WSX32 – Annexes – Risk and return

Business plan
2025-2030

Wessex Water
YTL GROUP

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WSX32 – Annexes – Risk and return

CONTENTS

This supporting document is part of Wessex Water's business plan for 2025-2030.

Please see 'WSX00 – Navigation document' for where this document sits within our business plan submission.

More information can be found at wessexwater.co.uk.

A1 Cost of embedded debt – report by KPMG

This annex contains confidential material and has been submitted to Ofwat separately.

A2 Risk-free rate – report by First Economics

The Risk-free Rate
Prepared for a Group of England & Wales Water Companies
2 August 2022

FIRST ECONOMICS
www.first-economics.com

1. Introduction

Ofwat's draft PR24 methodology consultation document states that Ofwat intends to use index-linked gilt yields as its proxy for the CAPM risk-free rate. Ofwat also notes that converting from an observed RPI real yield to a CPIH-stripped rate of return will be more challenging in PR24 compared to previous price reviews.

This short note discusses the issues that Ofwat will need to confront:

- section 2 focuses directly on the possible ways of calculating the risk-free rate; and
- section 3 looks more generally at the knock-on effects that the risk-free rate selection has on other aspects of the cost of capital calculation.

Drawing on both of these lenses, we question whether it is appropriate for Ofwat to place sole weight on index-linked gilts to the exclusion of other possible proxies for a riskless asset.

2. Calculating the Risk-free Rate

2.1 The issue

Ofwat sets price controls that index in line with CPIH inflation. Companies' RCVs also index with CPIH (with Ofwat transitioning to full CPIH indexation from 1 April 2025). Index-linked gilts, on the other hand, index with RPI inflation. This means that Ofwat has to make an inflation conversion in order to make use of published yield data in its cost of capital computation.

When converting yields on RPI-indexed gilts to a CPIH-stripped risk-free rate, it is important that Ofwat makes accurate allowance for current RPI inflation expectations. Any under- or over-statement of expectations will introduce error into Ofwat's calculation, i.e.:

- if Ofwat understates current RPI expectations, it will under-estimate the all-in, inflation-inclusive return that investors expect to make from index-linked gilts and, hence, also go on to under-estimate the current CPIH-stripped equivalent risk-free rate; but
- if Ofwat overstates current RPI expectations, it will over-estimate the all-in, inflation-inclusive return that investors expect to make from index-linked gilts and, hence, also over-estimate the current CPIH-stripped equivalent risk-free rate.

Importantly, the expectations that matter here are not Ofwat's expectations, companies' expectations or the expectations of any individual forecaster (e.g. the OBR). Rather, if Ofwat is to be able to obtain a genuine market-based estimate of the return that investors are willing to accept on a riskless asset, the conversion out of RPI real yield has to capture the expectations that buyers of index-linked gilts have as they make their purchases.

This has become more complicated in recent years as the RPI measure of inflation has started to become obsolete. An investor that is pricing an index-linked gilt in today's market will be aware, in particular, of the announcement made by the UK Statistics Authority (UKSA) and HM Treasury in November 2020 which stated that the Authority intends that the methodology for calculating RPI will be brought into line with the methodology for calculating CPIH from February

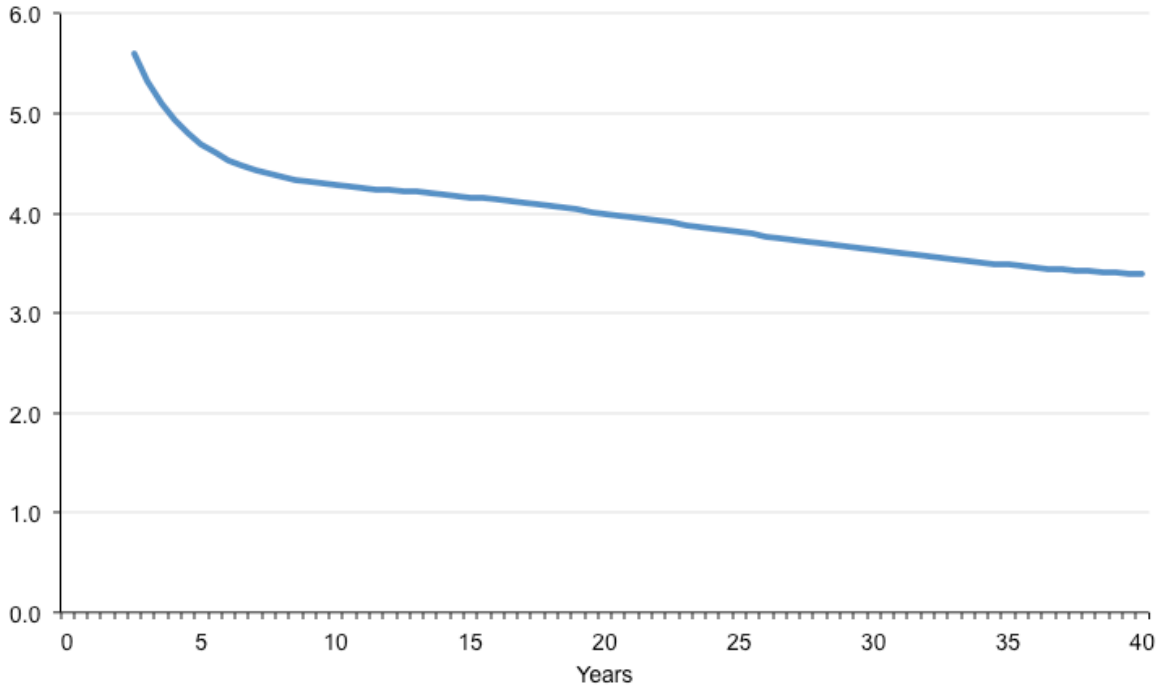
2030.[1] The investor will also be aware that the decision is the subject of an ongoing judicial review and that there has been discontent from pension funds and other investors in response to the government's refusal to compensate holders of RPI-denominated financial instruments.

Given this backdrop, an investor in the index-linked gilt market will have to form expectations not just about the future level of inflation, and the likely readings that the now statistically imprecise RPI will give, but also around the likelihood that the transition to CPIH will actually take place as intended on the timetable that the UKSA has signalled. The prices of index-linked gilts will then incorporate the marginal investor's probability-weighted assumptions about the likely worth of inflation indexation from 2030 onwards.

Ofwat does not have the ability to access prevailing market expectations directly. However, a priori, one would expect buyers and sellers to eliminate arbitrage opportunities so that the yields on nominal gilts equal the yields on index-linked gilts plus expected RPI inflation plus an inflation-risk premium. In principle, therefore, it ought to be possible to gain a good level of insight into investors' assumptions by examining the pricing of index-linked gilts versus the pricing of nominal gilts.

Figure 1 plots the so-called break-even inflation[2] curve as at 1 April 2022.[3]

Figure 1: Difference between the yield on nominal and index-linked gilts (%), 1 April 2022

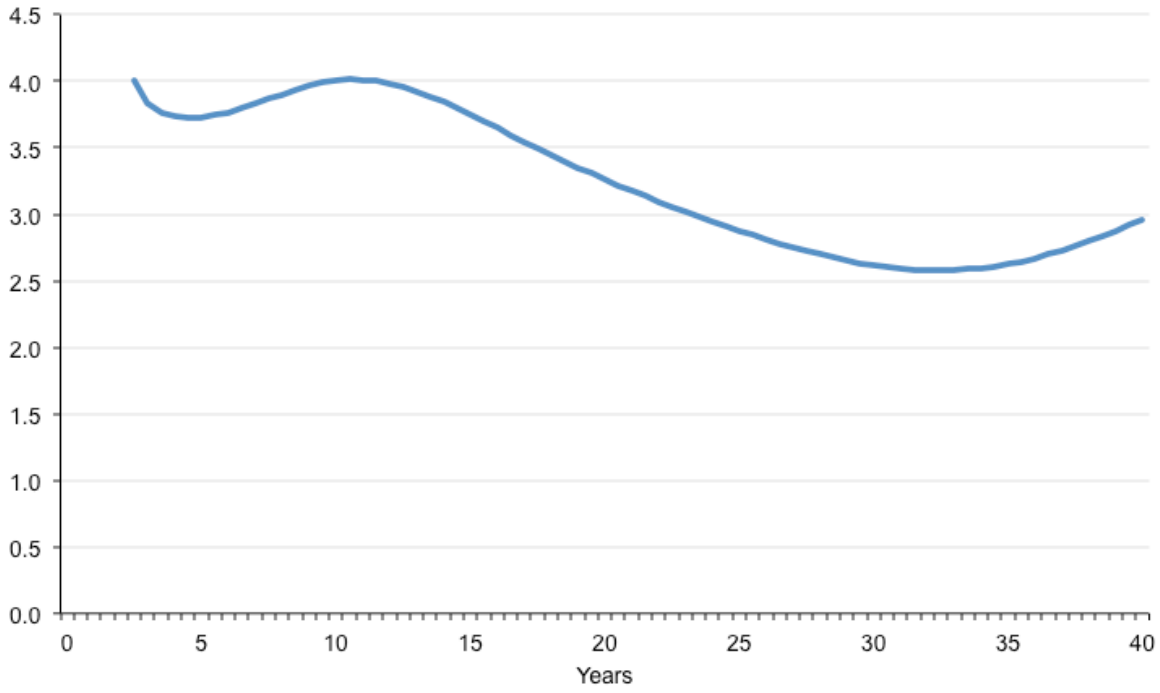


Source: Bank of England website.

[1] UKSA and HM Treasury (2020), A response to the consultation on the reform to Retail Prices Index (RPI) methodology.
[2] Break-even inflation is the average RPI inflation rate that would have to occur over the life of a bond in order for an index-linked gilt to generate the same return to maturity as a conventional gilt with the same tenor.
[3] We choose the date 1 April 2022 to ensure that there is alignment throughout the paper with the timing of the OBR's most recent inflation forecasts which were published at the end of March 2022.

The chart shows a difference of around 4.2 percentage points between 10-year nominal gilt yields and 10-year index-linked gilt yields and a similar 4.0 percentage points difference between 20-year nominal gilt yields and 20-year index-linked gilt yields. In and of themselves, these numbers are hard to interpret at a time of higher-than-usual inflation across the economy. Figure 2 therefore further develops the picture by unpacking the data in figure 1 into an instantaneous forward curve (i.e. a set of estimates of the prevailing rate of inflation at each moment in time over a 40-year horizon).

Figure 2: Instantaneous forward inflation curve (%), 1 April 2022



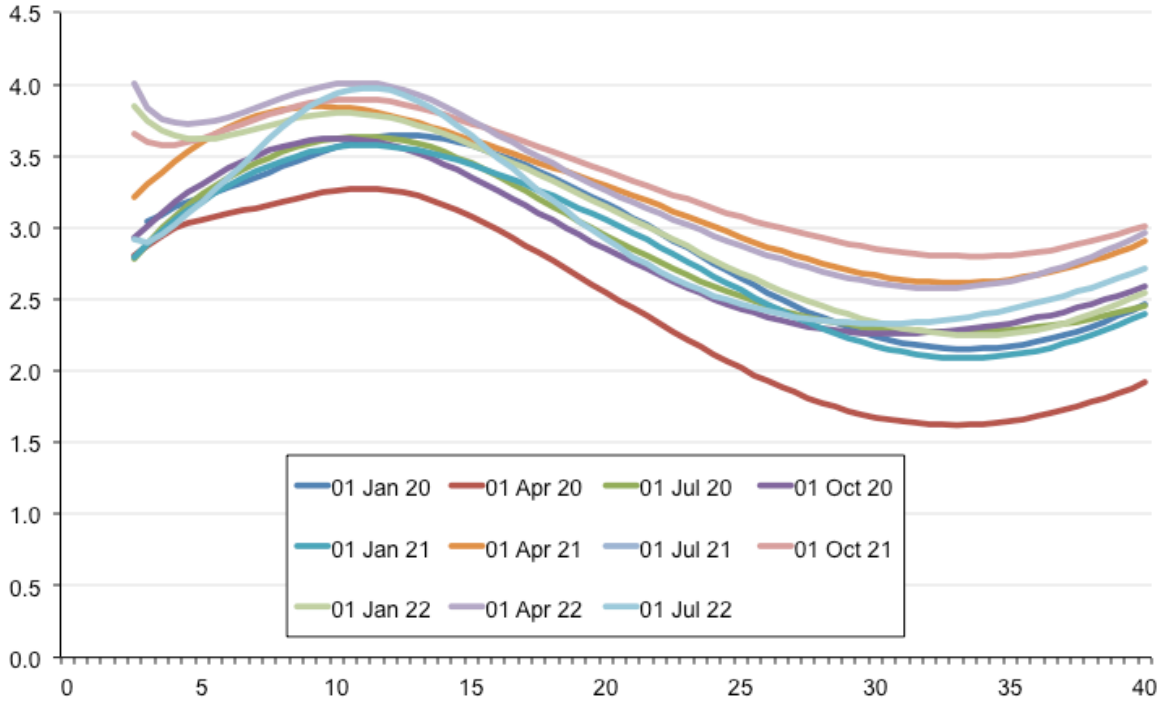
Source: Bank of England website.

The standout feature of this chart is the absence of any sign of a switch in RPI expectations at the point when the UKSA has said it will change its methodology (i.e. roughly year 8 in the chart). The profile of the line is also remarkable as regards both:

- the *level* of break-even inflation during the 2030s – i.e. up to 4% per annum versus the government's CPI inflation target of 2% per annum; and
- the *shape* of the forward curve – i.e. with expectations for inflation apparently increasing up to 2035 then decreasing up to 2050 then increasing again up to the 2060s.

These features of the data are not a new or transitory phenomenon. Figure 3 adds additional lines showing the forward inflation curve at the start of each quarter since the beginning of 2020. In each case, the level and shape of the curves are not dissimilar to figure 2.

Figure 3: Instantaneous forward inflation curve (%), earlier dates



Source: Bank of England website.

By any assessment, therefore, the story that the preceding charts tell is a challenging one. While we are admittedly not able to isolate precise RPI expectations from the above data, at least not without expending a great deal of effort to pin down the value of the (potentially time-varying) inflation-risk premium, it seems abundantly clear that the pricing of the different types of government bonds contains information that Ofwat needs to take account of in its PR24 work.

2.2 Ofwat's proposed approach

Ofwat examined the possible ways of dealing with uncertainty around inflation expectations in its July 2022 PR24 draft methodology consultation. The document states that Ofwat's preferred approach is to use 'Official forecasts' to convert RPI real yields to a CPIH-stripped equivalent. In practical terms, we interpret this to mean that Ofwat intends to:

- convert from RPI real to nominal in accordance with the OBR's RPI forecasts for a period of five years, a 3.0% RPI inflation assumption for the remaining years up to 2029/30, and 2.0% CPIH inflation thereafter; then
- convert from nominal to CPIH real by stripping out the OBR's CPI forecasts for five years and a 2.0% CPIH inflation assumption thereafter.

Table 1 illustrates the application of this approach by calculating the average annual RPI inflation rate that Ofwat's 'Official forecasts' would produce for a 15- and a 20-year period[4] starting 1 April 2022.

[4] This aligns with Ofwat's and the CMA's chosen horizons in PR19.

Table 1: Ofwat's proposed 15-year and 20-year RPI inflation forecasts as at 1 April 2022

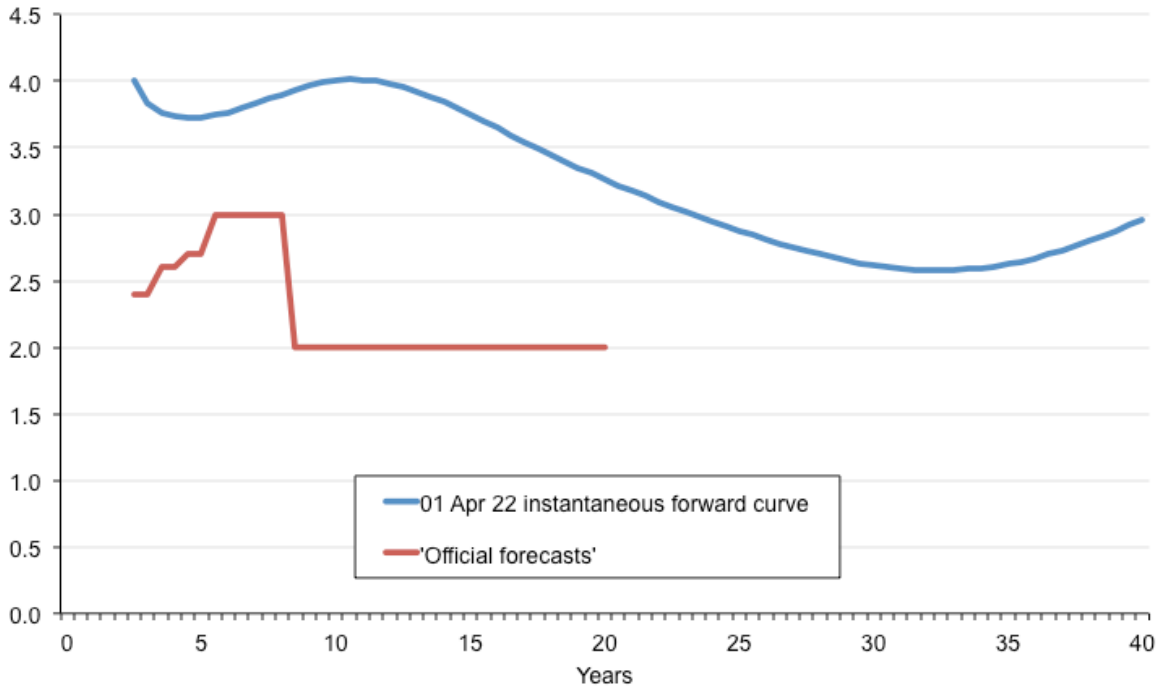
Year	'Official forecast'
2022/23	10.3%
2023/24	3.6%
2024/25	2.4%
2025/26	2.6%
2026/27	2.7%
2027/28 to 2029/30	3.0%
2030/31 onwards	2.0%
15-year average	**2.9%**
20-year average	**2.7%**

Source: OBR, Ofwat and First Economics' calculations.

It is immediately apparent that the inflation projections in the final row of the table fall short of the numbers seen in figure 1. Moreover, the scale of the difference is much larger than can be explained by any economic factor – e.g. the aforementioned inflation-risk premium.

Figure 4 further emphasises this point by superimposing the 'Official forecasts' from table 1 onto the instantaneous forward inflation curve. Again, there is a sizeable, unexplained gap between the two lines throughout the forecast period.

Figure 4: 'Official forecasts' vs instantaneous forward inflation curve (%)



Source: Bank of England website, OBR, Ofwat.

What we interpret figure 4 to be showing is that Ofwat, in effect, is in danger of introducing a significant mismatch between market pricing and regulatory assumptions. In extremis, the risk is that Ofwat will end up imposing its own regulator-created calculation of the all-in inflation

inclusive risk-free rate of return, and hence also the CPIH-stripped equivalent risk-free rate, rather than pick up a properly market-based measure of the prevailing riskless rate of return.

2.3 Conclusions

In our assessment, the picture that figure 4 presents gives Ofwat a serious problem to work through during PR24. We can understand why Ofwat would wish to approach the conversion of yields on index-linked gilts by assessing what expectations a rational investor ought to form about the future worth of RPI inflation indexation upon reviewing official forecasts and official policy statements. However, the evidence set out above indicates clearly that something is happening in the gilt market that is pushing the prices of index-linked and nominal gilts away from what Ofwat would regard as normal economic fundamentals.

The scale of the risks here are not trivial. In table 2 we calculate the value of the risk-free rate using two alternative RPI inflation assumptions, i.e.:

- break-even inflation averaging 3.75% per annum inflation, in line with the numbers in figure 1 less a modest inflation-risk premium; and
- the 'Official forecasts' from table 1.

The calculations show a margin of uncertainty around the risk-free rate computation worth up to 1 percentage point.

Table 2: Possible risk-free rate calculations, 1 April 2022

	Approach 1 **'Official forecasts'**	**Approach 2** **Adjusted break-even inflation**
20-year index-linked gilt yields	-2.15%	-2.15%
RPI inflation adjustment	2.7%	3.75%
CPIH inflation	(2.3%)	(2.3%)
CPIH-stripped real risk-free rate	-1.8%	-0.8%

In these circumstances, we think that it would be prudent for a regulator to look beyond just index-linked gilts to a wider basket of proxies for the riskless assets. We note that this this is not a novel idea – the possible other ways that there are of obtaining estimates of the risk-free rate have been discussed at length over a period of many years due to long-standing concerns about the "specialness" of index-linked gilts compared to other assets.

