COST OF CAPITAL FOR PR19

Report for Thames Water

March 2019

CONTENTS

EXECUTIVE SUMMARY

Thames Water has commissioned Frontier Economics to estimate the cost of capital for water and wastewater companies for PR19.

The aim is to have an independent analysis to inform Thames' business plan resubmission. Thames' September 2018 business plan adopted Ofwat's early view on the cost of capital.

Frontier's estimate considers market movements and the latest evidence since the early view was published (December 2017). It also addresses questions of methodology, some of which have arisen since the early view was published. We derive a point estimate of 2.67% (midpoint of our estimated range) for the vanilla weighted cost of capital (WACC) in RPI real terms, which is 37bps higher than Ofwat's early view.

Some of this difference is purely due to changes in market data since December 2017, such as the yield on the gilt and the iBoxx indices. Recognising that Ofwat will likely re-assess these market parameters at the final determination, we also show our estimate without updating these market parameters from the December 2017 data used by Ofwat. In this case, our estimate is 2.61%, 31bps higher than Ofwat's early view due to differences in our proposed methodologies.

Figure 1 below compares the estimates with Ofwat's early view, on the key parameters of the WACC.

Figure 1 Comparison of WACC components (real RPI)

Component	Frontier	Ofwat	Reason for difference (if any)
Gearing	60%	60%	Adopted Ofwat estimate
Total market return (TMR)	6.22%	5.44%	Evidence of higher TMR and appropriate interpretation of data
Risk-free rate (RFR)	-1.07%	-0.88%	Evidence of gilt market movement
Excl. market updates	*-0.87%*		
Equity risk premium (ERP)	7.29%	6.31%	Evidence of higher TMR and lower RFR
Excl. market updates	*7.10%*		
Debt beta	0.10	0.10	Adopted Ofwat's estimate
Asset beta (including debt beta)	0.37	0.37	Agreed with Ofwat's estimate
Notional equity beta	0.77	0.77	From above
Cost of equity (including debt beta)	4.57%	4.01%	From above
Excl. market updates	*4.62%*		
Ratio of embedded to new debt	75:25	70:30	APP19, historical debt and RCV evidence of a lower proportion of new debt
Nominal cost of embedded debt	4.70%	4.64%	Updated iBoxx, no halo reduction and adjustment for new issuance by 2020
Excl. market updates	*4.66%*		

Nominal cost of new debt	3.98%	3.40%	Updated iBoxx, forward adjustment and no halo reduction
Excl. market updates	*3.55%*		
Issuance and liquidity costs	0.10%	0.10%	Adopted Ofwat's estimate
Real overall cost of debt	1.57%	1.33%	From above
Excl. market updates	*1.44%*		
Appointee WACC (vanilla)	2.77%	2.40%	From above
Excl. market updates	*2.71%*		
Retail net margin deduction	0.10%	0.10%	Adopted Ofwat's estimate
Wholesale WACC (vanilla)	**2.67%**	**2.30%**	From above
Excl. market updates	***2.61%***		

Source: Frontier analysis and Ofwat, Appendix 12: Risk and return December 12 2017. Excluding market updates does not update the market data since Ofwat's early view on the cost of capital.

As shown in the figure, Frontier has found differences with Ofwat due to market movements and methodology approaches. The cost of equity difference is primarily due to methodological differences in estimating the TMR, as the market update to the risk-free rate is relatively small. The cost of debt difference is from both market updates and the removal of Ofwat's halo adjustment.

Finally, Frontier also identify factors that would suggest that the true cost of capital could lie towards the upper end of our range.

1 INTRODUCTION

Thames Water have commissioned Frontier Economics to provide an update on the weighted cost of capital (WACC) for PR19.

Thames Water's PR19 business plan adopted Ofwat's early view on the WACC for consistency with the regulator, but they note that this early view did not consider all information available now. Ahead of resubmitting its business plan for Ofwat's draft determination, Thames Water has asked Frontier to review the evidence on the appropriate cost of capital.

Ofwat's early view on the WACC was published in December 2017. Since then, there have been developments which could have impact on the cost of capital. These include the UK Regulators Network (UKRN) report, Ofwat's 'Back in Balance' consultation and Ofgem's cost of capital consultation.

Uncertainty and risks can further impact the cost of capital. Moody's issued a negative outlook for the sector, and uncertainty around Brexit and climate change have potential impacts for the water industry.

In addition, we have reviewed Ofwat's methodology and assumptions for estimating the WACC and we applied adjustments where we believe this is appropriate. This includes the total market return (TMR) estimation and the proportion of embedded debt.

We set out clearly where a change in a component of the WACC is due to an update of market data or difference in methodology. We have also adopted the Ofwat approach without review in a few areas, where Ofwat's approach is a relatively standard one and / or the impact on the estimated WACC is not material. This is summarised in the figure below.

Figure 2 Differences with Ofwat's view on components of the WACC

Component of the WACC	Comparison to Ofwat's early view
Gearing	Adopted Ofwat's estimate
Total market return (TMR)	Evidence of higher TMR and appropriate interpretation of data
Risk-free rate (RFR)	Evidence of gilt market movement
Equity risk premium (ERP)	Evidence of higher TMR and lower RFR
Debt beta	Adopted Ofwat's estimate
Asset beta (given assumed debt beta)	Agreed with Ofwat's estimate
Ratio of embedded to new debt	APP19, historical debt and RCV evidence of a lower proportion of new debt
Nominal cost of embedded debt	Updated iBoxx, removal of the 'halo' reduction and adjustment for new issuance by 2020
Nominal cost of new debt	Updated iBoxx, forward adjustment and removal of 'halo' reduction
Issuance and liquidity costs	Adopted Ofwat's estimate
Retail net margin deduction	Adopted Ofwat's estimate

Source: Frontier analysis and Ofwat, Appendix 12: Risk and return December 12 2017

We provide our WACC estimation on the basis of both our methodology (where different from those from Ofwat) and market updates.

This report is structured as follows:

- Section 2 discusses the estimation of the cost of equity, including reviewing the evidence we have found regarding the relevant elements mentioned above;
- Section 3 explores the estimation of the cost of debt, including updates to the data and our finding on the ratio between new and embedded debt; and
- Section 4 summarises our resulting estimates on the cost of capital, in comparison with Ofwat's 2017 early view.

Annexes provide details of the calculations for components of the cost of equity and the cost of debt.

2 COST OF EQUITY

KEY CONCLUSION

Our estimated overall cost of equity is 4.57%, which is higher than Ofwat's 4.01% (both real RPI).

We disagree with Ofwat's use of DGM as a primary method of estimation of the TMR.

Our TMR figure based on historic average is higher than Ofwat's estimate and our risk-free rate is lower reflecting current market conditions. Our cost of equity range is wider.

We agree with Ofwat's asset beta, and we adopt Ofwat's debt beta and gearing estimate. We agree that OLS is an appropriate method for beta estimate. We have reviewed the EV/RAV gearing adjustment and the RAR versus RER adjustments, as proposed in Ofgem's December sector consultation, and conclude that neither is appropriate to be applied to the water sector cost of equity.

Consistent with Ofwat, we use the Fisher equation when moving between different indices[1]. We use inflation forecasts consistent with Ofwat of 2% for CPIH and 3% for RPI.

2.1 Total Market Return

KEY CONCLUSION

We find little evidence of the decrease in the TMR as proposed by Ofwat informed by its DGM model, as we do not consider DGM to be the primary estimation method of the TMR.

We also do not assume a direct relationship between lower interest rates and lower returns on equity.

There is no one correct way to interpret historical data on equity returns in real terms, as the reported real return data is neither entirely consistent with RPI nor with CPI.

Our analysis results in a range for the TMR of 5.94% – 6.50% in RPI real terms.

2.1.1 Critical assessment of Ofwat's PR19 proposal

For PR19, Ofwat proposed to estimate the TMR based on short-term market evidence and dividend growth model (DGM) analysis. Ofwat found that the TMR has significantly decreased (by more than one full percentage point) compared to the most recent UK regulatory precedent set by the Competition and Markets Authority (CMA).

[1] For instance, when moving from nominal to CPIH (2% forecast inflation) the equation is $= \frac{(1+nominal)}{(1.02)} - 1$

Our analysis reaches different conclusions.

- We found little support for the significant decrease in the estimated TMR suggested by Ofwat.
- More generally, we consider that the proposed short-term DGM approach is not as suitable as the capital asset pricing model (CAPM) for setting regulatory allowance on the cost of equity for regulated water companies[2]. It is more exposed to judgement on input assumptions that drive the results to a significant extent. And it is prone to volatile short-term market movements, which can increase regulatory risk.
- Changing focus between short-term and long-term to reflect the lower value may amplify time-inconsistency issues for investors. This could lead to suboptimal investment decisions in the long run at the detriment of consumers.

We expand below in more detail on each of these points. We begin with our observation that we do not see evidence to support a read-across from observed low interest rates to assumed low equity returns.

There is no direct read-across from bond yield to expected equity return

Ofwat's starting point for the consideration of a shorter-term cost of equity approach is the view that interest rates and government bond yields will remain at historically low levels for the foreseeable future. This is the so-called 'lower for longer' scenario that Ofwat introduced in its PR19 methodology consultation document.

We agree with Ofwat's observation that the risk-free interest rates, and the yield on corporate bonds and various other fixed income assets, have declined significantly in the past ten years or so after the global financial crisis. Possibly this is due to a combination of quantitative easing and "flight-to-safety"[3]. We consider it reasonable to argue that such low interest rate environment would be unlikely to suddenly unwind in the near future. We would agree with the implied conclusion that the cost of debt in the sector, as per the cost of debt in the general economy, has significantly decreased as well.

However, we do not consider that this observed low interest rate directly translates into a low expected return on equity. The reason for this is that equity capital has unobservable and uncertain future cashflows. This is unlike fixed-income assets (such as gilt, corporate bonds and loans) whose future cash flows are well defined and hence the yield can be reliably implied by the market price. There is no equity equivalent of observable bond yield, which makes it a hypothesis that a low yield on bonds have led to a low expected return on equity in the market as a whole.

We recognise there are forces in a low-interest bond market that would suppress the expected equity return, such as quantitative easing. However, there are also other forces that would lead to a higher expected equity return such as "flight-to-

[2] Unless otherwise stated, we use water companies as a shorthand to refer to water and wastewater providers.

[3] This is the argument that during times of uncertainty, regulated equities have an increased demand as they are viewed as safer and more certain investments.

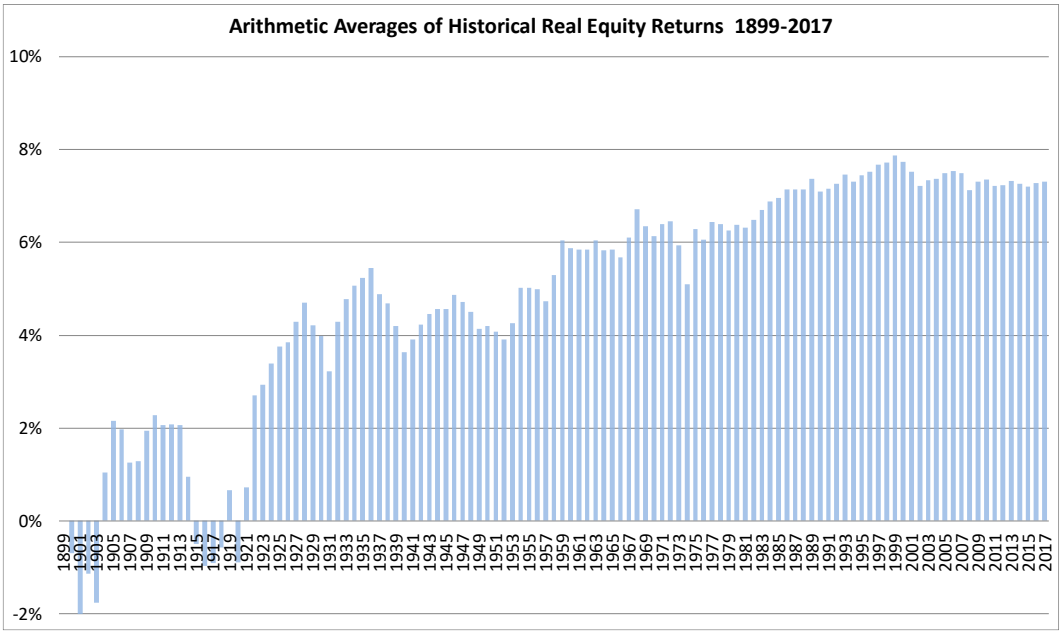
safety" when capital flows from equity to bonds driving the expected return on equity higher while the yield on bonds lower.

