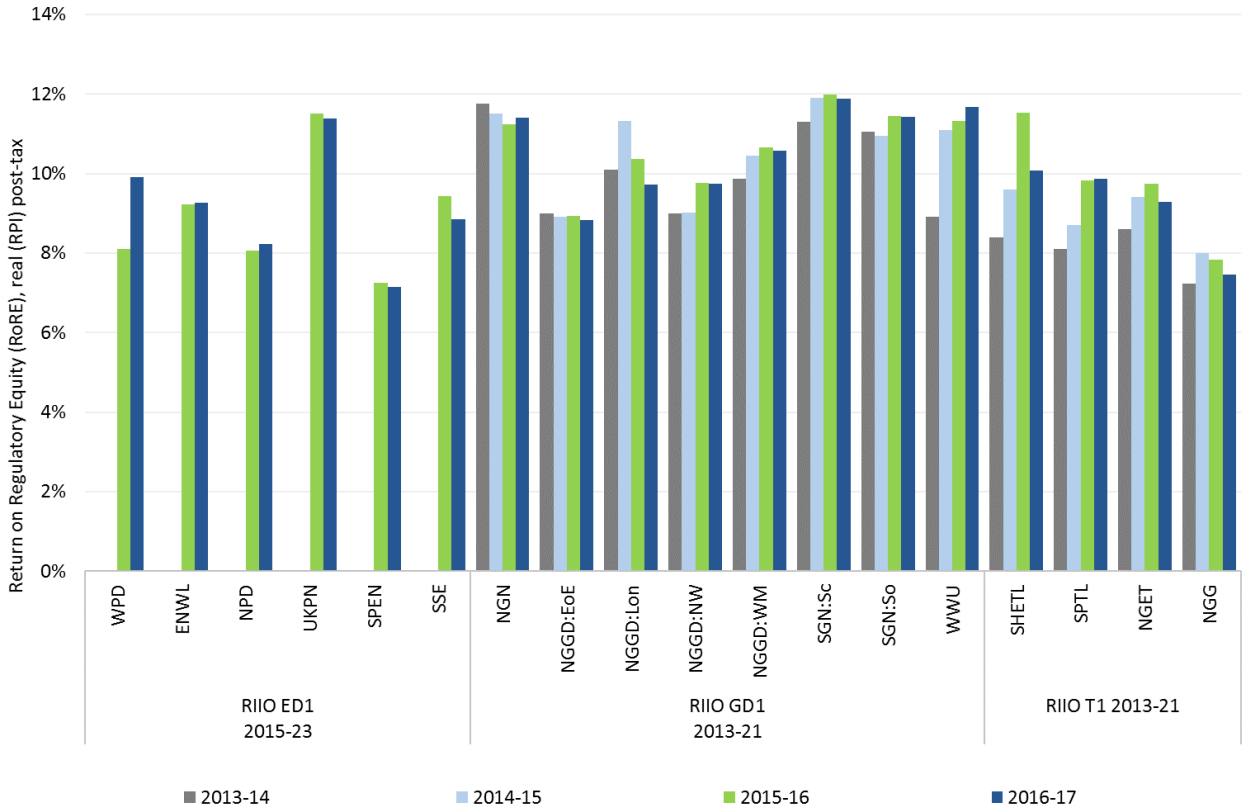
Table 2.2: Real (RPI) post-tax cost of equity allowances

Price control	Company/ companies	Cost of Equity	Notional Gearing
RIIO GD1 (2013-21)	All Gas Distribution Networks (GDNs)	6.70%	65.0%
RIIO T1 (2013-21)	Scottish Hydro Electricity Transmission Limited (SHETL) & Scottish Power Transmission Limited (SPTL)*	7.00%	55.0%
RIIO T1 (2013-21)	National Grid Electricity Transmission (NGET)	7.00%	60.0%
RIIO T1 (2013-21)	National Grid Gas Transmission (NGGT)	6.80%	62.5%
RIIO ED1 (2015-23)	Western Power Distribution*	6.40%	65.0%
RIIO ED1 (2015-23)	All other Distribution Network Operators (DNOs)	6.00%	65.0%

Source: Ofgem. Note: denotes fast-tracked companies*

[4] As the figures are post-tax, this does not include financing outperformance.

Figure 2.1: Forecast real (RPI), post-tax, RORE by network over RIIO price control



Source: CEPA analysis and Ofgem annual reports for each price control

Returns for the majority of companies have consistently been above the base cost of equity set out in Table 2.2 for all sectors.

The UKRN draft report considers that the RER is likely to exceed the RAR by at least some amount, given the information asymmetry and the advantage regulated firms have over the regulator, together with incentives leading to improved productive and dynamic efficiency. The authors consider the rent to be unavoidable.

If there is a reason to expect systematic outperformance on incentives at the industry level, this could be relevant for Ofgem in setting an appropriate base return. However, this is a difficult balance to strike as the purpose of incentive rewards is to deliver outputs that are valued by customers and care must be taken to ensure that any decision in this area is justified.

2.2. Market-Asset Ratio

The value of a company is understood to be based on the expected value of future revenues.

The Market-Asset Ratio (MAR) compares the implied value of an asset, either through transactions or through share prices, to the RAV. A MAR of 1.0 indicates that the market-implied value of the company is identical to the value implied by the RAV. A value above one indicates

that the market values the company above its asset value; this means that the investors in that company expect to receive a higher return than implied by the RAV itself. This could be through an allowed cost of capital above the required cost of capital or through other parts of the regulatory regime e.g. incentives or tax.

These calculations are computed as follows:

- *Transactions*: The total company value (as implied by the transaction amount divided by the % stake acquired), divided by the RAV.
- *Share prices*: The total enterprise value implied by market capitalisation and net debt divided by the RAV.

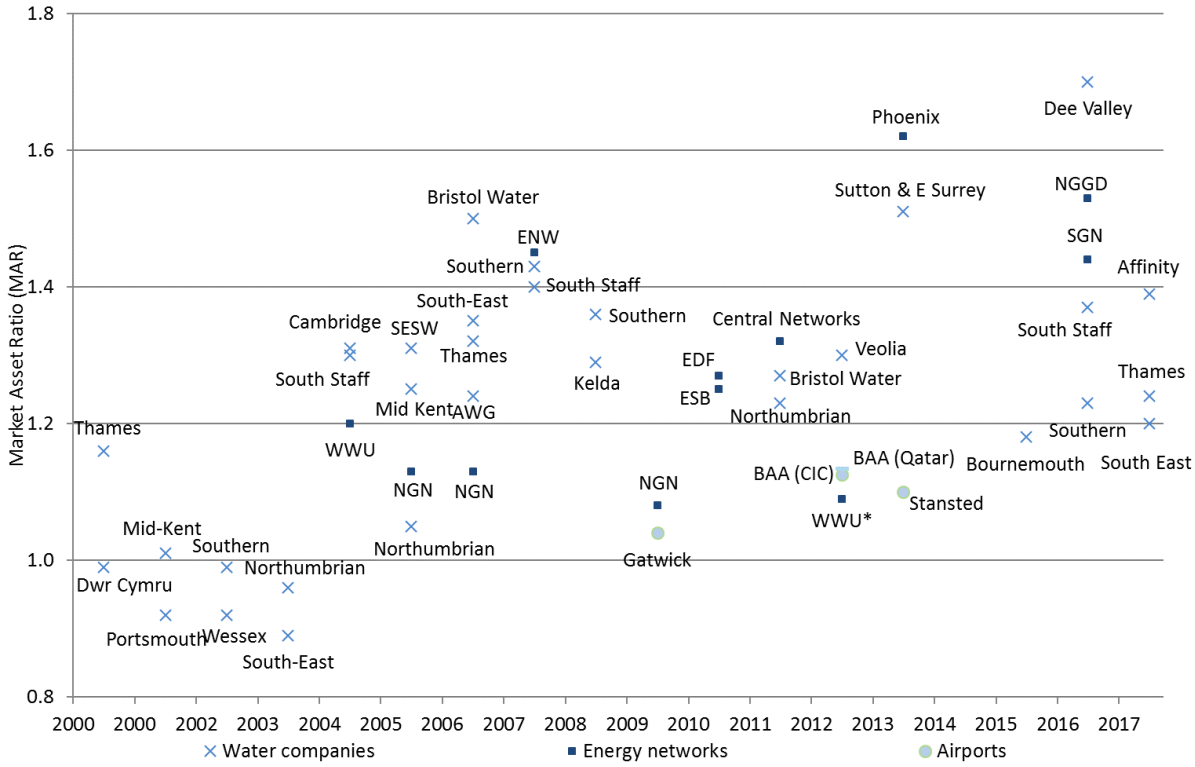
Decomposing MAR premia into precise views of outperformance is difficult, although if there is a significant and sustained MAR premia this is likely to imply that there are sources of expected outperformance for equity investors. The more data points are available that give a consistent answer, the less any premia can be explained by company-specific factors.

2.2.1. MAR premia – transaction evidence

Figure 2.2 sets out the transaction evidence for MAR. Recent energy transactions achieved MARs of 1.44-1.53, suggesting expectations of outperformance. This includes the sale of four gas distribution networks by National Grid and the sale of an equity stake in Scotia Gas Networks (SGN). We note that the sale of National Grid's distribution networks to Cadent involved a sale price that reflected the fair value of novated debt.

Across water and energy companies over the previous three years, MARs have been in the range 1.18-1.70.

Figure 2.2: MAR determined using transaction values



Source: CEPA analysis of transaction evidence

A CEPA briefing note indicated that the National Grid sale to Cadent would imply a cost of equity below the level set by Ofgem for RIIO-GD1[5].

2.2.2. MAR premia – daily listed share prices

An alternative approach to analysing MAR premia is to consider daily share price data. The strengths of this approach relative to using transaction data include having daily estimates of the MAR premia and the absence of any 'control' premia distorting the transaction value. A weakness of using this approach is that it is limited to listed comparators.

Figure 2.3 shows listed MAR premia for two regulated water companies, Pennon Group and Severn Trent, over the 2016/17 financial year (as the latest full financial year we have available). Both companies have unregulated assets, so this analysis is more indicative in nature than for entirely pure play comparators.

[5] CEPA (2017) Key questions for RIIO-T2 and GD2: Lessons from the sale of National Grid Gas Distribution, July 2017

Figure 2.3: Daily listed MAR premia for two water networks[6]

Source: Bloomberg, Ofwat, CEPA analysis

This shows that the MAR does change over time (for example, the MAR premium for Severn Trent falling from over 40% to below 20% in only two months) and we would expect the share price to be affected by statements from Ofwat about the forthcoming PR19 price control and the observed drop could be consistent with that.

2.2.3. Discussion of bid premia

There is discussion of observed MAR premia within the UKRN draft report. They find that investors' forward-looking anticipated returns are likely to have exceeded required returns due to two reasons. First, the RAR has systematically exceeded the CAPM-WACC (estimated using their preferred methodology) – that is, investors expect the allowed cost of capital to exceed their required cost of capital. Second, because regulated companies have systematically outperformed on cost targets and broader incentives, the RER has systematically exceeded the RAR – that is, investors expect to achieve further additional returns.

The authors disagree on the source of the premia, with Mason, Pickford and Wright (MWP) suggesting that both factors have made significant contribution to investor expectations,

[6] A further comparator would have been United Utilities, however information was not available for the 16/17 financial year at the time of the analysis and as such, we are not able to present comparable data.

whereas Burns considers that potential for outperformance on the cost of equity is less dramatic, albeit likely to explain a small proportion of the premium. Other factors listed include financial restructuring, tax arbitrage, control premium and the winner's curse.

In either case, this does indicate that the regulator assumed cost of equity has been above the required return. MWP consider that the difference between the RAR and CAPM-WACC is due to three main factors:

- a reluctance from regulators to bring their estimates of the risk-free rate down as market rates have decreased;
- regulators' assumed values of equity beta being too high relative to plausible econometric estimates; and
- the regulatory allowed return on debt being higher than the market cost of debt, with both nominal and real interest rates falling in a way that was unanticipated by markets.

While the interpretation of any MAR premia is challenging, we would agree with the authors that the cost of equity may have been overestimated in previous price controls in the energy sector. We discuss our proposed approaches to the individual cost of capital parameters later in this report.

2.3. Competitive benchmarks

Regulators in GB have increasingly used competition to bring efficiency to new, high value infrastructure projects. As such, the last few years have seen a range of competitive benchmarks develop. In energy, the OFTO regime has successfully attracted private capital. After eight years of OFTO tendering, investors continue to see the OFTO regime as attractive with the large number of projects and multiple rounds maintaining investor interest.

Competition has also been introduced in the water sector, such as the TTT project for which the tender process was completed in 2015 – with separate competitions for three construction packages to build the tunnel, and for the infrastructure provider which would own and finance the tunnel. Ofwat have highlighted that the cost of capital was a large focus of the TTT evaluation. The specified infrastructure project (SIP) regulations allowed TTT to be delivered and regulated under a separate licence, and Ofwat intends to use some of the lessons learned from TTT as the basis for a "Direct Procurement" process to introduce competition for future projects which are new, separable, and large (relative to the relevant water company's size). The Direct Procurement approach is based on a contractual, rather than licence-based approach.

In 2012, the NAO quoted the winning OFTO bidders' equity IRRs for TR1, at 9-11% nominal post-tax returns. For TR2 and TR3, the cost of equity bid by successful bidders fell to 8-9% nominal post-tax returns, with TR4 and TR5 costs of equity below this level[7].

Evidence from competitively bid infrastructure projects, such as OFTOs, indicates that specific projects can lock in a much lower cost of capital than has typically been applied in price controls over the same time period. These could be useful benchmarks for ensuring that the cost of capital estimates we recommend are consistent with current market conditions. However, we need to carefully consider how relevant these single projects are for larger mature networks with a portfolio of projects and undertaking a different range of activities.

We have also considered evidence from investor surveys, including Grant Thornton's publication entitled "Renewable energy discount rate survey results – 2017," which presents the surveyed results for levered and unlevered IRRs of renewable energy transactions in 2017. The results indicate that UK offshore wind projects yielded a levered IRR of 9.0% in 2017, slightly above the average of all surveyed countries (8.9%). However, it is not obvious how this data can be interpreted in the context of our benchmark range. The tax rate assumptions, which would play an important role in the calculation of the levered IRR, have not been specified. Further, it is not clear whether the IRR presented is an average of operational and construction phases or whether it includes both transmission and generation activities. Without this information, it is difficult to draw any useful inferences to use as a competitive benchmark.

2.4. Links to other regulatory decisions

Methodological changes to the calculation of the cost of capital set out in recent consultations and decisions by UK regulators are important to consider when determining Ofgem's approach to the cost of capital for RIIO-2.

2.4.1. Ofgem's approaches to RIIO-1

This section provides a brief overview of the approaches used by Ofgem to set cost of capital allowances for RIIO-1. It is provided as context to our proposed approach for RIIO-2.

Cost of Debt

The RIIO-1 price controls saw the introduction of cost of debt indexation, for the all-in cost of debt (i.e. combined allowance for new and embedded debt). Previously Ofgem had used a fixed ex-ante allowance for the cost of debt, however forecasts derived from market evidence proved to not be good predictors of future rates and led to gains and losses.

[7] More detail is provided in CEPA (2018) 'Review of cost of capital ranges for new assets for Ofgem's networks division.'

The cost of debt indexation mechanism used a notional cost of debt. This utilised iBoxx GBP non-financial corporate bond indices, focusing on bonds rated A and BBB, and with time to maturity in excess of ten years[8].

The application of this index is a key determinant of setting an allowance, and for RIIO GD1 and T1, a rolling ten-year trailing average was adopted. For most companies, equal weight was afforded to each data point, however for SHETL, bespoke weighting was used, such that the weight on data points corresponded to their RAV growth.

For RIIO ED1 there was a move away from a rolling ten-year trailing average to the use of a 'trombone' trailing average[9]. Under this approach, the length of the trailing average period began at ten years but from then on, the trailing average start point remained fixed such that the length of the trailing average period extended over time.

Cost of Equity

Following the Competition Commission's (CC) determination in relation to Northern Ireland Electricity in November 2013, Ofgem reconsidered its methodology on its assessment of the equity market returns for RIIO-ED1. The CC recommended a range of 5.0 to 6.5 percent – compared to Ofgem's range stated in March 2013 as 6.0 to 7.2 percent. Following a consultation, Ofgem decided that a greater weight should be placed on current market conditions in relation to the equity market return, as with the CC's approach. This led to Ofgem reducing the central reference point, used in the assessment of business plans, from 6.3 percent to 6.0 percent.[10]

There was also discussion of the impact of the RPI formula effect and its impact on the TMR. The decision on an adjustment will depend on the views around whether investors require real or nominal returns; we consider that the principles of Financial Capital Maintenance (FCM) would support investors requiring real returns. The formula effect describes how there is an expected increase in the difference between RPI and CPI inflation. If investors focus on a CPI-linked real return, the equivalent RPI-linked real return required will be lower with an increase in the RPI-CPI differential.

[8] There are two separate indices available from iBoxx to capture this data.
[9] The 'trombone' approach involves the length of the trailing average increasing from a fixed point, such that the trailing average period extends from ten years at the start of RIIO-ED1 by one year annually, such that there will be an 18-year trailing average at the end of the eight-year price control.
[10] Ofgem (Feb 2014) "Decision on our methodology for assessing the equity market return for the purpose of setting RIIO-ED1 price controls" available online

We consider that this approach is consistent with Ofgem's approach during RIIO-ED1 and recalibrating real RPI-linked returns for the formula effect. The real long-run RPI-linked TMR and risk-free rate were reduced by 40bps for the increased formula effect[11].

An alternative interpretation would be that investors focus on nominal returns. If this were the case, then regulatory decisions in real terms would need to be adjusted to reflect any differences in inflation assumptions, with the evidence used likely to focus on nominal rather than real returns. We discuss this topic further in Section 5.1.2 and Annex E.

2.4.2. Ofgem's approach to new assets

In January 2018, Ofgem published a CEPA report estimating the cost of capital ranges for new assets.[12] This was completed under the same framework as this report, with the intention of developing consistency in cost of capital decisions across Ofgem's networks division.

Our cost of capital estimates for new assets generally reflect estimates of a prevailing cost of capital at a particular point in time, for a specific investment category and time horizon, with construction and operational phases estimated separately. The framework for setting the cost of capital is therefore different to network operator price controls, where the cost of capital is being set for a price control with a mix of construction and operational phases, with ongoing financing.

A consistent approach does not mean that the cost of capital for new assets should match the cost of capital for RIIO-2.

2.4.3. Ofwat PR19 and CAA H7 methodologies

Cost of capital ranges

Ofwat has indicated a headline (appointee level) real RPI vanilla WACC of **2.40%, the mid-point of a 2.0-2.8% range**, for PR19 (the price review for the period 2020-2025). This compares to **3.74%** set for PR14[13]. The cost of new debt is to be trued up at the end of the price control based on outturn values, compared to what was estimated today. This means that the cost of capital may be different to what is set at the time of the determination.

The CAA has indicated a business as usual ('as is') real RPI vanilla WACC of **3.0% to 3.9%** for H7, the review of the regulatory arrangements to apply to Heathrow when the current arrangements expire at the end of 2019. This compares to **4.66%** set for Q6, the current price control period. The cost of new debt is proposed to be trued up at the end of the price control based on outturn values, compared to what was estimated today. This means that the cost of capital may be

[11] Ofgem (Feb 2014) "Decision on our methodology for assessing the equity market return for the purpose of setting RIIO-ED1 price controls" available online

[12] CEPA (2018) 'Review of cost of capital ranges for new assets for Ofgem's networks division.'

[13] Ofwat (2015) Final price control determination notice: policy chapter A7 – risk and reward

different to what is set at the time of the determination. The CAA has also proposed using a true-up for the appropriate weights to be placed on new and embedded debt over the price control.

Inflation measures for indexing the asset base

Ofwat is also moving away from RPI RAV indexation, with a portion of the asset base linked to CPIH inflation and another portion linked to RPI inflation (due to existing inflation-linked exposures). The translation between different cost of capital measures assumes an 100bps 'wedge' between RPI and CPIH inflation over PR19; CPIH inflation is based on the long-term inflation target of 2.0% adopted by the Bank of England. The CAA, however, has confirmed that it will continue to use RPI to index the RAV for Heathrow Airport Limited (HAL). This is due to the uncertainty that exists, and the consideration that introducing any potential additional financing risk for HAL to manage would not seem appropriate.

2.4.4. Relevance of recent regulatory consultations

There are clear benefits from having consistency between regulators on the cost of capital, especially as regulated assets may represent similar investments (and thus be considered substitutes). There are many similarities across UK regulated assets, but there are also differences that we would expect to influence the cost of capital.

Reasons why you may expect some differences in setting the cost of capital across sectors include:

- *timing* – the price controls begin at different points in time so will be based on different evidence and spanning different time periods;
- *length of price controls* – Ofgem currently utilises eight-year price controls while Ofwat and the CAA are typically shorter than this;
- *capex to RAV* – the investment intensity of a price control will affect the risks faced and the returns required;
- *investment horizon* – investors may have different investment horizons across different sectors;
- *risk allocation* – it may be that risk allocation between companies and consumers differs across sectors e.g. treatment of pension deficit costs; and
- *stability of charges* – as an example, regulated charges are a relatively small proportion of overall energy bills, while it is much larger in water.

With the use of a revenue cap in the water sector and RAV-based building blocks used to set revenues, we would definitely consider there to be key similarities. However, for sector- and

company-specific parameters, we would expect there to be differences between regulators to reflect the above differences. For national and economy-wide parameters, we would expect similarities, although for reasons noted above, these are not necessarily identical.

3. FRAMEWORK FOR SETTING THE COST OF CAPITAL

In this section, we set out the framework for which we are undertaking our cost of capital analysis for Ofgem. This covers a number of points including:

- the form of the cost of capital figures presented;
- the role of indexation, for both debt and equity;
- use of different cost of equity frameworks including the merits of CAPM;
- ways to think about the cost of equity;
- what our cost of capital ranges reflect; and
- an initial discussion of financeability.

Once we have established this framework, we go into the detailed analysis on the cost of debt (Section 4), the cost of equity (Section 5) and capital structure (Section 6).

3.1. Form of the cost of capital

There are different ways that the cost of capital can be presented and utilised in price control regulation. The two main dimensions are whether the figure is in nominal or real terms, and the treatment of tax.

3.1.1. Real, RPI-linked

The cost of capital figures that we present in this paper are in real, RPI terms[14]. This is consistent with the approach used for the RIIO-1 reviews, and real RPI figures have been produced in both the Ofwat PR19 final methodology and CAA H7 policy update consultation published in December 2017. We discuss the inflation assumptions used for estimating the cost of debt and cost of equity separately.

In Annex B we discuss the choice of inflation index and the implications this has, not just in setting the cost of capital, but more broadly in the price control. In this annex, we consider there to be three broad options that Ofgem could adopt for capturing inflation:

- continuing with RPI inflation;
- changing immediately to CPI or CPI(H) inflation;
- transitioning to CPI or CPI(H) inflation over the price control period from RPI.

[14] Unless otherwise stated.

The UKRN draft report recommends that the inflation measure chosen for estimating the WACC is consistent with the index chosen by the HM Treasury and implemented by the Bank of England for inflation targeting (currently CPI).

The approaches above involve indexation of the RAV and use of a real cost of capital[15]. Instead, an alternative approach to capture inflation could be to use a nominal WACC with a non-indexed RAV[16].

The choice of indexation of the asset base will have broader impacts than the cost of capital, for example, the impact of the choice of inflation on Real Price Effects (RPEs). This is not discussed in depth within this report.

3.1.2. Vanilla basis

A further dimension in establishing the cost of capital is the treatment of tax. In this paper the figures we present are in 'vanilla' WACC terms[17]. In the UK, interest is deductible before the payment of tax, so we do not need to worry about the tax on the cost of debt. The 'vanilla' WACC involves use of a post-tax cost of equity.

The choice of the WACC formulation used will depend on the treatment of taxation. Where there is a separate allowance for tax, a vanilla WACC estimate is used so there is no double counting of tax. The tax allowance could be set on a notional basis or could be estimated on a pass-through basis[18].

3.2. Indexation

As noted in Section 2, Ofgem currently utilises annual updating of the cost of debt allowance. This is referred to as cost of debt indexation. On the cost of equity, the current approach involves setting an ex-ante allowance that is not reset until the next price control decision. In this report, we discuss the use of indexation for both the cost of debt and cost of equity, with Annex A providing a more detailed discussion of indexation.

[15] Note that indexation of the asset base is the same concept i.e. updating the value of a parameter, as we use when discussing cost of debt and cost of equity indexation.
[16] Relative to the status quo approach of using a real WACC and an indexed RAV.
[17] Unless otherwise stated
[18] The latter approach would be used in cases where there are no benefits seen from incentivising companies to reduce their tax burden.

3.2.1. Cost of Debt

For the RIIO-1 controls, Ofgem uses a form of cost of debt indexation that provides an annually updated allowance for the overall cost of debt (i.e. both new and embedded debt together).

CEPA provided advice to Ofwat and the CAA in 2016 on approaches to setting the cost of debt; we recommended indexation of debt over an ex-ante allowance.[19] We consider that indexation remains a better option than an ex-ante allowance for the cost of debt for Ofgem's RIIO-2 determinations, based on a similar rationale.

There are two principal options around cost of debt indexation, namely:

- full cost of debt indexation (as per the current Ofgem approach); and
- indexation of new debt only (as per current Ofwat and CAA proposals).

The difference between the two approaches is whether the cost of embedded debt is indexed or not. As the embedded debt values are known, the expected value of the two approaches could be equivalent, although the timing of changes in embedded debt may vary.

A mechanistic approach to the cost of embedded debt provides less room for regulatory discretion and is more transparent. If firms' efficiently incurred embedded debt is materially different to what is assumed under a mechanistic approach, indexation of new debt only will look relatively more favourable for a regulator.

Our approach and associated ranges are based on indexation of all debt, as per Ofgem's current approach. However, if Ofgem considers that this is no longer appropriate, we would recommend use of indexation of new debt only as a more suitable option than a fixed ex-ante allowance.

3.2.2. Cost of Equity

In the same way the cost of debt is indexed during the price control, the cost of equity allowance could also be indexed rather than being based on a fixed ex-ante allowance. Ofgem, for RIIO ED1, discussed the potential for investigating the cost of equity indexation further[20].

We have been asked by Ofgem to consider the suitability of an indexation approach for equity, including options for how this could be introduced. When discussing the cost of equity, we use a two-track approach, with the first track focussed on an ex-ante allowance and the second track looking at options under cost of equity indexation.

[19] CEPA (2016) Alternative approaches to the cost of debt – A report for Ofwat and the CAA.
[20] Ofgem (2014) Decision on our methodology for assessing the equity market return for the purpose of setting RIIO-ED1 price controls, February 2014.

3.3. Use of frameworks

In developing our cost of capital recommendations, we have used the CAPM for assessing the cost of equity, as per the current Ofgem approach. Though it has been subject to extensive debate over its suitability, the CAPM is well-understood and the basis for UK regulatory determinations.

A full review of the CAPM and its suitability is outside the scope of this report. We do, however, make use of alternative sources of evidence and discuss alternative cost of equity models, both as cross-checks to ensure overall rate of return estimates are appropriate, and where evidence on individual CAPM parameters is not available.

3.3.1. CAPM

CAPM is a well-understood benchmark model for determining the cost of equity, used both academically and by finance practitioners. The small number of inputs and the simplicity and transparency of the model contribute to its widespread application.

Under CAPM, the cost of equity is estimated as follows:

$$R_e = R_f + \beta * MRP$$

cost of equity = risk-free rate + (equity beta x market risk premium)

The framework assumes that investors are only compensated for bearing market or systematic risk – that is, risks that cannot be diversified away through portfolio holdings. Per this equation, the CAPM framework assumes that that investors demand a return on their investment equal to the risk-free rate (R_f), plus a premium for the degree of systematic risk involved in a particular equity investment. This premium is calculated as the product of the equity beta (β) and the market risk premium (*MRP*). The equity beta measures the volatility between the returns of a particular equity investment and the returns of the market as a whole. The MRP is the measure of expected return, beyond the risk-free rate, that an investor expects when holding the market portfolio. The market risk premium can also be expressed as total equity market returns less the risk-free rate.

The CAPM framework assumes the expected excess return (above the risk-free rate) on an equity investment is in fixed proportion to the expected excess return of the total market, with the particular investment's degree of systematic risk determining the proportionality. The UKRN draft report recommends use of the CAPM as the basis for setting the cost of capital.

3.3.2. Multi-factor

A multi-factor model for estimation of the cost of equity assumes that multiple factors explain the expected return on equity, apart from just systematic risk captured through the CAPM beta.

As defined by the UKRN report, the multifactor model implies that the random variation over time in actual returns can be generalised for the purposes of asset pricing as:

$$E(R_i) = R_F + \beta_M RP_M + \beta_2 RP_2 + \ldots + \beta_k RP_k$$

Where $E(R_i)$ refers to the expected return of asset i, R_f refers to the risk-free rate, RP_m refers to the market risk premium, RP_k refers to the risk premia between assets i and k and finally, β_k captures the mutual correlation between returns on different assets (with the correlation between returns on asset i and the market portfolio denoted by β_m). In short, the additional explanatory power of the multifactor model over the CAPM addresses concerns of omitted variable bias in traditional CAPM beta estimation.

The UKRN report also points out that, while the returns for individual securities may be described more accurately by the multifactor model, this is only relevant in the cost of equity estimation if these additional factors are actually priced into the asset.

One common specification of the multifactor model is the Fama French three factor model which assumes a relationship between the size, book-to-market ratios and expected stock returns of companies. However, replicating academic evidence has been inconclusive.

3.3.3. DGM

The DGM[21] is a model for estimating the expected return of equity using discounted cash flow analysis. The model is based on the assumption that the current price of a stock is equal to the present value of all future dividend payments discounted to the present value. The DGM requires some assumption of the growth rate of dividends per share, G_{it}, and the result is sensitive to this assumption. As noted in the UKRN report, the DGM model "has indeed been widely used as an alternative to CAPM by regulators in the United States. But is it heavily reliant on, and sensitive to, the assumed path of future dividends for the individual stock".[22] The authors note that the DGM thus requires an assumption that dividend growth forecasts are more accurate than return forecasts.