The most recent, substantive contribution in this area came from the Competition & Markets Authority (CMA) in its PR19 determinations. In its report the CMA identified both a theoretical and a practical rationale for estimating the risk-free rate using basket of assets comprising index-linked gilts and AAA rated non-government bonds. We are aware that Ofwat disagreed/disagrees with some aspects of the CMA's reasoning, but we would suggest that the margin of error in an index-linked gilts only methodology is now far greater than the margin of error that arises from using additional proxies, for the reasons set out in the preceding charts and tables.

3. The Risk-free Rate, Debt Premium, Debt Beta and the Effect of Gearing

We note that a change in Ofwat's proposed approach would also help Ofwat resolve the concerns it identified in its PR24 consultation document about a seemingly counter-intuitive relationship between gearing and the cost of capital.

3.1 The issue

A priori, one would expect to see that the framework that Ofwat uses when calculating the cost of capital ensures that required returns remain broadly constant, at the margin, in the face of fairly modest changes in gearing. Ofwat's draft methodology document highlights that this is not a quality that Ofwat's PR19 calculations exhibit. In table 3 we reproduce Ofwat's analysis of the consequences of varying gearing from 60% down to 54.2%.[5] The final line of the table shows that Ofwat's estimate of the forward-looking WACC (i.e. comprising the cost of equity and the expected cost of new debt only) would have been a counter-intuitive 4 basis points lower at the lower level of gearing.

Table 3: Ofwat's depiction of the PR19 relationship between gearing and the marginal cost of capital

	PR19 final determination	Alternative gearing
Gearing	0.6	0.542
Risk-free rate	-1.39%	-1.39%
Expected market return	6.5%	6.5%
Unlevered beta	0.29	0.29
Debt beta	0.125	0.125
Equity beta	0.71	0.63
Cost of equity	4.19%	3.60%
Expected cost of new debt	0.31%	0.31%
Marginal cost of capital	1.86%	1.82%

Source: Ofwat.

The root cause of the above result is the size of the debt premium (i.e. the premium in the cost of debt vs the risk-free rate) relative to the size of the debt beta. In very simple terms, Ofwat's PR19 calculation of the cost of debt included an element of unexplained cost that does not fit within the standard CAPM framework. If a company were assumed to borrow more, Ofwat implicitly assumes that the company would have more of this additional cost, thus increasing the overall cost of capital. And if a company were assumed to borrow less, the implicit assumption would be that the company would face less of this cost, reducing the cost of capital.

Because Ofwat did not compute a debt premium directly in its PR24 work,[6] we cannot say what the 'additional cost' represents or what it was meant to pay for. One possibility that exists, therefore, is that there was simply an error somewhere within Ofwat's arithmetic and that the resulting scale of the debt premium was an unintentional accident.

[5] 54.2% is the actual historical gearing level of the listed companies that Ofwat used when estimating the PR19 beta.

[6] Ofwat made completely separate calculations of the risk-free rate and the allowed cost of debt without at any point cross-referencing between the different pieces of work.

The analysis that we provided in section 2 of this paper makes this a possibility that is worth taking seriously. If it were the case that Ofwat under-estimated the value of the CPIH-stripped risk-free rate, for the reasons set out in the preceding discussion, we would expect to observe exactly the same kind of out-sized debt premium and consequent counter-intuitive relationship between gearing and the cost of capital that we see in table 3. Table 4 illustrates this point by showing what happens if we increase – or 'correct' – the value of the PR19 risk-free rate by ~70 basis points. The final line of the table shows that the effect of varying gearing from 60% down to 54.2% disappears in this scenario.

Table 4: Alternative estimate of the relationship between gearing and the marginal cost of capital

	PR19 gearing	Alternative gearing
Gearing	0.6	0.542
Risk-free rate	-0.7%	-0.7%
Expected market return	6.5%	6.5%
Unlevered beta	0.29	0.29
Debt beta	0.125	0.125
Equity beta	0.71	0.63
Cost of equity	4.39%	3.86%
Expected cost of new debt	0.31%	0.31%
Forward-looking WACC	1.94%	1.94%

Source: First Economics' calculations.

Further credence for the suspicion that the problem here may lie in the selection of the risk-free rate can be found if we wind the clock forward two and a half years and look at the numbers as at 1 April 2022. Table 5 shows that the difference between the cost of new debt, calculated using Ofwat's PR19 methodology, and Ofwat's preferred estimate of the risk-free rate, calculated using Ofwat's proposed PR24 methodology has widened from 190 basis points to 270 basis points.

Table 5: Debt premium calculation, PR19 vs 1 April 2022

	PR19 final determination	Ofwat 'Official forecasts' approach, 1 April 2022
iBoxx A/BBB 10+ year benchmark (CPIH-stripped)	0.53%	0.9%
Risk-free rate (CPIH-stripped)	-1.39%	-1.8%
Debt premium	1.92%	2.7%

Source: Ofwat, IHS Markit iBoxx website and First Economics' calculations.

If we insert the updated numbers from the final column of table 5 into the PR19 cost of capital calculation, holding all other inputs the same,[7] we find that the effect of varying gearing from 60% to 54.2% has increased to an even more counter-intuitive 9 basis points.

[7] The 'expected cost of new debt' line in table 6 is calculated using Ofwat's formula in which the expected cost of new debt = (1 – probability of default) x iBoxx benchmark cost of debt – probability of default x loss-given default.

Table 6: Up-to-date depiction of the PR19 relationship between gearing and the marginal cost of capital

	PR19 gearing	Alternative gearing
Gearing	0.6	0.542
Risk-free rate	-1.8%	-1.8%
Expected market return	6.5%	6.5%
Unlevered beta	0.29	0.29
Debt beta	0.125	0.125
Equity beta	0.71	0.63
Cost of equity	4.07%	3.46%
Expected cost of new debt	0.7%	0.7%
Forward-looking WACC	2.05%	1.96%

Source: First Economics' calculations.

3.2 Ofwat's proposed approach

Ofwat's reaction to the issues set out above has so far focused on the calculation of the debt beta. Specifically, Ofwat's thesis appears to be that the counter-intuitive relationship shown in table 3 is a consequence of Ofwat under-estimating the debt beta, thus leaving an inexplicably large component of the debt premium as unexplained cost outwith the normal CAPM framework.

Ofwat's proposed fix for PR24, following this diagnosis, is the selection of a higher debt beta. The maths shown in table 7 below, taken from the PR24 methodology document, shows that an increase in the PR19 debt beta from 0.125 to 0.216 restores the expected relationship between gearing and the cost of the capital.

Table 7: Ofwat's proposed solution

	PR19 gearing	Alternative gearing
Gearing	0.6	0.542
Risk-free rate	-1.39%	-1.39%
Expected market return	6.5%	6.5%
Unlevered beta	0.29	0.29
Debt beta	0.216	0.216
Equity beta	0.69	0.63
Cost of equity	4.08%	3.61%
Expected cost of new debt	0.31%	0.31%
Forward-looking WACC	1.82%	1.82%

Source: Ofwat.

What Ofwat does not explicitly say in the draft methodology document is that the subsequent increase that there has been in the differential between Ofwat's preferred estimates of the risk-free rate and the cost of debt since PR19 would require Ofwat to use an even higher debt beta if it were to rerun the same calculation using today's market data. In table 8 we show that the required debt beta as at 1 April 2022 would be 0.30 – i.e. more than double the actual PR19 debt beta.

Table 8: Ofwat's implied solution, 1 April 2022

	PR19 gearing	Alternative gearing
Gearing	0.6	0.542
Risk-free rate	-1.8%	-1.8%
Expected market return	6.5%	6.5%
Unlevered beta	0.29	0.29
Debt beta	0.30	0.30
Equity beta	0.68	0.63
Cost of equity	3.85%	3.46%
Expected cost of new debt	0.7%	0.7%
Forward-looking WACC	1.96%	1.96%

Source: First Economics' calculations.

3.3 Conclusions

A debt beta of 0.216 pushes at the boundaries of plausibility. A debt beta of 0.30 goes well beyond the estimates that one can find in academic literature or in use among practitioners for a modestly geared company with investment-grade debt.

The conclusion that we draw from the preceding analysis is that the problem that Ofwat has identified is not, in fact, likely to be the product of a faulty debt beta selection, but rather it is much more likely to be bound up in the issues that we presented in section 2.

We set out in table 9 two alternative ways of updating the PR19 cost of capital calculation to incorporate data as at 1 April 2022. Both approaches give broadly equivalent estimates of the cost of capital at 60% and 54.2% gearing respectively. But our strong view is that the second set of parameters is a much more coherent representation of the prevailing debt premium paid by companies and the prevailing debt beta, each of which is in turn anchored by a much more realistic characterisation of the prevailing risk-free rate of return.

Table 9: Alternative updates to the PR19 cost of capital calculation

	Ofwat – high debt beta		Alternative risk-free rate	
Gearing	0.6	0.542	0.6	0.542
Risk-free rate	-1.8%	-1.8%	-0.8%	-0.8%
Expected market return	6.5%	6.5%	6.5%	6.5%
Unlevered beta	0.29	0.29	0.29	0.29
Debt beta	0.30	0.30	0.125	0.125
Equity beta	0.68	0.63	0.71	0.63
Cost of equity	3.85%	3.46%	4.36%	3.82%
Expected cost of new debt	0.7%	0.7%	0.7%	0.7%
Forward-looking WACC	1.96%	1.96%	2.16%	2.13%

Source: Ofwat, First Economics' calculations.

Our recommendation to Ofwat is that it can give greater weight to this alternative perspective when calculating the PR24 cost of capital.

Information sources

Bank of England yield curve data:

https://www.bankofengland.co.uk/statistics/yield-curves

OBR economic forecasts:

https://obr.uk/efo/economic-and-fiscal-outlook-march-2022/

IHS Markit iBoxx bond yield indices:

https://ihsmarkit.com/products/iboxx.html

Ofwat PR19 draft methodology consultation:

https://www.ofwat.gov.uk/wp-content/uploads/2022/06/Appendix-11-Allowed-return-on-capital-appendix.pdf

A3 Notional capital structure – report by Frontier Economics

frontier economics

NOTIONAL CAPITAL STRUCTURE

AN INDEPENDENT ASSESSMENT OF OFWAT'S PROPOSED APPROACH FOR PR24

02 SEPTEMBER 2022

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CONTENTS

Executive summary

We have reviewed Ofwat's proposal to lower the notional gearing level from 60% and conclude that it does not satisfy Ofwat's own notional gearing framework, nor is it supported by empirical evidence.

A group of water companies have asked Frontier Economics to assess Ofwat's proposal to reduce the notional gearing level for PR24. This work forms part of a wider piece of research on cost of capital at PR24 and other aspects such as beta levering and de-levering approaches are covered elsewhere. In this document we take 'gearing' to mean regulatory gearing i.e. the ratio of net debt for the appointed business to its regulatory capital value (RCV) rather than market value based measures of gearing.

Ofwat has proposed lowering the current notional gearing of 60% for PR24.

Ofwat introduces its proposed framework for setting the appropriate notional capital structure in its 2021 risk and return discussion paper.[1] In the context of this framework, Ofwat has suggested that the current notional gearing level of 60% may be too high and a lower gearing rate would be more appropriate to provide headroom against greater uncertainty.

There are a variety of conceptual considerations when thinking about the optimal notional gearing level. This conceptual framework is best interpreted via the market evidence.

Ofwat uses the concept of notional gearing for three purposes: (1) as an input into the weighted average cost of capital (WACC), (2) for the notional financeability assessment; and (3) for monitoring and enforcing financial resilience. Our scope of work focuses on the first two.

There are several factors that influence the range of optimal gearing and these will vary across the purposes described above. The overall optimal gearing range will need to balance minimisation of the pre-tax WACC, the impact of external factors such as sector risks, economic policy, and financial market conditions, the impact of interactions with behavioural factors, and the relevant social cost and benefits.

We make two observations in light of the complexity of this conceptual framework. Firstly, the framework endorses a range of gearing levels rather than a single optimal level. Secondly, the best way to implement the conceptual framework is to focus on the market data rather than attempting to estimate the optimal gearing range from first principles. Market data including credit rating agency criteria and actual company gearing levels will reflect private considerations in the conceptual framework while wider evidence on sector wide financial resilience should be used to assess whether the social optimal differs from the private optimal level of gearing seen in the market data.

Furthermore, regulatory practice dictates that the notional gearing level should be assessed on an independent and objective basis. Adjusting the notional gearing level away from this objective level in order to address financeability issues would not be consistent with Ofwat's financing duty.

We therefore asses Ofwat's proposals against the following set of questions:

- What is the market evidence on gearing? Is there a case to set notional gearing at a different level?

[1] Ofwat (2021) PR24 and beyond: Discussion paper on risk and return

- Is notional gearing the best tool to provide additional headroom for risk?
- Is the treatment of notional gearing in line with regulatory best practice?

The relevant market metric is regulatory gearing. Gearing ratios based on enterprise value (EV) are not relevant to financeability.

When reviewing the empirical evidence the relevant metric is regulatory gearing, typically measured as the ratio of net debt for the appointed business to its regulatory capital value (RCV). This is the metric used by credit rating agencies in their financeability criteria. Gearing levels based on enterprise value (EV) are inappropriate in the context of notional gearing for several reasons.

EV based metrics are useful to understand the amount of risk borne by equity. However, it is debt rather than equity that is the focus of the financeability assessment in regards to the level of notional gearing, specifically the ability of a company to service its debt and its associated credit default risk. For example, Moody's methodology for regulated water companies specifies that 'leverage ratios aim to capture different measures of how easily an issuer can repay its debt, coverage ratios focus more on the ability to service the debt prior to repayment'.[2] As water company cashflows are defined by their RCV, the EV is of limited consequence to debt investors. Therefore it is gearing in relation to the RCV that matters.

The current notional gearing level of 60% is already at the bottom end of the range implied by market evidence. There is no evidence to justify reducing it below current levels.

The market evidence across credit rating agency criteria, actual gearing rates, and regulatory precedent supports a range of 60%-75%. The current notional gearing level of 60% is therefore already at the bottom of this range:

- **Credit rating guidance**. Moody's ratio guidance for UK water utilities has threshold regulatory gearing range of 65%-72% for a Baa1 rating. A regulatory gearing level of 60% is actually at the midpoint of the Moody's 55%-65% range for an A3 rating which is higher than Ofwat's target for the notional company of BBB+/Baa1. The current level of 60% therefore already provides headroom for the notional company.

- **Actual sector gearing.** In the water industry, the current sector wide RCV weighted average gearing level is 68.5%[3] which is well above the 60% notional gearing level. Furthermore, the interquartile range of actual company gearing in 2021/22 was 63% - 72% and the lower quartile has remained at or above 64% over the past seven years. Currently only three companies have a gearing level below 60% and all three have non-standard capital structures that limit their value as comparators for the notional company or industry as a whole.[4] Excluding these three companies results in actual 2021/22 gearing levels ranging from 62% to 81%. Again this suggests that 60% already lies at the lower bound of efficient gearing levels. Furthermore, whilst there has been a modest reduction in actual sector gearing

[2] Moody's investor service (2018). Rating methodology. Regulated water utilities

[3] This is the total sector gearing level i.e. total net debt / total RCV

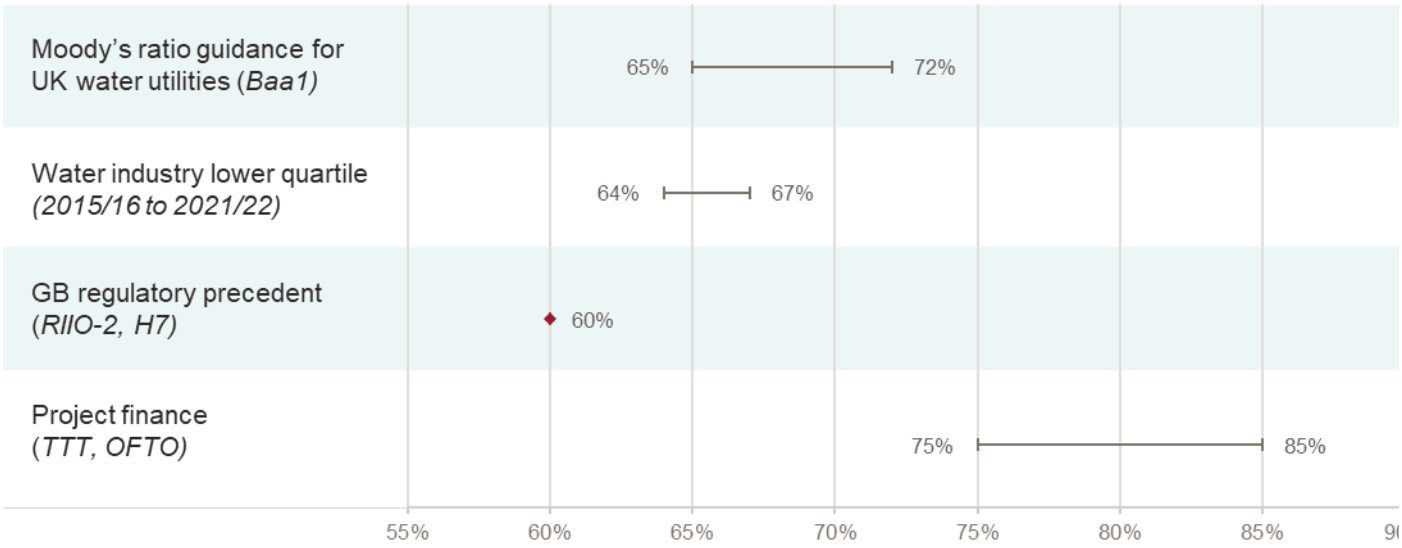
[4] The three companies are Hafren Dyfrdwy, Dŵr Cymru, and South Staffordshire Water. Haffren Dyfrdwy has a reported gearing level of 40% which reflects its ownership by Severn Trent and intragroup adjustments. Dŵr Cymru's gearing level reflects its limited by liability ownership structure and renders it incomparable to the rest of the sector. South Staffordshire Water's parent company, South Staffordshire plc, recently implemented a new group structure including the creation of a new intermediate holding company SSW Finance Limited (MidCo).

levels in 2021/22, much of this is likely due to companies moving towards the notional gearing in response to Ofwat's push for lower gearing as part of the PR19 strategy. This should not be interpreted automatically as evidence that the notional gearing should continue to fall as it risks becoming a self-fulfilling prophecy. gearing. More generally, even with the small reduction in total sector gearing in 2020/21, the majority of companies remain well above the 60% notional level, reinforcing its position as the bottom end of the market range.

- **Competitive infrastructure project finance.** Comparators from competitive infrastructure finance have also been consistently higher than 60%. For example, the Thames Tideway Tunnel currently has a gearing of 83% and Offshore Transmission Operators have typically been financed at gearing levels of 75%-85%.

- **Regulatory precedent**. Recent GB regulatory precedent for energy (RIIO-2) and aviation (H7) have all used 60% as their notional gearing assumption.

Figure 1 Summary of market evidence



Source: Frontier Economics

Furthermore, There is no evidence to indicate that the social optimal level of gearing would be below the level determined by the market evidence. Also to the extent that Ofwat has identified increases in the risk profile, we have not seen any rating agencies update their criteria to suggest lower gearing levels are required to address risk in the sector.

Even if additional headroom were required, Ofwat has not justified why lowering the notional gearing is the best option.

As Ofwat recognises in its draft methodology, credit ratings are based on multiple factors. Regulatory gearing only has a weighting of 10% in Moody's rating methodology and Ofwat has not provided evidence that it has considered other options for providing necessary headroom which may be more effective. Other regulators have considered alternative solutions to address uncertainty from factors such as increased risk of extreme weather. For example, Ofgem's draft determination for RIIO-ED2 includes a severe weather funding

mechanism, as well as severe weather allowances and re-openers. We recommend that Ofwat works with companies to understand the root cause, scale, and balance of any additional uncertainty and use this to assess solutions in the round.

Without clear market evidence and supporting assessment in the round, changing the notional gearing level risks undermining investor confidence and goes against regulatory best practice.

The government's recent review of economic regulation has highlighted the importance of stability in the regulatory regime to support long-term investment. This is key given that the water industry is likely to require significant investment in PR24 and beyond. Lowering the notional gearing rate without supporting evidence is likely to reduce investor confidence due to higher perceived regulatory risk. This in turn will undermine Ofwat's original intentions to support investment in the sector and may be perceived as counter-intuitive given the role of debt investment over the life of new assets.

While Ofwat argues that a change of up to 5% would not be unprecedented based on historical gearing levels, these should be considered in the context of the wider financial and regulatory environment and, in particular, the growth of RCV relative to annual costs over the past 30 years. This means that relying on historical gearing rates alone is not sufficient to argue that a change today is precedented, particularly as Ofwat has provided no empirical data or evidence to justify moving away from 60%.