Because one *cannot* disentangle the expected equity return from expected future dividend on equity, the link between the expected equity return and the observed bond yield is difficult to quantify precisely.

However, there is data on equity return that is readily observable: the historic *realised* (as opposed to expected) equity returns. The regulatory precedent and best practice in the UK has been to rely most primarily on the long-term historic realised returns to inform long-term future expected equity returns. The long-term historic average approach is recommended by the UKRN report in 2018 on the cost of capital (discussed further in the following section) .[4]

Figure 3 below shows the average historic realised returns on equity in the UK. Each bar in the chart represents the average return from 1900 to the year on the horizontal axis.

Figure 3 Long-term historic real equity return (adjusted for DMS long-term average inflation measure for the UK))



Source: Data from Credit Suisse Global Investment Returns Yearbook 2018 (DMS), Frontier analysis
Note: Every bar in the chart represents the average of the entire period from 1899 to that specific year.

It can be seen that the realised equity returns have not followed the significant decrease in the yield on gilt and corporate bonds in the last ten years.

In fact, the long-term average measured in 2017 (7.3%) is higher than that measured in 2015 (7.2%). Nominal returns were reported at 15% and 10% respectively for 2016 and 2017. It is therefore hard to reconcile Ofwat's conclusion that equity return should be "lower for longer" with the actual recent evidence from the equity market.

[4] Wright S. et al (2018) Estimating the cost of capital for implementation of price controls by UK Regulators, An update on Mason, Miles and Wright (2003), page 45

Although we acknowledge that realised returns are not a guarantee for expected future returns, the long-term historic average measures what has been achieved in the past and can therefore at least be considered indicative to what may be achieved in the future.

We note that there are other methods to estimate the equity market return, which could be used as cross checks. They are either expert opinions, such as surveys by finance academic and practitioners, or implied expected equity returns using market price of stocks while making assumptions on future dividend pay outs and growth. This is the underlying principle on which the DGM method is based. We discuss this in detail below.

Ofwat should not rely on DGM for its primary evidence

The Dividend Discount Model (DDM), or in this case the DGM, is an established method in corporate finance theory to calculate the value of an equity share. With the level of current dividend, *an assumption on the future dividend growth* (to perpetuity), and an *independently estimated* cost of equity, one can use the discounted cash flow equation to calculate the present value of the equity. The result can then be used to compare with the current share price to inform prospective investors as to whether the share is currently over- or under-valued.

Using the DGM method to estimate the cost of equity is the inverse logic to the above. It uses the observed market price of the share, combining it with *an assumption on the future dividend growth,* to backward imply a level of cost of equity such that the present value of the assumed future dividend is equal to the market price (see A.2 for our cost of equity example).

Any method to estimate expected equity returns can suffer from uncertainty, and our preferred long-term historic average approach is no exception, as the past is not always the best indication for the future. However, what makes the DGM method particularly susceptible to uncertainty is that the uncertainty on the result (i.e. the range) is largely *driven* by the chosen underlying assumption (long-term dividend growth). We show a range of long-term rates in A.2.3 which demonstrates this, where we have to make our own assumptions on long-term dividend growth in our cross check of the cost of equity through a DGM model in 2.7.

Furthermore, the DGM method is also more prone to being affected by market movements. The share price, or in this case the stock index, is changing every day. It is impossible to know if the change is due to a change in the assumption on future dividend or the underlying cost of equity. Ofwat's method of taking an average over the index value to moderate "volatility" effectively assumes that all of the market movements are due to a change in underlying cost of equity. This is unlikely to be true in reality. This is because a significant proportion of share movements are due to changes in investors' underlying assumptions of future dividend of the stocks.

To take this concept even further, classic economic theory predicts that investors evaluate shares not on what they think their fundamental value is, but rather on

what they think everyone else thinks their value is, or what everybody else would predict the average assessment of value to be.[5]

In any event, this introduces significant uncertainty to the underlying cost of equity that one tries to estimate using DGM and market share (index) price data. We show evidence of this from market movements for the cost of equity DGM cross check in 2.7.

We therefore argue that Ofwat should not rely on DGM as its primary method to estimate the TMR, and should use it only as a cross check. We note that no recent regulatory determination in the UK involved estimating the equity return by DGM analysis alone. The CMA's 2014 determination for NIE stated explicitly that it did not rely on the DGM analysis for its estimate but used it as a cross check.

> *"We use historical approaches (both ex ante and ex post) as our primary sources for estimating the equity market return, with forward-looking approaches being used only as a **cross-check** on our resulting ERP estimates."*[6]

The CMA explained why it did not rely on the forward-looking DGM approach (our emphasis):

> *"A limitation of this [DGM] approach is that it is necessary to make an assumption about future long-term growth of dividends (which has a major effect on the calculation since dividends beyond year 4 or 5 account for a large part of present value at plausible discount rates). We think such approaches, since they are based on current market data and short-run forecasts, are likely to be **more suitable for estimating the short-run ERP** and less so for estimating the long-run equilibrium ERP. Since we are concerned with the latter, we **place less weight** on results derived from this approach."*[7]

We agree with the CMA's view and see the DGM method as appropriate for a cross-check, as DGM-implied equity returns are known to be highly volatile on a daily basis and can be considered unstable even when averaged across a number of years. The CMA's decisions for both NIE in 2014 and Bristol Water 2015 considered the evidence on current and forward looking TMR and concluded that little weight could be attached to them.

Finally, the UKRN paper published in 2018 confirms the preferred approach on estimating the TMR using a long-term historic average, and expressed concerns on relying on methods such as DGM.

> *We can illustrate the difficulties that may arise here with reference to one recent application of the DDM: PWC's 2017 report to Ofwat, although we note Ofwat referred to a wide evidence base and placed limited weight on DDM. PWC's Figure 26 is reproduced below (Figure 4.9). This shows sensitivities of their EMR (here denoted TMR) estimates to changes in assumptions feeding into*

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5 Known as the Keynesian beauty contest, introduced by Keynes in Chapter 12 of his work *Keynes, General Theory of Employment, Interest and Money, 1936*

6 Competition Commission, Northern Ireland Electricity Limited Final Determination, March 2014, p.13.26.

7 Competition Commission, Northern Ireland Electricity Limited Final Determination, March 2014, p.13.30.

their model. These are very wide ranges indeed: considerably wider than the range of long-run historic average returns. [8]

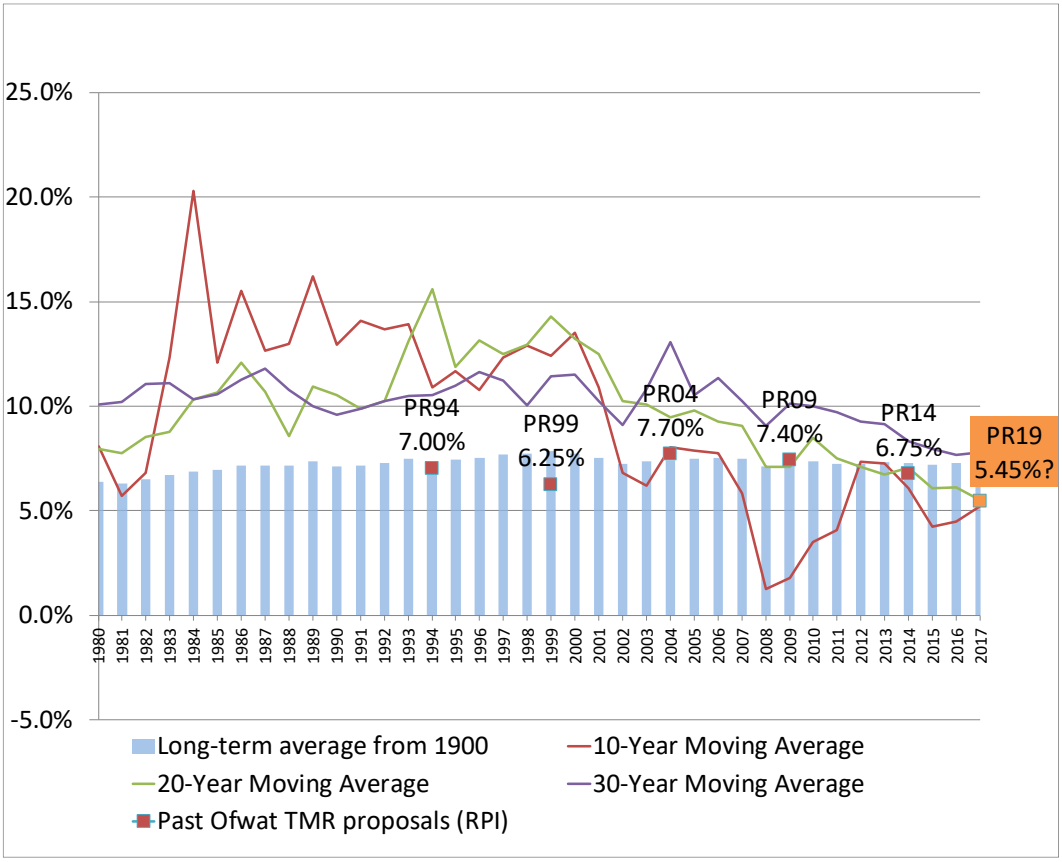
We consider therefore that Ofwat's proposed approach represents a departure from this regulatory best practice.

Increased regulatory risk

We argued above that short-term based approaches to estimate the TMR can increase regulatory risk due to the short-term volatility in market evidence as well as high exposure to judgement error.

There is an additional key implication regarding investors' perception of the regulatory regime regarding the time-inconsistency of regulators' behaviour. If regulators switch to a shorter term methodology when the current market return is lower than long-term average, this could generate a perception that the regulator could switch back to the long-term approach when market condition reverses. There is sufficient historic evidence to support such perception, shown in Figure 4 below.

Figure 4 Past Ofwat TMR proposals versus data on historic returns



Source: Data from Credit Suisse Global Investment Returns Yearbook 2018 (DMS), Ofwat past determinations, Frontier analysis

Note: DMS real returns based on inflation from DMS data source, and Ofwat real TMR based on RPI.

[8] Wright S. et al (2018) Estimating the cost of capital for implementation of price controls by UK Regulators, An update on Mason, Miles and Wright (2003).

In PwC's report for Ofwat, a similar chart was presented as evidence why the PR19 TMR needs to be more in line with the shorter-term evidence, such as 10-year, 20-year or 30-year averages. However, this chart shows that, since PR94, the allowed TMR has always been set at or close to the whole-period average, regardless of the levels of the 10-year, 20-year or 30-year averages. More specifically:

- both for PR94 and PR99, despite the fact that the 10-year, 20-year and 30-year averages (10%-15%) were all well above the whole-period average (7%), Ofwat's allowed equity market return was set at the whole-period average;
- similarly, at PR04 the 20-year and 30-year averages were above the whole-period average, but Ofwat set the allowed equity market return near the whole-period average; and
- a similar story applies to PR09 and PR14 as well, although the 20-year average was also in line with the whole-period average.

Ofwat is now proposing to switch the allowed market return away from the whole-period average towards the 10-year and 20-year averages at PR19, when these averages tip under the whole-period average in the past three years. The 10-year average was equal to the whole period average as recently as 2013 and could rebound in a few years' time, and that the 30-year average is still above the whole period average.

Viewed in this context, investors could plausibly interpret that whenever the short term market is lower than the long-term average, the regulator allows the shorter term market rate. And whenever the short-term market is higher than the long-term average, the regulator allows the long-term average.

The above interpretation, even if not intended by the regulator, can increase the perceived regulatory risk, which would lead to an increase in the betas for regulated water companies. In the long-term this would result in higher prices to customers, compared to maintaining the prevailing regulatory methodology for the cost of capital.