However, the authors of the UKRN report acknowledge that the DGM model does provide a useful cross-check on other cost of equity models. As such, we apply the DGM to supplement our findings under a CAPM framework, principally in establishing benchmarks for the TMR. Detailed discussion of the DGM is contained in Annex E.1.2, with a description of the data used in our cost of equity assessment contained within Section 5.

[21] also referred to as Dividend Discount Model (DDM) particularly by UKRN and PWC in its reports for Ofwat
[22] UKRN (2018): "Estimating the cost of capital for implementation of price controls by UK regulators".

3.3.4. Conclusions about cost of equity estimation models

Despite the drawbacks of the CAPM model, the UKRN report recommends that regulators should continue to base cost of equity estimations on the CAPM framework. We echo this recommendation, emphasising the benefit of transparency and simplicity of assumptions inherent in the approach. Yet, we also see the value in considering other frameworks to cross-check assumptions of the CAPM model and to ultimately ensure that results represent the market behaviour of investors.

3.4. Assumptions in estimating the cost of equity

Recent regulatory publications have indicated that the TMR has fallen and that forward-looking evidence on the TMR gives lower estimates than historic ex-post approaches (see Annex E for further details on different sources of data). This gives a range of possible outcomes, with the estimate dependent on the combination of interpretations and assumptions applied. Under current conditions, the lowest plausible TMR assessment results from the following assumptions:

(1) A judgement that required returns do vary over time and over different time horizons, and there is sufficient evidence to be able to distinguish those variations from noise in the data.

(2) The regulator wishes to set a cost of capital that varies over time as part of its risk allocation package (for example, to minimise the risk of a mismatch between allowed and required returns at any point in time).

(3) The time horizon to which the cost of capital pertains is relatively short (i.e. around five years or below).

(4) The regulator wishes to remunerate a one-off investment at a particular point in time.

Where all the above conditions are satisfied, current estimates for the TMR will be lower, but estimates will be more volatile over time. Relaxing any of these conditions at present would tend to push the TMR estimate up.

The most stable TMR assessment over time would result from either of the following interpretations:

(A) A judgement that required returns are stable over time and over different time horizons.

(B) The regulator wishes to set a stable cost of capital as part of the regulatory regime.

If either (A) or (B) are satisfied, the TMR assessment will largely be based on historic evidence.

Finally, under current conditions the following interpretations would also tend to push up the cost of capital and provide a more stable estimate of the TMR.

(C) Assuming a longer time horizon (e.g. ten years and above).

(D) Setting a rate intended to apply for a series of investments made over a period of time (e.g. over a price control period).

(E) Setting a rate to approximately remunerate a portfolio of historic investments at the point they were made.

Some of these assumptions require a degree of judgement about how to interpret evidence and remunerate investors e.g. (1) or (A). Other decisions are a function of the underlying investment, regime and approach e.g. (2) or (B). On the other choices, the regulator has a degree of discretion to adopt the assumptions most aligned with efficient financing.

Interpretations of the cost of capital can be thought of within this framework:

- In general, UK regulators have tended to base cost of debt estimates on a combination of (1), (2), (C), (D) and (E), however the cost of equity is typically seen as more nuanced.
- Our proposed ranges for the TMR relevant to new asset investments published in January 2018 are based on conditions (1)-(4).
- Our RIIO-2 range also incorporates conditions (1) and (2). There are then choices based on the regime faced:
    - If the cost of equity is not indexed, and if Ofgem takes a longer term perspective, then conditions (C) and (D) would tend to increase our estimate of TMR relative to the low end of the range.
    - If the cost of equity is indexed, and Ofgem takes a relatively short term perspective, something close to (3) may apply.
    - We would expect Ofgem to place weight on (D) for RIIO-2, given the portfolio of assets to be compensated, so in current conditions, although our proposed range for new asset investments does overlap with our RIIO-2 TMR, the new assets TMR is generally lower.

This framework could be used to interpret other regulatory decisions. As an example, Ofwat's view on the TMR appears to place most weight on (1), (2), (3) and (D), while the UKRN draft report focuses on something that is closer to (A)-(E). We consider that the Ofwat view is most appropriate for establishing the lower end TMR estimate, but that applying conditions (A)-(E) may currently overestimate the required equity return.

3.5. Development of WACC ranges

Estimates of the cost of capital reflect, to varying degrees, current market evidence. When new evidence becomes available, the assessment of the cost of capital can change. This highlights the

importance of clearly specifying the underlying approach to estimating the WACC, in such a way that the methodology is consistently applied regardless of market conditions. This is especially relevant when figures are being updated through the use of indexation.

3.5.1. Figures are based on evidence available today

The figures we include as ranges are based on evidence available today for an eight-year price control[23], beginning multiple years from the publication date of this report. However, it is reasonable to assume that underlying market evidence will change in the future which may require our ranges to be reassessed. Yet, the principles and approaches used to estimate these ranges should remain relevant regardless of changes in market evidence.

We note in particular that the beta analysis does rely, to some extent, on the policy choices under the regulatory regime. This is especially true for our interpretation of how cost assessment and cost incentives affect the cost of capital and, in turn, financeability.

3.5.2. Updates with indexation

Our estimates, where subject to an indexation mechanism (for either debt or equity), would need to be updated based upon outturn market evidence. The figures that we produce for the cost of debt are estimates of the cost of capital over the RIIO-2 price controls are based on evidence available today (i.e. using current forward curves to make projections). We note that these figures are liable to change where future outturn values differ from those values expected today. When making comparisons across regulatory determinations, if the time period for the price control differs, an adjustment is required to make two decisions comparable.

3.6. Financeability assessment

Part of Ofgem's duty in setting the cost of capital is to ensure the ability of efficient network companies to finance their activities in a reasonable way. Ofgem tests financeability with consideration of methodologies undertaken by the credit rating agencies to secure that the regulatory package allows the efficient notional network company to achieve an investment grade credit rating. Licensees have an obligation to maintain an investment grade credit rating as part of their licence.

3.6.1. Approach to financeability

Ofgem's financeability analysis does not intend to replicate the different rating agencies' methodologies, however rating agencies' methodology notes serve as a useful proxy to

[23] Changing the length of the price control is expected to have some impact on the cost of capital, although the principles we set out under our approach are generally relevant irrespective of the length of the price control.

determine if any financeability issues exist. For the purposes of this report, we assess financeability primarily utilising Moody's rating methodology as of March 2017, which sets out an approach to assessing credit risk for regulated electricity and gas networks globally.[24]

Credit rating agencies often employ an adjusted interest coverage ratio (AICR) [25] to analysis of regulated networks as this metric adjusts for regulatory depreciation allowances. It is intended to measure whether a network company can cover its interest payments after deducting an allowance for maintenance of regulated assets.

3.6.2. Results of financeability analysis

After making some assumptions, we apply a simplified version of the AICR to assess the financeability of our proposed ranges and gearing ratios. Across all plausible scenarios tested, there was no instance of the AICR ratio falling below investment grade. However, some scenarios did result in a Baa (or BBB) rating in the AICR metric.

If, after a more complete picture of the RIIO-2 package has emerged, it is determined that financeability concerns do exist, there are certain regulatory tools that may improve the credit metrics in the short term. These options include:

- *NPV positive interventions* - namely providing greater regulatory allowances;
- *NPV neutral interventions* - that re-profile cash flows, such as through changing indexation from RPI to CPI or changing the depreciation rate;
- *Limiting downside exposure* - through a floor on returns equivalent to the cost of debt or asymmetric incentive structures; and
- *Leaving financeability for the Licensees to manage*.

We discuss financeability and capital structure in detail in Section 6.

[24] Moody's Investors Service: "Rating Methodology - Regulated Electric and Gas Networks", (2017).
[25] Also referred to be Ofgem and other rating agencies as post maintenance interest coverage ratio (PMICR)

4. COST OF DEBT

4.1. Discussion and approach

This section focuses on what we consider to be the key issues for potential changes on the cost of debt for RIIO-2, including:

- the form of cost of debt indexation;
- the choice of the benchmark index used for setting the cost of debt;
- the trailing average type and length;
- transaction costs; and
- the choice of inflation measure.

This section discusses each of these key issues in turn and makes recommendations for Ofgem's approach in RIIO-2.

4.2. Form of indexation

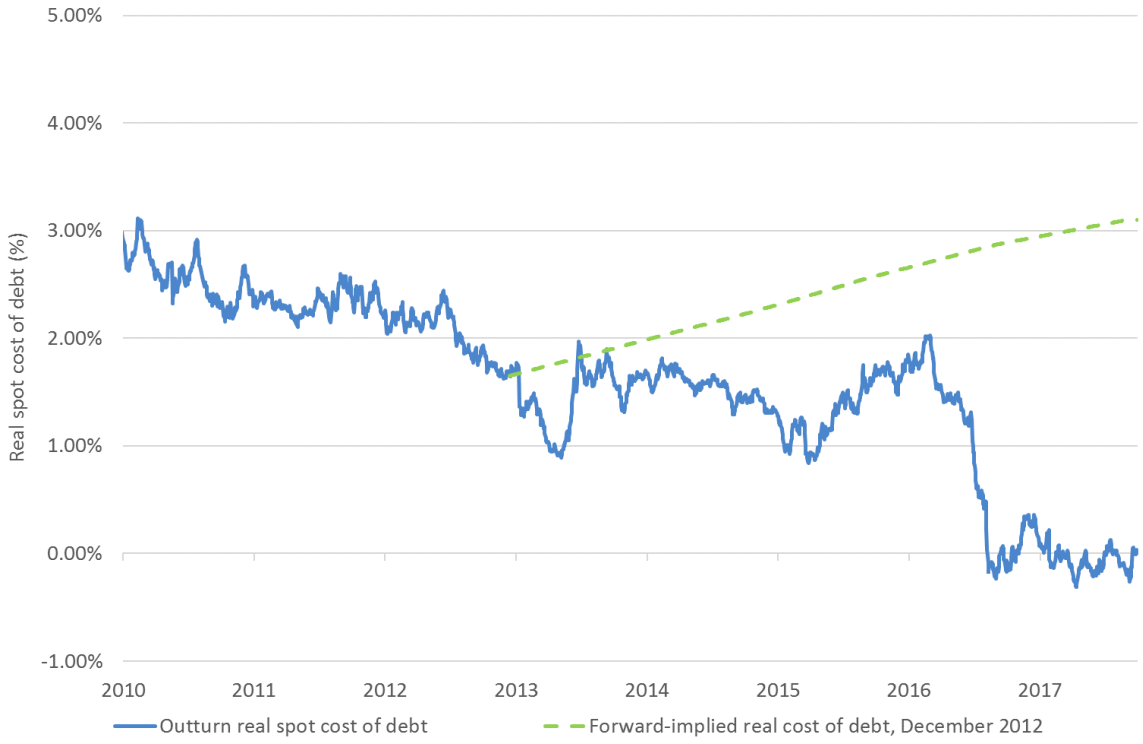
Ofgem applies indexation on the all-in cost of debt. We consider that indexation represents a better option than setting an ex-ante fixed estimate of the cost of debt, as discussed in Section 3.2.1. This represents a notional approach, although it is possible to treat actual debt costs as a pass-through. The use of a pass-through would imply that there are no net benefits from incentivising the cost of debt. We consider that use of actual debt costs would lead to instances of moral hazard, and that the optimal approach is to use a well-calibrated mechanism based on notional costs.

Comparing the outturn spot cost of debt used by Ofgem in their RIIO-GD1/T1 cost of debt indexation model shows that the latest yield is over 300bps lower than expected at the time of the final determination in December 2012[26]. The use of indexation relative to a fixed ex-ante estimate is therefore likely to have led to consumer benefits.

The difference of over 300bps in yield within a five-year period indicates the limited predictive power of forward curves. We note that the NAO estimated that adoption of the Ofgem cost of debt indexation for the PR09 price control would have led to savings over £840m[27], as a similar outcome was observed.

[26] We have used forward curves on UK 10yr gilts as a proxy for future changes in the spot cost of debt. We have taken figures implied by this forward rate evidence in March and September of each year.
[27] NAO (2015) Investigating the potential impacts of cost of debt indexation in the water sector

Figure 4.1: Comparing the outturn cost of debt to the forecast cost of debt for RIIO-GD1/T1



Source: iBoxx, Bloomberg

As noted in Section 3.2.1, our approach is based on indexation of the all-in cost of debt, rather than a separate cost of embedded debt and cost of new debt.

The indexation approach has been the subject of a CMA appeal by British Gas Trading Ltd, which may provide greater comfort to Ofgem that the approach is robust[28].

4.3. Network performance

It is important to understand why and how the energy network companies have outperformed the cost of debt allowance under the current approach. There are three reasons that might explain why outturn efficient debt costs differ from the index:

- *Outperforming the index by achieving a lower rate on the day.* Companies may achieve a lower rating on a certain day than the index would imply.
- *The tenor of the debt.* Companies may achieve a lower cost of debt if they issue shorter-term debt than assumed when setting the allowances (assuming an upwards sloping yield curve).

[28] CMA (2015) British Gas Trading Limited v The Gas and Electricity Markets Authority: Final Determination.

- *General timing of the debt.* Ofgem's allowance typically assumes an equal weighting of debt issued over time[29], but companies will not necessarily issue debt in a smooth pattern and potentially could be more likely to issue debt at times when rates are lower, giving the companies a lower average cost of debt as compared to the non-weighted average over time.

The cost of debt is likely to vary by company, for example a company with an A- credit rating is likely to have a lower 'on the day' cost of debt than a company with a BBB credit rating. In an environment where debt yields have fallen, companies with longer-dated historic debt will typically have a higher cost of debt.

We next present data on the three areas discussed.

4.3.1. 'On the day' outperformance

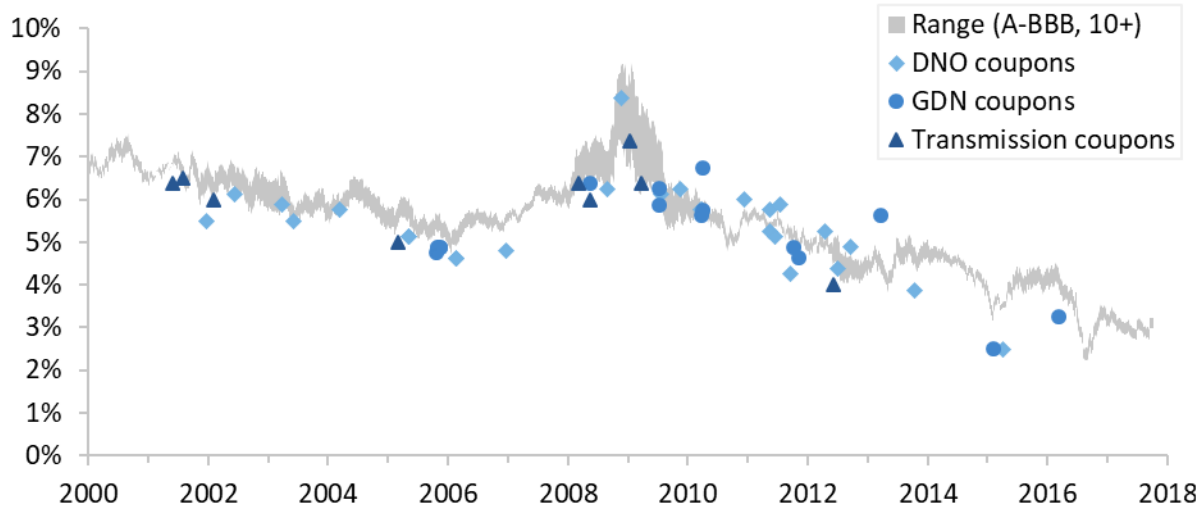
We consider outperformance of the companies' debt costs at issuance in both nominal and index-linked terms.

Nominal debt

This figure below demonstrates how energy networks have performed compared to the iBoxx indices. It shows the iBoxx indices for non-financial corporates A and BBB (10+ years), alongside actual nominal coupons raised by the GB energy network companies (again, with at least a ten-year tenor). On average, the companies' nominal coupons (of 10+ years) were issued at 38bps below the average of the daily A and BBB iBoxx nominal indices. Not all coupons were below the iBoxx range – 13% of shown coupons, or 25% by value, were issued at a rate higher than the average of the A and BBB values.

[29] Bespoke weighting for SHETL's RIIO-T1 cost of debt indexation model is an exception.

Figure 4.2: Nominal coupons raised by different types of companies since 2000, compared to the range of the iBoxx A and BBB indices (NFC 10+)

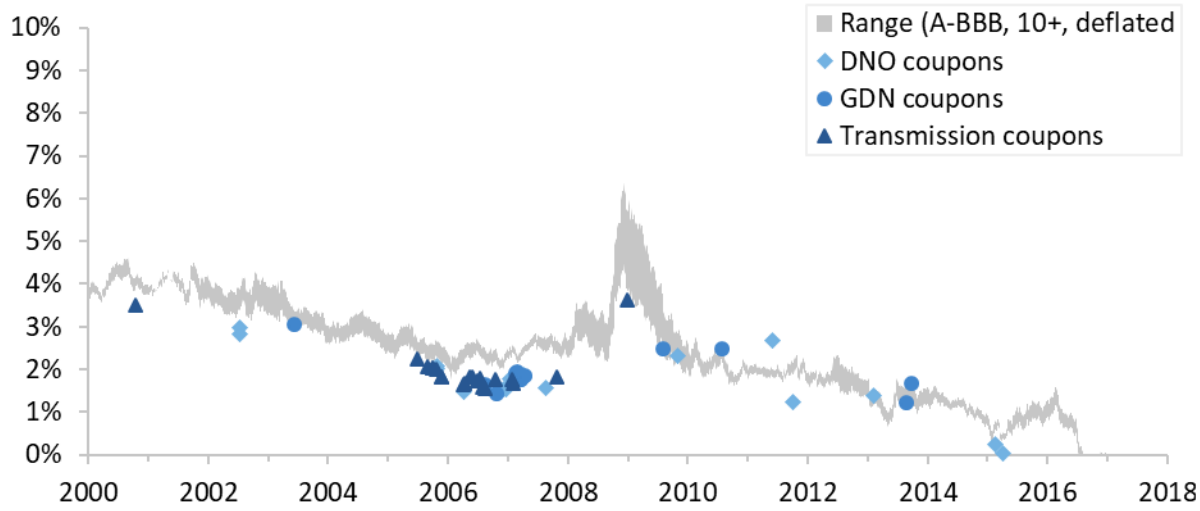


Source: CEPA analysis of iBoxx data

Index-linked debt

The figure below shows how energy networks have performed compared to the iBoxx indices in index-linked bonds that have a tenor of at least ten years (separated into DNOs, GDNs, and transmission companies). As the iBoxx indices used non-financial corporates A and BBB with 10+ years tenor, we have deflated the indices using 20-year breakeven inflation data. On average, the coupons shown were issued 49bps below the average of the two iBoxx indices. Around 9% of these coupons, or 14% by value, were issued at a rate higher than the average of the A and BBB values.

Figure 4.3: Index-linked coupons raised by different types of companies since 2000, compared to the range of the iBoxx A and BBB indices (NFC 10+) deflated by 20-year breakeven inflation



Source: CEPA analysis of iBoxx and Bloomberg data

Implications

Both of the figures above (nominal and index-linked) show that prior to around 2009 all coupons outperformed the index, but since then outperformance has become less certain. This may be partly explained by the fact that constituents of the iBoxx index changed and that bonds may have been issued at below par[30].

The constituents of an index can have a significant effect on the yields it presents. If regulated utility companies move towards 100% of the constituents of the indices, then we would not expect to see any outperformance on average – the index would more closely match the companies we are looking at.

As previously discussed in CEPA's report for Ofwat and the CAA,[31] the weighting of regulated utilities in iBoxx indices has increased from about 17% in 2010 to about 50% in recent years. As of September 2017, the A and BBB iBoxx non-financial corporate 10yr+ indices have a weighting of 50%. We therefore consider it appropriate to assume the full adjustment of 38-49bps based on historic evidence may not continue in future, although there is still scope for outperformance.

Our analysis of network performance is based on the iBoxx GBP non-financial corporate indices 10yr+ A and BBB indices, deflated by 20yr breakeven inflation. We note that 20yr breakeven inflation has been higher than 10yr breakeven inflation (the current basis for deflating nominal yields).

[30] Our analysis is based on the coupon rather than yield at issue.
[31] CEPA (Aug 2016) "Alternative approaches to setting the cost of debt for PR19 and H7" available online

The level of a perceived 'halo effect' was discussed in the CMA British Gas appeal, where the historic level of outperformance was observed at around 45bps, but where the CMA supported Ofgem's use of no net adjustment between the halo effect and issuance costs[32].

We assume no net adjustment in our high case cost of debt scenario, but assume that there is future outperformance on average across the industry for our low case.

4.3.2. Average tenor of the debt

We consider the average tenor of debt to ensure that the assumptions we have chosen for cost of debt indexation are appropriate. As the yield curve is typically upwards sloping, if we focus on only shorter dated debt within a portfolio, this may underestimate the true cost of debt (and vice-versa). An example of this could be with nominal and index-linked debt, where typically index-linked debt has a longer tenor than nominal debt. We consider both types of debt to allow for a more complete picture of network performance[33].

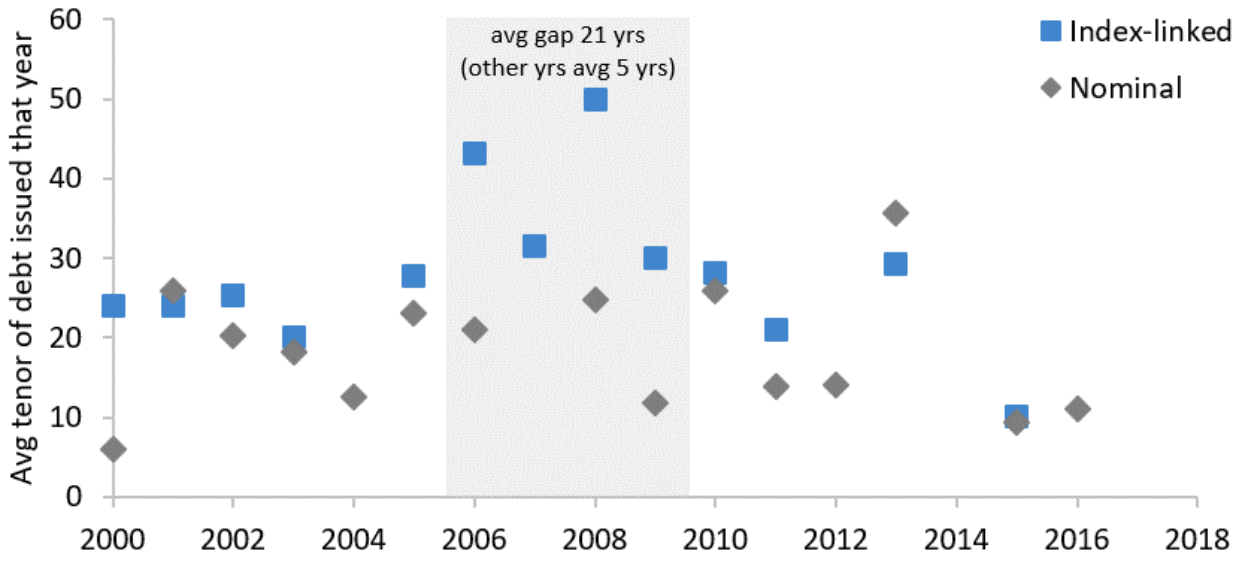
The figure below shows the average tenor of coupons by the network operators between 2000 and 2016. The average tenor of these coupons is 25 years, or 18 years for nominal coupons. The 10yr+ iBoxx indices used average around 19 (BBB) to 23 years (A) to maturity.

Over the period 2000 to 2016, index-linked coupons had a much higher tenor than nominal coupons (32 years and 18 years respectively). The difference in average tenor between the two types of coupon is highest between 2006 and 2009, as shown in the figure, when the gap is 21 years compared to just five years outside of this period. During this period, there is very long-dated index-linked debt that will continue to impact on embedded debt in forthcoming price controls.

[32] CMA (2015) British Gas v The Gas and Electricity Authority: Final determination.

[33] However, we note that our analysis focuses on bond finance only; regulated companies may also use debt finance, which is likely to be shorter term on average than bond finance.

Figure 4.4: Average tenor of nominal and index-linked coupons raised by GB regulated gas and electricity companies, showing a large increase in the gap between index-linked and nominal bonds in 2006-2009



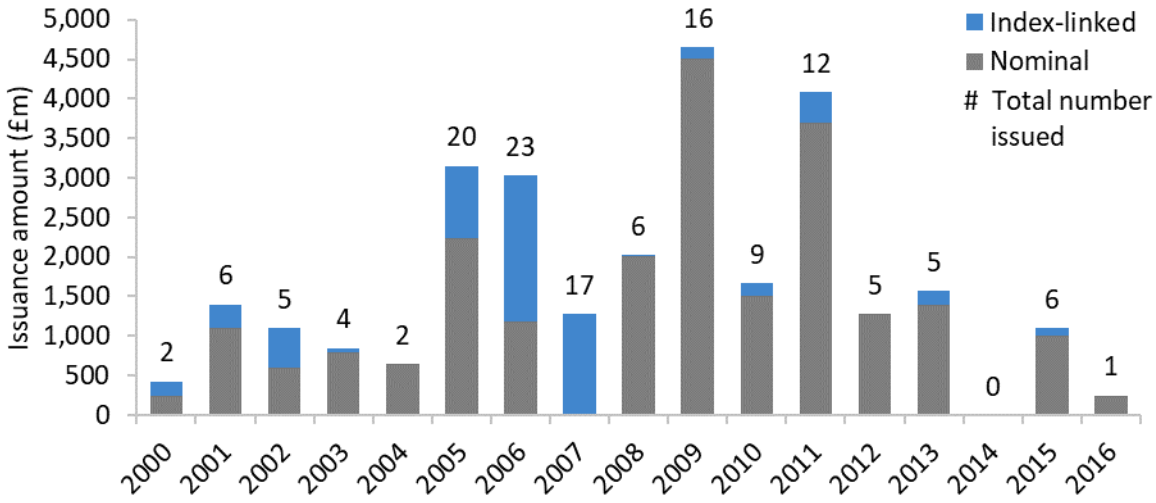
Source: CEPA analysis of iBoxx data

We consider that the iBoxx 10yr+ indices are appropriate benchmarks based on this range of evidence and we would not expect outperformance based on tenor of debt alone. When Ofgem are reviewing companies' actual embedded debt costs in-depth, historic debt tenors will have a material impact.

4.3.3. Timing of debt

The figure below shows the total amount issued in index-linked and nominal coupons between 2000 and 2016, only including coupons issued to GB energy network companies. There was a noticeable shift towards index-linked coupons in 2005-2007, before shifting again to nominal coupons representing the majority from 2008.

Figure 4.5: Total issued amount of index-linked and nominal coupons, by regulated GB energy network operator companies, and the total number issued by these companies that year

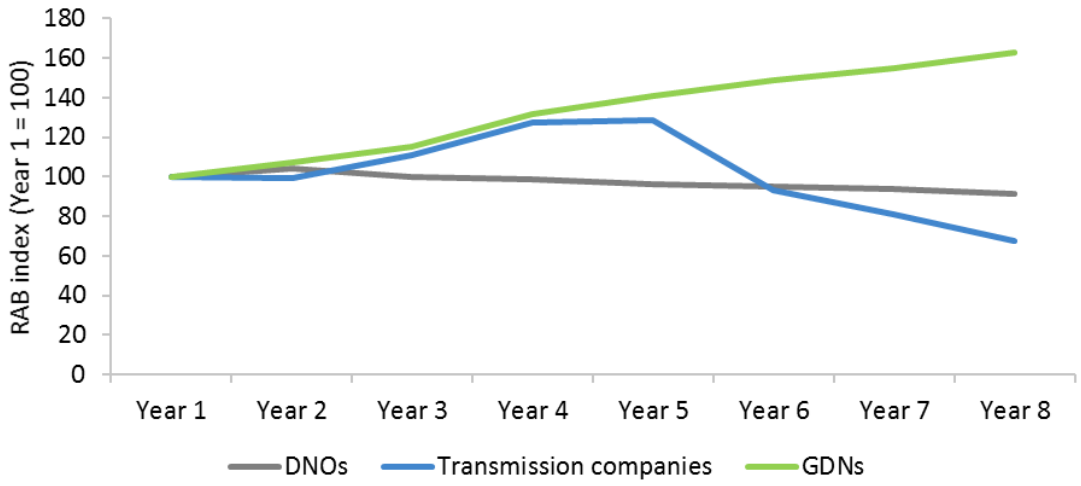


Source: CEPA analysis of iBoxx data

As discussed, if companies issue more debt when it is cheapest, they will beat a trailing average that uses a simple weighting of all periods. The reverse applies if companies issues debt when it is more expensive: they will then underperform a simple trailing average.

A weighted average might better reflect the actual cost of debt faced by companies, placing a greater weight on periods where the companies made the most additions to their RAV. The figure below shows how the RAV additions by the three industries differed over RIIO-1. This demonstrates that a weighted-average approach, as compared to a simple average approach, would lead to the different industries having a different assumed efficient cost of debt.

Figure 4.6: RAV additions by different types of energy network companies over RIIO-1



Source: CEPA analysis of Ofgem data

As the price controls are still ongoing, we cannot yet understand the implications for the cost of debt. This is because actual RAV additions may differ from what is expected, together with potential changes in the debt index itself. There will also be debt issued prior to the RIIO-1 price controls to consider.

4.4. Choice of index

We consider that the iBoxx family of indices remain appropriate for setting a suitable cost of debt allowance on a notional basis. Within the iBoxx publications, indices are available under four different categories:

- currency;
- company type;
- credit rating; and
- tenor of debt.