In summary, we have seen no significant evidence to support a move away from the current 60% gearing level which already lies at the bottom of the reasonable range informed by market data. Nor have Ofwat provided an impact assessment to demonstrate that a reduction in notional gearing levels is beneficial for customers, particularly as any change in gearing levels will have associated costs including equity issuance cost and tax liability impacts.

Without this evidence, there is a real risk that a reduction in the notional gearing level will mean companies are incentivised to move to inefficient actual gearing levels. This would lead to several adverse impacts including undermining investor confidence, over-reliance on a single source of financing, and equity issuance costs which ultimately need to be borne by customers.

1 Introduction

Ofwat published its draft methodology for the next price control period PR24 in July 2022. This set out its proposed approach to risk and return in PR24 and builds on its December 2021 discussion paper.

A group of water companies have asked Frontier Economics to independently assess Ofwat's proposed approach to notional gearing. Other aspects of risk and return have been addressed separately including issues relating to beta levering and de-levering approaches.

1.1 Ofwat's proposed approach

In its December 2021 discussion paper Ofwat introduced its proposed framework for setting the appropriate notional capital structure.[5] This framework is intended to:

- Incentivise efficient financing choices given the balance of risk faced by water companies;
- Reflect the scale and nature of investment needs;
- Take account of a range of appropriate benchmarks and evidence; and
- Allows the regulator to set a price control that is in the best interest of current and future customers.

In the context of this framework, Ofwat suggested that the current notional gearing level of 60% may not be fit for purpose for PR24 and that a lower gearing rate would be more appropriate. It justified this thinking on the basis that the water sector faces greater uncertainty in the future leading to a 'greater role for equity in order to provide a buffer against supply-side or demand-side shocks'.[6]

This discussion paper also addressed Ofwat's approach to estimating betas for the notional company in PR19, including its method for de-levering comparator raw betas and re-levering them in line with the notional gearing level. It draws heavily on a recent report by Professors Mason and Wright[7] who raise two issues with the approach taken at PR19: (1) measurement challenges for comparator gearing levels and (2) the positive relationship between notional gearing levels and the WACC. While treatment of the equity beta is not the focus of this work, we will address interactions with the level of notional gearing.

Ofwat has since published its draft methodology. It recognised that there was 'limited support for our proposed framework for determining the notional structure and companies were universally opposed to a reduction in notional gearing from 60%'.[8] However it is proposing to continue with its notional capital framework and remains minded to adopt a lower notional gearing level for PR24.

[5] Ofwat (2021) PR24 and beyond: Discussion paper on risk and return

[6] Ibid.

[7] Mason R, Wright S. (2021) A report on financial resilience, gearing, and price controls

[8] Ofwat (2022) Creating tomorrow, together: consulting on our methodology for PR24. Appendix 10 – Aligning risk and return

1.2 Structure of this document

The remainder of this document is structured as follows:

- Section 2 lays out the key theoretical arguments surrounding the level of notional gearing and uses these to develop a framework for notional gearing;
- Section 3 sets out empirical evidence against the notional gearing framework in the context of Ofwat's proposed approach in addition to the potential impacts of lowering the notional gearing;
- Section 4 summarises our overall conclusions.

2 Framework for notional gearing

In order to review Ofwat's proposed approach to notional gearing, we need to establish a conceptually justified method for establishing the notional gearing level. This should reflect corporate finance principles, regulatory best practice, and account for relevant precedent.

We first discuss the purposes of setting a notional gearing level, the way in which each of these affects the reasonable range, and the need for consistency. We then explain how the notional gearing level is linked to Ofwat's regulatory duties. Finally, we bring this together to set out a framework for setting notional gearing in practice.

2.1 Purpose of notional gearing

As a starting point it is important to recognise that Ofwat uses the concept of notional gearing for different purposes within the overall regulatory methodology:

- as an input into the weighted average cost of capital (WACC);
- for the notional financeability assessment; and
- as an input into the ongoing monitoring and enforcing financial resilience.

The range of reasonable figures for the notional gearing level may differ depending on which of these three purposes it is being used for. However, there needs to be consistency across the notional gearing levels used for estimating the WACC and the financeability assessment. This was noted by the Competition Commission's assessment who highlighted that consistency across the two was integral to achieving Ofwat's financing duty (see section 2.3).

We note that for monitoring and enforcing financial resilience a regulator could adopt a range for notional gearing, whereas for the other two purposes a point estimate of gearing is used.

In this report we focus on setting a notional gearing rate for the calculation of the WACC and notional financeability assessment. However, we note that while Ofwat states that actual gearing is a matter for companies, its decisions on notional gearing have important impacts on the price determination and actual financing of investments (discussed in 3.4).

2.2 Regulatory gearing vs. other gearing ratios

There are two broad categories of gearing metrics: (1) those based on book value and (2) those based on enterprise values (EV). In the context of notional gearing, it is book value rather than market value that is relevant. Gearing levels based on enterprise value (EV) are inappropriate in the context of notional gearing for several reasons.

Whilst EV based gearing metrics are useful to understand the amount of debt borne by equity, the financeability assessment focuses on the ability of companies to service their debt and their associated credit default risk. This is reflected in credit rating agency criteria which use regulatory gearing, the ratio of net debt for the appointed business to its regulatory capital value (RCV), as an input into the calculation of a company's

credit rating. For example, Moody's methodology for regulated water companies specifies that 'leverage ratios aim to capture different measures of how easily an issuer can repay its debt, coverage ratios focus more on the ability to service the debt prior to repayment'.[9]

We therefore disagree with the position that one should move away from regulatory gearing to market value based measures of gearing for the purpose of setting the notional gearing. The remainder of this document uses the term 'gearing' to refer to regulatory gearing.

2.3 Relationship with Ofwat's regulatory duties

While companies are free to set their actual gearing levels, Ofwat's decision on the notional gearing level acts as an important signalling mechanism to companies considering their own choice of capital structure. This is because both the allowed return and financeability assessment are underpinned by an efficient company with the notional level of gearing.

This means that Ofwat needs to consider its relevant regulatory duties when determining the notional gearing level. Ofwat has five primary regulatory duties. Of these we consider the following three to be of particular relevance when discussing notional gearing:

- To further the consumer objective to protect the interests of consumers, wherever appropriate by promoting effective competition (referred to as the consumer objective);
- To secure that water companies can (in particular through securing reasonable returns on their capital) finance the proper carrying out of their statutory functions (referred to as the financing duty); and
- To further the 'resilience objective' which is defined as:

  (a) to secure the long-term resilience of water undertakers' supply systems and sewerage undertakers' sewerage systems as regards environmental pressures, population growth and changes in consumer behaviour; and

  (b) to secure that undertakers take steps for the purpose of enabling them to meet, in the long-term, the need for the supply of water and the provision of sewerage services to consumers, including by promoting: (i) appropriate long-term planning and investment by relevant undertakers; and (ii) the taking by them of a range of measures to manage water resources in sustainable ways, and to increase efficiency in the use of water and reduce demand for water so as to reduce pressure on water resources.

There is no hierarchy between these primary duties. The CMA in the redetermination appeals following PR19 stated as follows:[10]

> *"The CMA has previously set out (in the CMA's Bristol PR14 Determination) that the primary duties are equally important and are intended to complement one another."*

[9] Moody's investor service (2018). Rating methodology. Regulated water utilities

[10] CMA; Anglian Water Services Limited, Bristol Water plc, Northumbrian Water Limited and Yorkshire Water Services Limited price determinations, Final report, March 2021, para 2.84.

The assessment of notional gearing most clearly relates to the performance of the financing duty. At the same time we note that the method in which Ofwat sets notional gearing could have an impact on both the consumer objective duty and the resilience duty (i.e. promoting long-term planning and investment), particularly if the method does not follow the principles of best regulatory practice. We refer to the potential implications for these duties further in this paper.

In terms of the financing duty, it is established regulatory practice[11] that this is achieved through:

- Setting a WACC that properly reflects the cost of debt and cost of equity, and a level of notional gearing that is appropriate for an efficiently financed company;
- Consideration of the importance of maintaining access to debt finance on reasonable, in the form of investment grade credit ratings; and
- An assessment that regulatory assumptions about costs and service performance are likely to be achievable.

The fact that the assessment is based on notional gearing rather actual gearing is consistent with the regulatory principle that actual capital structure decisions are a matter for the company and its investors. For example, the Competition Commission (2010) stated[12]:

> *"We agreed with Ofwat that Bristol Water's actual financial structure is for Bristol Water to determine, but that this was at Bristol Water's own risk. Accordingly, we considered it reasonable for us to conduct our assessments on the basis of assumptions as to financial structure that we considered to be reasonable in terms of gearing (as long as we applied such adjustments in calculating the WACC)"*

We note that the Competition Commission highlighted that the notional gearing estimate should be applied consistently to both the WACC calculation and the financeability assessment and that this was integral to achieving the financing duty.

Therefore, our conclusion with regard to the regulatory duties, reflecting the established regulatory practice outlined above, is that the notional gearing level should be assessed on an independent and objective basis. Adjusting the notional gearing level away from this objective level in order to address financeability issues would not be consistent with satisfying the financing duty.

Looking forward, government is proposing to launch a review of utilities regulators' statutory duties later this year. The review will consider what changes, if any, are required to ensure that UK regulation are transparent and predictable to facilitate investment, protect consumers, and deliver sustainable growth.[13]

2.4 Wider regulatory best practice

In addition to consistency with established economic and corporate finance principles, Ofwat's justification for changing the notional gearing level for PR24 needs to be in line with wider regulatory best practice.

[11] For example, see CMA (2021), paras 9.39, 10.72 – 10.73, or Competition Commission, Bristol Water plc, Report, August 2010, para 10.8.

[12] Competition Commission, Bristol Water plc, Report, August 2010, para 10.10.

[13] Department for Business, Innovation and Skills (2022). Economic regulation policy paper

Regulation in the UK is guided by the Government's Principles for Economic Regulation.[14] Ofwat is also a member of the UK Regulators Network (UKRN) and has signed up to their principles for cost of capital.[15] Both the Government and UKRN's principles for regulation include stability and predictability i.e. ensuring that the regulatory framework is stable across periods and that any changes are well justified to provide the necessary confidence for long-term investment.

Given the sector's new focus on long-term investment, this is more important than ever. This is emphasised in BEIS's recent consultation paper on the framework for better regulation which states that 'a key element to encouraging investment is providing a stable and predictable environment for investors and consumers'.[16] More generally, given the 20+ year investment horizons in the water sector, any changes in gearing levels should be gradual within a stable and predictable regulatory environment.

If Ofwat considers it appropriate to decrease the level of gearing for PR24, then it must imply that either approaches used previously to set the notional gearing level resulted in higher than optimal levels, or that the optimal level is decreasing. We have not seen any significant evidence to suggest that the previous approach to setting the notional gearing level resulted in inappropriately high values. Any change in gearing level must therefore be supported by clear market evidence that it remains in the reasonable range for gearing (we focus on establishing this range in section 3).

In the absence of this evidence, changing the notional gearing level risks introducing greater uncertainty into the regulatory environment without any actual benefit to consumers. This outcome would be inconsistent with Ofwat's regulatory duties (financing duty, consumer objective duty, and the resilience objective duty).

2.5 Framework for notional gearing

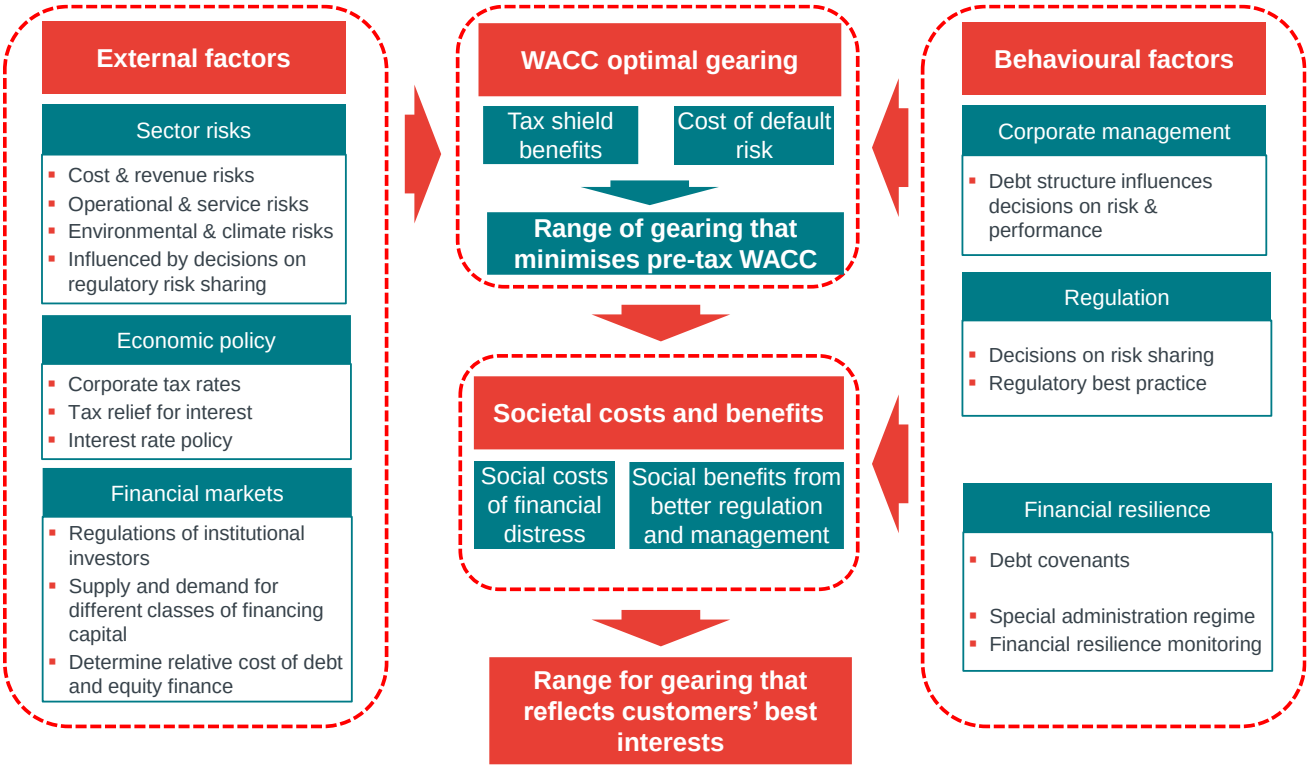
Our conceptual framework for assessing notional gearing is set out in Figure 2. The aim of this framework is to identify the wide range of factors that can influence a gearing assessment and to explore the complexity of the interactions. As we explain below we are not proposing this as a tool for estimating the notional gearing, but do consider that it is useful for understanding and assessing Ofwat's position.

[14] Department for Business, Innovation and Skills (2011) The Principles for Economic Regulation

[15] UKRN website. Accessed at: cost of capital | UKRN: the UK Regulators Network

[16] ibid

Figure 2 Conceptual framework for assessing notional gearing

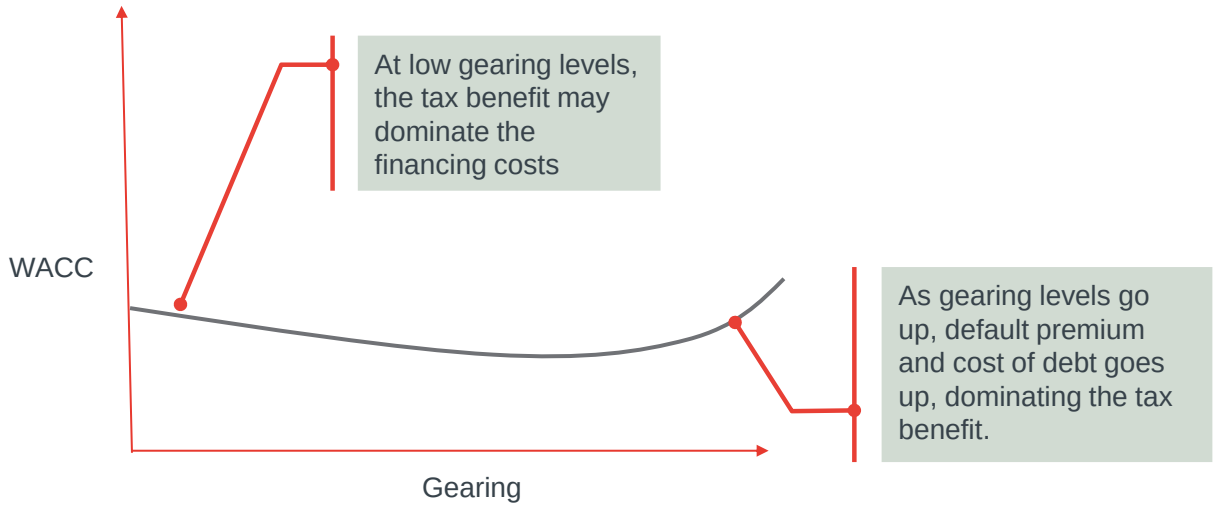


At the centre of the framework is the familiar concept that there is a range of gearing, for a given sector at a point in time, that minimises the pre-tax WACC. An illustration of this is shown in Figure 3. The shape of this relationship reflects the interaction of two factors:

- The tax shield benefits of debt acts to reduce the pre-tax WACC as gearing increases.
- The premium on the cost of debt for default risk acts to increase the pre-tax WACC as gearing increases.

Initially as gearing increases from 0% the tax shield effect dominates and the WACC falls but beyond a certain point the default risk effect becomes more important and the WACC increases again.

Figure 3 Pre-tax WACC and gearing – illustration



Source: Frontier Economics

In practice the shape of this relationship and the gearing range at which the WACC is minimised will depend on a number of factors, which we have divided into external and behavioural.

2.5.1 External factors.

The external factors that influence the appropriate level of gearing for a sector can be divided into: i) sector risks; ii) economic policy and iii) financial market conditions.

2.5.1.1 Sector risks

The upward slope of the gearing curve in Figure 3 is driven by the default premium on debt. This, in turn, depends on the probability of default at a given gearing level and also the expected recovery rate in the event of default. The nature of risks facing the sector will influence both of these. For the water sector the principal risks include:

- Cost risk. The risk that expenditure requirements within a price control period will exceed the allowance in price limits (for example due to changes in input costs).
- Operational and service risks. Performance issues in providing water services, or the treatment and disposal of wastewater, can result in additional costs or financial penalties.
- Environmental and climate risks. Changes in environmental targets and obligations, and changes in climate patterns, are an important underlying driver of both cost and service risk in the water sector.

Crucially, the impact of these risks on investors and gearing decisions, will depend on the regulatory treatment of risks. Elements of the regulatory methodology (for example, cost sharing rates, incentive caps and collars, re-openers) determine how risk is shared between the company (i.e. the investors) and customers. In addition, the regulatory methodology including the effectiveness of the Special Administration regime will influence the recovery rate on debt in the event of default.

Therefore the greater the degree of underlying risk (cost risk, operational & service risks, etc) the lower will be the optimal gearing range. At the same time, the more the regulatory regime shares risks with customers the higher will be the optimal gearing range.

2.5.1.2 Economic policy.

Economic policy factors covers:

- The corporate tax regime (main rate of corporation tax and system of capital allowances);
- The extent of corporate tax relief for debt interest payments; and
- Monetary policy with respect to interest rates.

A higher corporate tax rates will increase the optimal gearing range as it will increase the tax shield benefits of debt. An increase in interest rates will also increase the value of tax shield benefits but at the same time could be associated with an increase in the cost of debt relative to the cost of equity, which would act in the opposite direction (next section).

2.5.1.3 Financial market conditions

Financial market conditions covers a range of factors that influence the relative costs of debt and equity finance and, through that, the appropriate gearing level. These factors include:

- Rules and regulations that affect the demands from institutional investors for different asset classes. These include Basel regulations and Solvency rules.
- Trends in the investment policies of financial institutions and sovereign funds.
- Other changes in the supply and demand of capital for investment in infrastructure assets.

These factors determine the overall supply and demand conditions for equity and debt financing[17]. For example an increase in the demand for equity financing of infrastructure would increase the cost of equity financing relative to debt financing and therefore influence the optimal gearing range.

2.5.2 Behavioural factors

Alongside the external factors mentioned above there are set of considerations that we described as behavioural factors. In the economic literature these ideas have emerged from analysis of asymmetric information and Principal/Agent models of incentives and behaviours.

For the purpose of understanding notional gearing these factors can be divided into two areas:

- The relationship between decisions on gearing and the behaviour of company management in relation to risk and performance; and
- The relationship between decisions on gearing and the behaviour of regulators in relation to risk and performance.

[17] And also within debt financing the relative supply and demand for different credit rated debt issues.

In this section we summarise the nature of these issues. We do not aim to provide a full review of the literature. We note that Mason and Wright (2021) provided a summary of the literature on the second of these areas.