The credit rating agency Moody's issued negative outlook on UK regulated water sector following the publication of its PR19 final methodology and the "Back in Balance" consultation in 2018. These are real-life examples of potentially increased cost of debt that the sector is arguably already experiencing, as a result of concerns around the stability of the future regulatory approach. If a credit downgrade actually occurs to the water companies, then the increased cost of debt will crystallise. Annex B.1 discusses in more detail the increase in the cost of debt and cost of capital in general as a result of a credit downgrade.

Regulated water businesses are long term in nature, particularly in terms of customers' preferences for consistent service quality and bill stability. An approach that shifts towards a short-term and cyclical view of the cost of equity does not make sense in the context of long-term service quality and bill stability.

2.1.2 Discussion on TMR suggested in UKRN paper

The UK Regulators Network (UKRN) published a paper on the methodology of estimating the regulatory allowed cost of capital in 2018. It proposes to use a long-term historic average approach on the TMR, and proposes 6%-7% as real TMR for

the UK. This is based on the geometric average real equity returns for the whole period of 1900-2017 in the UK reported by the latest Credit Suisse Global Investment Returns Yearbook (DMS), and converted into arithmetic average by an adjustment factor in the range of 0.5% to 1.5%.

The paper argues that, for estimating the cost of equity, an arithmetic average is preferred. This logic is also confirmed by DMS in its original publication of the Global Returns Yearbook, entitled "The Triumph of the Optimist". The UKRN paper suggests that the appropriate adjustment to apply to the geometric average is in the range of 0.5%-1.5%, hence the proposed range of 6%-7% for the real TMR. We note that this is lower than the actual reported arithmetic average by DMS for this period, which is 7.3%, based on DMS's own long-term average inflation measure.

However, Ofgem in its December consultation document interpreted this as that the UKRN paper recommends a range for the TMR of 6%-7% in CPI real terms. While this is one interpretation of the long-term historic average, it is not the only one.

The measurement index of inflation in the past 117 years has changed significantly in the DMS data set, from "the index of retail prices", to RPI, and finally to CPI. It is difficult to estimate what a CPIH equivalent average yearly inflation would have been, especially as CPI has only become officially recognised in the DMS database in the 1980s. This makes it highly uncertain that the interpretation that 6%-7% real equity return should be interpreted in CPIH terms.

The data from DMS latest Credit Suisse Global Investment Return Yearbook 2018 shows that:

- the long term geometric and arithmetic averages of nominal TMR in the UK are 9.4% and 11.2% respectively; and
- the long-term geometric and arithmetic average inflation rate is 3.7% and 3.9% respectively (DMS's own inflation measure).

With the evidence above, it would appear that there are at least two alternative interpretations regarding the real TMR for the UK:

- **interpretation 2** - the TMR could be 6%-7% in RPI real terms (7.06%-8.07% CPIH), or
- **interpretation 3** - the TMR could be 9.9%-11.2% in nominal terms (7.75%-9.02% CPIH). The lower bound is based on the geometric average of 9.4% with a minimum adjustment of 0.5% to arithmetic average. The upper bound is the reported arithmetic average.

Interpretation 2 has been used in the past by UK regulators. However, we note two caveats to this interpretation:

- RPI is no longer the official inflation statistic; and
- RPI is currently considered to over-estimate inflation due to its formulas interacting with the way certain prices are measured.

In regard to interpretation 3, we recognise that economic principles would support a stronger case for taking the average historic returns in real terms than nominal

terms. Any extreme inflation events in the past which may not happen in the future could potentially skew the nominal return figures.

However, in the case of the UK, with the geometric and arithmetic average historic inflation in the past 117 years reported at 3.7% and 3.9% respectively by DMS, this potential skewedness is therefore less of a concern. In addition, we note that Ofwat itself takes a nominal interpretation in various places at PR19 in order to manage the transition from RPI to CPIH inflation indexation. The implied assumption is often that as long as the nominal rate of return is kept unchanged, a change to the inflation index directly translates to a corresponding change in the resulting figure in real terms. The underlying principle is not dissimilar to our nominal interpretation above.

Overall, all three interpretations have some potential challenges and caveats attached, without one being obviously superior. We note that the combined evidence suggests a wide range of 6.00%-9.02% in CPIH terms. It is therefore potentially unreasonable for Ofgem to choose the one interpretation that results in the lowest estimate.

2.1.3 Frontier estimation

In our view, a more plausible range might be somewhere towards the middle of the above range of 6.00%-9.02%. If we discard the very low end and very high end of range, an attenuated range of 7.00%-8.00% emerges. We further note that the latest CMA determination on Bristol Water 2015 suggested an RPI based TMR of 6.5%, which is 7.57% in CPIH terms. We further adjust down our upper bound by this.

In conclusion, we consider a narrower range of 7.00%-7.57% in CPIH terms is the most plausible range of the true TMR for UK for the AMP7 period. In real RPI terms, this is **5.94%-6.50%.** Our point estimate in CPIH and RPI terms are 7.29% and **6.22%**, respectively, the midpoint of our range.

We use this range for the TMR in our cost of equity calculations.

2.2 Risk-free rate

KEY CONCLUSION

We update the risk-free rate to reflect market movements, which gives a value of -1.07% in real RPI terms. This updated value is 0.2% lower than Ofwat's value.

Ofwat proposes to estimate the risk-free rate using short-term (six-month average) gilt yield with an uplift to reflect the forward curve's upward movement into the future.

In the context of estimating the TMR using a long-term historic approach, and recognising that the Equity Risk Premium (ERP) is the difference between the TMR and the risk-free rate, we consider Ofwat' short-term approach on the risk-free rate broadly reasonable.

This is because the risk-free rate is largely observable and the approach is therefore not exposed to the same challenge as estimating the unobservable TMR using a short-term approach as discussed above. We agree that it would be reasonable for the regulator to incorporate the latest observable market evidence in the estimate of the risk-free rate while including a forward-looking adjustment.

Nevertheless, we note the volatility and forecast error associated with this approach, as the risk-free rate exhibit significant movement on a monthly (sometimes daily) basis. The issue is particularly pronounced amid the current economic uncertainty (see section 2.5). There is a material risk that after Ofwat's determination on the risk-free rate, the market experiences a significant rebound in the risk-free rate during the period of AMP7.

As a way to mitigate the risk of forecast error, Ofgem is proposing at RIIO2 to index the risk-free rate in its allowance on the cost of equity. While we agree that this might mitigate windfall gains/losses regarding the risk-free rate allowance, the full impact of this proposed mechanism and the potential long-term effect on the sector is not yet fully understood. We therefore do not propose to evaluate this methodology until robust study has been carried out on this subject in due course.

Below we describe our estimate for the risk-free rate, in the context of the discussion above, keeping in line with Ofwat's proposed method for PR19.

Ofwat used a 6-month average gilt yield, with a forward curve uplift adjustment. We updated this analysis and obtain a nominal risk-free rate of 1.48% (average nominal ten-year gilt yield over six months to 31 October), adjusting for a forward uplift of 42 bps resulting in a risk-free rate of 1.90% in nominal terms. In real RPI terms this is **-1.07%**, and in real CPIH terms this is -0.10%.

We note that this is 0.2% lower than Ofwat's early view, due to market movement of the gilt yield.

2.3 Gearing

KEY CONCLUSION

We adopt Ofwat's early view of 60%.

Before publishing their early view on the WACC, Ofwat stated that the notional gearing would be no higher than the PR14 level of 62.5%. Their early view is that notional gearing for PR19 is 60%. Ofwat reached this conclusion from evidence on:

- Reduced gearing by some companies compared to 2014 levels; and
- A downward trend to debt to enterprise value in recent years.

Given the above points, we do not consider this estimate to be unreasonable. For simplicity, we adopt Ofwat's 60% gearing estimate.

2.4 Asset beta

KEY CONCLUSION

The area with the largest impact on asset beta is Ofgem's proposed adjustment to the gearing level used to de-lever the raw equity beta, informed by Indepen's research. We do not believe that this is an appropriate adjustment.

We find that OLS is as good an estimator as GARCH and latest beta estimates remain largely unchanged from 2017.

Our asset beta range is 0.32 – 0.41, and our point estimate is the midpoint of the range, 0.37, which is identical to Ofwat's early view on the asset beta.

Ofwat's estimation on equity beta and asset beta was in line with its own precedent and the methodology adopted by the CMA at previous determinations. We consider it largely reasonable and our own estimates are in line with Ofwat's results.

The UKRN paper discussed the merit of Generalised Autoregressive Conditional Heteroskedasticity (GARCH) estimation method, and Ofgem commissioned comprehensive further study on the subject of beta estimation, from academics as well as consultancies. We discuss our view regarding two of the most relevant issues raised by these studies; enterprise value (EV)/ regulated asset value (RAV) gearing adjustment and GARCH versus Ordinary Least Squares (OLS) beta estimation. And we report our own estimation results with up-to-date market data.

2.4.1 EV/RAV gearing adjustment

Ofgem introduced the concept that when de-levering the observed equity beta of benchmark companies, an adjustment needs to be made on the gearing level. The EV based on the market price of equity shares is replaced by the RAV value. This is according to the recommendation from Indepen[9]:

> *"It is potentially inconsistent to de-gear raw betas using one definition of gearing (Net debt / Enterprise Value (EV)) and then re-gear equity betas using a different definition of gearing (Net debt / RAV). If the Enterprise Value is larger than RAV, then by de-gearing and re-gearing, the notional equity beta may be overestimated"*

Indepen's study does not explore further why it considers this "inconsistent", beyond the observation that when EV is larger than RAV the capital value used for de-gearing and re-gearing are not measured on the same basis.

We hold the contrary view on this point. We consider that it would be inconsistent *not* to use the EV to de-gear a raw equity beta, because both the EV and the raw equity beta are derived from the same consistent set of market price of the equity.

In our view, re-gearing *should* be based on a different measure of the capital base (RAV) compared to the one used for de-gearing. The regulatory allowed return is

[9] Report available at https://www.ofgem.gov.uk/system/files/docs/2018/12/final_beta_project_riio_2_report_december_17_2018_0.pdf

based on the notional amount of equity proportional to the RAV and not market capitalisation of equity.

Furthermore, the suggested gearing adjustment could adjust allowed return on equity in circumstances where there is no change in the underlying cost of equity. To see this, consider the following example:

- Start by considering a regulated utility with an EV equal to its RAV. In this case, Indepen's method would suggest that no adjustment would be needed. Suppose, in this case, that the cost of equity is correctly estimated and that the allowed returned of £x is set equal to the cost of equity multiplied by the notional amount of regulated equity.
- Staying with the same underlying regulated business with the same regulated equity value and cost of equity, but now imagine that due to investors' more optimistic beliefs on future productivity gains (or more bullish macroeconomic assumptions in general) the market equity value is 10% higher than the notional regulated equity value. Because the business has the same cost of equity and the same notional regulated equity as the previous case, the total allowed return should remain at £x. This is consistent with the traditional method of de-gearing and re-gearing of equity betas. We note, however, that because the market value of the stock has increased in our example, the expected return on each £1 of equity invested decreases proportionally with the increase in share values.
- In contrary to the above situation, Indepen's proposed adjustment would lead to a 10% lower allowed return on equity on the notional structure due to the higher EV/RAV ratio, which in money terms would be equal to 0.91*£x. But since the notional regulated equity value and the cost of equity have not changed in our example, there would be no clear justification for such an adjustment.

This example shows that the gearing adjustment suggested by Indepen could adjust allowed returns on the notional equity in circumstances without an underlying change in the cost of equity.

In conclusion, we do not believe this gearing adjustment suggested is an appropriate method to use for the de-gearing of the raw equity betas.

2.4.2 GARCH vs OLS

OLS and GARCH are two methods for estimating beta. OLS is a line of best fit which minimises the sum of the squared differences from observations to the line of best fit. GARCH is a more complex model that allows for variation over time, meaning that past shocks and volatility affect current periods.

Analysis of the UKRN paper and Ofgem's consultation show that, although there are particular circumstances under which one is preferred to the other, in general OLS is as good an estimator as GARCH. Additionally, OLS is well-accepted and relatively simple. For these reasons, we use an OLS to estimate the asset betas.

In the following sections, we compare the results from different models and the sensitivity of different models to the parameters.