For currency, we consider that it remains appropriate to focus on GBP-denominated debt to reflect the assets from which returns are generated.

For company type, we consider that non-financial corporates continue to represent the best balance between a representative index and an index that is suitability independent of regulated companies' actions.

For credit rating, we propose to maintain the A and BBB broad ratings as reflective of current credit ratings and requirements under licences at the industry level. However, as we have discussed the yield from those indices does not necessarily match yields implied by these indices.

For the tenor of debt, although Figure 4.4 shows that recent issuances of debt have been at a shorter tenor, we propose maintaining the 10yr+ indices, unless evidence is provided why this is no longer appropriate.

4.4.1. Adjustments to the index

As noted in Section 4.2, company performance in the energy sector will not perfectly match up with the cost of debt implied by the iBoxx indices. We consider that a regulator should not be constrained in setting an efficient cost of debt by what indices are available and an adjustment to the index value is justified where the rationale for this adjustment can be explained.

Ofwat's PR19 final methodology involves a downwards adjustment of 15bps to the iBoxx 10yr+ indices to adjust to the outperformance in the sector. This was based on the utilities index equivalent being 17bps lower than the non-financials corporate index, and water companies' bond yields at issue being on average 15bps lower than the index over the decade to 2013.

We consider that the evidence available for regulated energy companies could support a downwards adjustment to the index. The level of outperformance in Section 4.2.1 appears to be greater than witnessed in the water sector, however as discussed in the CEPA report on the cost of debt for Ofwat and the CAA, regulated networks are comprising a greater proportion of the iBoxx indices and therefore industry-level performance could move increasingly in line with the index (all else remaining equal). This would imply that future performance could be lower than historic outperformance levels. This would need to be reflected in the adjustment chosen by Ofgem (if any).

In addition, the choice of adjustment could depend on if Ofgem wishes to make a company-by-company adjustment. An example of this could be where companies have different credit ratings or other features that reduce the perceived level of risk.

Our preference is to look at outperformance at the industry level, especially when estimating an initial range for the cost of capital. If there were to be company-specific adjustments, we would consider it to be more appropriate to reflect significant differences in characteristics, rather than simply reflecting different financing choices (which could be the choice of management).

In proposing an adjustment to our cost of debt range, in our high case, we assume that any outperformance is equal to efficiently incurred fees and make no adjustment. For our low case, we include a downwards adjustment of 25bps (prior to the application of fees). This assumes that there will be material outperformance, although to a lesser extent than a medium-term assessment of the halo effect on a comparison of yields at issue relative to our notional indices.

4.5. Trailing average length and weights

There are two issues that we discuss under the establishment of a trailing average. We consider it appropriate to include an allowance for embedded debt, consistent with other regulatory decisions and supportive of ongoing financeability.

Within our discussion of trailing average length; we look at the length of the trailing average period and whether simple or bespoke weights are used. Simple weights afford equal weighting to all data points, while the SHETL RIIO T1 cost of debt indexation mechanism, where weights were based on changes in the RAV, is an example of a bespoke mechanism.

A bespoke trailing average approach does add a complication of having separate cost of debt allowances for different companies under a price control. Rather than apply a bespoke weighting approach, regulators may choose to vary the length of the trailing average period to better reflect the nature of issuance. Where asset bases are growing, less weight should be placed on debt issued a long time ago – this may be reflected in a shorter trailing average period being used. Where there is a stable asset base over time, this would imply that debt issuance amounts would

be relatively stable over time and the trailing average period should reflect the average tenor of debt.

4.5.1. Trailing average length

Under the RIIO-1 price controls, there have been two approaches used on the trailing average length – for GD1 and T1, a ten year trailing average was used. For ED1, the trombone was used with a varying tenor extending in principle out to 18yrs by the end of the price control from 10yrs at the start. In the trombone approach, the starting point of the trailing average remains fixed while the end point extends to include new dates as they occur.

There are a number of options possible for the length of the trailing average. In the figure below we present three options: i) continuation of the RIIO ED1 trombone, ii) a 10yr average, and iii) a 20yr average. The trailing averages are based on the iBoxx GBP non-financial corporate A and BBB rated 10yr+ indices, with 10yr breakeven inflation used to deflate the allowance, as per the current approach[34].

Figure 4.7: Cost of debt – iBoxx index, with 10yr breakeven inflation

Source: CEPA analysis of data from Markit iBoxx and Bloomberg

As yields have trended downwards over the past 15yrs, longer trailing average periods are typically associated with higher allowances. For example, use of a 20yr trailing average would

[34] We proceed to discuss why we consider than 20yr breakeven inflation is the appropriate basis for deflating nominal yields under this approach.

increase the cost of debt allowance relative to the current approach by c.100bps based on current figures. Use of the 10yr trailing average indicates an expected real cost of debt yield of around 1% at the start of RIIO GD2 and T2, falling slightly over the remainder of RIIO-2.

4.5.2. Trailing average weights

Figure 4.6 highlights that RAV growth at the industry level across price controls does not follow the same path. Within sectors, growth will also differ by company.

We consider that bespoke weighting can bring about benefits, where an efficient company's financing approach is unlikely to match the profile of a simple average. However, where there are a number of companies, this approach brings about complexity if adopted in full across a sector. There may also be incentive impacts to be aware of.

Based on this, we would expect bespoke weighting to be used for investment profiles that differ significantly from the default assumption, as with SHETL for RIIO T1. We consider that flexing the length of the trailing average period is most likely to be used to reflect the size and timing of investment profiles.

4.6. Choice of inflation measure

Breakeven inflation is used to deflate nominal estimates into real estimates under Ofgem's current approach. This is done based on breakeven inflation estimates on the same day, rather than by applying today's inflation expectations to a nominal trailing average. This reflects that companies can issue index-linked or nominal debt, so removes scope to arbitrage between debt types due to differences in the inflation forecast used in setting a cost of debt allowance.

Ofgem currently use 10yr breakeven inflation estimates, calculated using the difference between yields on 10yr nominal and index-linked UK bonds. The use of breakeven inflation does provide a market-derived estimate of RPI inflation that regulated networks would face when going into the market.

However, we consider that there exists a mismatch between the length of the debt tenor for the iBoxx index and the time horizon for breakeven inflation. The nominal iBoxx index used is a 10yr plus index – this means that debt has at least ten years' time to maturity. Debt within the indices on average are close to 20 years in tenor. For the iBoxx GBP non-financial corporate indices, the average time to maturity as of the end of September 2017 is 23yrs for A rated debt, and 19yrs for BBB rated debt.

We consider that 20yr breakeven inflation provides a better measure for converting the nominal yield into an equivalent real yield and removes this mismatch. This would have the impact of reducing the real cost of debt, as 20yr breakeven inflation is higher than 10yr breakeven inflation. This is shown in the figure below.

Figure 4.8: Breakeven inflation (RPI)

Source: Bloomberg

Further discussion of inflation is discussed in Annex B and Ofgem may choose to adopt an approach to inflation indexation that uses CPI (or CPIH) inflation rather than RPI inflation. If this occurs, Ofgem will need to make sure that the approach to embedded debt is robust and does not create windfall gains or losses.

4.7. Adjustment for expected returns on debt

One the recommendations in the UKRN draft report is that regulators should adjust cost of debt estimates downwards to account for default risk (for consistency with use of expected returns). The impact of this adjustment is estimated as being 5bps for 10yr A-rated debt and 18bps for 10yr BBB-rated debt.

In our analysis we do not make any such adjustment. If Ofgem considered such an adjustment to be appropriate, this would reduce the cost of debt we have estimated.

4.8. Transaction costs

We consider that it represents good regulatory practice to include an allowance for efficient costs in financing. Previously, Ofgem has not included an explicit allowance for transaction costs. Instead, Ofgem has made the assumption that the level of efficient transaction costs is equivalent

to the outperformance its energy networks are able to derive against the iBoxx benchmark indices.

We consider that the statement could be broadly correct, but that there may be benefits from being more explicit: first ensuring that the chosen index better reflects the actual yields the companies face on their debt, and then to include a separate allowance for transaction costs. Longer term debt can be expected to have a lower annual transaction cost allowance than with short term debt, as the transaction cost is spread over a longer time period and embedded debt may not carry transaction costs in the same way that new debt does.

We include an allowance of 10bps, given limited information that is available. We would expect companies to justify the presence of these efficient debt costs to Ofgem and the requirement for this to be covered through the cost of capital.

4.9. Recommended approach for the cost of debt

Based on the analysis and discussion above, we provide our recommendation approach for estimating the cost of debt. This involves cost of debt indexation for both embedded and new debt together. With indexation, the value we present as our range will change over time, both prior to the beginning of the RIIO-2 controls and over the course of the price controls themselves.

In the table below, we set out our proposals for our range on the cost of debt.

Table 4.1: Proposed approach for estimating the cost of debt

	Low	High	Rationale
Choice of index	iBoxx GBP non-financial corporate A and BBB rated 10yr+ indices		Propose indices are consistent with issuance and efficient financing
Adjustment to index	-25bps	zero adjustment	At the low end, we include a downwards adjustment to reflect historic and expected outperformance on debt. At the high end, we assume that any adjustment for outperformance is netted off by transaction costs.
Transaction costs	+10bps		At the low end, an allowance for efficient transaction costs is included. At the high end, we assume that any outperformance is netted off by transaction costs.

	Low	High	Rationale
Trailing average length	10yrs	20yrs	The low end with a 10yr trailing average would be consistent a sector with a RAV that has grown or assuming that there is amortising debt[35]. The high end with a 20yr trailing average is more appropriate for a RAV that has not grown and consistent with the assumed tenor of debt (if assuming bullet payments).
Trailing average type	Simple average		For the purposes of our ranges, we have assumed simple averages are used. However, when further information is available on investment programmes and cash flows for RIIO-2, bespoke weights may be adopted.
Inflation	20yr breakeven inflation		This is consistent with the use of the 10yr+ indices and the implied inflation built into nominal yields.

Source: CEPA analysis

4.10. Recommended range for the cost of debt

Under this approach, the opening figures for our low and high case if implementing the indexation mechanism from today would be 1.50% to 3.30%[36]. For comparability to other price controls, we have sought to indicatively estimate what the cost of debt would be over the RIIO-2 price controls.

We have used forward rates on 20yr UK gilts to forecast expected changes in the market. The tenor is considered to be consistent with the approach taken, whereby the average tenor of our nominal indices are close to 20yrs, we use 20yr breakeven inflation and in our high estimate, we have also used a 20yr trailing average. The figures we quote are not estimates of a fixed cost of debt allowance over RIIO-2, but expectations today of what this figure might be.

The table below shows the expected real (RPI) cost of debt over the RIIO-2 price controls based on the recommended cost of debt indexation mechanism, assuming eight-year price controls.

Table 4.2: Indicative real cost of debt range for RIIO-2

Time horizon	Low	High
April 2021-Mar 2029 (GD2/T2)	0.30%	2.16%
April 2023-Mar 2031 (ED2)	0.35%	1.68%

Source: Bloomberg, Markit IBoxx, CEPA analysis

[35] Given the assumptions around the appropriate tenor of debt.
[36] This would be expected to change over the duration of the price control.

For setting an overall cost of capital range, we take the lowest and highest estimates from these calculations, namely a real (RPI) cost of debt range for RIIO-2 of **0.30% to 2.16%**.

We note that this may be materially different in practice, depending on changes in financial market conditions, both ahead of and during the RIIO-2 price controls.

Comparison to Ofwat cost of debt

The calculations capture the average cost of debt over the price controls. Based on current evidence, an indicative cost of debt estimate under our recommended approaches between April 2020 to March 2025 would be 0.36% (low) to 2.66% (high). For comparison to Ofwat's PR19 Final Methodology, we consider this to be most equivalent. Ofwat's real cost of debt range was 1.07% to 1.55% in real RPI terms.

Our wide range subsumes Ofwat's range and our low cost of debt estimates are materially below those produced by Ofwat over the same time horizon. We consider that this is driven by Ofwat's approach to embedded debt. Ofwat and its consultants, Europe Economics, look at the cost of embedded debt for the start of the price control, rather than over the PR19 price control (the CAA takes the same approach for its H7 policy update). This is based on 10yr and 15yr trailing averages of iBoxx indices, which means high yields over the Global Financial Crisis (2008-10) do not drop out of the embedded debt assessment over the course of the price control.

We consider that the rolling approach is sensible in that the cost of debt in April 2020 is unlikely to be the same as the cost of embedded debt in March 2025, as debt will have matured. Our low estimate shows that the impact of this could be as high as 100bps[37].

Our high estimate in this range is materially above Ofwat's cost of capital range. This is because we consider that the high estimate should take into account the possibility of a 20yr trailing average. This would increase the cost of debt today, but the cost of debt allowance relative to a 10yr trailing average depends on where rates move to. A potential difficulty in adopting such an approach could be if spot rates rise significantly above the trailing average – Ofgem would need to indicate a commitment to such a mechanism to ensure that the trailing average is selected as it is most appropriate, not for the figures it produces. Equally, Ofgem could be concerned that by adopting a 20yr trailing average rather than a 10yr trailing average, consumers may not gain the benefits of low rates.

[37] This is discussed in CEPA (2016) Alternative approaches to the cost of debt, Section 8.3.

5. COST OF EQUITY

In estimating the cost of equity for RIIO-2, we consider two approaches: an ex ante estimate of the cost of equity; and discussion of options should cost of equity indexation be introduced.

5.1. Track 1 – ex-ante

Under the ex-ante track, our assessment of the cost of equity is based upon setting a fixed allowance for the cost of equity with current data. We use the CAPM framework for estimating the cost of equity and make individual assessments on the cost of equity parameters. In Section 3.4 we discuss a framework for thinking about how to assess the cost of equity, in particular the TMR.

5.1.1. Risk-free rate

Discussion and approach

The risk-free rate is the theoretical rate of return on an investment with zero risk. While there are no investments with zero risk, UK regulators have traditionally regarded the return on UK index-linked gilts (ILGs) as a good proxy for the real risk-free rate as it is considered to have negligible default risk.[38]

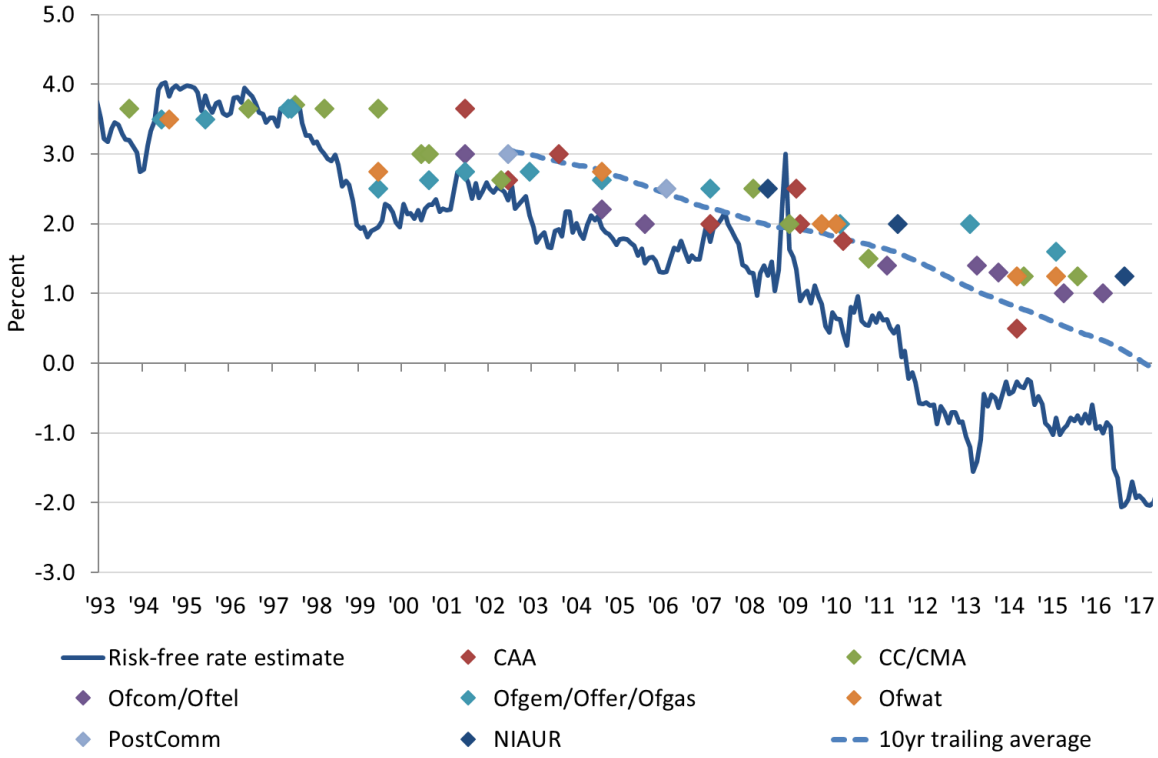
Regulators have previously placed weight on the hypothesis that gilt yields have been distorted, due to Quantitative Easing (QE) and other factors (e.g. reduced productivity) artificially depressing the estimates of the risk-free rate. Some market commentators also suggest that negative real gilt yields are caused by the fact that UK index-linked gilts are sought by investors as a protection against a surge in inflation. Both these arguments could lead a regulator to aim up from the evidence to remove the biases pushing real yields lower. We do not consider these to be strong arguments that would support aiming up.

ILG yields have been below zero for a prolonged period of time, meaning investors have likely priced in their expectations of future yields, and we consider that these yields do in fact represent a good proxy for the risk-free rate and that we should not adjust our estimates for any distortions[39]. Evidence from the Bank of England also illustrates that while the announcement of the first round of QE did have a material effect on yields, subsequent purchases have had a much more limited effect and yields have continued to decline[40].

[38] UK nominal gilts can be used to set the nominal risk-free rate in a similar way.
[39] This is consistent with the view put forward by the cost of capital study commissioned by the UKRN.
[40] Bank of England (2016) Staff Working Paper No 624, QE: the story so far.

Figure 5.1 below compares the risk-free rate estimated by a monthly average of 10-year zero coupon ILGs and a selection of risk-free rates set out in UK regulatory decisions over the past two decades[41]. This illustrates that a longer term trailing average on yields may have been considered more appropriate as a basis for setting the risk-free rate than a spot rate.

Figure 5.1: The risk-free rate[(a)] and UK regulatory decisions on risk-free rates



(a) The risk-free rate estimate is based on a monthly average of 10-year index-linked gilts

Source: Bloomberg, CEPA analysis

The recent Ofwat and CAA positions on the risk-free rate indicate a move away from aiming up on the risk-free rate, with Ofwat estimating a real risk-free rate of -0.88% and the CAA producing a range of -1.4% to -1.0%. Both approaches are based on a current risk-free rate with an adjustment for expected movements in rate over the price control.

Analysis

As noted above, there are two broad approaches for estimating the risk-free rate:

- utilising long-term trailing average yields (over the price control period); and
- taking current rates with adjustment for expected future movements in rates.

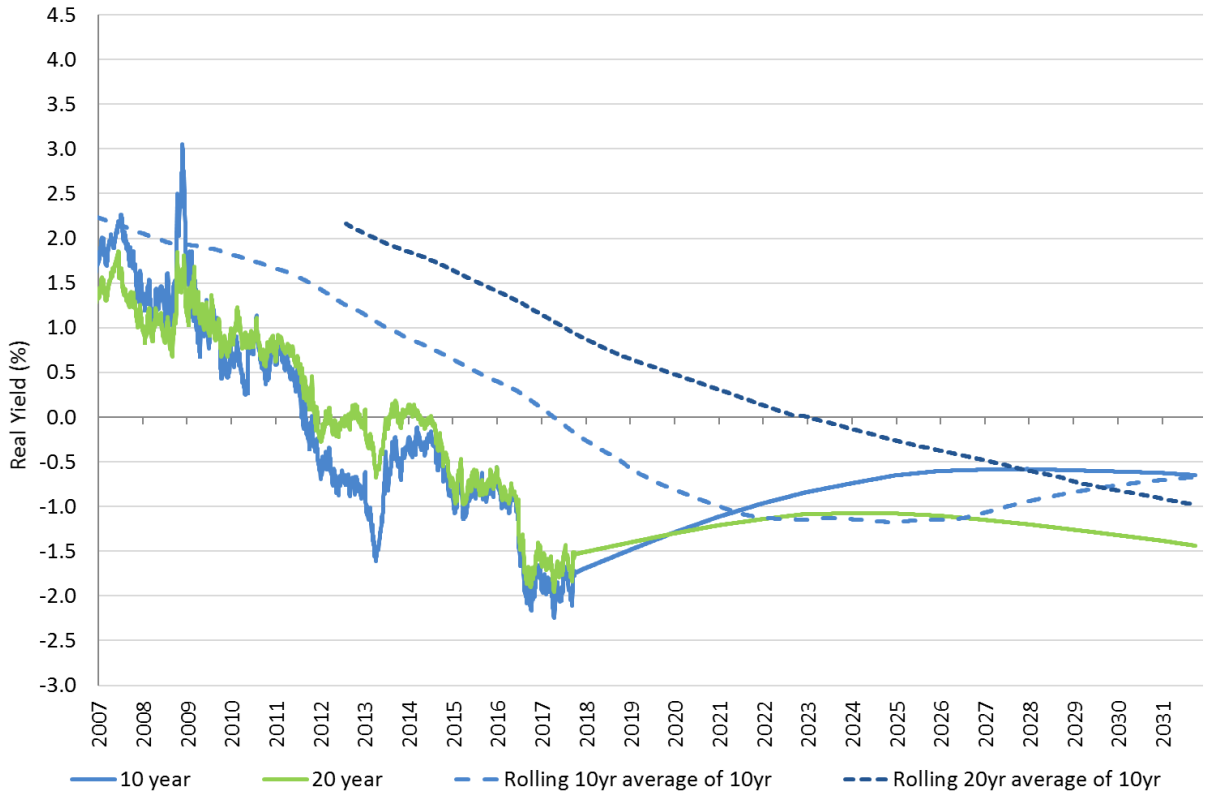
[41] The zero coupon yield on inflation-linked gilts are recommended by the UKRN for estimating the risk-free rate.

For considering long-term averages, we prefer to look at the expected trailing average over the price control period rather than the trailing average at one point in time. While the former approach is more simplistic, it means that the allowance would change based on the time of the determination, even when the current level of the yield and forward rate expectations do not change.

Use of a trailing average is not equivalent to 'aiming up', and instead would represent a view of the world around how equity should be compensated. The use of a spot rate and forward curves involves volatility in results and we have set out the limited predictive power of forward curves on government bonds in Section 4.2. The use of a trailing average would increase stability and be less affected by day-to-day movements.

The figure below shows the path that real yields are expected to travel on (based on forecast changes from forward curves) and what this means for the trailing averages. We note the limited predictive power forward curves have had, but this represents an appropriate basis for illustrating future rates. We note that RIIO-2 begins in 2021 for GD2 and T2, compared to 2023 for ED2.

Figure 5.2: Implied movements in UK index-linked bond yields



Source: CEPA analysis of Bloomberg data

The current spot rate, as of September 29, 2017, of the 10yr ILG is -1.74%, compared to -1.54% on the 20yr ILG.

Below, we present the expected figures derived from forward curves to obtain long-term trailing averages and estimates of future spot rates. We take a mid-year implied estimate for each financial year, with RIIO GD2 and T2 covering 2021- 2029 and RIIO ED2 covering 2023-2031.

Table 5.1: Forward-derived evidence on index-linked gilts over upcoming price control periods

Time horizon	Forecast spot rate evidence		Forecast trailing average evidence	
	10yr Spot rate	20yr Spot rate	10yr TA of 10yr	20yr TA of 10yr
RIIO GD2 and T2	-0.71%	-1.13%	-1.08%	-1.13%
RIIO ED2	-0.63%	-1.19%	-0.99%	-1.18%

Source: CEPA analysis of Bloomberg data

Note: GD2 and T2 time horizon assumed to be 1 April 2021 to 31 March 2029. ED2 assumed to be 1 April 2023 to 31 March 2031.

For the 20yr bond, the use of a spot rate and use of a trailing average end up being very similar over both time horizons considered. Forecast spot rate evidence on the 10yr bond is 36-37bps lower than the forecast 10yr trailing average.

Conclusion and initial range

For the low-end of our range, we consider that the current spot rate on 10yr ILGs is an appropriate basis. This is less likely to be relevant in an ex-ante setting of the cost of equity, but more relevant with cost of equity indexation, or alternatively if a regulator considers that forward curves lack of predictive power means that current rates are most appropriate for using in estimations. This gives a low-end estimate of **-1.75%**.

For the upper end of our range, we take the expected highest value presented above, the expected 10yr forecast spot rate over RIIO ED2. This gives us a high-end estimate of **-0.60%**.

5.1.2. Equity market returns

Discussion and approach

In estimating the cost of equity, we prefer to focus on the TMR and infer the MRP (rather than estimate the latter directly). In Annex E, we provide a detailed explanation of how we have approached estimating equity market returns. The annex discusses two overarching approaches to equity market returns:

- use of historic outturn returns (either unadjusted or adjusted); and
- use of forward-looking evidence, for example DGMs.

We consider that both approaches have benefits and drawbacks, so we look at a wide range of evidence in estimating a suitable range rather than focus on a single approach. We also consider recent regulatory guidance from Ofwat and the CAA on their upcoming price control decisions.

Analysis

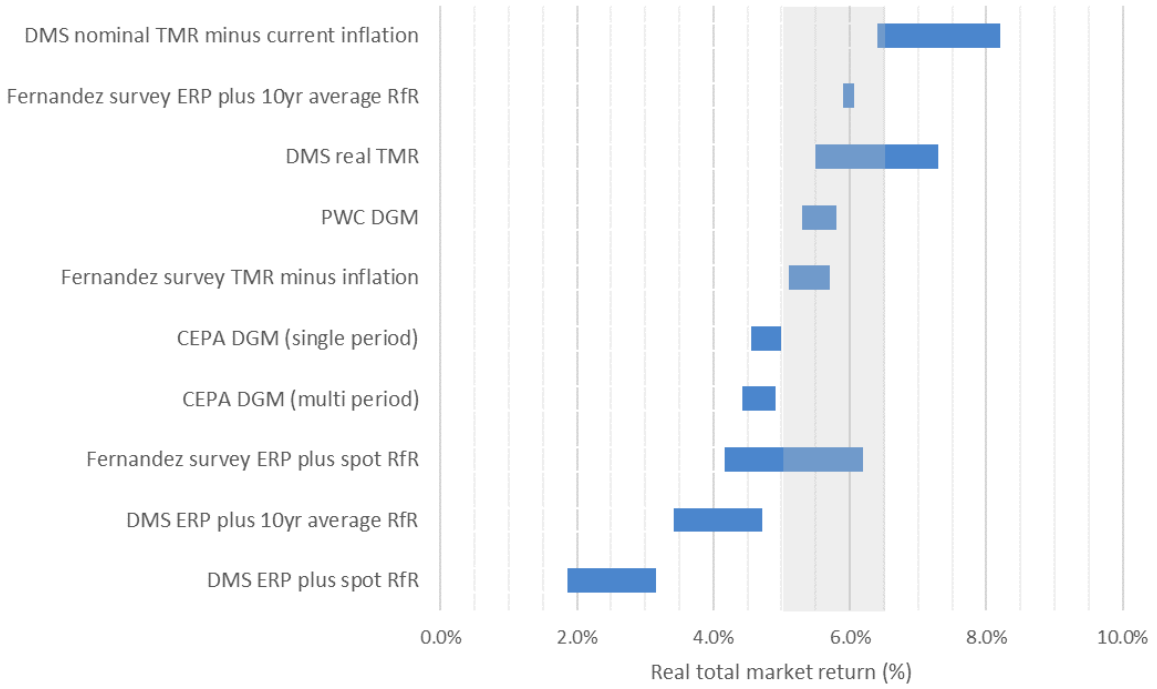
The figure below shows a range of historic return and forward-looking evidence. This reflects that there are a range of outcomes from looking at different sources of evidence. However, not all sources of evidence presented should be given equal weight in the range decision, particularly with evidence at opposing ends of the spectrum for the following reasons:

- taking the nominal TMR from DMS minus current inflation is likely to overestimate the TMR, due to historic inflation being higher than expected inflation; and
- taking a historic fixed ERP assumes that the risk-free rate is largely independent of the ERP, which we do not consider to be reflective of evidence. With a historically low risk-free rate, this is likely to underestimate the TMR.

In addition, we consider that survey evidence is likely to be less robust than other measures due to a lower degree of transparency underpinning the estimates[42].

[42] Although there is some regulatory precedent for using such evidence e.g. MMC British Gas 1993 decision, and this can potentially capture the forward-looking nature of the parameter.

Figure 5.3: Evidence on real TMR



Source: see Annex E for assumptions

We have highlighted in Figure 5.3 the broad TMR range from the Competition Commission (CC) Northern Ireland Electricity (NIE) determination in 2014[43]. This represents a key piece of evidence around the weights to be afforded to historic evidence and forward-looking approaches, as this was set out by the competition body and has influenced subsequent decisions by UK regulators.

The CC placed greater reliance than they had in the past on ex-ante estimates derived from historical data. The CC also relied on forward-looking evidence in arriving at their broad TMR range. The CC determined that the TMR cannot be regarded as fixed, elements of the historic return are unlikely to be repeated in future and realised returns had been higher than required returns[44]. Overall, the CC concluded that[45]:

"On a prospective basis, we see no reason why equity investors should expect to earn higher returns in the future than they have done in the past."

The UKRN draft report includes the concept of a very long-run return and the idea of a 'dragging anchor', whereby if the long-run return is stable, using this approach will get the TMR correct on average over this time horizon. The authors note their concern that arriving at an agreed

[43] As noted previously, we consider that investors care about real returns and as such, we do not consider the need to make an adjustment for changes in forward-looking estimates of inflation in utilising this estimate.
[44] CC (2014) Northern Ireland Electricity Ltd determination: Final determination, paragraph 13.146.
[45] CC (2014) Northern Ireland Electricity Ltd determination: Final determination, paragraph 13.160.

quantitative methodology is difficult to be captured in an implementable and defensible way[46]. While we understand the sentiment of this approach, we consider that the CC's analysis of different evidence types should also be reflected in our analysis.