2.5.2.1 Management behaviours

The relationship between gearing and management behaviours is based on the following observations, following Jensen and Meckling (1976) [18]:

- Investors have imperfect information about the decisions and performance of management;
- The incentives of management may not align to the long-term interests of investors; and
- Default has a relatively greater negative impact on management.

By imposing a higher level of gearing the investors impose a discipline on management, since management will be keen to avoid the costs associated with default. This managerial discipline could include a reduction in risk-taking activities. This would result in a shift of the WACC curve in Figure 3 and therefore alter the optimal gearing range.

In addition the discipline could result in additional managerial effort and focus on performance. This would not necessarily alter the WACC curve but would nevertheless increase the value of the firm. This aspect of the gearing relationship is important to note because it suggests that the level of gearing that is 'optimal' for the investors is not necessarily the level that minimises the pre-tax WACC.

The significance of management behaviours in the gearing decision is well understood. A 2004 report[19] by the Department of Trade and Industry and HM Treasury into the gearing levels of utilities stated as follows:

> *"In a world of imperfect (and asymmetric) information, managers in mature cash-rich firms might have an incentive to spend money on imprudent investment or acquisitions, to the detriment of shareholders. In such instances, imposing a capital structure with a greater proportion of debt can increase managerial focus on profits (necessary to service the debt), and hence raise firm value."*

2.5.2.2 Regulator behaviours

A similar relationship exists between gearing and regulatory behaviours: .

- Regulatory decisions should reflect the long-term interests of investors and customers;
- It is not possible for regulators to commit to long-term decisions and regulators face pressure from other stakeholders to make decisions in the short-term that may not align with the long-term interests; and
- Default by a regulated company would be seen as a regulatory failure (as well as imposing costs on customers) and therefore the regulator has an incentive to manage the risk of default.

[18] Jensen M.C. and W.H. Meckling (1976) 'Theory of the Firm: Managerial Behavior, Agency Costs and Ownership Structure, Journal of Financial Economics, 3, 305–60.

[19] DTI, The drivers and public policy consequences of increased gearing, A report by the Department of Trade and Industry and HM Treasury, October 2004.

As noted above, the Mason and Wright (2021) paper described this aspect of the gearing relationship and summarised the relevant literature, including the papers by Spiegel and Spulber (1994 and 1997).[20]

Essentially the argument is that a higher level of gearing encourages the regulator to take decisions that put less risk on the company. This reduction in risk results in a shift of the WACC curve in Figure 3 and therefore an increase in the optimal gearing range.

2.5.2.3 Conclusions on external and behavioural factors

In summary this section has sought to explain that there are a wide range of factors that contribute to decisions on gearing. These factors are numerous and with complex interactions between them. As a result it is not straightforward or realistic to try to make judgements on the appropriate gearing levels based on a qualitative appraisal of a small set of factors.

2.5.3 Social costs and benefits

The above section has identified that there may be a divergence between the level of gearing that is optimal from the perspective of the investor and the level of gearing that is optimal from a societal point of view. In other words there are differences between the private costs and benefits and the social costs and benefits of gearing.

Such decisions could arise from the following factors:

- Discipline on management – gearing may result in better decisions in relation to risk-taking and performance that provide additional societal benefits.
- Discipline on regulators – gearing may result in reduction in regulatory opportunism that benefits society but could also result in less challenging regulatory decisions that are negative for society.
- Inefficient decisions to avoid default – in the period prior to a potential default management may make decisions that are sub-optimal for society.
- Societal costs of default – in the event of default there may be some costs associated with a transfer of operations to a new owner. The Special Administration regime is designed to minimise such costs.

Many of these factors were discussed in some detail in the Mason and Wright paper. However, in its findings the paper appear to assume that the social optimal level of gearing was below the private optimal level. As the discussion above has tried to illustrate there are potentially additional social benefits from gearing as well as additional social costs. It is not possible therefore to simply conclude that the social optimal is lower than the private optimal gearing. Nevertheless, Mason and Wright do acknowledge the complexity of such an assessment.

> *"The socially optimal level of gearing equates the social marginal benefits and costs from debt. While simple to state conceptually, there are formidable empirical challenges to determining this equality.*

[20] Spiegel Y. and D. Spulber (1994). "The Capital Structure of a Regulated Firm," RAND Journal of Economics, 25(3), 424-440. Spiegel Y. and D. Spulber (1997). "Capital Structure With Countervailing Incentives," RAND Journal of Economics, 28(1), 1-24.

Indeed, there is no consensus about privately optimal levels of gearing, never mind the socially optimal ones."

2.5.4 How to assess notional gearing in practice

From the assessment above we conclude the following:

- The relevant gearing metric is regulatory gearing based on book values. This is because the financeability assessment is focused on the ability of companies to service their debt and cashflows are determined by the RCV value not the EV.
- The optimal gearing level depends on a wide range of risk and behavioural factors that are complex to assess.
- The optimal gearing for the investor is not necessarily to level that minimises the pre-tax WACC.
- The gearing level that is optimal for society may be higher or lower than the private optimal, but this too is very complex to assess.

In the light of these conclusions, our recommended approach to assessing notional gearing is as follows.

- The best way to implement the conceptual framework for notional gearing is to focus on the **market data** and empirical evidence for **regulatory gearing** to understand the reasonable range.

This empirical approach would seek to address the following questions:

- What is the market evidence on the reasonable range for gearing? This would include the current gearing levels in the industry and trends over time; evidence from credit rating agencies and other investors, evidence from comparable sectors, and regulatory precedent.
- Is there a case to set notional gearing at a different level to that implied by the market evidence?
- If there is a concern that the risk exposure of the sector is increasing, is notional gearing the best tool to provide additional headroom for risk?
- Is the treatment of notional gearing in line with regulatory best practice and the interpretation of regulatory duties?

3 Assessment

Having set out our recommended approach to assessing notional gearing, we now provide evidence against each part of this approach:

- What is the market evidence on the reasonable gearing range? Is there a case to set notional gearing at a different level?
- Is notional gearing the best tool to provide additional headroom for risk?
- Is the treatment of notional gearing in line with regulatory best practice?

3.1 What is the market evidence on gearing? Is there a case to set notional gearing at a different level?

Ofwat's draft methodology suggests that the current notional gearing level of 60% is too high and that additional headroom is required to ensure that companies can address increased risks posed by climate change and greater regulatory service performance risk.

As we discuss in section 2, while there is sound economic and finance theory to link the optimal gearing rate with the level of risk in the sector, theory alone cannot tell us what this optimal level of gearing is for the water sector. For this we need to refer to real world observations in addition to sector specific analysis such as credit rating agencies.

Ofwat has not provided any quantitative evidence on the balance of risk to suggest why a notional gearing rate of 60% is too high to handle the risks facing companies over the PR24 period. If this were the case, we would expect to see:

- **Credit rating agency criteria.** Updated guidance from credit rating agencies that reduces target levels of regulatory gearing below 60% for BBB+/Baa1 (this is Ofwat's target for the notional company).[21]
- **Actual gearing levels and company performance.** Evidence that credit ratings for actual companies have been falling over time for companies with higher gearing rates following the recent pandemic and extreme weather events, or that companies are unable to borrow efficiently at current gearing levels.
- **Regulatory precedent.** Evidence of higher notional gearing rates in other sectors which face similar challenges from climate change or other sources of uncertainty.

We examine each of these sources of evidence below.

3.1.1 Credit rating agency criteria.

One reason Ofwat sets a notional gearing level is to carry out a financeability assessment of the notional company i.e. that an efficient company with the notional capital structure can raise reasonable finance on reasonable terms for its operations. Financeability of companies is largely determined by their credit rating,

[21] Ofwat (2022) Creating tomorrow, together. Consulting on our methodology for PR24

which is assessed by rating agencies. Investors will rely on this credit rating when deciding whether or not to lend money and the terms of this financing. In PR19, Ofwat targeted BBB+/Baa1 for the notional company and it proposes to continue to do so for PR24.[22]

Ofwat justifies its proposals to reduce the notional gearing level on the basis that greater uncertainty in the sector means companies require a larger equity buffer to remain financeable. If this is true, we would expect to see evidence of credit rating agencies lowering the target regulatory gearing level for any given investment grade rating below 60%. This has not been the case. Moody's gearing ratio guidance[23] for UK water utilities has a target gearing level for Baa1 of 65%-72%.[24] Fitch's sector specific rating methodology for regulated utilities has a target level of 70% for BBB before relevant business and regulatory risks are accounted for which would increase the actual target gearing threshold. [25] Looking outside the water sector, Moody's recently updated its scorecard for regulated electric and gas networks in March 2022. Its unadjusted target regulatory gearing level for Baa is 60%-75%.[26]

Table 1 Moody's rating criteria

ISSUER RATING	RCV GEARING RANGE
A2	Up to 55%
A3	55% - 65%
Baa1	65% - 72%
Baa2	72% - 80%

Source: Moody's ratio guidance for the UK water utilities (2018)

These ranges have remained unchanged over recent years despite the sector going through recent periods of significant volatility and uncertainty. Moody's methodology for water companies was last updated in 2018 and this methodology continues to be applied to assess water companies this year.[27] Its recent 2022 update of its rating methodology for regulated electric and gas networks in 2022 maintains the unadjusted 60% - 75% target leverage ratio for Baa that was in its 2017 guidance.[28] Whilst Fitch publishes an updated sector navigator more frequently, the unadjusted target regulatory gearing level for EMEA regulated networks has also remained the same over the last 5 years.

[22] Ofwat (2022) Creating tomorrow, together. Consulting on our methodology for PR24

[23] There is a difference between credit rating ratios guidance and credit rating agency methodologies. Rating agency methodologies set out a target level of regulatory gearing for any given rating. However, this the target prior to relevant business and regulatory risks. Once these risks are accounted for the relevant gearing threshold is typically higher. For example, Moody's target for regulated water companies in its 2018 rating methodology for Baa is 55-70% but its actual target threshold for Baa1 is 65% - 72% and for Baa2 is 72%-80%.

[24] Moody's investors service (2018) Sector in-depth. Regulator's proposals undermine the stability and predictability of the regime

[25] Fitch Ratings (2022) Sector navigators. Addendum to the Corporate Rating Criteria, Page 204

[26] Moody's investors service (2022) Regulated Electric and Gas Networks Rating Methodology

[27] One example is Moody's 2022 updated assessment on United Utilities which was carried out based on its 2018 methodology.

[28] Moody's investors service (2017) Regulated Electric and Gas Networks Rating Methodology

In summary the evidence from rating agencies does not support the notion that additional headroom is required from notional gearing to maintain the target credit rating. In fact, the lower bound for a Baa/BBB+ rating based on Fitch and Moody's rating criteria (once business and regulatory and business risks are accounted for) is 65%. The current notional gearing level of 60% is already below the lower limit of the target range for credit rating agencies.

3.1.2 Actual gearing levels

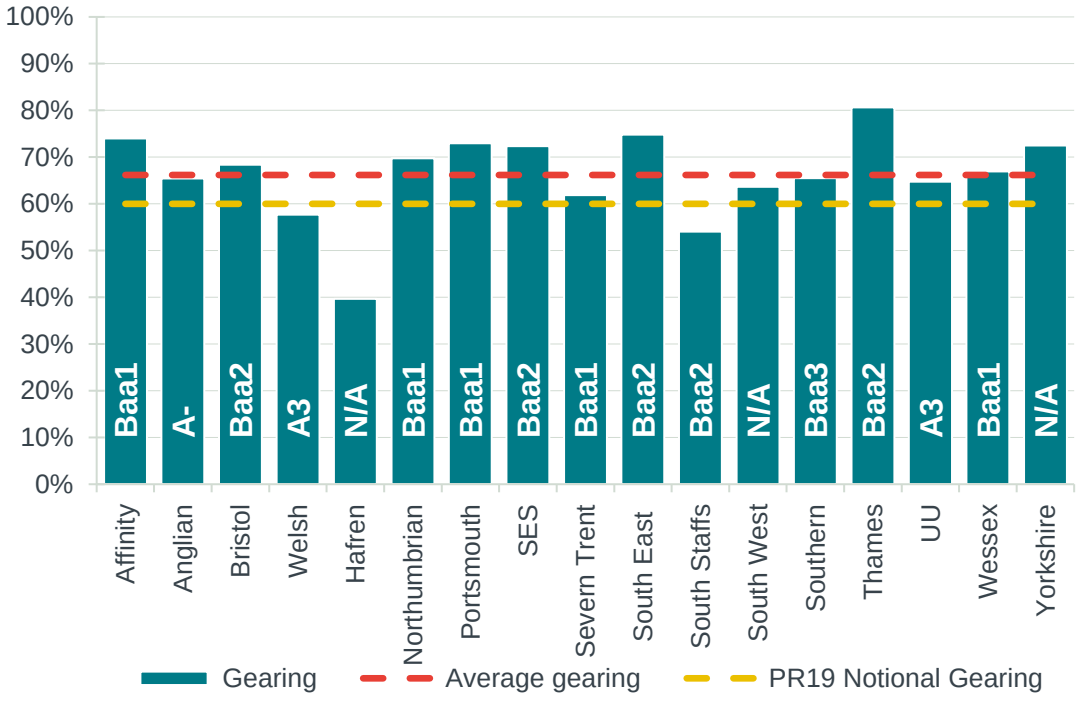
Ofwat argues that water companies expect to face significant investment needs over PR24 and beyond and therefore it is reasonable to expect the notional gearing to reduce gearing in order to increase its capacity to borrow efficiently. If this were the case, we would expect this to be evident in the market data to show:

- Actual gearing levels in the water industry below 60%;
- Significant reduction in gearing levels for companies with significant RCV growth.

3.1.2.1 Evidence from the water sector

We have reviewed historical data on actual gearing levels in the water industry and have seen no clear evidence that companies would be unable to borrow efficiently over PR24 at current gearing levels.[29]

Figure 4 Total gearing and adjusted gearing across the water sector (2021/22)



Source: 2021/22 Annual Performance Reports
Notes: Bar labels show Moody's credit rating, where applicable;

[29] We have no reason to believe that the industry as a whole is inappropriately geared and Moody's recent 2022 sector outlook for industry was stable.

In fact, the majority of water companies have gearing ratios well in excess of 60%. Figure 4 shows that as of the 31 March 2022, only three companies had a regulatory gearing level below 60% and a significant number of companies have gearing ratios exceeding 70%. All three companies with gearing ratios below 60% have non-standard capital structures that limit their applicability as comparators for the notional company or industry as a whole and Ofwat should not place undue weight on these datapoints.[30] Excluding these companies shows actual industry gearing levels ranged from 62% to 81%. All water companies are rated investment grade by Moody's, and there does not appear to be a strong correlation between gearing level and credit rating in this case.

Figure 5 gives an overview of summary statistics since 2015/16, with the boundary for the lower quartile of gearing ratios remaining at least 64% throughout the period. Again this suggests that 60% already lies at the lower bound of the range of reasonable gearing levels.

Figure 5 Gearing statistics over time

YEAR	WEIGHTED AVERAGE	AVERAGE	MAX	MIN	UQ	LQ
2021/22	68%	66%	81%	40%	72%	64%
2020/21	73%	70%	83%	45%	77%	67%
2019/20	72%	71%	82%	60%	77%	66%
2018/19	70%	69%	82%	56%	76%	65%
2017/18	71%	70%	83%	57%	78%	64%
2016/17	68%	71%	84%	56%	78%	65%
2015/16	71%	71%	83%	52%	78%	64%

Source: 2021/22 Annual Performance Reports
Notes: Weighted average based on 2019/20 RCV

When considering the trends in gearing over time it is important to bear in mind possible changes to the wider context of the financial and regulatory environment (discussed further in section 3.3). The trend in sector gearing level is shown below in Figure 6.

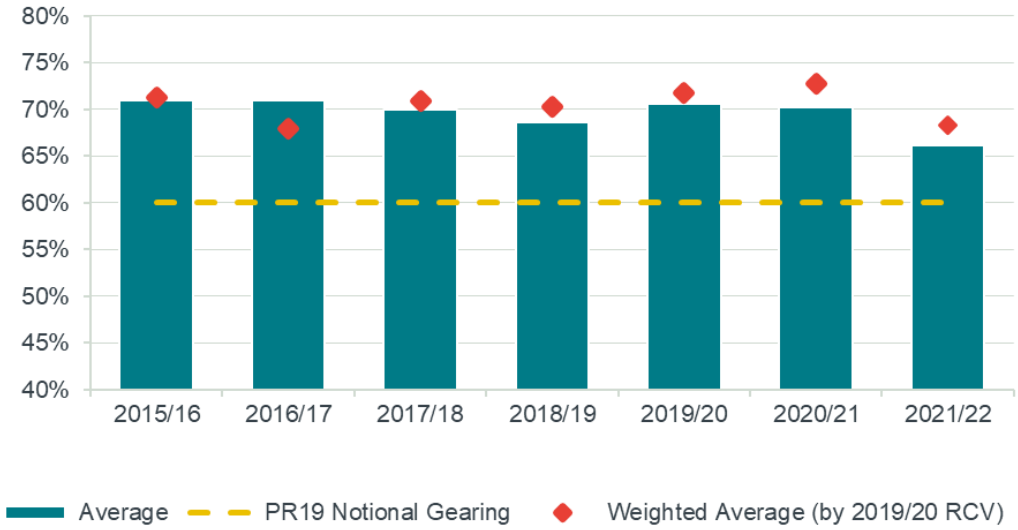
- Sector gearing has been consistently above and the average weighted by RCV has been approximately 70% over this period.
- There has been no clear trend over time, although gearing fell to around 68% in 2021/22.

While there has been a modest reduction in 2021/22, this could be driven by considerations beyond the notional gearing framework. This includes the impact of the GOSM which penalises companies for actual gearing companies that diverge too far from notional gearing levels, the impact of inflation, and company

[30] The three companies are Hafren Dyfrdwy, Dŵr Cymru, and South Staffordshire Water. Haffren Dyfrdwy has a reported gearing level of 40% which reflects its ownership by Severn Trent and intragroup adjustments. Dŵr Cymru's gearing level reflects its limited by liability ownership structure and renders it incomparable to the rest of the sector. South Staffordshire Water's parent company, South Staffordshire plc, recently implemented a new group structure including the creation of a new intermediate holding company SSW Finance Limited (MidCo).

specific adjustments to capital structures that should not affect the assessment of notional gearing. More generally, even with the recent reduction in total sector gearing in 2020/21, the majority of companies remain well above 60% gearing reinforcing its position as the bottom end of the reasonable range for gearing.

Figure 6 Total gearing across the water sector over time

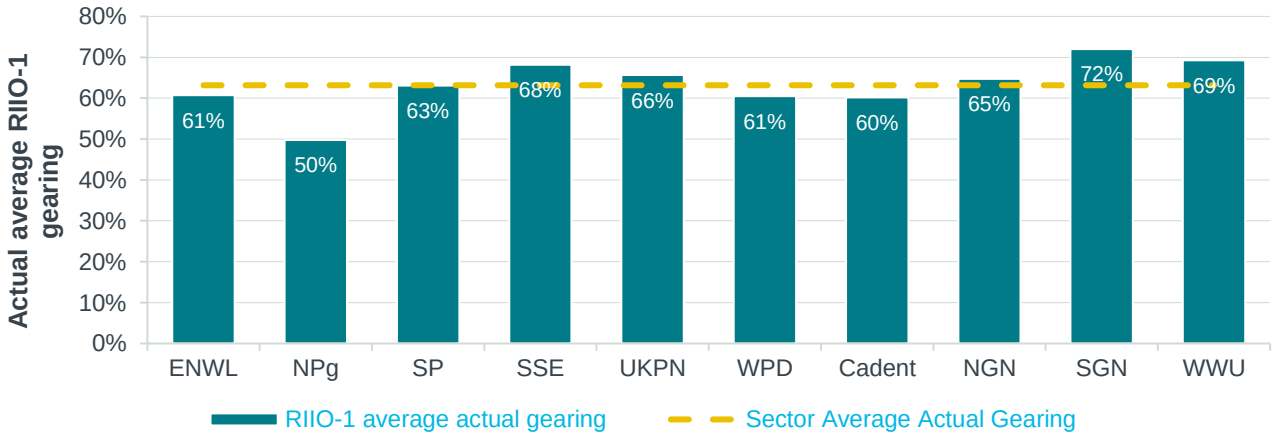


Source: Annual Performance Reports

3.1.2.2 Evidence from other sectors

We have reviewed gearing levels in the energy sector as a comparable benchmark. Taking the average gearing ratio of each energy network company across RIIO-1 gives an average gearing ratio of 63%. As shown on Figure 7 just one of these companies had an average gearing ratio below 60%. National Grid PLC had a gearing ratio of 66% in the year ending 31 March 2019[31], with a strong Moody's credit rating of Baa1.