OLS models are generally as good as GARCH

The UKRN paper provides evidence for further examination of GARCH but no justification for discontinuing the use of OLS. We note that one of the authors, Burns, dissented against the lower betas found using GARCH given the single specification and particular dataset. This is also the conclusion drawn by Indepen in their analysis for Ofgem on different estimation methods.

GARCH is appropriate where there is significant volatility and variation over time. The evidence of the UKRN report showed this is the case for two utility stocks, Severn Trent (SVT) and United Utilities (UU), and so GARCH is an appropriate econometric methodology.

To test how OLS performs against GARCH estimators, we undertook a Monte Carlo simulation exercise. The results of this were as follows:

- the UKRN finding of lower GARCH betas than with OLS is probably **not** a systematic finding;
- one of the GARCH estimators presented in the UKRN report, short-run beta, tends to over-estimate the unconditional beta;[10]
- the statistical uncertainty (confidence intervals) around the OLS estimator is similar to the statistical uncertainty surrounding most of the GARCH estimators. This suggests that the UKRN report's finding that OLS produces higher beta estimates than GARCH (using high frequency returns) was likely due to chance rather than any systematic bias; and
- long-run beta has very wide confidence intervals, suggesting that individual point estimates derived using this estimator should be viewed with great caution.

This evidence is corroborated in Indepen's report. It reviews a range of methods, including GARCH, OLS and least absolute deviations (LAD), with single-whole-period and rolling estimates. Indepen's study found that the different methods led to similar results.

Parameter sensitivity analysis

The results from the UKRN GARCH model are sensitive to the specification of the beta regression. Indepen's report showed that the time period is the most sensitive parameter. This parameter affects results in all models, not just GARCH. Over the time period used:

- the estimates are lowest for 2000-2018;
- the central estimate comes from the estimates for 2008-2018; and

[10] In fact, short-run beta (beta SR) is generally not a consistent estimator of the unconditional beta. A consistent estimator is one that produces estimates that approach the true value of a parameter as the sample size increases to infinity. The Wright and Robertson technical appendix to the UKRN report (p.3) notes that the expected value of the beta SR, $E\left(\frac{\hat{\sigma}_{12,t}}{\hat{\sigma}^2_{11,t}}\right)$ does not equal beta except in special cases. Since beta SR is the average of all the short-run betas, and the sample average moves closer to its expected value as sample size increases, this implies that beta SR) does not move closer to β as sample size increases. Because of this, it is generally not a consistent estimator.

- the upper bound is calculated from 2013-2018 data only.

Similar findings emerge from our analysis of the UKRN paper. The GARCH specification in the UKRN paper is highly sensitive to both the time period and the reference day. We conducted sensitivity tests to arrive at this conclusion.

- Estimation period – the authors of Annex G of the UKRN paper argue that a very long time period should be used for estimation, and present evidence that using a longer time period gives lower estimates. We tested a range of time periods, including periods longer than in the UKRN report. We find that the exact time period used in the UKRN report gives some of the lowest estimates compared to both longer and shorter estimation periods.
- Reference day selection – using monthly or quarterly data involves arbitrary selection of a reference day for calculating returns. We test a series of alternative reference days and find that the estimates are very sensitive to this. Had alternative reference days been selected, results would have been higher or lower.
- Model specification – the UKRN report uses a single GARCH specification (BEKK GARCH) to obtain estimates. We have tested a variety of alternative univariate and multivariate estimates. Results from alternative univariate models tend to be higher than BEKK GARCH.

2.4.3 Frontier beta estimation results

Our OLS estimation is consistent with the method that the CMA adopted for its determination on NIE in 2014.[11] As Ofwat also uses OLS estimations, the methodological differences are minimal. For simplicity, we have adopted Ofwat's debt beta assumptions. We have included 2018 data. Our results are shown in the table below, where we identify a range of 0.32 – 0.41, with the midpoint being 0.37.

Figure 5 Asset beta results by rolling time period for estimation and frequency of data

Frequency of data	2 years	5 years	10 years
Daily (trading days)	0.34	0.39	0.32
Weekly	0.32	0.39	0.33
Monthly	n/a	0.41	0.33

Source: Frontier analysis of Bloomberg data

We estimated asset betas for different combinations of frequency and estimation windows for data up to November 2018. A full description of the data and methodology is in A.1.

Ofwat's point estimate for the asset beta is 0.37, including a debt beta of 0.1. This is in line with the middle of our range. Annex A.1.3 compares Ofwat's beta results with Ofgem's, noting where Ofgem differed in underlying assumptions.

However, we also identify and discuss additional risk factors in the section below that could suggest that the true beta may lie towards the top of our range.

[11] Competition Commission, Northern Ireland Electricity Limited Final Determination, March 2014

Overall, the midpoint of our range, 0.37, can therefore be considered a conservative point estimate, which we use for the calculation of the cost of equity.

2.5 Uncertainty and risks

KEY CONCLUSION

Brexit and climate change are increasing the uncertainty and affecting market conditions. It is hard to quantitatively assess the potential impacts. However, the uncertainty is likely to cause the true cost of equity to sit more towards the upper end of our estimated range.

2.5.1 Brexit

At the time of writing, the outcomes of Brexit remain highly uncertain despite negotiations since Ofwat's early view was published.

The uncertainty is twofold as we do not know what the form of the exit will be nor the eventual impacts of this change to the status quo. Regardless of the form of Brexit, the economy will likely be impacted to some extent (for an unknown period) and this could affect the cost of equity and cost of debt. The Bank of England concluded that Brexit will likely reduce the growth rate and increase inflation in the short term.[12]

The Bank has modelled four different scenarios for the form of Brexit. In order of declining openness and integration with the EU it considered:

- Close Economic Partnership;
- Less Close Economic Partnership;
- Disruptive; and
- Disorderly scenarios.

Due to the current uncertainty, the overall effect of Brexit on the future cost of equity of water companies is ambiguous. This is partly because the different components may be affected in opposite directions and the magnitudes of effect are not known.

Figure 6 below summarises the potential effect of Brexit on the relevant parameters of the WACC.

[12] Bank of England, 2018: "EU Withdrawal Scenarios and Monetary and Financial Stability"

Figure 6 Potential Brexit impacts of the components of the cost of equity

Component	Direction of effect	Argument
Beta	Ambiguous	▪ Could decrease, similar impact to during the Financial Crisis, consistent with the *flight to safety* theory. ▪ Could increase due to Brexit and other risks such as nationalisation offsetting the flight to safety effect (as the safety haven status of water stocks may become undermined and flight-to-safety can shift outside of UK).
RFR	Ambiguous	▪ The Bank's reasoning for the Base Rate rising or falling is that it views Brexit as a negative supply shock, but demand could also fall due to reduced trade and uncertainty[13]. ▪ Whether the Bank will have to increase or decrease the Base Rate therefore depends on the magnitude of the effects of Brexit on demand and supply. ▪ Real rates are eroded by higher inflation[14]. □ Inflation forecasts peak at 6.25% and 4.25% in disorderly and disruptive Brexits. □ Inflation forecasts peak at 2.25% in Close and Less Close Brexits: these are the forms the Bank views as most likely.
TMR	Ambiguous but unlikely to change materially	▪ Higher volatility may increase required return on equity. ▪ Fall in economic growth could reduce equity returns. ▪ Real returns are eroded by higher inflation (as above). ▪ But due to the long-term nature of expected TMR, there is unlikely to be material change.

Source: Frontier Economics analysis

We note that the potential withdrawal of European Investment Bank (EIB) loans will not directly affect the cost of equity. It may impact the equity returns as stock prices may go down, but this does not necessarily directly translate into a change in the underlying risk.

This combination of lower growth and general uncertainty could also increase the risk of a political or regulatory intervention in the water sector, because of concerns over low performance. This would increase the beta as interventions in the market increase the overall uncertainty about future interventions and their effects on companies' performance.[15] This kind of overall uncertainty can make the UK a less

[13] Bank of England, 2018: "EU Withdrawal Scenarios and Monetary and Financial Stability". Text states "In such circumstances [of negative supply shocks], the appropriate monetary policy response will depend on whether the hit to demand is more than that to supply." p56

[14] Bank of England, 2018: "EU Withdrawal Scenarios and Monetary and Financial Stability"

[15] The Back in Balance report from Ofwat has a similar effect of increasing regulatory uncertainty, according to Moody's. We discuss the implications for the cost of debt in 3.1.2.

attractive choice for international infrastructure investors as compared to utilities in other countries.

2.5.2 Climate change

The uncertainty around the effects of climate change should be considered as an additional element to the potential higher risk for future price control periods. The effect may not have been fully reflected in the observed longer-term beta estimates of publicly traded water companies.

The pace and effects of climate change are uncertain. Climate change poses a risk to water companies through severe weather affecting supply. While water companies can mitigate against the risk of severe weather to some extent, they cannot fully hedge against a risk that is out of their direct control.

Therefore, water companies are more likely to miss Outcome Delivery Incentives (ODIs) and Performance Commitments (PCs), leading to the associated financial penalties and reputational risks. Climate change may push the likely outcome of ODI into a more asymmetric distribution than envisaged in business plans. This suggests that the true cost of equity for AMP7 may lie towards the higher end of our estimated range.

Climate change will likely also lead to additional costs for companies. There is a risk that these costs would not be fully funded, particularly since the impacts of climate change would not be uniform across companies. One company may experience severe weather changes more than another because of geographical and meteorological differences.

2.6 Adjustment for allowed versus expected returns

KEY CONCLUSION

The Ofgem consultation proposed a downward adjustment on the allowed returns due to expected costs and incentives outperformance during the RIIO2 price control period. There are significant drawbacks on this adjustment. In any event, the circumstances in water are different and any such adjustment would be unwarranted.

The Ofgem consultation included a 0.5% reduction in the proposed return on equity. This effectively lowered the allowed cost of equity (and the allowed WACC) from the centre to the bottom of the estimated range. In making this adjustment, Ofgem introduced a distinction between the regulatory allowed return (RAR) and the regulatory expected return (RER). The RER differs from the RAR to the extent that investors believe that the regulatory company can outperform or underperform the other components of the regulatory settlement (i.e. the cost allowances, incentive mechanisms or the allowed cost of debt).

This adjustment followed a recommendation from a subset of authors of the UKRN report. They argued that the aim in making a regulatory determination should be for the RER to be equal to the WACC. They argue that if this condition is met then investors will be prepared to commit finance to the regulated activity.

Therefore, to the extent that utilities are expected to outperform on their cost or incentive allowances, the RER would be higher than the allowed return (RAR). In this case to ensure the RER is equal to the WACC, Ofgem therefore proposes to set the RAR below the estimated WACC.

Ofgem did not apply this approach mechanistically. It identified that the energy utilities had outperformed cost and incentive allowances in the past and concluded that investors would expect to continue to outperform to a material degree. Ofgem considered that setting the allowed cost of equity at the bottom of its estimated range (and 0.5% below the centre point of its range) was reasonable in this context.

In our view, there are significant drawbacks in applying such an adjustment. There are objections based on regulatory principles and practical objections in any application to the water sector.

From the perspective of regulatory principle there are strong arguments against this adjustment.

- First, in terms of the application of a building block methodology it can be argued that it is better for a regulator to estimate each component correctly in the totex calculations rather than trying to introduce offsetting errors. There is already sufficient uncertainty in estimating the individual components of the WACC and this would introduce further uncertainty around the estimation of future outperformance. Basing estimates of future outperformance on past outperformance data may not be appropriate.
- Second, the methodology that regulators allow a fair return on the RAV / RCV has been central to the success of the regulatory model in the UK since privatisation (demonstrated by the decline in risk premiums over that period). To deviate from this methodology (even with a reasoned basis) may increase risk perceptions and undermine confidence in the model. Investors may be concerned that once the link between the WACC and the allowed return has been amended once that it may be amended again.
- Third, the proposed adjustment may distort investment decisions by changing the baseline level of returns that companies would now use in CBA analysis to determine whether to proceed with certain investments or not. The regulator may argue that outperformance potential was spread equally across different potential asset classes to offset this effect. It is not obvious that this is a safe assumption.
- Finally, the adjustment does not sit well with the idea that regulators are aiming to mimic the outcomes of a competitive market, where innovation is rewarded through returns above the WACC.