In Annex E, we consider the benefits from using multiple sources of information, rather than for example relying solely on ex-post historic returns. If long-term returns are stable, focusing on ex-post historic returns only will on average get the answer correct over the long-term. However, we consider that Ofgem should look to get the cost of equity right over the short-term, not just the long-term, so reliance on ex-post historic returns is not the optimal approach.

Recent regulatory publications

There are two aspects of the Ofwat and CAA December 2017 publications that we consider are useful references in estimating the TMR:

- adjustments to ex-post historic returns; and
- weight on forward-looking evidence.

Historic evidence is useful in providing a more stable estimate, but may not reflect current conditions in equity markets. PwC, in advising both the CAA and Ofwat, utilise two adjustments to ex-post historic evidence to create ex-ante estimates. The two adjustments relate to i) one-off non-repeatable factors not expected to occur in the future, and ii) the impact of the RPI formula effect[47].

The one-off factors were seen to have contributed 40bps to historic returns – as such, this value is subtracted from the ex-post returns to arrive at an ex-ante estimate. The RPI formula effect was estimated as being equivalent to 33bps – this figure is also subtracted to establish a real ex-ante TMR. We discuss adjustments to the TMR further in Annex E.

Conclusion and initial range

We consider it appropriate to consider both historic return evidence and forward-looking evidence in establishing a range for the TMR and take the CC NIE TMR range as our starting point. We do not consider that the weight of available evidence points to a suitable estimate outside of this range.

A potential exception would be the CEPA DGM estimate, which currently provides an estimate slightly below this range. However, this is one data point and there are a number of specifications

[46] A recommendation in the UKRN draft report is that equity market returns should focus on long-term historic returns.
[47] The RPI formula effect refers to change in the computation of RPI inflation from 2010.

for DGM, which means we do not propose to adjust the CMA NIE range lower. As such, we propose a TMR range of **5.0-6.5%**.

Selecting a point estimate from this range will depend on the view taken by Ofgem; forward-looking evidence and cross-checks from competitive benchmarks would lead to a figure from the lower part of the range using current evidence, while relying more on historic regulatory determinations and unadjusted ex-post historic returns would lead to a position in the upper part of the range[48].

Ofwat for their PR19 Final Methodology have a real TMR range of 4.85% to 6.13%; this places more weight on prevailing evidence. Given the longer time horizons we are looking at (the next price controls will not start until 2021 and RIIO-ED2 may finish in March 2031), we consider there to be more scope to accommodate the slightly higher historical averages in our range.

5.1.3. Beta

Discussion and approach

As pure-play company betas are often unobserved, estimating beta requires a range of techniques, including both quantitative and qualitative analysis. There are a number of methodological choices in undertaking quantitative beta analysis, discussed in depth in Annex C. Qualitative analysis is often undertaken by considering relative risk in relation to the benchmarked comparators or in relation to other regulatory determinations.

We discuss three different methodological choices below, namely:

- choice of suitable comparators;
- returns frequency and returns horizon; and
- UKRN study and 'conventional' beta analysis.

Choice of comparators

Our comparator set includes an energy network, National Grid (NG) and three water and waste water utilities, United Utilities (UU), Severn Trent (SVT) and Pennon (PNN).

While NG may appear the most natural comparator, according to 2017 accounts, only 36% of operating profit comes from UK regulated network businesses. This means that other operations are influencing the observed beta for the company and this is not a 'pure play' comparator.

[48] Cost of equity indexation could involve placing more weight on current evidence, as this will be updated over the course of the price control. We note that new regulatory guidance/ determinations could provide a different viewpoint by the time of the RIIO-2 price control decisions.

SSE is another listed entity. However, with only 4% of revenues coming from UK regulated entities, we consider that the beta will be dominated by other parts of their business and not provide a reliable comparator.

The other comparators are regulated water companies. As such, we must factor in the differences between water and energy networks in order to translate this evidence into suitable beta estimates for RIIO-2.

As stated in the framework section, we consider that it is most appropriate to focus on UK-based evidence, as the assets generating returns are based in the UK. While the use of other international energy networks may increase the breadth of the comparator set, more adjustments are required in light of regulatory and commercial regimes and use of a different relative index.

Returns frequency and returns horizon

For both Ofgem's RIIO-1 beta estimates and Ofwat's PR14 determination, regulators looked at two-year and five-year investment horizons. However, Ofgem looked at daily returns, while Ofwat looked at weekly and monthly returns. This highlights the fact that there is no consensus over the most appropriate returns frequency for estimating beta. In this section we present a range of evidence rather than focus on a single method.

UKRN study and use of 'conventional' beta analysis

Our approach to beta analysis is a relatively conventional approach, taking an established approach to estimation and not making bespoke adjustments. One of the recommendations is that UK regulators should use more technically sophisticated tools for assessing the beta. Given the challenges in estimating beta, we support attempts to shed light on beta. This report focuses upon more traditional estimate of beta.

A further recommendation of the UKRN draft report concerns adjustment to the beta for the level of gearing. Our approach uses a simple re-levering formula without including taxation and with a zero debt beta.

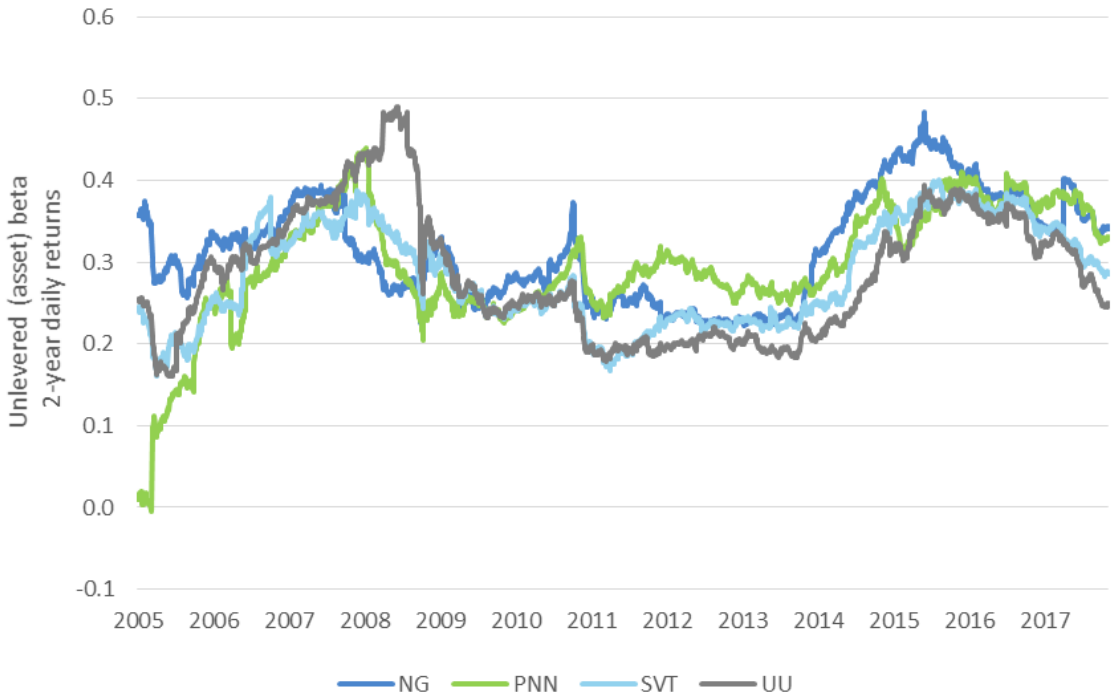
Analysis

For our analysis we present estimates of the asset beta, first showing results across our comparator set and then looking at results on average for our comparators under different methodological choices.

Asset beta by comparator

The figure below shows asset beta estimates for the four noted comparator companies.

Figure 5.4: Unlevered (asset) betas for comparator regulated utilities[49]



Source: CEPA analysis of Bloomberg data

There are large movements in beta estimates over time. With this variation and in the absence of a clear rationale as to why the figures are moving, we consider that the medium term average beta is a better estimate than the spot beta.

Asset beta by returns frequency and horizon

The above analysis reflects two-year daily estimates of beta. In the figure below we show alternative methodological choices.

[49] Our asset beta estimates are based on net debt gearing and assume a zero debt beta.

Figure 5.5: Unlevered (asset) betas for comparator regulated utilities[50]

Source: CEPA analysis of Bloomberg data

We consider that a broad range of 0.20 to 0.40 for the asset beta appears appropriate. This does give a very broad outcome for the cost of equity and as such we propose to focus on a narrower range. We select a narrower range of 0.25 to 0.35 as our starting point for beta analysis[51].

RIIO-2 versus RIIO-1 regimes

Even if pure play energy network comparators were observable, we must also consider the extent to which historic beta evidence can represent a proxy for future systematic risk in the RIIO-2 regime. While the details of the RIIO-2 regulatory package have not yet been determined, changes to the incentive regime or investment programme could influence the cost of capital, in particular the asset beta[52].

In the RIIO-GD1 determination, Ofgem stated that it "regard[s] the scale of investment as the most significant differentiator of risk affecting both the asset beta and the appropriate level of notional gearing"[53].

[50] This uses the mean of our four comparator companies.
[51] As a point of reference, for the DPCR5 Final Proposals, Ofgem indicated an asset beta range of 0.24 to 0.34, very close to our proposed range here.
[52] We note that
[53] Ofgem: "RIIO-GD1: Final Proposals – Finance and uncertainty supporting document", (2012).

The extent to which investment intensity affects beta will be affected by the regulatory regime, including incentives around cost efficiency. This could include the sharing factor used, as well as any re-openers for exceptional events.

We do not consider asset stranding to be a risk for the RIIO-2 price controls, with the presence of the RAV and depreciation policy. However, with potential changes in the future utilisation of networks, it is an issue that should be considered as the approach taken will have implications for revenues under future price controls.

Relative risk of regulated water networks

Further information regarding the RIIO-2 regimes will become available over time and this will help provide greater clarity on how the regulated energy sector compares to the regulated water sector. A key piece of information will be the size of investment programme across different sectors.

We consider that the energy sector is broadly comparable in (systematic) risk profile to the water sector. There are differences in the regime, but this is likely to influence the position within a range rather than the setting of that range and there are going to be ways in which the energy sector has both higher and lower systematic risk than the water sector. One example of the latter is on pension deficit cost recovery, where greater protections are available in the energy sector relative to the water sector.

We note that Ofwat has set out an asset beta of 0.37 within its PR19 Final Methodology, however this uses a debt beta of 0.10[54]. When de-levering raw equity betas, the debt beta will lead to a higher asset beta. However, when this is re-levered to the notional gearing level the difference between the asset beta and equity beta is reduced.

Conclusion and initial range

We consider that greater weight should be placed on empirical beta estimates, with regulators in our view having a tendency to adopt conservative beta estimates[55]. Instead, we consider that our narrow range of 0.25 to 0.35 represents the appropriate starting point for the asset beta. In setting our range however, we need to be aware that certain sectors or companies will have large investment programmes relative to the size of their asset base (as per the Scottish TOs for RIIO T1). We consider that including a broader range to capture any additional systematic risk provides an allowance for more exceptional cases such as this.

This gives an asset beta range of **0.25 to 0.40**. We discuss in Section 7 the selection of a point estimate from within this range.

[54] This equates to a 0.31 asset beta with the use of a zero asset beta.
[55] This is consistent with the views expressed in the 2012 RIIO Financeability study by Imrecon/ECA.

5.1.4. Recommended range for the cost of equity

The parameter estimates give a post-tax cost of equity range in real (RPI) terms of **3.07% to 5.08%**. As noted previously, there are different estimates that can be derived from combinations of parameters.

Comparison to Ofwat cost of equity

Our proposed cost of equity range subsumes the quoted Ofwat PR19 Final Methodology real (RPI) post-tax cost of equity of 3.41% to 4.69%, with Ofwat indicating a point estimate of 4.01%. We consider that our broader range is appropriate given both that this represents an initial assessment and the need to cover a range of sub-sectors[56].

The difference in the post-tax cost of equity between PR14 and the PR19 Final Methodology is 165bps; the difference between the CAA's Q6 post-tax cost of equity and its H7 policy consultation is c.190bps. For both regulators, there has been very little movement in the beta term, so this difference reflects a change in estimated market parameters[57]. The PR14 and Q6 determinations were made after the CMA's provisional NIE determination.

[56] Ofwat has used notional gearing of 60%, which falls within our notional gearing range of 50-65%. At this stage, we have not adopted point estimates for any parameters – and, given that our assessments of gearing and asset beta are inter-related, we do not consider it appropriate to present an estimate for a specific gearing assumption.
[57] With a small change in notional gearing contributing to a lower figure for Ofwat.

5.2. Track 2 – Indexation of cost of equity parameters

Under this second track, we consider the feasibility of a cost of equity indexation approach and its implications. We discuss why a regulator may choose to index the cost of equity and options available if this approach was determined to be preferable to setting an ex-ante cost of equity.

5.2.1. Choice of whether to index

For the cost of debt, a notional benchmark is available for the all-in cost of debt. However, on the cost of equity, there are different parameters to be estimated and these utilise different sources of evidence to one another. We discuss how a decision on cost of equity indexation can be made and options available for achieving this.

Assessment criteria

The five assessment criteria selected for choosing whether to index or not are as follows:

- Does the underlying value of the parameter change over time?
- Is the parameter difficult to forecast accurately?
- Is the parameter observable?
- Does a measure exist that is representative for the parameter?
- Is the parameter uncontrollable for the company?[58]

If the answers to each of these questions is 'Yes', then there are arguments in favour of indexation.

Review of performance against criteria

We make an assessment against the above criteria for each cost of equity parameter[59].

Table 5.2: Assessment of whether parameters should be indexed

	Risk-free rate	TMR	Beta
Is the underlying parameter value expected to move within a price control?	✓✓	✓	X[60]
Is the parameter difficult to forecast accurately?	✓✓	✓	✓✓

[58] Noting that the company may be able to mitigate against some of the risk, but this may not necessarily be efficient.
[59] Note that we assume constant gearing with respect to beta.
[60] While there may be some movement in the beta value, we would expect the risk faced to be relative stable. As an example, we would expect the beta value to be the cost of equity parameter which is least likely to change during any potential mid-period review in a price control.

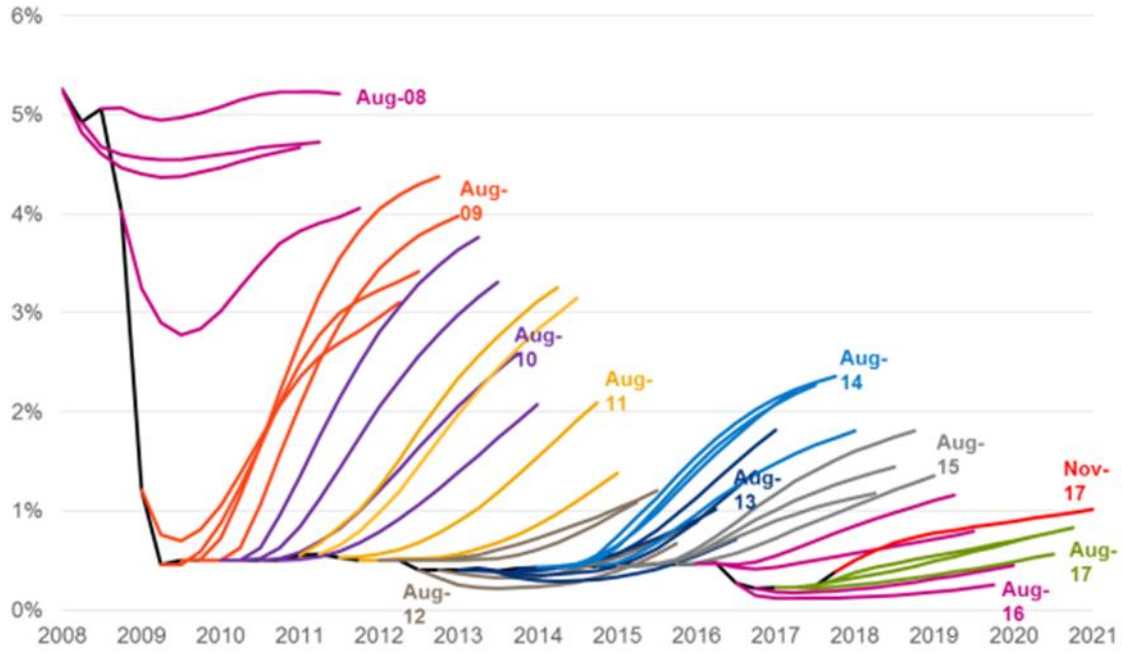
	Risk-free rate	TMR	Beta
Is the parameter observable?	✓✓	✓	✓
Does a representative measure exist?	✓✓	✓	✓
Is this uncontrollable for the company?	✓✓	✓✓	✓

Note: two ticks signify a clear 'yes', a single tick signifies a partial 'yes' and a cross signifies a 'no'
Source: CEPA analysis

Given that we consider the equity beta should not move materially within any price control period (and that volatility in the empirical equity beta estimates is difficult to explain), we do not consider there to be benefits from indexing beta.

There appear to be clear arguments for indexing the risk-free rate, which does move and often in different ways to that predicted by forward curve evidence. The figure below, quoted in Ofwat's PR19 final methodology, shows market expectations of movements in the Bank of England's base rate at different points in time, relative to what actually occurred.

Figure 5.6: Market implied expectations of the Bank of England base rate



Source: Ofwat PR19 Final Methodology

It should be relatively straightforward to index the risk-free rate as government bond yields represent proxies for the risk-free rate. If the risk-free rate is considered to be independent of the ERP, it is possible to index the risk-free rate by itself. We discuss the relationship between the two parameters in Annex E, and consider that there is evidence of an imperfectly offsetting relationship between the risk-free rate and ERP (i.e. the coefficient between the risk-free rate and ERP is a non-zero value between 0 and -1).

Focusing on the parameter in isolation, the justification for indexing the ERP (or TMR) is not as strong as for the risk-free rate, but it does meet most of the assessment criteria set out above and therefore this parameter could be indexed. Unlike with the cost of debt or risk-free rate, there are a number of evidence sources used in estimating the ERP or TMR, so there is greater room for judgement to influence the decision. We consider that this approach has scope to be better than assuming a fixed value for the whole of the price control as is currently done.

To apply indexation for both the risk-free rate and the ERP or TMR, decisions would be required on the relationship between the risk-free rate and ERP, and the weight to place on different pieces of evidence for estimating the ERP or TMR. This is something that is done implicitly when setting an ex-ante cost of equity, so the main difference is that this would need to be explicit. The reduction in the degree of discretion comes at the benefit of additional transparency.

5.3. Indexation options shortlisted

While there are multiple options available around the indexation of the cost of equity, these ultimately depend on the views of the regulator on the relationship between the risk-free rate and ERP. Our three options for indexation represent different views on that parameter:

- **Index risk-free rate only** – assume a fixed ERP and change the cost of equity in line with the risk-free rate.
- **Index risk-free rate with offsetting adjustment assumed for ERP** – the risk-free rate is indexed, while an assumed delta in the ERP is used based on movements in the risk-free rate, e.g. a 1% rise in the risk-free rate is assumed to lead to a 0.5% decrease in the ERP.
- **Index risk-free rate and ERP or TMR** – index the risk-free rate and ERP or TMR such that any changes in evidence can be captured.

The counterfactual would be using an ex-ante approach on all parameters for equity.

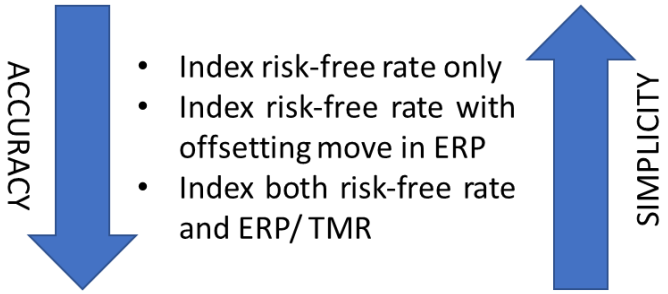
Under these approaches, there are variants on the precise indexation method; the regulator could apply a trigger or deadband, or potentially pain-gain share type mechanisms around changes in the parameter[61].

- Under a trigger or deadband mechanism, an adjustment is only made when a pre-defined change is met or when the indicator deviates outside specified bounds.
- A pain-gain share mechanism would involve adjusting a factor by a certain proportion rather than by the entire amount.

[61] This would involve dampening the impact of any change in the cost of equity.

5.4. Comparison of approaches

The trade-off between the three options is, put broadly, one of simplicity versus accuracy. This is represented below.



Indexing the risk-free rate only

Relative to the current ex-ante approach to setting the cost of equity, indexation of only the risk-free rate could potentially lead to a more representative cost of equity. If we consider that sources of evidence represent appropriate proxies for the cost of equity, the other two approaches are likely to be more accurate that an ex ante allowance or indexing the risk-free rate only.

While there is an initial exercise to determine a mechanistic approach for indexation, this should not create much of an ongoing regulatory burden, especially given that indexation is used on the cost of debt and with other annual adjustments being made. As such, we think that indexing only the risk-free rate is unlikely to represent the best approach to cost of equity indexation (however, it may lead to a better estimate of the cost of equity than an ex-ante approach).

Indexing risk-free rate with offsetting change in the ERP

For the second approach, with indexation of the risk-free rate and an offsetting adjustment in the ERP, the coefficient between risk-free rate and ERP may use historic evidence. PwC, on behalf of Ofwat, analysed the movement in DDM estimates over two horizons to estimate this coefficient, finding for 2000-2016 that the coefficient was [-0.76] and for 2010-16 the coefficient moved to [-0.88]. Alternatively, looking at DMS evidence on TMR and the risk-free rate provides another point of evidence to utilise. A report by Harris and Marston (2013) found that the coefficient between the risk-free rate and ERP was [-0.79] based on US evidence between 1986 and 2010[62]. This evidence supports a negative, but not one-for-one relationship between the two parameters.

Annex E contains a more detailed discussion on the relationship between the risk-free rate and ERP.

[62] Harris and Marston (2013) Changes in the Market Risk Premium and the Cost of Capital: Implications for practice.

Indexing the risk-free rate and ERP or TMR

For the third approach, there would need to be an explicit weighting on the different sources to use, rather than an implicit one as at present. There has been detailed discussion of the relationship between the risk-free rate and ERP from the CMA NIE 2014 determination in a UK regulatory context, so there should be an established evidence base to draw upon.

5.5. Overall feasibility of cost of equity indexation

We consider that there are potential benefits from cost of equity indexation relative to a fixed allowance, although there are questions to be addressed before this could be introduced, outlined below.

5.5.1. Issues to be addressed

We present issues to be addressed under a cost of equity indexation approach below. We do not consider that any of these are insurmountable, but further analysis would be beneficial.

- *Estimates of coefficients and weights* – as discussed above, with reduced discretion, the precise values chosen are very important.
- *Use of absolute values or relative changes* – rather than index using absolute values, one option is to use the change in values from evidence to undertake indexation.
- *Allowance for historically incurred equity* – while long-term trailing averages have been used in previous regulatory decisions for the risk-free rate and TMR; if a regulator considers that there should be consideration for equity issued in the past, a trailing average rather than spot rate would be appropriate.
- *Financeability impact* – in the following section of the report, we discuss financeability and the impact of a lower cost of equity; this exercise could potentially be more challenging if there is uncertainty around future values for a parameter – although if the cost of equity moves in the same direction as the cost of debt, there may be benefits.
- *Plausibility of values* – use of more discretion permits use of cross-checks, such as competitive benchmarks; how can these be incorporated into the analysis to ensure that the overall cost of equity value is plausible?
- *Substitutes for investment* – indexation of the cost of equity would differ to the approach of other regulators; if the cost of equity was expected to be lower or higher at points in time relative to other sectors, would you see flows out of or into the energy sector?

5.5.2. Alternative approaches

There are alternative approaches available that are closer in design to a fixed ex-ante approach, but involve some adjustments. An example of this would be a trigger or deadband mechanism where the cost of equity only changes if evidence moves by a set amount. When rates remain steady, benefits from any form of indexation are more limited than they are when rates are more volatile and uncertain.

Use of a trigger or deadband approach does have its own challenges, however. For example, there is a question of how to set the level of the deadband. Overall, the use of a deadband could be a transitional approach for RIIO-2.

5.6. Transaction costs on equity

As discussed in the CEPA (2018) report on the cost of capital for new assets, where external equity is being raised this incurs transaction costs. We consider that this is best left outside of the cost of equity itself and included as a separate item. In the new assets report, CEPA considered that 3% of new external equity was appropriate as a transaction cost. This is our starting point for RIIO-2.

6. FINANCIAL STRUCTURE AND FINANCEABILITY

A company's financial structure is the mix of debt and equity finance used to fund assets; the debt portion of this mix is known as gearing. Within the weighted average cost of capital, the company's financial structure determines the balance between the costs of debt and equity in calculating the overall cost of capital. Financial structure, in particular gearing, is also used as an input into the equity beta calculation as part of the CAPM model, with the equity and asset betas typically being related through the following formula[63]:

$$\beta_a = (1 - g) * \beta_e$$

where the subscripts *a* and *e* denote the asset and equity betas respectively, and *g* denotes the level of gearing.

Notional gearing refers to the regulator's view of the efficient (from a societal perspective) level of debt used to fund assets. Notional gearing may differ from the company's actual gearing, which is determined based on the company's view of optimal capital structure in its business. While notional gearing is often informed by the industry's actual level of gearing, it is ultimately a judgement decision for the regulator to set the level of notional gearing which achieves credit rating levels consistent with targets, whilst balancing an appropriate cost of capital.

Notional gearing is used for two distinct but related purposes in our determination of the appropriate cost of capital: to calculate the cost of capital and to assess financeability implied by the regulatory package. As a result of the re-levering formula, a change in gearing has offsetting effects – higher gearing places more weight on cheaper debt relative to more expensive equity, but leads to a higher equity beta that increases the cost of equity.

Notional gearing also plays a role in determining financeability and indirectly impact on the credit rating of the Licensee. This section includes discussion on the appropriate level of notional gearing and the financeability of the Licensees.

6.1. Empirical evidence on gearing

Empirical gearing evidence can come from observed network companies regulated by Ofgem and also from publicly traded comparators. This section provides both sources of gearing evidence.

Different network industries may have different optimal gearing levels, so it is important to consider each of these industries individually. Estimates of network industry gearing are provided below along with the assumed notional gearing in RIIO-1.

[63] Where a zero debt beta is assumed.

Table 6.1: Empirical gearing evidence and regulatory determinations of notional gearing

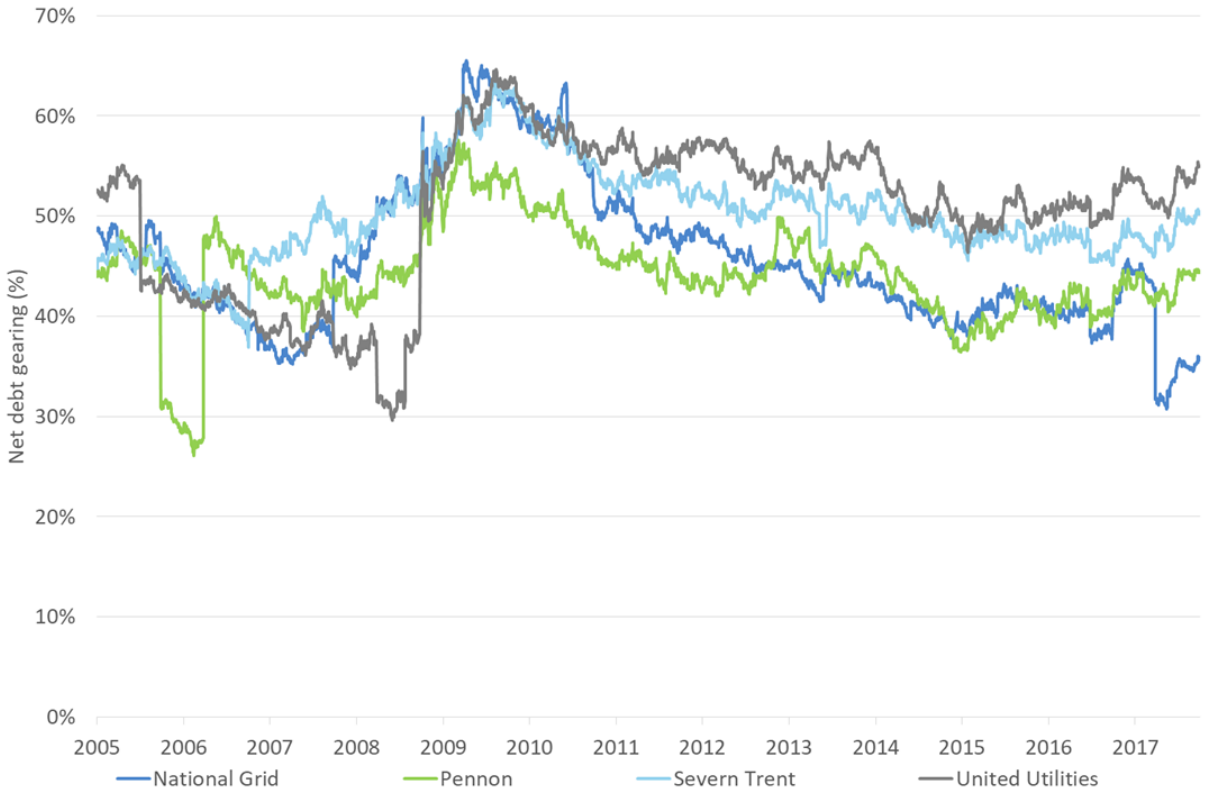
Network industry	2016/17 estimate net debt/RAV	RIIO-1 notional gearing
Gas distribution networks (GDNs)	58%	65% (RIIO-GD1)
Distribution network operators (DNOs)	50%	65% (RIIO-ED1)
Transmission owners and system operators	48%	55%-62.5% (RIIO-T1)

Source: Ofgem data, RIIO-1 determinations and CEPA analysis

The table above shows that actual gearing as of March 2017 is around or below the lower end of the range provided in RIIO-1 of 55-65%.