Figure 7 RIIO-1 average gearing levels



Source: Annual Performance Reports

[31] National Grid (2019) NG.Debt

3.1.2.3 Evidence from project finance

Competitive infrastructure project finance has some differences in risks and regulation, its similarities make it a useful comparator. Ofwat argues that water companies expect to face significant investment needs over PR24 and beyond and it is therefore reasonable to expect the notional company to reduce gearing in order to increase its capacity to borrow efficiently. However the Tideway project, the largest infrastructure project carried out in the UK water sector since privatisation, currently has a gearing of 83%[32] and this figure has risen over the duration of the project. In its 2015 Ofwat guidance on the Tideway Tunnel, Ofwat recognised that the efficient level of gearing for an Infrastructure Provider such as this could be greater than the notional assumption of 62.5%.[33] In the energy sector, Offshore Transmission Operators have typically been financed at gearing levels of 75% to 85%.[34]

The risk profile of individual infrastructure projects will differ from that of an integrated utility business. Nevertheless, there is no evidence that gearing levels are declining for these projects and they highlight the importance of debt financing in infrastructure investment as a whole.

3.1.3 Regulatory precedent

The final balance of risk is a result of intrinsic risk filtered through regulatory treatment. Furthermore, as noted in the recent government policy paper on economic regulation, there is a need for greater consistency across regulated sectors to ensure the UK continues to maintain a stable and predictable environment for investment.[35] It is therefore useful to consider wider regulatory precedent when setting the notional gearing level for PR24. In our view the evidence from other regulatory precedent is less relevant than the direct market evidence on gearing or the credit rating agency criteria, nevertheless it is still useful to consider.

We agree that water companies may face more uncertainty in the future arising from the impacts of climate change or new environmental statutory requirements. However this is not unique to the water sector. The energy sector is directly responsible for decarbonising electricity by 2035 as well as the open question of the role of hydrogen. Beyond utilities, aviation is one of the sectors that has been hardest hit by the pandemic. Ofgem and the CAA's approach to addressing uncertainty in the recent RIIO-ED2 and H7 Final Proposals are valuable sources of regulatory precedent.

We have summarised recent decisions on regulatory gearing in Great Britain (GB) in Figure 8 below. This shows that a notional gearing level of 60% remains consistent with wider UK regulation, including the RIIO-ED2 draft determination and CAA H7 Final Proposals, both of which were published in summer 2022.

[32] Tideway (2021). Reconnecting London with the River Thames. Annual report 2020/21

[33] Ofwat (2015). Ofwat guidance on approach to the economic regulation of the Infrastructure Provider for the Thames Tideway Tunnel

[34] Frontier (2022)

[35] Department for Business, Innovation and Skills (2011) The Principles for Economic Regulation

Figure 8 Recent GB regulatory precedent

SECTOR	DETERMINATION	DATE	NOTIONAL GEARING
Energy	Ofgem GD2 and T2	December 2020	60%*
	Ofgem ED2 (draft determination)	June 2022	60%
Aviation	CAA H7	June 2022	60%

Source: Frontier Economics

*Note: * Ofgem used a notional gearing assumption of 60% for gas distribution networks. For the electricity transmission companies it set notional gearing to 55% for financeability but used 60% for calculation of allowed return on capital. The UKRN, which includes Ofgem, report a notional gearing level of 60% for GD2 and T2.*[36]

We recognise that Ofgem's proposed notional gearing level of 60% is in fact a reduction compared to the 65% assumption used in ED1. However we do not consider this to be strong evidence to reduce the notional gearing level in the water industry. First, Ofgem's proposed gearing level is 60% which is in line with the current notional gearing level in PR19. Furthermore, Feedback from network companies found that 'in general, networks were content with [Ofgem's] proposed notional gearing of 60% and the decrease in notional gearing from RIIO-ED1 was reasonable', possibly because this roughly reflects the actual gearing levels of the networks. This is not the case in water where 'companies were universally opposed to a reduction in notional gearing from 60%'. Finally, several companies argued that reducing notional gearing below 60% was not practical which echoes feedback from water companies to Ofwat.

[36] UKRN (2022) Cost of capital – annual update report, Table 2

3.1.4 Case study: Heathrow H7 final proposals

Aviation has been one of the hardest hit sectors by the pandemic and there remains uncertainty on future trends in passenger numbers. It is therefore a particularly relevant case study on both the efficient level of actual gearing in the face of market shocks and how to address future uncertainty in the regulatory regime.

Heathrow has remained resilient with a gearing level that is higher than 60%

Prior to the pandemic in 2018 Heathrow (SP) had a class A gearing of 68.2% and a class B gearing of 76.6%. Whilst its class A gearing has fallen marginally to 64.9% by March 2022, its class B gearing remains largely unchanged at 76.5%.[37] Importantly, Heathrow remained resilient to the largest shock to hit aviation in its history at gearing levels above 60%.

Today Heathrow Funding Ltd has a S&P credit rating of BBB+ and BBB- for its class A and class B debt respectively, and a Fitch rating of A- and BBB for its class A and class B debt respectively.[38] It has maintained an investment grade rating at its current gearing level even in the face of further uncertainty around passenger numbers and environmental policy.

The CAA has recognised that notional gearing is not the right tool to manage future uncertainty

In setting its recent H7 Final Proposals the CAA recognised the higher level of uncertainty facing Heathrow. This includes greater uncertainty around passenger forecasts as well as the need to address future pandemic risks. It has addressed this risks with targeted adjustments to the Traffic Risk Sharing (TRS) mechanism and a standalone revenue allowance for low probability but significant events.

Notably, it did not consider it necessary to reduce the notional gearing ratio in order for the notional company to be financeable. It chose to maintain the 60% notional gearing level it used in Q6.

Relevance to PR24

Heathrow's resilience throughout the pandemic despite a higher gearing level than the majority of water companies does not support Ofwat's view that lower gearing levels are required to address future uncertainty. Furthermore, rather than simply assuming that reducing the notional gearing is the most efficient way to address financeability concerns, Ofwat should consider its full range of options for addressing this uncertainty, including more targeted interventions, and move forward with the optimal mix. Ofwat's preferred approach to addressing asymmetric risks is to manage these at the source which is inconsistent with its approach to notional gearing.[39]

3.1.5 Summary of market evidence on gearing

Given the range of factors that influence notional gearing, and the band for rating agency expectations, the level of notional gearing was historically stated as a range, which left a choice of point estimate within that range. Evidence from credit rating agencies suggest that the range of reasonable gearing levels for a BBB+/Baa1 rating is 65% - 72%. Actual company gearing levels typically exceed 60%, with exceptions limited to companies with non-standard capital structures and are therefore poor comparators for the notional

[37] Heathrow (2022) Heathrow Investor Update

[38] Heathrow (2022) Credit ratings

[39] Ofwat (2022) Creating tomorrow, together: consulting on our methodology for PR24. Appendix 10 – Aligning risk and return

company. Recent regulatory precedent in energy and aviation have used 60% as the notional gearing level. We therefore conclude that the current notional gearing level of 60% already lies at the lower bound of the reasonable range and there is no evidence that either the range or point estimate has changed from PR19.

3.1.6 Is there a case to set gearing at a different level?

The second question of this part of the assessment is to consider whether there is reasonable case to set gearing at a level different to that implied by market data, bearing in mind the challenges to doing so outlined in section 2. Two possible motivations have been put forward by Ofwat in recent publications.

- First, that the private optimal level of gearing is higher than the social optimal level and therefore the market evidence should be adjusted downwards (see Mason and Wright (2021)).
- Second, that the sector faces increased risk posed by climate change and greater regulatory service performance risk.

On the first point we have argued above in section 2 that there are social costs and benefits from gearing and there is no reason to believe, in principle, that the social optimal is below the private optimal. Specifically in the context of water, the sector has shown a high degree of financial resilience over the past 15 years in the face of severe financial, economic and other shocks. Furthermore, analysis of gearing and performance data does not identify a causal relationship between higher gearing and lower performance. Finally, the sector regulations include several mechanisms to protect customers and incentivise service improvements including re-openers, cost sharing, and incentive sharing. Even in event that a default did occur, the impact on consumers is minimised via ring-fencing conditions and the Special Administration regime The view that the social costs of gearing are managed by existing regulations was supported by the CMA[40]:

> *"The examples of Wessex and Dŵr Cymru discussed in paragraph 9.1168 show that these tools – specifically ring fence measures – have been successfully deployed without obvious harm to either customers or taxpayers."*

Therefore there is no evidence base on justify diverging from the market evidence on this ground.

On the second point, that the sector faces increased risks, there are two observations we make.

a. To the extent that Ofwat has identified increases in the risk profile, we have not seen any rating agencies update their criteria to suggest lower gearing levels are required to address risk in the sector.
b. To the extent that underlying risks are increasing there are a number of regulatory options for how the risk should be allocated between companies and customers. It would not be appropriate for the regulator to conclude that a downward adjustment to notional gearing is the right solution without proper consideration of the other options.

This second observation is addressed below.

[40] CMA; Anglian Water Services Limited, Bristol Water plc, Northumbrian Water Limited and Yorkshire Water Services Limited price determinations, Final report, March 2021, para 9.1201.

3.2 Is notional gearing the right tool?

As we set out in section 3.1 we see no evidence in the market to suggest that additional headroom on the notional gearing metric is required in order to maintain the target credit rating for the notional company.

Ofwat recognises the inconsistency between its target notional gearing rate and the credit rating criteria in its draft methodology, stating that as the credit rating is an in the round assessment, they do not consider that each financial ratio for the notional company needs to fall within the guidance range for BBB+/Baa1. It also considers a stronger gearing ratio to provide a buffer to manage the impact of other risks that may impact the credit rating. However, we identify two issues with this line of reasoning.

First, the current gearing level of 60% is already below both Fitch and Moody's target threshold for a Baa/BBB+ rating. This means that a notional gearing level of 60% already provides headroom for managing other risks.

Second, Ofwat has not justified why reducing the notional gearing level is the most efficient way to provide additional headroom. As it has recognised, credit ratings are based on multiple factors and regulatory gearing only has a weighting of 10% in Moody's methodology. Ofwat's 2021 discussion paper recognises that other changes including the likely reduction in cost of embedded debt and proposed move to full CPIH indexation of the RCV may generate more headroom at PR24.[41] Other changes such as the introduction of long-term delivery strategies (LTDS), which include climate change adaptive planning scenarios, have also been introduced to mitigate risk.

Before deciding on an appropriate response Ofwat aim to understand both the root cause, scale, and balance of additional uncertainty and use this to assess potential solutions in the round. Creating more notional gearing headroom cannot address cashflow or interest cover (ICR) risks arising from factors such as extreme weather events, environmental pressures, or an increase in bad debt due to changes in the wider economic climate. Other regulators have recognised where these risks are better managed through other regulatory mechanisms and provision of revenues to manage this risk. For example, Ofgem's draft determination for RIIO-ED2 includes a severe weather 1-in-20 funding mechanism that allows companies to recover the efficient costs incurred directly incurred as a result of severe weather. It is also considering other options such as a severe weather 'use it or lose it' allowance and severe weather re-openers.[42]

Figure 9 Regulatory precedent on risk management mechanisms

SECTOR	RISK	MECHANISM
Energy (ED2)	Severe weather events	Severe weather 1-in-20 funding mechanism. This would act as an ex-post cost pass-through with efficient costs associated with the event reported and trued-up in the next charging period.

[41] Ofwat (2021) PR24 and beyond: Discussion paper on risk and return

[42] Ofgem (2022) https://www.ofgem.gov.uk/sites/default/files/2022-06/RIIO-ED2%20Draft%20Determinations%20Core%20Methodology.pdfRIIO-ED2 Draft determinations – Core methodology document

SECTOR	RISK	MECHANISM
Energy	Severe weather events and other exceptional events	Performance under the interruptions incentive scheme in these circumstances are discounted to recognise the impact of these events
Aviation	Low frequency, high impact shocks that only result in downside risk to passenger volumes e.g. storms, pandemics	Up-front revenue allowance for expected loss of profit
Aviation	Bad weather	Heathrow is not liable to pay rebates for disruption due to bad weather to airlines (unless it occurs alongside a failure on Heathrow's part)

Source: Frontier Economics

Given the importance of setting notional gearing on an objective basis, and the complexity of factors that determine the appropriate gearing range, any decision to make an adjustment to the objective assessment should be take carefully and with an appropriate impact assessment. To apply an adjustment based on a qualitative assessment of a sub-set of risk factors itself runs the risk of introducing greater uncertainty into the regulatory environment without any actual benefit to consumers.

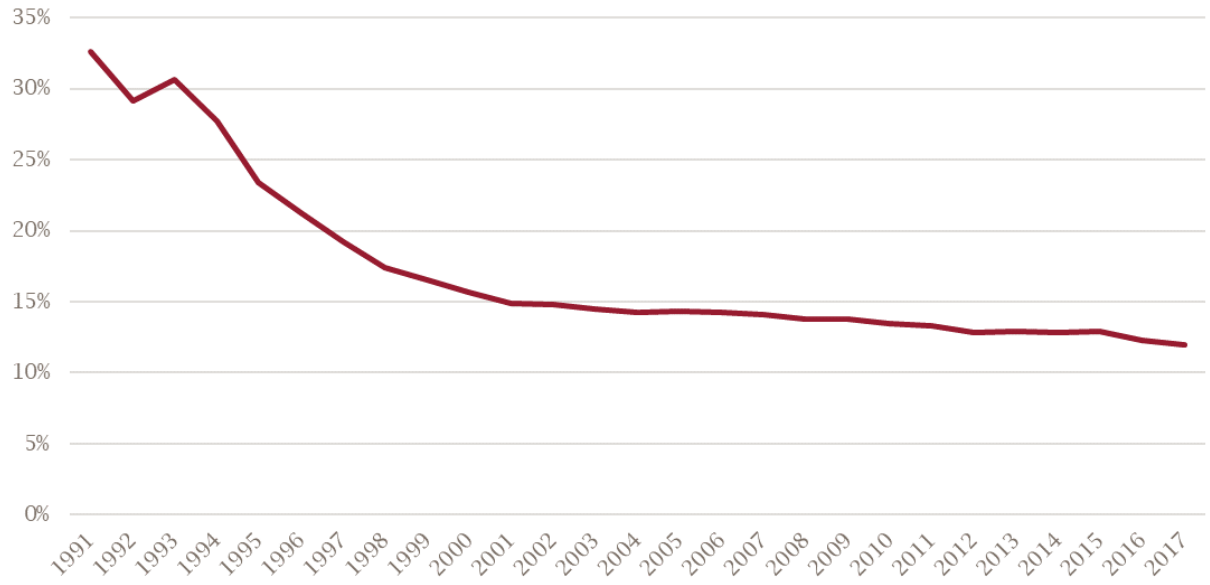
3.3 Is it in line with wider regulatory best practice?

The recent Government review and consultation on economic regulation has highlighted the importance of stability in the regulatory regime to support long-term investment. This is more important than ever as the water sector moves to address risks such as climate uncertainty, new environmental regulation, and net zero. Lowering the notional gearing rate without compelling evidence of the need to do so will reduce investor confidence and undermine Ofwat's original intentions to support investment in the face of greater uncertainty and is inconsistent with Ofwat's duties.

Ofwat states that the notional gearing rate has varied with each price control from PR99 onwards and has fluctuated within the 50% - 62.5%. This is used as evidence to argue that a change of up to 5% would not be unprecedented. We do not agree that comparisons of notional gearing decision over time are meaningful in this context. Notional gearing levels at any one point in time need to be taken in the context of the wider financial and regulatory environment which has changed significantly since PR99. Over this period of time the scale of the regulatory asset base (RCV) has increased materially compared to the size of the companies' operations. This means that the companies are better able to absorb many of the cost and operational risks at a higher level of gearing than previously.

This is illustrated in Figure 10 which shows that annual operating and capital costs as a percentage of RCVs have fallen over time, demonstrating a change overall risk profiles. This means that relying on historical gearing rates alone is not sufficient to argue a change today is precedented, particularly as Ofwat has presented no empirical data to justify moving away from 60%.

Figure 10 Annual costs as a % of RCV



Source: Frontier Economics

3.4 Impact of a reduction of notional gearing

We have shown that there is no compelling empirical evidence to justify reducing the current notional gearing level of 60%. We now consider the impact on companies and consumers of such a reduction. .

While companies are free to set their actual capital structures, changes in the notional gearing level will affect actual company decisions over time. Ofwat recognises this in its draft methodology and uses the notional gearing to 'signal to companies changes in the level of risk which companies may need to consider in their actual capital structures'.[43] If these changes means companies adjust actual capital structures away from the efficient level observed in the market, this could lead to several adverse impacts on companies and consumers.

As we discuss in section 2 the choice of gearing level impacts several factors including the pre-tax WACC, behavioural factors, external factors, and societal costs and benefits. Distorting actual gearing from the optimal level risks negatively impacting some or all of these factors. For example, if companies lower actual gearing rates, this could push up the WACC (assuming that companies are already at or below the optimal gearing from a WACC perspective) and undermine the ability of companies to invest for the future. This would result in significant consumer harm.

We note that this was a key consideration in the redetermination appeals following PR19 where the CMA concluded that: [44]

[43] Ofwat (2022) Appendix 10 Aligning risk and return

[44] CMA; Anglian Water Services Limited, Bristol Water plc, Northumbrian Water Limited and Yorkshire Water Services Limited price determinations, Final report, March 2021,

> *"The effects on customers if there is an actual reduction in investment over time are likely to be higher, because investment can bring additional wider benefits."*

It therefore accounted for the need to promote investment and address the risk of exist of capital from the sector when choosing a point estimate for the cost of equity. A similar line of reasoning applies to the notional gearing level. If Ofwat sets its point estimate for the notional gearing level outside the reasonable range this could risk underinvestment at a key time for the industry.

Additionally, a lower gearing rate could soften the discipline imposed on management or regulators to make the appropriate decisions in relation to risk and long-term planning. It could also lead to a shift away from the optimal mix of financing. If lower notional gearing rates pressure companies into reducing actual gearing rates, this will increase reliance on equity financing compared to the mix of financing that had been determined by the market. This impact would be exacerbated during a period of investment and RCV growth. Capital markets are deep and may well be able to absorb this with minimal impact. Nevertheless, this factor should be part of any impact assessment.

Finally, reducing actual gearing is not costless even if there are no issues in terms of access to capital. Historically regulators have allowed 5% for equity issuance costs (RIIO-2[45], ED2[46], and PR09)[47]. However, these only focus on direct costs, so are likely to be an underestimate of the full cost of issuing equity, since carry costs have not been considered. This is an additional cost for consumers that would need to be set against the benefits, if any, of the gearing reduction.

[45] Ofgem (2021) RIIO-2 Final Determinations – Finance Annex (REVISED)

[46] Ofgem (2022). RIIO-ED2 Draft Determinations – Finance Annex. Para 10.86

[47] Ofwat (2021) PR24 and beyond: Discussion paper on risk and return

4 Conclusion

Ofwat has not provided any evidence to support its proposals to reduce the notional gearing level nor has it carried out analysis to understand whether notional gearing is the right tool and the net impact any reduction will have on consumers.

The assessment of notional gearing is closely related to Ofwat's statutory financing duty (and is also likely to impact on both the customer objective duty and the resilience duty). It is well established that carrying out the financeability assessment on notional gearing is consistent with regulatory principles, and that actual capital structure decisions are a matter for a company and its investors. Therefore Ofwat's assessment of notional gearing should be assessed on an independent an objective basis. Adjusting the notional gearing level away from this objective level in order to address financeability issues would not be consistent with satisfying the financing duty.

We have set out the conceptual framework for assessing the optimal range for notional gearing. We first establish that the relevant metric for assessing notional gearing is the regulatory gearing level rather than gearing metrics based on EV. Company cashflows are determined by their RCV not their EV and therefore regulatory gearing is the relevant metric. This is reinforced by credit rating agency criteria which all refer to the proportion of net debt to the RCV in their credit rating methodologies.

We then conclude that the best way of implementing this conceptual framework is to draw on the available market data and empirical evidence to estimate the reasonable range of notional gearing and review the current notional gearing level in this context.

Ofwat recognises the need for market evidence in its own notional gearing framework which requires the notional gearing level to take into account a range of appropriate benchmarks and evidence. However, its proposals are not consistent with its own framework.