Furthermore, from a practical perspective we do not consider that an adjustment of this type is warranted in the water sector. The primary reason for this is that Ofwat is proposing a tougher approach to cost allowances and incentives and there is no reason to consider that, on average, the RER would exceed the RAR at PR19.

Ofwat's methodology for PR19 is materially more stretching than PR14. Cost allowances will include a 'frontier efficiency' improvement in addition to the upper-quartile benchmark and ODI targets are set on forecast upper-quartile for the key

common targets. Overall there is no evidence that there is general expected outperformance in PR19.

In conclusion, it would not be appropriate for Ofwat to make an adjustment to the allowed WACC to reflect the RER.

2.7 Cost of equity cross check using DGM

KEY CONCLUSION

DGM is less preferred as an estimation method of the cost of equity compared with the CAPM method, and we only use it as a cross check. We do not use our DGM estimates to inform our range for the cost of equity, or for the TMR (as per Ofwat's method).

The results are above Ofwat's range, and show variation since they were last calculated in January 2018.

Ofwat used DGM to estimate the TMR as a method of forward looking estimation, instead of the conventional long-term historic average returns. To do this, Ofwat calculated the implied cost of equity on the whole equity market, using assumptions around future growth rates for dividends and dividend yields.

As discussed in section 2.1.1, we do not consider DGM to be as reliable a primary method to estimate the cost of equity, either for individual stocks or for the market. However, since Ofwat has relied on DGM for the TMR, we propose that for completeness it is worth conducting DGM analysis directly on the implied cost of equity of traded water companies, Pennon (South West Water), Severn Trent and United Utilities, as a cross check on the overall level of the cost of equity estimated from the CAPM method.

For this analysis, we use:

- dividend yield data from Bloomberg
- short-run dividend forecasts from Bloomberg data; and
- long-run dividend growth forecasts: upper bound is real GDP growth (RPI) and lower bound is -0.5%

Ofwat's advisor, PwC, also used a GDP growth forecast in its analysis. The lower bound figure is -0.5% annual real growth in RPI terms. This negative growth rate reflects two factors. First, that the reduction in the overall WACC at PR19 may result in a transition to a lower dividend level. Second, that the indexation of RCV is transitioning to CPIH, which is expected to be lower than RPI. We view this as a lower bound, acknowledging the discussion in section 2.1.1 around the importance of the growth bounds on results. A full discussion of the DGM approach and forecasts is in Annex A.2.

We present the results from the actual gearing, as obtained from Bloomberg. We then re-gear the results with Ofwat's notional gearing, and compare the results with Ofwat's early findings.

DGM results for actual gearing

The results below are based on actual gearing from companies.

Figure 7 DGM results for the cost of equity – actual gearing

Long-term dividend growth rate	-0.5%	Long-term GDP: 1%
United Utilities	4.72%	6.08%
Severn Trent	4.48%	5.84%
Pennon	5.20%	6.54%
Average	**4.80%**	**6.15%**

Source: Frontier analysis

Note: Average is a simple mean

DGM results for re-geared

The cost of equity results presented in Figure 7 are calculated with the actual gearing levels of each company. To accurately compare them to the costs derived by Ofwat, it is necessary to re-gear with Ofwat's notional gearing level of 60%.

This re-gearing involves using the CAPM methodology with the Miller equation:

$$regeared\ r = risk\ free\ rate + \frac{1}{(1-notional\ gearing)*(1-actual\ gearing)*(r-risk\ free\ rate)},$$

where r is the cost of equity. Ofwat's risk-free rate of -0.88% RPI real is used for illustration purposes.

Figure 8 DGM results for the cost of equity – re-geared

Long-term dividend growth rate	-0.5%	Long-term GDP: 1%
United Utilities	4.91%	6.32%
Severn Trent	4.73%	6.16%
Pennon	5.95%	7.46%
Average	**5.20%**	**6.65%**

Source: Frontier analysis

Note: Average is a simple mean

Conclusion on DGM

We find that the averages from the DGM model (even excluding Pennon), re-geared, are above Ofwat's RPI real range of 3.41% to 4.69%.

This analysis was also conducted by Frontier in January 2018 for South West Water as support for its PR19 business plan. The re-geared results below show that this method produces results that can change materially within a short period of time.

Figure 9 DGM results for the cost of equity January 2018 – re-geared

Long-term dividend growth rate	-0.5%	Long-term GDP: 1%
United Utilities	4.80%	6.47%
Severn Trent	4.72%	6.51%
Pennon	6.08%	8.04%
Average	**5.20%**	**7.01%**

Source: Frontier analysis

Note: Average is a simple mean

2.8 Frontier estimate of cost of equity

2.8.1 CAPM estimation

To calculate the cost of equity, we use the CAPM equation:

$$Cost\ of\ equity = RFR + \beta * ERP,$$

where $ERP = TMR - RFR$.

The table below presents our estimates from the outlined changes in the methodology and market updates, compared with Ofwat's early view. We also present results that exclude market updates but reflect only methodological differences, recognising that when Ofwat comes to estimate these later market data will have moved further. We do not provide a separate estimate for the beta without any market updates, as our point estimate is consistent with Ofwat's.

Figure 10 Estimates of components of CAPM

Component	Nominal	Real (CPIH)	Real (RPI)	Range (real RPI)
Gearing			60%	
Total market return (TMR)	9.43%	7.29%	6.22%	5.94% - 6.50%
Risk-free rate (RFR)	1.90%	-0.10%	-1.07%	
Excl. market updates	*2.10%*	*0.10%*	*-0.87%*	
Equity risk premium (ERP)	7.53%	7.38%	7.29%	7.01% - 7.57%
Excl. market updates	*7.33%*	*7.19%*	*7.10%*	*6.81% - 7.38%*
Debt beta			0.10	
Asset beta (including debt beta)		0.37		0.32 – 0.41
Notional equity beta		0.77		0.65 – 0.88
Cost of equity (including debt beta)	7.73%	5.61%	4.57%	3.49% - 5.56%
Excl. market updates	*7.77%*	*5.66%*	*4.62%*	*3.56% - 5.58%*

Source: Frontier analysis

Our point estimate of the real (RPI) cost of equity based on our CAPM analysis is 4.57%, compared to 4.01% from Ofwat. Ofwat's range is 3.41% – 4.69%, which includes our point estimate. Our range is slightly wider than Ofwat's at 3.49% - 5.56%.

The DGM cost of equity range is 5.20% – 6.65% in real RPI terms, which is higher than our CAPM range, and entirely outside Ofwat's range.

As discussed previously, however, we attach less weight to the DGM method and do not consider that a short-term method such as this should be used as a primary method to estimate the cost of equity. Nevertheless, it can provide a cross check on the CAPM range, and is consistent with our view that the true value might sit above the midpoint of our CAPM range due to the uncertainty around Brexit and climate change.

3 COST OF DEBT

KEY CONCLUSION

Our estimated cost of debt is 1.57%, compared to Ofwat's 1.33% (both RPI real). The difference arises from a different methodology and updates on the data. More specifically,

- we do not include a reduction to account for the 'halo' effect, and we see evidence of a lower proportion of new debt; and
- since Ofwat's early view was published, the iBoxx rate has increased.

3.1 Cost of new debt

KEY CONCLUSION

Our methodology does not include the reduction from expected outperformance (the so-called 'halo' effect), as we do not see evidence of this. We included updated market data. We estimate the cost of new debt at 3.98% nominal.

The negative outlook and warning on the regulatory regime by Moody's poses a risk for an increased cost of debt, further decreasing the likelihood of any future halo effect. This market development has not been factored into Ofwat's early view.

3.1.1 Ofwat's view

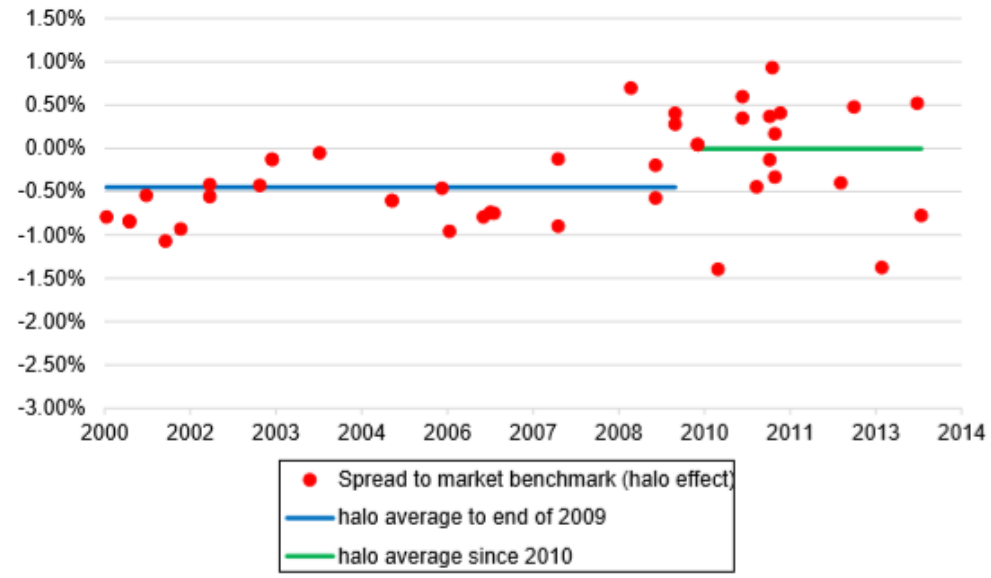
Ofwat's estimate of the cost of new debt has three components:

- spot iBoxx yield: 3.01%;
- forward uplift for by the middle of 2020-25: 54 basis points (bps); and
- reduction of 15 bps on the account of expected outperformance in debt cost.

We dispute the validity of the 15 bps outperformance reduction, which is the 'halo' adjustment that has been the subject of substantial analysis and debate. We do not see evidence of its existence. The latest regulatory precedent from the CMA at the RIIO ED1 appeal from British Gas Trading, where the CMA has carried out its own analysis, suggests that the halo is not likely to exist even though it may have existed prior to 2013.[16]

[16] CMA - British Gas Trading Limited v The Gas and Electricity Markets Authority, Final determination. September 2015.

Figure 11 The CMA's analysis on halo effect pre and post period of financial volatility in markets



Source: CMA analysis of actual DNO debt positions and the iBoxx index.

Similarly, CEPA's analysis in 2016 found two bonds issued after 2013 and found no halo effect, and recommended that a detailed study is undertaken to review the size of any potential halo effect, and would need to be repeated at each price control determination.[17]

Ofwat ultimately relied on analysis by Europe Economics, where the halo is based on a spread between the iBoxx utilities and the iBoxx non-financial. This is arguably a less reliable method to measure halo effect compared to that used by the CMA, as it does not directly compare water bond issuance with that of the iBoxx benchmarks. Comparing spread is inherently less accurate as it is more difficult to finely control for maturity and credit rating differentials which could all cause minor differentials in debt spread. This was also pointed out in CEPA's study.

Recent credit warning on the water sector following the December final methodology and the "Back in Balance" consultation makes it even more unlikely that there would be any halo remaining in the water sector. We explore this in more detail below.

3.1.2 Credit downgrade risk

Moody's issued a credit negative outlook after Ofwat's final methodology, and then a warning on the regulatory regime and further negative outlooks for four water companies following Ofwat's Back in Balance consultation in May 2018. Moody's reiterated its negative sector outlook in December 2018, after business plans had been submitted.

[17] CEPA - Alternative Approaches to Setting the Cost of Debt for PR19 and H7, August 2016.

A credit downgrade would impact the WACC through increasing the cost of debt, further reducing any likelihood of a halo remaining in PR19. Figure 12 below shows the effect of a credit downgrade of one sub-notch on the cost of debt in basis points.

Figure 12 Increase in debt spread for a 10 year bond

One sub-notch downgrade to	Increase in debt spread (bps)
Baa1	31.6
Baa2	20.0
Baa3	26.4
Average	**26.0**

Source: Bondsonline, Frontier Economics analysis.

Alternatively, companies may choose to decrease their gearing to avoid a credit downgrade. We estimate the companies would need to reduce gearing by 6% – 9% for this, and that this would increase the WACC by 0.22%.