We also consider that gearing evidence from publicly traded comparators, shown below, is consistent with our inference on beta. As emphasized in Section 5, our comparator set includes an energy network, National Grid and three water and waste water utilities, United Utilities, Severn Trent and Pennon.

Figure 6.1: Empirical gearing of comparator set



Source: Bloomberg data and CEPA analysis

The figure shows that empirical gearing is roughly in line with the gearing observed from network companies in the preceding analysis.

At this stage of the RIIO-2 process, we do not have details of the full scale of the capex program, thus it is reasonable to assume a gearing level based on the empirical evidence and consistency with RIIO-1 decisions, presented in Table 6.1. Based on this, our initial RIIO-2 range is 50-65%, with the low end drawn from evidence on regulated utility gearing and the high end based on previous regulatory decisions.

Sensitivity of WACC to changes in gearing

As mentioned above, changing the notional gearing has offsetting impacts in the post-tax WACC calculation[64]. On one hand, increasing the gearing ratio increases the equity beta which results in a higher cost of equity. On the other hand, increasing gearing increases the weighting of the cost of debt in the WACC. The cost of debt, in theory and in practice, is usually lower than the cost of equity so this lowers the WACC. In short, the relationship between gearing and the WACC is non-linear. The relationship between the level of gearing and the cost of capital depends on the parameters chosen; in some cases, the increase in the proportion of (cheaper) debt has a smaller effect than the impact on the equity beta and cost of equity (or vice-versa).

6.2. Financeability

In setting the cost of capital, Ofgem seeks to ensure the ability of "efficient network companies to secure financing in a timely way and at a reasonable cost in order to facilitate the delivery of their regulatory obligations".[65] Ofgem and other regulators have historically used credit rating agencies' methodology notes as a guide to ensure that the proposed regulatory package allows regulated networks to maintain an investment grade (IG) credit rating.[66]

At RIIO GD1/T1 Ofgem set out its intention to assess Licensee financeability at a notional level, considering six credit ratios, compared against the three major credit rating agencies' ranges that are consistent with a BBB-A range. Ofgem stressed that it is more concerned with a holistic, long-term view of financeability, noting that short-term shortfalls in credit metrics can be mitigated by adjusting dividend policy or by issuing new equity.

As pointed out in the March 2011 RIIO GD1/T1 strategy document, Ofgem's financeability analysis does not intend to replicate the different rating agencies' methodologies, however these methodology notes serve as a useful proxy to determine if any financeability issues exist. For the analysis to follow, we primarily consider Moody's rating methodology as of March 2017, which sets out its approach to assessing credit risk for regulated electricity and gas networks globally.[67]

[64] As gearing increases, we would expect the effective tax rate to reduce, hence consideration of gearing is broader than the post-tax WACC.
[65] Ofgem: "RIIO-T1: Initial Proposals for National Grid Electricity Transmission plc and National Grid Gas plc", (2012)
[66] Baa under Moody's credit scale and BBB under S&P and Fitch's rating scale.
[67] Moody's Investors Service: "Rating Methodology - Regulated Electric and Gas Networks", (2017).

Moody's rating methodology is highly transparent and easily accessible, and we would not expect large differences in rating between credit rating agencies.

A further consideration is the Licensee's own financeability duties as part of their debt covenants. We do not currently have sight of these obligations and so where relevant, Ofgem could request this information from Licensees ahead of any decision.

Interest cover ratios represent 27.5% of the Moody's rating assessment for regulated energy networks. This will be impacted by the allowed return and cash interest costs. In the context of a real WACC with inflation-linked RAV, these metrics will come under pressure in a low cost of equity environment, especially if the cost of debt trends upwards while the cost of equity remains flat.

There are however possibilities around how this could be dealt with in practice:

- Companies could influence the timing of their obligations through index-linked debt or swaps[68].
- Companies may need to manage any transitional effects over a period of years (though probably not over multiple price controls).
- The regulator may need to modify its approach (specific options considered below).

Qualitative financeability assessment

Under Moody's updated rating methodology, financial ratios that are directly responsive to cost of capital parameters make up 40% of the weight for the overall implied credit rating. These are affected by decisions made by Ofgem. The regulatory regime qualitative factors make up the remaining 60% of the overall credit rating.[69] These more subjective factors, their respective weights and projected ratings (based on recent Moody's ratings) are presented in the table below.

[68] In non-regulated sectors, a similar approach could hold for revenues, although we discount this here.

[69] We also consider a case where Ofgem sets a cost of equity that credit rating agencies view as undermining the stability and predictability of the regime.

Table 6.2: Qualitative sub-factors in Moody's regulated electric and gas networks rating methodology

Sub-Factor[70]	Overall weight	Projected rating[71]
Stability and predictability of regulatory regime	15%	Aaa
Asset ownership model	5%	Aa
Cost and investment recovery	15%	A
Revenue risk	5%	Aaa
Scale and complexity of Capital program	10%	A
Financial Policy	10%	Ba[72]

Source: CEPA analysis and Moody's Investor Service

The above sub-factors imply a qualitative credit rating for Ofgem regulated electricity and gas networks which sits comfortably above the investment grade threshold, meaning that the impact of changes in cost of capital parameters have only a limited impact on the overall implied credit rating.

However, for some low level of cost of capital, Moody's may consider that the regulatory package has significantly affected the risk of regulated network companies and this may cause Moody's to downgrade regime-specific sub-factors[73]. This highlights the importance of setting a cost of capital that accurately reflects market evidence and expectations, and where there are differences to other determinations that this is justified.

Quantitative financeability assessment

The RIIO model puts greater emphasis on the role of equity in delivering outputs in a financeable manner. As discussed in Section 5, there are many plausible interpretations of market based evidence which could result in a lower cost of equity compared to previous Ofgem decisions for regulated networks. This effect has the potential to impact the financeability ratios which are analysed as part of the quantitative sub-factor analysis, making up 40% of the overall implied credit rating.

[70] Regulated networks may also benefit from an addition factor – "Structural Considerations and Sources of Rating Uplift From Creditor Protection" due to structural enhancements that are incorporated into the regulatory licence. This may result in an upward notch adjustment to the overall implied credit rating from the other scored factors.
[71] Based on the typical rating for an Ofgem-regulated network.
[72] Based on Moody's rating of Cadent Gas Limited from June 2017. Other networks may have different scores under Financial Policy
[73] However, if the approach is consistent and justified, we would consider that this risk is minimised.

As Ofwat discusses in its PR19 final methodology[74], the ratio of cash to inflationary return has fallen as the real WACC has fallen, but the figure used for RPI inflation has remained broadly constant. A move to CPI or CPIH inflation would increase the ratio as the real WACC would increase, while the inflation return would decrease.

The adjusted interest coverage ratio (AICR) [75] is of particular interest to regulated networks as it adjusts for regulatory depreciation allowances. It is intended to measure whether a network company can cover its interest payments after deducting an allowance for maintenance of regulated assets. With a lower cost of equity, funds from operations will be reduced while other components of the AICR remain relatively constant; this puts downward pressure on interest coverage. For RIIO-1, the AICR ratio was the first to break when stress-testing the regulatory package for the purposes of financeability assessment.

Under the Moody's methodology, the default position is that the interest costs are taken in nominal terms, while the cost of capital is applied in real vanilla WACC terms. With this approach and the increasing role of the inflationary return within the cost of capital, the AICR metric is especially sensitive. In practice, we would not expect regulated companies to bear this full inflation mismatch (which would improve the ratio) – this could be through the use of index-linked debt or through swaps, to more closely match costs and revenues.

Our analysis focuses on the AICR metric as the most sensitive metric to financial market conditions, in addition to working under several simplifying assumptions. To start out, we assume that price control allowances are set to exactly remunerate companies for costs incurred and that companies receive, on average, incentives and other revenues equal to zero. We assume that the RAV is constant over the life of the price control (i.e. that capex spend is offset by depreciation) and that the cost of debt faced by the company is roughly equal to the allowed cost of debt. Finally, we assume that the companies' gearing level is equal to the notional gearing level set by the regulator. While these assumptions may appear strong, they are in line with the assumptions that underpin the theory of economic and incentive regulation.

Moody's reference a 1.40x AICR as the basis for a Baa (i.e. BBB equivalent) credit rating. Our assessment looks at the AICR using the mid-point of our ranges on WACC parameters. We find that this leads to an AICR ratio of 1.32x under these simplifying assumptions.

[74] Ofwat (2017) Final Methodology, Appendix 12: Risk and return.
[75] Also referred to be Ofgem and other rating agencies as post maintenance interest coverage ratio (PMICR)

Table 6.3: AICR testing cost of capital scenarios

Parameter	Base case (mid-point of suggested range)
Nominal cost of debt	2.5%
Weight on IL debt	25%
Gearing	57.5%
Real post-tax WACC	3.4%
AICR	1.32x
Equivalent Moody's rating	**Ba**

Source: CEPA analysis

This ratio would be improved (worsened) with:

- lower (higher) notional gearing;
- a greater (lower) proportion of index-linked debt (to cover the mismatch noted above);
- a lower (higher) cost of debt; or
- a higher (lower) cost of equity.

In light of the low interest rate environment and proposed reduction in the cost of equity, the AICR is slightly below the Baa threshold under the Moody's methodology. The AICR is one of four quantitative metrics and only forms part of the overall assessment. As discussed above, the qualitative criteria are currently supportive of a comfortable investment grade rating and the AICR metric has previously been the weakest performing metric.

Potential solutions to poor financeability outcomes

As stated above, Ofgem's financeability tests do not perfectly mirror those undertaken by the credit rating agencies. However, if Ofgem were to disregard the guidance from credit rating agencies in developing its regulatory package, and if the package resulted in a credit rating downgrade below IG, regulated networks would have reasonable ground to appeal the decision due to Ofgem's duty to ensure that regulated companies can finance their activities. For this reason, it is important for Ofgem to consider credit rating agencies' approach to financeability when assessing the overall financeability of the efficient notional company.

Ofgem could potentially leave any financeability issues to the Licensees to manage, as long as this was consistent with its regulatory duties. Ofgem also has the option of letting Licensees implement the appropriate capital structure that delivers efficient costs. Licensees individually have the incentive to maintain investment grade credit rating due to the additional costs related to falling into sub-investment grade territory (i.e. investment grade credit spread). All companies

have various options to improve credit metrics such as by injecting equity or reducing dividend pay-out to shareholders.

If, after a more complete picture of the RIIO-2 package has emerged, it is determined that financeability concerns do exist, there are certain regulatory tools that may improve the credit metrics in the short term. These options include:

- **NPV neutral interventions:** There are several ways to re-profile the cash flows such that more cash is received upfront.
    - For example, some form of switching from RPI to CPI will bring cash flows forward as the WACC will increase, yet the RAV indexation will decrease in the later years of the price control.
    - One of the causes of the weak interest cover ratio is the mismatch with inflation. Moving to a nominal WACC and non-indexed RAB would lead to strengthened credit metrics on interest cover.
    - Another option is to increase the rate of fast money, i.e. the portion of totex that flows as opex rather than is added to the RAV and returned in depreciation.
    - Ofgem could also decrease asset lives such that depreciation is accelerated and the allowances are increased. The offsetting effect is that the RAV decreases faster. The downside of this approach is that current consumers are potentially subsidising future consumers, and asset lives have previously been set to match economic lives more closely.
- **NPV positive interventions:** Giving the network companies more money across the life of the price control (for example by increasing the WACC) is a straightforward way to improve financeability. However, the downside to this approach is that it increases the cost to consumers and potentially overcompensates shareholders. As such, if parameters have been appropriately estimated, there is a question why an NPV positive intervention would be required (and this option would be considered only if a NPV-neutral intervention was not possible).
- **Limiting downside exposure:** To reduce the uncertainty of returns that arises from cost of debt indexation, Ofgem could implement a floor on the cost of debt such that, if empirical evidence points to a cost of debt that falls below the floor, Ofgem will provide the floor as a minimum allowance. This would provide confidence to creditors and credit rating agencies that the companies will always have sufficient funds to meet their obligations. Similarly, Ofgem could create incentive schemes that are asymmetric with greater upside potential. This also has the impact of reducing cash flow uncertainty. The

downside of this approach is, again, an increased cost to consumers and potential overcompensation to shareholders.

Not all of these options will be perceived by rating agencies as positive to the credit quality of the networks, however. Moody's recently changed the outlook for regulated UK water utilities to negative in response to Ofwat's final methodology note which threatens to significantly cut allowed returns from 2020. In response to Ofwat's change in indexation measures resulting in increased cash returns and decreased RCV growth, Moody's stated that "such intergenerational movements of cash flow do not fundamentally alter a company's credit quality".[76] Rather, Moody's noted that "companies that strengthen balance sheets to offset risks may be better place to maintain credit quality," giving credence to the notion that Licensees are ultimately responsible for managing their financeability.

[76] Moody's Investors Service: "2018 outlook changed to negative as tough price review outweighs current performance" (2018).

7. SUMMARY OF RIIO-2

In this chapter, we set out what the parameter estimates mean for estimating a cost of capital. With indexation, the cost of capital can update each year. We are proposing to continue with full cost of debt indexation for the RIIO-2 price controls and have presented options for if Ofgem wished to index the cost of equity, rather than set a fixed ex-ante allowance. We consider that our ranges are suitable for capturing a starting value on the cost of equity, but that Ofgem may wish to select a point estimate.

7.1. CEPA proposed range

In the table below we set out our proposed range for the individual cost of capital parameters and what that means overall for the (real) vanilla WACC.

Table 7.1: CEPA proposed cost of capital range, real (RPI) vanilla terms

Parameter	Low	High
Gearing	65%	50%
Cost of Debt	0.30%	2.15%
Risk-free rate	-1.75%	-0.60%
Total Market Return	5.00%	6.50%
Equity Risk Premium	6.75%	7.10%
Asset beta	0.25	0.40
Equity beta	0.71	0.80
Cost of Equity	3.07%	5.08%
Vanilla WACC	**1.27%**	**3.62%**

Source: CEPA proposals[77]

7.2. Financeability

Financeability can act as a constraint on the selection of a cost of capital estimate, though as highlighted in Section 6, there are a number of ways other than adjusting the cost of capital to support financeability and to determine a price control settlement that an efficient company is able to deliver. As further information becomes available, a greater understanding of the true financeability impact of a decision will be available.

[77] Our range includes the highest level of gearing in the 'low' case and the lowest level of gearing in the 'high' case. Conventionally, higher gearing is associated with a lower cost of capital, when taking into account tax. In addition, the approach leads to a narrower range for the cost of equity and cost of capital. Intuitively, investors in a lower asset beta company would have more scope to gear up.

Based on high-level modelling, we consider that at this stage, the setting of a cost of capital range that best reflects the financing costs faced by an efficient entity should be undertaken independently of financeability. If there are problems identified, then further work is required to make sure that Ofgem meets its statutory duties for the price control.

7.3. Selecting a point estimate from our range

Given the stage in the regulatory cycle, we have not been asked to provide a point estimate for the cost of capital. The methodological choices adopted by Ofgem will dictate to a large degree the point estimate chosen, which could be in different parts of the range for individual parameters. We provide some further discussion below:

- *Gearing*: until further information is available on the investment programme and the overall regulatory regime, it is difficult to judge. However, in light of actual gearing being below the notional assumptions and with tax potentially be treated as a pass-through, we do not foresee any major issues in selecting a point estimate from the lower half of our range.
- *Cost of Debt*: as we propose continuing with cost of debt indexation, a methodology rather than point estimate is required. Adopting a longer term trailing average would lead to a figure higher in our starting cost of capital range. This would be expected to fall during the price control (based on forward curves), but remain materially above the 10yr trailing average. Given growth in the RAV over the past 10-20yrs and assuming a mixture of amortising and bullet payment structure debt, we consider that the lower bound is more appropriate than the upper bound. More detailed modelling of different movements in market rates could be used to better understand how different specifications of cost of debt indexation mechanisms would impact on company financeability and charges ultimately borne by consumers. Ofgem could use criteria e.g. fairness, to support any decision here.
- *Risk-free rate*: a spot estimate representing our lower bound would likely only be adopted if no weight were placed on forward curves or if the risk-free rate were indexed.
- *Total Market Return*: we have adopted a range we consider to be consistent with the CMA NIE determination. As highlighted by the recent Ofwat and CAA publications, prevailing evidence on the TMR points to a figure lower within our range. The upper bound would involve placing most weight on historic evidence in a manner consistent with the CMA approach. However, the UKRN draft report indicates that this may have overestimated real returns by up to 100bps and that 6.0% may represent a more appropriate upper bound based on a historic ex-post approach. This would also reduce the starting point for historic ex-ante approaches.

- *Asset beta*: as noted in Section 5, our 'business as usual' asset beta is 0.25 to 0.35, with our upper bound at 0.40 to capture companies that face greater systematic risk. The UKRN draft report considers that more advanced econometric techniques may provide greater clarity on the beta term if Ofgem moved away from a 'conventional approach.'

Ofwat's PR19 Final Methodology indicates a 2.4% real (RPI) vanilla WACC, which would sit in the middle of our range. This is a useful reference, although differences in risk in the sector, timing of the price control and how the cost of debt will change with indexation means that the decisions are not identical.

ANNEX A PRINCIPLES FOR INDEXATION

A.1. Context for indexation

Indexation is used in a regulatory context to mean where revenues are adjusted to reflect outturn values within a regulatory period. An example of this is revenue indexation, where revenues are adjusted by outturn inflation each year. The alternative is an ex-ante forecast being used, with regulated entities benefitting or losing out from differences in outturn to the forecast values. As such, indexation changes risk allocation and tariffs relative to the ex-ante forecast approach.

A.1.1. Regulatory decisions on the cost of capital

In network price controls, Ofgem have applied indexation for the allowed cost of debt. The allowance is updated annually to reflect outturn yields from indices produced by Markit iBoxx, with a ten-year rolling average applied for RIIO-GD1 and RIIO-T1, and a 'trombone' trailing average approach used for RIIO-ED1.[78] Ofgem have also previously discussed the potential for adopting an indexing approach on the cost of equity.[79]

The indices used are nominal price indices, with breakeven inflation being used to convert this into real prices. Updated breakeven inflation estimates are used in this indexation approach.

In the methodology for their next price control (PR19), Ofwat have indicated a greater role for indexation within the cost of capital.[80] This relates to the cost of debt and inflation, where both measures had previously been treated as ex-ante forecasts. Ofwat considered three separate options on the cost of debt:

- fixed allowance for both new and embedded debt;
- index new debt, with fixed allowance for embedded debt; and
- index all-in cost of debt.

The proposal from Ofwat was to adopt the second option, namely to index new debt only. This would be made in nominal terms, with a true-up at the end of the period and a reconciliation made at that point into real CPIH and real RPI equivalents.

This highlights that indexation can be considered around the cost of debt, cost of equity and on inflation (separately to broader revenue indexation).

[78] The 'trombone' approach involves the length of the trailing average increasing from a fixed point, such that the trailing average period extends from ten years at the start of RIIO-ED1 by one year annually, such that there will be an 18-year trailing average at the end of the eight-year price control.
[79] For example, Ofgem (2014) Equity Market Return consultation.
[80] Ofwat (2017) PR19 Draft Methodology, Appendix 13 Risk and Reward.

A.1.2. Applicability across Ofgem regulatory regimes

The idea behind indexation within the cost of capital is that allowances are adjusted to more closely match the cost of finance taken out by regulation. When considering different regulatory regimes and asset types e.g. IDC for OFTOs compared to network price controls, one size will not fit all and any decision needs to be consistent with what is assumed to be the behaviour of a notional efficient company.

For new assets, such as interconnectors or transmission links connecting offshore wind farms, the investment is treated as a standalone project rather than a portfolio of projects as with onshore networks. Indexation mitigates forecast risk, but where there is no forecast risk (e.g. a one-off raising of finance), the benefit of this risk mitigation is not present. It is also worth bearing in mind that indexation can remove predictability, for example, for interconnectors, indexation would lead to changes in the levels of the cap and floor.

A.2. Implementation of indexation

To create a framework around whether to choose indexation, we have developed a set of criteria to aid us in this assessment. These relate to the choice whether to index, rather than determining how to index – however, to make a complete assessment, there will need to be a view on what the form of indexation will look like.

There are different options available if you choose to use indexation, on the cost of debt, cost of equity or inflation. There is a brief discussion of these options below.

Timing of adjustment

A regulator can choose to make a periodic (e.g. annual) adjustment to the allowed real return *during a price control*, or to make an adjustment for the difference between forecast and outturn costs *at the end of a price control* ('true up'). Where within-period volatility is a concern, an end of period adjustment may be the preferred choice.[81] Relative to the water sector, where Ofwat have proposed an end of period adjustment for the cost of debt for PR19, annual adjustments create less of an issue in the energy sector, as:

- network charges represent a small proportion of overall bills;
- the regulatory regime involves annual updates to allowances and new investment such as Strategic Wider Works; and
- the principle of annual updates has already been established with indexation of the cost of debt.

[81] For a further discussion, see CEPA (2016) Alternative approaches to setting the cost of debt for PR19 and H7.

Therefore, annual adjustments help to avoid a step-change at the end of the price control, meaning the allowance reflects the cost of finance at a point in time.

Length of trailing average (for certain parameters)

The choice of trailing average should be reflective of the assumed financing profile of the notional company and the regulatory duties. If the regulator is looking to price based on a new entrant to the industry, they would not have any existing debt or equity, and as such a spot rate would be more applicable.

In the case of Ofgem, we consider it accepted regulated practice and consistent with regulatory duties to include an allowance for embedded debt. Failure to do so at present could risk financeability and the future ability to raise finance at efficient rates, while in the future it may be that a trailing average gives a lower allowance than the spot rate, leading to benefits for consumers. The question about embedded equity is discussed in Section 3 of this report.

Simple or custom weighting (for certain parameters)

For the RIIO-T1 price control, Ofgem introduced cost of debt indexation for Scottish Hydro Electricity Transmission Limited (SHETL) that involved applying custom weightings based on growth in the asset base, rather than use a simple ten-year trailing average. This reflected the larger investment programme required for the price control relative to the size of the starting asset base.

The advantage of custom weighting is that it minimises windfall gains or losses based on timing choices that are out of the control of regulated companies. It is particularly useful where financing is infrequent or irregular.

The disadvantage of custom weighting is that it moves away from the notional efficient company used as the basis for setting an allowance. This means that there can be multiple cost of debt allowances within an industry and adds complexity.

Choice of index/ comparators

Indexation involves a mechanistic adjustment to an allowance and a suitable measure/ index is required for this. For economy-wide parameters, the most suitable index should be selected.

For company-specific parameters,[82] there are trade-offs in the selection of an index. At one end of the spectrum, actual costs could be used if these were deemed to be reflective of the costs of the notional entity (or is more consistent with regulatory duties). Conversely, a broader set of comparators, e.g. non-financial corporates, could be used.

[82] Or industry-specific, i.e. cost of debt and beta (and to a lesser extent tax and gearing).

Actual costs are likely to more closely reflect the characteristics of a regulated company; it mutes incentives to reduce costs as the approach more closely equates to a pass-through. The use of a broader group is likely to lead to a larger sample size and this reduces the impact of individual additions/ removals to the index. It is possible to adjust a broader comparator index and so we consider such an approach is more appropriate than using specific company costs.

Use of deadband or cap and collar

Indexation could be applied only if movements reach a pre-defined threshold, or alternatively the extent of parameter changes could be capped in one or both directions. While such measures can add predictability and reduce volatility, the choice of their values is subjective and the risk is distorted, leaving this allocated in part to the consumer and in part to the regulated entity. We do not include these in our analysis of the options, but these can be added to an indexation approach if they are seen to be beneficial.

Pain-gain share measures

As with other regulatory mechanisms, an incentive can be set up whereby the company retains a proportion of benefits/ costs relative to a target level. This can be done with indexation or used without indexation. The difficulty on the cost of capital is that the cost of equity is not observable (unless bid under competitive tension) and so a pain-gain share mechanism is realistically limited to the cost of debt only.

The cost of debt is affected by levels of debt (i.e. gearing) and the tenor of debt chosen (typically longer tenors have higher yields). We consider that a pain-gain share mechanism is difficult to envisage without scope for gaming or leading to financing choices that may not be optimal in terms of efficient cost or risk profile.

ANNEX B INFLATION

In this annex, we discuss the choice of inflation measure, in particular the decision whether to retain RPI as the basis for indexing the asset base, or whether to switch to an alternative measure. This could involve a transition or a direct change.

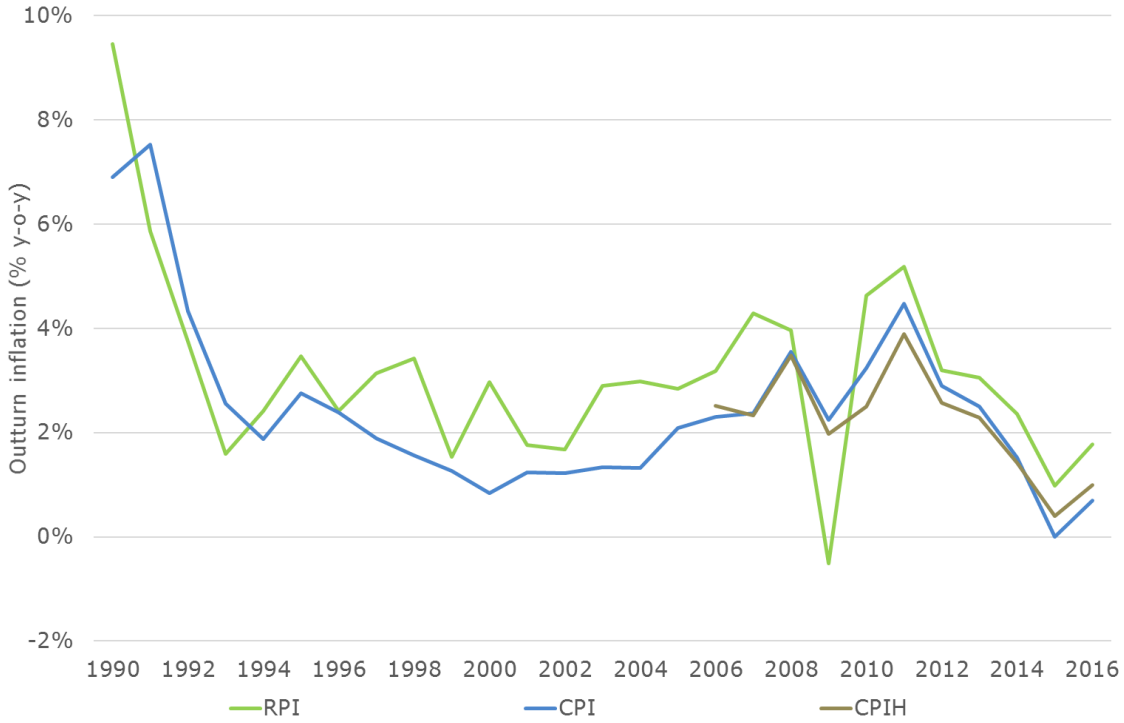
B.1. Context and background

The cost of capital is used in different ways in different regulatory regimes. Where the asset base and/ or revenues are linked to inflation, the cost of capital is typically set in real terms. When looking at inflation, there are different options around what can be used – typically UK regulators have used RPI inflation, but there have been calls to move to CPI or CPIH inflation.

B.1.1. Impact of different inflation measures

The figure below shows differences in inflation. RPI has typically been higher than CPI and CPIH inflation, however this relationship does not hold for all time periods.

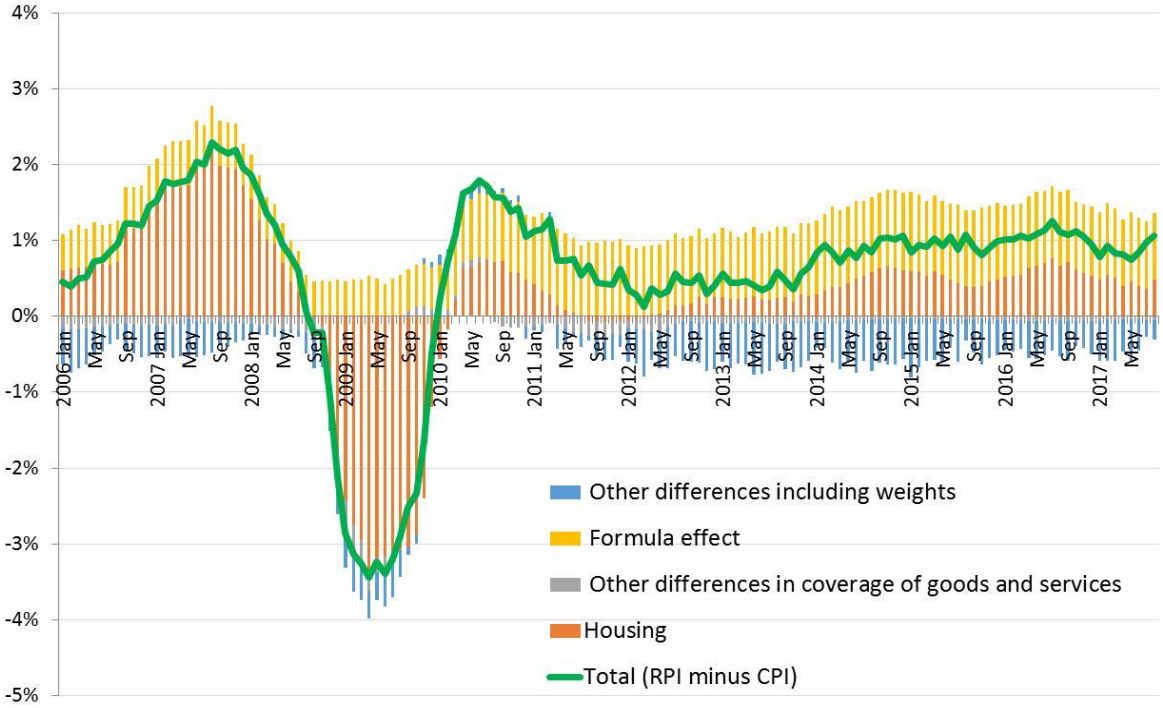
Figure B.1: Inflation outturn



Source: Office of National Statistics

In setting a forward-looking estimate of inflation, it is important to consider what is driving this difference. The figure below looks to break down the differences between RPI and CPI inflation over time.