Figure 11 Assessment against Ofwat notional gearing framework

OFWAT REQUIREMENT	EVIDENCE	
Incentivises efficient financing choices given the balance of risk faced by water companies	✗	The most recent credit rating criteria for regulated utilities have not increased the target gearing range for any given credit rating, even in the face of greater uncertainty. This suggests the market considers the equity buffer at 60% gearing to be sufficient to address supply-side or demand-side shocks.
Reflects the scale and nature of investment needs	✗	We agree that companies are likely to face greater investment needs in the future to address challenges of climate change, environmental standards, and other pressures. However, there is no evidence to suggest that companies are unable to borrow efficiently at the current level of notional gearing. In fact, recent large projects such as the Thames Tideway Tunnel are highly geared and achieved a low cost of capital by doing so.

OFWAT REQUIREMENT	EVIDENCE
Takes account of a range of appropriate benchmarks and evidence	✗ We have not found any empirical evidence from either actual gearing levels, credit rating agency criteria, or regulatory precedent to suggest the notional gearing level should fall below 60%.
Allows the regulator to set a price control that is in the best interest of current and future customers	✗ From a theoretical standpoint the gearing level that is optimal for society could be higher or lower than the private optimal level. However, this is extremely complex to assess and Ofwat has not provided any evidence to demonstrate that the social optimal is lower. Adjusting the notional gearing level in a way that could undermine investor confidence or make it more difficult for companies to invest in the long-term is not in the best interest of current and future customers.

Source: Frontier Economics

We have assessed Ofwat's proposals against our own recommended approach for assessing notional gearing in practice which considers four questions:

- What is the market evidence on gearing? Is there a case to set notional gearing at a different level?
- Is notional gearing the best tool to provide additional headroom for risk?
- Is the treatment of notional gearing in line with regulatory best practice?

We conclude the answer to each of these questions is no. The review of market evidence consistently shows that the current notional gearing level of 60% already lies at the lower bound of the reasonable range for gearing. In fact, credit rating agency criteria suggests the lower bound of the reasonable range lies at 65% and the majority of water companies have gearing levels well above 60% while maintaining an investment grade credit rating.

Furthermore, Ofwat have not shared any analysis to show that it has considered financeability in the round and that adjusting the notional gearing level is the best option for providing greater headroom. Other regulators have chosen other solutions to address uncertainties associated with climate change, for example via re-opener mechanisms or specific allowances. Its approach to notional gearing is inconsistent with its preferred approach to address asymmetric risk at its source.

We also observe a wider point on consistency across PR24. Ofwat emphasises the need to rely only on market data for other aspects of cost of capital including its beta analysis. At the same time it has not relied on any market data to justify its proposals for notional gearing. Ofwat should adopt a consistent and evidence based approach to its cost of capital proposals.

We conclude that Ofwat's proposed reduction in notional gearing is neither consistent with its own notional gearing framework nor with our framework for estimating national gearing in practice. A review of market evidence shows the current notional gearing level of 60% already lies at the bottom of the reasonable range. There is no evidence to justify reducing it below current levels.

A4 Use of Market-to-asset ratios (MARs) – report by KPMG

Use of Market-to-asset ratios (MARs) as a cross-check in the context of regulatory price controls

Report for Water UK

September 2022

Contents

Glossary

AER	Australian Energy Regulator
AMP	Asset Management Plan
CAPM	Capital Asset Pricing Model
CMA	Competition and Markets Authority
CoD	Cost of Debt
CoE	Cost of Equity
DCF	Discounted Cash Flow
DNO	Distribution Network Operator
EV	Enterprise Value
GDN	Gas Distribution Network
IMH	Inelastic Market Hypothesis
MAR	Market-to-Asset Ratio
MFM	Multi-Factor Model
NPV	Net Present Value
ODI	Output delivery incentive
Ofgem	Office of Gas and Electricity Markets
PAYG	Pay As You Go
PR	Price Review
RCV	Regulatory Capital Value
RoRE	Return on Regulated Equity
SVT	Severn Trent
TV	Terminal Value
UKRN	UK Regulators Network
UU	United Utilities
WaSC	Water and Sewerage Company
WoC	Water only Company

Important notice

This Report has been prepared by KPMG LLP ('KPMG', 'we' or 'our') for Water UK on the basis of an engagement contract between Water UK and KPMG (the "Engagement Contract"). Water UK commissioned the work to assist Water UK in its considerations regarding Ofwat's Draft Methodology Consultation for the Price Review 2024 (PR24). The agreed scope of work is set out in Section 1.1 of this Report. Water UK should note that our findings do not constitute recommendations as to whether or not Water UK should proceed with any particular course of action.

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Executive summary

Context and objectives

In July 2022, Ofwat published its Draft Methodology for the 2024 price reviews, which sets out how Ofwat will determine the allowed revenues for water companies from 2025 to 2030. Ofwat proposed to rely on Market to Asset Ratios (MARs) as the main cross-check in determining its allowed cost of equity. Ofwat stated that it considers MARs to be important, given the readily available share price for some water companies and some data available on the pricing of equity stakes in private transactions of regulated water companies.

KPMG has been commissioned by Water UK to review and explore the use of MARs as a cross-check on the cost of equity in the context of regulatory price controls, to help inform Water UK's consultation response to the draft methodology. This Report investigated the appropriateness of using MARs to inform the allowed rate of return and in particular:

- examined MARs by reference to the first principles, compared them to other potential cross-checks against a set of criteria for good regulation;
- explored the extent to which MARs, as an indicator, meet the requirement for efficient pricing, particularly in reference to efficient market theory, to test if they could provide an unbiased and efficient estimator of the required return; and
- analysed market evidence on MARs and their characteristics in market data to assess the information embedded in MARs in practice.

Regulatory precedent

The use of MARs as a cross-check has been tested at recent regulatory determinations for water and energy industries in GB, by Ofwat, Ofgem and the CMA. There was also a parallel consideration of the issue by the Australian Energy Regulator in determining its rate of return instrument.

MARs have been considered by regulators as a tool to inform the allowed rate of return because they provide independent market information about the value of regulated companies, which, in turn, is assumed to be linked to companies' returns. MARs rely on the data that is often publicly available, and, in some instances, even time series data covering longer periods of time.

Despite these apparent features, the regulatory precedents involve many stakeholders, including academics, noting significant limitations of MARs and specific problems with using and interpreting this data to inform regulatory determinations of the allowed returns. In the circumstance when it is relied on, as a sense check, for regulatory determinations, it was associated with lacking precision, likely biases, and the risks of wrong interpretation based on unsupported hidden premises and assumptions. Still, some regulators argued that after controlling for various factors, there is still useful information that can be inferred from MARs.

In Australia, it was deemed inappropriate to use MARs to inform regulatory precedents due to the level of subjectivity and uncertainty in the assumptions used to disaggregate the observed ratios. MARs have also not been used deterministically to inform the cost of equity estimate by the CMA in the latest RIIO-2 determinations, but were recognised as one possible cross-check in a suite of others, albeit not one exclusively to rely on.

On the PR19 water re-determinations, the CMA emphasised problems with MARs and did not use them to estimate the required returns.

Criteria for cross-checks

A good, unbiased, precise and independent cross-check can be an effective tool in an economic regulator's toolkit to assist in the calibration of regulatory determinations. However, not all cross-checks are effective and robust. Therefore, there is a need to assess each cross check against a set of relevant criteria that can distinguish between them and inform a view on their strengths and effectiveness. This report provides a synthesis on MARs by assessing MARs against a clear set of criteria to conclude on that basis whether MARs can be relied upon to inform the estimates of the required returns for the sector.

In developing the cross-check criteria, a four-step process was followed to identify principles that could characterise a regulatory tool. The process reviewed the existing regulatory guidance such as the principles of good regulation,[1] the UK regulated networks' cost of capital principles,[2] the context and issues that regulators (CMA, Ofgem and Ofwat) have historically considered when using cross-checks in making their regulatory determinations and finally a step to consolidate and distinguish between principles that could characterise a regulatory tool versus ones that would describe how a regulator regulates.

Based on this process, a defensible cross-check would be transparent, targeted, objective, incentive compatible, and consistent with regulatory precedent and academic literature.

It is important to acknowledge that any cross-check is subject to limitations, and it is unlikely that a single cross-check would perfectly satisfy all five elements of the criteria. The criteria are intended to guide the assessment and ensure that a given cross-check is as robust and effective as possible. The criteria developed in this Report are then used to assess MARs and other cross-checks.

The use of MARs

For water price control determinations, the use of MARs has been explored in PR14,[3] PR19[4] and now in PR24[5] to test the estimate for the cost of equity. While MARs are a market-based measure of the expected cashflows of the firm versus its regulatory capital value, which is largely driven by investors' expectations, this Report explores whether a MAR that is above or at 1 can be relied upon deterministically or with some level of precision and confidence to decide on a lower or higher allowed cost of equity sector-wide.

We consider the robustness of MARs from a top-down perspective, being informed by academic research and empirical evidence. This view is later supplemented with the detailed bottom-up quantitative analysis.

For MAR to be 1, the enterprise value for a regulated network must reflect the present discounted value of the allowed cashflow and the allowed rate of return must be equal to an investors' assumed cost of capital. If it is assumed that a business's operational performance (totex and output delivery incentives), economic conditions and finance assumptions will be precisely consistent with the current and future regulatory regime and allowances over the valuation period, then the market value of the business will be equal to the RCV, which results in a MAR of 1 and neutral NPV.[6] However, in practice, these assumptions are not plausible and do not hold, particularly in the context of incentive-based regulation, where

[1] Better Regulation Task Force, Principles of Good Regulation available here. Ofwat must have regard to these principles according to the Water Industry Act 1991 Section (2)
[2] UKRN, Cost of capital and price controls. See here.
[3] CMA, PR14 Bristol Water – Final decision, p.336.
[4] CMA, PR24 Anglian Water Services, Bristol Water plc, Northumbrian Water Limited and Yorkshire Water Services Limited price determination – Final report, p.1087.
[5] Ofwat, PR24 Draft methodology – allowed return on capital – Appendix 11, July 2022, p.24.
[6] Oxera, 'Do market-to-asset ratios provide reliable evidence on the cost of capital? Note prepared for gas distribution networks', 2007.

companies are incentivised to outperform on the regulatory allowance for the benefit of consumers.

All factors that might affect the market price or the enterprise value—and assumed performance scenarios for these factors—are estimated with uncertainty in future periods. This means that isolating the contribution, or 'peeling away' from assumed outperformance on the allowed cost of equity is inherently difficult and needs to be interpreted with caution.

Market efficiency is also an important consideration in terms of the robustness and reliability of the pricing signals embedded in traded and transactions-based MARs. In markets that are not fully efficient, selective observed price signals often do not reflect a fair market value of assets (single market price), and so cannot be relied upon to inform estimates of such prices.

Transactions of non-listed companies are very infrequent and suffer from a significant selection bias as to when they occur, and which assets are traded. They do not reflect the true underlying market price that would be revealed from continuous, efficient and liquid market, as opportunities arise on a sporadic bespoke basis at isolated points in time carefully chosen by the sellers, which results in a significant selection bias. The ability of private transactions' MARs data to explain the fundamentals of a particular asset, including the regulatory price control parameters determining its cash flows, not to mention informing specifically a single input parameter, is therefore significantly compromised.

Empirical and academic evidence suggests that public stock markets are much more efficient than the private markets, but still exhibit varying degree of inefficiencies due to supply-demand imbalances, exposure to economic and market cycles, low demand elasticity and behavioural biases. It is near-impossible to determine to which extent the stock price at a particular point in time is affected by these factors. Drawing conclusions from traded MARs about an investor-assumed discount rate is not sufficiently robust without appropriate adjustments that ensure that MAR reflects only the fundamental value drivers.

Given that there are many factors that could influence MARs, several of which are very difficult to measure (such as management quality, behavioural biases), it is not possible objectively to strip out the effects of all these other drivers and isolate the implied cost of equity with any degree of precision. This is consistent with the academic literature, which notes that market prices, or the enterprise value, of firms are endogenous and are affected by many factors that make it difficult to find a relation between valuations and transactions.[7]

The complexity increases further, when observing private transaction MARs, as there are additional factors that are likely to influence the MAR values in such transactions. These factors include the dynamics of a private auction set up and including winners' curse, implications of private value, management biases, and control premia and capturing a non-representative one-time snapshot that is affected by the economic situation of the specific time chosen for the transaction. In addition, private transactions could be highly confidential, and the information is not available in a timely and transparent manner.

All these factors create the complexity and uncertainty that ultimately undermines reliability of the approach based on peeling away all relevant drivers to isolate the impact of a single parameter (the allowed rate of return) on MARs.

Quantitative analysis

Quantitative analysis presented in this report considers whether, based on the bottom-up, stylised sensitivity analysis and actual MARs' data decomposition, it is possible to arrive at a single conclusion about a given input parameter (even if it is a range), or whether it can support multiple and diametrically opposite conclusions that can be derived from the same data, subject to assumptions about the underlying investor inputs including their required

[7] Habib and Ljungqvist, Firm value and managerial incentives: a stochastic frontier approach – Journal of Business, 2005.

return on equity. The bottom-up analytical approach numerically confirms the conclusions arrived at when exploring MAR challenges from a top-down perspective.

We examine, using a quantitative analysis, MARs from three perspectives: first, a sensitivity analysis of the enterprise value and MARs to the various regulatory parameters; second, a review of the drivers of recent transaction MARs, based on the publicly available data; and finally, a view of equity analysts on the observed traded MARs, including their key drivers, based on the published broker reports.

To analyse the sensitivity of MARs to common regulatory and valuation assumptions, the report presents a sensitivity analysis that tests the impact of regulatory and valuation variables. This is aimed at understanding the scenarios that contribute to MAR being greater than 1, particularly when comparing the impact of investors' discount rate to other regulatory levers.

At a high level, the analysis concludes that it is possible to have MAR above 1 even if the discount rate exceeds the allowed cost of equity, with other variables contributing to the upward valuation. The analysis also shows that it is not possible to estimate the impact that changes in the discount rate make on MAR with any degree of accuracy, unless there is certainty about all the other assumptions related to operational and valuation assumptions over the valuation period.

Considering private transactions, it is observed that they generally exhibit significant premia to RCV, largely through the bidder-specific prices for a given asset. It is noticeable that the implied MARs from private transactions are mostly higher than the traded companies' MARs. This supports the conclusion that various factors affecting private transactions mentioned above (selection bias, timing, private value, auction design, etc.) have a significant impact on prices.

The review of analysts' sum-of-the-parts valuations on the traded water companies, Severn Trent Group (SVT) and United Utilities (UU), since March 2021 shows a wide range of assumptions about the contribution to each company's total enterprise value from different sources, including an estimated premium to RCV, the non-regulated and retail businesses, and any pension surplus or deficit. Decomposing the average observed MAR with the range of these components indicates that the underlying regulatory MAR varies from 0.88 to 1.30 for SVT and from 0.74 to 1.18 for UU.

This broad range of values provides uncertainty as to the consistency and repeatability of the underlying assumptions that are used to derive the RCV premium. There are also broad ranges for the component parts. For example, a consolidation of analysts' report derives a range of 1.01 to 1.11 and 1.00 to 1.10 for the impact of non-regulated businesses on MAR for SVT and UU respectively. This indicates that there is neither a consistent view about the total value and therefore the implied MARs that can be used as a starting point, nor are there consistent views about the decomposition of the observed MARs into constituent value drivers.

Evaluation of MARs and other cross-checks against the established criteria

Based on this information and analysis, the use of MARs as a regulatory cross-check for the allowed return on equity has been assessed against the five criteria identified above:

- **Transparent**, whether the approach uses widely observed information, which gives replicable results. On this basis, as while the input information to derive traded MARs is generally available, that for transactions MARs is not (especially in the case of private companies), it appears that MARs only **partially** fulfil the criterion of transparency.
- **Targeted**, whether the indicator can accurately isolate the desired effect from other factors. The target of the cross-check in this instance is to assess and provide a

measure of whether the allowed return on equity is sufficient, but not excessive. However, there are many unknowns in the determination of a company's value, and the calculated MAR cannot be solely attributed to a difference in investors' assumed return of equity from the allowed return, suggesting that MARs **do not** meet this criterion.

- **Objective**, whether the cross-check can be relied upon as an unbiased indicator. Transaction MARs are by their nature biased towards the winning bidder's aims, assumptions, and strategic advantages. Traded MARs (when taken in aggregate rather than one individual assessment) do reflect a much broader set of market expectations and assumptions for the company and could thus be considered to having a wider, more informed view of the various valuation assumptions. In this regard it would suggest that MARs do **partially** meet this criterion.
- **Incentive compatible**, whether the indicator could distort regulatory incentives. The application of MARs by the regulator to revise the allowed cost of equity (whether up or down) could cause regulated companies to behave in ways which were not intended and not in the best interests of consumers. Specifically, if it was feared that any outperformance – whether in totex, ODIs, or financing – which pushed the company's MAR above 1 would subsequently result in a further reduction in the allowed cost of equity, this could further dampen incentives for improved performance as companies may fear that any rewards gained during a price control will be clawed back in part at the next price control through a reduced cost of equity. This potential ratchet effect would tend to suggest that MARs are **not** incentive compatible as a cross-check.
- **Consistent**, whether the indicator is consistent with established regulatory precedent and academic research. MARs have been adopted and accepted as a cross-check on a varying basis over time by regulatory authorities, however only as one of a broad suite of other cross-checks. Academic literature and research has been generally clear that MAR cannot be used to observe cost of equity without controlling for other factors which influence companies' values. On this basis, while MARs have been occasionally used by regulators as a cross-check among other indicators, the academic dismissal of them as a basis for the cost of equity would suggest that they **partially** meet the consistency standard.

A comparison of MARs against other potential cross-checks for the cost of equity, specifically multi-factor models (MFMs), financeability tests (as conducted by the CMA), hedge ratios and quantification of risk exposure, has also been undertaken. This has been carried out at a high-level to provide an indication of whether there are other cross-checks that might be more appropriate than MARs.

In general, the assessment suggests that there are better options than MARs for use as cross-checks on the allowed cost of equity in regulatory price control determinations. There is a risk that if MARs are used to inform the allowed cost of equity, mainly based on the most recent private transactions or from listed utilities in GB, this may be incentive incompatible and may result in an estimate of the required rate of return on equity that is biased.

Overall, the analysis presented in this Report leads to the conclusion that the use of MAR as a cross-check is unlikely to assist regulators in determining an allowed cost of equity estimate in an unbiased and efficient way, one that facilitates investments, while furthering consumers' interests.

1 Context

In July 2022, Ofwat published its Draft Methodology for the 2024 price control reviews (PR24).[8] The Draft Methodology sets out Ofwat's proposal for how it will set the allowed revenues for water companies from April 2025 to March 2030.

As per previous price reviews, Ofwat has indicated that it will use the Capital Asset Pricing Model (CAPM) to derive a cost of equity estimate. Ofwat has now also indicated that it may consider Market-to-Asset Ratio (MAR) ratios reported in the market as a cross-check in deriving the allowed cost of equity. This must concern MARs as reported in the media because MARs on many transactions are either not in public domain or not possible to verify.

Ofwat has stated that is considers MARs to be an important cross check, given share prices available for some water companies and (some) information available on the pricing of equity stakes in private transactions of regulated water companies.[9]

MAR is the ratio of the enterprise value (EV) of a company to its regulatory capital value (RCV). The EV can be derived from the observed share price or from the value of the transaction if and when reported in the media or otherwise revealed. MAR is effectively a special form of the market-to-book ratio, which is used in corporate finance as one valuation metric.

For PR24, Ofwat proposes to use MAR analysis as evidence that could support an adjustment to the CAPM-derived mid-point estimate of the allowed return on equity. Ofwat notes that there should be a high evidential bar to move away from the mid-point estimate. As part of its methodology consultation, Ofwat's Q7.4 requests stakeholders to respond whether they agree with the proposed approach in setting allowed return on equity.[10]

1.1 Scope

KPMG has been commissioned by Water UK to assess the potential suitability of MARs as a cross-check on the allowed rate of return in the context of regulatory price controls, to inform Water UK's response to the draft methodology. This report examines:

- the level of consistency between the theoretical model and the real-world valuation of assets, which includes an exploration of why MAR may vary from 1;
- the advantages and challenges of drawing inferences from MAR, based on general theory and specifically from occasional private transactions and share prices; and
- a quantitative analysis, which explores the extent to which the allowed rate of return can be linked to MARs given different contributors to MARs for listed entities and in private transactions.

1.2 Structure of this report

This report is structured as follows:

- **Section 1** sets out the context, scope and precedent surrounding the use of MARs in regulatory determination.

[8] The Draft Methodology is out for consultation with a closing date of 7th September. See https://www.ofwat.gov.uk/consultation/creating-tomorrow-together-consulting-on-our-methodology-for-pr24/.
[9] Ofwat, PR24 - draft methodology – allowed return on capital – Appendix 11, July 2022, p.24.
[10] Ofwat, PR24 - draft methodology – response template, July 2022.

