Europe Economics

PR19 — Initial Assessment of the Cost of Capital

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1 Introduction

Europe Economics has been commissioned by Ofwat to provide advice on the Weighted Average Cost of Capital (WACC) for the regulated UK water companies in the context of the upcoming price review (PR19) determining prices for 2020-25.

This report provides our current view as to the ranges, for each of the WACC parameters, within which a regulator might reasonably exercise judgment[1] and our current recommendations for point values.

1.1 PR19 recommendation

Table 1.1 summarises Europe Economics' recommended values for WACC and its components for PR19. The estimates are provided in real, nominal and RPI-deflated terms, where nominal figures are obtained by inflating the real figures by 2 per cent CPI inflation, and RPI-deflated figures are obtained by deflating the nominal figures with 3 per cent RPI. See Section 2.3.1 for a discussion regarding the distinction between real, nominal and RPI-deflated terms, and Chapter 3 for evidence regarding inflation.

Table 1.1: Europe Economics' recommendations for PR19

	Formula	Real			Nominal			RPI-deflated		
		Low	Point	High	Low	Point	High	Low	Point	High
Notional gearing (47)	A	60%	**60%**	60%	60%	**60%**	60%	60%	**60%**	60%
Cost of equity										
Risk-free rate (27)	B	-0.29%	**0.00%**	0.50%	1.70%	**2.00%**	2.51%	-1.26%	**-0.97%**	-0.48%
Total market return (42)	C	6.25%	**6.75%**	7.00%	8.38%	**8.88%**	9.14%	5.22%	**5.71%**	5.96%
Equity risk premium	D	6.54%	6.75%	6.50%	6.68%	6.88%	6.63%	6.48%	6.68%	6.44%
Unlevered beta (58)	E	0.30	**0.30**	0.30	0.30	**0.30**	0.30	0.30	**0.30**	0.30
Debt beta (59)	F	0.15	**0.125**	0.10	0.15	**0.125**	0.10	0.15	**0.125**	0.10
Asset beta (60)	G	0.37	**0.36**	0.35	0.37	**0.36**	0.35	0.37	**0.36**	0.35
Re-levered (equity) beta (60)	H = (G – F * A) / (1 – A)	0.71	**0.72**	0.72	0.71	**0.72**	0.72	0.71	**0.72**	0.72
Overall cost of equity (post-tax) (61)	I = B + D * H	4.35%	**4.86%**	5.18%	6.44%	**6.96%**	7.28%	3.34%	**3.84%**	4.16%
Cost of debt										
Cost of new debt (75)	J	1.32%	1.57%	1.79%	3.35%	3.60%	3.83%	0.34%	0.58%	0.81%
Cost of embedded debt (71)	K	2.32%	2.84%	3.19%	4.37%	4.90%	5.25%	1.33%	1.84%	2.18%
Proportion of new debt in total debt (68)	L	30%	30%	30%	30%	30%	30%	30%	30%	30%
Overall cost of debt (pre-tax) (77)	M = (1 – L) * K + L * J	2.02%	**2.46%**	2.77%	4.06%	**4.51%**	4.82%	1.03%	**1.47%**	1.77%
Appointee WACC (vanilla)	**N = A * M + (1 – A) * I**	**2.96%**	**3.42%**	**3.73%**	**5.01%**	**5.49%**	**5.81%**	**1.96%**	**2.42%**	**2.73%**

Note: The calculations of the above figures were done with higher precision than two decimal places, and thus those figures do not always follow from other figures as presented in this table due to rounding. See the definition of "real returns" on page 14 (Section 2.3.1).
Source: Europe Economics.

In addition, we propose the retail margin to be 1.0 per cent (see Chapter 14).

[1] We note that we are defining a "range" in this document, not as the full range of possible outcomes but, instead, as the range within which we believe a regulator might exercise reasonable discretion. Our "ranges" for individual parameters and the overall WACC should be interpreted in this light.

1.2 Structure of the report

The remainder of this report has the following structure:

- Chapter 2 Background — provides a high-level overview of key macroeconomic and regulatory developments since PR14 (Section 2.2), and a discussion on key methodological issues (Section 2.3);
- Chapter 3 Inflation — provides evidence on three measures inflation (RPI, CPI and CPIH);
- Chapter 4 Risk-Free Rate — provides an estimate of the risk-free rate, including an adjustment for the expected rise in interest rates;
- Chapter 5 Total Market Return — provides an estimate total market return using Dividend Growth Model and Market-to-Asset Ratio model;
- Chapter 6 Gearing — provides our analysis of different measures of gearing;
- Chapter 7 Beta — provides our estimates of asset betas, debt betas, and re-levered equity betas;
- Chapter 8 Overall Cost of Equity — provides the overall estimate of the cost of equity for PR19;
- Chapter 9 Cost of Embedded Debt — provides the estimate of the embedded cost of debt based on companies' submissions and iBoxx indices;
- Chapter 10 Cost of New Debt — provides the estimate of the new cost of debt based on iBoxx indices;
- Chapter 11 Overall Cost of Debt — provides the overall estimate of the cost of debt for PR19, including our estimate of the proportion of new-to-embedded debt;
- Chapter 12 Overall WACC — provides the overall weighted cost of capital for PR19;
- Chapter 13 Financeability — provides a high-level financeability analysis;
- Chapter 14 Retail Margin — provides our analysis of net retail margins.

2 Background

2.1 Previous decision — PR14

Ofwat's final determination on the WACC components in PR14 are presented in Table 2.1 below.

Table 2.1: PR14 final determination

	PR14 final determination
Gearing	62.5%
TMR	6.75%
ERP	5.50%
Risk-free rate	1.25%
Asset beta	0.3
Equity beta	0.8
Cost of equity	5.65%
Cost of new debt	2.00%
Cost of embedded debt	2.65%
Ratio of embedded to new debt	75:25
Allowance for debt fees	0.10%
Overall cost of debt	2.59%
Appointee WACC (vanilla)	3.74%
Retail margin	0.90%
Retail margin WACC adjustment	0.14%
Wholesale WACC	3.60%

Source: Ofwat (2014), "Final price control determination notice: policy chapter A7 — risk and reward".

2.2 Key developments since PR14

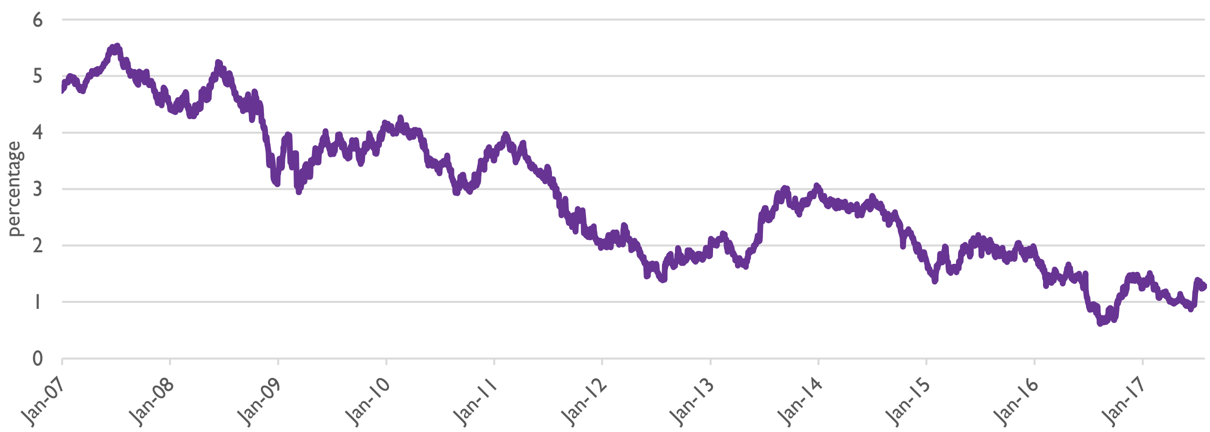
2.2.1 Macroeconomic developments in the UK

A more placid macroeconomic and financial outlook than previously, but subject to risks

Relative to the data period used in PR14 (especially PwC's July 2013 document, where the previous five years of data encompassed the most volatile period in UK economic and financial conditions since the 1920s), the period from 2014 onwards has been much more benign and stable, and the outlook for the next few years is also relatively stable (though subject to considerable uncertainty with respect to the implications of Brexit — as we shall discuss further below).

One way to illustrate this dramatic shift is by considering the yields on UK government bonds over the past ten years. We report those in Figure 2.4.

Figure 2.1: Nominal yield on UK 10-year government bond benchmark



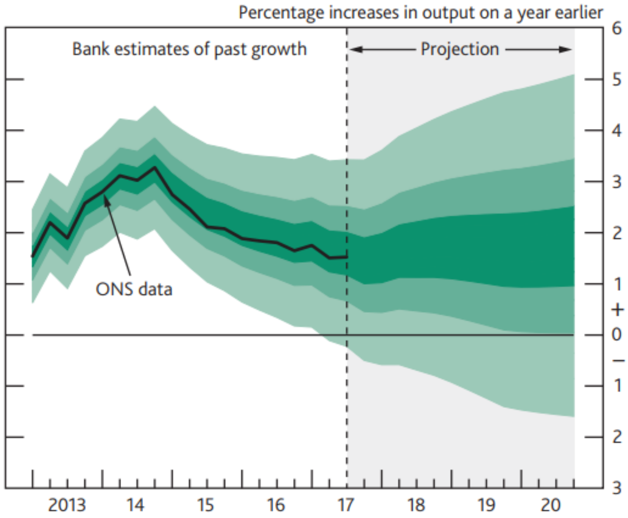
Source: Thomson Reuters.

We can see the volatility in bond yields in 2007 and 2008, with a dramatic cut in late 2008 and early 2009 as Bank of England interest rates were slashed and quantitative easing (QE) was introduced. Then we see a fall then spike up again in yields again in mid-2011 following the US debt downgrade, blow-up in the Eurozone crisis and rising inflation reaching 5 per cent. Then a fall in 2012 as inflation fell back and Eurozone fears eased. By the time the PwC PR14 cost of capital report was completed in July 2013, yields were rising again, but the context was one in which yields were rising but materially lower than they had been only two years earlier and dramatically lower than four and a half years earlier.

As to the current situation, we can see that although current yields are indeed lower again than only a couple of years ago and lower than their five-year average, they sit broadly within (albeit towards the bottom of) a range that has been fairly steady (albeit with some ups and downs), apart from a drop then rise immediately following the EU referendum. Although there has perhaps been a further drift down in yields over the past five years, recent years have been more stable than the equivalent period in the run-up to PR14, allowing us to use recent data to inform our cost of capital estimate in a much more straightforward way this time than was feasible at either PR14 or PR09.

The outlook for the next few years is of a continuing relatively placid macroeconomic and financial backdrop, but with considerable uncertainty as to what may occur at or around the time of Brexit. The following chart gives the latest Bank of England GDP growth forecasts, illustrating the stable outlook to 2020.

Figure 2.2: Bank of England projections for GDP based on market interest rate expectations



Source: Bank of England (2017), "Inflation report", November 2017.

After 2020 the picture becomes much more uncertain. In advance of the EU referendum, most economic analyses forecast that a Leave vote would mean the UK would sacrifice of the order 2-3 percentage points of GDP growth between 2016 and 2020.[2] Confidence in such estimates has eroded as the recession predicted by HM Treasury and 71 per cent of economists in the immediate aftermath of the EU referendum vote[3] has not transpired. There is still a widespread expectation of some Brexit impact, but it is no longer expected to be associated with a significant downturn or recession. For example, the Office for Budget Responsibility expects Brexit to cost the UK more than two percentage points in lost growth by the early 2020s.[4] That view could revert back towards expectations of a recession during the next price control period if, for example, the Brexit negotiations were to result in "no deal".

A further dimension of uncertainty has arisen following the 2017 General Election and the minority government that has been formed. Either factor (or the interplay between them) could result in a significant shift in macroeconomic expectations or in financial conditions during the price review period or in the price control period itself thereafter.

A yet further dimension of uncertainty — that may start to become important at some point in the price control period — concerns interest rates. The US Federal Reserve has already entered an interest rate rising cycle — indeed, on 14 June 2017 it raised interest rates again to 1.00 to 1.25 per cent. In 2015 there were expectations that the UK might mirror US interest rate rises when they came, and indeed, in November the Bank of England increased the bank rate for the first time since March 2009 — from 0.25 per cent to 0.5 per cent (see Figure 2.3). As argued by the Bank of England "In line with the framework set out at the time of the referendum, the MPC [Monetary Policy Committee] now judges it appropriate to tighten modestly the

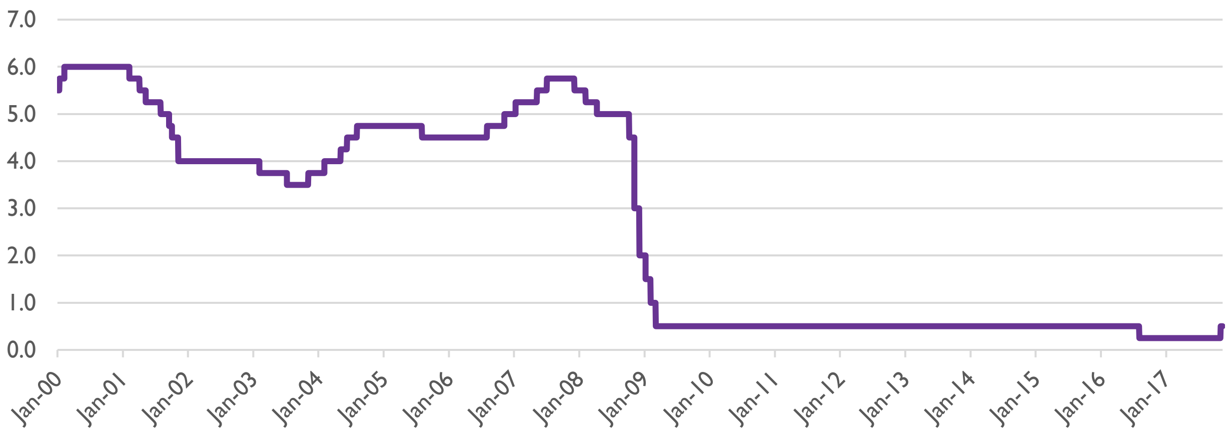
2 See, for example, The Economic Consequences of Brexit: A Taxing Decision, OECD, April 2016.

3 See: Bloomberg (2016), "Get Ready for a U.K. Recession, Interest-Rate Cuts and More QE".

4 See OBR (2017), "Economic and fiscal outlook", March 2017, Table 1.1, p. 9. The November 2017 Economic and fiscal outlook did not change the assessment of the impact of Brexit. However, see later for the OBR's significant updates to its view of productivity growth prospects.

stance of monetary policy in order to return inflation sustainably to the target. Accordingly, the Committee voted by 7-2 to raise Bank Rate by 0.25 percentage points, to 0.5%."[5]

Figure 2.3: Official Bank Rate



Source: Bank of England (series: IUDBEDR).

If further increases to the bank rate occur during the regulatory control period, the process could be relatively smooth, in which case its main implications might be for the cost of debt and perhaps the risk-free rate. But there could also be challenges in maintaining financial stability in a period of rising rates.

Lastly, there is an ongoing debate about the UK and global outlook for productivity, with a significant section of opinion (though as yet by no means a consensus) that the long-term outlook for productivity growth is much weaker than in the past. We discuss this very important issue, and its connection to prospects for the cost of capital, in more detail below[6], but here it is worth noting that the OBR downgraded its expectation for average productivity growth over the next five years by 0.7 per cent per annum (in turn driving a 0.5 per cent per annum reduction in potential output growth).[7]

The macroeconomic situation, and any changes in it between the time of this report and the time of the final PR19 determination, could have a number of implications for the cost of capital. It might affect the cost of equity via implications for the risk-free rate (e.g. if the long-term sustainable growth rate fell or if policy rates were markedly reduced). It might affect the cost of equity via implications for the equity risk premium (if that became either temporarily or permanently elevated). It might affect the optimal level of gearing. It might affect betas (if, for example, the riskiness of other companies in the economy rose because of higher macroeconomic volatility). It might also affect debt premia on new debt (e.g. the baseline for any indexation mechanism).

Evolution of GDP, inflation and real interest rate

Figure 2.4 shows the evolution of the UK's real Gross Domestic Product since 2007, including the forecasted growth for the period 2017-2022 based on the latest IMF World Economic Outlook (April 2017), and for

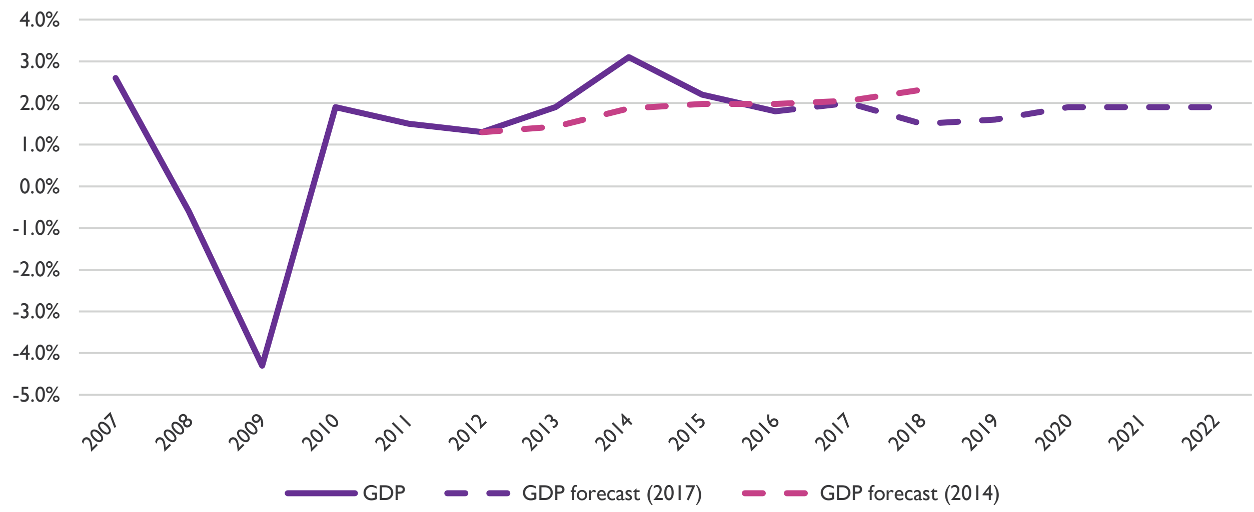
5 Bank of England, "Monetary Policy Summary, November 2017".

6 See Section 2.3.2.

7 See Table 3.1 of OBR, Economic and Fiscal Outlook, November 2017.

the period 2014-2019 based on the IMF World Economic Outlook from October 2013. As of 2021, GDP is expected to grow at 1.9 per cent.

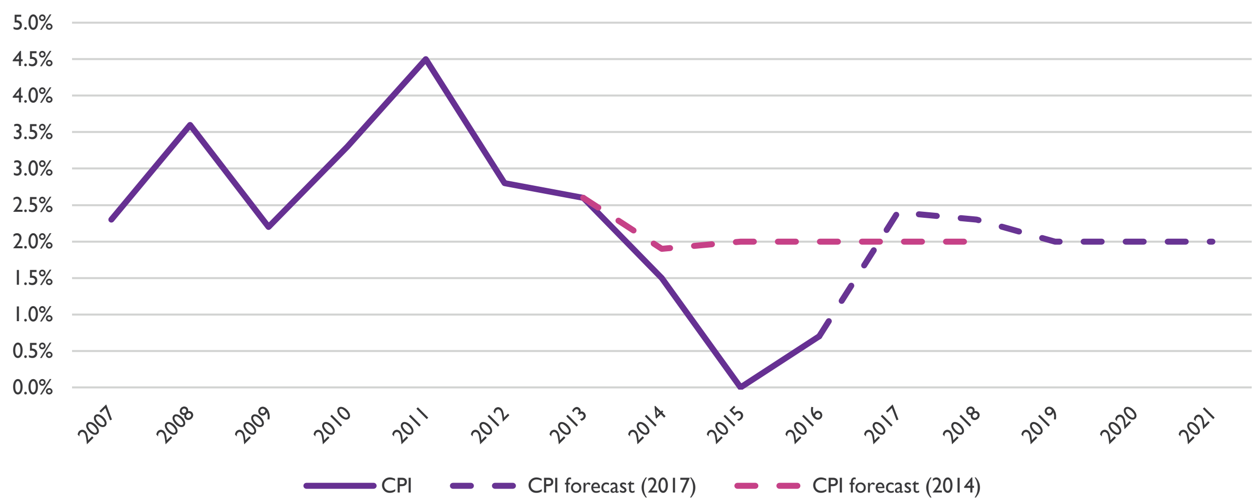
Figure 2.4: UK real GDP growth rate



Source: IMF, "World Economic Outlook" (2013, 2017).

Figure 2.5 shows the evolution of UK's inflation measured by Consumer Price Index (CPI). The dashed part of the line is based on Office for Budget Responsibility's forecasts as of 2017 (purple line) and as of 2014 (pink line). CPI is expected to be 2 per cent in 2021.

Figure 2.5: UK inflation (CPI)

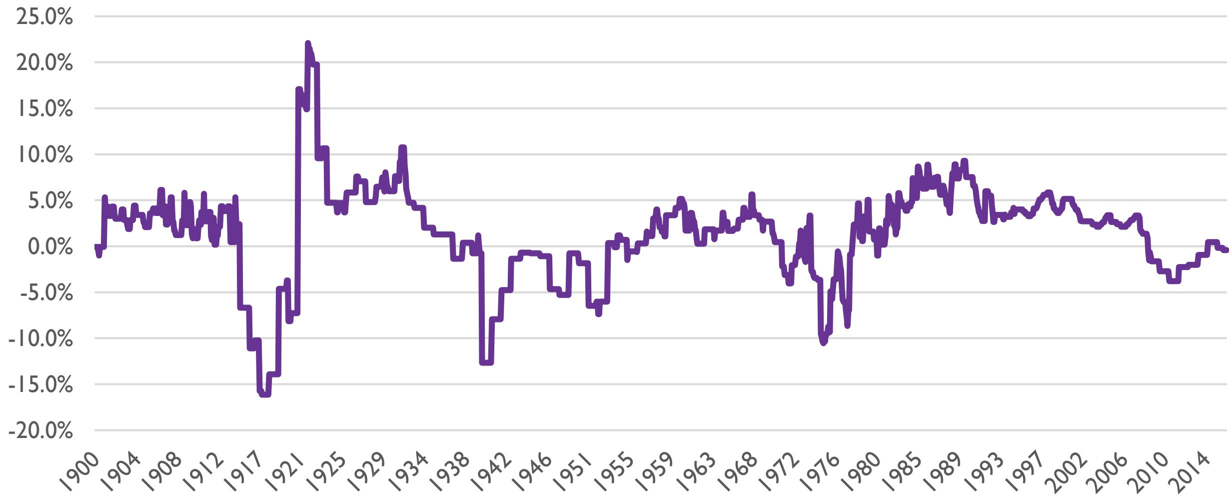


Source: ONS, OBR (2014, 2017).

To understand recent macroeconomic developments as part of a broader picture, Figure 2.6 shows the real interest rate in the UK since 1900. The Bank of England has recognised four low interest regimes in that period: the late 1910s, the 1930-40s, the 1970s and the current post-financial crisis period.[8]

8 Bank of England (2017), "Real interest rates and risk". As to longer-term risks to the upside, a recent Bank of England study has noted that the current "real bull market" in bonds is, at 34 years in duration, the second longest since the thirteenth century, and that bond market reversals and that when bond markets turn, real rate reversals have averaged 315 bps over the first 24 months. — see Bank of England Staff Working Paper 686, October 2017.

Figure 2.6: Real interest rates



Source: Bank of England, 'A millennium of macroeconomics data'.

Figure 2.7 illustrates the evolution of the spread between the average of two iBoxx non-financials indices — one comprising bonds with an A rating, and one comprising bonds with a BBB rating — and the general 10-year UK government bond. We can see that current spreads lie at the bottom of a range that has been in place since mid-2010, and fairly stable over the period except for two periods of temporary elevation (in 2011/2012 and in early 2016).

Figure 2.7: Spread between the average of iBoxx non-financial A and BBB indices and 10-year UK government bond

Source: Thomson Reuters.

2.2.2 Ofwat's methodology for PR19

In "Delivering Water 2020: Consulting on our methodology for the 2019 price review" Ofwat outlined its proposed approach to determining the cost of capital in PR19.[9]

For this current report, Ofwat has highlighted the following key methodological changes:

[9] Ofwat (2017), "Delivering Water 2020: Consulting on our methodology for the 2019 price review".

- implementation of separate controls for network plus, bio-resource, water resource, and retail activities;
- for retail customers that cannot change suppliers, the average revenue controls will be set by reference to a net margin covers earnings before interest and tax;
- the cost of capital for wholesale controls will be set by reference to a notional capital structure;
- cost of new debt will be indexed to an efficient benchmark with fixed allowances for the cost of embedded debt;
- cost of equity will take account of the expected market environment that will persist in 2020-25;
- there will be a transition to CPIH indexation.

Furthermore, in its draft methodology Ofwat concluded that "[c]urrent evidence indicates lower costs of both debt and equity and so we expect the return on capital or base returns to be lower for PR19."[10]

2.3 Key methodological issues

Assessing Weighted Average Costs of Capital (WACCs) for water sector for PR19 requires engaging with a number of fairly involved methodological issues. Some of these will most naturally be addressed in the technical sections below where they arise, but some of a more general nature are best considered separately, and that is what we shall do in this section.

Specifically, here we shall consider the following, interlinked issues:

- What does "real" mean, both in the interpretation of historic evidence and in the production of an assessment of real returns over the forthcoming price control period? (Section 2.3.1);
- What is the correct weight to give to international versus UK and "past-to-future" as opposed to "present-to-future" methods for estimating total market returns? (Section 2.3.2);
- What is the correct weight to apply to "observed asset" versus "equilibrium concept" approaches to estimating the risk-free rate of return? (Section 2.3.3);
- What is the correct weight to give to "let the data speak" versus "use practitioner insight" methods for estimating idiosyncratic parameters such as the equity beta or cost of new debt? (Section 2.3.4);
- Is the use of present-data-focused "let the data speak" approaches to estimation consistent with the underlying rationale for preferring the Capital Asset Pricing Model over other ways to estimate the cost of capital? (Section 2.3.5).

We shall now consider these questions in turn.

2.3.1 What does "real" mean?

In economic and finance theory, the central motive for investment is understood as the generation of returns that can then be used for consumption. Therefore, the value of returns lies in how much consumption those returns facilitate — i.e. the "real" value of returns.

So far, so straightforward. But in historic or current data the real value of returns is only ever estimated, typically by deflating estimates of nominal returns by estimates of contemporaneous or expected inflation. This, as we shall see, creates a series of challenges for our analysis, affecting:

- the way we infer a real risk-free rate from market data — in particular because in the UK there are no longer any government bonds indexed to an official inflation statistic;
- the way we interpret evidence from further back than the past few years on real total market returns and regulatory precedent on the building blocks of the cost of capital;
- the way we interpret evidence on real returns internationally relative to those in the UK;

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[10] Ofwat (2017), "Delivering Water 2020: Consulting on our methodology for the 2019 price review", page 191.

- the way we analyse the wedge between the real WACC and the RPI-deflated WACC to be applied to different portions of water sector firms' assets;
- the extent to which our results should be seen as a departure from figures used in past regulatory determinations.

Inflation is not measured perfectly for a wide range of reasons, of which three have achieved prominence in recent years.

First, there is the issue that the real consumption value of a given nominal amount of money varies not only with the prices of goods available but also with their quality. For example, if prices are unchanged but quality improves, the consumption value of a given amount of money will rise. This issue has been most widely discussed in the computing sector, where for an extended period improvements in quality were a much more rapid driver of changes in real value than were changes in price (e.g. the quality of a standard personal computer increased enormously whilst its price stayed largely unchanged). This factor led a number of countries to introduce more or less extensive "hedonic adjustments" in their inflation measures, in some years reducing the effective inflation rate by one percentage point or more.

These methodological improvements meant current and future estimates of inflation and real returns were doubtless improved. However, it is far from straightforward to make hedonic adjustments to historic data and the further back in time one goes the less feasible such an exercise becomes. What, for example, should be the correct hedonic adjustment, if any, to apply in the 1920s and 1930s as automobiles, electrical equipment and radio improved, or in the 1950s as household appliances such as washing machines and fridges improved? It is also far from certain that the correct hedonic adjustments over time would be the same in different countries.

A second issue is what is known as the "chain linking" debate. As prices change, relative prices change as well and so does the basket of goods consumed, partly through the evolution of tastes and technology and partly in response to changes in prices, quality and budgets. When we calculate real values and how they evolve over time, should we use the basket of goods at the start of the period, at the end, in each year as we go along, or some weighted combination of these? To take a couple of concrete examples, if we are comparing real returns in 2017 with those in 1900, what weight should one give to changes in the prices of horse fodder or wash-boards, versus changes in the prices of smart-phones or air travel tickets?

In real GDP series this issue has come, in recent years, to be addressed via "chain-linking", whereby the real value of production is calculated each year in the prices of the preceding year and in the prices of the current year, with the two series then combined into a "chained volume measure". By contrast, standard consumer price indices used for estimating headline inflation used a fixed-weights basket that is only updated every few years.

A third key issue illustrating the imperfect nature of inflation measures has been the evolution of what is regarded as the official inflation measure in the UK. For many years, the retail prices index (RPI) was regarded as the best measure of inflation. Even when the consumer prices index (CPI), launched in 1996, started to be used by the Bank of England (BoE) as its official inflation target in 2003, RPI was widely regarded as a superior measure of inflation because of the wider range of products included in its based of goods and services (in particular, because the RPI included a measure of housing costs — often constituting one fifth or more of total costs — of which no measure was included in the CPI). RPI continued for a number of years to be the standard measure used for assessing inflation for the purposes of benefits uprating and in utility regulation.

As well as differences in the basket of goods and services included, the other important difference between RPI and CPI concerned the mathematical method via which the two series averaged individual price changes into an overall measure of inflation. The RPI series uses arithmetic averaging, whereby price changes in the appropriately weighted products were summed and then divided by the total number of products. To take a stylised case, suppose in an economy there were two products consumed initially in equal volumes, the RPI were 100 in the base year, and the price of one product went up by 25 per cent whilst the price of the other product went down by 20 per cent. Then the RPI in the next year would be $(125 + 80)/2 = 102.5$, so RPI inflation would be 2.5 per cent.

By contrast, CPI inflation is calculated using geometric averaging, whereby the average of a set of N values is obtained by multiplying all the values together and taking the Nth root. Taking our stylised example again to illustrate, if the CPI were 100 in the base year, it would become $\sqrt{125 \cdot 80} = \sqrt{10000} = 100$ in the following year, so CPI inflation would be zero.

These two averaging methods equate to two underlying economic assumptions. The RPI arithmetic averaging method is equivalent to the assumption that as the prices of goods and services change, household do not change their consumption patterns in response. The CPI geometric averaging method is equivalent to the assumption that, as a good's or service's prices change, households change their consumption so as to keep the amount of money spent on each good or service unchanged — e.g. if the price of a good rises by 25 per cent, households consume only four fifths as much of that good.[11]

The assumption of constant amounts of money being spent on goods as prices change is a feature of some simple economic models[12] and is arguably a more realistic assumption in a modern economy in which most goods purchased are not necessities and in which consumers can borrow and lend to smooth consumption over time. But it is by no means obvious that the relative merits of an assumption of unchanged consumption versus unchanged expenditure are invariant over time — e.g. that the RPI method would have been equally as worse an assumption in, say, 1900 as it was in 2017. Indeed, it is at least arguable that the relative merits of the CPI method have increased markedly over the past century or so, as more and more households had more flexibility, spending lower proportions of their total budgets on necessities, more able to store products and more able to borrow and lend to smooth consumption as financial markets developed. To over-state the point for simplicity, perhaps the RPI method was best in 1917 and the CPI method best in 2017?