Figure B.2: Differences between RPI and CPI inflation by component



Source: Office for National Statistics.

At a high level, RPI typically provides a larger measure of inflation than CPI (or CPIH) and therefore we expect the use of CPI to result in more cash to be recovered earlier than would be the case with using RPI. This will affect charges faced by consumers and is also likely to affect a financeability assessment.

B.1.2. Issues with RPI inflation

Credibility

In January 2013 the National Statistician found that the formula used to calculate the RPI does not meet international standards. In March 2013, the RPI was de-designated as a national statistic by the UK Statistics Authority (UKSA). Subsequently, in January 2015, a review by Paul Johnson explained that: "the use of the Carli formula (within RPI) is statistically flawed and can result in an upward bias in recorded inflation".

The Bank of England's CPI target also provides a degree of comfort (if inflation expectations are credible) and predictability from using such an approach.

Ability to forecast

One of the key challenges around setting an ex-ante cost of capital is getting forecasts correct. Based on OBR forecasts for RPI and CPI, there has been less deviation between expected and outturn inflation for CPI over both the RIIO-T1/ GD1 and RIIO-ED1 periods.

RIIO T1/ GD1 determinations

Table B.1: Analysis of RPI forecast accuracy at March 2012: RIIO T1/ GD1 determination

	2012/13	2013/14	2014/15	2015/16	2016/17	Average
Forecast (OBR: Mar-12)	2.50%	2.10%	3.50%	3.90%	4.10%	3.22%
Outturn	3.28%	2.45%	0.90%	1.56%	3.14%	2.27%
Difference	-0.78%	-0.35%	2.60%	2.34%	0.96%	0.95%

Source: OBR & ONS

Table B.2: Analysis of CPI forecast accuracy at March 2012: RIIO T1/ GD1 determination

	2012/13	2013/14	2014/15	2015/16	2016/17	Average
Forecast (OBR: Mar-12)	2.00%	1.90%	2.00%	2.00%	2.00%	1.98%
Outturn	2.83%	1.63%	0.00%	0.50%	2.30%	1.45%
Difference	-0.83%	0.27%	2.00%	1.50%	-0.30%	0.53%

Source: OBR & ONS

The difference for CPI is almost half of the error for RPI in this case, though this only covers a short time horizon.

RIIO ED1 determination

Table B.3: Analysis of RPI forecast accuracy at March 2014: RIIO ED1 determination

	2012/13	2013/14	2014/15	2015/16	2016/17	Average
Forecast (OBR: Mar-14)	3.30%	2.40%	2.90%	3.60%	3.70%	3.18%
Outturn	3.28%	2.45%	0.90%	1.56%	3.14%	2.27%
Difference	0.02%	-0.05%	2.00%	2.04%	0.56%	0.91%

Source: OBR & ONS

Table B.4: Analysis of CPI forecast error at March 2014: RIIO ED1 determination

	2012/13	2013/14	2014/15	2015/16	2016/17	Average
Forecast (OBR: Mar-14)	2.80%	1.70%	1.90%	2.00%	2.00%	2.08%
Outturn	2.83%	1.63%	0.00%	0.50%	2.30%	1.45%
Error	-0.03%	0.07%	1.90%	1.50%	-0.30%	0.63%

Source: OBR & ONS

The difference for RIIO ED1 is less pronounced, however the CPI difference is materially less than for RPI.

Dealing with end of life price changes

Although it is not an immediate concern, something that may be encountered in future is how to deal with the end of life of a network. Where revenues are flat over a diminishing user base, charges increase, and this may have knock-on impacts on use; this leads to a cyclical impact. Use of CPI inflation by reducing the indexed amount to be recovered in later periods, could be one way in which this is addressed.

Volatility

One criticism of RPI is that it is more volatile than CPI. This may be more of a concern in water than in energy given the industry and charging structure, but is still something to consider. If we look over two time horizons (twenty years and eight years), we see that RPI has been more volatile over both time horizons.

Table B.1: Analysis of historic annual inflation data to August 2017

	RPI	CPI	RPI-CPI	RPI	CPI	RPI-CPI
First period of data	Jan 1997	Jan 1997	Jan 1997	Aug 2009	Aug 2009	Aug 2009
Last period of data	Aug 2017	Aug 2017	Aug 2017	Aug 2017	Aug 2017	Aug 2017
Mean	2.79%	1.94%	84bps	2.89%	2.20%	69bps
Standard deviation	1.37%	1.09%	28bps	1.56%	1.39%	16bps
Range	7.16%	5.33%	183bps	7.01%	5.32%	169bps

Source: Office for National Statistics.

B.1.3. Arguments for maintaining use of RPI inflation

There are arguments why Ofgem may wish to stick to RPI inflation. The overall assessment may differ between different assets and over time.

Absence of CPI-linked market

While we can demonstrate that the use of RPI for indexing the RAV can be perfectly offset by the use of RPI for discounting the WACC, in reality, there seems to be a genuine price differential given the demand for RPI investments versus the demand for CPI (or CPIH) linked investments. A RAV that is indexed by CPI (or CPIH) may be less desirable for investors, resulting in a larger cost of equity and a net loss for consumers although we expect this would be more theoretical than practically observable. The Debt Management Office has not issued CPI linked products because of the lack of demand for such products.

Quantifying the real risk-free rate on a CPI or CPIH basis is more difficult due to the lack of observations of CPI linked government gilts. In addition, estimating the relevant 'wedge' over long term is difficult if no direct CPI-linked evidence is available. Further, most cost of equity studies are quoted in RPI discounted terms with respect to regulatory determinations.

Existing RPI-linked obligations

Hedging RPI linked revenues with RPI linked debt is a popular treasury approach by existing networks. Ofwat received arguments from water network companies that any move away from RPI would result in companies losing hedging benefits: we would expect Ofgem would also receive similar arguments again (in addition to those received to the October 2015 consultation) during any RIIO-2 proposals for change. However, a consultancy study by Oxera (on behalf of Ofwat) argued that the companies would not suffer any material loss of hedging benefit (and that CPI may in fact be a better hedge against non-RPI-linked-debt). Information on the extent of RPI-linked exposures for networks and the costs of breaking that exposure would be useful evidence ahead of making a firm decision for networks.

This would not apply to new assets, where financing is to be undertaken and we do not need to worry about any pre-existing RPI-linked obligations. As such, a decision on the correct inflation measure could differ between new assets and networks.

Complexity

If an approach is adopted to take into account existing RPI-linked exposures, while at the same time transitioning to a CPI-linked regime, the approach is likely to be relatively complex and difficult for the average consumer to engage with. This is a key consideration, although if CPI indexation is the long-term preference, there will be the need for a transition at some point.

B.2. Further considerations

B.2.1. NPV neutrality

In theory any move away from RPI (or use of CPI or CPIH) will be NPV neutral if the present value of future net cash flows is equivalent to what they would have been under RPI. However, there are reasons why this may not be the case in reality as opposed to theory, including:

- **Income v capital investor preference**: some investors seek capital growth (via indexation of the RCV) more than cash income (via WACC returns). The current investor pool may have been attracted by capital appreciation. For assets with very long useful lives (or slow depreciation rates, i.e. 40, 50 or 60 years) not using RPI will materially adjust the timing of future cash income and asset valuations in the intervening period.

- **RPI investor preference**: Investors may be willing to pay more (or receive less) in return for holding an RPI asset. This may be particularly relevant for investors with large RPI liabilities such as pension schemes. This preference could be an irrational one however and may not take into account the impact of a new hedging position 'in-the-round' or on a systematic risk / notional basis.
- **Investment constraints**: Companies with larger growth challenges may be able to meet consumer (or investor) challenges more quickly due to the ability to invest in more (efficient) projects than would be the case under an RPI WACC.
- **Forecasting errors**: As noted above, using RPI can result in larger forecasting errors than using CPI or CPIH. The ability for independent sources to forecast RPI is hampered by its unique formula: over the period of an 8-year RIIO price control period the RPI can have a 700bps range compared to the 434bps range that we observe for CPIH. We compared the forecast error for RPI (for the RIIO 1 price controls) and observe that it could be almost twice as large compared with CPI. Although we expect that using either CPI or CPIH (compared to RPI) could result in lower forecasting errors, there are relatively few sources for independent CPIH forecasts.

B.2.2. Regulatory determinations

Relevant examples of moving away from RPI by regulators include:[83]

- **Ofwat:** In 2016 Ofwat consulted[84] on moving away from RPI to using either CPI or CPIH for the purposes of indexing the water sector RAVs. Ofwat stated that from April 2020 it would index only 50% of the RCV by RPI and that the other 50% (plus all new RCV) would be indexed by either CPI or CPIH thereafter. Ofwat also stated that they would deflate base cost data using the same inflation index as for revenues. In 2017 Ofwat confirmed[85] they would use CPIH to index customer bills and to transition towards CPIH indexation for the RCV.
- **Water Industry Commission for Scotland (WICS):** WICS moved from RPI to CPI in its 2014 determination of Scottish Water's price controls.[86] This was supported by the Consumer Forum which believed that customers would recognise CPI as the official UK measure of

[83] The CAA have also applied CPI for the NATS price control, but not for the regulation of airports. See Annex C of CAA (Jan 2015) "Decision on modifications to NATS (En Route) plc licence in respect of the Oceanic price condition for 2015-2019. CAP 1254" available on the CAA website here.
[84] Ofwat (2016). "Water 2020: our regulatory approach for water and wastewater services in England and Wales."
[85] Ofwat (2017). "Delivering Water 2020: Consulting on our methodology for the 2019 price review."
[86] Water Industry Commission for Scotland (2014). "The Strategic Review of Charges 2015 – 2021: Draft Determination."

inflation given that it was also used for many pensions and benefit calculations. Scottish Water does not have access to index-linked debt and so there was no claim that they would lose hedging benefits. To reduce uncertainty during the transition, the price caps are set as nominal for the first three years after the change.

- **Ofcom**: Started to use CPI instead of RPI in a range of price controls from 2014, and proposed to make CPI its default index for charge controls.[87] This decision is mostly due to the official status of CPI including its use in the Bank of England's inflation target. Ofcom noted that while regulatory predictability is important, effective planning and notifying stakeholders should suffice to minimise any negative effects of changing the chosen index. To compensate for any negative impacts of the transition, Ofcom decided to continue to forecast the nominal cost of capital charge controls using RPI, as government debt is currently indexed to RPI.

B.3. Options for Ofgem

B.3.1. Options for existing monopoly RIIO assets

- **Status quo**: Ofgem could remain with RPI use insofar as possible. This may be motivated by a desire to let financial markets lead the change to CPI/CPIH however Ofgem may recognise that any 'status quo' is likely to be 'time-limited' given that the price controls are set to run for 8-year periods (to 2029 and 2031 respectively) this option may need supplemented with a 'step-in' or 'review' clause. Any such step-in may also require financeability testing and 'X' resetting.
- **Ofwat approach**: Ofgem could follow Ofwat's lead and transition towards CPIH over a long period of time. This could mean splitting the RCV into RPI linked and CPIH linked components and calculating a cost of capital in RPI and CPIH terms. Such a transition may need support from reconciliation models and adjustments to current price control models.
- **Immediate transition**: Ofgem could try and push ahead with a new regime that is mostly (if not exclusively) based upon CPIH under the assumption that transition arrangements have limited benefits and that CPIH should be the main measure of inflation by 2029 or 2031 (the likely end points of RIIO2). There may be a legitimate view that a financial market for CPI/CPIH has not developed because of the lack of demand and that RIIO2 (or 'new' asset procurement) provides an opportunity to stimulate the market to move on from RPI linked financial products.

[87] Ofcom (2013) "Review of the wholesale broadband access markets"

B.3.2. Options for competitively tendered assets

- **RIIO approach**: Ofgem could seek to maximise consistency across network asset regulation by ensuring a similar (or identical) approach to both RIIO and competitively tendered assets.
- **Market-led**: Ofgem could continue to allow 'biddable' inflation to be part of the competition. One argument in favour of this is that it will allow better pricing and forecasting by tendering parties. Consumers are also likely to benefit from more accurate bids.
- **Regulator-led**: Ofgem could specify to how inflation will operate within each tender. This may allow for better comparisons between tendering parties and help to develop a CPIH market. This option may complement the immediate transition option identified above.

B.4. How Ofgem could evaluate its options

- **Value**: Finding the best deal for consumers may mean Ofgem are tempted by a novel or 'transition' approach. Quantifying this value will be quite difficult given the NPV issues we set out above. In theory the use of an inflation measure will not (and should not) affect value in-and-of-itself but there are many practical issues to consider before this assumption holds in reality. Regulatory burden and other priorities will be a factor in determining if any estimated value is worth the cost, risk and complexity.
- **Accuracy**: Use of ex-ante RPI forecasts has resulted in material errors in price control assumptions. Ofgem may be confident it can add to the existing RPI framework to protect (or 'true-up') such errors ex-post (for example, by adjusting the real-RPI-adjusted cost of equity). However, any incremental regulation will have a limited shelf-life and Ofgem may consider a 'straight-switch' to be best long-term solution.
- **Transparency**: Sticking with the RPI status quo may require Ofgem to be more transparent about how consumers are protected. This could involve a transition plan, a 'step-in' policy, and/or a 'review' point. Any Ofwat style transition may require new models to be created, audited and published. Any distinction between competitively tendered network assets and RIIO2 assets may need to be highlighted and explained in terms of consumer benefits.
- **Legitimacy**: RPI use may require Ofgem to highlight, in great depth, to both consumers and other stakeholders, how consumers are being protected. In addition, using a CPI/CPIH WACC for the RIIO2 price control may increase legitimacy in the eyes of investors and credit rating agencies, under the assumption that credit ratios such as the PMICR are improved.

- **Complexity**: Ofgem may consider that additional complexity of remaining with RPI (in whole or in part) is not worth the benefit. Ofgem could also consider whether time spent justifying or managing RPI use is an efficient use of the resources available to it. Ofgem may require companies to submit 'nominal' cost forecasts so that inflation options remain open until later in the RIIO2 process and to allow for simple comparisons across assets.

ANNEX C METHODOLOGICAL CONSIDERATIONS AROUND ESTIMATING BETA

C.1. Role of the equity beta

The equity beta measures the systematic, non-diversifiable risk of a levered asset or of a portfolio of levered assets, relative to the market as a whole.[88] The equity beta of a specific company is an input to the CAPM framework in determination of the expected equity return to investors in that specific company.

Company equity betas can be determined in several ways:

- Betas can be observed directly from market evidence through an ordinary least squares (OLS) regression (or through comparator benchmarking) and applied mechanistically;
- Discretional adjustments can be applied to observed equity betas to account for varying levels of risk; or
- The equity beta can be estimated bottom-up through a theoretical model that does not require observed benchmarks.

We focus our discussion on the various approaches that use observed equity betas from comparator companies as a benchmark to infer betas for companies who are not publicly traded

C.1.1. Use of empirical evidence

One approach is to base the equity beta assumption directly on empirical evidence of comparator betas without post-estimation adjustments. In this sub-section we consider how this approach could be applied.

Directly observed comparator equity beta

There are a number of options available in estimating beta directly and mechanistically adjusting it to the specific gearing level of the individual company. The adjustments take estimates of the observed raw (levered) equity beta and then translate this into an asset beta and finally re-lever the asset beta to arrive at the re-levered equity beta.

The asset beta, which is not directly observable through market data, represents the equity beta of a company with no debt. In performing comparator equity beta benchmarking, we must remove the impact on the observed company's discretionary gearing decision, to make the beta more easily translatable to other comparator companies whose equity betas we do not observe.[89] Once the asset beta has been calculated, it is necessary to re-lever the asset beta at

[88] Levered assets refer to assets that are funded through both equity and debt.
[89] The asset beta is also commonly referred to as the unlevered beta

the company specific (notional or actual) gearing level to arrive at the individual company's equity beta. This re-levered equity beta is the input into the CAPM framework. The mechanics required to arrive at the re-levered equity beta from the observed comparator company raw equity beta are summarized in Annex C.

The table below discusses various options in estimating the observed raw equity beta and converting this raw equity beta to reflect company specific gearing.

Table C.1: Choices in approach for estimating beta

Option	Description
Estimates of raw equity beta	
Comparator companies	The inclusion of observed comparable companies to benchmark the appropriate equity beta requires careful consideration. Ideally, comparator companies should be pure-play – publicly traded company focused on only one industry of product – though these comparators are difficult to find. In practice, regulated utility network comparators may have international or non-regulated business areas which distort the equity beta. Benchmarking against companies that are not pure plays may require discretionary adjustments to the equity beta, upward or downward.
Sample size	A larger sample size of comparator companies may be more statistically significant however a smaller, more representative sample size may better reflect the systematic risk of the company in question. Betas can be estimated by averaging the betas of every company within a particular industry (such as a Bloomberg Classification), or through hand-selecting a few specific companies that are particularly relevant in terms of future business risk.
Returns frequency	The returns frequency determines the period over which returns are calculated. Conventional options include daily, weekly, monthly, and annual returns, although theoretically, return frequency can be any discrete period over which prices are recorded. Using higher return frequency (e.g. daily) increases the number of observations in the OLS regression, however this may introduce a non-trading bias. A non-trading bias is introduced when the equity stock in question does not trade everyday but the market does, systematically reducing correlation with the market index for reasons that do not represent market risk. A lower frequency of returns (e.g. weekly or monthly) will reduce the likelihood of a non-trading bias, especially for illiquid stocks; the trade-off of using lower frequency returns is the number of observations in the OLS regression. If number of observations is a concern, it is possible to use daily returns and apply a post-estimation adjustment to account for the non-trading bias.
Returns horizon	In order to calculate beta, we must decide on the horizon for which we wish to calculate returns. There are trade-offs involved in this selection; a longer horizon (such as five years) provides more observations in the OLS regression, but assumes that characteristics of the firm such as business risk and leverage have remained constant for the period. Since the beta

Option	Description
	should estimate forward looking risk, a longer return horizon may capture information that is weighted too heavily on backward looking evidence. On the other hand, shorter horizons (such as two years) may be less statistically robust, especially depending on the selected returns frequency, but may better represent the future operations of the business. When estimating beta, it is important to consider whether the observed company has undergone dramatic business changes recently as this will help determine the appropriate returns horizon.
Use of trailing average	After determining the appropriate assumptions for returns frequency, horizon and index, we must then determine from what point in time we wish to consider the calculated equity beta. As with other parameters estimated from historic market data, the equity beta can be set based on the spot rate or based on some trailing average period and there are trade-offs associated with each approach. Using the spot equity beta may best represent the future expectations for beta as it will not capture uncharacteristic changes in business risk. However, the spot equity may be more volatile and less predictable than a trailing average. It's important to consider the use of a trailing average in conjunction with the selected returns horizon; if a longer returns horizon is used and a long trailing average period is used, data points included in the sample may not represent the current and future business risk.
Relative index	There are no indices that represent the true market portfolio. Convention is to use an equity index to estimate the equity beta, but what is the appropriate scope of the index? The underlying index used to represent the market portfolio should be consistent with the market used to estimate the risk-free rate and market risk premium. Ensuring that the marginal investor in the index selected is diversified and also that the index represents are a large selection of equity assets will increase the robustness of the market portfolio assumption. For the purposes of UK regulation, the FTSE All-Share index appears to best fit these criteria.
Currency	Where estimates are used from different markets/ jurisdictions, using different currencies to estimate returns can lead to differences in beta estimates.
Estimation adjustments	Bloomberg's adjusted beta calculation biases the beta estimate toward one, regardless of industry or market.[90] A more sophisticated adjustment, known as the Vasicek Adjustment, shifts the OLS beta estimate toward one and the magnitude of the shift is greater when the standard error the OLS estimate is higher. Both adjustments utilize a prior expectation that beta is equal to one. This is to reflect the fact that betas are used to estimate future risk and that over time, equity betas tend to move toward one due to the survivorship phenomenon.

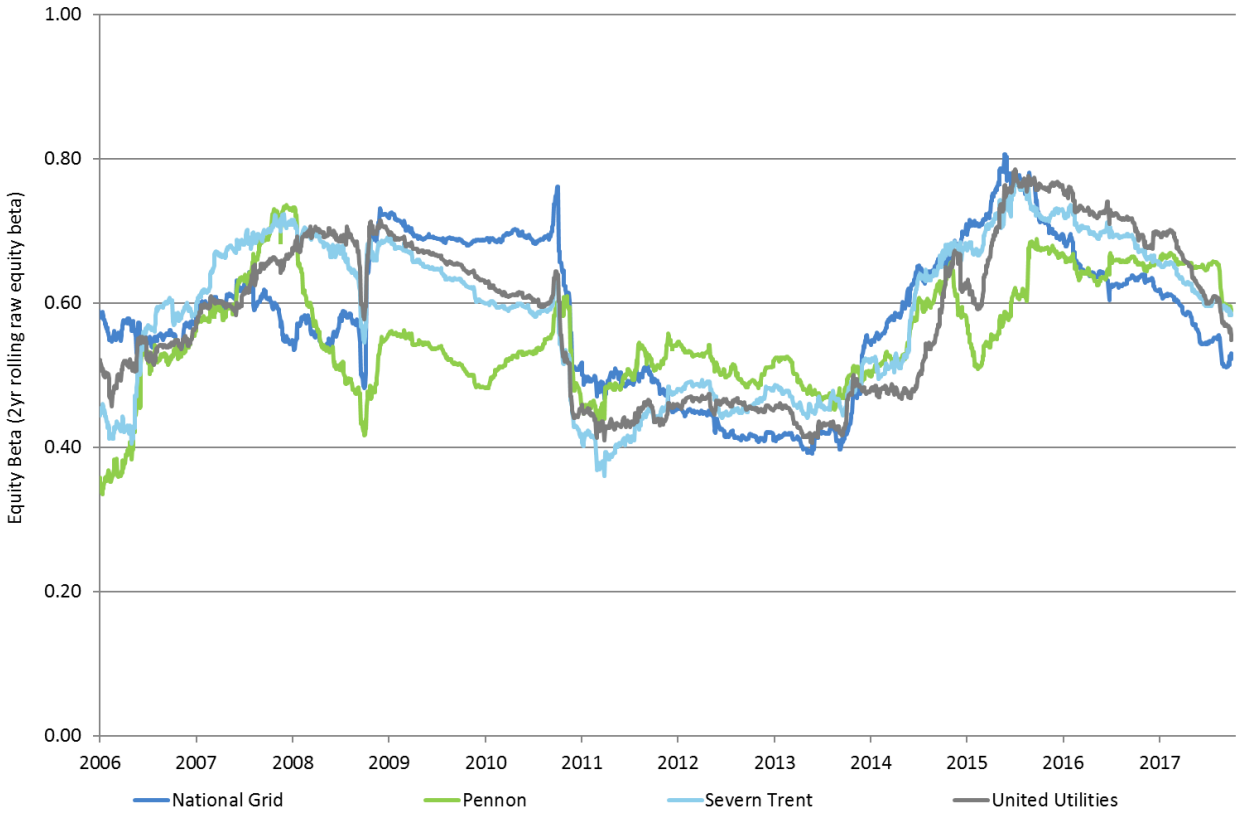
[90] Adjusted beta = Regression Beta (0.67) + 1.00 (0.33). This is known as the Blume Adjustment.

Option	Description
	However, the rate of convergence to one will vary greatly across companies and the extent to which this movement towards one is representative of a pure-play regulated utility is uncertain. Given the purposes of estimating an equity beta for use in forward looking periods defined by price controls, this adjustment is likely not required for regulated utilities.
Conversion to asset beta/ re-levered equity beta	
Gearing	Gearing, applied to un-lever and re-lever the equity beta, can be calculated either by subtracting cash positions from total interest bearing debt (net debt) or by including only interest bearing debt (gross debt). It is convention to use net debt in WACC calculations to consider the fact that if a company were acquired today, it could pay down debt with cash on hand. There is also a question of what point in time gearing should be calculated. Gearing measures typically change on a quarterly basis when companies release quarterly earnings and balance sheets. The levering calculation can utilise gearing calculated from the most recent data point or as an average across the averaging period used to calculate the raw equity beta.
Debt beta	The beta of a portfolio is equal to the weighted average of the betas within that portfolio. As a firm's assets can be considered a portfolio of its debt and equity holdings, the asset beta can be thought of as the weighted average of the equity beta and the debt beta. Debt betas, which measures how the value of cash flows to debtholders change with market conditions, are often assumed to be zero for several reasons. First, debt betas are likely quite close (almost negligibly close) to zero, especially for the companies in question with investment grade credit rating. Next, calculating a precise debt beta is not straightforward and there is not a large body of academic research in this area (as opposed to equity betas). Finally, assuming a zero equity beta rather than small positive equity beta simplifies the un-levering and re-levering equation and requires less assumptions. The mechanics behind the un-levering and re-levering process and a description of common assumptions is provided in Annex C.
Re-levering of equity beta	The CAPM model implies that the equity beta changes with the level of gearing. Where gearing increases, the equity beta is posited to increase in a way that is linked to the proportion of equity used in the financing structure. The outcome of this is that the post-tax cost of capital tends not to be very sensitive to the level of gearing. Our approach utilises this relationship in translating between an asset beta and equity beta estimates, however in practice investors may not vary their perceptions of risk in line with gearing as predicted within CAPM.

Empirical evidence on the raw equity beta for our chosen comparators

The figure below highlights the two-year daily raw equity beta for our comparators. If no adjustment was made for leverage, this may be a source of evidence for estimating the equity beta, independent of the level of gearing.

Figure C.1: Raw equity betas for chosen comparators



Source: Bloomberg

C.1.2. To what extent can we rely on the empirical estimates of beta?

Wider considerations

Beta represents a measure of a company's exposure to systematic market risk, relative to other firms in the market**.** Regressing stock prices on the market index is a common tool for estimating this risk, but it may not be the best estimation method. Empirical estimates of beta using the ordinary least squares (OLS) regression method change significantly over time, and across different estimation assumptions. As discussed above, this may be due to changes in underlying business risk or gearing levels, or it might also represent noise in the estimation. Thus, it is important to understand what might be causing changes in beta over time in order to draw a conclusion as to the robustness of the beta estimate using the OLS regression method. If there are biases in the estimate, it is important to understand these biases.

Methodological adjustments – regression

In the RIIO Financeability Study (2012) by Imrecon and ECA, the equity beta was a key area of focus. The authors looked at disaggregating the equity beta into two component parts; a performance beta and a valuation beta. This analysis suggested that the evidence was consistent with an equity beta of 0.35 to 0.50, lower than traditional equity beta estimates.

One of the reasons why the RIIO Financeability Study arrived at lower unadjusted raw betas than regulatory determinations was due to the winsorization technique which reduce the effect of outliers in the regression calculation. The results included two-tail and upper tail only estimates. Over the 2000 to 2012 period, the estimates changed from 0.51 using the traditional approach to 0.40 using the winsorization approach.[91]

Regression analysis

CEPA also tested the impact of outliers on the standard OLS regression-estimated raw equity beta to better understand what underpins the unadjusted empirical beta estimates. Our analysis identifies the five observations that have the greatest influence on the resulting coefficient (those with the largest residual) and then drops these observations before rerunning the OLS regression, a method known as Cook's Distance. The analysis considered the weekly raw equity betas for the four regulated UK networks considered to most closely represent pure-play businesses against the FTSE All-Share index. At first, we considered a returns horizon from 2005 to present. The coefficients from the OLS regression and the adjusted OLS regression are presented below.

Table C.2: Impact on weekly equity beta estimate, 2005-present

Estimation coefficients	Pennon	United Utilities	Severn Trent	National Grid
Raw equity beta (unadjusted)	0.67***	0.66***	0.68***	0.60***
Raw equity beta (Adjusted for removing outliers)	0.62***	0.61***	0.64***	0.50***

Source: Bloomberg, CEPA analysis

The table shows that, after removing the five outlier observations, the betas fall quite significantly. These five observations all occurred within the Global Financial Crisis period. While in reality, it would not be prudent to consider a returns horizon of such a long time frame, this analysis does help to illustrate the fact that the standard OLS regression estimation method may produce results that are not likely to be representative of future risk.

[91] p19, Imrecon and ECA (2012) RIIO Financeability Study

We then performed the same analysis for the period 2010 to present and found that the predicted coefficient representing the raw equity beta did not change after removing the outlying observations. Therefore, it is important to consider whether shock events included in the selected returns horizon have skewed the estimation of beta and adjust the estimation method appropriately.

Adjusting for relative risk

Comparators used in beta analysis are unlikely to be perfect comparators for companies and industries being regulated. There are likely to be differences in the systematic risk within different industries. For example, if comparators are used from the water sector, adjustments may be required to make them suitable for the energy sector.

One example where the risk differs between energy and water networks is in the treatment of pension deficit payments. In the RIIO Financeability Study, the impact of Ofgem's 2010 decision to provide full investor protection to historic defined benefit pension schemes was estimated to reduce National Grid's implied equity beta by 0.17.[92] In the water sector, consumers fund only 50% of deficit recovery payments.