- **Section 2** identifies criteria that could be used to assess suitability of cross-checks for determining the allowed rate of return.
- **Section 3** explores whether MAR could be used to inform the allowed rate of return, how this relationship is reflected in the economic theory and in the real world. This section draws on academic literature review and considers also various consultants' reports on the matter.
- **Section 4** quantifies the potential determinants of MAR values as a result of the considerations identified previously. This section presents the results of a stylised sensitivity analysis which tests the impact of different regulatory and valuation assumptions, including equity discount rate, on the modelled MAR for a hypothetical water company. In addition, it considers two listed water companies' traded MARs and the range of analyst reports' views on the various value contributions (such as the impact on non-regulated business, retail premium, etc) on the observed MAR values, and some recent transaction MARs in the regulated utilities sector.
- **Section 5** concludes the report by assessing MAR against the cross-check criteria from Section 2. This section also considers how MAR compares to other cross-checks.

1.3 Regulatory precedent

It is commonplace for economic regulators, in the UK and internationally, to rely on various sources of evidence to support and test the reasonableness of their modelling and the associated forecasts in making their regulatory price determinations. The use of a cross-check as supporting evidence on the bottom up derivation of the cost of capital estimate can sometimes provide further confidence that an estimated variable is reasonable and reflects updated and relevant information; equally it could introduce a bias and result in wrong estimates.

The use of MARs as a cross-check has been explored and tested at recent regulatory determinations for water and energy industries in GB. Similarly, there was a parallel consideration of the issue by the Australian Energy Regulator (AER) in determining its 2018 binding rate of return instrument for gas and electricity regulated networks.[11]

This section sets out the regulatory precedents of the use of MARs in the price setting process.

RIIO-2 methodology consultation

For the RIIO-2 sector specific methodology consultation in 2018, Ofgem noted that it exercised some caution when considering MARs. First, as there may have been limited information in listed share prices as these stocks could have, particularly in the short run, been influenced heavily by wider market "noise". Second, as noted in the UKRN Study, any premium on corporate transactions could, at least in part, reflect (i) a control premium; or (ii) a winner's curse.[12]

RIIO-2 final determinations

For the RIIO-2 final decision for transmission and gas distribution, Ofgem considered MAR to be a strong piece of evidence, when having regard to trading premiums for UU, SVT, National Grid (NG) and SSE. Ofgem inferred that based on the traded MARs either the actual cost of equity was below estimates and/or there was an expectation that companies

[11] AER, Rate of return guidelines – explanatory statement, July 2018. Please note that MARs are referred to as regulatory asset base (RAB) multiples in Australia.
[12] Wright, Burns, Mason and Pickford (2018), Estimating the cost of capital for implementation of price controls by UK Regulators (CGL1/C/22), page 13.

would outperform. It re-iterated that cross-checks should be applied carefully and weighted appropriately but disagreed that no weight can be placed on them at all.[13] Ofgem's MAR cross-check, alongside other cross-checks, supported an estimate for the cost of equity below the mid-point estimate. Despite this, Ofgem decided to allow a cost of equity above the mid-point but stated that the cross-checks provided it with confidence that its estimates were appropriate.

CMA appeals on RIIO-2 final determinations

As part of the appeals regime for energy, which is merit-based and different to the water industry, several regulated networks[14] highlighted incorrect inferences from Ofgem's use of MAR, such as that a MAR greater than 1 did not imply necessarily that the allowed rate of return was above the company's cost of capital.[15] Ofgem opined that MARs were not perfect but could provide a powerful directional cross-check. It added that the reliance on a range of cross-checks was something that the CMA was unable to do for PR19 redetermination, given the information at the time.

The CMA concluded that Ofgem was not wrong to use MAR as a cross-check for its cost of equity estimate. The CMA recognised various problems with making inferences from MARs for the allowed rate of return but agreed that Ofgem's cross-check indicated that Ofgem's allowed return on equity was not too low.[16]

Australian rate of return determination

In Australia, as part of the development of the binding rate of return instrument in 2018, the AER considered and consulted on the use of MARs (also referred to as RAB multiples) as a cross-check for its allowed rate of return.[17] This included the consideration of input from expert evidence, consumer groups, Energy Networks Australia and regulated networks.

The AER decided not to rely on MARs, given the level of subjectivity and uncertainty in the assumptions used to disaggregate observed ratios. It concluded that it was not appropriate to inform its rate of return forecast. The AER deduced that there was a need to control for many factors, including any interaction between them, such as outperformance of expenditure, unregulated revenue, control premium, possible over-optimism of assumptions and the economic circumstances at the time of the transaction.[18]

UK Regulators Network (UKRN) cost of equity study

As part of the UKRN cost of equity study in 2018,[19] Phil Burns undertook a MAR analysis (also referred to as bid premia) on the contemporaneous energy network transactions. He cited several factors that could contribute to the observed premium including outperformance on costs, outputs, cost of debt, financial restructuring, tax arbitrage[20] as well as cost of equity outperformance. Burns also noted that premia may result from unobserved investor assumptions that may be considered unrealistic or optimistic but are nevertheless the reality behind the premia. Burns concluded that:

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[13] Ofgem, RIIO-2 Final determinations – Finance Annex, 3 February 2021, page 54.
[14] Cadent Gas Limited, National Grid Electricity Transmission plc, National Grid Gas plc, Northern Gas Networks Limited, Scottish Hydro Electric Transmission plc, Southern Gas Networks plc and Scotland Gas Networks plc, SP Transmission plc, Wales and West Utilities Limited.
[15] CMA, Final determination – Volume 2A: Joined Grounds: Cost of Equity, 28th October 2021, page 203.
[16] CMA, Final determination – Volume 2A: Joined Grounds: Cost of Equity, 28th October 2021, page 222
[17] AER, Rate of return guidelines – explanatory statement, July 2018.
[18] Ibid.
[19] Wright, Burns, Mason and Pickford (2018), Estimating the cost of capital for implementation of price controls by UK Regulators (CGL1/C/22), specifically Appendix J.
[20] Burns noted that Evidence from MARs for quoted pure-play utilities are generally not subject to the issues of control premium and winner's curse, though there remains the challenge of understanding the unobserved investor assumptions.

"fundamentally, the analysis highlights the challenges that arise in seeking to use transaction premia evidence to make inferences about the cost of equity…Overall, evidence from transaction premia is less reliable and much harder to interpret than other sources of evidence on the cost of equity." [emphasis added]

In the same UKRN study and in the context of relying on CAPM-WACC to determine the regulated return, Wright et al argue that even though regulated companies have achieved efficiency gains, for consumers' benefits, the magnitude of the observed premia suggests that the market assess the returns to not be commensurate with the risks. They note that the market likely expects this situation to persist into the future.

PR19

For PR19, Ofwat's draft methodology indicated that market expectations about equity returns could be drawn from MARs.[21] Ofwat pointed to evidence from listed companies (UU and SVT) to say that trading premia are not explained by outperformance alone. The analysis was support by a PwC report.[22] In the PR19 final determination, Ofwat used MAR evidence (c.15% premium over RCV for UU and SVT) to indicate that the package (including the rate of return) is stretching but achievable.

Ofwat indicated that MARs indicate outperformance potential for companies, both for the top performers and their peers. [23] This was subject to a CMA redetermination, as part of the appeals regime. This is the last relevant regulatory precedent for water companies. The CMA did not give MAR analysis weight in coming to a final view on the point estimate for the cost of capital noting that it remained "cautious about using market prices to determine the point estimate for the cost of equity or overall cost of capital".[24]

The CMA highlighted the difficulties in correctly interpreting MAR data and has acknowledged that there is a wide range of reasons why prices may rise and fall over time.[25] The CMA referenced Europe Economics' analysis, which estimated a MAR premium of 2 per cent for United Utilities and 18 per cent for Severn Trent, the wide range raised doubt as to whether that premia alone implies that the allowed cost of equity should be higher or lower than determined. In addition, the CMA also noted concerns with relying on methodologies that consider outperformance over one or two price control periods rather than long-term cashflow of a water company.

On balance, the CMA concluded that MARs did not present sufficient evidence of the WACC estimate's appropriateness for the entire water sector.

PR14

For PR14, the CMA considered MARs as a potential crosscheck in its re-determination for Bristol Water. The CMA stated that "[in] principle, the market prices of asset transactions relative to the regulatory asset value (either M&A activity or traded share prices) can also provide an indication of the value of the cost of capital as a whole, and in particular whether the cost of equity appears to be consistent with observed market".[26]

However, the CMA noted that in considering MARs, there are a number of assumptions that are required, the largest of which are: (a) investor assumptions on future trends in the cost of capital beyond the current review; (b) investor assumptions on the potential for outperformance on other aspects of the regulatory framework; and (c) implied values for

[21] Ofwat, PR19 Draft methodology, Appendix 10, page 15.
[22] PwC report on refining the balance of incentives for PR19, page 87.
[23] Ofwat, PR19 final determination – allowed return on capital – technical appendix, p.27.
[24] CMA (2021), PR19 Final Report (CGL2/7), para. 9.1358
[25] CMA (2021), PR19 Choosing a point estimate for the Cost of Capital – Working Paper (CGL1/C/36), para.90)
[26] CMA, Bristol Water plc – A reference under section 12(3)(a) of the Water Industry Act 1991 – report, 6th October 2015, para 10.201.

other parts of the business, where the traded shares include both unregulated and regulated businesses.

The CMA noted that there are a number of reasons why investors may value assets at figures greater than that implied by the RCV and did not use MARs to make any explicit adjustment to its estimates for the allowed cost of equity. However, the CMA did state that it received some comfort from the fact that the ratios it considered indicated that the allowed cost of capital for Bristol Water was consistent with its statutory duties.

Summary

Based on the regulatory precedents, some regulators have tried to use MARs as one of a range of overall cross-checks, despite many stakeholders highlighting problems with this approach, noting their limitations, and general recognition that any conclusions drawn must be treated with caution and careful consideration.

It appears that all parties recognise MARs' limitations in informing the allowed rate of return. This includes lack of transparency as all the data required to draw such inferences is almost never available; subjectivity, as it is affected by other factors such as control premium or unregulated businesses; the uncertainty in the assumptions used to disaggregate observed ratios; the difficulty in interpreting the observed values; potential presence of optimistic or unrealistic investors' assumptions or 'noise' that could not be observed and finally its degree of reliability. At the same time there is certain apparent appeal of MARs as direct market evidence that regulators are keen to explore.

Regulators have used MARs on occasions to respond to criticisms that the allowed rates of return they set are too low. In the regulatory precedent, MARs have not been used deterministically to inform the cost of equity estimate and the analysis of precedents indicates that, when MAR as a cross-check was used, it was always heavily criticised by at least some stakeholders and was used as a part of a cross-check suite rather than on its own.

Overall, contrary to other methods such as CAPM, precedents indicate that there is no consensus on either the use of MARs to inform the allowed rate of return, or the method that should be employed in such an analysis.

2 Criteria for evidence to inform setting of allowed rate of return

One of the common objectives of public utility regulation is to ensure that investors are sufficiently remunerated, but not more than necessary, for the funds they provide to a regulated firm.[27] This ensures that investors have adequate incentives to invest in regulated public utilities, but consumers are not paying more than required for the services they receive.

Regulators rely on a range of cross-checks to come to their view of elements that make up regulated companies' allowed rate of return, as a way to test the robustness of their estimates. For example, Ofgem used the Modigliani-Miller cost of equity inference and MARs to support its cost of equity estimates in the RIIO-2 determinations for gas distribution and gas and electricity transmission networks.[28] Other forms of cross-checks, which were used to sense check cost of debt, include relying on alternative forecasting approaches, such as the use of a bottom-up approach (balance sheet approach) to test a top-down approach (benchmark index approach).[29]

Cross-checks can be an effective tool in an economic regulator's toolkit to assist in the calibration of regulatory determinations. However, not all crosschecks are effective, accurate, or unbiased. Therefore, there is a need to develop a set of criteria that can distinguish and judge the reliability and effectiveness of different cross-checks.

The cross-check criteria can be developed to check if the evidence can be relied upon to support many estimates, including the cost of equity. The principles identified aim to be robust, defensible and in line with established economic regulatory framework. The process for developing the criteria used in this report was as follows:

First, we had regard to existing regulatory principles, particularly best practice guidance that is legislated in the current water economic regulation framework. The principles of good regulation, that are prescribed in legislation include the following: **proportionality**, **accountability**, **consistency**, **transparency** and **targeting**. [30] The essence of three of these principles is relevant for consideration of robustness and effectiveness of cost of capital cross-checks.

Second, we considered the principles that UKRN have regard to in determining the cost of capital, which are designed to ensure that regulators take an effective and efficient approach in setting the cost of capital in all their respective sectors. The cost of capital principles include **consistency** between regulators, being **risk reflective**, whereby the reward reflect the allocation of risk, relying on **evidence**, facilitating **investment** in the interest of consumers, being clear and transparent in **communication** and **review** the principles and approaches regularly so that they are in line with **good practice.**[31]

Third, recent regulatory determinations were reviewed, such as decisions by Ofwat, Ofgem and the CMA, to infer how cross-checks were used, the intent and the context surrounding their use. The review provided guidance on the current issues, including contention surrounding their use and the resulting outcomes. For example, in the CMA's RIIO-2 final decision on the cost of equity, concerns around cross-checks related to lack of transparency,

[27] This is in reference to the financing duty of Ofwat. Water Industry Act 1991 Section 2.
[28] CMA, Final determination: Volume 2A: Joined Grounds: Cost of equity, October 2021.
[29] Ofwat, PR19 final determinations – Allowed return on capital technical appendix, December 2019.
[30] Better Regulation Task Force, Principles of Good Regulation available here. Ofwat must have regard to these principles according to the Water Industry Act 1991 Section (2)
[31] UKRN, Cost of capital and price controls. See here.

their interdependence on the variable they are intended to assess or their inconsistency with regulatory precedent.[32] Relying on recent regulatory determinations means that the criteria is contemporaneous and is in line with regulatory best practice.

Fourth, a cross-check is a regulatory tool that would support the mechanism that discharges regulators' financing and consumer duties. The focus was to consolidate and identify the principles that would characterise a regulatory tool rather than what would describe the manner with which a regulator regulates (i.e., the principles of proportionality and accountability were deemed to be more pertinent to the regulator's approach to economic regulation rather than a regulatory tool criterion).

Based on the four-step process above, the developed set of criteria below is objective and can be used to evaluate cross-checks in any upcoming price control review. The test used is whether a given cross-check would be:

- **Transparent** in that it would use information that can be widely observed and verified, and the results can be replicated consistently, including its approach and calculation methodology. For a cross-check to be transparent, any of the underlying calculations and mechanics need to be traceable, verifiable and the variation in outcomes (if any) explainable by reference to plausible and defensible assumptions. Transparency is an important element of the criteria as it ensures that all parties understand how any given assumptions influence a cross-check, which is in line with clear and transparent regulatory determinations.
- **Targeted**, which is the extent to which the indicator can isolate the effect in question from other factors and can therefore give accurate results. It would mean that there is limited to no doubt that the cross-check is assessing what is supposed to be assessed. Significant associated noise, surrounding the assessed variable, would render it difficult to distinguish between what is being measured and other non-relevant factors and would not be robust justification and evidence. In addition, it would provide an indication of accuracy, or how close the observed value is to the true value.
- **Objective** and can be relied on as an unbiased indicator. Objectivity ensures that the cross-check's underlying assumptions do not skew towards a specific pre-determined outcome and that there is a degree of independence between the cross-check and the variable that it is intended to assess.
- **Incentive compatible**, particularly whether it is compatible with regulatory objectives, one that facilitates investment in consumers' interests. Incentive based regulation is based on a series of carefully calibrated incentive mechanisms applied to costs and service levels. All incentives are designed to provide an economic motivation for companies to apply additional effort where the cost of that effort is less than the benefit to consumers. This aligns incentives between consumers and network companies to promote overall welfare gains for both. An indicator that is likely to distort incentives, or one that is associated with a ratchet effect, [33] or discourage investments in infrastructure that consumers want is unlikely to be incentive compatible.
- **Consistent** with established regulatory precedent and academic research. Consistency as a principle is largely based on the principles of good regulation, cost

[32] For example, the use of nominal gilts as cross-check to estimate and the use of SONIA swap as a cross check for the RFR. See CMA, Final determination: Volume 2A: Joined Grounds: Cost of equity, October 2021

[33] Ratchet effect is a term that is used to describe the approach of using current performance as a partial basis for setting future targets, which creates a dynamic incentive problem for the enterprise. Martin L. Weitzman, The "ratchet principle" and performance incentives, the Bell Journal of Economics.

of capital principles and is an important consideration for investors, regulated entities, and regulators alike. It ensures that cross-checks would be used in a predictable way that provides certainty and stability to those who are regulated. It would also provide confidence that regulatory approaches are best practice, or in the case of new regulation that it considers international precedent if any.

The criteria set out above are used to evaluate MARs and also to compare them with other forms of cross-checks (such as multi-factor modelling and financeability) in Section 5 of this report.

Finally, it is important to acknowledge that any cross-check will be necessarily subject to limitations, and it is unlikely that a single cross-check could fully satisfy all five criteria. The criteria used are intended to guide the assessment and ensure that a given cross-check is sufficiently robust that it can be reasonably relied upon without the risk of introducing additional bias or noise to the estimates.

3 The use of MARs

This section assesses the potential suitability of MARs as a cross-check on the allowed cost of equity in the context of regulatory price controls. It sets out the determinants of MARs, based on theory and practice, and also considers economic fundamentals, such as market efficiency and the design of auctions and how these could affect the observed MAR values.

For water price control reviews, the use of MARs has been explored in PR14,[34] PR19[35] and now in PR24[36] to test the estimate for the cost of equity.[37] MARs have been considered by regulators as a tool to inform the allowed rate of return because they appear to provide independent market information about the value of regulated companies, which, in turn, must be linked to companies' returns. Some of their benefits include the reliance on data that is publicly available, and, in some instances, time series data covering longer periods of time. However, regulatory precedent has noted MAR's limitations, and suggested that conclusions are drawn with caution and careful consideration.

Therefore, this section explores whether a MAR that is above or at 1 could be actually relied upon deterministically to inform on a lower or higher cost of equity, having regard to the determinants of MAR and the relevant cross-check criteria.

3.1 Determinants of MAR

3.1.1 Theoretical framework of MAR

MARs are the ratios between the observed enterprise value (EV) of a company and its regulatory RCV. It is derived by having regard to standard corporate finance and the regulated companies' building block model. MARs could be deduced from either the outcome of singular private transactions (**transaction MARs**) or based on utilities that are listed stocks, which is subject to continuous trading by multiple market participants (**traded MARs**).

Standard corporate finance theory – Equation 1

One of the common ways of valuing an asset is by reference to the discounted cashflow over time. For each annualised cashflow for year I, CF_{t+i}, there is a corresponding cost of capital $R_{t\to i}(CF_{t+i})$. The EV is the discounted value of the expected future cashflows, which reflects the amount that a rational investor should pay to acquire an asset:

$$EV_t = \frac{Annual\ Cashflow}{Cost\ of\ Capital} = \sum_{i=1} \frac{E_t(CF_{t+i})}{(1 + R_{t\to i}(CF_{t+i}))^i}$$

This means that enterprise value of a firm or a company is equal to the sum of all future cashflows, which is discounted by the investors' cost of capital.

Regulated network building block model – Equation 2

For regulated utilities, the revenue allowance of a regulated firm is determined using the RCV. It reflects the amount that the regulated network owes to its investors, where $AROR_{t\to i}(CF_{t+i})$ is the allowed regulated rate of return.

[34] CMA, PR14 Bristol Water – Final decision, p.336.
[35] CMA, PR24 Anglian Water Services, Bristol Water plc, Northumbrian Water Limited and Yorkshire Water Services Limited price determination – Final report, p.1087.
[36] Ofwat, PR24 Draft methodology – allowed return on capital – Appendix 11, July 2022, p.24.
[37] Ofwat, PR19 final determination – allowed return on capital technical appendix, p.27.

$$RCV_t = \frac{Annual\ Cashflow}{Allowed\ regulated\ rate\ of\ return} = \sum_{i=1} \frac{E_t(CF_{t+i})}{(1 + AROR_{t\to i}(CF_{t+i}))^i}$$

This is similar to Equation 1, but specifically for regulated utilities. It is by design, that the sum of the future cashflows, which simply is revenue minus expenditure, when discounted by the allowed rate of return is equal to the RCV.

Derivation of MAR – Equation 3

Equation 3 means that MAR represents the ratio between the EV and its regulated capital value.

$$MAR = \frac{EV_t}{RCV_t}$$

In theory and under strict assumptions, the ratio between EV (Equation 1) and RCV (Equation 2), would be equal to 1, only if the allowed cashflow and allowed cost of capital is precisely equal to actual cashflow and actual cost of capital.