To make matters worse, neither RPI nor CPI data is available for the full span of time series often considered in assessing historic real returns for cost of capital purposes (back to 1900 or earlier), and other estimates are used instead. Furthermore, the averaging methods used in different countries are not equivalent, creating difficulties in cross-country comparisons. Given vast international and over-time differences in inflation rates during the more-than-a-century of data typically considered in long-run total market return analysis, ignoring inflation and attempting to focus purely on nominal returns is not a viable alternative, either.

This issue has been further complicated in recent years by the interplay between the RPI's averaging method and methodological changes in the gathering of data in the early 2010s, which led to a sudden jump in the "wedge" between the outcome of using the RPI and CPI averaging methods. This led to a statistical inquiry in the UK which resulted in RPI being de-designated as an official statistic. Subsequently, the UK's Office for National Statistics (ONS) has put additional effort into developing a variant of the CPI that did include housing costs, to improve its coverage — the CPIH. This CPIH has now become the ONS' official headline measure of inflation, as will be the new measure Ofwat transitions to in its own inflation uprating mechanisms. However, CPIH is as yet available only for a relatively short time period and there are few estimates available of how it will evolve in the future.

Despite RPI no longer being an official inflation measure and despite its accuracy as an estimate of inflation being likely to have been unstable over time, the UK government's index-linked bond series remains RPI-linked and (despite a consultation having been conducted on doing so), the UK's debt management office has as yet issued no CPI-linked bonds. That means that the standard data used to estimate "inflation expectations" from the wedge between nominal bond yields and inflation-linked bond yields is all based on RPI expectations.

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11 $1.25 \cdot 4/5 = 1$.

12 Technically-minded readers might observe that this will, for example, be a consequence of log utility functions.

To summarize the conclusions of this section:

- economic and finance theory teach us that it is the real, not nominal value of returns that should count for WACC assessment;
- real values can only be assessed using some estimate of inflation;
- inflation is measured only imperfectly, and the degree of imperfection is unlikely to have been constant over time;
- inflation is measured differently in different countries and the merits of different inflation measures are unlikely to be exactly the same in different countries, meaning cross-country comparisons are unlikely to involve consistent imperfections in inflation measurement;
- the longer-term time series and standard inflation expectations data available in the UK are all based on a measure of inflation that the ONS deems does not meet best practice standards and that is widely acknowledged to not be stable over time;
- international variations and movements over time in inflation mean it is unlikely to be feasible to base assessments only on nominal returns, despite the problems with inflation measurement.

For the reasons set out above, the approach we shall adopt to inflation, to real versus nominal variables, and to the interpretation of real variable evidence historically and internationally, in this report is as follows.

- When interpreting recent or historic data, we shall deflate by the CPI to obtain our best-estimate of real returns.
- We shall base our models on real returns.
- Taking our real estimates, we shall inflate by our estimate of CPIH over the price control period (which we shall take as 2.0 per cent, for reasons explained later) to obtain nominal estimates.
- Taking our nominal estimates, we shall deflate by our estimate of RPI over the price control period (which we shall take as 3.0 to 3.2 per cent, for reasons explained in Chapter 3) to obtain RPI-deflated estimates.

We emphasize that where we use the term "real returns" unqualified in this report, that refers to the consumption value of returns — an underlying economic concept. RPI is not a measure of inflation and RPI-deflated returns are not "real returns" (and we avoid misleading quasi-concepts such as "RPI-real returns"). RPI-deflated returns are simply a calculation device that Ofwat requires in order to perform indexation calculations as part of the price control. RPI-deflated returns are, for example, not comparable to estimates of "world real returns". Neither, given the instability in the implications of RPI methodology that led to the RPI review, can RPI-deflated returns over the forthcoming price control period be directly compared to RPI-deflated returns permitted in past controls. The correct focus for historic and international comparison is on estimates of real returns, not RPI-deflated returns.

Finally, we note that many UK regulators have historically had a policy of calculating a "real" WACC, which was then often inflated using RPI. In a number of our tables below presenting regulatory precedents we take it that such "real" values have typically been equivalent to what we term a RPI-deflated WACC, but that has not always been explicit, as opposed to, say, the real value being in fact an estimate of the real value, such that if RPI was an overstatement of inflation the consequence was that the nominal value was too high (with the real value correct) rather than that the real value was too low (with the nominal value correct). Indeed, in some cases where international evidence has been central to the estimation of the WACC or its components such as the TMR (e.g. the two Smithers and Co TMR studies from 2003, and 2014), there is a good case to be made that the estimates were closer to estimates of truly real returns. Until 2013 it was standard to regard RPI as one (not necessarily inferior) estimate of inflation, so the distinction between a real return and an RPI-deflated return would be unlikely to have been clear in the minds of WACC analysts. Insofar as regulatory precedents were for RPI-deflated values, changes in the wedge between RPI-deflated and real-terms values over time mean that historic RPI-deflated values may not be comparable to currently-assessed figures. One implication is that in considering to what extent our results are comparable to or a departure from past regulatory precedent, it is not always straightforward to determine whether the relevant comparison is

- for past determinations of a "real" WACC, between our "real" values and the "real" values in those determinations, or between our "RPI-deflated" values and the "real" values in past determinations;
- for past determinations of a "nominal" WACC, between our "real" values and the nominal values in those other determinations, deflated by the CPI at the time, between our "RPI-deflated" values and the nominal values in those other determinations, deflated by the RPI at the time, or some other option altogether.

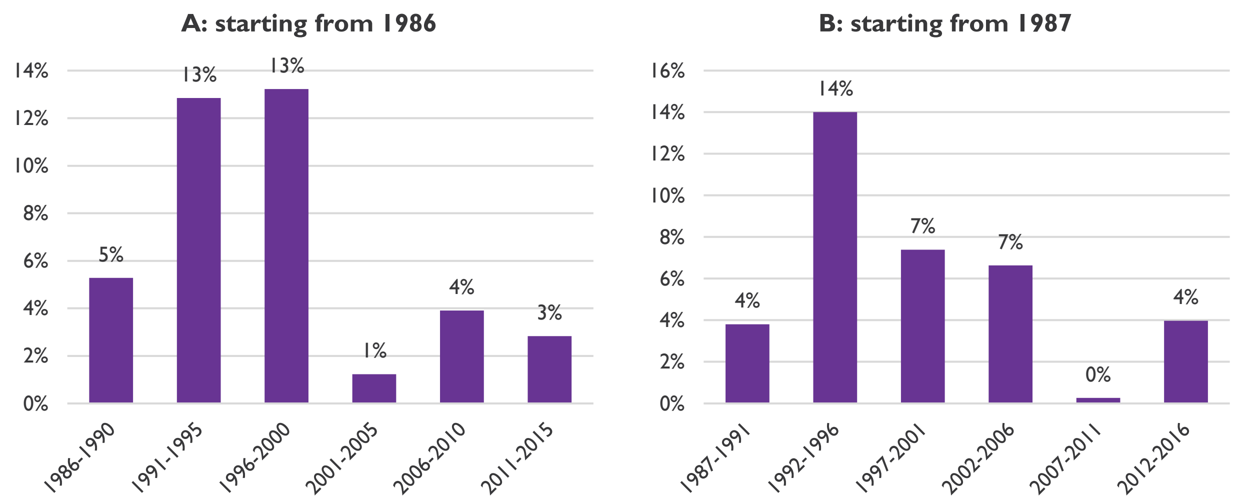
2.3.2 What is the correct weight to give to international versus UK and "past-to-future" as opposed to "present-to-future" methods for estimating total market returns?

Two key concepts in modern finance models are the "risk-free rate of return" and the "total market return". In the next section (2.3.4) we shall consider certain conceptual issues arising for this price review regarding the risk-free return. But first we shall consider a central question regarding the total market return (the return on a portfolio consisting of all assets, typically proxied by the total return on all listed equities or some significant subset thereof). The question concerns what weight to give to different bases for estimating expected future returns.

The total market return, by its nature, includes risky assets. That means that in any one period (e.g. any one year) actual returns will be a poor indicator of expected returns — if returns always turned out as expected, they would not be risky. Even returns over a decade or two may give only a relatively inaccurate indication of what returns were expected at the time investments were made, and measures of average return can be extremely sensitive to the exact period chosen.

For example, Figure 2.8 illustrates how the average returns are affected by the selected period under consideration. Panel A (on the left) shows five-year averages starting from 1986, and Panel B (on the right) shows five-year averages of the same data but starting from 1987.

Figure 2.8: FTSE 100 total 5-year average real returns starting from 1986 (A), and from 1987 (B)



Source: Thomson Reuters, Europe Economics' calculations.

By comparing these two graphs with the data shifted by just one year we can see how sensitive equity returns analysis, even over quite long time periods, can be to minor changes in time period. The message of the chart on the left (starting 1986) might appear to be that something fundamental changed from 2000 onwards, and that we have shifted to an era of much lower returns than was true before that. But the message of the chart on the right — merely a one-year nudge in the window — might naturally be quite different — that returns have been of the order of 4 to 7 per cent for decades with (unsurprisingly) occasional periods higher or lower (1992-1996 and 2007-2011), but with nothing particularly different about recent periods from the more distant past.

Because equity returns data can be sensitive to time window in this kind of way, when analysts use past data to estimate future returns, they have often used very long-run series, so that the realised outturns might capture a significant portion of the total probability distribution of returns that an investor today might be embodying in decisions about the future.

This is sometimes referred to as a "backwards-looking" or "historic" estimation approach, but it is important to grasp a way in which such characterisations are potentially misleading. The purpose of considering past data is as a basis for estimating the future. This is a past-to-future method, not really a "backwards-looking" method as opposed to some alternative "forwards-looking" method.

In our view, the best way to understand consideration of long-term historic data is as a series of independent draws from the probability distribution of returns. If the future distribution of potential returns is the same as that in the past, looking at past data can be regarded as a kind of sampling experiment. If we have a large enough sample of independent draws, we can form a decent statistical model of the underlying true distribution, which we can then use to model the future.[13]

It is also for that reason that the correct way to calculate the expected return from such past data is as the arithmetic average return, because the expected return of a probability distribution is the arithmetic mean.

It is, of course, possible that even with a century of data and even if the distribution of expected returns were stable (see below), the observed outcomes give a biased sample of the distribution of expected outcomes. It is, for example, sometimes argued that returns in the US in the 1950s and 1960s were very high, low probability returns that an investor today would not ascribe anything like a two decades in a century (20 per cent) probability of being repeated in the future.[14]

Furthermore, it has long been recognised, in UK economic regulation, that although a long run of data provides a large sample from which to estimate a probability distribution for future returns, some account may need to be taken of the risk that the expected probability distribution is not stable over time.[15] That could be so because of lasting structural changes (future returns may, over the very long run, be higher or lower than those seen in the past) or because of disturbances (drops or increases in expected returns) that, though temporary, may last over an entire investment cycle. One well-known example of this is that in the period following the 2008 financial crisis, Ofwat and a number of other regulators accepted a temporary

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[13] Suppose, for example, there were a pair of dice where one was unsure how fair they were and hence what number to expect from a throw of those dice. Each throw from the past could be seen as one possibility for the future, and if the same result had occurred some given percentage of the time in the past one might say that was the right expectation for the future as well. If the past throws of the dice can all be seen as independent draws from the dice throwing result probability distribution the expected result of throwing the dice would then be the arithmetic average of all those past throws. In the same way, if past returns can be seen as independent draws from a stable distribution of possible returns (as implied by the Fama's "weak" form market efficiency), a large number of past returns gives us a sample distribution that could be reasonably expected to resemble the actual underlying returns distribution. The expected return is then the arithmetic average of that distribution.

[14] See Fama and French (2002), "The equity risk premium", and Mehra and Prescott (1985), "The equity puzzle".

[15] We note in passing that the use of a long run of data here in no way implies that the regulator is using a "long-term approach" or using "long-term averages". Even if a price control period were only one year, one would still face the issue of how best to estimate what the expected return an investor in the assets acquired in that year would demand.

elevation in Equity Risk Premia (in Ofwat's case their advisors, Europe Economics,[16] proposed a "crisis" premium of 6 per cent versus its "normal time" premium of 5 per cent).[17]

Over a longer timescale, recent years have seen a number of claims for why total market returns might in the future be expected to be systematically lower than those in the past. Greater longevity may change human impatience — we discount the future less if we live longer. Demographic changes might change the equilibrium balance in the population (perhaps older people have different risk appetites from the young, so a society with a much higher proportion of older people might have a different equilibrium risk appetite from a society with more younger people). Others suggest that future technological improvements might lead to less rapid productivity improvements than past improvements. The nature of background risk might change, as the chances of dying in wars or from sudden diseases change, again affecting tastes. Lower population growth might generate fewer positive productivity spillovers. And the public sector debt overhang from large deficits in the 2010-2015 period across much of the developed world might drag down growth over the next fifteen years from what otherwise might have been achieved (even if such growth is, perhaps, faster than in the 2010-2015 period itself).[18]

A further possibility is that it is not so much that the future will not resemble the past but, rather, that the future *will* resemble the longer-term past and instead it is the more recent past that is unusual. This thought draws its moral from the developments in bond market yields over the long term. As we can see in the figure

[16] See Europe Economics (2009), "Cost of Capital and Financeability at PR09".

[17] A variant of this approach might adjust past data to exclude periods for which the future is thought very unlikely to resemble the past. In the case of the UK it is not clear that historic data gives a poor indication of future possibilities, and the experiences of the past decade suggest that episodes that had been thought unrepeatable historical anomalies, such as early 1930s-style banking crises, can turn out to be all too possible in the future. Nonetheless it could be argued that in the UK some historical periods should be excluded, such as perhaps the First World War, the high returns of the 1950s, or the returns of the high inflation period in the 1970s. One particularly well-known case of this is that in the period following major debt crisis, returns can be depressed for a decade or more, as explored in the well-known series of studies by Reinhart & Rogoff (often referred to via the name of their book, *This time is different*). This might, for example, mean that although the historic UK arithmetic mean total market return reports in the DMS dataset is 7.3 per cent, that could over-estimate what returns should have been expected over the past decade and what might reasonably be expected over the next few years.

[18] On a technical point, we note that our discussion assumes that investors have rational expectations, so that their expected returns are the mean of the distribution of possible returns. There has always been a tradition in finance theory of challenging this assumption. However, rational expectations remains the centre-piece of modern finance theory and we shall not rehearse that debate here.

below, the period 1970 to 2000 is quite unusual, historically, and the recent pattern could be seen as a reversion to an older historic norm rather than as a departure from the past.

Figure 2.9: 10 year bond yield

Source: Bank of England, 'A millennium of macroeconomics data'.

These points are controversial, and there is by no means a consensus that, for the indefinite future, growth or returns will in fact be systematically lower than those in the recent or more distant past. For example, the November 2017 Office for Budget Responsibility *Economic and Fiscal Outlook* states: "The sustained weakness of productivity growth… raises the possibility that it may prove more durable, especially since it appears to be a common phenomenon across the advanced economies. In particular, some commentators have argued that the advanced economies have entered an era of more or less permanently subdued productivity growth for essentially structural reasons… we do not find that particular thesis altogether convincing".[19]

Opponents of the above view might reasonably point out that there have been frequent predictions of secular stagnation in the past that came to nothing. The term comes from a speech in 1938 that failed to anticipate the booms of the 1950s. Many gloomy outlooks were produced in the mid-1970s, failing to anticipate the 1980s, 1990s and 2000s booms. Just as in boom periods overly-optimistic prognosticators declare "this time it's different" and boom times can last for ever, so in slower-returns periods those more pessimistic declare "this time it's different" in the negative direction. A third view is that, even if perhaps future returns might be a little lower than those in the past, they will not be as much lower as some of the gloomier analyses claim.

Although there may not be a consensus that for the indefinite future, growth or returns will be systematically lower than in the past, there is more of a consensus that the growth in potential GDP will be lower over the next few years than in the past. For example, the OBR went on, after the section quoted above, to state: "recent experience, allied to the prospect of continued subdued investment and historically-low interest rates, has led us to judge that some of the recent weakness will indeed prove more enduring, at least within our forecast horizon". Accordingly, it cuts its forecasts for potential output growth by 0.4, 0.5, 0.4, 0.6 and 0.6 percentage points for the years 2017 to 2021, respectively. This was associated with a reduction in forecast per capita ouput growth to an average of below 0.9 per cent per annum out to 2022. That compares with an average of around 2 per cent from 1961 to 2016.

A lower (and perhaps further slowing) underlying rate of growth in potential output should be expected to be associated with a lower cost of capital than was true for past periods with higher growth in potential

[19] OBR (2017), Economic and Fiscal Outlook, November 2017, paragraph 3.25.

output. That is a standard result in long-term economic growth models.[20] It can also be understood intuitively, as follows. If, in an economy in equilibrium, government bond yields are very low but economic agents are investing in those bonds nonetheless, that means they must be turning down investment in all other assets, and in particular all other real economy assets (e.g. shares in utilities firms). If we can assume that tastes are stable and that risk has not changed, that must mean the expected return on all other real economy assets is low. If the expected return on all real economy assets is low, then if the share of capital in the economy is stable (i.e. expected returns are not low because labour is taking a heightened share of the value of total output) that must mean expected output is low — i.e. that expected GDP growth is poor. And the converse also applies — if the medium-term rate of growth in potential output rises, we should expect the cost of capital to rise, also.

The above does not imply that no consideration or weight should be given to past-to-future methods of estimating the future distribution of returns. But it may mean that, relative to past reviews in which the consensus on the interpretation of past data in predicting the future was clearer, less weight should be placed on past-to-future methods, since it would be all too easy to over-state returns (if the secular stagnation hypothesis proves correct) or to over-adjust them downwards.

Instead, relatively more weight than in the past might reasonably be given to present-to-future methods, where we use current data or data from the recent past to infer what expected future returns are via returns models such as the Dividend Growth Model (DGM), via analytical methods such as Market-to-Asset-Ratios (MAR) analysis, or via analyst forecasts.[21] That is what we shall do below in Chapter 5.

2.3.3 What is the correct weight to apply to "observed asset" versus "equilibrium concept" approaches to estimating the risk-free rate of return?

What is the "risk-free rate"? In some conceptions it is an underlying equilibrium variable in the economy, like the "natural rate of unemployment", "output gap", or many other economic variables. We cannot observe the natural rate of unemployment or output gap directly. Instead, we use various evidence and models to attempt to estimate or infer them. Those that say the risk-free rate of return should be understood as such an equilibrium concept contend that a range of evidence is relevant to its estimation — often including estimates of the medium-term sustainable growth rate of the economy (since in long-term economic growth models there is an equilibrium relationship between the medium-term sustainable growth rate and the risk-free rate of return).

An alternative approach treats the notion of a risk-free asset as an approximation, with models deploying the idea of a "risk-free rate" as being more or less representative of reality partly according to how close to risk-free some actual asset in fact is. The usual proxy chosen is a government bond. The risk-free rate is then the yield on this observed asset.

The great advantages of this observed asset approach are its concreteness and its simplicity. The interpretation of the risk-free rate of return is straightforward — it is the yield on *that* asset. And the process of measuring the risk-free rate is simple — it is simply a matter of obtaining the relevant yields.

Two key disadvantages of the observed asset approach are as follows. First, it means that to whatever extent the government bond is materially non-risk-free, the Capital Asset Pricing Model (CAPM) or other models involving the risk-free rate will produce flawed results. But it is by no means obvious why the CAPM could not have been used in, say, Ireland or Greece or Spain in 2012. Perhaps the idea in that case is that some

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20 For example, in the Ramsey-Cass-Koopmans model, in equilibrium the risk-free rate of return and the growth rate of potential output are positively correlated.

21 We acknowledge that the use of present-to-future models is controversial. For example, the Smithers & Co (2014) study for Ofgem stated "There is…no straightforward, systematic, transparent and replicable way of incorporating "recent evidence" into estimates of the market cost of equity."

other bond would serve as the "observed asset", but it is by no means obvious why the CAPM requires there to be any one asset that is near-risk-free (as opposed to, say, a risk-free asset being able to be constructed from a mixed portfolio of other assets).

Second, there is no guarantee in theory or practice that an approximately risk-free asset will provide an approximately risk-free return. That will in particular not be the case if a material portion of purchases of the asset are by agents not seeking an investment return.

For that reason, if a significant portion of the marginal purchasers of a government bond do not buy it in order to secure an investment return, its yield cannot straightforwardly be interpreted as a quasi-risk-free rate of return.[22] That might be relevant if, for example, those purchasing government bonds did so in order to inject broad money into the economy (e.g. if the purchasers were central bank buyers) or if they were holding bonds to meet regulatory requirements (e.g. Basel rules).

For such reasons, in many recent regulatory determinations relatively low weight has been placed upon up-to-date government bond yields in assessing risk-free rates. Absent an alternative robust basis for risk-free rate estimation, regulators have often used long-term (say, ten year) averages of yields. It is far from clear that such averages provide any meaningful basis for risk-free rate estimation. Why would we imagine that an average of, say, 0.5 per cent, over a period in which inflation-adjusted yields might have fallen from 2.5 to -2 per cent, would give any robust basis for estimating the current risk-free rate? Why, for example, is such an average a better assumption that assuming the 2.5 per cent level is correct and all of the fall is induced by the purchaser motivation distortion, or that -1 per cent is correct and there is a 1 per cent negative distortion induced by purchaser motivations? The use of averaging appears entirely arbitrary and heavily dependent upon the averaging period chosen.

Whilst in other circumstances the argument from market distortions such as QE would be decisive and if we were simply attempting to estimate the risk-free rate for its own sake, government bonds would not be a good indicator (and indeed we ourselves have used other methods in other contexts), it is by no means obvious that the errors from other techniques for estimating the risk-free rate would not end up being larger, in an overall assessment, than the error in assessing the risk-free rate from government bonds. In addition, here, in particular, the use of an observed-asset approach is the natural partner of a "let the data speak" present-to-future approach to estimating the total market return. We therefore believe that in this case there are advantages in being consistent — despite all the well-made points of objection that can be raised. We have an asset. We believe it near risk-free. We can observe its yield. Let's use that.

2.3.4 What is the correct weight to give to "let the data speak" versus "use practitioner insight" methods for estimating idiosyncratic parameters such as the equity beta or cost of new debt?

Given that, drawing on the above, we will use a heavily latest-data-driven approach to estimating the total market return and the risk-free rate, it is natural to apply this approach consistently in other parts of the price control also.

For example, in UK regulatory analyses there have been two approaches commonly taken to the estimation of the cost of new debt. In one, the "debt premium approach", the cost of new debt is decomposed into a risk-free rate and a debt premium. The debt premium is then added to the risk-free rate estimate to provide the estimate for the cost of new debt. In the other, "all in cost of debt approach", the cost of new debt is estimated directly from the yields on relevant bonds. In more stable periods with more certain data, there

[22] Furthermore, since government bonds are both a non-trivial portion of capital and a benchmark for other assets such as bonds or mortgages, a deviation in returns created in this way will spill over into returns on other assets. Indeed, this was precisely one of the secondary motivations for QE — an attempt to reduce bond yields on other assets.

are methodological advantages in the debt premium approach (and it is what we would normally advocate), but in this setting where we are more data-driven and less intuition, theory, historical context, and precedent-driven, we believe it is better to use an all-in cost of debt approach.

2.3.5 Is the use of present-data-focused "let the data speak" approaches to estimation consistent with the underlying rationale for preferring the Capital Asset Pricing Model over other ways to estimate the cost of capital?

One of the main merits of placing heavy weight upon the CAPM in regulatory cost of capital analysis is that it allows for intuitive engagement by non-statistically-minded or finance-literature industry practitioners, allowing a deeper pool of wisdom, insight and information to be gathered and deployed in setting a cost of capital over the many months of a price review. A key drawback, therefore, of a heavily present-data-focused "let the data speak" approach to cost of capital analysis is that it risks excluding precisely that wisdom, insight and information that was supposed to be the key merit of using the CAPM.

We acknowledge that this is indeed an issue here, though there would still be an important role for this industry insight to assist in reality-checking results and in selecting the final determined value of parameters from within recommended ranges.

In our view, this issue — though real — does not justify shifting away from the CAPM as the central model. It may, however, mean that slightly more weight should be placed upon cross-check models in this price review than has sometimes been the case in the past.

Another methodological issue here is related to the consistency of the time horizon chosen for estimating different CAPM components. One potential criticism of approaches taken by or proposed to regulators in recent years, whereby risk-free rate estimates should be based on long-term averages is that this is inconsistent with the way betas are calculated. Specifically, the use of longer-term windows might have tended to raise risk-free rate estimates, but the use of similarly longer-term windows for beta estimation would have depressed beta estimates — yet this was rarely noted. Instead, there was a danger of cherry-picking inconsistent methodologies that would lead to higher answers.

By the same logic, since in our approach we use up-to-date gilts market figures for estimating the risk-free rate, this implies that we should use recent windows of high frequency (e.g. daily) data to assess the systematic component of equity returns.

One further point to note is that, because we are heavily focused on letting the latest data speak, in what follows we make no reference to past regulatory precedents for the risk-free rate, the cost of debt, the overall cost of equity or the overall cost of capital as these have little to no weight in our analysis.[23]

[23] We do, however, refer to regulatory precedent for the total market return, the gearing, for the unlevered beta and for the debt beta, for the reasons explained below in Sections 5.2, 6.3, 7.2.1 and 7.2.2.

3 Inflation

3.1 Approach

There are three main measures of inflation which need to be considered for this report, i.e. CPI, CPIH and RPI. All three capture monthly changes to the level of prices of consumer goods and services in the UK, however each is based on a slightly different set of goods and services. In particular, as explained by the ONS, "[t]he most significant differences in coverage relate to the treatment of housing costs, particularly owner-occupier costs, which are included in CPIH and RPI but excluded from the CPI. There are also differences in the population covered, RPI covers only private households but excludes the top 4% of households by income and pensioner households who receive at least three-quarters of their income from benefits. The CPIH and CPI, by contrast, cover the expenditure of all private households, institutional households and visitors to the UK".[24]

The relevance of each of these measures is as follows:

- CPIH — CPIH was designated by the UK Statistics Authority as a National Statistic[25] and was recommended to become the main measure of inflation.[26] Ofwat has also indicated that it intends to change its approach and consider CPIH (rather than RPI) to be the relevant measure of inflation.
- CPI — is currently the benchmark set for the Bank of England in its inflation targeting. Until the Office of Budget Responsibility (OBR) starts developing CPIH forecasts,[27] CPI continues to be the best approximation of future CPIH levels.
- RPI — a majority of the industry's inflation-linked instruments as well as government bonds continue to be linked to RPI rather than CPI or CPIH. RPI is not, however, an official inflation statistic and has been de-designated as a national statistic since 2013, with the National Statistician concluding that the formula used to produce the RPI does not meet international standards.

Below we present the evidence which informed our inflation assumptions. In particular, the evidence capture:

- the past evolution of CPI, RPI and CPIH;
- the relationship between those three measures; and
- CPI and RPI forecasts until 2021.

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24 ONS (2017), Quality and Methodology Information (QMI): Consumer Price Inflation (includes all 3 indices — CPIH, CPI and RPI).

25 UK Statistics Office (2017) Letter from Ed Humpherson, Director General for Regulation: "National Statistics status of Consumer Prices Index including Owner Occupiers' Housing".

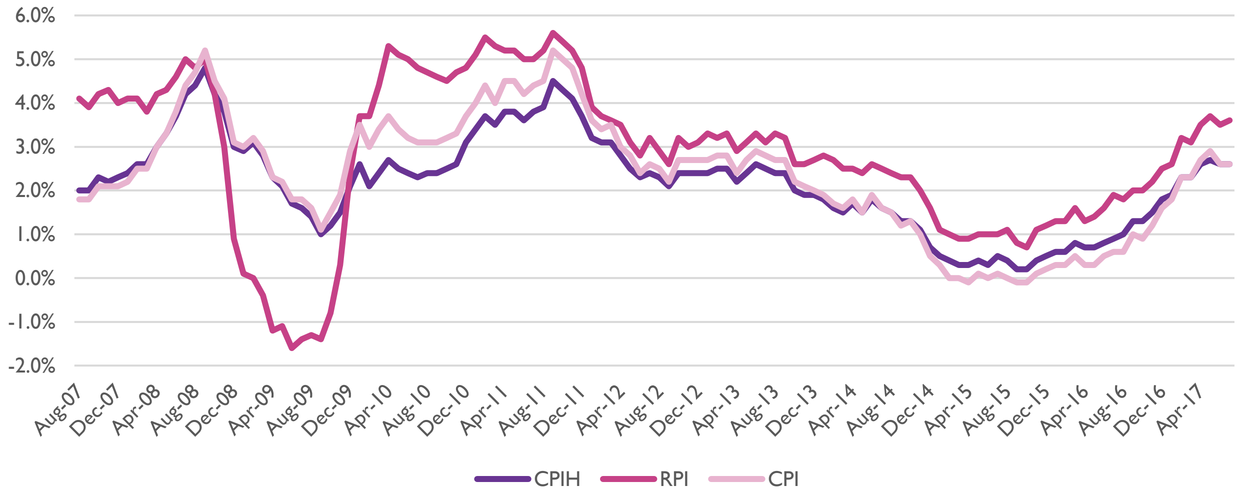
26 See UK Statistics Authority (2015), "UK Consumer Price Statistics: A Review".

27 As stated by the OBR: "The ONS also publishes several other inflation measures, such as CPIH, but as these do not currently affect the public finances, we do not need to forecast them". See OBR (2017), "Economic and fiscal outlook", March 2017.

3.2 Evidence

Figure 3.1 illustrates the evolution of CPI, CPIH and RPI in the past 10 years. The figure shows that while all three measures tend to move together the implied level of price changes is slightly different for each of them.

Figure 3.1: CPI, CPIH and RPI — 2007-2017



Source: ONS.

The co-movement of CPI, CPIH and RPI is captured in Table 3.1 below. It is noteworthy how low the correlation between CPI and RPI has been over the past ten years and how much that correlation has changed in recent years, suggesting that any "wedge" between CPI and RPI is unlikely to be highly stable over time. On the other hand, as the table illustrates, the correlation between movements in CPI and CPIH has been very strong over the entire period under consideration, with the only material deviation arising in 2009 to 2011 as house prices fell

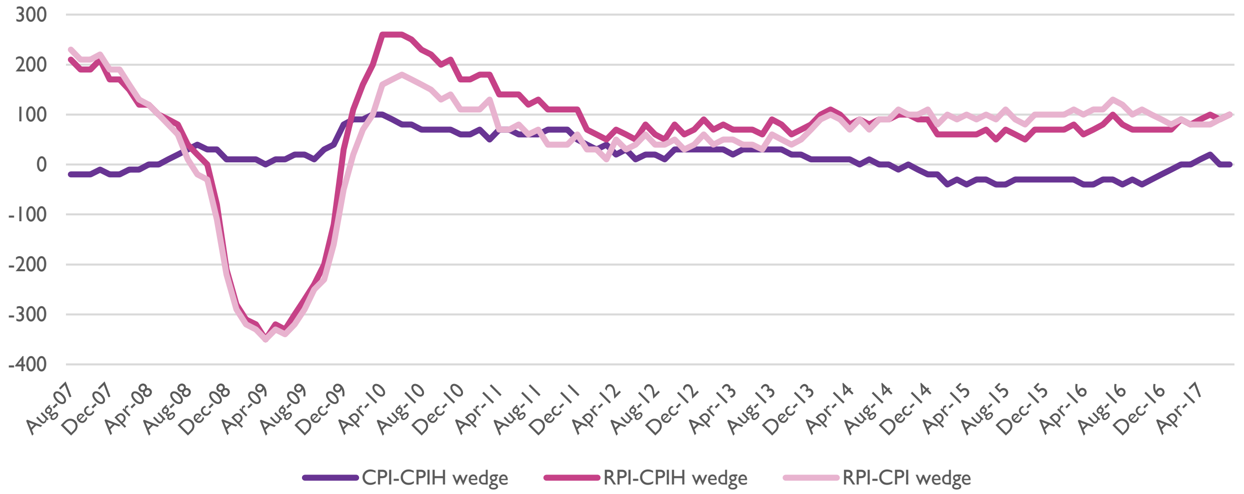
Table 3.1: Correlation between CPI, CPIH and RPI

	August 2007-July 2017			January 2012-July 2017		
	CPI	**RPI**	**CPIH**	**CPI**	**RPI**	**CPIH**
CPI	100%	71%	98%	100%	98%	99%
RPI	71%	100%	69%	98%	100%	99%
CPIH	98%	69%	100%	99%	99%	100%

Source: ONS, Europe Economics' calculations.