Full methodologies for the effects of a credit downgrade are in Annex B.1.

3.1.3 Additional uncertainty and risks from Brexit

Brexit uncertainty does not only have the potential to affect the cost of equity, but also could impact the cost of debt. We continue to view the ongoing uncertainty to likely to cause a higher level of cost of debt in future.

Because of Brexit, the cost of new debt for water companies could increase. This is because finance from the EIB may be withdrawn[18], or because a slowdown in the economy will lead to tighter financial conditions, as in the Financial Crisis[19]. Or indeed both may happen.

In its "disorderly Brexit" scenario[20], the Bank of England considers that term premia on gilts could rise by 100 basis points.

We also note that at PR09, Ofwat considered that the effect of tighter macroeconomic financial conditions on the cost of debt for water companies would be limited by the fact that Water companies would continue to be able to source competitive finance from the EIB[21]. But with Brexit, this may no longer be an option.

There could also be additional risk arising from higher inflation. New debt would be protected from increases in inflation as it will be indexed in PR19, but reconciliation will only occur at the end of the price control which may have an impact on water companies if Ofwat's long-term inflation forecasts are inaccurate because of Brexit uncertainty. Ofwat's forecasts are for 2% CPIH and 3% RPI inflation whereas the Bank of England forecasts inflation peaks of 2.25% – 6.5% CPI for Brexit scenarios.

[18] Oxera, 2016: "Brexit: potential implications for the water sector in England and Wales", p2 and Richard Laikin blog post on LinkedIn: https://www.linkedin.com/pulse/brexit-implications-uk-water-richard-laikin/

[19] Bank of England, 2018: "EU Withdrawal Scenarios and Monetary and Financial Stability", p4

[20] This scenario assumes that following Brexit the UK loses its existing trade agreements and is unable to cope smoothly with customs arrangements.

[21] Ofwat, 2009: "Future water and sewerage charges 2010-15: Final Determinations"

3.1.4 Frontier's estimate of cost of new debt

We have not included a halo effect adjustment in our estimate of the cost of new debt, as the evidence we have reviewed does not support the effect. Moreover, elements such as Brexit and the credit negative outlook of the entire sector would make any future halo effect even less likely.

Since Ofwat's early view, the iBoxx rate has increased from 3.01% to 3.49%. Our revised forwards uplift is 42bps. Our estimate for the cost of new debt is therefore 3.98%.

If the market update is not included, our removal of the halo adjustment alone would result in an estimate of the cost of new debt at 3.55%.

3.2 Cost of embedded debt

KEY CONCLUSION

Market movements have increased the iBoxx spot yield and reduced the forward uplift. We also remove Ofwat's halo adjustment on the cost of new issuance up to 2020.

We estimate the cost of embedded debt at 4.70% nominal.

3.2.1 Ofwat's view

Ofwat's early view of 4.64% (nominal) is based on the median of all water companies. This includes an adjustment on the debt yet to be issued by 2020, and Ofwat has used an assumed market iBoxx rate (3.02%)[22], minus 15 bps for outperformance and an uplift of 16 bps for market forward rates up to 2020.

3.2.2 Frontier's estimate of cost of embedded debt

We have updated the spot iBoxx and forward uplift as per Ofwat's methodology, but we reverse the halo adjustment of 15 bps, for the reasons outlined above. We adjust Ofwat's early view of the cost of embedded by 10% of our total adjustment, because Ofwat's indicated that the new issuance before 2020 accounts for approximately 10% of the total embedded debt.

On 31 October 2018, the iBoxx spot rate was 3.49%. This is 47 bps higher than Ofwat's estimate in 2017. We estimate that the forward uplift is 15 bps, which is 1 basis point lower than Ofwat's estimate. By reversing Ofwat's 15 bps of halo adjustment, our total uplift is 61bps.

As this uplift is only applicable to the "new debt" proportion of the embedded debt (i.e. the debt companies will raise between now and the start of AMP7), the 61 bps uplift should only apply proportionally (10% according Ofwat's own figure) to Ofwat's total estimate on the cost of embedded debt.

[22] This is consistent with Ofwat's embedded debt analysis on p78 of Appendix 12 Risk and return in the December Final Methodology.

This means that we adjust Ofwat's cost of embedded debt figure by a total of 6 bps. Therefore, our estimate for the embedded debt is 4.70%.

If we do not include the updated market data in our estimate, then our estimate of the cost of embedded debt is 4.66%.

3.3 Ratio between new and embedded debt

KEY CONCLUSION

We use business plan table data and find a lower estimate of the proportion of new debt. We use alternative public data source to analyse the historic proportion of new debt as a cross check to our analysis of new debt for PR19.

We disagree with Europe Economics' analysis and results on the proportion of new debt for PR19.

In conclusion, we have adopted Ofwat's PR14 assumption of 25% new debt, as a conservatively high estimate.

Ofwat has used Europe Economics' estimate on the proportion of new to embedded debt. Our understanding of the finding from Europe Economics is that 30% of the total debt would need to be raised during PR19, which is consistent with 15% of total debt being new debt on average throughout PR19. Therefore, in assuming 30% new debt for AMP7, Ofwat may have misinterpreted its advisor's results.

Moreover, the analysis of Europe Economics does not benefit from companies' own plan on how much new debt they are going to raise throughout PR19, which is made available in business plan table APP19 that companies submitted to Ofwat in September 2018.

We have looked at the business plan tables to see what debt companies have forecast. We have also carried out a cross check by looking at historical debt issuance, on both notional and actual gearing. Full methodologies are included in Annex B.2.

APP19 in the business plan tables reports opening, issued and repaid debt. We looked at the issued debt compared to the opening debt of each year in PR19, and looked at the weighted average for the 5 year period. This shows 17.64% of debt over the period is on average new.[23]

As a cross check to our above results based companies' business plan submission for AMP7, we looked at historical new debt issuance by water companies during the previous price control period, reported by Bloomberg. Our analysis shows that average new debt for PR14 was 11.3% and 11.5% for actual and notional gearing respectively (full methodology is in B.2). We only use this figure as a cross check as it may be underestimating the amount of new debt issuance due to potentially incomplete record in Bloomberg.

[23] This excludes all swaps as consistent with Ofwat's method. The floating aspect of old debt should already be accounted for in Ofwat's debt calculation

Overall, we consider Ofwat's PR19 early view of 30% as too high and not supported by forecast or historic evidence. The assumption of 25% used at PR14, is in our view, would be a more reasonable estimate (although arguably still erring on the high side).

3.4 Frontier estimate of overall cost of debt

Our overall cost of debt is calculated using the components below, including estimates where the update on market data has been removed.

Figure 13 Estimates of cost of debt components

Component	Nominal	Real (CPIH)	Real (RPI)
Ratio of embedded to new debt	75 : 25		
Nominal cost of embedded debt	4.70%		
Excl. market updates	*4.66%*		
Nominal cost of new debt	3.98%		
Excl. market updates	*3.55%*		
Issuance and liquidity costs	0.10%		
Inflation	n/a	2.00%	3.00%
Nominal overall cost of debt	4.62%		
Excl. market updates	*4.48%*		
Indexed overall cost of debt	**4.62%**	**2.57%**	**1.57%**
Excl. market updates	*4.48%*	*2.43%*	*1.44%*

Source: Frontier analysis. Excluding market updates does not update the market data since Ofwat's early view on the cost of capital.

We use the same issuance and liquidity costs as Ofwat for simplicity.[24]

Our real RPI estimate of 1.57% is just outside of Ofwat's range of 1.07% - 1.55% for the overall cost of debt. The estimate excluding market updates is within the range at 1.44%.

[24] Detailed analysis of these parameters is not in the scope of this work

4 SUMMARY OF COST OF CAPITAL

4.1 WACC table

The table below compiles our estimates on the WACC and its components for nominal, CPIH and RPI values. We provide our range in real RPI. Our real RPI wholesale WACC estimate is 2.67%.

Figure 14 WACC components – Frontier estimates

Component	Nominal	Real (CPIH)	Real (RPI)	Range (real RPI)
Gearing			60%	
Total market return (TMR)	9.43%	7.29%	6.22%	5.94% - 6.50%
Risk-free rate (RFR)	1.90%	-0.10%		-1.07%
Excl. market updates	*2.10%*	*0.10%*		*-0.87%*
Equity risk premium (ERP)	7.53%	7.38%	7.29%	7.01% - 7.57%
Excl. market updates	*7.33%*	*7.19%*	*7.10%*	*6.81% - 7.38%*
Debt beta			0.10	
Asset beta (including debt beta)		0.37		0.32 – 0.41
Notional equity beta		0.77		0.65 – 0.88
Cost of equity (including debt beta)	7.73%	5.61%	4.57%	3.49% - 5.56%
Excl. market updates	*7.77%*	*5.66%*	*4.62%*	*3.56% - 5.58%*
Ratio of embedded to new debt			75 : 25	
Nominal cost of embedded debt			4.70%	
Excl. market updates			*4.66%*	
Nominal cost of new debt			3.98%	
Excl. market updates			*3.55%*	
Issuance and liquidity costs			0.10%	
Overall cost of debt	4.62%	2.57%		1.57%
Excl. market updates	*4.48%*	*2.43%*		*1.44%*
Appointee WACC (vanilla)	5.86%	3.79%	2.77%	2.34% – 3.17%
Excl. market updates	*5.80%*	3.72%	*2.71%*	*2.28% –3.09%*
Retail net margin deduction			0.10%	
Wholesale WACC (vanilla)	**5.76%**	**3.69%**	**2.67%**	**2.24% – 3.07%**
Excl. market updates	***5.70%***	***3.62%***	***2.61%***	***2.18% – 2.99%***

Source: Frontier analysis. Excluding market updates does not update the market data since Ofwat's early view on the cost of capital.

The elements regarding the wider uncertainties discussed in this paper may support a point estimate higher than the midpoint of the range. For instance, if there is a credit downgrade, the average increase in the cost of debt for 10 year corporate bonds (26bps) would change the WACC to 2.72% real RPI – an increase of 4.5bps.

4.2 Comparison to Ofwat's early view

We review where our estimates are different to Ofwat's early view, and highlight where these are methodological differences, market updates or where we have taken Ofwat's position for simplicity.

Figure 15 Comparison of WACC components (real RPI)

Component	Frontier	Ofwat	Reason for difference
Gearing	60%	60%	Adopted Ofwat estimate
Total market return (TMR)	6.22%	5.44%	Evidence of higher TMR and appropriate interpretation of data
Risk-free rate (RFR)	-1.07%	-0.88%	Evidence of gilt market movement
Equity risk premium (ERP)	7.29%	6.31%	Evidence of higher TMR and lower RFR
Debt beta	0.10	0.10	Adopted Ofwat's estimate
Asset beta (including debt beta)	0.37	0.37	Agreed with Ofwat's estimate
Notional equity beta	0.77	0.77	From above
Cost of equity (including debt beta)	4.57%	4.01%	From above
Ratio of embedded to new debt	75:25	70:30	APP19, historical debt and RCV evidence of a lower proportion of new debt
Nominal cost of embedded debt	4.70%	4.64%	Updated iBoxx, no halo reduction and 10% adjustment for new issuance by 2020
Nominal cost of new debt	3.98%	3.40%	Updated iBoxx, forward adjustment and no halo reduction
Issuance and liquidity costs	0.10%	0.10%	Adopted Ofwat's estimate
RPI real overall cost of debt	1.57%	1.33%	From above
Appointee WACC (vanilla)	2.77%	2.40%	From above
Retail net margin deduction	0.10%	0.10%	Adopted Ofwat's estimate
Wholesale WACC (vanilla)	**2.67%**	**2.30%**	From above

Source: Frontier analysis and Ofwat, Appendix 12: Risk and return December 12 2017

For simplicity, we adopt Ofwat's debt beta, gearing, issuance and liquidity costs, and retail net margin deductions.

We agree with Ofwat's asset beta point estimate.

Our other components differ due to both methodologies and market updates, as outlined in Figure 15 and throughout the report. Because of these, our wholesale vanilla WACC is 37bps above Ofwat's estimate in RPI terms. If we do not include market updates, it is 31bps above Ofwat's estimate.