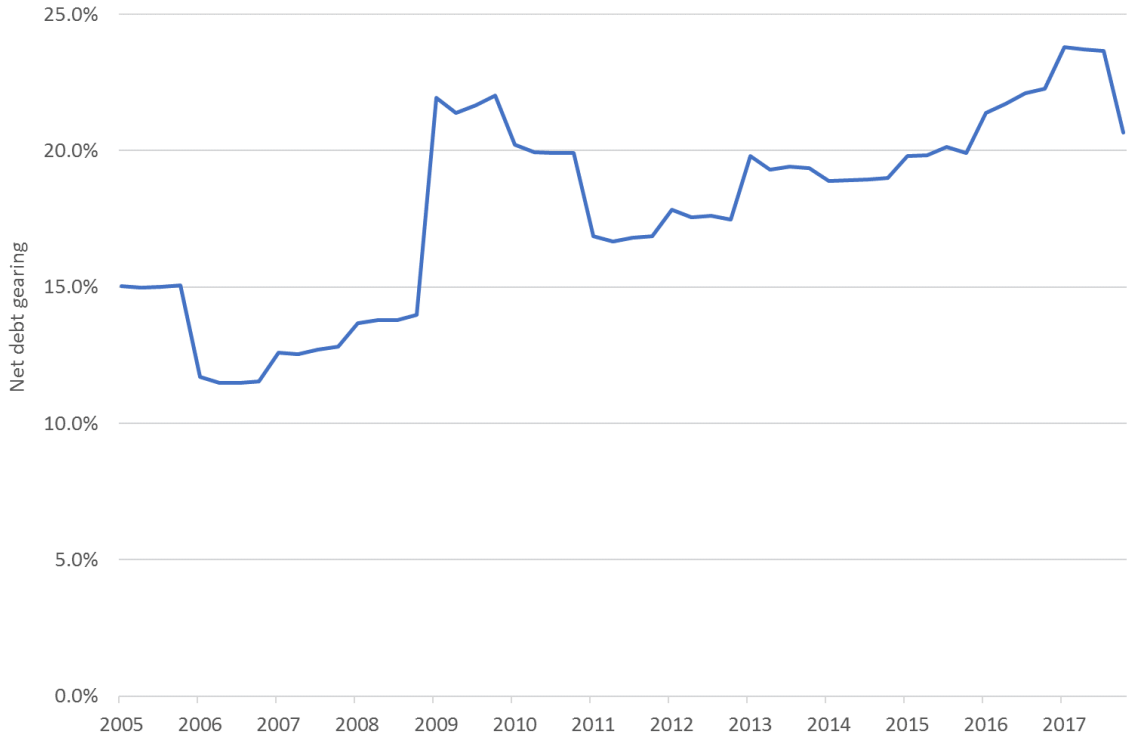
As a general point, where relative risk is used, it is important to distinguish between diversifiable and non-diversifiable risk, as only non-diversifiable risk should be taken into account when estimating the equity beta. We discuss relative risk between regimes and assets in more detail in the cost of equity sections in Part 2 and Part 3.

Changes in market gearing

According to corporate finance theory, high gearing increasing equity risk. However, in the beta un-levering calculation, gearing changes of the company relative to the market as a whole are not taken into consideration. The figure below shows changes in the market level of gearing over time.

[92] Ofgem (2010) Price Control Treatment of Network Operator Pension Costs under Regulatory Principles

Figure C.2: FTSE100 Non-financial gearing



Source: Bloomberg, CEPA analysis

There is a broad upwards trend in market levels of gearing, however in the beta estimate, market levels of gearing are not relevant. However, when determining how risky a firm is relative to the market, it seems logical to consider how the company's gearing changes relative to market gearing. We can consider a two-period model to show this:

- In period 1, let us assume that both company and market gearing is 30%, with a raw equity beta of 0.8.
- In period 2, both the company and market gearing increases to 40% and the raw equity beta is unchanged at 0.8.

If you were to re-lever your equity beta based in period 2 down to 30%, it would lead to an equity beta below 0.8. This intuitively seems inconsistent as the company has moved in line with the market, yet our theoretical re-levering calculations only look at changes in company rather than market gearing. This has the potential to introduce a bias in our beta calculations. However, it is difficult to adjust for these changes in a robust way over a time series as a suitable starting point needs to be identified[93].

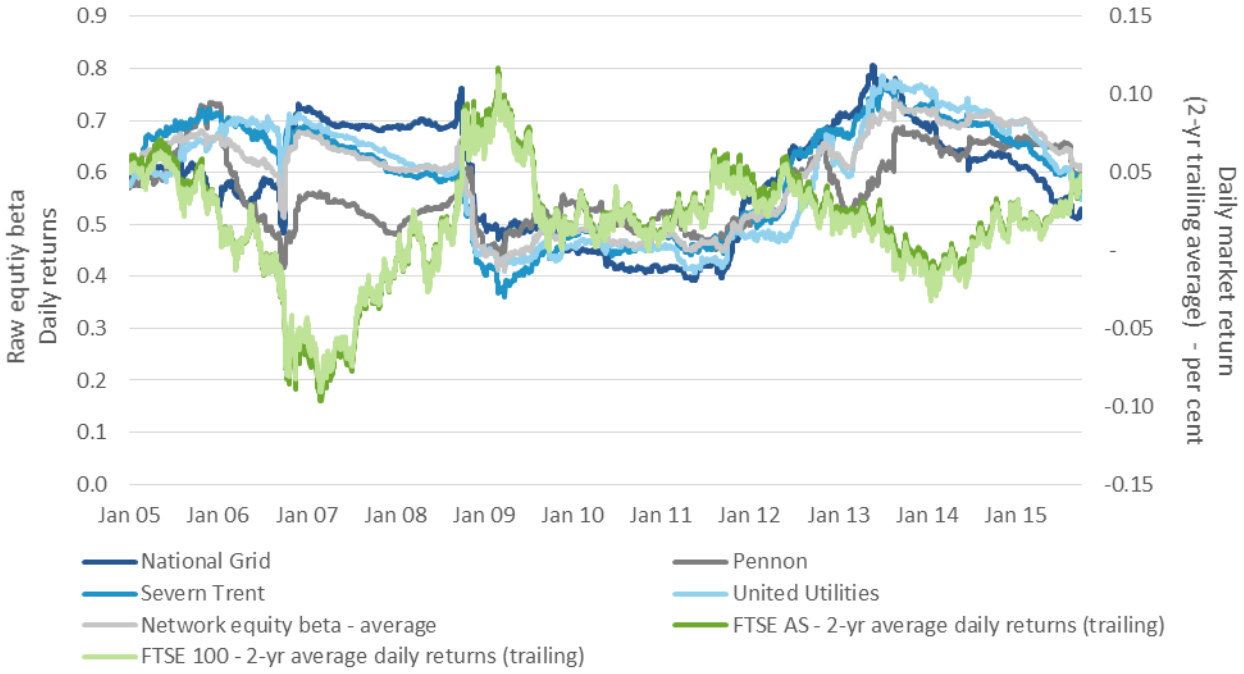
[93] In a two-period model, an adjusted change in gearing can be used to estimate beta.

Varying beta

A further area where the theoretical model may not be representative of markets in practice is having a single beta figure that reflects risk. As discussed above, businesses will not necessarily have a constant risk profile, however they are unlikely to change to the extent witnessed in markets, as some of this movement may represent noise.

One hypothesis to explain the volatile observed betas for regulated utilities is that the beta characteristics of a regulated utility may change in different states of the market. For example, regulated utility stocks may exhibit defensive characteristics in market downturns, while being closer in behaviour to the broader market in market upturns. Table 3.6 below shows that, in periods of market downturn and equity sell-offs (such as the periods 2005 to 2007, 2009 to 2010 and 2012 to 2014) the comparator set equity betas increase, while in periods of market growth and equity investment, equity betas decrease.

Figure C.3: UK regulated utility raw equity betas against the market portfolio



Source: Bloomberg and CEPA analysis

This analysis further questions the robustness of the OLS method as an unbiased estimator of beta.

Skewness

Discussions around a varying beta lead in to questions around returns that are asymmetric in nature. This issue has been discussed in depth in the aviation sector, where airports near to

capacity have argued that they face greater downside risk than upside risk given that they bear volume risk.

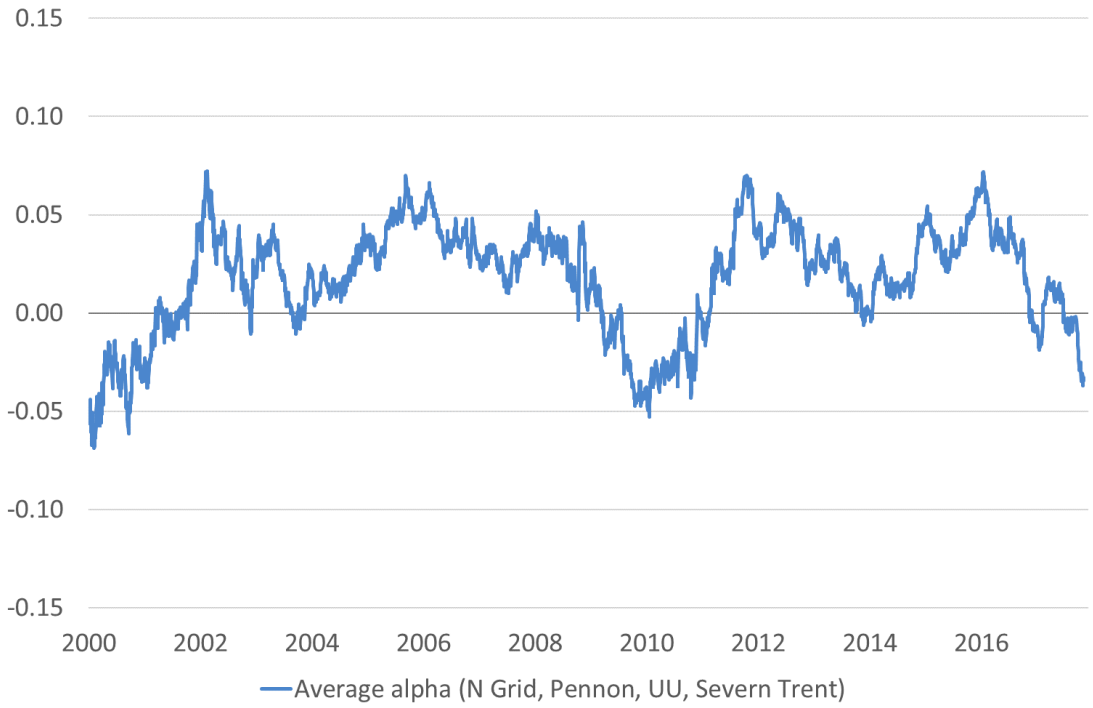
Within this report, we conduct relative risk analysis. If the beta risks are asymmetric, then a regulator must choose whether to make any adjust to beta. This is not considered under the standard beta estimate.

Alpha

Alpha is a measure of the return on an investment relative to the market portfolio return. Alphas greater than zero indicate outperformance and alphas less than zero indicate underperformance relative to the market portfolio.

The figure below shows the observed equity alpha for the utilities in our comparator sample. Over time, alpha has been relatively volatile and has turned negative recently. Alpha may help explain movements in the beta term over time if further analysis is undertaken to understand the drivers of empirical betas.

Figure C.4: Alpha for listed utility networks



C.1.3. Alternatives to empirical evidence

As mentioned at the beginning of this section, the equity beta can be estimated bottom-up through a theoretical model that does not require observed benchmarks. These alternative approaches include:

- pure qualitative assessment – if empirical estimates are not seen to be valuable, it is possible to use a qualitative assessment of beta based on risks relative to the market; risk modelling may be implemented to give a view on the likelihood and impact of these risks.
- company-specific DGM estimates – in estimating the TMR, a DGM is a forward-looking evidence source that can be used based on the market; however, it is also possible to use company-specific DGMs to estimate a total company-specific equity return. It is important to assess whether the high dividends are reflective of a high level of risk (hence required return), or if this is from a source of excess profits. For regulated networks as an example, high dividends could potentially reflect overly generous determinations. If dividend yields are higher than the market, this would lead to an equity beta above one - this would clearly not be appropriate if the network were earning excess returns while facing limited risk. The approach therefore has a degree of circularity, which would suggest this should not be used in making assessments.

ANNEX D DE-LEVERING AND RE-LEVERING EQUITY BETAS

Based on Modigliani & Miller, the value of a levered firm is equal to the value of an unlevered firm plus the present value of the tax shield; this is represented in the right-hand side of the equation below. Further, the market value of a levered firm is the market value of debt plus the market value of equity; this is represented in the left-hand side of the equation.

$$D + E = V_u + tD$$

Where D = market level of debt, E = market level of equity, V_u = value of an unlevered firm and t is the marginal tax rate. Applying the property of beta, which states that the portfolio beta is a weighted average of the betas of the individual assets in the portfolio, to the relationship above, we arrive at the following property:

$$\frac{D}{D+E}\beta_D + \frac{E}{D+E}\beta_E = \frac{V_u}{V_u + tD}\beta_A + \frac{tD}{V_u + tD}\beta_{TD}$$

Where β_D = debt beta, β_E = raw equity beta, β_A = asset beta or unlevered beta and β_{TD} represents the interest tax shield as a result of being levered (having positive gearing).

The assumptions made at the next stage determine the exact application of the un-levering (to arrive at the asset beta) and re-levering (to arrive at the company specific equity beta) process:

1. Many regulators assume that debt is riskless, or that it does not fluctuate with general market conditions. Mathematically, this means **$\beta_D = 0$**. While this assumption is strong, the debt beta should be close to zero and estimating the actual debt beta will introduce further complexity to the process. This assumption is convention in the UK and Australia, but is not consistently applied.

2. A sensible assumption is that the risk of the interest tax shield cash flow is the same as the risk of the firm's unlevered cash flows. This assumption is mathematically represented as **$\beta_A = \beta_{TD}$**.

   An alternative assumption is that **$\beta_{TD} = \beta_D = 0$**. This assumption is less common in the UK regulatory context. It implies that the certainty of receiving tax shield cash flows does not fluctuate with market conditions, even if the certainty of receiving cash flows from business operations does. Since tax shield cash flow is a function of cash flow from business operations, this assumption seems less plausible than **$\beta_A = \beta_{TD}$**.

Applying the first two assumptions, **$\beta_D = 0$** and **$\beta_A = \beta_{TD}$** yields the following equations:

$$\frac{E}{D+E}\beta_E = \frac{V_u}{V_u + tD}\beta_A + \frac{tD}{V_u + tD}\beta_A$$

$$(1)\ \frac{E}{D+E}\beta_E = \beta_A$$

$$(2) \quad \beta_E = \beta_A \frac{D + E}{E}$$

We can use equation (1) to un-lever the raw equity beta using the observed company's gearing level to arrive at an asset beta. Then, we can use equation (2) to re-lever the asset beta using the company in question's desired level of gearing (notional or actual).

ANNEX E ESTIMATING THE TOTAL MARKET RETURN (TMR)

The CAPM framework requires observing market expectations to form the market risk premium. These observed market expectations can be inferred from a variety of different sources and methodologies, each with strengths, drawbacks and their own intricacies.

In this annex we discuss the choice of historical versus forward-looking evidence, how to utilise this evidence in practice and sources used in arriving at our real (RPI) TMR range of 5.0% to 6.5%.

E.1. Choice of historical versus forward-looking evidence

In this sub-section we consider different types of evidence that can be used in estimating the TMR. The choice of this evidence depends on the perspective taken about equity market returns, including the following questions:

- How stable is the TMR over time?
- Is there evidence of a structural break in the TMR?
- Does a low-risk free rate imply lower future equity returns?

We consider the choice of evidence depends on the nature of the investment and we consider it prudent to assess a range of evidence rather than focusing solely on any one measure for RIIO-2.

E.1.1. Categorising different approaches

There are three different types of evidence we consider in analysing the TMR:

- *Historical ex-post*: outturn historic returns proxy expected future returns, with expected returns relatively constant.
- *Historical ex-ante*: this approach involves adjusting historic returns for factors that are not expected to be repeated in future, thus expected equity returns are not equivalent to unadjusted outturn returns.
- *Forward-looking*: this approach uses expectations of the future e.g. surveys, dividend yields and growth, as the basis for estimating equity returns.

The perspective adopted on the TMR will help guide the choice of sources used.

E.1.2. Perspectives on the stability of the TMR

While the risk-free rate can be estimated by readily available proxies, the Market Risk Premium (MRP) is expectations-driven and as such, cannot be as readily observed. There are two mutually-

exclusive well-documented assumptions at either end of a spectrum which underpin how the market risk premium can be estimated.

- **TMR is generally stable.** This is the approach that has historically been adopted by UK regulators – whereby the MRP is estimated by subtracting the more-observable risk-free rate from an estimate of the TMR. Under this assumption, the MRP fluctuates to offset movements in the risk-free rate. That is, there is an implicit assumption that there is an inverse relationship between the risk-free rate and the MRP.

  By definition, MRP relates to the compensation required by investors to bear equity risk. Consistent with financial theory, in times of depressed economic conditions or elevated economic uncertainty, investors tend to exhibit higher levels of risk aversion, thereby increasing the demand for risk-free assets (pushing down the risk-free rate), and requiring higher levels of compensation for taking equity risk. This phenomenon is considered as a 'flight to quality'.

- **MRP is generally stable, TMR is not.** Alternatively, the MRP can be directly estimated by assuming that the MRP is relatively stable. Under this approach, the MRP and the risk-free rate can be independently estimated. The TMR is derived by adding the fluctuating risk-free rate to a relatively stable MRP estimate. The Australian Energy Regulator tends to place greater weight on this assumption in its approach to setting cost of capital.

The latter approach poses two problems which can have adverse policy implications:

- Firstly, it produces a more volatile cost of equity. The regulatory uncertainty could have adverse impacts on long-run investment decisions and may bring about some volatility in consumer prices.
- Secondly, it could lead to excessively low and unrealistic levels of total equity market returns when paired with very low interest rates. Setting a cost of equity that falls significantly below the market means under-compensation of regulated firms, and if this results in underinvestment, it could lead to longer-term reliability issues for consumers.

For regulatory purposes we consider that on balance, continuing to derive market risk premium through an assumption of equity market returns is a superior approach as it avoids excessive volatility between decisions, produces less volatile consumer bills, and provides some certainty to the businesses which supports long-term investment decisions.

E.1.3. Structural changes in the TMR

Traditionally UK regulators have used long-term historic averages to estimate expected equity market returns, often referring to the longest time period as published in the annual Credit Suisse

Global Investment Returns Yearbook[94], when looking at the total market return. This is authored by Dimson, Marsh and Staunton (DMS). The 2017 Yearbook indicates an arithmetic average of 7.3 per cent and a geometric average of 5.5 per cent using the longest available time period, since 1900.

Using a long-term historic average of equity market returns or the equity risk premium only can lead to significantly different costs of equity. The assumption underpinning the use of this data is that historic reality is the best indicator of future expectations.

However, the current sustained low-interest rate period and the accompanying period of low equity market returns in the face of increased economic and financial uncertainty, have diverged significantly from very long-run historical averages. There are a number of methods which take into account forward-looking evidence, for example survey-based evidence, surveying practitioners and investors on their expectations for future required returns to equity, and forward-looking evidence inferred from the current prices of traded assets using dividends and earnings growth models.

This issue of a potential structural change in total equity market returns was brought to light in 2014 in the UK regulatory space when the Competition and Markets Authority (CMA), the appeal body for regulatory decisions, in its provisional determination for Northern Ireland Electricity Limited (NIE), set out an approach for the market risk premium that placed greater weight on contemporary market evidence rather than historical evidence. This resulted in a lower estimate for the equity market return than regulators have typically used in the past.

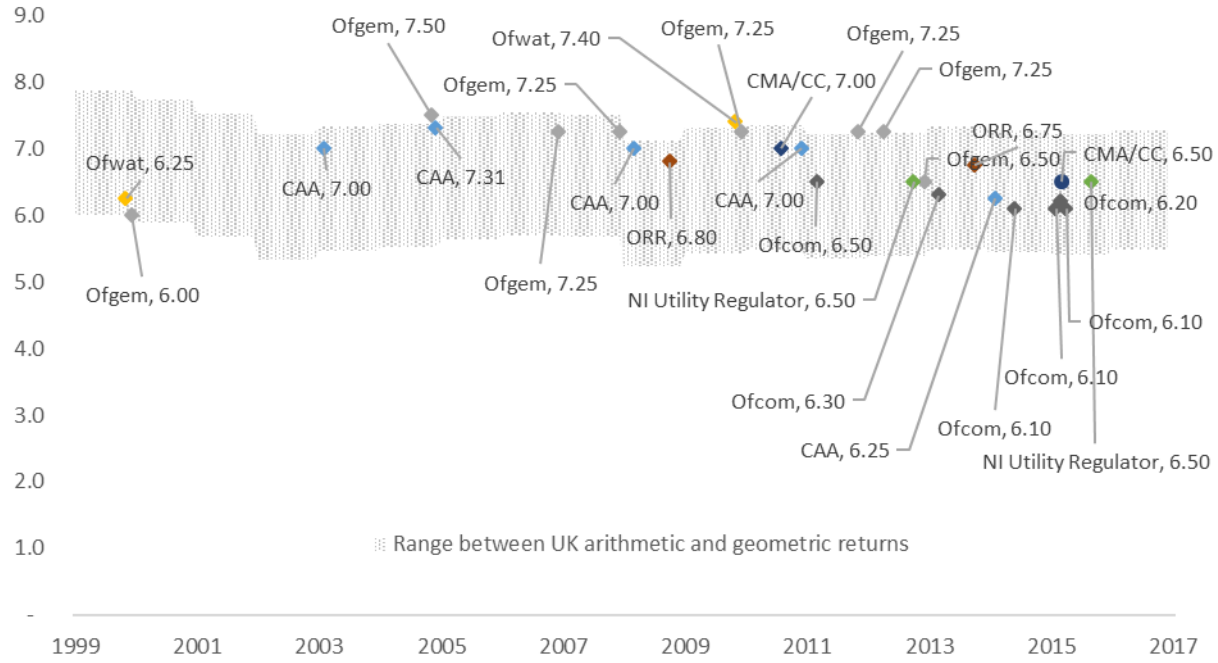
This prompted Ofgem to conduct a review into its methodology for RIIO-ED1. Following extensive consultations, Ofgem decided to similarly place greater weight on current market conditions, based on the Dividend Growth Model (DGM), in its cost of equity determination for electricity distribution network operators. This led to a 0.7 per cent reduction in the cost of equity to 6.0 per cent, relative to the previous price control in electricity distribution, DPCR5. This was also lower than the cost of equity for both the RIIO-GD1 and RIIO-T1 determinations.

The weightings that should be placed on historical evidence and current market data have continued to be a subject of debate in the UK regulatory sphere. For instance, in the recent Ofwat PR19 consultations, Ofwat proposed to adopt a methodology put forth by PwC that utilises forward-looking estimates derived from the DGM to determine cost of equity. This was met by some criticisms in its consultation responses.

The figure below includes UK regulatory decisions on the real total market return (TMR) and this demonstrates how the CMA NIE decision has led to a downwards movement in regulatory network determinations on the TMR.

[94] Authored by Dimson, Marsh and Staunton.

Figure E.1: UK regulatory decisions on real TMR relative to historic returns evidence[(a)]



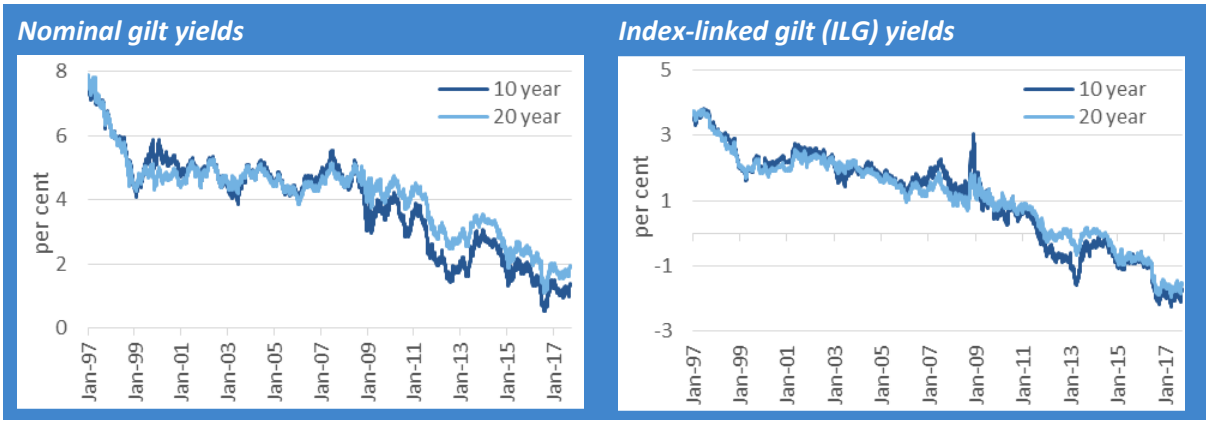
Source: Credit Suisse Global Investment Returns Sourcebook, CEPA analysis of regulatory decisions
(a) Real total market returns for the UK since 1899-2016, arithmetic and geometric means

It is therefore imperative to future cost of capital decisions to determine whether in the current economic and financial environment, continued reliance on historical data to determine cost of equity will lead to adverse policy implications. There are some key questions that we seek to answer before estimating the appropriate equity market return.

Has there been a structural shift towards lower interest rates?

There is evidence that the UK has entered a period of lower interest rates. Figure E.2 presents the 20-year trend in both nominal and index-linked gilts since 1997 – a steady decline in interest rates since the GFC is clear.

Figure E.2: Nominal and index-linked UK gilt yields, 2007 to 2017



Source: CEPA analysis of Bloomberg data

There is a general expectation that interest rates will remain significantly below historical levels. For example companies such as HICL Infrastructure, a long term equity investor in infrastructure, have adopted lower discount rates used for UK infrastructure assets since 2012[95]. We also see evidence of lowering expectations as evidenced in the Financial Conduct Authority's (FCA's) 2014 decision to lower the growth rates that pension fund providers must use in their illustrations of possible future returns from 5%, 7% and 9%, to 2%, 5% and 8% respectively. The recent Ofwat PR19 final methodology consultation also proposed a forward-looking based calculation of cost of equity on account of a 'lower for longer' period[96].

On the other hand, the Bank of England in its May 2017 Inflation Report has stressed that UK's interest rate outlook remains uncertain, and there is evidence through forward yields, OBR forecasts, and overnight index swaps which suggest there are market expectations for a rate rise in the short term, as noted by KPMG in a response to the Ofwat consultation[97].

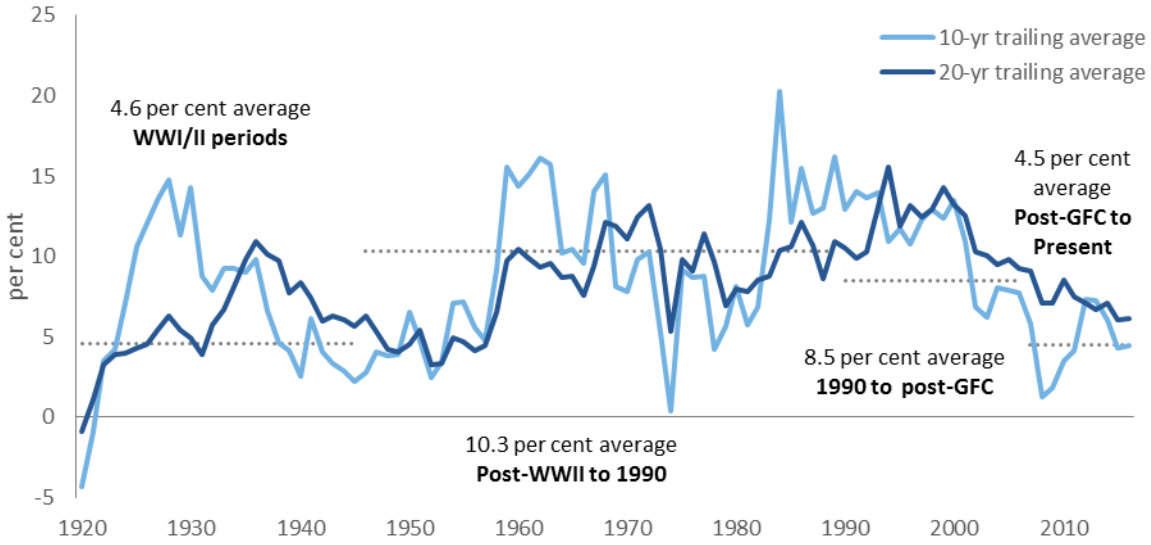
Has there been a structural shift towards lower equity market returns?

It is less clear that there has been a structural shift towards lower equity market returns. A 2016 report by the McKinsey Global Institute suggests that investment returns over the next 20 years are likely to fall short of the returns for the previous period 1985-2014 as the trends that boosted growth have been less prevalent. This growth was driven by stronger corporate profits, revenue from new markets, declining corporate taxes as a result of advances in automation and global supply chains, sharp declines in inflation, demographic trends supporting investment, productivity gains, and rapid growth in China.

[95] HICL publish a discount rate for WACC since 2012, most recently in November 2017, using a long-term risk-free rate of 1.8% and a risk premium of 5.5% for UK assets (in nominal terms).
[96] Ofwat (2017) Delivering Water 2020: Consulting on our methodology for the 2019 price review
[97] KPMG (2017) A review of Ofwat's proposed approach to total market returns

However, while there is some evidence that market returns are lower than the previous decade (see Figure E.3), equity market returns are significantly more volatile compared to interest rates. As such, it is more difficult to draw a conclusion as to whether the recent lower returns since the GFC will persist.