The wedge between CPI, CPIH and RPI has also changed over time with especially high variations in the RPI wedges before 2012 (see Figure 3.2).

Figure 3.2: Wedge between CPI, CPIH and RPI



Source: ONS, Europe Economics' calculations.

Table 3.2 shows that, as of January 2012, the RPI-CPI wedge was 30bps, and gradually increased to 100 bps in July 2017. The average RPI-CPI wedge since January 2012 was 77bps.

Table 3.2: Wedge between CPI, CPIH and RPI (basis points)

	CPI-CPIH wedge	RPI-CPIH wedge	RPI-CPI wedge
As of August 2007	-20	210	230
As of January 2012	40	70	30
As of July 2017	0	100	100
Average since January 2012	-2	75	77

Source: ONS, Europe Economics' calculations.

Table 3.3 shows the latest OBR inflation forecasts. Based on those figures we can see the wedge between RPI and CPI is expected to increase in the coming years to 120bps. As noted above, there are no forecasts for CPIH.

Table 3.3: RPI and CPI forecast as of March 2017

	2016	2017	2018	2019	2020	2021
RPI	1.7%	3.7%	3.6%	3.1%	3.1%	3.2%
CPI	0.7%	2.4%	2.3%	2.0%	2.0%	2.0%
Wedge (bps)	**100**	**130**	**130**	**110**	**110**	**120**

Source: OBR.

3.3 Conclusion

For this report we propose an **RPI of 3.0 per cent** and **CPI (as the best proxy for CPIH) of 2 per cent**. This corresponds to an assumed 100bps wedge between RPI and CPI(H). These assumptions should be reviewed for the final determination as the inflation forecasts for the 2020-25 period become available.

4 Risk-Free Rate

4.1 Approach

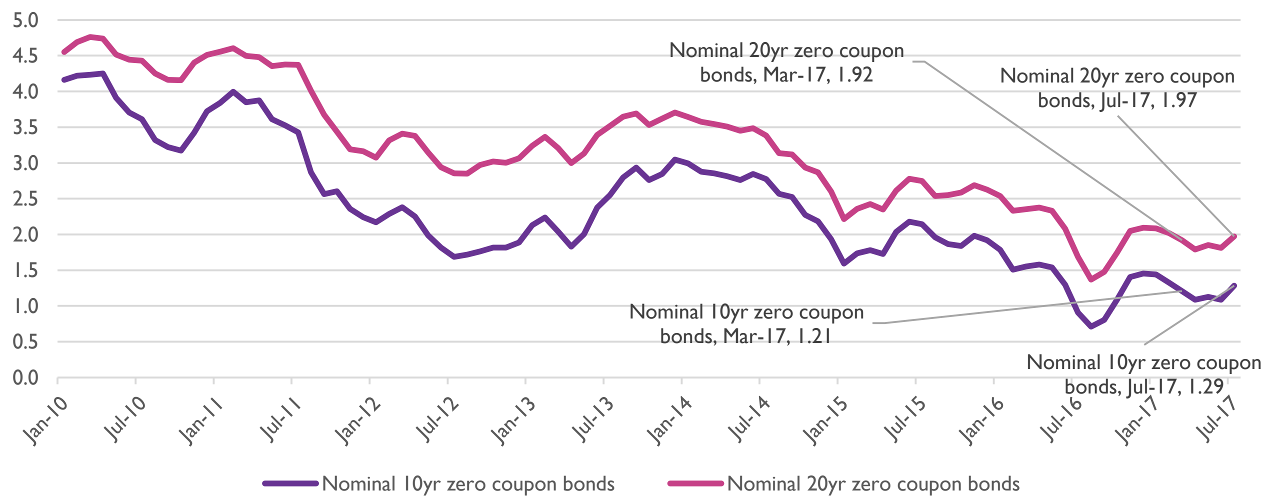
In PR14, the risk-free rate was based on the yield from UK government index-linked gilts with 10 year maturities. As noted in Appendix 13 to Ofwat's 2017 consultation on PR19, "[t]he evidence we present in figure 2 implies a real [*i.e. RPI-deflated*] risk free rate that should be negative over the entire 2020-25 price control period. […] We therefore consider that current evidence suggests that the risk free rate for PR19 should be considerably lower than the risk free rate we set at PR14, reflecting current market conditions."[28]

In this report, the risk-free rate is estimated based on nominal yields on zero-coupon government bonds with maturity of 10 and 20 years.[29] In order to obtain an estimate that would be applicable to 2020-25 period, we used Bank of England's forward rates to adjust the yields by the amount interest rates are expected to rise by 2025.

4.2 Evidence

The monthly average yields on zero coupon UK gilts are illustrated in Figure 4.1. As of March 2017, the average nominal yield on a 10-year bond was 1.21 per cent, and 1.92 per cent on a 20-year bond.

Figure 4.1: Nominal zero coupon UK gilt yields — monthly averages



Source: Bank of England (series codes: IUMAMNZC, IUMALNZC).

In order to estimate the risk-free rate for period 2020-2025, we need to adjust the currently observed yields by the expected rise in interest rates. The expected rise in interest rate can be estimated by subtracting nominal spot rates from nominal instantaneous forward rates for each maturity horizon respectively. To account for potential volatility in those predicted rates across time, we analysed daily data between January 2017 and July 2017, and calculated the 25th and 75th percentile of the distribution of the results. These are illustrated in Figure 4.2 below.

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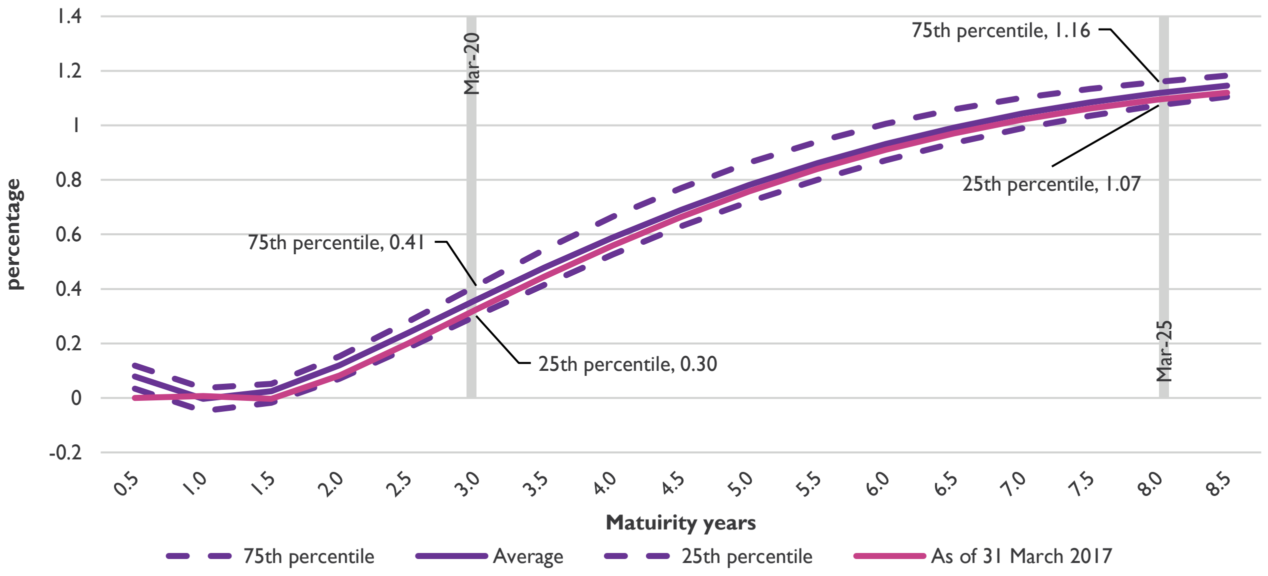
[28] Ofwat (2017), "Delivering Water 2020: consultation on PR19 methodology. Appendix 13: Aligning risk and return".

[29] We use nominal yields instead of real ones, as the Bank of England does not report real yields on zero-coupon government bonds.

Based on the 25th percentile, the figure shows that — compared to the yields observed in March 2017 — interest rates are expected to rise by 30bps before March 2020 and 107bps by March 2025. Based on 75th percentile, interest rates are expected to rise by 41bps by March 2020 and 116bps by March 2025. Therefore, the average expected rise during the 2020-25 period is between 69bps (based on 25th percentile) and 79bps (based on 75th percentile).

Figure 4.2: Forward minus spot nominal rates based on the distribution of daily estimates between Jan 2017 and Jul 2017



Source: Bank of England, Europe Economics' calculations.

Forwards curves typically contain an underlying term premium, sometimes thought to reflect liquidity risk or changes in the extent to which investors bear inflation risk over different horizons. Since this premium would be captured by the forward curves even if no rise in interest rates is expected, it should be subtracted from the above estimates. Pflueger and Viceira (2015)[30] estimated that the average liquidity premium on UK government bonds over 1999-2014 was 50bps, but declined to around 10bps towards the end of the series. Golden et al. (2010)[31] decompose nominal and real rates, estimating the average inflation risk premium on UK gilts over 1985-2009 period to be 35bps. The increase in the inflation premium with term would therefore be less than this. Here we assume a total premium, combining liquidity and inflation risk term effects, of 20bps.

Therefore, the expected average rise in interest rates in 2020-25 period is between 49bps and 59bps. Combined with the yield on 10-year and 20-year government bonds of 1.21 per cent and 1.92 per cent respectively, we estimate the nominal risk-free rate to be between 1.69 per cent and 2.50 per cent.

4.3 Conclusion

Our proposed nominal range for the nominal risk-free rate is **1.70-2.51 per cent**. The lower end is based on the observed yield on 10-year government zero-coupon bond as of March 2017 (1.21 per cent), adjusted for the lower end of the expected rise in interest rates in 2020-25 period (0.49 per cent). The upper end is

[30] Pflueger and Viceira (2015), "Return predictability in the Treasury market: real rates, inflation, and liquidity".

[31] Golden et al. (2010), "Forecasting UK inflation: an empirical analysis", Heriot-Watt University.

based on the observed yield on 20-year zero-coupon government bond as of March 2017 (1.92 per cent), adjusted for the upper end of the expected rise in interest rates in 2020-25 period (0.59 per cent).

Without ignoring the evidence produced by the yields on 20-years to maturity bonds, as is standard in the UK regulatory analysis and in most financial markets discussion we put more weight on the yields for 10-years to maturity government bonds (i.e. the lower end of the range). As such, our proposed **point estimate is 2.00 per cent**.

Table 4.1: Risk-free rate — conclusion

	Lower end	Point estimate	Upper end
Real	-0.29%	0.00%	0.50%
Nominal	1.70%	2.00%	2.51%
RPI-deflated	-1.26%	-0.97%	-0.48%

Note: "Real" is not equivalent to "RPI-deflated" return. See the definition of "real returns" on page 14 (Section 2.3.1).
Source: Europe Economics.

5 Total Market Return

5.1 Approach

In its 2017 consultation document, Ofwat indicated that its work and PwC's analysis on different approaches to estimating total market return (TMR) "suggest that placing too much weight on long-term, historical evidence is likely to overstate the cost of equity for 2020-2025. […] This is because there is good reason to expect significantly lower returns to persist to 2025 than observed from long-term historical evidence."[32] In consequence, we focus predominantly on forward-looking approaches to the TMR estimation based on market data, where possible.

There are two principal ways in which total market return (TMR) could be estimated:

- "build-up" approach involves, first, determining the components of total market return — i.e. risk-free rate and equity risk premium — and then summing them to obtain total market return;
- "decomposition" approach requires estimating total market return directly from the relevant market data, and then decomposing it into risk-free rate and equity risk premium.

In this report, we adopt the "decomposition" approach. This is in line with Ofwat's proposed methodology described in the "Aligning risk and return" appendix to the consultation document.[33]

Within this broad category, there are a number of ways in which total market return could be determined, including:

- Dividend Growth Model (DGM);
- Market-to-Asset Ratio (MAR) model; and
- average of historical returns.

We consider the evidence produced by all three approaches, alongside recent regulatory precedents.

In this section we discuss the methodological choices within Dividend Growth Models (Section 5.1.1), and methodological assumptions relevant for Market-to-Asset Ratio models (Section 5.1.2). We then proceed to presenting the evidence produced by each of the three broad approaches (Section 5.2), and conclude in Section 5.2.6.

5.1.1 Dividend Growth Model (DGM)

Dividend Growth Model (also known as the Gordon Growth Model, or constant growth Dividend Discount formula) expresses the current value of a stock as that stock's expected next-period dividend divided by the real required rate of return less the growth rate of the stock shares. Taking a broad market index (e.g. FTSE All Share) as the basis for the model allows to estimate the rate of return for the market as a whole, i.e. to determine the total market return.

If the future growth of dividends is assumed to be constant, the infinite summation of the valuation of a current stock price is given by:

$$P_0 = \frac{D_1}{r - g}$$

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32 Ofwat (2017), "Delivering Water 2020: Consulting on our methodology for the 2019 price review".

33 Ofwat (2017), "Delivering Water 2020: consultation on PR19 methodology. Appendix 13: Aligning risk and return".

where P_0 is the current price of the stock, D_1 is the expected next period dividend, r is the required rate of return, and g is the expected constant long-term growth rate of earnings.

Solving for r gives an approximation of the TMR,

$$r = \frac{D_1}{P_0} + g$$

In other words, the TMR is the prospective dividend yield of a stock plus the constant long-term growth rate of dividends. Because the dividend yield is expressed through a one-period difference between price and expected dividend, it represents prospective rather than historical or realised dividend yield for the stock.

A major caveat to be taken into account for the DGM is its assumption of constant long-term growth. In practice it is often not possible to predict the next period dividend even for a relatively steady stock. Multi-stage variations of this model therefore allow for differentiation of growth between dividend periods (for example, short and long-term). However, these often require further assumptions to be made about when and by how much a dividend will vary over time.[34]

To illustrate, a multi-stage DGM model where we assume different short-term growth rate in the first three years and another long-term growth rate in the following years, would rely on the following formula:

$$P_0 = \frac{D_0 \cdot (1 + g_{ST})}{(1+r)} + \frac{D_0 \cdot (1 + g_{ST})^2}{(1+r)^2} + \frac{D_0 \cdot (1 + g_{ST})^3}{(1+r)^3} + \frac{D_0 \cdot (1 + g_{ST})^4 \cdot (1 + g_{LT})}{(1+r)^4} + \frac{D_0 \cdot (1 + g_{ST})^4 \cdot (1 + g_{LT})^2}{(1+r)^5} + \cdots$$

where D_0 is the amount of dividends paid in period 0, g_{ST} is the short-term growth rate, and g_{LT} is the long-term growth rate. This is equivalent to:

$$P_0 = \frac{D_1}{(1+r)} + \frac{D_2}{(1+r)^2} + \frac{D_3}{(1+r)^3} + \frac{D_3 \cdot (1 + g_{LT})}{(1+r)^4} + \frac{D_3 \cdot (1 + g_{LT})^2}{(1+r)^5} + \cdots =$$

$$= \frac{D_1}{(1+r)} + \frac{D_2}{(1+r)^2} + \frac{D_3}{(1+r)^3} + \frac{1}{(1+r)^3} \cdot \left(\frac{D_3 \cdot (1 + g_{LT})}{(1+r)} + \frac{D_3 \cdot (1 + g_{LT})^2}{(1+r)^2} + \cdots \right) =$$

$$= \frac{D_1}{(1+r)} + \frac{D_2}{(1+r)^2} + \frac{D_3}{(1+r)^3} + \frac{1}{(1+r)^3} \cdot \frac{D_4}{r - g_{LT}}$$

In both one-stage and multi-stage models, some serious restrictions apply to the assumed (short-/long-term) growth rate g — in particular it may not equal the rate of return r (or prices would be infinite), nor can it exceed it (or current prices would be negative). Thus, the model often fails when it is applied to high-growth stocks, either because differences in valuation become disproportionately sensitive as g approaches r, because g cannot equal r, or the price value will be negative.

Within this general framework, there are several decisions and assumptions a modeller has to make. In particular, those assumptions are associated with:

- whether the model should use nominal or real values,
- whether the relevant model outputs are spot estimates or rolling averages.

[34] McClure (2008) "Digging into the Dividend Discount Model".

Regarding the first point — our models operate in real terms. Based on Fama and French (2002) paper[35] as well as statistical tests we conducted[36], we argue that estimations based on real returns are more accurate than those based on nominal returns.

Regarding the second point — based on academic research[37] as well as statistical tests we conducted, we argue that rolling 5-year averages are more accurate predictions than spot returns.[38]

Multi-stage DGM model based on GDP growth

The key features of the model are:

- multi-stage — the model assumes a different short-term dividend growth rate (i.e. a growth rate applicable for the first five years) and a different long-term growth rate (which is applicable for all subsequent periods of time);
- capital growth modelled with historic GDP and IMF forecasts of future GDP;
- real — the model inherently operates in real terms (i.e. all nominal inputs are translated into real July 2017 terms);
- accounts for buybacks by directly adding them to the amount of dividends.

Variant of the multi-stage DGM model based on GDP growth with expected inflation

This model is a variant of our multi-stage DGM model described above, and thus has the same basic features. The difference is in how the expected dividend growth is modelled. In particular, the dividend growth rates are based on real GDP growth rates, which are first translated into nominal terms using CPI and then deflated back to real terms with expected, rather than actual, inflation.

We estimated the inflation expectations based on HM Treasury UK economy forecast reports. This was done by calculating a weighted average between the expected RPI inflation in the current calendar year and the next calendar year, where the weights were determined by the months of the year in which the expectations were provided.[39]

It should be noted that because the inflation expectations in HMT reports are per calendar year rather than for the next 12 months, HMT-inferred estimates are likely to obscure some of the volatility in the inflation expectations, i.e. the estimates tend to be closer to long-term mean than actual expectations over the next 12 months (and actual inflation figures). As such, the rolling five year average of real returns is likely to be close to what we would get by simply deflating the rolling five year average of nominal returns by the average inflation expectation (as compared to deflating each month of nominal returns with the relevant inflation expectations for that month).

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35 "One can estimate expected returns in real or nominal terms. Since portfolio theory says the goal of investment is consumption, real returns seem more relevant, and only results for real returns are shown." See Fama and French (2002), "The equity risk premium".

36 See footnote 38.

37 For example, as mentioned by PwC "[…] using data for the US market, Damodaran found the technique with the best predictive power of actual returns over the following 5-years was recent averages of implied outputs such as DDM". See PwC (2017), "Refining the balance of incentives for PR19".

38 Specifically, we compared sum of the squared errors and aggregate absolute errors for real versus nominal models and for five year average versus spot models (for comparable time windows), over the period 2000 to 2017. Real models always outperformed nominal models. Five year averages outperformed spot estimates in respect of sum squared errors, and in respect of absolute errors in all but one case.

39 For example, as of March 2017 the expected CPI 2017 was 2.9 per cent for 2017, and 2.6 per cent for 2018, from which we get an estimated inflation of 2.85 per cent ($= 10/12 \cdot 2.9\% + 2/12 \cdot 2.6\%$, where the $10/12$ weight represents the number of months left in 2017 for the 2017, and $2/12$ represents the number of months in 2018 until March 2018).

Multi-stage DGM model based on dividend growth

The key features of the model are:

- multi-stage — similarly to the other DGM models, the model assumes a different short-term dividend growth rate for the first five years and a different long-term growth rate;
- capital growth modelled on the actual annual growth in dividends and buybacks;
- real — the model inherently operates in real terms (i.e. all nominal inputs are translated into real July 2017 terms);
- accounts for buybacks by directly adding them to the amount of dividends.

By definition, the average return on a stock is the average dividend yield plus the average rate of capital gain. For a firm with a ratio of dividends to prices that is stable over time, in the long-run the compound rate of dividend growth will tend to approach the compound rate of capital gain, since the present value of capital is, at any point in time, the discounted present value of the future stream of dividends. If we have an estimate of the future growth rate of dividends, we can therefore use that to estimate the future growth in capital.

The dividend-price ratio may not be stable for various reasons. For example, firms might move, over time, away from dividends towards share repurchases as a way to deliver payoffs to shareholders. In addition, if the period over which dividends are analysed is too short, the assumption of convergence may introduce a bias.

Furthermore, because it is compound dividend and capital growth, not simple annual returns, that converge over the long run in the model, the use of the model to calculate annual simple returns will intrinsically produce a downwards bias if and insofar as the dividend growth rate is less volatile than the rate of capital gain, because for two series with the same compound growth rate the series with the higher variance will have a higher simple annual growth rate. (This is a consequence of exactly the same mathematics that means "geometric" averages are always less than arithmetic averages.)

In their consultation response KPMG notes[40] that by their nature DGM models are models based on a convergence in compound returns, though it somewhat misstates the nature of the issue. It is not that the answer produced by a DGM model must, by its nature, have an adjustment equivalent to the difference between arithmetic and geometric returns added to it. Rather, it is that because there is convergence only in compound ("geometric") returns, if and insofar as annual returns on capital are more volatile than those on dividends, the annual average return for dividends produced by the model will be an under-statement of the annual average return of the capital value series that the dividends are proxying for.

Fama and French note this issue in their 2002 paper and recommend an adjustment of half the difference between the historic variances of the growth rates of the dividends and capital series.

Many dividend growth models (including that developed by PwC for their 2017 report[41]) do not use estimates of dividend growth directly. Instead, they use estimates of GDP growth as in the long-term the dividend growth and GDP growth tend to follow similar trends.[42] Such GDP growth estimates are often conceived as a proxy for dividend growth, which would in turn be serving as a proxy for capital growth. But there is no intrinsic reason why average GDP growth could not be conceived as providing a direct estimate of average capital growth. In that case the issue of a variance effect does not arise — average GDP growth is providing a direct estimate of (arithmetic) average capital growth.

We note, by way of context, that average GDP growth has tended to be higher than average dividend growth in recent decades, with the consequence that average dividend growth plus a volatility adjustment is only a

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40 KPMG (2017), "A review of Ofwat's proposed approach to total market returns".
41 PwC (2017), "Refining the balance of incentives for PR19".
42 ECB (2007), "Monthly bulletin" September 2007.

little higher than average GDP growth. This also suggests that adding a volatility adjustment to average GDP growth might result in an over-statement of capital growth.

For a dividends-based model, then a volatility adjustment might be required, depending on the relative volatility in returns on dividends and on capital. In a number of past determinations, the Competition Commission estimated the historic variances of the growth rates of the dividends and capital series for the UK at around 150 basis points, and hence used a volatility adjustment of 75 basis points, but it would be incorrect to use that past figure in a forwards-looking model today. The wedge between the volatility in dividends and buybacks and that in capital values has fallen in recent years, and indeed with notoriously very low volatility in market prices over the past year, on some measures dividend and buyback volatility may even actually be higher than volatility in capital values.We do not use a volatility adjustment in our analysis below, but we note that even if a volatility adjustment were included, given that any plausible such adjustment would be less (probably materially less) than the 75 bps the Competition Commission has used in the past, any volatility adjustment would take the results for our dividends-based model no higher than the results produced by our GDP-based model, and as such would not affect our final range.

Summary of DGM models

Table 5.1 summarises the assumptions we made in each of the three DGM models.

Table 5.1: Summary of approach taken to DGM models

	Multi-stage DGM based on GDP growth	Multi-stage DGM based on GDP growth with HMT-inferred inflation	Multi stage DGM based on dividend growth
Dividends and buybacks	Dividends and buybacks paid by FTSE All Share members, distributed evenly across months when no dividends are paid (e.g. if a company paid dividends in March and then in September, then the amount paid in September is evenly distributed across April, May, June, July, August and September). Data cover the period From Jan 200 to Mar 2017.	As in 'Multi-stage DGM based on GDP growth' model.	As in 'Multi-stage DGM based on GDP growth' model.
Basis for growth rates	GDP (IMF)	As in 'Multi-stage DGM based on GDP growth' model.	Annual growth in dividends and buybacks per share (Bloomberg).
Short-term growth	Short-term growth rate is defined as average of real GDP growth in a given month for the next 5 years (e.g. for July 2013, it is the average of the GDP growth rate in July 2013, July 2014, July 2015, July 2016 and July 2017)	As in 'Multi-stage DGM based on GDP growth' model.	Short-term growth rate is defined as average of real dividends and buybacks growth in a given month for the next 5 years (e.g. for July 2013, it is the average of the dividend and buyback growth rate in July 2013, July 2014, July 2015, July 2016 and July 2017). Annual dividend and buyback growth rates were calculated based on 12 month rolling sums of dividends and buybacks per share.

	Multi-stage DGM based on GDP growth	Multi-stage DGM based on GDP growth with HMT-inferred inflation	Multi stage DGM based on dividend growth
Long-term growth	Long-term growth rate is the long-term GDP growth as expected in a given year, drawn from OBR and HM Treasury figures, with some interpolation from Europe Economics analysis.	As in 'Multi-stage DGM based on GDP growth' model.	For years 2018-2022, dividends and buybacks were assumed to grow at 1.6%, which is the average dividend and buyback growth inferred from FTSE All Share and FTSE All Share Total Return since 1991.
Inflation	CPI (ONS)	Inferred from HM Treasury UK economy forecast reports. This was done by calculating a weighted average between the expected RPI inflation in the current calendar year and the next calendar year, where the weights were determined by the months of the year in which the expectations were provided.	As in 'Multi-stage DGM based on GDP growth' model.
Volatility adjustment	n/a	n/a	Would be calculated as half of the difference (if any) between the variance in growth rates for capital and the variance in growth rates for dividends and buybacks. Our model does not add any adjustment.

Source: Europe Economics.

The key difference between the models is associated with the assumed short-term and long-term growth rates (including how inflation is factored into those assumptions). To illustrate the implications of this difference, in Table 5.2 below we provide the averages of short-term and long-terms growth rates from each of our models for the period October 2015-March 2017.

Table 5.2: DGM growth assumptions — averages between October 2015 and March 2017

	Multi-stage DGM based on GDP growth	Multi-stage DGM based on GDP growth with HMT-inferred inflation	Multi stage DGM based on dividend growth
Average short-term growth rate	1.8%	1.5%	0.3%
Average long-term growth rate	2.0%	2.0%	1.6%

Source: Europe Economics.

5.1.2 Market-to-assets ratio (MAR)

The MAR analysis exploits the fact that market valuations differ from regulatory valuations captured in Regulatory Capital Values (RCV). In particular, for companies which are listed on a stock exchange we can compare their market enterprise values to their RCV to calculate the market premium on RCV. In the simplest version of the analysis, the cost of equity is determined by the following relationship:

$$cost\ of\ equity\ (CoE) = regulated\ rate\ of\ return \cdot (1 - premium\ on\ RCV)$$

Having determined the cost of equity for the listed companies, the analysis requires making some assumptions on the equity beta(s) appropriate for the companies under consideration and on the risk-free rate. Those three variables then allow for estimating the TMR according to the following CAPM formula:

$$TMR = RFR + ERP = RFR + \left(\frac{CoE - RFR}{\beta}\right)$$

where, RFR is the risk-free rate, ERP is the equity risk premium, and β is the equity beta fort the companies under analysis.

As noted by the CMA, MAR analysis could be used as a cross-check in estimating cost of capital. In its 2015 final determination on Bristol Water the CMA argued that "[i]n principle, the market prices of asset transactions relative to the regulatory asset value (either M&A activity or traded share prices) can also provide an indication of the value of the cost of capital as a whole, and in particular whether the cost of equity appears to be consistent with observed market evidence. We can therefore use it to cross-check this level of cost of capital. The use of market asset ratios (MARs) to estimate actual expected returns on capital was comparable to the use of dividend growth models. Both require a number of assumptions around projections of future growth in returns."[43]

Our MAR-based estimates of the TMR are produced by the PwC's MAR model,[44] which we updated with the latest data. Because the data used to calculate the market premium on RCV need to be capturing the regulatory and market valuations of the companies at the same point in time, the latest available data is for March 2017 (as RCV is only estimated as of the end of a fiscal year). We also made minor adjustment regarding the translation of nominal results to real results, but otherwise we did not make any changes in the PwC's model.

We produced two different versions of the model: one where the enterprise value is — consistently with the PwC's model — based on the book value of debt, and one where the enterprise value is calculated as the sum of market capitalisation and fair value of debt less cash.[45] The data for fair value of debt were obtained from the annual reports published by United Utilities and Severn Trent.

5.1.3 Average historical returns

As many regulators, we refer to the Global Investment Returns Yearbooks as the source for long-term averages of returns. While it is true that the longer the series the more accurate our forward-looking estimates are likely to become, the 2017 edition of the Yearbook suggests that some phenomena in the past are unlikely to occur again and should therefore be treated as "non-repeatable". In our analysis below, we report both the returns based directly on averages since 1900 and the scale of the adjustment that accounts for the non-repeatable events.

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43 CMA (2015), "Bristol Water plc", paragraph 10.201.

44 See a description of PwC's approach in PwC (2017), "Refining the balance of incentives for PR19", pages 83-87.

45 For MAR analysis, PwC used a schedule of outperformance assumptions starting from 2016 until 2050, which is based on RCB and PwC's assumptions. There are separate outperformance assumptions for totex, ODI, SIM and financing. The averages of SVT outperformance assumptions over 2016-2050 period for each of these areas are: 0.5 per cent for totex, 0 per cent for ODI and SIM, and 0.9 per cent for financing. The averages of UU outperformance assumptions are: 0.3 per cent for totex, 0 per cent for ODI and SIM, and 1.3 per cent for financing.

5.2 Evidence

In Section 5.2.1 we present the results produced by the following versions of DGM models:

- Our multi-stage DGM model where capital growth assumptions are based on GDP growth (including a variation of the model which incorporates inflation expectations);
- Our multi-stage DGM model where capital growth assumptions are based on dividends growth.

In Section 5.2.2, we present the results produced by the updated MAR model which was developed by PwC.

Section 5.2.3 provides potential responses to some of the issues companies raised in response to Ofwat's consultation, sections 5.2.4 and 5.2.6 provide an overview of recent regulatory decisions and international evidence regarding the TMR.