ANNEX A COST OF EQUITY

A.1 Asset beta estimation

We updated Ofwat's beta analysis to include 2018 data. We found that Ofwat's point estimate is in the middle of our asset beta range, and that there has been limited movement in betas since Ofwat published their early view.

A.1.1 Methodology and data

Our methodology is consistent with CMA in the 2014 NIE determination. This methodology used the following raw data:

- *Total return data for water companies:* we used daily frequency data on the share price of United Utilities, Severn Trent and Pennon Group[25] (Bloomberg);
- *Total return data for FTSE All Share Index:* daily frequency data on total returns values for the FTSE All Share index (Bloomberg);
- *Net debt position of water companies:* daily frequency data on the net debt position of each of the three water companies (Bloomberg); and
- *UK nominal spot yield with 10 year maturity:* daily frequency data on the UK nominal spot yield with 10 year maturity, to proxy for values of the risk-free rate (Bank of England yield curve).

We then constructed a series of excess returns, for two, five and ten year windows. We use three different frequencies of data in the estimation:

- *Daily returns*: all trading days;
- *Weekly returns*: Tuesdays as the representative weekday; and
- *Monthly returns*: we use the midpoint of the month, unless it is not a trading day (in which case we use the16th, or the 14th if the 16th is also not a trading day).[26]

With these data series, we used an OLS model to estimate the asset beta for each water company, by regressing each companies excess return on the FTSE Allshare index excess return. Using a debt beta assumption of 0.1, we calculate the equity beta using the actual gearing. Finally, we used Ofwat's notional gearing of 60% to re-gear back to the asset beta.

The beta figures presented are a simple average of the water companies.

Figure 16 Asset beta results by rolling time period for estimation and frequency of data

Frequency of data	2 years	5 years	10 years
Daily (trading days)	0.34	0.39	0.32
Weekly	0.32	0.39	0.33
Monthly	n/a	0.41	0.33

Source: Frontier analysis of Bloomberg data

The mid-point of this 0.32 – 0.41 range is 0.37.

[25] Parent company of South West Water

[26] We did not estimate monthly on the two year window due to the small sample size.

A.1.2 Rolling beta estimates

We looked at how much variation there has been in asset betas for water companies over time, by varying the start date for the regressions.

We found that while there is variation over time, there has not been significant movement since Ofwat's early view in December 2017. The betas tend to fall when the share prices go into volatile conditions.

Figure 17. Daily 2 years

Figure 18. Daily 5 years

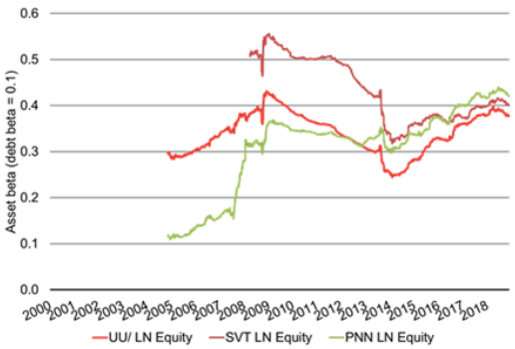


Figure 19. Weekly 2 years

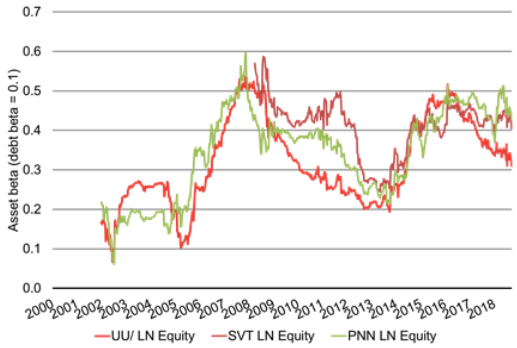


Figure 20. Weekly 5 years

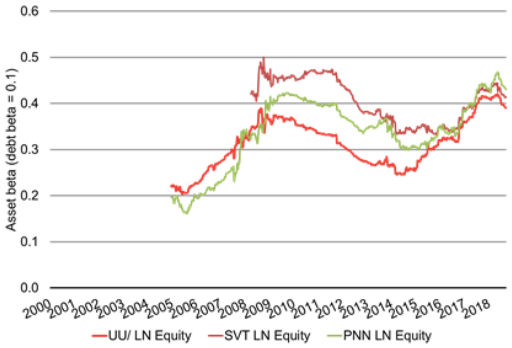


Figure 21. Monthly 2 years

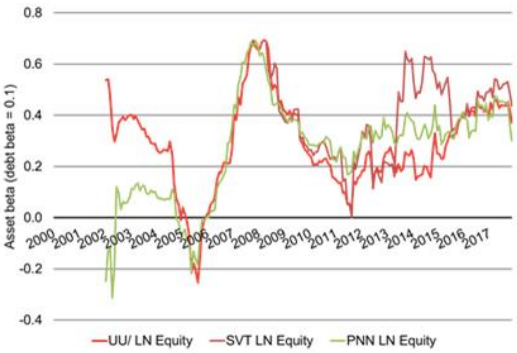
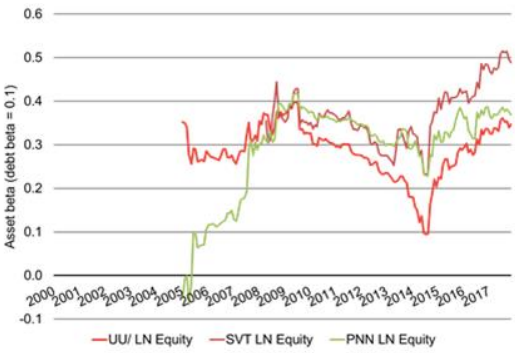


Figure 22. Monthly 5 years



Source: Frontier analysis
Note: Bloomberg data

A.1.3 Ofgem's beta components

Figure 23 summarises the assumptions underlying the calculations of equity beta in Ofgem's December 2018 report.

Figure 23 Ofwat and Ofgem equity beta assumptions

Component	Ofwat	Ofgem		
		Low	Midpoint	High
Raw equity beta	0.63	0.60	0.65	0.70
Observed Gearing	49%	56%	56%	56%
Debt beta	0.10	0.15	0.13	0.10
Asset beta	0.37	0.35	0.36	0.36
Notional gearing	60%	60%	60%	60%
Equity beta (re-geared)	0.77	0.65	0.70	0.76

Source: Ofwat Appendix 12: Risk and return December 12 2017; Ofgem RIIO 2 Sector methodology December 18 2018; Ofgem RIIO2 Finance annex December 18 2018; Frontier calculations

There are four main findings from this comparison.

1. Ofgem appears to have used the spot gearing level to de-gear rather than the average gearing level consistent with the raw beta estimation window, while the latter is commonly considered as the better practice. This explains a substantial difference in the resulting asset beta estimates, and we expect the network companies to pick up on this shortfall in Ofgem's methodology in their response to the consultation.
2. Ofgem uses an adjustment on the gearing level used for the de-gearing, which we criticise in section 2.4.1, and this explains the remaining discrepancy in the final equity beta estimates.
3. There are differences in the assumptions made for the debt beta, but the calculation of the re-geared equity beta is not sensitive to this assumption.
4. There are differences in the methods used to estimate the raw equity beta, but the statistical method employed is less important than the time period under consideration, and Ofwat and Ofgem arrive at a similar raw estimate.

A.2 DGM

A.2.1 DGM approach

As discussed in 2.1.1, the main challenge of estimating a DGM cost of equity is that expected dividends are not directly observable in the market and therefore must be assumed.

Assuming a constant growth (g) of the dividend per share (DPS), this leads to a cost of equity (r) equal to:

$$r = DPS_1/P_0 + g$$

Where P_0 is the price of the stock in the initial period.

In this section, we provide details of the methodology we have used to derive our cost of equity figures using DGM.

We have estimated the cost of equity for United Utilities, Severn Trent and Pennon[27]. We have applied a two-stage DGM approach, using Bloomberg's forecasts of dividends per share for the first three years and assuming a constant dividend growth rate after that. This formulation for the DGM has been commonly applied by regulators in the US. The rationale for this is that it is possible to obtain short-term estimates from analysts' reports and only assume a constant growth rate in the long-term.

This means that the cost of equity can also be estimated using the following formula:

$$P_o = \sum_{i=1}^{3} \frac{DPS_i}{(1+r)^i} + \left(\frac{DPS_3 * (1+g)}{r-g}\right)\left(\frac{1}{1+r}\right)^3$$

To estimate a range for the cost of equity we have used two alternative options for the long-run DPS growth rate: a) setting it equal to the GDP growth rate; and b) assuming it is -0.5% per year.

Additionally, we have considered the fact that the three water companies under consideration pay interim dividends in the middle of the year and that this interim dividend accounts for around 36% of the total annual dividend.

Therefore, our approach can be expressed mathematically as:

$$P_o = \frac{0.36 * DPS_1}{(1+r)^{0.5}} + \frac{0.64 * DPS_1}{(1+r)^1} + \frac{0.36 * DPS_2}{(1+r)^{1.5}} + \frac{0.64 * DPS_2}{(1+r)^2} + \frac{0.36 * DPS_3}{(1+r)^{2.5}} + \frac{0.64 * DPS_3}{(1+r)^3} + \left(\frac{DPS_3 * (1+g)}{r-g}\right)\left(\frac{1}{1+r}\right)^3$$

Where:

- P_0 is the share price data on the ex-dividend final date;
- DPS_i is the Bloomberg dividend forecast for year i;
- r is the cost of equity; and
- g is the expected DPS growth after the third year

The stock price and the DPS forecasts have been obtained from Bloomberg. As explained above, two options have been used for the long-run dividend growth: the long-run expected GDP growth (see A.2.3 for the methodology of this estimate) and a -0.5% growth rate.

[27] We have not estimated the cost of equity for Dee Valley as it is a small water-only company and its risk profile may not be representative of the industry. In addition, it raises a practical difficulty because its stock is covered by only a few analysts. It is not possible to disaggregate the DGM and we therefore present cost of equity results only for Pennon group, and not separately for South West Water.

It is worth noting that we have calculated the cost of equity in real terms. For this reason, we deflate DPS forecasts using RPI inflation forecasts made on the year for which the cost of equity is calculated.[28]

Even under this formulation, the resulting estimation has a few caveats:

- analyst forecasts can have two problems: circularity and optimism bias; and
- if the number of years with reliable dividend estimates is small, the assumed long-term growth rate is still an important driver of results.

We discuss these in more detail in the following sections.

A.2.2 Short-term dividend forecasts

Analyst forecasts are the only direct source for future dividend estimates. However, the potential issues with the use of such forecasts are circularity and optimism bias.

The issue of circularity stems from the fact that i) analysts' dividend forecasts depend on their expectations of future regulatory provisions, which are going to be decided by the regulator and ii) the analyst projections can influence the regulatory determination through the DGM calculation.

In practice, the circularity issue is unlikely to be material, for the following reasons.

- DGM estimates are only one of the methods used by Ofwat to assess the cost of equity (and TMR). Therefore, any analyst is unlikely to perceive a material relationship between the dividend projections and the allowed return on equity, even with Ofwat's current greater emphasis on the DGM.
- Furthermore, the analyst dividend projection has a relatively small role in the DGM assessment. The more significant variables are the current dividend yield and the long-term dividend projection.

The second issue with using analysts' forecasts is possible optimism bias. There is some empirical evidence to show, on average, analysts forecasted higher dividends than the true dividends. In this case, using analysts' forecasts of dividend would lead to a higher allowed cost of equity than necessary.

It remains an open question if there is a significant optimism bias in the dividend projections for regulated utilities. Regulated utilities are usually characterised by more stable profits and dividends and less information asymmetry between management and investors than other sectors. Changes by the regulator which increase uncertainty may impact this.

A.2.3 Long-term dividend forecasts

Long-term dividend expectations by equity investors are also unobservable. In practice, there are several plausible options for setting the long-term dividend growth rate. It can be proxied by:

- historic dividend growth rates;
- analysts' forecasts of dividend growth in the short/medium-term;
- estimated long-term GDP growth rate;

[28] Interim dividends are deflated with half of the annual inflation rate.