Figure E.3: Historical real equity market returns in the UK



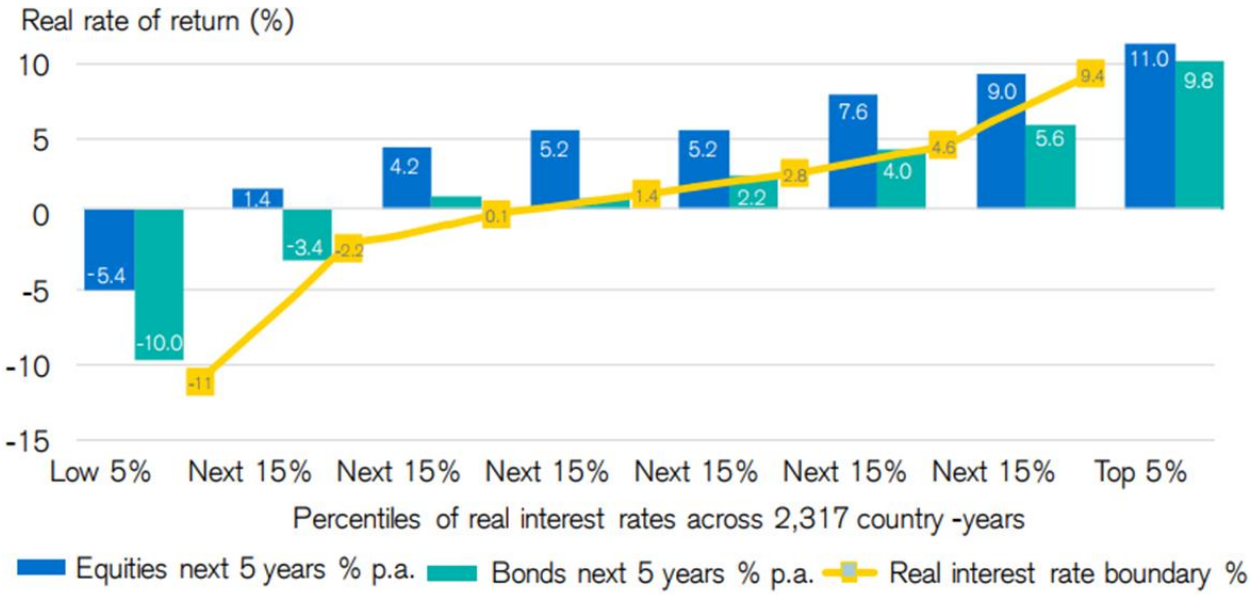
Source: CEPA analysis of Credit Suisse Global Investment Returns Yearbook 2017

Therefore, we consider that there is inconclusive evidence of a downward structural shift to lower equity market returns, and it would not be prudent to ignore historic evidence entirely when setting expectations over a longer time horizon. In any case, the assumption of a structural downward shift contradicts the assumption of stable long-term equity market returns discussed earlier.

E.1.4. Relationship between the risk-free rate and future equity returns

Evidence from DMS sets out that lower interest rates today also could imply lower equity returns in the near-term future. This is shown in the figure below.

Figure E.4: Link between interest rates and future equity returns

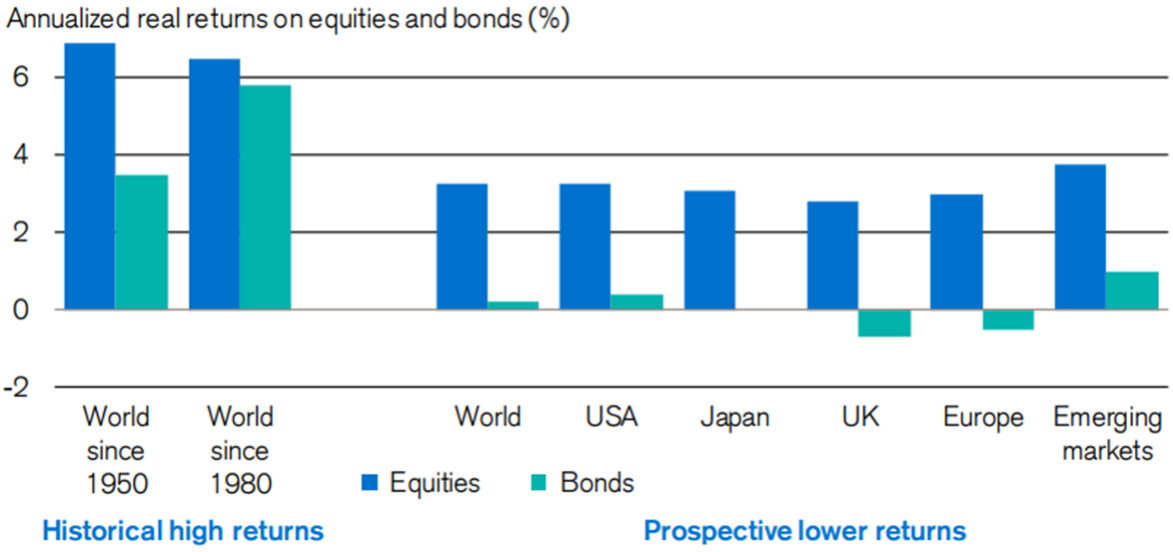


Source: Credit Suisse, Global Investment Returns Yearbook 2017 slide deck

The equity returns forecast by DMS for the UK in future mirror the world index in being lower than historic levels over longer-time horizons.

The figure below shows a real annualised return of around 3% for the UK, as prospective future returns.

Figure E.5: Difference between historical returns and prospective future returns



Source: Credit Suisse, Global Investment Returns Yearbook 2017 slide deck

We do not use this aspect of DMS evidence directly in arriving at a TMR estimate, but it does support the proposition that the appropriate TMR is below the level implied by historical returns.

E.1.5. Comparing historical and forward-looking evidence

It may be appropriate that different weights be placed on historic and forward-looking evidence depending on the type of decision that requires the market return input. Table E.3 assesses the relative merits of using long-run historical versus forward-looking data.

Table E.1: Comparison of relative merits between using long-run and forward looking market evidence to estimate market return expectations

Consideration	Long-run historical evidence	Forward-looking market evidence
Considerations of higher significance to decisions relating to shorter-periods e.g. IDC		
Relevance to current market outlook	Historical data is backward-looking.	By definition, based on current market expectations.
Matching of investment incentives to borrowing costs	May create incentives for over-investment when the market anticipates lower returns than historic, and deter investment when the market anticipates higher returns than historic.	Better matches investment incentives with current market data.
Considerations of higher significance to decisions relating to longer-periods e.g. RIIO2		
Stability / (minimal volatility) between decisions	Less volatile as based on long-term historic trends.	Much more volatile as market views change with new information.
Investor confidence	Provides long-term stable returns on their long-run averages.	More uncertainty between each decision, which can be mitigated by a commitment to a certain approach/ methodology.
Considerations of similar significance to shorter- and longer- term decisions		
Degree of interpretation required	Need to assess whether historic figures are appropriate for estimating future equity return expectations, but overall there is limited need for interpretation	Greater number of assumptions are required, for example with DGM analysis.
Intergenerational equity – investors & consumers	May lead to over-rewarding of current investors (or over-charging of current consumers) at the expense of future investors, based on present levels.	More accurate representation of current business costs to current investors and consumers.

It is far from clear that one method represents an optimal model. We consider that the approach chosen for estimating the TMR should reflect the nature of that decision. For example, if you are looking at expected equity returns for a new asset for a two-year horizon, a more representative

forward-looking measure of the TMR could be used, whereas for a thirty-year investment where forecasting becomes very difficult, you would likely look to lean most heavily on historic evidence as the basis for a more long-run return.

E.2. Utilising historic and forward-looking evidence

The previous sub-section considered ways to think about the TMR and merits of different approaches. In this sub-section we consider questions of how to interpret this evidence, especially for historic evidence. We find that:

- The choice between arithmetic and geometric returns can lead to differences of between 100-200bps on the TMR.
    - The choice of measure will depend on what is being estimated. The UKRN draft report considers that in practice investors focus on geometric returns and this should be the starting point for considering historic evidence.
- The observation period can make very material changes to the TMR
    - The CMA (2014) NIE determination and the UKRN draft report both focus on the longest available time-series for the UK (since 1900) – focus on the post-war period could lead to a higher answer than this, while focusing on much more recent data could lead to a lower answer.
- Care is required in interpreting 'real' historic data.
    - The DMS data set typically used in estimating historic returns includes a blend of inflation indices. The UKRN draft report indicates a downwards adjustment of 30bps is required to convert this into a CPI equivalent. A further adjustment would be required to convert this into a real RPI return.
- The holding period does make a difference, although to a lesser extent than the factors noted above.
    - Based on the longest available time series, as the holding period increases, the arithmetic and geometric averages converge.
- Calculation approaches can lead to differences in outcomes, although this is linked to the choice of holding period and observation period.
    - The CMA (2014) NIE determination looked at four separate measures of return, including overlapping, simple, Blume, and JKM.
- Adjusting for one-off factors may lead to a reduction in the TMR relative to historic returns.

- Both DMS and Ofwat have indicated that adjustments are required to translate historic equity returns into future returns.

- The calibration of the DGM is subjective and can lead to a range of outcomes.
  - There are a number of input assumptions and different model calibrations for estimating future equity returns using this methodology.

E.2.1. Arithmetic vs geometric averages

Geometric averages are lower than arithmetic averages as they do not take into account the volatility of annual excess returns over the averaging period. The more volatile the sequence of returns, the greater the extent to which the arithmetic mean will exceed the geometric mean. In practice, a blended measure should be used, for example the Blume (1974) formula below where T= number of historical years of data and N= number of forecast years.

Returns(T) = geometric mean(T-1)/(N-1) + arithmetic mean*(N-T)/(N-1)*

The UKRN draft report posits that regulators should start with the geometric mean of returns. An adjustment of one to two percentage points should be added, depending on the extent to which regulators want to account for serial correlation.

E.2.2. Observation period

While the time series does extend back to 1900, this does not necessarily mean that the full time series must be used in estimating future returns. Changes in the nature of the UK market over this very long-run time period means that the earlier years in this sample may not be representative of the market today, particularly with two World Wars. There may be a number of structural breaks over the longest time horizon.

However, using periods that are very short in nature may not be good estimates of future equity returns. Where equity returns are cyclical, information would be required over full business cycles to avoid the scope for misleading results. The scope for one-off events or chance to affect evidence based off a smaller sample is higher.

We present returns over different time periods below on real geometric returns for equities.

Table E.2: Real equity returns, geometric, over different time horizons

Time horizon	Real UK geometric equity returns
1900-2016	5.5%
1967-2016	6.9%
1988-2016	6.4%
2000-2016	2.4%

Source: CEPA analysis of DMS (2017)

The choice of time period therefore has a substantial effect on inferences drawn from historic outturn evidence.

E.2.3. Role of inflation

The DMS data used to estimate historic ex-post real returns are based on different inflation measures. This means that care is required when translating this into expected future real returns. This is especially true when relationships between inflation measures change e.g. with the formula effect expected to increase the size of the wedge between RPI and CPI inflation. This choice in part depends on whether we assume that investors target real returns or nominal returns. We consider that investors are more likely to target real returns than nominal returns, consistent with principles of Financial Capital Maintenance (FCM).

The UK evidence produced by DMS uses CPI inflation since 1988, to infer real returns[98]. Using annual data from the ONS, the difference between CPI inflation and RPI inflation over this time horizon has been 0.72%, hence real CPI and RPI returns would not be equivalent. Translating between CPI and RPI real returns is a topic discussed in the UKRN draft report.

The UKRN draft report estimates that the use of CPI within the longest available time series for the UK from DMS would lead to a reduction in the outturn historic return by c.30bps (taking the geometric mean from 5.5% in real terms based on a blend of indices to 5.2% in CPI-real terms). In order to translate this into an implied forward-looking value in RPI-real terms, we would need to adjust for the expected RPI-CPI wedge. If this is assumed to be 120bps, this approach could give a c.4.0% geometric mean RPI-real return.

Given the impact on the TMR, we consider that decisions on the TMR need to explain the underlying inflation assumptions and the perspective adopted on whether investors require real or nominal returns.

E.2.4. Holding period

A further factor that will influence the results drawn from historic data is the choice of holding period. Over the longest available time horizon, longer holding periods generally reduce the arithmetic mean, but increase the geometric mean. The difference between arithmetic and geometric means halves between 1yr and 20yr holding periods.

[98] Over the full time horizon back to 1900, DMS use a hybrid of inflation measures.

Table E.3: Impact of holding period on UK real equity returns (1900-2016), based on overlapping returns[99]

	1yr	2yr	5yr	10yr	20yr
Arithmetic mean	7.3%	7.2%	7.0%	6.9%	7.0%
Geometric mean	5.5%	5.5%	5.6%	5.6%	6.1%

Source: CEPA analysis of DMS (2017)

E.2.5. Calculation approaches

As per the CMA (2014) NIE determination, there are alternative approaches to estimate historic equity returns. The CMA indicated a real return across different historic ex-post measures of between 6-7% (real, RPI terms). The table used to illustrate this is shown below.

Figure E.6: CMA equity returns under different calculation approaches

TABLE 13.7 **Real returns, 1900 to 2012**

per cent

	Return on equity				*ERP‡*			
	*Simple**	*Overlapping†*	*Blume§*	*JKM§*	*Simple**	*Overlapping†*	*Blume§*	*JKM§*
UK market, DMS data								
1-year holding period	7.1	7.1	7.1	7.0	6.0	6.0	6.0	5.9
2-year holding period	7.5	7.0	7.1	7.0	6.2	5.8	6.0	5.9
5-year holding period	6.7	6.8	7.0	6.8	5.2	5.3	5.9	5.7
10-year holding period¶	6.4	6.8	6.9	6.6	5.1	5.3	5.8	5.5
20-year holding period	6.7	6.9	6.8	6.1	5.7	5.6	5.7	5.1
UK market, Barclays data								
1-year holding period	6.9	6.9	6.9	6.8	5.8	5.8	5.8	5.8
2-year holding period	7.2	6.7	6.8	6.8	6.0	5.5	5.8	5.7
5-year holding period	6.2	6.4	6.8	6.6	4.8	5.0	5.7	5.6
10-year holding period¶	6.0	6.4	6.7	6.3	4.7	4.9	5.7	5.3
20-year holding period	5.9	6.4	6.5	5.8	5.1	5.1	5.5	4.9

Source: CC calculations based on *Credit Suisse Global Investment Sourcebook 2013*, written by Dimson, Marsh and Staunton (DMS) and Barclays Equity Gilt Study.

The choice of different measures of real returns will influence the findings from an ex-post review.

The UKRN draft report suggests historic ex-post analysis points to a range of 6-7%, but in real CPI terms. The real RPI equivalent is likely to be around 100bps lower than this, based on our 3% RPI inflation estimate and the Bank of England's 2% CPI inflation target. This would reduce the real RPI TMR to 5-6%.

E.2.6. Adjusting for one-off factors

If we consider that long-term historic averages no longer provide a good indication of future returns, alternative evidence could be used. In the RIIO-ED1 networks decision on equity returns,

[99] Real estimates based on DMS' use of blended inflation indices.

Ofgem remained open to prospective market returns differing from historic achieved returns due to a structural break in conditions. A similar conclusion could be reached if Ofgem placed weight on the hypothesis put forward by DMS that equity investors in the 20th century may have benefitted from higher than expected returns; this was referenced by Ofgem in their RIIO-ED1 equity returns consultation.

As noted in the main body of this report, PwC, in advising Ofwat for PR19, assume future returns are 40bps lower than historic returns due to one-off factors. DMS, in adjusting for non-repeatable factors assume up to 150bps difference in the future expected return for a globally diversified equity investor relative to the corresponding arithmetic mean return[100].

E.2.7. Calibrating DGM evidence

One of the most commonly used sources of forward-looking return expectations is the DGM.[101] This can be used to estimate a total equity market return based on the current dividend yield and expectations of macroeconomic growth. A single-stage model involves one fixed macroeconomic growth assumption, while multi-stage models involve varying macroeconomic growth assumptions.

Ofwat's proposed PR19 methodology consultation in July 2017 suggested this would be a key piece of forward-looking evidence in setting a total market return and this was confirmed with the PR19 Final Methodology in December 2017. The approach used by their consultants, PwC and Europe Economics, involves the use of a multi-stage model, whereby the macroeconomic growth rate for five years is based on short-term forecasts, with a long-term growth estimate used thereafter. We have applied the same DGM framework to increase consistency between the UK regulators. However, the DGM is sensitive to input assumptions which change based on prevailing forecasts, causing differing DGM results at different points in time. When using a DGM approach, care needs to be taken that the estimates are appropriate.

The Bank of England have recently updated their approach to estimating the DGM. The change incorporates share buybacks and is considered to better capture variation in risk-free rates across maturities and to capture variation in long-term growth expectations[102]. Our DGM estimates and those employed by PwC for Ofwat also include share buybacks.

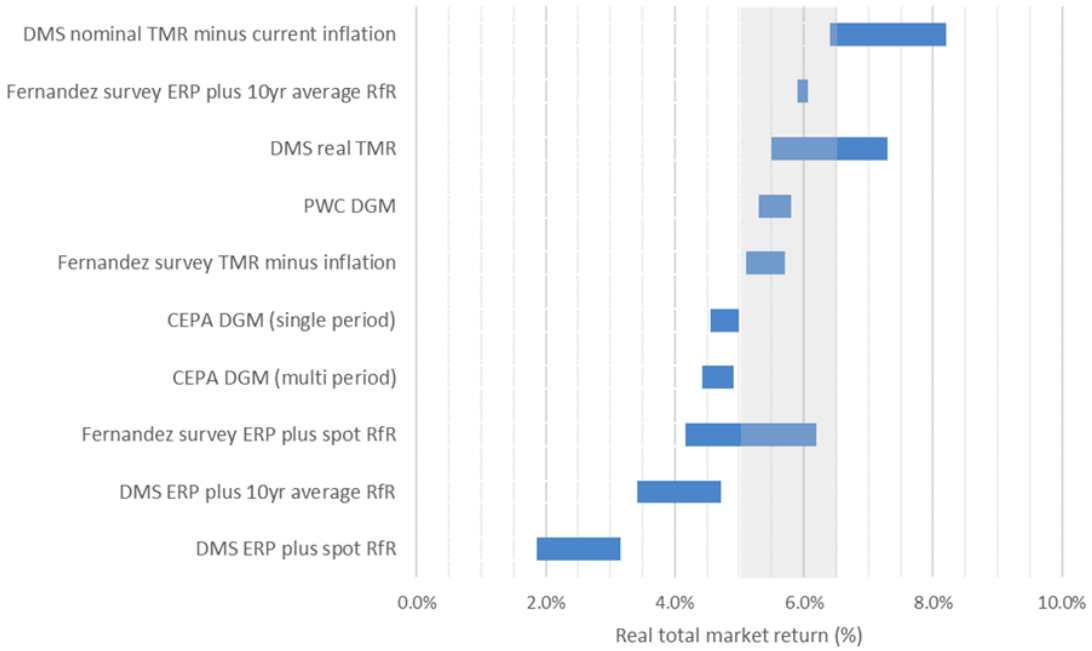
E.3. Evidence used in estimating the TMR range

The discussion above alluded to the fact that there are several different approaches to determining market expectations for the total equity market return. We now present some of

[100] DMS (2017), Credit Suisse Global Investment Returns Yearbook 2017, p37
[101] Or Dividend Discount Model (DDM)
[102] Bank of England (2017) An improved model for understanding equity prices, Dimson & Rattan, 16 June 2017

these various approaches and their corresponding values in the figure below. These sources incorporate both long term historic evidence of equity returns and forward-looking market expectations (presented on a real basis). Descriptions of these sources can be found in Table E.4 below the figure.

Figure E.7: Sources of evidence for estimating the real total market return



Source: CEPA analysis of Bloomberg, PwC, DMS, Fernandez and Bank of England data

The figure above has highlighted the DGM models as particularly relevant for Ofgem's future determinations of total market return. More detail on the appropriate selection within this range of evidence is discussed in the main body of the paper.

Table E.4: Description of total market return sources

Source	Description
Nominal TMR (DMS) minus current inflation estimate	Total market returns sourced from the Dimson Marsh and Staunton Credit Suisse Global Investment Returns Yearbook 2017 for nominal equities from 1900 to 2016. The geometric mean forms the lower bound at 9.4% and the arithmetic mean forms the upper bound at 11.2%. Our current inflation estimate is subtracted from this.
Real TMR (DMS)	Total market returns sourced from the Dimson Marsh and Staunton Credit Suisse Global Investment Returns Yearbook 2017 for real equities from 1990 to 2016. The geometric mean plus inflation assumption forms the lower bound at 5.5% and the arithmetic mean forms the upper bound at 7.3%. This is lower than the nominal TMR minus current inflation estimate above, for which historic inflation over this period has been 4.1%.

PWC DGM	A multi-stage dividend growth model that captures both short-term expectations of future dividend growth and long-term expectations of future dividend growth, including a provision for buybacks. The lower bound of 8.3% relates to the spot DGM from March 2017, while the 8.8% upper bound refers to the five-year average DGM output. We then adjust for expected inflation.
ERP (Fernandez survey) plus 10 year avg RFR	The Fernandez study surveys finance and economics professors, analysts and managers from 41 countries on their expectations for risk free rate and market risk premium. The lower bound of 8.1% is taken directly from the survey results for MRP and risk free rate of 5.9% and 2.2%, respectively while the upper bound of 8.5% is taken from the survey results of the MRP of 5.9% and the one-year average gilt yield of 2.6%. We then adjust for expected inflation.
CEPA DGM (single period)	A single-stage dividend growth model that captures expectations of constant future dividend growth, including a provision for share buybacks. The lower bound of 7.5% uses current dividend growth and an expected constant growth rate. We then adjust for expected inflation.
CEPA DGM (multi period)	A multi-stage dividend growth model that captures both short-term expectations of future dividend growth and long-term expectations of future dividend growth, including a provision for buybacks. The lower bound of 7.4% reflects the latest spot rate estimate while the 7.9% upper bound of represents the two-year average DGM output. We then adjust for expected inflation.
ERP (Fernandez survey) plus pot RFR	The Fernandez study surveys finance and economics professors, analysts and managers from 41 countries on their expectations for risk free rate and market risk premium. The lower bound of 7.3% is taken from the survey MRP plus the spot gilt yield of 1.4% while the upper bound of 8.1% is taken directly from the survey results for MRP and risk free rate of 5.9% and 2.2%, respectively. We then adjust for expected inflation.
ERP (DMS) plus 10yr avg RFR	Nominal premiums of equities vs. bonds sourced from the Dimson Marsh and Staunton Credit Suisse Global Investment Returns Yearbook 2017 for real equities from 1990 to 2016. The geometric mean of 3.6% plus ten-year average gilt yield of 2.6% forms the lower bound at 6.2% and the arithmetic mean of 4.9% plus 10 year average gilt yield of 2.6% forms the upper bound of 7.5%. We then adjust for expected inflation.
ERP (DMS) plus spot RFR	Nominal premiums of equities vs. bonds sourced from the Dimson Marsh and Staunton Credit Suisse Global Investment Returns Yearbook 2017 for real equities from 1990 to 2016. The geometric mean of 3.6% plus the spot gilt yield of 1.4% forms the lower bound at 6.2% and the arithmetic mean of 4.9% plus the spot gilt yield of 2.6% forms the upper bound of 7.5%. We then adjust for expected inflation.

Source: CEPA analysis of Bloomberg, PwC, DMS, Fernandez and Bank of England data

Different combinations of these sources may be used for various regime decisions depending on their specific characteristics.

ANNEX F OVERVIEW OF CEPA DGM

The outputs from a DGM approach are sensitive to the inputs used. As such, the development of a DGM only provides an answer based on what is assumed in the first instance. As noted above, both PwC and Europe Economics present DGM evidence in their work for Ofwat on the cost of equity. The CEPA DGM is very similar in its specification to these models, although usually slightly different input assumptions for the model.

F.1. Framework

We consider that the framework set out by PwC and Europe Economics, namely using short-term growth rate forecasts for five years and then switching to a long-run growth estimate, is an appropriate starting point. We focus on a UK stock exchange, the FTSE All Share index, together with expectations of GDP growth rate in the UK. This approach is consistent with PwC and Europe Economics. GDP growth is often used as a proxy for dividend growth and are often seen as being better than analyst estimates that are more prone to optimism bias. Our DGM is in nominal terms and the outputs are representative of a TMR, as is the case for the PwC and Europe Economics DGM specifications. The model outputs are semi-annual.

F.2. Basis for assumptions

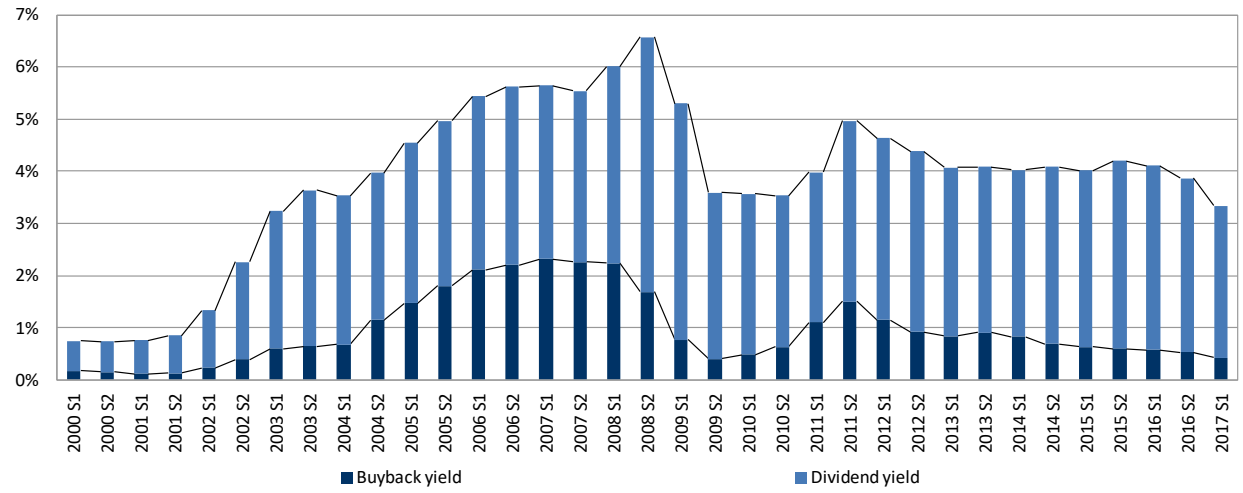
There are three inputs used in our multi-stage DGM:

The *current dividend yield* is based on the dividend itself and also the share buyback. This represents a source of additional shareholder returns and is used in the updated Bank of England model[103]. The inputs from Bloomberg are shown below[104].

[103] W. Dison and A. Rattan, Bank of England (2017). An improved model for understanding equity prices.

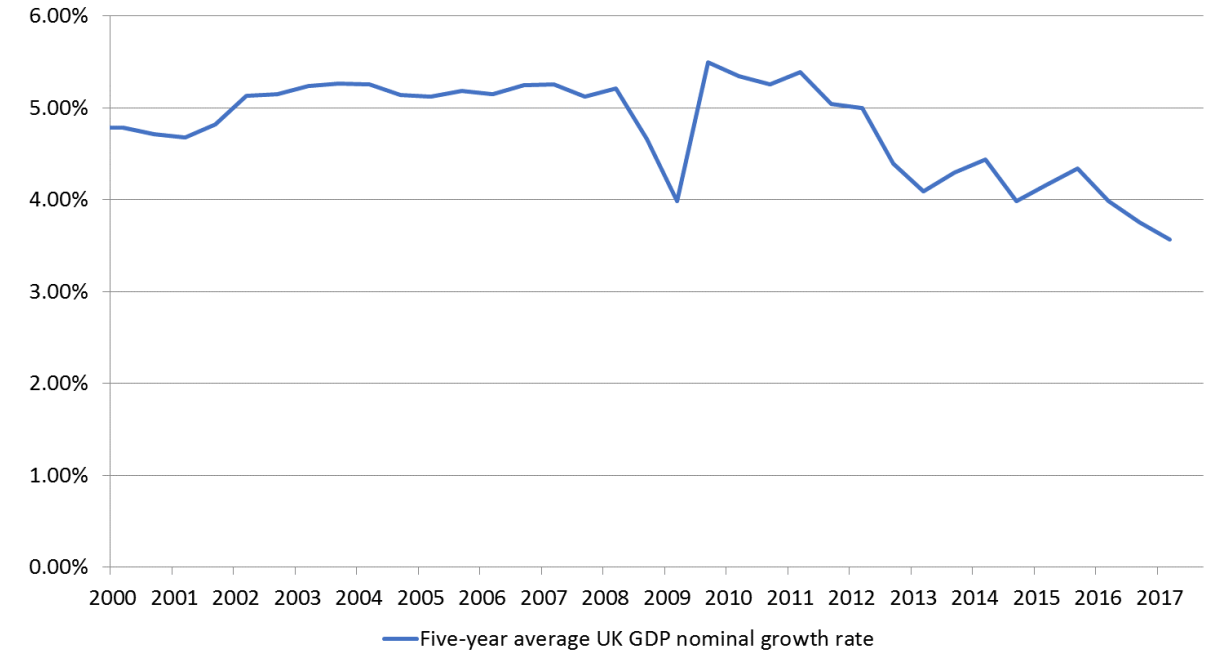
[104] The Bloomberg data used is based on a template that calendarises (i.e. smooths) equity repurchases and dividend yields. This approach maximises data availability and reduces the impact of different companies operating on different financial years.

Figure F.1: Dividend yield used in CEPA model



The *short-term growth rates* are taken from the Office of Budget Responsibility's (OBR) Economic and Fiscal outlook projections. We take the average growth forecasts over the coming five-year period for our short-term growth rate estimate.

Figure F.2: Short-term GDP growth rates used in CEPA DGM analysis



Source: OBR

Finally, the *long-term growth rate* inherently entails a degree of subjectivity. The latest OECD GDP growth rate estimate to 2060 averages just 2.20%[105], while a historic nominal growth

[105] OECD (2017). GDP long-term forecast (indicator). doi: 10.1787/d927bc18-en (Accessed on 25 November 2017)

estimate since 1949 would give a 7.94% long-term growth rate[106]. Our preference is to utilise a real growth estimate and apply a suitable inflation figure - we consider that historic periods with very high inflation skew the results. We use real UK GDP growth from 1950-2016 to give us a real growth rate of 2.5%[107]. This has been deflated by a mix of Consumer Price Inflation (CPI), Producer Price Inflation (PPI) and Services Price Inflation. Historically speaking, GDP growth has been higher than dividend growth for UK stocks, which means that using GDP growth is likely to over-estimate the cost of equity. We consider that using the Bank of England's 2.0% CPI target is appropriate for arriving at a long-term view of nominal growth. This gives us a long-term nominal growth assumption of 4.5%.

[106] CEPA analysis of ONS dataset, GDP at market prices, current prices, seasonally adjusted.
[107] CEPA analysis of ONS dataset, GDP, chained volume measure (CVM)