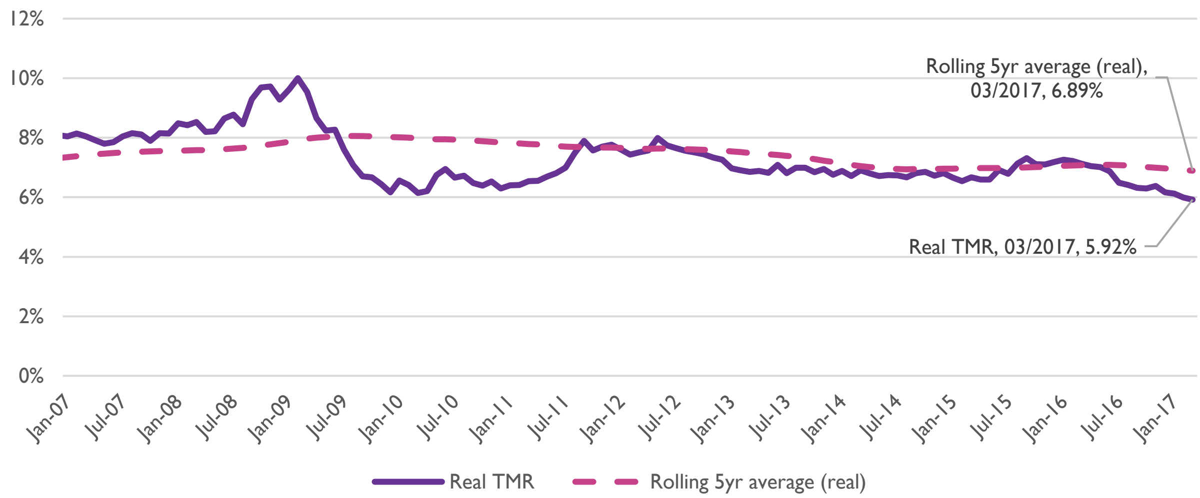
5.2.1 Dividend Growth Models

Multi-stage DGM based on GDP growth

Reflecting our discussion in 2.3.1, our models operate in real, rather than RPI-deflated or nominal, terms.

Our version of multi-stage DGM model where capital growth expectations are based on GDP growth rates, produces a real TMR spot estimate of 5.92 per cent (as of March 2017), and a 5-year average of 6.89 per cent (see Figure 5.1). This is equivalent to a TMR range of 8.04-9.03 per cent in nominal terms (assuming 2 per cent inflation), and 4.89-5.85 per cent in RPI-deflated terms (with an RPI of 3.0 per cent).

Figure 5.1: Multi-stage DGM based on GDP growth (up to March 2017)



Note: "Real" is not equivalent to "RPI-deflated" return. See the definition of "real returns" on page 14 (Section 2.3.1).
Source: Europe Economics, Bloomberg's data.

Variant of the multi-stage DGM model based on GDP growth with expected inflation

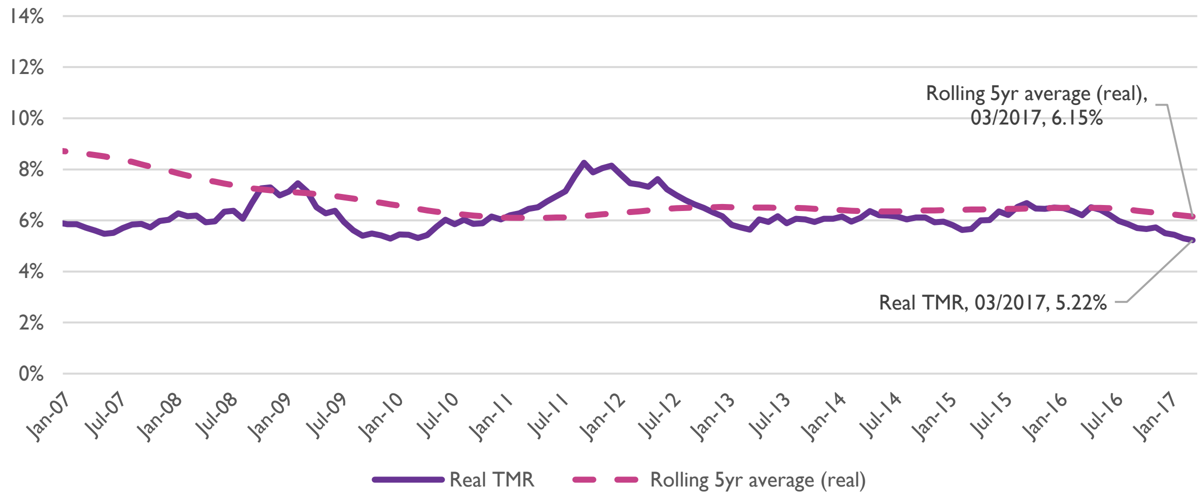
As a cross-reference, we also estimated this DGM model using expected inflation (see the description of our approach under Variant of the multi-stage DGM model based on GDP growth with expected inflation heading in Section 5.1.1), rather than actual inflation. This variant of the model produced a 6.15 per cent spot real TMR estimate as of March 2017, and 6.79 per cent 5-year average (which is equivalent to 8.27-8.92 per cent in nominal terms, and 5.12-2.75 per cent in RPI-deflated terms). This is within the range produced by the multi-stage DGM model based on GDP growth rates discussed above.

Multi-stage DGM based on dividend growth

Our version of multi-stage DGM model where capital growth expectations are based on dividend growth rates, produces a real TMR spot estimate of 5.22 per cent (as of March 2017), and a 5-year average of 6.15 per cent (see Figure 5.2). Given that the model is based on dividend growth rather than GDP, it might require a volatility adjustment. However, in this case the variance of the dividend and buyback growth and the variance of capital gains are broadly equal, and thus the adjustment is not necessary (see the discussion under Multi-stage DGM model based on dividend growth heading in Section 5.1.1).

This range is equivalent to a TMR range of 7.33-8.27 per cent in nominal terms (assuming 2 per cent inflation), and 4.20-5.12 per cent in RPI-deflated terms (with an RPI of 3.0 per cent).[46]

Figure 5.2: Multi-stage DGM based on dividend growth (up to March 2017)



Note: "Real" is not equivalent to "RPI-deflated" return. See the definition of "real returns" on page 14 (Section 2.3.1).
Source: Europe Economics, Bloomberg's data.

Summary of our DGM models

Table 5.3 summarises the results produced by the four DGM models discussed above. The table provides spot figures and five-year averages (in real, nominal, and RPI-deflated terms), as well as a minimum and maximum real value of the five-year average TMR since October 2015.

Table 5.3: Summary of our DGM models

	Multi-stage DGM based on GDP growth (Figure 5.1)	Multi-stage DGM based on GDP growth and HMT-inferred inflation	Multi stage DGM based on dividend growth (Figure 5.2)
Real spot TMR	5.92%	6.15%	5.22%
Real rolling 5yr average	6.89%	6.79%	6.15%
Nominal spot TMR	8.04%	8.27%	7.33%
Nominal rolling 5yr average	9.03%	8.92%	8.27%
RPI-deflated spot TMR	4.89%	5.12%	4.20%
RPI-deflated rolling 5yr average	5.85%	5.75%	5.12%
Real min 5yr average since Oct 2015	6.89%	6.79%	6.15%
Real max 5yr average since Oct 2015	7.09%	7.02%	6.50%

Source: Europe Economics.

[46] These figures do not include any upwards adjustment for volatility.

Other DGM evidence

We also make note of other evidence produced by DGM models. In particular, the Competition Commission in its 2014 final determination regarding Northern Ireland Electricity indicated that the "real" (probably RPI-deflated, though this is not stated explicitly) TMR range supported by Bank of England's DGM model was 5.0-6.0 per cent.[47]

Ofcom in its *Wholesale Access Market Review* argued that based on the Fama and French approach a long-run real TMR would be around 5.7 per cent.[48]

Finally, the Bank of England recently updated its Dividend Growth Model. As of 31 March 2017 the model produced an equity risk premium estimate of 9.19 per cent.[49] Combined with a risk-free rate approximated by the average spot yield on UK gilts over the next 40 years — which was -1.66 per cent as of July 2017 — that implies a TMR estimate of 7.53 per cent in RPI-deflated terms (or 8.58 per cent in real terms using an RPI of 3 per cent and a CPI of 2 per cent). However, we note that the Bank of England places more reliance upon this model for considering changes in the ERP than in the levels thereof.

5.2.2 Market-to-Asset Ratio models

Table 5.4 illustrates the results of the two versions of the updated PwC's MAR model. The model relying on the book value of debt produces a nominal TMR range of 7.37-8.60 per cent.

As a cross-check we also conducted MAR analysis with fair value of debt rather than book value of debt. Fair value of debt is provided by companies in their annual reports, however it usually does not account for the fact that regulated companies are insulated from market opportunities insofar as the regulator distinguishes between embedded and new debt. The higher the proportion of embedded debt in overall debt, the less relevant conditions in debt markets are. To reflect that, we construct a "regulatory market value" — a weighted average between fair and book values of debt with weights equal to the proportion of new debt (30 per cent) and embedded debt (70 per cent) respectively (see Section 9.2 for the underlying analysis of the new-to-embedded debt ratio).[50] After adjusting the enterprise values for the regulatory market value of debt, the nominal TMR range drops to 6.85-7.08 per cent.

Table 5.4: MAR analysis results (as of March 2017)

	Based on book value of debt	Based on regulatory market value of debt
Nominal range	7.37% — 8.60%	6.85% — 7.08%
Real range	5.27% — 6.47%	4.75% — 4.98%
RPI-deflated range	4.25% — 5.44%	3.73% — 3.96%

Note: "Real" is not equivalent to "RPI-deflated" return. See the definition of "real returns" on page 14 (Section 2.3.1).
Source: PwC's model, updated by Europe Economics.

47 CC (2014), "Northern Ireland Electricity Limited price determination", paragraph 13.155. We note that 5 to 6 per cent was specifically the CC's interpretation of the Bank of England's DGM model. The CC's overall TMR range was 5 to 6.5 per cent.

48 Ofcom (2017), "Wholesale Access Market Review - Annexes", paragraph A16.61.

49 Bank of England (2017), "An improved model for understanding equity prices", Visual summary of the article.

50 For a fuller discussion of different gearing concepts and the relative merits of book value, fair value and regulatory market value approaches to gearing, see Section 6.1.1.

5.2.3 Consultation responses

Consultation responses near-universally vigorously opposed Ofwat's Delivering Water 2020 Consultation method and range. In Table 5.5 we provide potential responses Ofwat or PwC might offer to some of the consultation responses received.

Table 5.5: Potential responses to consultation responses

Area	Objection	A potential response Ofwat/PwC might offer
General	Such a large drop violates an implicit regulatory contract and will lead to a higher cost of capital later.	Regulators have price reviews to amend methods as well as to update data.
General	Historic data and regulatory precedent suggest a range of 6.25-7.3%.	This is broadly correct, though Ofcom adopted 6.0% recently and the Competition Commission has suggested 5% as a lower bound.
DGM	Forwards-looking methods are too unstable to be used for regulatory purposes.	Methods such as smoothing can address stability issues.
DGM	Recent data is not out of line with historic data.	This is correct regarding the post-2014 period. But the post-2000 data does suggest a break with pre-2000 data.
DGM	DGMs should have a volatility uplift of 75-150 bps added.	The volatility uplift is half the difference between the variances of dividend growth & capital growth, with recent data suggesting that would be materially below 75 bps. It is correct to apply that uplift for DDMs based on dividends data, but not necessary for a DGM based on GDP data.
DGM	PwC notes that 5 year rolling averages produce superior forecasts to spot estimates but its range is based on its spot estimate.	It is correct that 5 year rolling averages produce superior forecasts. But PWC did not neglect the rolling figures in producing its range.
DGM	The Bank of England & Bloomberg report much higher DGM figures than PWC's.	This is correct.
MARs	PwC assumes no outperformance on debt.	This is incorrect.
MARs	PwC assumes no RCV uprating.	This is incorrect.
MARs	PwC assumes all activities are regulated when in fact some are unregulated.	This is correct and is absorbed in the MARs analysis reported here.

Source: Europe Economics.

5.2.4 Regulatory precedents

Given the wide range of results produced by different methods in estimating the TMR (perhaps naturally reflecting the intrinsic uncertainty of estimating a risk- and expectations-reflecting parameter in an uncertain environment), all regulators must ultimately exercise judgement in choosing a final figure. It is of interest to consider the judgements drawn by other regulators. Furthermore, it is reasonable to suppose that investors attempting to anticipate the returns that would be provided via regulation might take account of the judgements drawn by other regulators, so for reasons of regulatory consistency and to reduce regulatory risk, it is important to bear in mind what other UK regulators have done, though without being bound by it and whilst recognising that both data and best-methods can change. (That is, after all, one of the reasons for having a cycle of price reviews.)

Below we present recent UK regulatory determinations on total market return. Similar to risk-free rate, total market return is common to the entire economy and thus determinations from a wider range of sectors than just water and energy might be a useful reference point in PR19. We can observe that the determinations presented in Table 5.6 range from 6.0 per cent to 6.75 per cent. However, we should also note that these figures are possibly expressed in terms equivalent to our RPI-deflated terms (rather than real terms).

Table 5.6: Real (typically equivalent to RPI-deflated?[51]) total market return — regulatory precedents

Regulator	Sector	Year	Total Market Return
Ofcom	Telecoms	2017	6.00%
CMA	Water	2015	6.50%
Ofcom	Telecoms	2016	6.10%
UR	Gas	2016	6.50%
Ofcom	Telecoms	2015	6.10%
CAA	Airports	2014	6.25%
CAA	Air traffic control	2014	6.25%
CC	NI Electricity	2014	6.50%
Ofcom	Telecoms	2014	6.10%
Ofwat	Water & sewerage	2014	6.75%
UR	Water & sewerage	2014	6.50%
ORR	Rail network	2013	6.75%

Source: Ofcom (2017), "Wholesale Local Access Market Review — Annexes", UKRN (2017), "Cost of Capital — Annual Update Report".

5.2.5 Average historical returns

We note that as of 2017 the average historical total market return in the UK was 7.3 per cent.[52] As discussed in Section 2.3 there is some reason to question to what extent even this more-than-a-century of data gives an unbiased sample of the distribution of expected returns and, even if it were an unbiased sample, to what extent certain of the returns periods in the past might be repeated in the future.[53] The most recent DMS sourcebook and its accompanying slide pack attempt to estimate what proportion of long-term global returns were the product of such unanticipated or non-repeatable events. In slide 16 of the DMS slidepack accompanying the latest yearbook, DMS contend that from the average geometric return of 5.1 per cent one should subtract around one per cent to account for real dividend growth and changes in P/D ratio, as we illustrate in Figure 5.3 below.

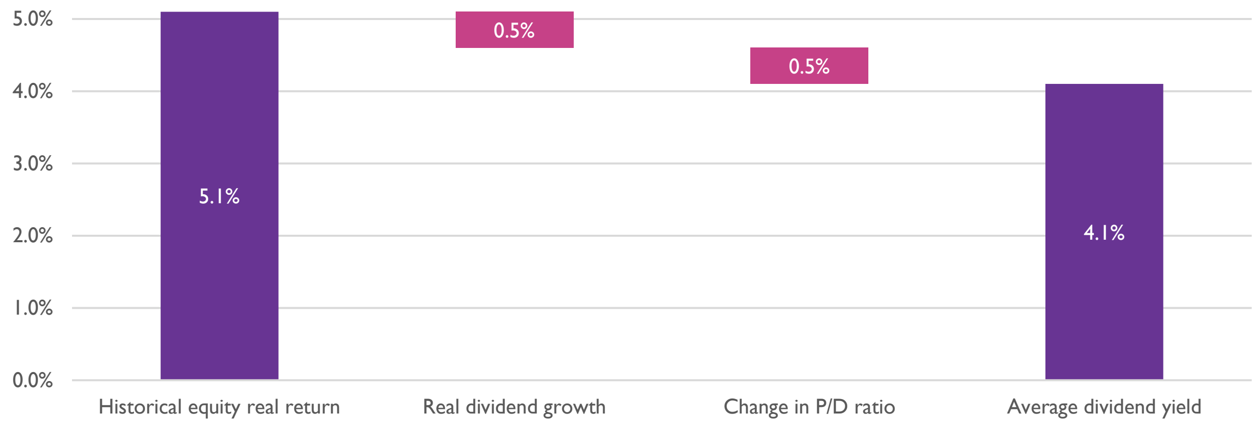
If we could assume a similar downwards adjustment for the UK, that would suggest a forward-looking total market return of around 6.3 per cent rather than the 7.3 per cent historic arithmetic average figure.

51 See final paragraph of Section 2.3.1 for explanation.

52 See Table 2 in DMS (2017), "Credit Suisse Global Investment Returns Yearbook 2017 — Summary Edition".

53 As noted above in Section 2.3.1, there are also difficulties in interpreting "real returns" historically, ranging from changes in the availability of official inflation statistics over time, to uncertainty over the appropriate degree of hedonic adjustment in the past, to recent methodological challenges with the change in the definition of clothing in the RPI index. It is unclear how these various factors would net out — e.g. whether they would mean a rise in returns or a fall.

Figure 5.3: Illustration of DMS analysis of non-repeatable events — world-wide geometric average ERP



Source: DMS (2017), "Global Investment Returns Yearbook 2017 — Slide Deck".

5.2.6 International evidence

As argued in Smithers and Co (2014), determinations of cost of equity in the UK should not be based solely on UK data, partly because UK returns have historically tracked global returns and partly because the UK has a globally integrated capital market. For this review we believe this point is especially relevant in light of the potential distortions created by the challenges in interpreting historic data and past regulatory judgements creating by the weaknesses in the RPI and the transition from RPI to CPIH in official inflation statistics.[54] In addition to the judgements drawn by regulators in recent international determinations, we also note that the historical average total market return in the world as reported in DMS (2017) was 6.5 per cent.

Table 5.7: International regulatory decisions — real TMR

Regulator	Country	Year	Sector	TMR
BNetzA	Germany	2017	Energy	6.29%
CER	Ireland	2016	Water	6.75%
CER	Ireland	2015	Energy	6.60%
ARCEP	France	2015	Telecoms	7.81%
AEEGSI	Italy	2015	Energy	6.00%
ComReg	Ireland	2014	Telecoms	6.85%

Source: CER (2016), CER (2015), ComReg (2014), ARCEP (2015), BNetzA (2017), AEEGSI (2015).[55]

[54] "In MMR we argued strongly that, in highly integrated global stock markets, we should not look exclusively at data from the UK, which is (at least in recent data) a relatively small market in global terms. At the same time we argued (MMR Section 2.4.6) that the relatively stable experience of the UK economy – with an absence either of significant positive or negative surprises, and (as illustrated by Figure 1.2) a return close to the global average, meant that it might (largely coincidentally) be regarded as a good proxy for global expected returns.
We continue to regard this argument as valid, but it should not be over-interpreted, as implying that only evidence from UK markets should be considered in setting a figure for the market cost of equity. This caveat is of particular importance given the possibility (discussed below) that changes in the measurement of UK RPI inflation may introduce new distortions. Since this is a UK-specific problem, it becomes all the more important to take into account evidence from other markets." See Smithers and Co (2014), "The Cost of Equity Capital for Regulated Companies: A Review for Ofgem".

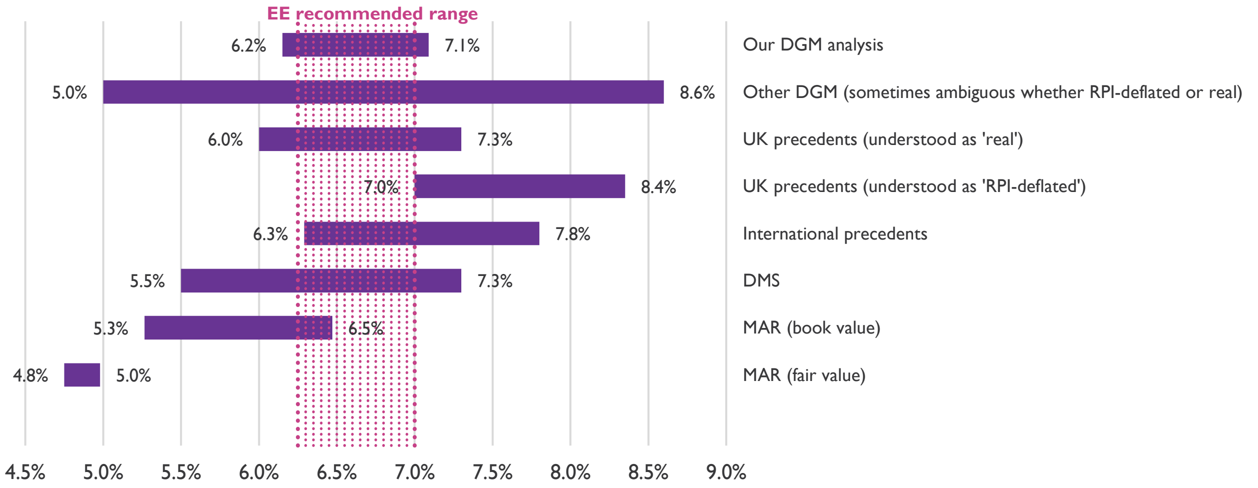
[55] CER (2016), "Irish Water Second Revenue Control 2017-2018"; CER (2015), "Decision on DSO Distribution Revenue for 2016 to 2020", ComReg (2014), "Cost of Capital: Mobile Telecommunications, Fixed Line Telecommunications, Broadcasting (Market A and Market B)"; ARCEP (2015), "Décision n° 2015-1371 de l'Autorité de régulation des communications électroniques et des postes en date du 5 novembre 2015 fixant le taux de

5.3 Conclusion

In developing our view on the plausible forward-looking TMR we considered a vast number of TMR estimates, as illustrated in Figure 5.4 below. The figure includes:

- our DGM analysis — the range is formed by minimum and maximum 5-year averages produced by our DGM models (see Summary of our DGM models in Section 5.2.1);
- other DGM evidence, i.e. evidence produced by other organisation using DGM models (see Other DGM evidence in Section 5.2.1);
- UK precedents — showing the implications of interpreting those determinations as expressed in real or RPI-deflated terms (see Section 5.2.4 for details regarding the precedents and Section 2.3.1 for discussion regarding the distinction between real and RPI-deflated terms);
- international precedents (see Section 5.2.6);
- DMS figures — where the lower end is based on the global figure adjusted downwards by one per cent to account for non-repeatable events, and the upper end is based on the UK historical average unadjusted for non-repeatable events (see Sections 5.2.4 and 5.2.6);
- MAR analysis — distinguishing between the results produced by a model with book value of debt and with a regulatory market value of debt adjustment (see Section 5.2.2).

Figure 5.4: Summary of real TMR results



Note: Figures underlying the 'UK precedents (understood as 'RPI-deflated')' series were produced by taking the regulatory decisions and translating them to real terms using a 2 per cent CPI and 3 per cent RPI assumptions. See the definition of "real returns" on page 14 (Section 2.3.1).
Source: Europe Economics.

Selecting a usable range, for the purposes of regulatory price-setting, from such a vast and contradictory range of evidence, is challenging. It should also be noted that when evidence is so unclear, one should be wary of false precision — there is little reason to believe we can produce a robust estimate of the TMR at anything more than 0.5 (or at best, 0.25) intervals.

We noted in Section 2.3 that uncertainties about the definition of inflation in the UK and challenges in interpreting historic data meant we would place more weight upon forward-looking methods and upon international evidence than has perhaps been standard in previous determinations. International regulatory judgments have lain in the range 6.5-7.0 per cent with the exception of two outliers.

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rémunération du capital employé pour la comptabilisation des coûts et le contrôle tarifaire des activités de télédiffusion régulées pour les années 2016 à 2018"; BNetzA (2017), "Beschlusskammer 4", AEEGSI (2015), "Criteri per la determinazione e l'aggiornamento del tasso di remunerazione del capitale investito per I servizi infrastrutturali dei settori elettrico e gas per il periodo 2016-2021 (TIWACC 2016-2021)".

In our preferred DGM model, the latest forwards-looking estimate is 6.89 per cent and values have been in the range 6.89 to 7.09 per cent in the period since October 2015. For the dividends-based model values have been in the range 6.15 to 6.50 per cent in the period since October 2015 (see Summary of our DGM models above).

We also note that the MAR analysis ranges up to 6.5 per cent, whilst DMS estimates for the UK range down to 6.3 per cent and for the world down to 5.5 per cent if one includes a one per cent adjustment for non-repeatable events.

Bearing these various sources of evidence in mind, our proposed real TMR range, for our purposes here, is **6.25-7.0 per cent**. Noting our preferred forwards-looking model's latest estimate of 6.89 per cent, our proposed **point estimate is 6.75**. Table 5.8 presents the ranges in real, nominal and RPI-deflated terms.

Table 5.8: Total market return — Europe Economics' plausible range conclusion

	Lower end	Point estimate	Upper end
Real	6.25%	6.75%	7.00%
Nominal	8.38%	8.88%	9.14%
RPI-deflated	5.22%	5.71%	5.96%

Note: "Real" is not equivalent to "RPI-deflated" return. See the definition of "real returns" on page 14 (Section 2.3.1).
Source: Europe Economics.

6 Gearing

6.1 General approach

6.1.1 Actual versus notional gearing

It is necessary to distinguish between notional gearing (i.e. the gearing determined for the notional entity's capital-raising at the margin) and actual gearing (i.e. the average gearing of actual firms). There are two key ways notional and actual gearing differ.

First, the actual gearing of firms may not be technically or socially efficient. By 'not being technically efficient' we mean that, as with other parts of the price review such as operational expenditure, firms may not arrange their financial structure so as to provide optimal cost, risk and quality. Notional gearing may differ from actual gearing in being closer to the gearing of a reasonably efficient firm.

Second, a firm's actual gearing, even if debt and equity were raised efficiently when they were raised, may not be in the optimal ratio for new capital raising at the margin now. Notional gearing should be set at a level that would be efficient at the margin.

One potentially important way average gearing might differ from efficient gearing at the margin concerns the fair value of debt. If market equilibrium yields change (e.g. fall) after debt is issued, then the market value of debt will change (e.g. by rising). Consider an extreme case for illustration. Suppose that in year Y a firm raised $£50\mathrm{m}$ in debt and $£50\mathrm{m}$ in equity to fund an RCV of $£100\mathrm{m}$. Then debt would have been raised at $£50\mathrm{m}/(£50\mathrm{m}+£50\mathrm{m}) = 50\%$ gearing. But now suppose we are conducting a price review in year Y+2, and that since Y market yields have halved but equity values remained unchanged, so the market value of the firm's debt has doubled to $£100\mathrm{m}$.[56] Then the firm's actual gearing will be at $£100\mathrm{m}/(£50\mathrm{m}+£100\mathrm{m}) = 66.67\%$. That actual gearing will be the figure relevant for calculations such as the unlevered beta. But if we are considering what the correct ratio is to assume for the firm's future capital-raising (the notional gearing), the more relevant figure might well be the ratio in which it has raised debt and equity in the past — i.e. the debt to RCV of 50 per cent.

In the case of the water sector, a pure fair value approach to gearing is likely to over-deviate from the book value gearing. The reason is that water sector companies have embedded debt allowances, so their revenues depend to some extent on the yields at which they were raised, shielding the company from a portion of market yield movements. That means that instead of pure fair value figures, it is more appropriate to use a "regulatory market value" approach to gearing, defined using a value of debt derived from the weighted average between the fair value of debt and the book value of debt, with weights equal to the proportion of new debt (30 per cent) and embedded debt (70 per cent) respectively.[57]

6.1.2 Iterating using financeability analysis

There is little consensus regarding theories of optimally efficient gearing and regulators typically do not consider calculations of optimally efficient gearing feasible. Instead, they seek to provide a notional gearing that is reasonable. That point is reinforced by the Modigliani-Miller Capital Structure Irrelevance theorem that suggests that (under certain assumptions) capital structure makes no difference to firm value. Although it is widely believe that the Modigliani-Miller theorem cannot be a literal representation of the practical reality

[56] Implicitly, this assumes for the purpose of the thought experiment that these are infinite maturity bonds.

[57] See Section 9.2 for the underlying analysis of the new-to-embedded debt ratio.

for firms in capital-raising, it does seem plausible that for many firms there will be a wide range of capital structures over which the precise capital structure makes relatively little difference.

Let us make this thought concrete with a stylised example. The normal assumption is that, although perhaps for some reason, say, 53 per cent gearing might be the truly optimal level for firm Z, the difference between gearing being 45 per cent and being 60 per cent might be quite small. So it might make little practical difference whether the regulator determined gearing at say 50 or 55 per cent, provided the figure the regulator chose was consistent with figures chosen elsewhere in the review. For example, if the regulator chose a notional gearing of 55 per cent and assumed a credit rating of BBB+, the firm concerned had better be able to achieve a credit rating of BBB+ at 55 per cent gearing, otherwise there is an inconsistency.

The implication here is that, although the regulator may have some latitude to choose gearing in a fairly coarse-grained and to some extent arbitrary manner, it is important to check that the gearing chosen is consistent with the rest of the review. We recommend that the best way to do this is to conduct a financeability analysis using the gearing chosen with the flexibility to adjust the gearing assumption if the financeability analysis reveals an issue. Or to put the point another way, we recommend the gearing assumption should be developed iteratively, beginning with a figure informed by the firms' actual net debt to RCVs and then using financeability analysis to hone that figure once the price control is sufficiently advanced that financeability models including opex, capex and their associated cash-flows, can be developed.

A further point to note regarding gearing concerns how much is it reasonable for a regulator to change notional gearing between one review and another. One basis for consideration here is how much firms have changed or do change their own gearing. Firms themselves sometimes make very marked step changes in their gearing — e.g. if there is a leveraged buy-out or if a firm goes to a zero-equity basis or just engages in some more modest but still significant capital restructuring. Such shifts can be rather large — for example, the ADI takeover of BAA in 2006 changed BAA's gearing from around 54 per cent in 2005 to around 89 per cent in 2006[58]. Regulators might not want to change gearing as much as this at one go (and under some circumstances it may be easier to raise gearing than to reduce it — e.g. if debt is more readily available than equity), but what firms have actually done is important context in considering what is feasible for them to do or to assume would be feasible for a notional firm to do.

In the context of the current review, we do not believe that a shift from 62.5 per cent to, say, 60 per cent gearing constitutes in any way an implausible adjustment. Indeed, we would suggest that even much larger adjustments could be considered candidates — e.g. to 55 or even 50 per cent.

6.2 Provisional analysis methodology

6.2.1 Actual gearing

Actual gearing can be defined in a number of ways, of which three relevant here are:

- book value of net debt to RCV (which we shall refer to as "RCV gearing");
- book value of net debt to book value of net debt plus market capitalisation (referred to in standard financial data-provider sources as "enterprise value", so we refer to this as "enterprise value gearing");
- fair value of net debt to fair value of net debt plus market capitalisation (which we shall refer to as "fair value gearing").

Enterprise value gearing is most abundantly and straightforwardly available at high frequency, as it is the "gearing" measure quoted by standard financial data-providers. For beta estimation, the standard approach has long-been to use 2-year rolling averages of enterprise value gearing. We quote enterprise value gearing

58 Gearing defined as a ratio of net debt to net assets. See BAA plc, BAA results for the year ended 31 March 2006.

figures here both for consistency with past estimates and in order to increase comparability with data on other firms available via standard financial data providers. Fair value calculations can only be done via a time-consuming exercise of consulting company accounts and performing recalculations. Nonetheless, we have obtained fair value gearings for our main two firms so as to cross-check results and to provide an up-to-date spot estimate.

We consider RCV gearing to be primarily of interest for the notional level of gearing.

6.2.2 Notional gearing

There is no one standard approach to estimating notional gearing in UK regulation. Some regulators focus more upon the actual gearing of companies (e.g. Ofcom in its regulation of BT). In other sectors, the "notional" level chosen takes more account of wider factors such as what level of gearing the regulator feels comfortable will not give rise to financial distress over the control period and a request to re-open the control or, even worse, a need to enact special resolution measures.