- projected growth rate of the company's replacement cost value; or
- an assumption of 0% per year, or negative growth if feasible.

The first option can be particularly appealing in the case of a constant historic dividend growth rate, which could indicate a stable company policy. In this case, historic rates can be a good proxy but using them would undermine one of the advantages of DGM, which is the fact that it is forward looking.

The second option has the advantage of relying on the closest possible estimate (especially if circularity and optimism bias have been corrected for to the extent possible). But it might lead to inconsistent results in the long-run.

The third option overcomes this consistency problem by setting the dividend growth rate equal to the GDP growth rate but at the risk of not reflecting accurately the situation of the company in question.

A growth rate that is sustainable and closer to the company's reality could be the expected growth rate of its regulatory capital value[29]. This is not necessarily a good proxy for future dividends because the size of a company increases does not mechanistically mean that the dividend per share grows. But it acknowledges the difficulty of dividend per share increasing systematically in the long run if the company does not grow.

In practice, it is common to test the results under several options to derive an appropriate range for the cost of capital. We have used a lower bound of -0.5% and an upper bound of long-term GDP growth of 1%; both real RPI. The negative growth rate in the lower bound reflects two factors. First, that the reduction in the overall WACC at PR19 may result in a transition to a lower dividend level. Second, that the indexation of RCV is transitioning to CPIH, which is expected to be lower than RPI.

There are many estimates of long-term GDP growth, some of which are summarised in the table below:

Figure 24 Long-term GDP growth estimates

Estimate	Source	Ofwat source	Date of estimate
0.7%	IMF		November 2017
0.9%	IMF	Europe Economics PR19 – Initial assessment of the cost of capital: final report	April 2017 (IMF) December 2017 (EE)
1.2%	Consensus Economics	PwC Refining the balance of incentives for PR19	October 2016 (CE) June 2017 (PwC)
0.4%	OBR	*Referenced by both Europe Economics and PwC*	November 2017

Source: *Frontier analysis*

Note: *real RPI – where data was in real CPI a wedge of 1% was used to calculate the RPI real figures*

[29] The regulatory company value is equal to the amount that stakeholders and debt holders have invested in the regulated activity in question.

Additionally, it is reasonable to use completed business cycles to inform forecasts of the long-term economic growth rate. Using data from the IMF, the average real RPI GDP rate of the past two complete business cycles (1982 – 1991 and 1992 – 2007) is 1.83%. Including the current partial business cycle since 2008 gives an average growth rate of 1.31%. Therefore, after reviewing this evidence it is reasonable to use 1% real RPI growth as the estimate for long-term GDP growth.

ANNEX B COST OF DEBT

B.1 Credit downgrade risk

Moody's negative outlook on the water industry has increased the likelihood of a credit downgrade. This change in outlook was issued following Ofwat's final determination with a further warning after the 'Back in Balance' consultation, which suggested the regulator will have greater levels of intervention over companies finances. This in turn negatively affects the stability and predictability of the current regulatory environment.

A credit downgrade can impact the cost of debt, or it can lead to a reduction in gearing to avoid a direct impact on the cost of debt. We look at the effects of both responses, noting that only one could occur.

B.1.1 Changes in debt premium

We look at what would happen if companies' credit ratings fell by one notch (i.e. from A3 to Baa1).

This would send a negative signal to debt holders that regulatory risk has increased, which means investors would demand a higher debt premium for their continued investment into the water companies. All else being equal, an increase in debt premium would lead to an increase in the cost of capital. We used Reuter's debt spread data to estimate the impact. Our results are shown below. We focus on A3 – Baa2 ratings as most water companies fall within these.

Figure 25 Changes in debt premium for a 5 year corporate bond

One notch downgrade to	Increase in debt premium (bps)
Baa1	25.8
Baa2	18.0
Baa3	25.8
Average	**23.2**

Source: Bondsonline, Frontier calculations

Figure 26 Changes in debt premium for a 10 year corporate bond

One notch downgrade to	Increase in debt premium (bps)
Baa1	31.6
Baa2	20.0
Baa3	26.4
Average	**26.0**

Source: Bondsonline, Frontier calculations

For a one notch credit downgrade, the debt premium will increase by 0.23% and 0.26% on average, for a 5 and 10 year bond respectively.

The extent of the increase depends on the bond's maturity and the grade of the score post-downgrade.

These estimates are used to inform our calculations of the potential impact of credit downgrades on the WACC. We focus on the average increase in debt premium for a 10 year corporate bond, as the tenor of bonds issued are typically 10 years or

longer. Figure 27 shows how the WACC changes with a 0.26% increase in the debt premium. It also contains a breakdown of how the different scores will have different impacts on the WACC. For all other components of the cost of capital, the values from Ofwat's PR19 early view is used here for illustration purposes.

Figure 27 Impact on WACC from an increase in debt premium (10 year bond)

Types of WACC	Average increase (bps)	A3 to Baa1 (bps)	Baa1 to Baa2 (bps)	Baa2 to Baa3 (bps)
Nominal vanilla WACC	5.16	6.17	4.08	5.23
Real (CPIH) vanilla WACC	4.50	5.51	3.42	4.57
Real (RPI) vanilla WACC	4.50	5.51	3.42	4.57
Average	4.72	5.73	3.64	4.79

Source: Frontier calculations

As shown above, a 0.26% increase in debt premiums leads to an 0.05% increase in the WACC. Similar results can be found for individual score downgrades, where the WACC would increase when debt premiums rise/increase.

B.1.2 Changes in gearing

Alternatively, companies can choose to de-gear to maintain their original credit ratings, which leaves the debt premium and other components unchanged as credit risk remains the same. To assess the appropriate reduction in gearing, we have replicated Moody's 2018 rating methodology, but did not consider qualitative risk characteristics. In terms of how we modelled the de-gearing, our methodology is as follows.

- We collect the most recent credit ratings, based on the corporate family rating, for all water companies from Moody's.
- We identify the most prevalent credit ratings which will be the focus of the model. Figure 28 below identifies the number of water companies associated with a particular credit rating. For the purposes of our model, we looked at ratings A3, Baa1 and Baa2.

Figure 28 Number of companies in each rating

Credit Rating	Total no. of companies	WaSC	WoC
A2	1	1	0
A3	3	3	0
Baa1	7	3	4
Baa2	4	2	2

Source: Moody's

An average company was created to represent each credit rating, by using Moody's indicated rating[30]. The scores selected to represent each sub-factor of the

[30] The indicated rating can be found in Moody's 2015 rating methodology.

average company are based on how frequent a score occurs, within a sub-factor, for companies with the same credit rating. We used the rules below.

- A score that occurs at least twice will be chosen to represent the sub-factor for the average company[31].
- In the event where there are multiple scores that appears at least twice, the score with the highest frequency is selected.

To model a one notch credit downgrade, we assumed this will occur in the sub-factor 'Stability and Predictability of Regulatory Environment' below.

Figure 29 Moody's Rating Methodology

Rating Factors	Factor Weighting	Sub-Factors	Sub-Factor Weighting
BUSINESS PROFILE	50%	Stability and Predictability of Regulatory Environment	15%
		Asset Ownership Model	5%
		Cost and Investment Recovery (Ability & Timeliness)	15%
		Revenue Risk	5%
		Scale and Complexity of Capital Programme & Asset Condition Risk	10%
FINANCIAL POLICY	10%	Financial Policy	10%
LEVERAGE AND COVERAGE	40%	Adjusted Interest Coverage OR FFO Interest Coverage	12.5%
		Net Debt / Regulated Asset Base OR Debt/Capitalisation	10%
		FFO / Net Debt	12.5%
		RCF / Net Debt	5%
Total	100%	Total	100%
UPLIFT FOR STRUCTURAL CONSIDERATIONS		Up to 3 notches	

Source: Moody's Rating Methodology, Regulated Water Utilities, June 2018.

For a company to maintain its original credit rating, gearing can be reduced which will affect the four sub-factors under "Leverage and Coverage". The gearing used in the model is an average of the gearings[32] from all companies in a certain credit rating. For example, the gearings for companies rated A3 will be averaged and used. Gearing is then adjusted so that at least one of the leverage and coverage ratios meets the criteria for a higher indicated score. This process continues until we reach the original credit rating e.g. A3.

To decide if the criteria for a higher indicated score has been met, we used the following steps.

- Assess whether the midpoint of the implied new range[33], because of reduction in gearing, is relatively close to the midpoint of the criteria for a higher score. The closer the midpoints, the greater the likelihood of the criteria being met.

[31] For example, the score Aa occurs at least twice for a sub-factor amongst n number of firms, who has a credit rating of A3. Aa will then be used to represent the same sub-factor for the average company.

[32] The gearings used for this exercise can be found in Ofwat's 'Monitoring Financial Resilience' data pack for 2017-2018. To be specific, 2018 gearings are used.

[33] The implied new range is the criteria for the original score multiplied by the impact of a reduction in gearing. It provides an indication as to what the financial ratios could be with a smaller gearing.

- Alternatively, if the upper bound of the implied new range sits comfortably in the criteria for a higher score (i.e. greater than the lower bound of the criteria by 3% or more), then the criteria is met.

Using the methodology above, a sensitivity analysis was carried out, which involves the selection of appropriate sub-factor scores to model a low and a high scenario. In addition, we modelled a two notch credit downgrade to understand how gearing changes under this scenario. Shown below, Figure 30 presents our results from this modelling exercise.

Figure 30 The average reduction in gearing

Downgrade by	Low scenario	High scenario
One notch	6%	7%
Two notches	6%	9%

Source: Frontier calculations

The model suggests that gearing could be reduced by up to 10% and this translates into an increase in the WACC. A higher weight is now associated with the cost of equity, which is greater than the cost of debt. However, there are difficulties in arriving exactly at the original credit rating, even with close replication of Moody's rating methodology. When a sub-factor reaches a higher indicated score, the transition in the credit rating is not smooth and leads to overshooting. The rating is now slightly better than the original pre-downgrade rating. It should be noted that we select a sufficiently large gearing level for the average company to just enter a higher indicated score for a sub-factor. Combined with qualitative factors which were not considered, the overshooting can be mitigated.

B.2 Proportions of embedded and new debt

Ofwat assumed that the average proportion of new debt is 30% by the end of AMP7, with the remaining 70% being embedded debt. Data from APP19 of the business plans shows that companies are estimating that on average 17.6% of debt will be new. As a cross check on this, we tested the ratio of historic debt for water companies. The debt issuance data was collected from Bloomberg for all water companies except one[34].

The new debt ratio is defined as the total new debt divided by net debt, where net debt is equal to the RCV multiplied by gearing. RCV and actual gearing data is from Ofwat's most recent financial monitoring report. Gearing could refer to the notional or actual value, therefore, giving us two ways to calculate the ratio. The figure below demonstrates the differences in the model when using a particular gearing.

[34] Debt data for the WaSCs and WoCs was found using Bloomberg, other than Dee Valley Water.

Figure 31 Comparing model differences with different types of gearing

	Notional Gearing	Actual Gearing
Value of gearing	60%	The companies' actual gearing[35]
Sample period	2010-2018	FY 2014 - 2017
Weighting methodology	By a company's RCV[36] in 2018	By a company's **average RCV** over the years listed above

Source: Frontier's Methodology

To calculate the new debt ratio for the average water company, weighted averages were used. The weights used, shown below, differ depending on the type of gearing. Under actual gearing, the yearly ratios for each company are aggregated and then weighted by their average RCV. Whereas for notional gearing, the RCVs in 2018 are used as the weights. These weighted averages are then adjusted to be accurate for a five year period to match the length of AMP 7. The results of this exercise are shown in Figure 32.

Figure 32 Results for the proportion of new debt

	Notional Gearing (%)	Actual Gearing (%)
Average new debt raised per year	4.6	4.5
New debt raised for 5 years	23.0	22.6
Average new debt over 5 years:	**11.5**	**11.3**

Source: Frontier calculations

Independent of the type of gearing used, our findings suggest that the proportion of new debt should be approximately 11-12%, which is significantly lower than the 30% assumed by Ofwat.

[35] This information can be found in Ofwat's Monitoring Financial Resilience data pack for 2015-2016 and 2017-2018.

[36] This information can be found in Ofwat's Regulatory Capital Values spreadsheets.

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