In practice, this means that the regulator chooses a level of credit rating for the company that it considers compatible with the companies' obligations under their license, with the regulators' duties (if they exist) to ensure that the functions of regulated entities are financeable, and with appropriately low risk for customers that price controls are re-opened or customer services are degraded as a result of companies becoming bankrupt between price reviews.

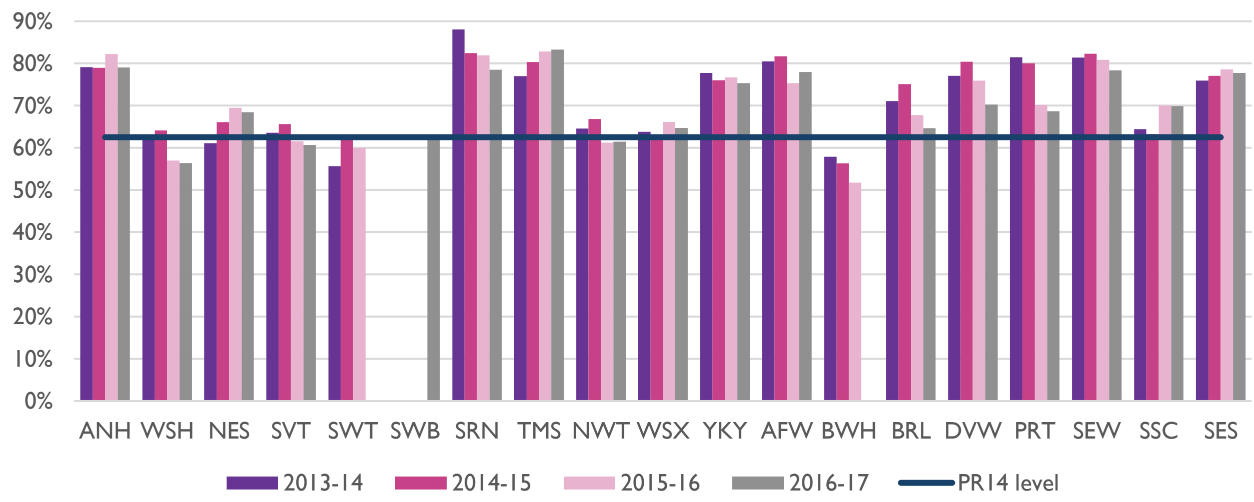
Based on this credit rating, the notional level of gearing is set such that the notional company could secure that credit rating at the overall determined WACC.

6.3 Evidence

6.3.1 Gearing of UK water companies, 2014-17

Below we present the evidence on the actual level of gearing of the UK water companies. Figure 6.1 compares the actual level of gearing in years 2014-2017 with the notional level of gearing at PR14 (i.e. 62.5 per cent). We can see that in most cases the RCV gearing — the ratio of the net book value of debt to RCV — was either close to the notional level or higher. We can also see that there is no significant consistent pattern — gearing for some firms rises but for others falls. There is however perhaps some mild suggestion of a drop, with 10 firms having lower gearing in 2016/17 than in 2014/15, and only 5 firms a higher gearing.

Figure 6.1: Net debt to RCV ratio — 2014-2017

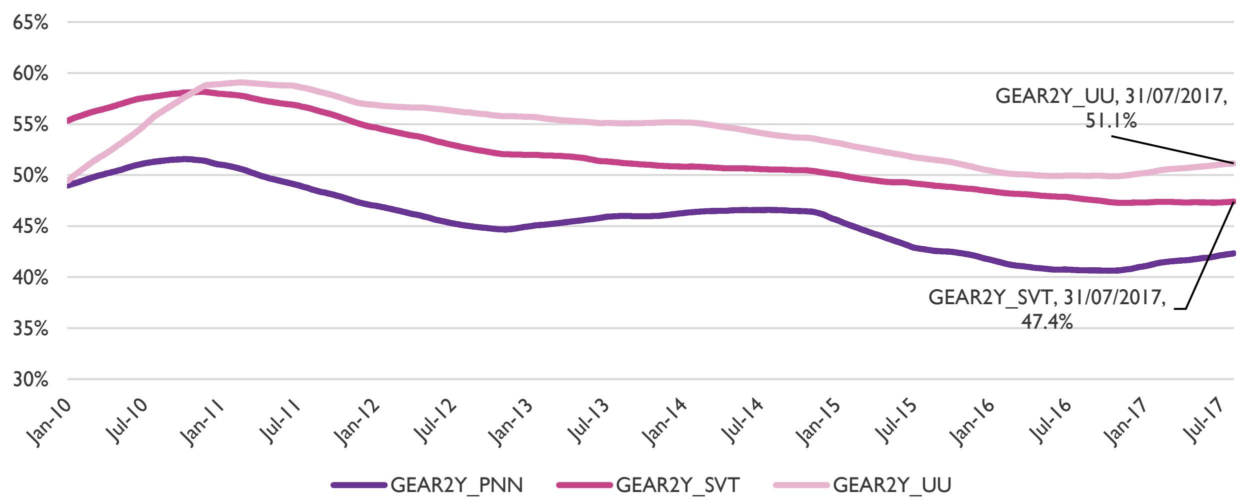


Source: Ofwat.

6.3.2 Our analysis

For companies listed on a stock exchange, in addition to the estimates relative to the RCV, we can also estimate the level of gearing based on enterprise value gearing and fair value gearing. Figure 6.2 illustrates 2-year rolling average levels of enterprise value gearing. We can observe that gearing has been declining in recent years — the average gearing between UU and SVT decreased from around 58 per cent in 2010 to 49 per cent in 2017.

Figure 6.2: Enterprise value gearing — 2yrs rolling average



Source: Thomson Reuters, Europe Economics' calculations.

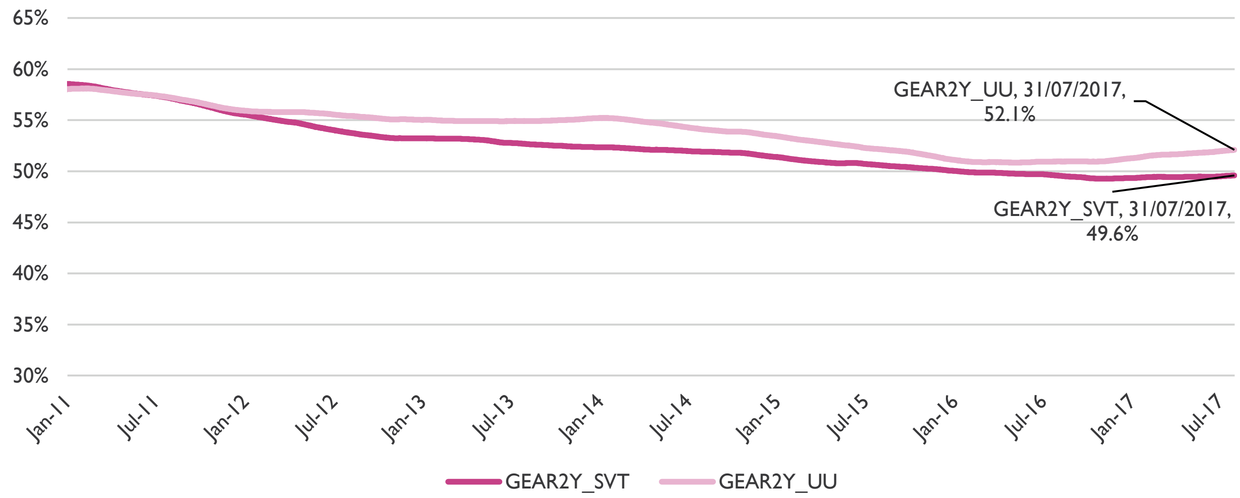
Cross-checking gearing estimates adjusted for regulatory market value of debt

We have also estimated gearing after adjusting for the regulatory market value of debt.[59] Figure 6.3 illustrates 2-year rolling average regulatory market value gearing, where net debt is defined as the regulatory market value of debt less cash, and the total capital value is calculated as the sum of net debt and market capitalisation.

[59] See Section 5.2.2 for more details regarding the market value of debt adjustment.

As of July 2017, regulatory market value gearing was 52 per cent for United Utilities, and 50 per cent for Severn Trent. For comparison, equivalent figures based on the book value of debt (i.e. enterprise value gearing) are 51 per cent for United Utilities and 47 per cent for Severn Trent (see Figure 6.2 above).

Figure 6.3: Regulatory market value gearing — 2yrs rolling average



Source: Thomson Reuters, UU and SVT annual reports, Europe Economics 'calculations.

6.4 Conclusion

Gearing has fallen since PR14. As mentioned above, the average gearing between UU and SVT decreased from around 58 per cent in 2010 to 49 per cent in 2017. We therefore suggest that the initial notional gearing (subject to financeability iteration) should not exceed the PR14 level, and should arguably be set lower. This is consistent with Ofwat's view presented in the PR19 consultation stating that Ofwat is minded to set the gearing level no higher than 62.5 per cent. We propose **60 per cent** as a working assumption. However, for the final determination the appropriate level of notional gearing should be determined iteratively in light of financeability analysis. As noted above, we believe that even a larger shift — to 55 or 50 per cent — in notional gearing could be considered as a candidate for the final determination.

We also note that the actual level of fair value gearing for United Utilities and Severn Trent is materially different from the notional level of 60 per cent. This will have implications for determining the equity betas (see Sections 7.1.2 and 7.2.2).

7 Beta

7.1 Approach

Since three of the UK water companies — namely United Utilities (UU), Severn Trent (SVT) and Pennon (PNN)[60] — are listed on a stock exchange, we can use market information to estimate the beta for at least some water industry firms.

In the current report, the Europe Economics' approach employed to estimate asset betas is consistent with the CAPM model. For the calculations we use daily data on net debt, current enterprise value, equity returns of the three companies and returns of the relevant domestic equity index (i.e. FTSE All Share).

7.1.1 Asset beta and equity beta

Empirical specification

The unlevered equity beta (β_i) measures the covariance between the company (*i*) return over the safe rate with the market return over the safe rate. The equation to be estimated is usually:

$$R_{i,t} = \alpha + \beta_i R_{m,t} + \varepsilon_{it}$$

where $R_{i,t}$ is the log excess return on asset *i* at date *t* (log return net of the logarithmic safe rate), $R_{m,t}$ is the log excess return on the market, α is a constant, β_i is the equity beta, and ε_{it} is an error term — the non-systematic component of the return to the asset — which may display both heteroskedasticity and autocorrelation.

The excess return $R_{i,t}$ is constructed as a data manipulation prior to estimation and is defined as:

$$R_{i,t} = ln\left(\frac{P_t + D_t}{P_{t-1}}\right) - \ln(1 + R_{f,t})$$

where P_t is the price today, D_t is dividend per share that becomes known today, P_{t-1} is the price yesterday, and $R_{f,t}$ is the safe rate available today.

Since a substantial body of academic and regulatory literature supports that the idea the potential bias from not netting off the risk free rate is negligible in most cases, we have therefore opted for carrying out the estimations without netting off the risk-free rate from individual share and market index returns.

Data frequency

In principle daily data are preferred to weekly, monthly, or yearly data because they allow estimates on larger samples. However, as Smithers and Co (2003) illustrate, a concern with the use of daily data is represented by the possibility of returns being serially correlated, while this risk is likely to be less material in the presence of weekly or monthly data. Nevertheless, Smithers and Co (2003) point out that it is possible to control for autocorrelation by using the Newey-West correction method in order to obtain consistent standard errors. Furthermore, if there are reasons to believe that heteroskedasticity may also be a problem, the Newey-West method corrects for it as well.

[60] Pennon is the parent company of South West Water.

We have therefore decided to estimate equity betas on daily data, and we have carried out the estimations controlling for both heteroskedasticity and serial correlation using the Newey-West correction method. For reference, we also estimated the betas using weekly and monthly data.

Estimation period

Equity betas vary over time. This might be because of changes in gearing or changes in the underlying correlations between company and aggregate returns (i.e. asset betas). We therefore place most weight upon an estimation window that is as recent as possible, because today's observation is the forward looking estimate. On the other hand, the more historic data points are used to calculate each beta (the more days back in time, say, that the data window extends over which we are comparing variation in the stock's value with variation in the market as a whole), the more statistically significant results will be.

Smithers and Co (2003) note that gains in estimation accuracy become less as more observations are added. For example, going from one year to two years of daily data (i.e. around 250 observations to around 500 observations) will reduce the standard error by 40 per cent, but going from three to four years only reduces the error by 15 per cent.

It would be possible to use an explicit time-series estimation technique to account for the time variation. However, these techniques, as noted by Smithers and Co (2003), are susceptible to over-fitting and can find apparent time variation where none exists. The techniques are also non-linear and not widely used for regulatory purposes.

We have therefore adopted the Smithers and Co (2003) recommendation and have based our analysis primarily on two years rolling betas. As additional cross-checks we also estimate betas on 1-year and 5-year windows of daily data.

Adjustments to estimated betas

Two main adjustments, the so-called Bayesian and Blume adjustments, have been used in some past estimations of beta, with the effect of bringing the estimated betas closer to one.

The argument for Bayesian adjustment is that the estimation of beta ignores the fact that the beta of an average company is by definition equal to one. The Bayesian adjustment takes account of measurement uncertainty (as estimated explicitly in the calculation of the raw beta) by employing a weighted average between the beta estimate for the company and a constructed average beta for the market as a whole that would be equal to one. The weights are based on the relative uncertainty in measurement — the higher the uncertainty in the company beta estimates relative to the variance of all betas in the market, the less weight is placed on the company beta. The Blume adjustment is based on an empirical observation (made in 1971) that betas tended to move towards one over a (long) time period. Mean reversion is sometimes offered as an explanation for this observed movement. In later investigations, however, Blume found that the reasons for the movement in the betas had to be explained by some real changes in the perceived risks of the companies — the tendency for companies to evolve could mean that companies of extreme risk (high or low) tend to have less extreme risks over time.

Our view is that the use of the Blume adjustment is arbitrary and inappropriate. A Bayesian adjustment has a stronger theoretical rationale and we have explored the use of Bayesian adjustments here but have found that they are so small that they have no impact at the second significant figure.[61] This is in line with the findings

[61] We have also estimated the impact that a Bayesian (Vasicek) adjustment would have on the beta of United Utilities and Severn Trent. For practical purposed, the Bayesian adjustment has been caluclated bases on the FTSE 100 (as opposed to the FTSE All Share). The Bayesian adjustment is computed according the following equation:

of Smithers and Co (2003) that in practice Bayesian adjustments are unlikely to make a material difference if daily data are used in the estimation.

De-levering equity beta into asset beta

When comparing the betas of different firms, one has to take into account the different gearing levels that firms choose since (other things being equal) a firm with higher gearing will exhibit a higher equity beta and there is a difference here between the gearings of the firms we are considering and between their gearing and the notional gearing.

Asset betas are calculated in order to control for the effect of differing levels of gearing. An asset beta is a hypothetical measure of the beta that a firm would have if it were financed entirely by equity. By comparing different firms' asset betas it is possible to isolate shareholders' perceptions of underlying systematic risk, and carry out an assessment of the relative riskiness of different companies after controlling for gearing. Another useful concept is the "unlevered beta", which is simply the equity beta multiplied by the portion of total capital that is equity.

Asset betas are calculated using the following formula:

$$\beta_A = (1-g)\beta_{E_{raw}} + g\beta_{D,}$$

where $\beta_{E_{raw}}$ is the "raw" equity beta, $(1-g)\beta_E$ is the "unlevered beta", β_D is the debt beta, g is the actual enterprise gearing.

When the debt beta is assumed, for calculation purposes, to be zero, the role of the asset beta is instead played by the unlevered beta, β_U:

$$\beta_U = (1-g)\beta_{E_{raw}}$$

Based on the above the relationship between equity beta and asset beta is therefore expressed by the following formula:

$$\beta_{E_{raw}} = \frac{\beta_A - g\beta_D}{(1-g)}$$

or, alternatively:

$$\beta_{E_{raw}} = \beta_A + (\beta_A - \beta_D)\left(\frac{D}{E}\right)$$

where *D* is the company's debt and *E* is the company's equity.[62]

It is important to stress that, since interest payments on debt are tax-deductible, specific assumptions on firms' financing rule can have an implications for the relationship between equity beta and asset beta. The formula commonly used in UK regulatory practice is that proposed by Brealey and Myers.[63] The assumption

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$$\beta_{Adj} = \left(\frac{Var\ Pop.}{Var\ Pop. + (SE\ beta\ regress.)^2}\right)\beta_i + \left(\frac{(SE\ beta\ regress.)^2}{Var\ Pop. + (SE\ beta\ regress.)^2}\right)$$

where $Var\ Pop.$ is the variance of across all the equity betas of the FTSE 100 constituents (all betas have been estimated based on daily data covering the period 31-Jul-2015 -31-Jul-2017), and $SE\ beta\ regress.$ is the standard error of the OLS regression to estimate the company-specific beta (i.e. β_i). Base on the above calculation we found the adjustments for Unitised Utilities and Severn Trent betas to be nugatory, i.e. 0.00030 and 0.00028 respectively.

62 It is perhaps worth noting the following definitions. Debt beta: A measure of undiversifiable risk faced by debt investors. "Unlevered beta" is a measure of the undiversifiable risk that investors would face if the assets were 100 per cent equity financed, based on the calculating assumption that the debt beta is zero. Asset beta is a measure of the actual undiversifiable risk faced by investors in an underlying asset, including the true debt beta.

63 See p. 555 of Brealey and Myers (2000) "Principles of Corporate Finance", *McGraw-Hill,* Sixth Edition.

underlying this formula is that firms rebalance their debt-to-equity ratio continuously, i.e. in each period they adjust the debt so as to keep it at a constant fraction of the enterprise value (Brealey and Myers refer to this assumption as “Financing Rule 2”).[64] The same formula is proposed by Harris and Pringle (1985)[65] who argue that the systematic risk of the interest rate tax shields is identical to that of the firm’s underlying cash flow, and as a result, tax shields should be discounted at the required return to assets.

However, other formulae have been developed to reflect different financing rule assumptions. For example if the amount of debt (rather than the proportion of debt) is kept constant over time (this is referred to as “Financing Rule 1” in Brealy and Myers (2000)), the relationship between equity beta and asset beta (assuming a zero debt beta) follows the Hamada equation[66]:

$$\beta_{E_{raw}} = \beta_A + \beta_A \left(\frac{D}{E}\right)(1-T)$$

In our view, the assumption of a constant capital structure rather than a constant amount of debt is likely to better reflect the situation in a utility with frequent new investments and debt rollover opportunities (though neither assumption is perfect). The Financing Rule 1 assumption seems more naturally applied in a setting where a company raises debt once and self-liquidates at the end of its one-off financed project, when debts are repaid in one go. Furthermore, the assumption that the tax shield is subject to the systematic risk of the company as a whole seems more plausible than alternatives such as its being subject only to the systematic risk of the cost of debt. After all, if the company were not paying tax, it would need to raise less capital overall, not simply less debt (say). Accordingly, we use Financing Rule 2.

Gearing measures used for unlevered beta

The different gearing measures are discussed above in Chapter 6 on Gearing. We calculate unlevered betas based on enterprise value and book value of debt and also using fair value gearing with data obtained from United Utilities' and Severn Trent's annual reports.

Re-levering asset beta into equity beta

Once a decision is taken on what is the appropriate asset beta value for UK water companies, this can be expressed back as equity beta through a re-levering exercise which makes use a notional gearing level g (see Chapter 6 for a discussion on Gearing), through the following formula:

$$\beta_E = \frac{\beta_A - g_N \beta_D}{(1-g_N)},$$

where g_N is the notional gearing. The value of debt beta will directly affect the asset betas and the re-levered equity betas.

7.1.2 Debt beta

The cost of new debt for water companies is higher than the risk-free rate — there is a “debt premium". That means, by definition, that market participants (rightly or wrongly) believe there is some probability of water companies defaulting on their debts.[67] Such defaults create a wedge between the risk-free rate and the cost of new debt in two ways. First, a default probability creates a wedge between the promised cost of debt

64 See p. 560 of of Brealey and Myers (2000) “Principles of Corporate Finance”, *McGraw-Hill,* Sixth Edition.

65 Harris, R.S. and J.J. Pringle (1985), “Risk-Adjusted Discount Rates Extension from the Average-Risk Case”, *Journal of Financial Research*, (Fall), 237-244.

66 Hamada, R.S. (1972), “The Effect of Firms’ Capital Structure on the Systematic Risk of Common Stock”, *Journal of Finance*, 27: 435-452.

67 We note that defaults have been very rare in developed economy utilities sectors. Nonetheless, the market data indicates that market participants do perceive some risk of default.

and the expected cost of debt: because the amount promised might sometimes not be paid, the expected cost of debt must (by definition) be lower than the promised cost of debt.

$$expected\ return\ on\ debt = prob(default) \cdot \%\ loss\ given\ default + \left(1 - prob(default)\right) \cdot promised\ cost\ of\ debt.$$

Secondly, if there is a correlation between when defaults are most likely to occur, or the losses on default when defaults occur, and the broader returns cycle, there will be a yield cost reflecting the systematic risk borne — i.e. a debt beta.

The CAPM applies to any asset — an electricity grid, a plastics bottle-making machine, an equity claim on a telecoms firm or a debt claim on a water network. So the expected cost of debt can be expressed, in the CAPM, as

$$expected\ return\ on\ debt = RFR + \beta_D \cdot ERP,$$

It is worth observing the relationship between the probability of default, the loss given default and the debt beta. For any given debt premium, the lower the probability of default and loss given default, the higher the debt beta must be. Conversely, the lower the debt beta, the higher the probability of default and loss given default must be. The assumption of a zero debt beta is equivalent to the assumption that all of the debt premium is to be accounted for by the probability of default and loss given default and that no default risk has a systematic component. That will not typically be correct.

However, when adjusting for small differences in gearing, it is often mathematically convenient to assume a debt beta of zero because even with a debt beta of 0.1 or 0.2, the mathematical impact would only arise at the second or third significant figure.

In this case, however, the enterprise value gearing of listed companies differs materially from the notional gearing. Average enterprise value gearing across the three listed water companies — both 1yr and 2yrs rolling averages — is 48 per cent as on July 2017 and the average excluding Pennon is 49 per cent (see Figure 6.2), whilst the notional gearing level is 60 per cent. Hence, unlevered betas must be re-levered at a materially different gearing. In such a situation it is inappropriate to assume a zero debt beta in order to determine the asset beta.

This is illustrated in Table 7.1 which shows that:

- when debt beta equals zero, unlevered betas are identical with asset betas, and the actual level of gearing has no impact on re-levered betas;
- when actual gearing is the same as notional gearing, then non-zero debt beta will affect asset betas but not re-levered betas;
- when actual gearing differs from notional gearing, this difference has a direct impact on re-levered betas.

Table 7.1: Debt beta mechanics — illustration

Actual gearing	Unlevered betas	Debt betas	Asset betas	Notional gearing	Re-levered betas
Debt beta equals zero					
	0.30	0.00	0.30	60%	0.75
Actual gearing equals notional gearing					
60%	0.30	0.10	0.36	60%	0.75
60%	0.30	0.15	0.39	60%	0.75
Actual gearing is different from notional gearing					
50%	0.30	0.10	0.35	60%	0.73
50%	0.30	0.15	0.38	60%	0.71

Source: Europe Economics.

In order to determine the appropriate level of debt beta, we proceed as follows.

We recall the definition of the expected return on debt.

$$\begin{aligned} &expected\ return\ on\ debt \\ &\qquad = prob(default) \cdot \%\ loss\ given\ default + \big(1 - prob(default)\big) \\ &\qquad \cdot promised\ cost\ of\ debt. \end{aligned}$$

The definition of the debt premium is that

$$debt\ premium = promised\ cost\ of\ debt - RFR,$$

where RFR stands for risk-free rate, and which is equivalent to:

$$promised\ cost\ of\ debt = RFR + debt\ premium\,.$$

From those two equations it follows that:

$$\begin{aligned} &expected\ return\ on\ debt \\ &\qquad = prob(default) \cdot \%\ loss\ given\ default + \big(1 - prob(default)\big) \cdot (RFR \\ &\qquad + debt\ premium) \end{aligned}$$

As noted above, from the CAPM we know that:

$$expected\ return\ on\ debt = RFR + \beta_D \cdot ERP,$$

and therefore

$$\beta_D = \frac{\big(1 - prob(default)\big) \cdot debt\ premium - prob(default) \cdot (RFR + \%\ loss\ given\ default)}{ERP}.$$

RFR, ERP and $debt\ premium$ are WACC components which we estimate in this report. With probability of default and percentage loss given default based on external sources (such as credit rating agencies' reports), we could in principle calculate a debt beta (but see Section 7.2.2).

7.2 Evidence

7.2.1 Unlevered betas

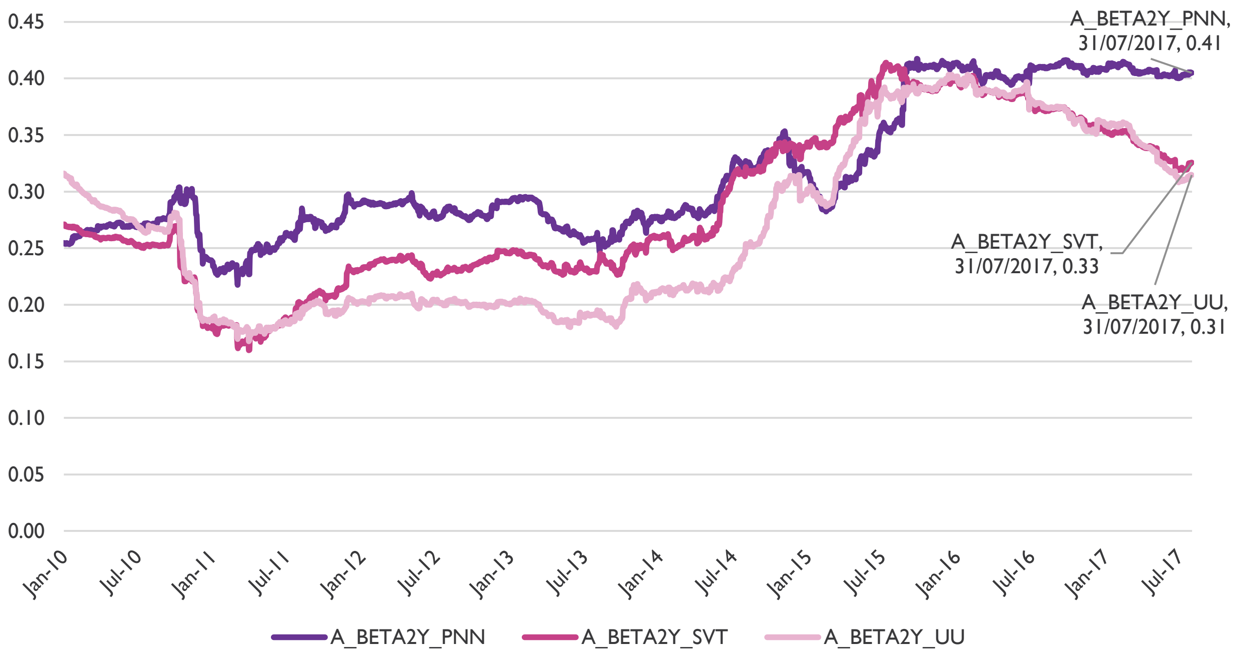
In this section we present the evidence regarding unlevered betas. We show the evolution of betas using data of different frequencies and different trailing windows for the analysis. In particular:

- Figure 7.1 shows betas for individual companies based on daily data and one-year trailing window;
- Figure 7.2 shows betas for individual companies based on daily data and two-year trailing window;
- Figure 7.3 shows betas for individual companies based on daily data and five-year trailing window;
- Figure 7.4 shows betas for individual companies based on weekly data and two-year trailing window;
- Figure 7.5 shows betas for individual companies based on weekly data and five-year trailing window;
- Figure 7.6 compares average betas for United Utilities and Severn Trent based on daily and weekly data, both estimated using two-year trailing window;
- Figure 7.7 compares average betas for United Utilities and Severn Trent based on daily, weekly and monthly data, all estimated using five-year trailing window.

Figure 7.1: Daily unlevered beta — 1yr trailing window

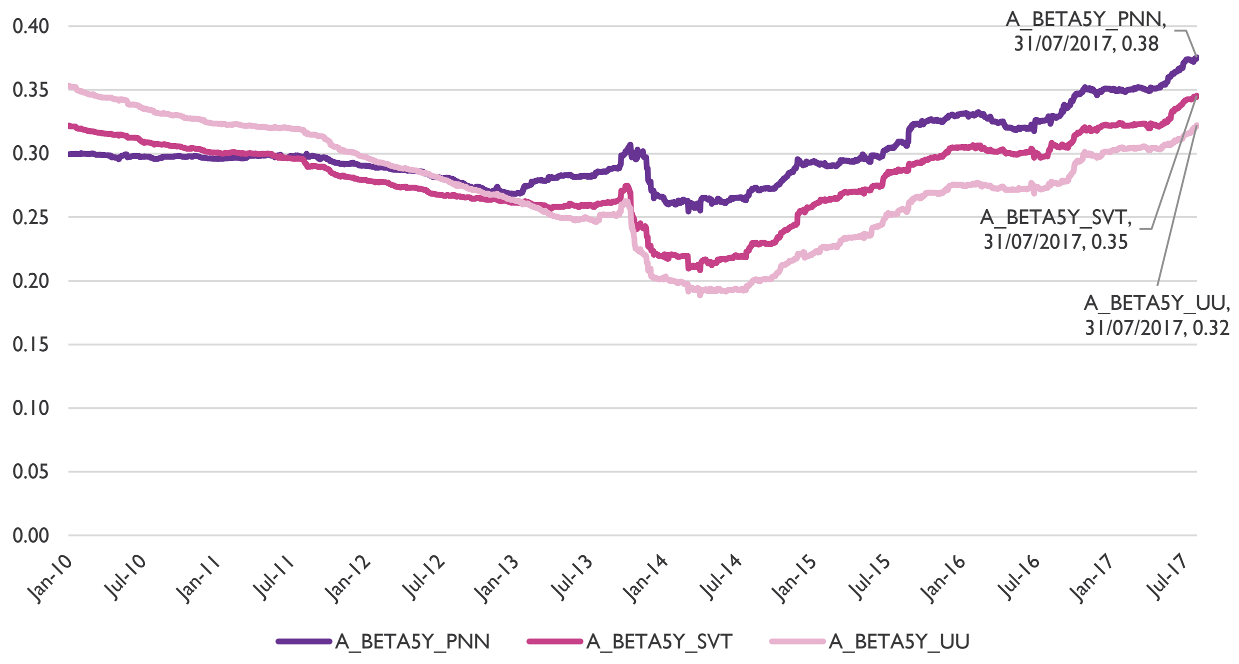
Source: Thomson Reuters, Europe Economics' calculations.

Figure 7.2: Daily unlevered betas — 2yrs trailing window



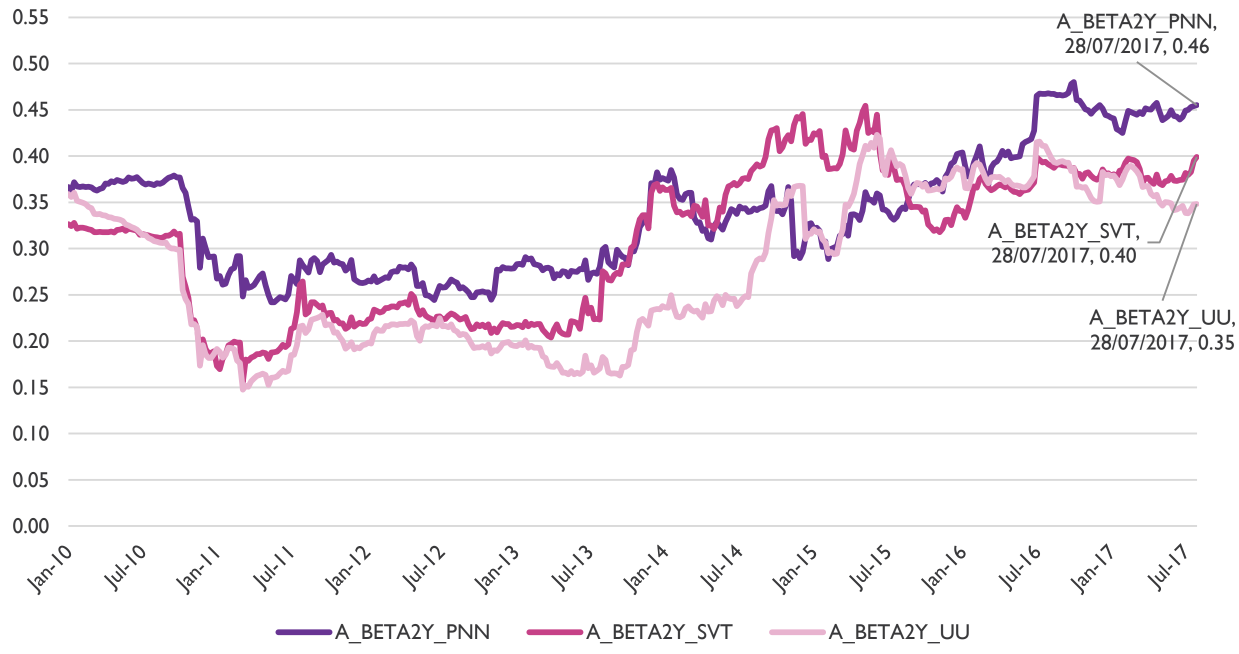
Source: Thomson Reuters, Europe Economics' calculations.

Figure 7.3: Daily unlevered betas — 5yrs trailing window



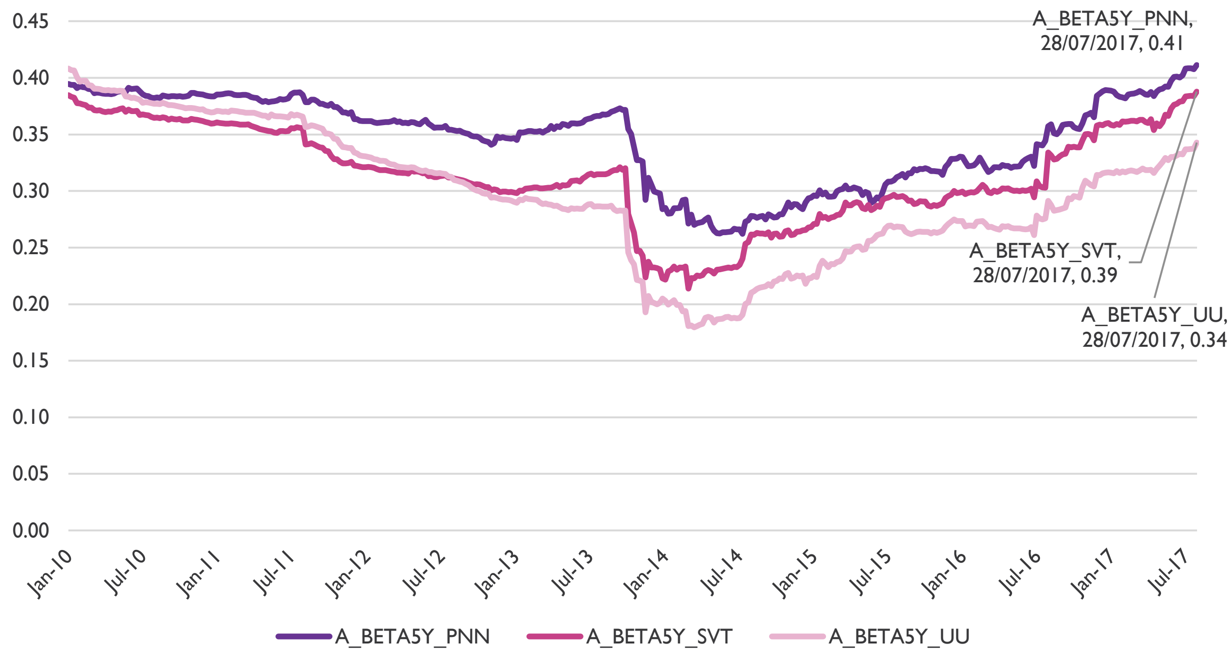
Source: Thomson Reuters, Europe Economics' calculations.

Figure 7.4: Weekly unlevered betas — 2yrs trailing window



Source: Thomson Reuters, Europe Economics' calculations.

Figure 7.5: Weekly unlevered betas — 5yrs trailing window

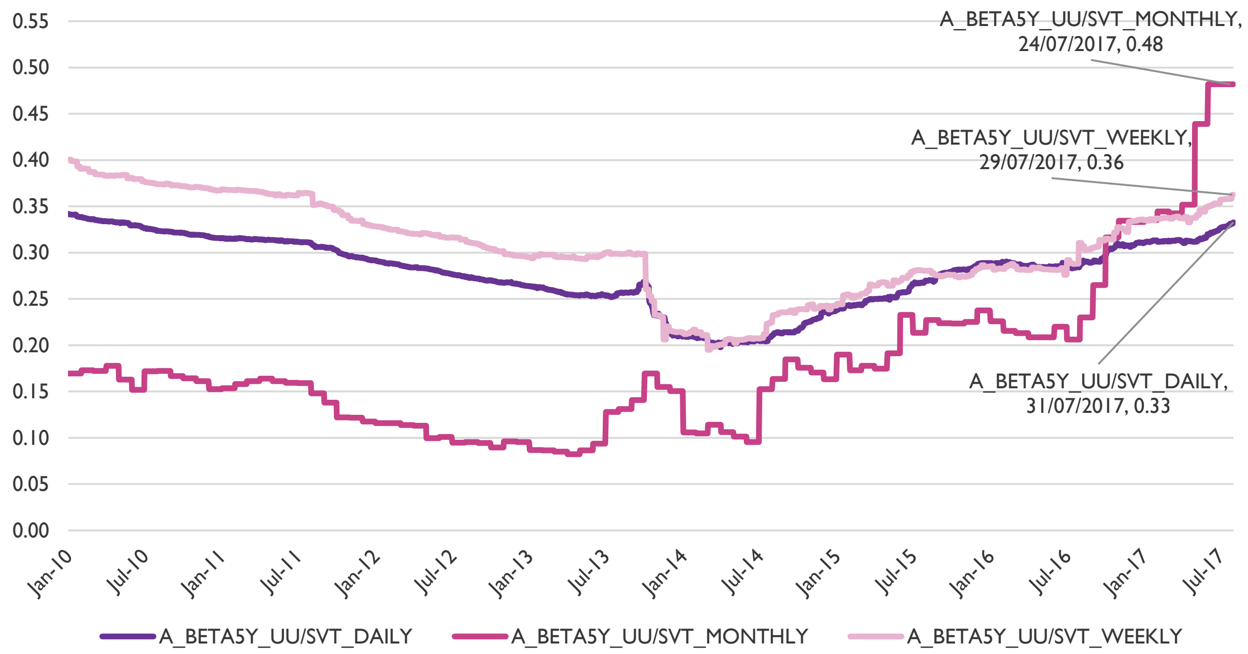


Source: Thomson Reuters, Europe Economics' calculations.

Figure 7.6: Daily and weekly UU/SVT average unlevered betas — 2yrs trailing window

Source: Thomson Reuters, Europe Economics' calculations.

Figure 7.7: Daily, weekly and monthly UU/SVT average unlevered betas — 5yrs trailing window



Source: Thomson Reuters, Europe Economics' calculations.

Based on our analysis, we argue that:

- the estimates based on daily data are better than the estimates based on weekly or monthly data as daily estimates they rely on larger sample sizes — confidence intervals are significantly narrower compared to those of estimates based on weekly or monthly data;
- the estimates based on 2-years trailing windows (see Figure 7.2) are better than those based on shorter and longer trailing windows as, on the one hand, they ensure robustness in terms of number of observations and, on the other, they reflect recent movements in betas.[68]

Table 7.2 summarises the estimates of unlevered betas for each of the companies and the weighted average for the water sector (i.e. for all three companies) as well as the weighted average for United Utilities and Severn Trent only. Alongside the central estimates we report the upper and lower end of the 95 per cent confidence intervals. Based on the average for United Utilities and Severn Trent, we propose the unlevered beta range to be between **0.27 and 0.37**.

Table 7.2: Unlevered betas — summary of results

	1yr daily unlevered betas			2yrs daily unlevered betas		
	-95% cf.	Central	+95% cf.	-95% cf.	Central	+95% cf.
PNN	0.24	0.38	0.51	0.34	0.41	0.47
SVT	0.16	0.27	0.37	0.28	0.33	0.37
UU	0.14	0.24	0.35	0.27	0.31	0.36
UU/SVT	0.15	0.25	0.35	**0.27**	0.32	**0.37**

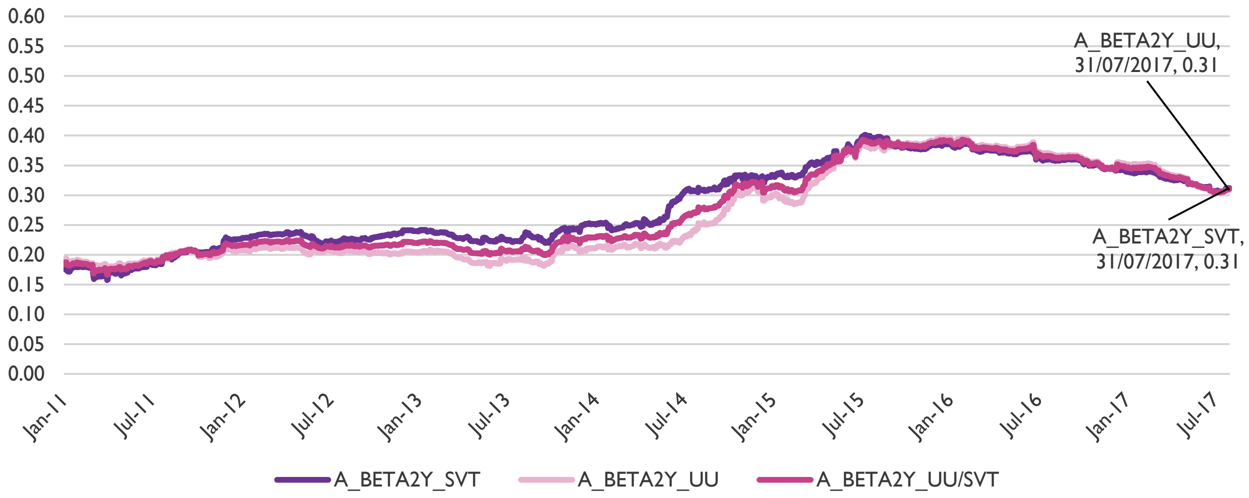
Source: Europe Economics.

[68] If beta data were available for a wide range of firms in the industry, we believe that an industry-wide beta would be better. However, in this context we have data only from two firms, so it is more transparent to report the figures separately. We note that, although data is available for Pennon, it includes a large proportion of non-regulated water assets. We have nonetheless cross-checked our results adding in Pennon in proportion to its asset size and doing so would not fundamentally change our results.

Cross-checking beta estimates with regulatory market value of debt adjustment

As a cross-reference we also estimated unlevered betas after adjusting for regulatory market value of debt.[69] Figure 7.8 illustrates the daily unlevered betas using as an input regulatory market value of debt rather than book value of debt. As of the end of July 2017, the unlevered betas based on 2-year trailing window was 0.31 for Severn Trent and United Utilities.

Figure 7.8: Daily unlevered betas adjusted for regulatory market value of debt — 2yrs trailing window



Source: Thomson Reuters, UU and SVT annual reports, Europe Economics' calculations.

Conclusion on unlevered beta

Our enterprise-value gearing based unlevered beta point estimate, under the preferred data window of two years, is 0.32 (Table 7.2). Our fair value beta equivalent is 0.31 (Figure 7.8). Regulatory precedent for the water sector has long favoured an unlevered beta in the region of 0.3, but one should acknowledge that that figure is lower than recent regulatory precedent in other to-some-extent comparable sectors such as gas networks. Amongst the qualitative reasoning the only factor we believe likely to affect systematic risk (as opposed to changing idiosyncratic risks for firms and affecting their incentives) is debt indexation, which should reduce systematic risk. The reason for such reduction is that debt indexation is a form of insurance for firms against adverse movements in financing costs, and is thus a transfer of systemic risk from companies to consumers. The transfer of such risk to consumers should therefore reduce systematic risks for firms. However, though the principle that debt indexation will reduce systematic risk is clear, the degree to which that is so (or indeed whether it is material at all) is less clear.

Other changes in Ofwat's methodology are unlikely to affect betas. In particular:

- introducing more competition might increase companies' exposure to volume risk (e.g. erosion of market shares), however such risk is non-systematic and hence diversifiable for investors (one firm's market share loss is another firm's market share gain and an investor in both firms would be left in a neutral position);
- the switch from RPI to CPIH should not affect betas, especially since CPI(H) has been less volatile than RPI and thus, if anything, could contribute to a reduction in risk;
- more challenging efficiency and ODI targets would — if they increased risks — increase them at the company-level, hence such risks should be diversifiable and thus non-systematic.

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[69] See Section 5.2.2 for more details regarding the market value of debt adjustment.

Accordingly, although there could be an argument for raising the unlevered beta to slightly above 0.3 (as indeed the CMA did in 2016) we believe the correct implication to draw at this time (pending more data by the end of the PR19 period) is that we should maintain the unlevered beta at **0.3**.

7.2.2 Debt betas

In section 7.1.2, we developed a formula allowing us to illustrate the order of magnitude of debt beta based on the risk free rate (RFR), equity risk premium (ERP), debt premium, probability of default and percentage loss given default.

$$\beta_D = \frac{\left(1 - prob(default)\right) \cdot \ debt\ premium - prob(default) \cdot \ (RFR \ + \%\ loss\ given\ default)}{ERP}.$$

We estimated the values of the RFR (see Section 4) $debt\ premium$ (see Section 10.5 for cost of new debt estimates), and ERP (see Section 5.2.6 for TMR estimates). These estimates are: $RFR = 2.0\%$, $debt\ premium = \ 1.62\%$, and $ERP = \ 6.75\%$.

To illustrate the interaction between the debt beta, the probability of default and the loss given default, let us first suppose that $prob(default) = 0.2\%$, and $\%\ loss\ given\ default = 20\%$.[70]

Then, we obtain $\beta_D = 0.23$. If the probability of default is lower, , debt beta will be higher. For example, if we assume that $prob(default) = 0.01\%$, $\beta_D = 0.24$.

Such analysis implies debt beta is unlikely to be less than 0.2 or more than 0.25. However, in the Competition Commission (CC) hearings on the CAA Q5 review[71], the CC argued that as well as adjusting for the probability of default, the debt beta should incorporate a "liquidity" factor (which would fall outside CAPM).[72] This took down the CC's estimate to 0.09-0.19. The CC then argued that because this was the first time a debt beta was being used, it would take a value from the bottom end of the range, and adopted an estimate of 0.1. The same debt beta was used by the CC in Bristol Water review.[73] Moreover, Ofcom used a debt beta of 0.1 in the 2017 Wholesale Local Access Market Review.[74]

Conclusion on debt betas

Our view remains that a debt beta estimate of around 0.2 is most likely to be accurate, but regulatory precedent favours values in the 0.1-0.15 range. Accordingly, we have based our calculations of asset beta and our re-levering calculations upon a **0.10-0.15** debt beta.

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70 We have taken the 0.2 per cent as a rounding of the median in Table 19 of S&P Global (2015), "2015 Annual Global Corporate Default Study And Rating Transitions". The 20 per cent is a typical estimate of "costs of bankruptcy" across many sectors. There would be almost no difference to the results if, for example, loss given default were to be 10 per cent.

71 See paragraphs 4.88-4.90 of CC (2007), "BAA Ltd: A report on the economic regulation of the London airports companies (Heathrow Airport Ltd and Gatwick Airport Ltd)".

72 The CC argued that by including liquidity cost in the calculation of debt beta they are saying "that a firm's cost of debt includes a certain number of basis points to compensate lenders for holding illiquid assets and a certain number of basis points to cover the expected costs of default, neither of which can strictly speaking be ascribed to the notion that lenders require compensation for bearing systematic risk. By stripping out these premia, we are left with a measure of the pure 'risk premium' which in turn can be used to estimate a debt beta." See CC (2007), "Heathrow Airport Ltd and Gatwick Airport Ltd price control review", Appendix F, paragraph 97.

73 See Appendix N of CC (2010) "Bristol Water Plc price determination". It should also be noted that the CMA (the Competition and Markets Authority) did not use debt beta in the latest 2015 Bristol Water review arguing that the "debt beta has very little impact on the overall cost of capital if Bristol Water's gearing level (and the level of gearing used to calculate the WACC) is similar to the comparators used to estimate the asset beta". See CMA (2015), "Bristol Water plc" final report, paragraph 10.150.

74 See Ofcom (2017), "Wholesale Local Access Market Review – Annexes", paragraph A16.101.

7.2.3 Asset betas and re-levered (equity) betas

Taking our working value for unlevered beta of 0.30, the re-levered (equity) beta with the assumed debt beta of 0.15 is 0.71, and 0.72 with the assumed debt beta of 0.10.

Table 7.3: Re-levering betas — based on unlevered beta point estimate

Actual gearing	Unlevered beta	Debt beta	Asset beta	Notional gearing	Re-levered (equity) beta
49%	0.30	0.00	0.30	60%	0.75
49%	0.30	0.10	0.35	60%	**0.72**
49%	0.30	0.15	0.37	60%	**0.71**
49%	0.30	0.20	0.40	60%	0.70

Source: Europe Economics.

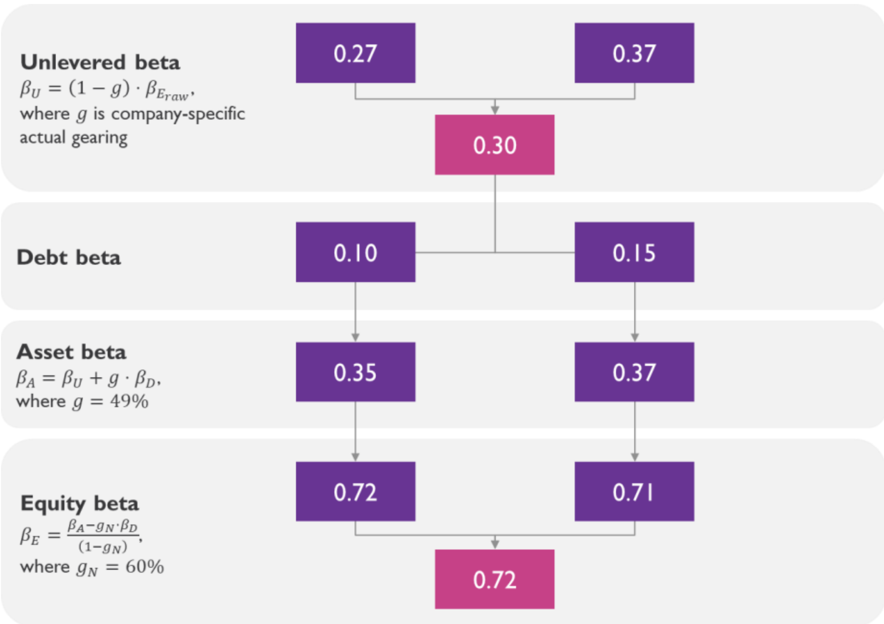
Conclusion on re-levered (equity) beta range

Our proposed range for re-levered beta is **0.71-0.72** based on 60 per cent notional gearing. The lower end if based on the figure produced with 0.15 debt beta, and the upper end is produced with 0.10 debt beta. Both ends are based on unlevered beta of 0.30. Rounding the centre-point of that range, our proposed **point estimate is 0.72**.[75]

7.3 Conclusion

Our proposed beta ranges are based on the model using book value of debt. Our conclusions are summarised in Figure 7.9 below.

Figure 7.9: Betas — conclusion



Source: Europe Economics.

[75] The wholesale WACC could in principle be disaggregated across the supply chain. However, at this stage, as set out in Section 8.3 our view is that there is not a robust basis for assigning different parts of the wholesale supply chain differing betas or gearing levels.

8 Overall Cost of Equity

In this section we set out our view on the overall appointee cost of equity, then discuss whether there is a basis for adding a small company premium to the cost of equity or having different costs of equity for different wholesale controls (Sections 8.2 and 8.3).

8.1 Conclusion on appointee cost of equity

We calculate the overall appointee cost of equity based on our estimates of the risk free rate (see page 27), total market return (see page 42), and equity beta (see page 60). Our proposed range for real cost of equity is **4.53-5.18 per cent**, and the **point estimate is 4.86 per cent**.

Table 8.1: Overall cost of equity (post-tax) — real

	Low	Point estimate	High
Notional gearing (page 47)	60%	60%	60%
Total market return (page 42)	6.25%	6.75%	7.00%
Risk-free rate (page 27)	-0.29%	0.00%	0.50%
Equity-risk premium	6.54%	6.75%	6.50%
Debt beta (page 59)	0.15	0.125	0.10
Asset beta (page 60)	0.37	0.36	0.35
Re-levered (equity) beta (page 60)	0.71	0.72	0.72
Cost of equity (post-tax)	**4.35%**	**4.86%**	**5.18%**

Note: "Real" is not equivalent to "RPI-deflated ". See the definition of real returns on page 14 (Section 2.3.1).
Source: Europe Economics.

Below, we also present the cost of equity in nominal (Table 8.2) and RPI-deflated (Table 8.3) terms.

Table 8.2: Overall cost of equity (post-tax) — nominal

	Low	Point estimate	High
Notional gearing (page 47)	60%	60%	60%
Total market return (page 42)	8.38%	8.88%	9.14%
Risk-free rate (page 27)	1.70%	2.00%	2.51%
Equity-risk premium	6.68%	6.88%	6.63%
Debt beta (page 59)	0.15	0.125	0.10
Asset beta (page 60)	0.37	0.36	0.35
Re-levered (equity) beta (page 60)	0.71	0.72	0.72
Cost of equity (post-tax)	**6.44%**	**6.96%**	**7.28%**

Source: Europe Economics.

Table 8.3: Overall cost of equity (post-tax) — RPI-deflated at 3 per cent RPI

	Low	Point estimate	High
Notional gearing (page 47)	60%	60%	60%
Total market return (page 42)	5.22%	5.71%	5.96%
Risk-free rate (page 27)	-1.26%	-0.97%	-0.48%
Equity-risk premium	6.48%	6.68%	6.44%
Debt beta (page 59)	0.15	0.125	0.10
Asset beta (page 60)	0.37	0.36	0.35
Re-levered (equity) beta (page 60)	0.71	0.72	0.72
Cost of equity (post-tax)	**3.34%**	**3.84%**	**4.16%**

Note: See page 14 (Section 2.3.1) for discussion on the distinction between real returns and RPI-deflated returns.
Source: Europe Economics.

8.2 Lack of a basis for a small company premium for the cost of equity

For completeness, we note that, as at PR09 and PR14, we do not believe that finance theory, general empirical evidence, or evidence from the UK water sector in particular, supports the view that there should be a water-only company (WoC) cost of equity premium or small company premium. Regarding the small company premium, the CMA argued that "[s]ize alone did not support the need for an uplift",[76] and therefore we shall not repeat past discussions here.

However, that leaves open the question of whether differences in the nature of a water-only business versus a water and sewerage business (regardless of size) might entail differences in betas. The 2010 CC judgement and the 2015 CMA judgement in the Bristol Water appeals both accepted that Bristol Water's business has a higher operating leverage than those of Water and Sewerage companies and that this implies a different exposure of equity to systematic risk. In 2010 the adjustment was a rise in the unlevered beta of 18 per cent (which the CC said explicitly was an overstatement of the effect[77] whilst in 2015 the adjustment was 13 per cent, raising the unlevered beta to 0.32.

In interpreting this issue it is important to begin by being clear as to what is being said. This is not a small company premium. It is an operational gearing adjustment. Operational gearing adjustments are appropriate when underlying general systematic risk exposure is similar but business models differ, so operating costs will vary and will vary in their responsiveness to economic shocks. That means that if a cost of capital is to be applied to regulatory building blocks that involve costs calculated from an entity with materially higher or lower operational gearing, the cost of capital associated with that materially higher or lower gearing needs to be calculated so that operational and capital expenses are calculated on an apples-to-apples basis.

More specifically, an operational gearing adjustment to a beta is normally used in two kinds of case. First, if an asset beta assessment is based on equity market evidence from another sector or another country where the general business exposure is likely to involve similar systematic risk, but the business model for the comparator involves materially different operational gearing, an operational gearing adjustment will be appropriate. Second, if two firms at different points in a supply chain are exposed to fundamentally the same demand risk, then although beta estimates from one part of the supply chain can be used to inform estimates for the firm at another part of the supply chain, there may need to be an adjustment for operational gearing differences.

In the case of WoCs and WaSCs, if the underlying business risks of water and of sewerage are similar but different business models are used to develop them, that might be reflected in two ways. First, water-only

[76] CMA (2015), "Bristol Water plc", Appendix 10.1, paragraph 101.
[77] CC (2010), "Bristol Water plc", Appendix N, paragraph 129.

companies would have their own separate business costs (say, totex) assessments. And second, the partner of those different business costs assessments might be different capital costs assessments, e.g. implemented via an operational gearing adjustment.[78]

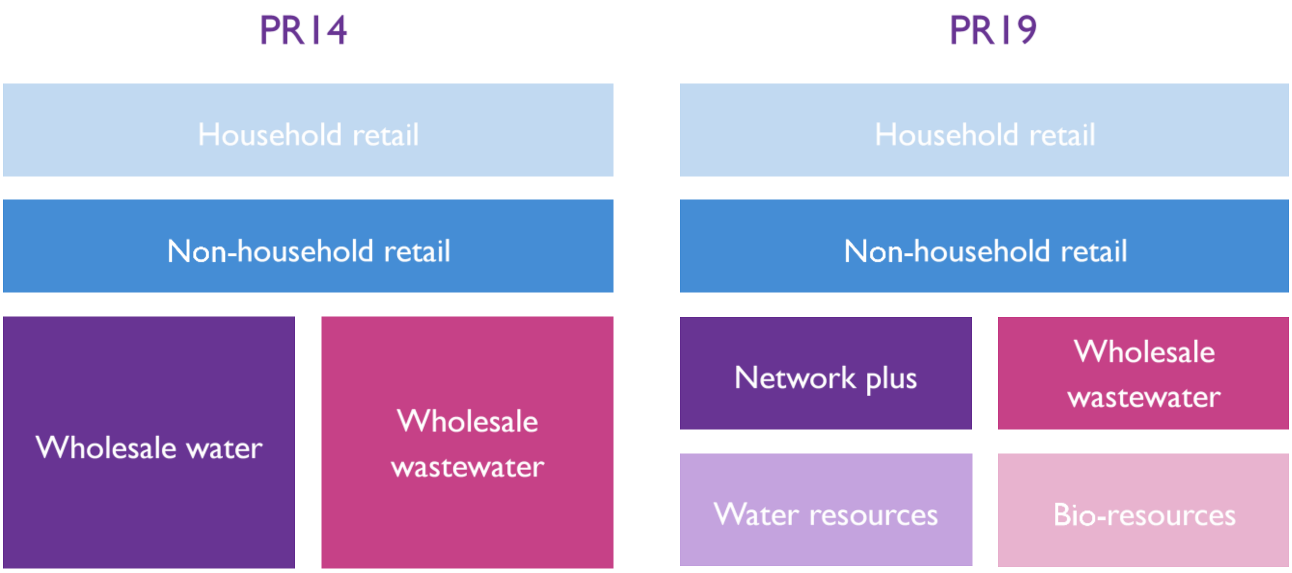
On the other hand, if the sector's notional financial structure and notional business expenses structures are common across the sector, but one firm (say) chooses to organise its business model such that it has a materially higher level of operational expenses, it will be doing that for some reason. For example, it may thereby achieve lower operational expenses. In Ofwat's regulatory model, the firm will in that case already benefit by having a lower efficiency improvement target. If a firm could increase its operational gearing, thereby cutting its operational expenses, and as a consequence have a lower efficiency improvement target on totex but a higher WACC allowance, that would create a perverse incentive to pursue high operational leverage.

The question then would be whether WoCs as a whole, without totex efficiency targets reflecting that separate business model not the business model of the water plus water and sewerage sector as a whole, have a business model involving higher operational leverage. Our understanding is that that is not how Ofwat's regulatory model works. WoCs have their totex regulated on a common basis with WaSCs, so their implied notional entity should be one with a similar business model, also — i.e. there should be no operational gearing adjustment.

8.3 Lack of basis for differences in the cost of equity across different water services

The new regime introduces separate price control for water resources and bio-resources, as set out below.

Figure 8.1: Subdivision of the water sector for PR19 versus PR14



We analyse retail margins in Section 14. In the section on beta we have discussed why we believe changes to competition, the switch from RPI to CPIH indexation, more challenging ODI targets, and debt indexation should not be expected to change the beta. We have discussed above some aspects of the issue of the lack of evidence for differences between water and wastewater activities.

[78] We note that this is consistent with Ofwat's existing policy that companies must justify their proposals about the proportion of totex that is expensed or capitalised, according to the unpinning economic substance of each control.

That leaves the question of whether there is a basis for differences in bio-resources from other sectors.

The 2020-25 period is a transitional phase with Ofwat having the objective of making greater use of markets and moving to a fully volumetric basis at PR24. The form of control is what is termed a "modified average revenue control".

The revenue requirement for bio-resources will be based on the standard building blocks of RPI-X regulation as applied to the water sector (including totex, depreciation, return allowance and taxes). The price control will be on a volumetric basis (scaling with tonnes of dry solids (TDS) treated). Companies will be required to forecast TDS and will be granted a financial allowance per unit of TDS, thereby delivering a revenue requirement, given forecast volumes.

There will be a volume forecasting accuracy incentive in the form of a revenue adjustment for outturn TDS treated, but with a tolerance such that forecasts must be inaccurate by more than 6 per cent either way for them to be penalized. Thus there is some financial risk from mis-forecasting TDS but it is limited to cases of significant error.

The bio-resources price control will benefit from the same risk mitigants that apply to other wholesale price controls, such as the five year price review cycle, price control reopening mechanisms, indexation and indexation.

Pre 2020-RCV is protected from any risk of under-recovery from the average revenue control – sunk costs are guaranteed to be recovered by the revenue control. Post 2020 investment will face some volume risk if outturn volumes are different to the forecast.

Thus the key differences relative to other wholesale areas are (i) the price control will be on volumetric basis (tonnes dry solids of bio-resource) rather than revenue basis and (ii) there is no totex cost-sharing incentive.

As we discussed above in Section 7.2.1, changes to the control will only have an impact on the cost of capital if they increase exposure to systematic risk. Company-specific risk changes will not have an impact.

- The bio-resources forecasting incentive is a company specific issue under each company's control
- The bio-resources volumetric risk has specific and systematic aspects to it:
  - To some extent companies have choices, such as whether to build their own assets to treat, or to pay a third party, with efficient investment being remunerated and inefficiency being a classic company-specific factor.
  - In principle changes in market wide-demand could have systematic components, for example exposure to (and to forecasting errors in) the weather, population growth and trade effluent. However, the forecasting incentives here firms face here are not fundamentally different from those that apply to revenue forecasting incentives in other wholesale controls and are likely to be materially correlated (i.e. errors in forecasting of TDS and of households billed are likely to be correlated).

The only change in risk in respect of water resources, relative to network plus, is in regards to risk-sharing with major new investment schemes. For water resources, the RCV allocated at 31 March 2020 will receive the same type and degree of regulatory protection as it would have received under the wholesale revenue controls. For significant new investment that is incurred post 2020, Ofwat intends companies to bear some of the risk arising from forecasts associated with the need for the scheme. However, such mechanisms are for the companies to propose and at this stage (in the absence of visibility of what those future schemes might be), we shall proceed on the basis that forecast errors are likely to be specific rather than systematic.

Some aspects of market wide demand risk could in principle impact on the cost of capital, for example, if related to changes in industrial demand, but it is by no means clear that the degree of impact on systematic risk would be material. Ofwat expects very compelling evidence if companies propose a cost of capital increment for new water resource investment in 2020-2025 and for them to demonstrate how such an increment would be aligned with the proposed risk sharing arrangement.

Hence, in conclusion, though in principle there could be differences, at this stage these factors do not provide a robust basis for assuming non-negligible differences in the cost of equity for bio-resources or water resources from that for other wholesale controls. Accordingly, we use the same values across the wholesales controls.

9 Cost of Embedded Debt

9.1 Approach

In the 2017 consultation Ofwat proposed "to set a fixed allowance for the cost of embedded debt. Our assessment will draw on relevant benchmark data (for example, indices of bonds for companies with similar credit ratings) and information contained in company balance sheets. Where there is evidence the sector outperforms market benchmark data, we will take this into account in setting the efficient cost of embedded debt." [79]

In line with that proposal, we based our cost of embedded debt estimates on two sources of information: companies' submissions and yields on iBoxx indices. The analysis of companies' outperformance is provided in Section 10.3.

9.1.1 Companies' submissions — lower end of the range

In order to develop a view on the efficient cost of embedded debt we analysed the interest rate paid by UK water companies as reported in their submissions to Ofwat.

Our starting point was the average interest rate paid on all debt instruments reported by the companies. Because the objective of this project is to determine the cost of capital for an efficient water company it might be argued that we should exclude inefficient debt from our analysis. Furthermore, non-standard instruments might have the benefit of reducing future costs on debts that have not yet been raised, which might mean that including the already-incurred cost but not observing the yet-to-be gained benefit might lead to an over-statement of the underlying embedded debt cost. This effect could also lead to distorted incentives for the timing of the issuance of non-standard instruments — encouraging their being issued shortly before embedded debt cost data cut-offs, so that they produce both a higher embedded debt cost and, later, an outperformance on the cost of new debt.

While we agree in principle that some non-standard instruments might be inefficiently acquired, identifying debt that was not efficient *at the time of issuance* is not a straightforward task. We accept that, at the lower end of our range, one might consider the possibility that all debt instruments other than the most standard bonds and loans were acquired inefficiently or reflecting a different capital structure from that assumed for the notional entity (if, for example, some instruments have been put in place to reduce risk to investors brought about by high levels of leverage). However, we consider the best assumption to be that excluding all non-standard instruments that might be included in a notional structure that is efficient could underestimate the efficient cost of embedded debt. This is because some types of debt instrument — while potentially more expensive — might reduce a company's exposure to risk and therefore (inter alia) the cost of the standard type of debt instruments.

As such, the starting point of our analysis is the interest rate paid on all debt instruments. However, in order to account for the fact that there might be inefficient debt on companies' balance sheets, we examine what implications excluding certain types of instruments or certain companies have on the average interest rate. In particular, we calculate the average interest rate after excluding:

- preference shares and perpetual debt;
- preference shares and perpetual debt as well as eight particularly expensive swaps, and one amortising loan;

[79] Ofwat (2017), "Delivering Water 2020: Consulting on our methodology for the 2019 price review".

- preference shares and perpetual debt, one particularly expensive amortising loan as well as all swaps;
- preference shares, perpetual debt, one particularly expensive amortising loan, all swaps, as well as loans from a parent company, variable and callable bonds, redeemable debt, credit/revolving facilities, operating/financial leases, amortising term facilities.

Moreover, we calculate the average interest rate on all types of debt instruments for the following sub-samples of water companies:

- core 11 companies in terms of standard-to-total debt (by principal amount), where non-standard debt is defined in the same way as in the last bullet point of the list above[80], and the core 11 companies are determined by removing the three top and three bottom companies;[81]
- core 11 companies in terms of total debt-to-RCV ratio and the core 11 companies are determined by removing the three top and three bottom companies; [82]
- listed firms;[83] and
- non-listed firms.[84]

In all our calculations we adjust the cost of a debt instrument if it matures before March 2020. We assume that an equal amount of debt will be issued at a forward-looking cost of debt, and therefore — for debt instruments maturing before March 2020 — we overwrite the interest provided by the companies with the upper end of the new cost of debt (see Section 10.5) excluding the adjustment for the expected average rise in interest rates and liquidity cost.

9.1.2 iBoxx indices — upper end of the range

In order to develop a view on the efficient cost of embedded debt we analysed historical yields on four different iBoxx indices:

- iBoxx 10+ non-financials A — grouping A-rated bonds of non-financial companies with maturity of at least 10 years;
- iBoxx 10+ non-financials BBB — grouping BBB-rated bonds of non-financial companies with maturity of at least 10 years;
- iBoxx 15+ non-financials A — grouping A-rated bonds of non-financial companies with maturity of at least 15 years;
- iBoxx 15+ non-financials BBB — grouping BBB-rated bonds of non-financial companies with maturity of at least 15 years;

The indices comprise only fixed-rate bonds with at least one year to maturity at the time of index rebalancing.[85]

Based on those four indices we calculated the average iBoxx 10+ for non-financials rated A or BBB — which is an arithmetic daily average of the yield on iBoxx 10+ for non-financials rated A and the yield on iBoxx 10+ for non-financials rated BBB.

We then used 10-year and 15-year averages of this combined index as estimates of the upper end of the cost of embedded debt.

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80 That is — preference shares, perpetual debt, one particularly expensive amortising loan, all swaps, as well as loans from a parent company, variable and callable bonds, redeemable debt, credit/revolving facilities, operating/financial leases, amortising term facilities.

81 Specifically, the core 11 in this case includes: BRL, DVW, NWL, PRT, SES, SVT, TWUL, UU, WSH, WSX, and YKY.

82 Specifically, the core 11 in this case includes: DVW, NWL, PRT, SEW, SRN, SSC, SWB, TWUL, UU, WSX, and YKY.

83 That is: SEW, SVT, and UU.

84 That is: AFW, ANH, BRL, DVW, NWL, PRT, SES, SRN, SSC, SWB, TWUL, WSH, WSX, and YKY.

85 See Markit (2017), "Markit iBoxx GBP Benchmark Index Guide".

For reference, we also calculated the average iBoxx 15+ for non-financials rated A or BBB — which is an arithmetic daily average of the yield on iBoxx 15+ for non-financials rated A and the yield on iBoxx 15+ for non-financials rated BBB. However, because the data for iBoxx 15+ index only goes back to 2006, we were unable to calculate the 15-year average yield. Moreover, because the average tenor of debt among the UK water companies is 16 years, the iBoxx indices comprising bonds with 10+ years to maturity (rather than 15+ years to maturity) appear to be a more suitable benchmark in this case. Therefore, we place more weight on the 10+ indices.

9.2 Proportion of new to embedded debt

There are two main reasons for raising new debt: refinancing debt that has matured and financing new investments. We estimated the amount of debt that will mature before March 2020 from the companies' submissions — this is illustrated in the second column of Table 9.1 below. The amount of debt that will need to be raised to finance new investments is estimated based on the expected RCV as of 2019/20 (see Column 4 in Table 9.1), RCV growth for the period 2015-2020 (see Column 5 in Table 9.1),[86] and the gearing level of 60 per cent. Specifically, we assumed that the UK water companies will maintain the same rate of RCV growth in 2020-25 period as they had in the previous regulatory period, and that 60 per cent of those new investments will be financed with debt (see Column 6). Combining the amount of debt that will need to be raised to refinance debt that matures before March 2020 and the amount of debt that will need to be raised to finance new investments, we obtain the total amount of new debt to be raised in 2020-25 period (Column 7 in Table 9.1). We estimate the total amount of debt in PR19 by adding the amount of debt raised to finance new investments to the amount of debt as of March 2017 (Column 3 in Table 9.1), and express the new debt as a proportion of the total 2020-25 debt in the last column of Table 9.1.

On a company level the proportion of new debt in total debt ranges from 10 per cent to 42 per cent depending on the current maturity profile of debt and expected RCV growth. There will also be a small amount of short-term bank debt that will also need to be refinanced over the period. Our estimate is that, on average, **30 per cent** of the total debt would need to be raised in 2020-25 period.

Table 9.1: Proportion of new debt in total debt

Company	Debt: <3yr as of March 2017	Total debt as of March 2017	RCV 2019/20 20	Total nominal RCV growth	New debt due to RCV growth	Total new debt to be raised in 2020-25	Total debt in 2020-25	% new debt @ 60%
AFW	0	921	1,268	10.5%	80	94	1,001	9%
BRL	72	320	577	23.1%	80	80	400	20%
DVW	2	55	107	32.2%	21	21	76	27%
ANH	480	6,287	8,481	15.3%	777	2,881	7,064	41%
NWL	343	2,783	4,442	8.0%	214	877	2,997	29%
PRT	4	104	159	17.2%	16	16	120	14%
SES	34	201	278	18.1%	30	30	231	13%
SEW	288	979	1,454	17.4%	151	151	1,130	13%
SWB	162	2,281	3,676	9.9%	217	517	2,499	21%
SRN	300	3,790	5,291	13.6%	431	1,109	4,221	26%
SSC	30	228	408	15.5%	38	38	266	14%
SVT	662	5,101	9,781	17.6%	1,033	1,842	6,134	30%
TWUL	856	10,608	15,157	16.4%	1,493	3,290	12,101	27%
UU	1,391	6,988	11,991	10.5%	759	2,586	7,747	33%
WSH	48	3,186	6,058	14.4%	525	1,123	3,711	30%

86 Regulatory Capital Values are obtained from Ofwat's website.

Company	Debt: <3yr as of March 2017	Total debt as of March 2017	RCV 2019/20 20	Total nominal RCV growth	New debt due to RCV growth	Total new debt to be raised in 2020-25	Total debt in 2020-25	% new debt @ 60%
WSX	152	2,010	3,448	15.7%	325	975	2,335	42%
YKY	802	4,829	7,152	15.4%	662	1,521	5,491	28%
Total	**5,625**	**50,671**	**79,729**	**14.25%**	**7,140**	**17,438**	**57,811**	**30%**

Note: In theory, some of the debt that matures before 2020 might be refinanced in 2020-25 period, and thus count as new debt rather than embedded debt.

Source: Companies' submissions, Europe Economics calculations.

This estimate should be treated as preliminary, and should be reviewed once the RCVs for 2020-2025 are determined by Ofwat.

9.3 Evidence

9.3.1 Companies' submissions — lower end of the range

We examined whether particular debt instruments are driving the overall average for the industry, and for WOCs and WASCS separately. The tables below present the average interest rate paid on debt by water companies based on:

- all their reported debt instruments (Column 2) ;
- all the reported debt instruments excluding preference shares and perpetual debt (Column 3);
- all the reported debt instruments excluding all of the above and eight particularly expensive swaps, and one amortising loan (Column 4);[87]
- all the reported debt instruments excluding all of the above and all swaps (Column 5);
- all the reported debt instruments excluding all of the above and loans from a parent company, variable and callable bonds, redeemable debt, credit/revolving facilities, operating/financial leases, amortising term facilities (Column 6).[88]

In all cases we substituted the cost of debt that will mature before March 2020 with 3.19 per cent, i.e. the upper end of our proposed cost of new debt (see Section 10.5) excluding the adjustment for the expected average rise in interest rates and liquidity cost.

We propose to use the estimates in the fourth column, i.e. based on the all debt instruments excluding preference shares, perpetual debt and the nine particularly expensive debt instruments. This would suggest the cost of embedded debt at 4.86 per cent. However, since we do not have evidence showing that swaps and other types of non-standard debt instruments are indeed raised efficiently, it is at least possible that the estimates in the last column (i.e. accounting for standard debt instruments only) reflect the cost of debt for a notional efficient entity in a more accurate way.[89] This implies the lower end of the embedded cost of debt range to be **4.37 per cent**.

87 The eight swaps we excluded all had the nominal interest rate on the payable leg above six per cent, and the interest rate on the receivable leg below one per cent. The amortising loan was taken at a fixed interest rate exceeding 10 per cent.

88 Note that while we technically include instruments such as credit/revolving facilities and operating/financial leases in the estimates in columns (2-4), in practice due to different characteristics of these types of debt instruments and/or inability of firms to estimate their actual cost, these instruments are not fully accounted for.

89 As argued in CEPA (2016), "UK regulators have typically not included fees for swaps and derivatives - this depends on what the regulator assumes efficient financial behaviour from the notional entity". See CEPA (2016), "Alternative approaches to setting the cost of debt for PR19 and H7", page 130.

Table 9.2: Average nominal interest rate paid on debt at 3.0 per cent RPI

Type	Total	Total excl. preference shares and perpetual debt	Total excl. […] and 8 particularly expensive swaps and 1 amortising loan	Total excl. […] and all swaps	Standard debt only
WOC	5.81%	5.79%	5.79%	5.79%	5.46%
WASC	4.87%	4.88%	4.81%	4.28%	4.32%
Total	**4.93%**	**4.93%**	**4.86%**	**4.36%**	**4.37%**

Source: Companies' submissions, Europe Economics calculations.

As part of the sensitivity analysis we also estimated all of the above figures assuming RPI at 2.8 per cent. The results are shown in Table 9.3 below.

Table 9.3: Average nominal interest rate paid on debt at 2.8 per cent RPI

Type	Total	Total excl. preference shares and perpetual debt	Total excl. […] and 8 particularly expensive swaps and 1 amortising loan	Total excl. […] and all swaps	Standard debt only
WOC	5.23%	5.20%	5.20%	5.20%	5.35%
WASC	4.81%	4.81%	4.73%	4.20%	4.20%
Total	**4.83%**	**4.83%**	**4.76%**	**4.26%**	**4.25%**

Source: Companies' submissions, Europe Economics calculations.

In order to determine whether the industry average is driven by a small number of outliers, we also calculated the average interest rate on all types of debt instruments for four different sub-samples of water companies. Table 9.4 illustrates the average yield on debt for:

- the core 11 companies that remained after excluding top three most intense users of non-standard debt and top three users of standard debt;
- the core 11 companies that remained after excluding three companies with the highest debt-to-RCV ratio and three with the lowest debt-to-RCV ratio;
- listed firms, i.e. United Utilities, Severn Trent and South West Water;
- non-listed firms.

In Table 9.4, we can see that after excluding companies with the highest and lowest use of non-standard debt, the average yield declines from 4.94 per cent to 4.92 per cent. The average for the core 11 companies in terms of debt-to-RCV ratio declines slightly more to 4.87 per cent. The latter almost precisely coincides with our preferred estimate reported in Table 9.2.

Table 9.4: Average interest rate for different subsamples of companies (at RPI of 3 per cent)

	Average yield (weighted by principal sum outstanding)
Core 11 in terms of standard-to-total debt (by principal amount)	4.92%
Core 11 in terms of total debt-to-RCV ratio	4.87%
Listed firms	4.25%
Non-listed firms	5.18%
All	**4.94%**

Source: Companies' submissions, Europe Economics calculations.

9.3.2 iBoxx indices — upper end of the range

The 10- and 15-year average for the two iBoxx indices are illustrated in Table 9.5 below. The 10-year average of the average 10+ index for non-financials with A or BBB rating was 5.00 per cent as of 31 July 2017. The 15-year average of the same index was 5.25 per cent. For reference the 10-year average of the average 15+ index for non-financials with A or BBB rating was 5.05 per cent. As mentioned above, we consider the 10+ index to be a more suitable benchmark for UK water companies, and therefore we base our recommendation on the average yields of the 10+ index for non-financials with A or BBB. We take the 15-year average (i.e. **5.25 per cent**) to be the upper end of our proposed embedded cost of debt range.

Table 9.5: Average yields on iBoxx indices

	Average Non-Financials 10+ A & BBB	Average Non-Financials 15+ A & BBB
spot 31 July 2017	3.02%	3.15%
10y average (1 August 2007 — 31 July 2017)	5.00%	5.05%
15y average (1 August 2002 — 31 July 2017)	**5.25%**	n/a

Source: Europe Economics.

9.4 Conclusion

Our proposed nominal range for the cost of embedded debt to be **4.37-5.25 per cent**. The lower end is based on the average cost of debt currently held by the water companies (see Section 9.3.1), and the upper is based on the 10-year average of the average 15+ index for non-financials with A or BBB rating (see Section 9.3.2).

We round our best estimate of 4.86 per cent (shown in Table 9.2) to **4.90 per cent** to serve as our working point estimate.

Table 9.6: Cost of embedded debt — conclusion

	Lower end	Point estimate	Upper end
Real	2.32%	2.84%	3.19%
Nominal	4.37%	4.90%	5.25%
RPI-deflated	1.33%	1.84%	2.18%

Note: "Real" is not equivalent to "RPI-deflated" return. See the definition of "real returns" on page 14 (Section 2.3.1).
Source: Europe Economics.

10 Cost of New Debt

10.1 Approach

In order to develop a view on the efficient cost of new debt we analysed recent yields on the four different iBoxx indices listed in Section 9.1.2.

The latest available spot yields (as of end of July 2017) for those four indices are used as an indication of the current cost of debt. Those yields are then adjusted to account for the rise in interest rates expected to occur in 2020-25 period, and for debt issuance and liquidity costs. As in the case of the cost of embedded debt, we place more weight on the iBoxx 10+ index (rather than iBoxx 15+ index) as it represents the current tenor of debt among the UK water companies more closely.

10.2 Debt issuance and liquidity costs

Table 10.1 shows the estimated debt issuance costs. The average based on all the issues in 1993-2017 period is 5bps, and the average based on issues since 2000 is 3bps. Taking also into account PwC's estimate of 6bps issuance cost for Artesian debt,[90] we propose the range to be **3-6 bps**.

Table 10.1: Debt issuance costs

Company	Overall number of issues	Average issuance cost — overall (bps)	Average issuance cost — after 2000 (bps)
AFW	2	3.22	3.22
ANH	11	12.18	3.25
NWL	4	4.65	2.87
SVT	7	3.60	4.12
SEW	1	1.50	1.50
SSC	2	3.26	3.26
TWUL	15	3.43	3.28
UU	18	3.70	3.18
WSX	6	2.42	2.21
YKY	6	2.20	1.97
Average	**72**	**4.68**	**3.05**

Note: The averages here are defined with respect to all debt issues rather than being an average of company averages.
Source: Bloomberg, LSE, ICE, Europe Economics' calculations.

In addition to issuance costs, companies also bear a cost of maintaining financial liquidity. Companies have different approaches to ensuring liquidity, but among the common ones are revolving credit facilities — for the purpose of this report we assume that the cost of such facilities is a good approximation of liquidity costs in general. There is a cost associated with revolving facilities even if — as often is the case — they are not drawn upon.

Informed by information sourced from companies and drawing on some internal Ofwat analysis, we take the cost of undrawn credit facilities to be around 35-45 bps and assume that on average firms have the credit facilities for the amount of around 10 per cent of the value of their debt. This implies the liquidity cost of around **3.5-4.5 bps**.

90 PwC (2017), "Company specific adjustments to the WACC", page 23.

Combining debt issuance and liquidity cost gives a range of 6.5-10.5 bps. Taking 5bps as a conservative estimate for issuance costs and rounding the upper end of the liquidity cost, we propose **10 bps** as a working point estimate.

10.3 Debt indexation and outperformance

Ofwat (2017) consultation proposes to index the cost of new debt. The consultation proposal is to "base the allowance on changes in the iBoxx indices for non-financial companies with a tenor of 10-plus years. We consider a 50:50 mix of A and BBB rated indices reflects the appropriate credit profile of the notional company and constitutes a robust benchmark with a range of different companies and sectors. The average tenor of debt in these indices is also aligned with the borrowing profile of the sector".[91]

In line with this proposal, we assume indexation of new debt would rely on an average of A and BBB rates iBoxx non-financial indices with at least 10 years to maturity. It would be better to avoid using the iBoxx index for GBP-denominated utilities to index the cost of new debt because this index is to a material extent comprised of bonds issued by regulated UK water companies, and such circularity could potentially mean that inefficiently raised bonds could boost yields on that index, over-compensating firms for inefficient decisions. Therefore, the more general iBoxx index for non-financials is a more appropriate choice of a benchmark.[92]

That said, there is naturally a difference between yields on the iBoxx utilities index and the iBoxx utilities for non-financials companies. The historical analysis of this difference could be helpful to understand the relationship between the two indices. In particular, estimating the average wedge between yields on utilities' and non-financials' bonds over the past 10 or 15 years could be used a starting point for developing the indexation mechanism and outperformance of water companies against the benchmark comprising a broader set of non-financial companies.

Our analysis shows that — depending on the time horizon and the iBoxx non-financials index we choose — the wedge as of July 2017 was between 13 and 17 bps (see Table 10.2). As mentioned above, this type of analysis would not be adequate once the indexation mechanism is in place, but it is a useful starting reference point.

Table 10.2: Average wedge between iBoxx utilities index and iBoxx non-financials index (bps)

	Average Non-Financials 10+ A & BBB	Average Non-Financials 15+ A & BBB
Over the last 10 years	-13.74	-13.06
Over the last 15 years	-16.52	n/a

Source: Thomson Reuters, Europe Economics' calculations.

Insofar as the iBoxx utilities index provides a good indication of the cost of new debt for UK utilities, the above estimates of the wedge between iBoxx indices could also be used to capture the level of outperformance achieved by UK utilities. While the iBoxx utilities index covers more than just water companies, it could be assumed to be a good proxy for the cost of debt faced by water companies in particular.

[91] Ofwat (2017), "Delivering Water 2020: Consulting on our methodology for the 2019 price review".

[92] While bonds issued by utilities are also part of the instruments incorporated into the iBoxx index for non-financials, they only account for a small proportion of all bonds and should therefore not affect the index in a significant way. At the same time, there is a clear co-movement between the iBoxx index for non-financials and for utilities, which means that the changes in the index for non-financials could be assumed to be a good approximation of the changes in the index for utilities.

It should be noted that the iBoxx utilities indices might not capture the actual cost of debt for water companies in a very precise or robust manner. The indices comprise only fixed-rate bonds with at least one year to maturity at the time of index rebalancing. Specifically, the indices exclude perpetual bonds, floating-rate bonds, convertible bonds, and private placements, and perhaps also EIB debt.[93] This means the indices only capture the cost of a subset of the debt instruments without accounting for the cost of other instruments and potential cost implications of interactions between various debt instruments.[94]

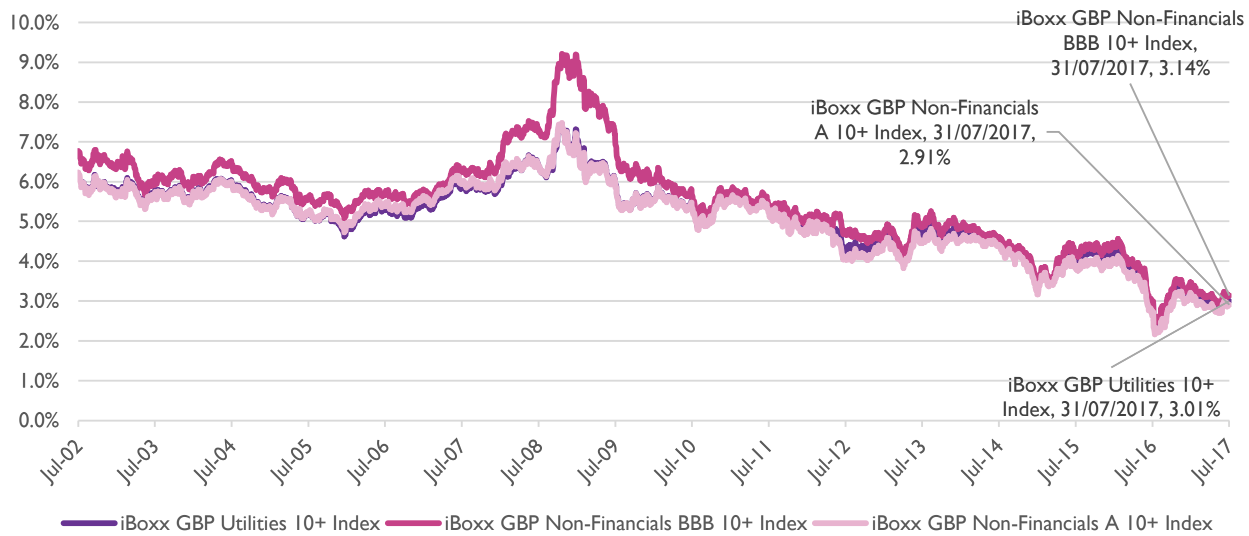
Noting the averages for the past 10 and past 15 years of 13.7 to 16.5, using our preferred method, our rounded estimate thereof is **15 bps**.

10.4 Evidence

10.4.1 Our analysis

The yields on iBoxx indices for bonds with 10 years or more years to maturity are illustrated in Figure 10.1. As of 31 July 2017, the spot yield on the index for non-financial companies with an A rating was 2.91 per cent and the spot yield on the index for non-financial companies with a BBB rating was 3.14 per cent.

Figure 10.1: Nominal iBoxx 10+ yields



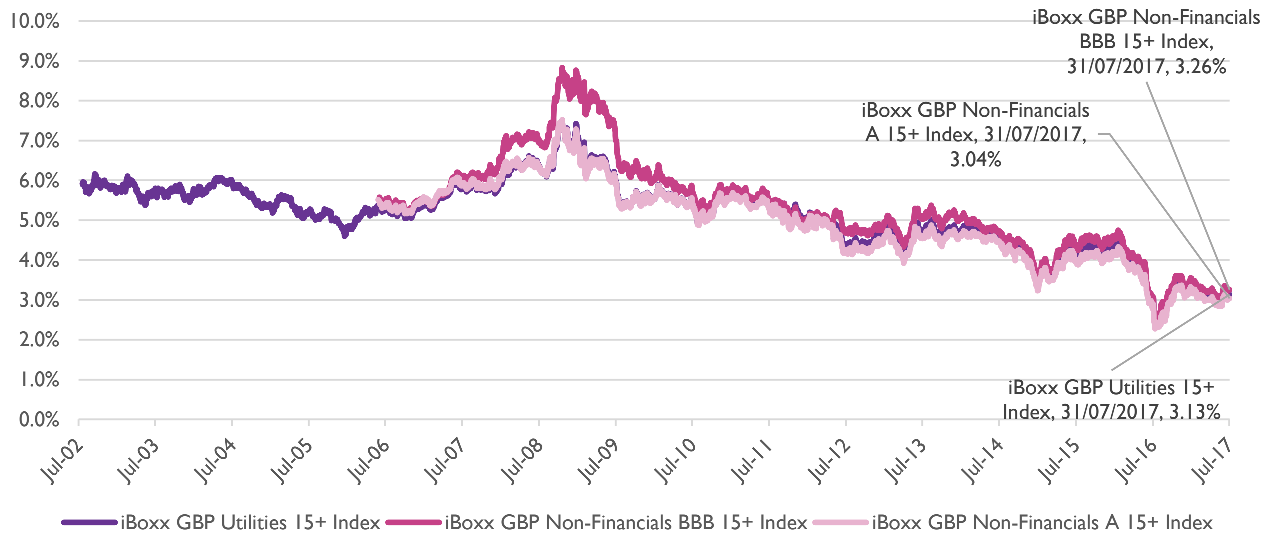
Source: Thomson Reuters.

For reference, the yields on iBoxx indices for bonds with 15 years or more years to maturity are illustrated in Figure 10.2. As of 31 July 2017, the spot yield on the index for non-financial companies with an A rating was 3.04 per cent and the spot yield on the index for non-financial companies with a BBB rating was 3.26 per cent.

93 See Markit (2016), "Markit iBoxx GBP Regulated Utilities Index Guide".

94 We note that in its 2016 report on "Alternative approaches to setting the cost of debt for PR19 and H7" CEPA provided its estimates of the outperformance. In the report, CEPA argued that since 2008 the outperformance was 55bps on average, ranging from 30bps in 2013 to 80bps in 2015. We should note that these estimates were obtained using a different method and, thus, are not directly comparable to our estimate. For details, see CEPA (2016), "Alternative approaches to setting the cost of debt for PR19 and H7", pages 84-85.

Figure 10.2: Nominal iBoxx 15+ yields



Source: Thomson Reuters.

10.5 Conclusion

Our proposed nominal range for the cost of new debt is **3.35-3.83 per cent**. The lower end is based on the sum of the spot yield for the iBoxx 10+ index non-financial companies with an A rating (2.91 per cent) and the lower end of the expected rise in interest rates estimated in Section 4.2 (49bps), from which we subtracted 15bps to account for the possibility of outperformance (illustrated in Table 10.2 and discussed in Section 10.3). The upper end is based on the spot yields for the iBoxx 10+ index for non-financial companies with a BBB rating (3.14 per cent) and the upper end of the expected rise in interest rates (59bps).[95] We added 10bps to both ends to account for issuance and liquidity costs.

It should be noted that the proposed range represents the average cost of net debt over the price control period informed by our analysis of the future increase in interest rates. Insofar as Ofwat adopts an indexation mechanism, the allowed cost of new debt will be adjusted in light of the actual movements in interest rates.

Our proposed nominal **point estimate is 3.60 per cent** — the mid-point in the above range.

Table 10.3: Cost of new debt — conclusion

	Lower end	Point estimate	Upper end
Real	1.32%	1.57%	1.79%
Nominal	3.35%	3.60%	3.83%
RPI-deflated	0.34%	0.58%	0.81%

Note: "Real" is not equivalent to "RPI-deflated" return. See the definition of real returns on page 14 (Section 2.3.1).
Source: Europe Economics.

95 We did not subtract the outperformance from the upper end to account for the possibility that the outperformance might not be as large.

11 Overall Cost of Debt

In this section we calculate the overall cost of debt based on our estimates of the cost of new debt (see Section 10.5), cost of embedded debt (see Section 9.4), and the average proportion of embedded debt in overall debt (see Section 9.2).

11.1 Possibility of a cost of debt premium for water-only companies or small companies

At PR14 Ofwat's position on the cost of debt for water-only companies was as follows: "While the six smaller WoCs (Bristol Water, Dee Valley Water, Portsmouth Water, Sembcorp Bournemouth Water, Sutton & East Surrey Water, and South Staffordshire Water) did not face higher equity costs, they did face higher debt costs equivalent to 15 basis points on the WACC."[96]

As at PR14 (and indeed PR09 before that), we believe it is plausible that water-only companies or small companies face some differences in their costs of raising debt. Our analysis above already to some extent includes this factor in our range — e.g. we include the costs of raising Artesian debt in our issuance costs; and we include the embedded debt costs of WoCs in our embedded debt analysis. That might mean that the point within our range that should be chosen for a water-only company or a small company might be different from that chosen for a large WaSC, rather than that there should be an uplift to the range itself.

This point is further reinforced by noting that current debt costs for WoCs are materially different from those for WaSCS.[97]

However, although these figures reinforce the idea that WoCs may have a higher cost of debt, we do not regard the wedge here as necessarily a good indicator of the scale of any additional costs WoCs may face in raising debt. There are a number of reasons for this.

A first point to note is that, as in the case of the cost of equity, the case for a small company uplift (as opposed to a wedge reflecting any difference in the nature of a WoC business relative to a WaSC business) is weak, and even were that not so it is not straightforward to deem all WoCs as "small companies". In particular, SEW and AFW are by no means small and indeed AFW has not proposed a small company uplift.

Next, one of the key factors supposedly differentiating WoCs from WaSCs is the use of Artesian debt, but we have already included an allowance for Artesian debt costs in our range by including Artesian debt instruments in estimating the average cost of embedded debt and by explicitly taking into account higher issuance costs of such instruments.

A third factor is that in some cases WoCs with higher costs of debt have higher gearing that our assumed notional level.[98] A more highly geared business model may deliver some gains to the company but it would be a mistake to pair that with a cost of debt wedge.

We do not seek to resolve this issue at this stage. Ofwat's position is that, as at previous reviews, WoCs will need to demonstrate that they face higher costs and that there is some corresponding consumer benefit.

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[96] Ofwat (2014), "Final price control determination notice: policy chapter A7 – risk and reward". We also note that in PwC's analysis of Company specific adjustments to the WACC it stated: "We continue to recommend that Ofwat applies 25bps uplift to the cost of debt for small WoCs" — see PwC (2014), "Company specific adjustments to the WACC".

[97] See Table 9.2 in section 9.3.1 for details on our analysis.

[98] See Figure 6.1 in Section **Error! Reference source not found.**.

11.2 Conclusion

The overall cost of debt is calculated as a weighted average of the new cost of debt (see Section 10.5) and the embedded cost of debt (see Section 9.4), where the weight applied to the new cost of debt 30 per cent as determined by the estimated proportion of the new debt in overall debt in 2020-25 period (see section 9.2).

Our proposed nominal range for the **overall cost of debt is 4.07-4.82 per cent**, which is equivalent to 2.03-2.77 per cent in real terms, and 1.04-1.77 per cent in RPI-deflated terms.

Our proposed **point estimate is 4.51 per cent** in nominal terms, which is equivalent to 2.46 per cent in real (real terms) and 1.47 per cent in RPI-deflated terms.

Table 11.1: Overall cost of debt (pre-tax) — conclusion

	Nominal			Real			RPI-deflated		
	Low	Point	High	Low	Point	High	Low	Point	High
Cost of embedded debt	4.37%	4.90%	5.25%	2.32%	2.84%	3.19%	1.33%	1.84%	2.18%
Cost of new debt	3.35%	3.60%	3.83%	1.32%	1.57%	1.79%	0.34%	0.58%	0.81%
Overall cost of debt	**4.06%**	**4.51%**	**4.82%**	**2.02%**	**2.46%**	**2.77%**	**1.03%**	**1.47%**	**1.77%**

Note: "Real" is not equivalent to "RPI-deflated" return. See the definition of "real returns" on page 14 (Section 2.3.1).
Source: Europe Economics.

12 Overall WACC

This section provides our overall WACC estimates. The overall point estimates are constructed from the point estimates for individual WACC components (Section 12.1).

An alternative to using point estimates of individual components to produce an overall point estimate, which might be considered for the final determination, would involve a Monte Carlo analysis. In a Monte Carlo analysis the range for each individual WACC component is treated as the range of a probability distribution and values are selected at random from those distributions then constructed into a final answer. This process is repeated many times (e.g. thousands of times) to produce a distribution for the overall WACC figures. A decision can then be made where in that overall WACC distribution the determined figure should be (e.g. at the 50th percentile, some lower percentile, or some higher percentile — e.g. if "aiming up").

12.1 Overall WACC with preferred estimates

Below we present the overall WACC based on our preferred estimates in real (Table 12.1) nominal (Table 12.2), and RPI-deflated (Table 12.3) terms.

Table 12.1: Overall WACC with our preferred estimates — real

	EE recommendation		
	Low	**Point estimate**	**High**
Cost of equity			
Risk-free rate (page 27)	-0.29%	0.00%	0.50%
Total market return (page 42)	6.25%	6.75%	7.00%
Asset beta (page 60)	0.35	0.36	0.37
Re-levered (equity) beta (page 60)	0.71	0.72	0.72
Overall cost of equity (post-tax) (page 61)	4.35%	4.86%	5.18%
Cost of debt			
Overall cost of debt (pre-tax) (page 77)	2.02%	2.46%	2.77%
WACC			
Notional gearing (page 47)	60%	60%	60%
WACC (vanilla)	**2.96%**	**3.42%**	**3.73%**

Note: See the definition of "real returns" on page 14 (Section 2.3.1).
Source: Europe Economics.

Table 12.2: Overall WACC with our preferred estimates — nominal

	EE recommendation Low	EE recommendation Point estimate	EE recommendation High	PR14 determination for reference
Cost of equity				
Risk-free rate (page 27)	1.70%	2.00%	2.51%	4.09%
Total market return (page 42)	8.38%	8.88%	9.14%	9.74%
Asset beta (page 60)	0.35	0.36	0.37	0.3
Re-levered (equity) beta (page 60)	0.71	0.72	0.72	0.8
Overall cost of equity (post-tax) (page 61)	6.44%	6.96%	7.28%	8.61%
Cost of debt				
Overall cost of debt (pre-tax) (page 77)	4.06%	4.51%	4.82%	5.46%
WACC				
Notional gearing (page 47)	60%	60%	60%	62.5%
WACC (vanilla)	**5.01%**	**5.49%**	**5.81%**	**6.64%**

Note: Nominal PR14 figures were produced by inflating the real/RPI-deflated figures from Table 12.3 by 2.8 per cent inflation.
Source: Europe Economics, Ofwat (2014), "Final price control determination notice: policy chapter A7 — risk and reward".

Table 12.3: Overall WACC with our preferred estimates — RPI-deflated at 3 per cent RPI

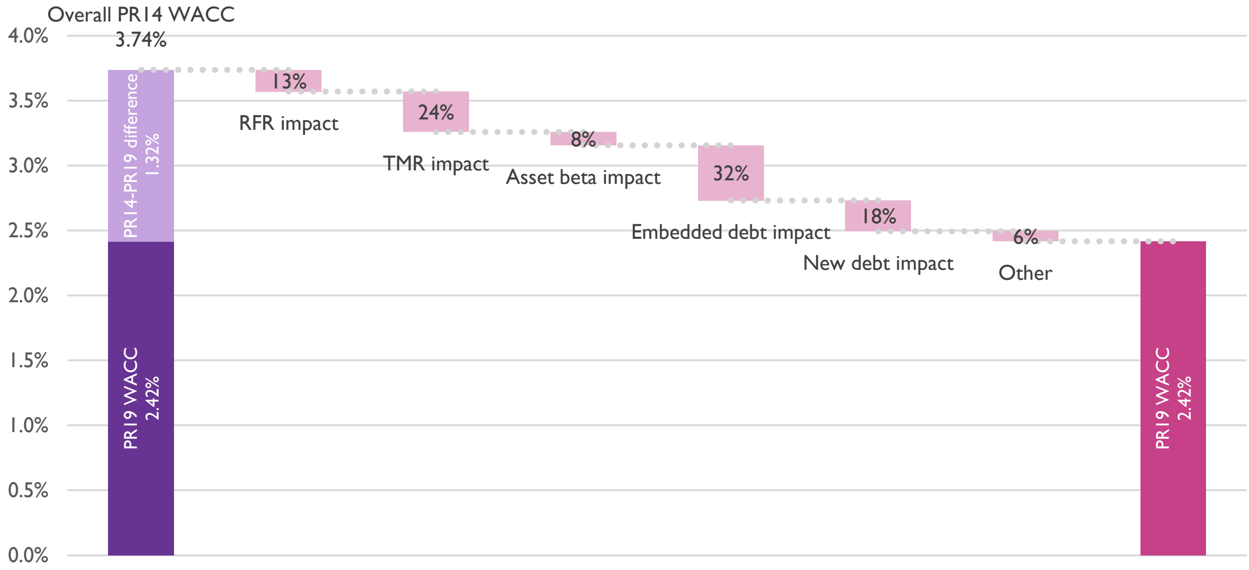
	EE recommendation Low	EE recommendation Point estimate	EE recommendation High	PR14 determination for reference
Cost of equity				
Risk-free rate (page 27)	-1.26%	-0.97%	-0.48%	1.25%
Total market return (page 42)	5.22%	5.71%	5.96%	6.75%
Asset beta (page 60)	0.35	0.36	0.37	0.3
Re-levered (equity) beta (page 60)	0.71	0.72	0.72	0.8
Overall cost of equity (post-tax) (page 61)	3.34%	3.84%	4.16%	5.65%
Cost of debt				
Overall cost of debt (pre-tax) (page 77)	1.03%	1.47%	1.77%	2.59%
WACC				
Notional gearing (page 47)	60%	60%	60%	62.5%
WACC (vanilla)	**1.96%**	**2.42%**	**2.73%**	**3.74%**

See page 14 (Section 2.3.1) for discussion on the distinction between real returns and RPI-deflated returns.
Source: Europe Economics, Ofwat (2014), "Final price control determination notice: policy chapter A7 — risk and reward".

We can see that the figures recommended here represent a considerable drop from those in PR14. It is of interest to account for the drivers of change. In Figure 12.1 we illustrate what proportion of the total 1.32

percentage points drop is accounted for by changes in the risk-free rate, total market return, asset beta, cost of embedded debt, and cost of new debt.

Figure 12.1: Drivers of change in overall RPI-deflated WACC



Note: The impact attributable to a particular WACC component was calculated by keeping all other WACC components at the PR14 level, as per the final determination, and changing the value of the component under consideration to the level proposed in this report.
Source: Europe Economics.

From Figure 12.1 we can see that the main driver of change is the fall in the cost of embedded debt. The combined decline in the cost of new and embedded debt accounts for almost half of the difference.

12.2 Principles for revisiting assumptions for the final PR19 determination

The analysis in this report allows us to make an initial assessment of the cost of capital in PR19, but for the final determinations it will need to be updated with the latest available evidence. While all WACC components will need to be revisited the final assessment should be particularly vigilant about assumptions and evidence in the following three areas:

- WACC components which are the main drivers of the difference between the cost of debt in PR14 and PR19 — this category includes cost of debt (both new and embedded) and total market return (see Figure 12.1 for reference);
- WACC components which are most data-responsive and thus subject to change as economic conditions evolve — this category includes risk-free rate and beta;
- WACC components which are determined iteratively based on the outcomes for cost of capital determinants — this category includes gearing.

12.3 Conclusion

Our proposed range for real WACC is **2.96-3.73 per cent**, and the **point estimate is 3.42 per cent**.

Table 12.4: Overall WACC — conclusion

	Lower end	Point estimate	Upper end
Real	2.96%	3.42%	3.73%
Nominal	5.01%	5.49%	5.81%
RPI-deflated	1.96%	2.42%	2.73%

Source: Europe Economics.

13 Financeability

13.1 Approach

The basis of our financeability analysis is Moody's (2017) report commenting on PR19. The key measures of financeability are Funds From Operations (FFO) and Adjusted Cash Interest Cover Ratio (ACICR). As described in Moody's (2017) "ACICR measures a company's ability to meet its interest payments after payment of capital charges. Capital charges are the cost of maintaining the RCV at its existing level. They are represented in the calculation by the RCV run-off. ACICR is a more conservative measure than interest cover. It provides an indication of interest coverage assuming companies cannot reduce capital charges."[99]

ACICR is defined as follows

$$ACICR = \frac{FFO\ (pre\text{-}interest) - \ RCV\ run\text{-}off}{cash\ interest},$$

where $FFO\ (pre\text{-}interest)$ is funds from operations before adjusting for interest (i.e. return + depreciation); $RCV\ run\text{-}off$ is equivalent to depreciation, and therefore the metrics ultimately captures the ratio of return to interest. A higher return-to-interest ratio indicates a lower likelihood of default on debt obligations.

In our analysis we need to account for the fact that starting from 2020 Ofwat will begin indexing the RCV, on which the allowed return is calculated, by CPIH rather than RPI.[100] As a result, in the first year of the regulatory period half of the RCV will be indexed by RPI and half by CPIH. All new additions to the RCV will also be indexed by CPIH. We illustrate the evolution of CPIH-indexed RCV in section 13.2.2.

13.2 Analysis

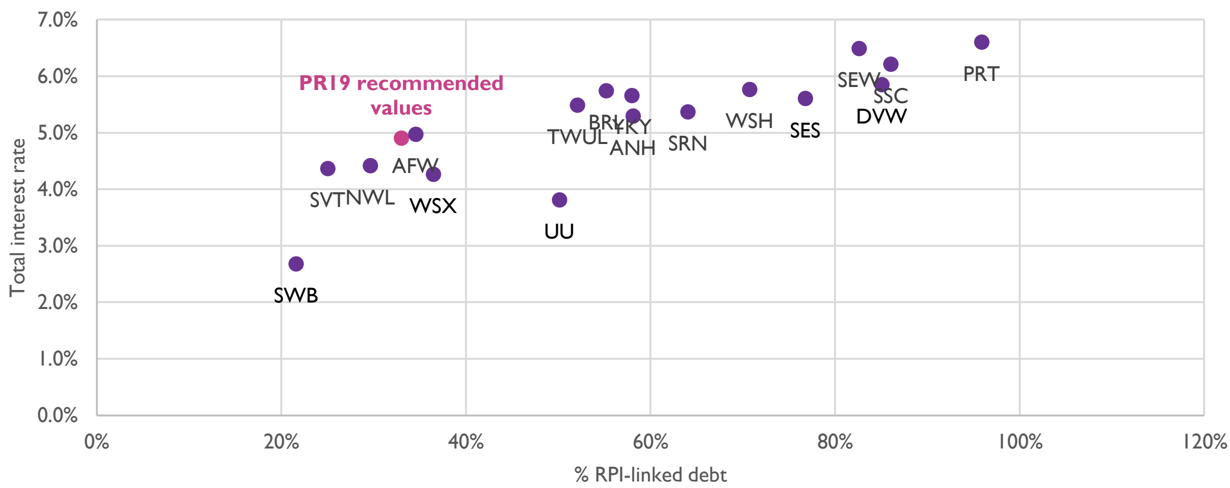
13.2.1 Proportion of inflation-linked debt

We analysed the relationship between the proportion of RPI-linked debt and the overall yields paid on debt. The overall yield is the average yield paid on all debt instruments (including both RPI-linked and non-RPI-linked debt). This assumption is motivated by one of the effects theory would predict, i.e. that a higher proportion of inflation-linked debt could result in lower yields on non-inflation-linked debt as issuing debt linked to RPI (or inflation) reduces company's exposure to inflation risk. As illustrated in Figure 13.1 below, indeed we can observe a positive relationship between the proportion of RPI-linked debt and the overall yield paid on debt. We can also distinguish between two groups of firms — one with the proportion of RPI-

[99] Moody's (2017), "Ofwat signals challenging price review".
[100] Ofwat (2017), "Delivering Water 2020: Consulting on our methodology for the 2019 price review", page 191.

linked debt ranging between 22 and 36 per cent, and another for which RPI-linked debt accounts for more than half of the overall amount of debt outstanding.

Figure 13.1: Nominal cost of debt vs proportion of RPI-linked debt



Note: For the purpose of this analysis, the nominal cost of debt was estimated based on all debt instruments reported by companies.
Source: Companies' submissions, Europe Economics calculations.

The previously assumed level of **33 per cent** of inflation linked-debt is broadly consistent with what firms do.

13.2.2 Average proportion of RPI/CPIH-indexed RCV

Table 13.1 below illustrates the transition from indexing RCV by RPI to indexing by CPIH as per Ofwat's illustrative true-up model.[101] We can see that the proportion of CPIH-indexed RCV increased for a little over a half in 2020-21 to over 60 per cent in 2024-25. In our financeability analysis we assume the average split between CPIH- and RPI-indexed RCV of 42:58.

Table 13.1: Evolution of the proportion of RPI/CPIH-indexed RCV

	2020-21	2021-22	2022-23	2023-24	2024-25	Average
RPI-indexed RCV	30,944	30,350	29,774	29,213	28,669	**42%**
CPIH-indexed RCV	34,502	37,751	40,953	43,886	46,209	**58%**
% RPI	47%	45%	42%	40%	38%	**42%**
% CPIH	53%	55%	58%	60%	62%	**58%**

Source: Based on RCV figures for 2020-25 obtained from Ofwat's website.

13.2.3 Financeability results

In our analysis our aim was to follow the approach Moody's set out in its 2017 UK Water Sector comment as closely as possible.[102] That said, we adjust Moody's approach in two ways:

- as discussed above, we assume that the proportion of CPIH-indexed RCV will gradually increase over 2020-25 period as new capital is added to RCV and as old capital depreciates — our estimate of the share of CPIH-indexed RCV over the period is thus higher, i.e. 58 per cent, than the level assumed by Moody's (50 per cent), which implies — other things being equal — higher returns and better financeability results;

[101] See RPI-CPI illustrative true-up model on Ofwat's website.
[102] Moody's (2017), "Ofwat signals challenging price review", Sector comment, 17 July 2017.

- in calculating the amount of nominal interest, we adjust the formula using the Fisher equation, which states that the relationship between nominal rate, real return and inflation is $r_{nominal} = (1 + r_{real}) \cdot (1 + inflation) - 1$, instead of relying on a simplified version which assumes that $r_{nominal} = r_{real} + inflation$.

Moreover, we updated our assumptions regarding notional gearing and depreciation rate, which both improve the financeability results compared to the illustrative example form Moody's paper. In particular:

- a lower level of notional gearing improves the financeability ratios as less debt implies — all else equal — less interest, and thus better interest coverage ratio; and
- a higher depreciation rate[103] increases funds from operations, and thus the adjusted interest coverage ratio.

Based on an illustrative case for a limited number of variables where the depreciation rate is equal 4.5 per cent,[104] and RCV is equal to 1000, we can see in Table 13.2 below that our proposed range for the cost of capital would slightly improve companies' financeability (measured by adjusted ICR) compared to PR14. Specifically, given our proposed range for PR19 the **adjusted ICR is between 1.38 and 1.44**. Based on the point estimate, the adjusted ICR is **1.42**, compared to 1.30 in PR14.

[103] The 4.5 per cent rate we use in this model is a rounded figure from Ofwat's forecasts for 2020-25, which is 4.6 per cent. See RPI-CPI illustrative true-up model on Ofwat's website.

[104] As per the RPI-CPI illustrative true-up model on Ofwat's website.

Table 13.2: Financeability — illustration

	PR14	PR19		
		Lower end	Point estimate	Upper end
Gearing	62.5%	60%	60%	60%
Real cost of debt (pre-tax)	—	2.03%	2.46%	2.77%
Real cost of equity (post-tax)	—	4.35%	4.86%	5.18%
Real vanilla WACC	—	2.96%	3.42%	3.73%
RPI-deflated cost of debt (pre-tax)	2.59%	1.03%	1.47%	1.77%
RPI-deflated cost of equity (post-tax)	5.65%	3.34%	3.84%	4.16%
RPI-deflated vanilla WACC	3.74%	1.96%	2.42%	2.73%
Depreciation rate	4.0%	4.5%	4.5%	4.5%
RPI inflation rate	3.0%	3.0%	3.0%	3.0%
CPI inflation rate		2.0%	2.0%	2.0%
Proportion of IL debt	33%	33%	33%	33%
RCV	1000	1000	1000	1000
Debt	625	600	600	600
Average % RCV indexed by RPI-deflated WACC	100%	42%	42%	42%
Average % RCV indexed by real WACC	—	58%	58%	58%
Return	37	25	30	33
Depreciation	40	45	45	45
Interest	29	18	21	23
FFO	49	52	54	55
FFO (pre-interest)	77	70	75	78
Debt/RCV	62.5%	60.0%	60.0%	60.0%
Adjusted ICR	**1.30**	**1.38**	**1.42**	**1.44**
FFO ICR	2.69	3.82	3.56	3.41
FFO/Debt	7.8%	8.7%	9.0%	9.2%

Source: Moody's (2017), Europe Economics.

13.3 Conclusion

Based on this illustrative analysis, we could expect the financeability of the water companies to improve compared to PR14. The adjusted ICR consistent with our point estimate WACC figures is **1.42** compared to 1.30 in PR14.

That said, this financeability analysis should be treated as indicative. It only focuses on a limited number of variables, and for the final determinations we suggest to conduct a more thorough financeability analysis based on revenue models for each company.

14 Retail Margin

In this section, we discuss the approach taken to propose the ranges for retail margins of Ofwat regulated water companies. The margin analysis was based on a combination of comparator analysis of actual retail margins.

14.1 Approach

Margin analysis was conducted on a set of potential candidate comparators and previous regulatory determinations. Potential candidate comparators include firms in energy retail, mobile, train operators and postal services sectors. The candidate comparator industries were selected on the basis of their similarity to water companies and the retail margins were only disaggregated on household and non-household basis for retail energy firms.

The criteria for selecting comparators includes the following:

- asset composition of the comparators (fixed vs variable cost base) — whether the chosen comparators are as asset light and rely on working capital in the same way as the retail water companies;
- the nature of their business — whether the business relies on external contractors, is IT heavy etc. and operates in the UK or has a Europe wide presence;
- their risk exposure during business operation — the main risks and uncertainties faced by the business, and whether they are similar to those of the retail water companies;
- the regulatory environment they face — comparators should ideally face similar regulatory risk;
- the pace of the industry they operate in; and
- their client base — comparators' client bases should ideally be the same as those of retail water companies (should have household and non-household customers).

Moreover, with retail non-household water market opening to competition the following risks will faced by firms:

- contract risk from supplying to non-household customers;
- customer insolvencies, phoenix companies (companies emerged from the collapse of one company) and corporate abuse risk;
- data protection risk;
- dealing with brokers — similar to the energy markets;
- water companies can learn from the experiences of retail energy markets which are open to competition.

Based on the comparator assessment criteria and the risks faced by water companies, the selected comparator companies and their actual retail margins are presented in the tables below.

- Table 14.1 shows retail EBIT margins for energy, water, mobile, rail, and postal companies;
- Table 14.2 shows household EBIT margins for energy companies;
- Table 14.3 shows non-household EBIT margins for energy companies.

Table 14.1: Retail EBIT margins from actual company accounts

	2011	2012	2013	2014	2015	2016	5 year average (2012-2016)
Centrica	6.8%	6.6%	5.8%	5.1%	5.3%	6.2%	5.8%
E.ON UK	3.3%	2.5%	3.5%	3.8%	3.6%	5.5%	3.8%

EDF Energy Holdings	-0.9%	-1.4%	-0.8%	0.5%	0.2%	-0.1%	-0.3%
Scottish Power	0.1%	4.6%	4.4%	4.9%	4.4%	3.5%	4.4%
SSE	3.6%	4.3%	2.9%	4.7%	5.4%		4.3%
RWE Npower	1.2%	2.9%	2.5%	2.1%	-1.7%	-1.6%	0.9%
First Utility Limited	1.6%	1.2%	-1.1%	1.9%	0.2%		0.6%
Good Energy Limited	6.2%	10.2%	8.2%	-2.6%	7.4%		5.8%
Average energy	**2.8%**	**3.9%**	**3.2%**	**2.5%**	**3.1%**	**2.7%**	**3.1%**
Scottish Water Business Stream	7.0%	9.7%	10.1%	10.5%	9.5%	7.4%	9.5%
Average water	**7.0%**	**9.7%**	**10.1%**	**10.5%**	**9.5%**	**7.4%**	**9.5%**
Tesco Mobile	0.0%	0.2%	0.1%	0.5%	0.4%		0.3%
Lebara Mobile	1.8%	0.2%	-4.1%	-7.5%	-1.7%	2.2%	-2.2%
Lycamobile UK	4.0%	6.3%	3.0%	1.2%	3.6%		3.5%
Average mobile	**1.9%**	**2.2%**	**-0.3%**	**-1.9%**	**0.8%**	**2.2%**	**0.5%**
London Overground Rail Operations	0.7%	6.8%	5.1%	0.8%	3.0%	7.7%	4.7%
First Capital Connect	0.5%	0.7%	0.8%	2.0%	1.4%		1.2%
Royal Mail Group Limited	-2.7%	0.5%	2.7%	3.4%	2.3%		2.2%
Average rail and post	**-0.5%**	**2.6%**	**2.9%**	**2.1%**	**2.2%**	**7.7%**	**2.7%**
Overall average	**2.2%**	**3.7%**	**2.9%**	**2.1%**	**2.9%**	**3.9%**	**3.0%**

Source: Regulatory annual accounts, Europe Economics' calculations.

Table 14.2: Household retail EBIT margins from actual company accounts

	2011	2012	2013	2014	2015	2016
Centrica plc	7%	7%	6%	5%	7%	7%
E.ON UK plc	2%	2%	4%	5%	4%	7%
EDF Energy Holdings Ltd	-5%	-3%	-3%	-0.2%	-1%	-1%
Scottish Power Ltd	-0.4%	5%	5%	6%	6%	5%
SSE plc	6%	6%	4%	6%	6%	
RWE Npower plc	-2%	4%	3%	2%	-7%	-6%
Average energy	**1.26%**	**3.39%**	**3.09%**	**3.97%**	**2.64%**	**2.41%**

Source: Regulatory annual accounts, Europe Economics' calculations.

Table 14.3: Non-household retail EBIT margins from actual company accounts

	2011	2012	2013	2014	2015	2016
Centrica plc	7%	6%	5%	5%	-1%	2%
E.ON UK plc	5%	3%	3%	3%	2%	4%
EDF Energy Holdings Ltd	2%	0.2%	1%	1%	1%	0%
Scottish Power Ltd	2%	5%	3%	1%	0%	-1%
SSE plc	0.2%	0.3%	1%	2%	4%	
RWE Npower plc	4%	2%	2%	2%	2%	1%
Average energy	**3.41%**	**2.82%**	**2.57%**	**2.36%**	**1.36%**	**1.39%**

Source: Regulatory annual accounts, Europe Economics' calculations.

We also looked at the regulatory precedent on retail margins. Table 14.4 presents the retail margins proposed by various regulators in their price control determinations.

Table 14.4: Retail margins in regulated sectors

Regulator	Year	Margin/Turnover	Segment
Uregni (Power NI supply)	2014	2.2%	HH and NHH
CER (Bord Gáis Energy)	2013	20%	HH and NHH
Commission for Energy Regulation	2012	2.0%	HH and NHH
Ofcom (Royal Mail)	2012	5%-10%	HH and NHH
Utility Regulator Northern Ireland	2011	1.7%	HH and NHH
Uregni (Power NI supply)	2011	1.7%	HH and NHH
Commission for Energy Regulation	2010	1.3%	HH and NHH
CER (Public Electricity company)	2010	1.3%	HH and NHH

Regulator	Year	Margin/Turnover	Segment
Utility Regulator Northern Ireland	2009	1.5%	HH and NHH
Water Industry Commission Scotland	2005	3.2%	NHH
Ofgem/ Offer	1998	1.5%	HH and NHH
Monopolies and Mergers Commission	1995	0.5%	HH and NHH
Offer	1994	1.0%	HH and NHH

Source: Various regulatory determinations.

Competition and Markets Authority's (CMA) investigation probed into the retail margins of energy companies. The investigation concluded that the retail energy EBIT margins should be around 2 percent based on benchmark comparator analysis with greater weight placed on margins of GB energy companies. It further suggested retail margins of 1.25 percent based on ROCE analysis though it admitted that the ROCE analysis was based on very asset-light companies. The CMA investigation conclusions and the average energy company margin are presented in Table 14.5 below.

Table 14.5: CMA investigation of retail energy margins

	Retail margins
Actual energy company margins (5 year average 2012-2016)	3.14%
CMA margins	2.00%
CMA and energy company average margin	2.57%
CMA ROCE	1.25%

Source: CMA (2016), "Appendix 9.13: Retail profit margins", Europe Economics calculations.

14.2 Evidence

In Table 14.6, we present the retail margins ranges. The ranges reflect the volatility in potential comparator margins over the last 6 years as well as their average values.

Table 14.6: Retail margin ranges from actual company accounts and regulatory determinations

	Ranges retail net margin
Regulatory determinations	0.50-5.00
Retail EBIT/Retail Turnover	2.81-3.14
Household EBIT/Retail Turnover	1.26-3.97
Non-household EBIT/Retail Turnover	1.36-3.41

Source: Europe Economics.

For non-household margins the actual retail margins of potential firms would give a better range as the market is open to competition whereas for household margins, some weight should be placed on regulatory determinations. Therefore, for household margins, we take the lower bound of the range from the regulatory determinations and the upper bound of the range from the actual retail margins (Table 14.7).

Table 14.7: Proposed retail margin ranges

	Lower end	Upper end
Household EBIT/Retail Turnover	0.50%	3.97%
Non-household EBIT/Retail Turnover	1.36%	3.41%

Source: Europe Economics.

14.3 Conclusion

The evidence presented in this section would be consistent with a fairly wide range for both the household (0.5 per cent to 3.97 per cent) and non-household (1.36 per cent to 3.41 per cent) retail margins. The margins initially recommended by PwC in PR14 (1.0 per cent for household margin, and 2.5 per cent for non-household margin) lie within these ranges and thus are consistent with them. The final retail margin recommended by PwC was 0.90 per cent.[105] The calculation of retail margins is subject to considerable methodological challenges and the basis for changing or challenging retail margins is fairly limited. At this stage, we propose rounding to **1.0 per cent** retail margin as our working value.

Perhaps the main point of interest emerging from our data is that, whereas at the time of PR14, household retail margins tended to be lower than non-household margins, over the past five years that pattern has reversed. Thus, although we do not consider that these data currently provide a robust basis for changing the retail margins materially from those used previously, the area we suggest should be the focus of any additional consideration before the final PR19 decision should be any further evidence that emerges supporting a reversal in the relative size of household and non-household margins.

105 PwC (2014), "Updated evidence on the WACC for PR14".

Appendix

Europe Economics

A. Abbreviations

Acronym	Definition
ACICR	Adjusted Cash Interest Cover Ratio
AEEGSI	Autorità per l'Energia Elettrica il Gas ed il Sistema Idrico
AFW	Affinity Water
AMP	Asset Management Plan
ANH	Anglian Water
ARCEP	Autorité de Régulation des Communications Électroniques et des Postes
BoE	Bank of England
BRL	Bristol Water
CAPM	Capital Asset Pricing Model
CER	Commission for Energy Regulatio (now Commission for Regulation of Utilities)
ComReg	Commission for Communications Regulation
CPI	Consumer Price Index
CPIH	Consumer Price Index including a measure of owner occupiers' Housing costs (OOH)
DGM	Dividend Growth Model
DVW	Dee Valley Water
EBIT	Earnings Before Interest and Tax
ERP	Equity Risk Premium
FE	Firmus Energy (Distribution) Ltd
FFO	Funds From Operations
GDP	Gross Domestic Product
ICR	Interest Cover Ratio
IMF	International Monetary Fund
MAR	Market-to-Asset Ratio
NWL / NES	Northumbrian Water
OBR	Office for Budget Responsibility
ONS	Office for National Statistics
PGNL	Phoenix Natural Gas Limited
PNN	Pennon
PR	Price Review
PRT	Portsmouth Water
QE	Quantitative Easing
RCV	Regulatory Capital Value
RFR	Risk-Free Rate
RPI	Retail Price Index
SES	Sutton and East Surrey Water
SEW	South East Water
SRN	Southern Water
SSC	South Staffordshire Water
SVT	Severn Trent
SWB	South West Water
TMR	Total Market Return
TWUL / TMS	Thames Water
UU	United Utilities
WACC	Weighted Cost of Capital

WASC	Water and Sewerage Company
WOC	Water Only Company
WSH	Dwr Cymru
WSX	Wessex Water
YKY	Yorkshire Water