If MAR is greater or less than 1, then it can be deduced that the allowed rate of return is greater or less than 'true' rate of return, only if cashflows are precisely equal the allowed revenues without any deviation. In addition, if financing assumptions (such as cost of debt and gearing) is assumed to be fixed, then theoretically MAR could be an indicator of how the allowed return on equity compares to actual return on equity.

3.1.2 One equation and many unknowns

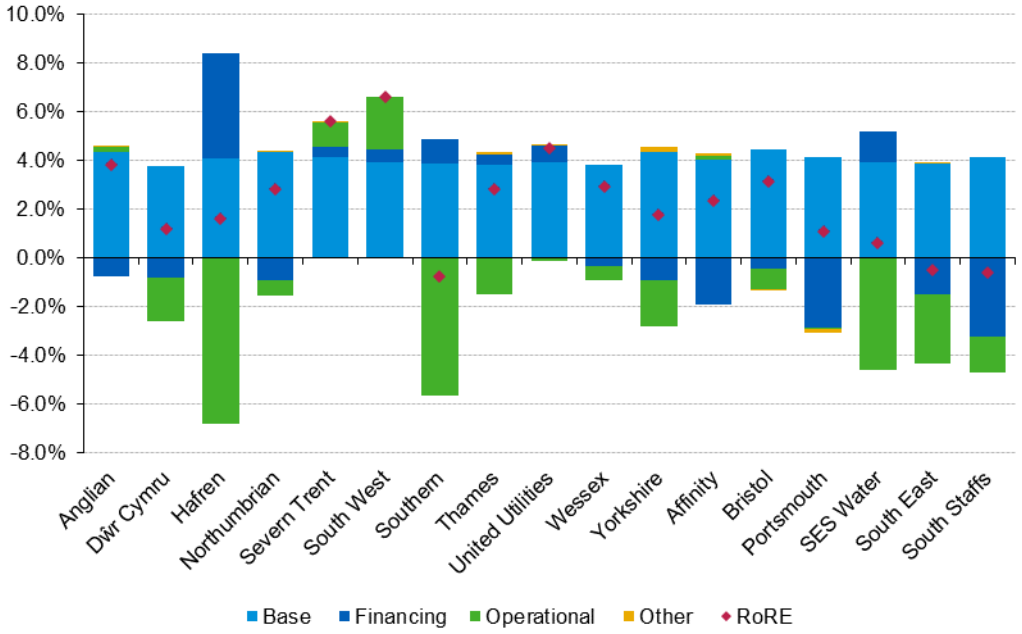
This section explores whether a theoretical MAR of 1 can reasonably hold in practice. It also examines whether MAR as a cross-check is likely to satisfy the **targeted** criterion, particularly when considering all the elements that could influence a regulated entity's cashflow.

For MAR to be 1, the expected annual cashflows must be equal to the future allowed revenues and the allowed rate of return must be equal to an investors' assumed cost of capital, as per equation 3. However, in practice, the EV of a regulated utility is affected by many variables, which could be contributing to a MAR being greater than or less than 1. It could be due to one or a combination of factors that influence a regulated entity's cashflows.

Performance

The regulatory regime is explicitly designed to reward/penalise out or under performance as part of incentive-based regulation. The outperformance varies per regulated network and would vary year-on-year. Figure 1 shows the RoRE performance for 2021 only, which illustrates the variation from base RoRE for all water companies. The current and future stream of cashflows will depend on the actual and forecast performance of a regulated entity.

Figure 1: Water company performance against base returns 2020-21 (RoRE by source)



Source: Ofwat, monitoring financial resilience report 2020-21, Return on Regulated Equity, Notional Structure

Operational performance and actual expenditure, that is higher or lower than expected due to both management actions and exogenous factors, will impact the current and future cashflow of a regulated entity. Academic literature notes there is a significant dependency between value and the quality of management, governance and management's incentives.[38] In addition, investors will have differing assumptions on an individual company's performance against its regulatory settlement. In practice, when investors value a company, they will have regard to the estimated cashflows over time and their potential ability to influence the cashflows, so that the investment is NPV positive. Their investments will also likely go beyond over multiple price control periods, so it does not align with the price control period.

Similarly, operational performance, that is higher or lower than expected due to management control as well as exogenous shocks will also influence the current and future cashflow of a regulated entity. This could manifest itself in different ways through a given price control period, it could occur via changes in government policies, changes in demand forecasts or changes in the macroeconomic conditions or unforeseen events (natural events, pandemic, etc).

Financial performance that is higher or lower than allowed will also influence current and future cashflows of an entity. The assumptions about ability of regulated companies to outperform the notional allowed cost of debt has historically contributed to an out/under performance, therefore, accounting for this source of out/under performance is important when considering the overall change in cashflow.

As operational out or under performance, which includes expenditure, financing and other determinants (such as output delivery incentives) will impact the cashflow of a regulated entity and therefore, it will have an impact on any observed MAR.

[38] Habib and Ljungqvist, Firm value and managerial incentives: a stochastic frontier approach – Journal of Business, 2005.

Non-regulated or non-wholesale parts of the business

Companies' non-regulated[39] and non-wholesale businesses, which contribute to the enterprise value, but are not included in the RCV, will affect an entities' cashflows, so will likely impact the observed MAR values. For example, a review of analysts' sum-of-the-parts valuations on the traded water companies, SVT and UU, since March 2021 shows an estimated premium to RCV, particularly from the non-regulated and retail businesses that ranges between 1.2 to 11.4 per cent for SVT and one that ranges between 0 to 10.5 per cent for UU.

In order for the MAR values to be consistent with the theoretical MAR of 1, any influence of the non-regulated and non-wholesale parts of the business would need to be adjusted for as it could inflate the MAR premium.

Summary

If one assumes that, after controlling for all other factors unrelated to the business performance itself that might be relevant for valuation, a business' operational performance, economic conditions and finance assumptions will be exactly consistent with current and future investors' assumptions, in perpetuity, then the market value of the business will be equal to the RCV, which results in a MAR of 1 and neutral NPV.[40] However, based on what is described above, in practice, there is significant variability in companies' performances over time as reflected in investors' assumptions, which would mean that MAR will not be equal to 1.

In practice, all factors that might affect the market price or the enterprise value —and assumed performance scenarios for these factors—are estimated with uncertainty in future periods. This means that isolating the contribution from assumed outperformance on the allowed cost of equity is inherently difficult and needs to be interpreted with caution, consistent with regulatory precedent.[41]

Even in the current price control period for which regulatory targets/revenue allowances are known, investors take a view on all different sources of performance against regulatory targets, which are individually and together estimated with uncertainty. The uncertainty increases the longer the period covered by the analysis. Both traded and transaction MARs rely on an extensive set of assumptions which are individually and together estimated and/or assumed with significant uncertainty.

As such, as there are many unknowns that build up a company's value, and the calculated MAR cannot be solely attributed to a difference in investors' assumed return of equity from the allowed return, suggesting that MARs do not meet the targeted criterion, without ensuring that all of its determinants are known with certainty.

3.1.3 Analogies with Tobin's Q

This section tests whether the use of MARs is consistent with academic literature, particularly in reference to a well-known valuation measure (Tobin's Q). Tobin's Q is the ratio between market value of an asset to their replacement value or cost. As MARs are a special form of the market-to-book ratio or price-to-book ratio, as they specifically relate to regulated companies (book value is based on the RCV). These ratios are closely related to Tobin's Q.

This section explores how the academic literature views the determinants of Tobin's Q as an analogy for the use of MAR in setting price controls.

[39] AER, Draft – Rate of return guidelines – Explanatory Statement, July 2018.
[40] Oxera, 'Do market-to-asset ratios provide reliable evidence on the cost of capital? Note prepared for gas distribution networks', 2007.
[41] Ofgem, RIIO-2 Sector specific methodology consultation, 2018, paragraph 3.127.

Given the importance of understanding what drives value, there is substantial literature on the determinants of Tobin's Q. The literature finds that Tobin's Q depends on a wide range of factors beyond the cost of equity.

For example, McConnel and Servaes presented an analysis that shows a significant positive relationship between Q and the fraction of shares owned by institutional investors.[42] This presents additional consideration for the drivers of Tobin's Q and analogously MAR. McConnel and Servaes control for all other variables such as research and development intensity, financial leverage, advertising intensity and the replacement value of assets.[43]

Edmans, Goldstein and Jiang identified that there are many variables that affect determinants of value for firms such as growth, leverage, actual turnover, market share, firm's age and the relative research and development expenses compared to sales.[44] Edmans, Goldstein and Jiang argue that market prices, hence valuations, are endogenous and are affected by many factors that make it difficult to find a relationship between market prices and takeover activity.[45]

These two research papers alone reference a wealth of other analysis on the topic, which present that Tobin's Q, and analogously MAR, depend on a wide range of factors. The academic literature suggests that to deduce or establish a meaningful correlation between enterprise value and one specific determinant, one has to control for all other variables, which have to be quantifiable and controllable. This is not possible in the case of MARs.

3.2 Market efficiency

The use of MAR as a cross-check for cost of equity implies that MAR provides reliable information in relation to an asset's fair market value, based on robust pricing signals derived from an efficient market, i.e., that MARs represent an efficient pricing signal.

This section considers whether the assumption that MARs are market efficient pricing signals holds true, both by reference to literature and from an empirical perspective, since that would define the degree to which MAR could be relied upon in policy decisions. In the event that the assumption is not true, it would question whether MAR as a cross-check satisfies the objectivity and transparency criteria for a robust and reasonable cross-check.

3.2.1 Efficient market theory

Efficient market theory is a concept developed by Eugene Fama in 1970, whereby three different forms of market efficiency were identified: strong form, semi-strong form, and weak form. In a strong form, the highest level of market efficiency, prices reflect all public and private information. As new information arises, the market absorbs the news almost in real time, and the prices of stocks and other securities adjust along with it. In a semi-strong form, prices reflect only publicly available information about economic fundamentals, including the public market data, as well as the content of financial reports, economic forecasts, company announcements, and so on. In a weak-form efficient market, public data is only partially reflected in prices.

[42] It was observed that Tobin's Q could change depending on the structure of equity ownership of firms, namely there was a curvilinear relationship (essentially MAR values ramped up and then down after a certain peak at 40-50%). McConnel and Servaes, Additional evidence on equity ownership and corporate value – Journal of Financial Economics, January 1990.
[43] McConnel and Servaes, Additional evidence on equity ownership and corporate value – Journal of Financial Economics, January 1990, page 605.
[44] Edmans, Goldstein and Jiang, The real price effects of financial markets: the impact of prices on takeovers – the Journal of Finance, June 2012.
[45] Habib and Ljungqvist, Firm value and managerial incentives: a stochastic frontier approach – Journal of Business, 2005.

An efficient capital market could be defined as the one where prices change rapidly in response to changes in demand and supply, thus producing“"fai”" prices at any time. An efficient market benefits from the perfect, complete, costless, and near-instant transmission of high quality and reliable information among participants. As well as information, an efficient capital market will usually require liquidity through a large enough collection of buyers and sellers to accurately influence prices. Pricing information in such a market robustly reflects both the underlying market conditions and company fundamentals.

Conversely, an inefficient market is one in which asset prices do not accurately reflect true value of assets, which may occur for several reasons. Market inefficiencies may exist due to information asymmetries, a lack of buyers and sellers (i.e., low liquidity), high transaction costs or delays, market psychology, and human emotion, among other reasons.

The general consensus is that it is unlikely that markets are strong-form efficient since they might not reflect some of all of the private information. This would be relevant for the observed traded MARs. At best, some argue that the market is semi-strong-form efficient. This is also confirmed through empirical observation: most markets do display some level of inefficiencies, as demonstrated by investor ability to consistently outperform markets over long periods, which by definition is impossible in strong form efficient markets. This is a useful lens when observing the long history of traded MARs. Informational efficiency of stock prices varies across markets and from country to country, based on the transparency of information, number of participants, liquidity, the effectiveness of regulation, and the likelihood that rational arbitragers will drive out noise traders.

In relation to the use of MARs specifically for the UK regulated assets, it is relevant to consider the level of market efficiency implied in the transactions-based and publicly traded MARs, to understand whether the MARs satisfy the objective and transparent criteria.

3.2.2 Inefficiencies related to private transactions

Private markets have historically significantly outperformed public ones for similar regulated assets, suggesting that there may be other factors other than assets’ fundamentals that affect prices and that there is ‘one price’ in the market. This might be associated with a number of specific factors, such as private transactions process set-up (including the impact of winner’s curse), high transaction barriers and relatively few participants, private information and illiquid assets at a certain size of the equity cheque. There are also additional idiosyncrasies such as management determination to succeed, the use subjective and optimistic assumptions related to future operational and financial performance, agency problems, the control premium effect.

Auction theory

We consider whether the typical set-up of a process around a private transaction of an equity stake in a utility can be assumed in around to result in an efficient price, particularly where such prices are considered to be relied on to derive a MAR a cross-check on the allowed return. This is tested through a review of the academic literature on auction theory and the analysis of the auction set-up in transaction processes.

The set-up of a private transaction can be either in the form of sealed bid or open auctions. Each has a different formal process, which has a different design. The hypothesis on whether they result in different outcomes has been the subject of academic research since the 1960s.

The literature notes the outcome of an auction will be influenced by a number of factors such as bidder heterogeneity, entry costs, collusion, correlation in bidders’ values, risk aversion,

transaction costs and revenue maximisation or efficiency.[46] In addition, if the information bidders receive during a sealed auction is not perfectly consistent with other bidders, then bidding behaviour will be affected.[47]

Specifically in the UK regulated utility sector, transactions have typically followed a multi-stage sealed bid auction approach, which is particularly attractive to sellers as it offers the greatest potential to secure higher revenue as indicated by academic literature and seen in practice, although it may attract a smaller number of bidders. (There are sometimes bilateral negotiation processes, but these typically apply to situations where existing shareholders have pre-emption rights to acquire other shareholders' stakes before an open process.)

The first phase will often be open to a range of credible interested parties, with a common information memorandum provided by the seller (and sometimes a benchmark valuation model). The bidders will be required to submit a non-binding offer based on this relatively limited information and their assumptions, often on a relatively short timescale which can restrict the opportunity to overcome the inherent information asymmetry between seller and buyer.

The seller will then shortlist a subset of the bidders for a more detailed second stage in which more thorough due diligence can be undertaken. In this, more detailed vendor due diligence (VDD) reports prepared by the seller and their advisors will be provided, as will access to key company information (internal financial, tax, accounting information, contracts, growth plans, etc.) in a data room, and also meetings with company management to address any key issues and questions. At the end of this stage, the shortlisted bidders will submit a binding offer in competition with each other. It is at this point where bidder's individual biases for the asset may be revealed through the need to "bid up" in order to win the auction.

The most attractive bid will then usually be taken through to a final negotiation phase. The detailed terms will be agreed with further opportunities to revise the price, and for the seller to achieve as high a price as possible (e.g., "best and final offer", "put up or shut up" requests).

The way transactions are set-up, whether through an open auction, sealed bids or private negotiations will have an impact on the observed values. Particularly as bidders are unlikely to be heterogenous, entry costs vary significantly and there is likely to be information asymmetry between bidders. Therefore, the values derived from private transactions are unlikely to meet the objective criterion, as they are likely to be biased by the auction set-up and are unlikely to represent the efficient price.

Winner's curse

Common-value auctions, where the value of the object is the same for all bidder but is not known at the time of the auction, is associated with the widely acknowledged phenomena known as the 'winner's curse'.[48] The 'winner's curse' results from the bidders' failure to account for the adverse selection problem inherent in winning auctions for items that are uncertain in value, meaning that the bidders' estimate may be overly optimistic.[49] By default, the highest bidder, the winning bid, is the one with the most optimistic estimate of the item's value, hence the curse.[50] This is different to irrational behavioural over-paying, which are discussed in the context of general behavioural biases and could be a result of path dependence or over-extrapolating or over-optimism.

[46] Susan Athey, Jonathan Levin, Enrique Seira, Comparing open and sealed bid auctions – national bureau of economic research, December 2008
[47] David J Salant, A primer on Auction Design, Management, and Strategy, December 2014.
[48] Koch and Penczynski, The winner's curse: conditional reasoning and belief formation – Journal of Economic theory, December 2017.
[49] Kagel and Levin, Common value auctions and the winner's curse – Princeton University Press, August 2002.
[50] Ibid.

In a hypothetical private transaction situation, even if the enterprise value of a regulated utility perfectly reflects the discounted value of the future stream of cashflows, the 'winners curse' suggests that the winning bidder will overpay by a factor that exceeds the RCV, which will result in a MAR that is greater than 1. The 'winner's curse' thus creates further uncertainty around the observed MAR values. For a MAR to be consistent with the theoretical model, it would be necessary to measure, capture and remove the winner's curse factor to obtain a clean MAR.

High transaction barriers (ease or difficulty with which transactions are made, including costs)

High initial costs, relatively large amounts of capital required, the knowledge needed to assess assets, and the necessary contacts (in the industry and relevant advisors such as investment banks) to be informed when assets become available all create significant barriers. Investing in the UK regulated utilities requires expert levels of knowledge of the regulatory framework and the associated businesses to be able to appropriately price the risk.

There are high barriers to entry in terms of having to undertake extensive due diligence to assess historical and plausible future performance as there is limited information in the public domain and companies are not widely covered by sector analysts. Transaction costs associated with an acquisition are also high compared to investing in public (secondary) markets due to the legal, banking, and advisory fees.

Few participants and low frequency of trades

High transaction barriers restrict the number of participants and transactions in private markets. This leads to low frequency of trades, which is a source of major market inefficiency, because an efficient capital market requires liquidity through a large enough collection of trades to accurately influence prices. Investors are unable to sell assets at any point they like, which means that they usually require an illiquidity premium.

In the UK regulated utilities space, the majority of investors have a medium- to long-term investment horizon, sometimes due to the nature of the corresponding liabilities they manage (e.g., pension funds and insurance companies). The limited number of participants and relatively long holding periods mean that transactions do not come up frequently and that whenever they do, these could be subject to many behavioural biases and specific circumstances in terms of the strategy of a buyer, point in the economic and regulatory cycle, etc.

A small cohort of potential buyers and sellers in these situations is less likely to result in an efficient price. These transactions are point-in-time estimates that are prone to biases rather than continuous market pricing signals indicating the level of return at which the market would commit capital to the sector in general.

Availability of data

Private markets are characterised by the ability to control what type of information can be made available. There is generally less regulation that requires their full transparency, as opposed to public markets. This creates information asymmetry and limits market efficiency.

Any analysis of MARs from auction transactions is necessarily speculative since only the successful bidder knows the exact assumptions and rationale behind their bid price. Often the exact terms of the sale are not publicly disclosed, and only speculated or inferred in press commentary. The assumptions made by bidders are estimated with uncertainty and may not be a true reflection of the underlying parameters and, by definition, will not match the assessment made by other bidders that arrived at their own valuations.

Additional idiosyncrasies for transaction MARs

There are additional idiosyncrasies associated with transactions for non-listed regulated companies which impact the MAR:

- Bidders are often **driven by a management determination to succeed in a transaction** (often reinforced by remuneration practices) and optimism bias. Investors develop views about specific sources of value that often increase valuations (such as outperformance, growth rates, exit multiples, etc.) but these are specific to each transaction and not consistent over time.
- Investors **use subjective and optimistic assumptions related to future operational and financial performance,** which do not necessarily reflect past performance. This is particularly noticeable in terminal value (TV) assumptions which are often typically a premium to the RCV, determined from previous transactions with the assumption that high exit multiples will be achievable in the future.
- There is also an **"agency" problem** associated with MARs in that the individuals leading the acquisition process and making the assumptions on future performance are predominantly interested in securing an asset. They are unlikely to be responsible for the MAR outturn at the exit as it would typically happen many years in the future.
- **Seller's expectations will also be conditioned by the outcome of previous similar transactions** and their unwillingness to sell at a loss. The price they are willing to accept will normally only be at a MAR greater than 1. Similarly, if they had assumed a premium to RCV in their valuation on their original acquisition, they would have an imperative to recover that on exit.
- **Individual bidders may be willing to pay a "control premium"** over and above the fundamental value of the company when acquiring a majority stake which reflects the ability to exercise control over the company's operations and hence increase expected cash flows.

Industry players will often be able to identify areas of operational overlap with the potential for cost savings and synergies which could justify a higher valuation than non-sector participants. This may be tempered by regulatory constraints or requirements to ensure that they can continue to regulate effectively.

Summary

Overall, a range of characteristics and limitations of transaction processes indicate that private markets are subject to very material inefficiencies that constrain their ability to provide efficient pricing signals in relation to an asset's fair value.

Transactions for non-listed companies do not reflect a continuous, efficient and liquid market as opportunities arise on a sporadic bespoke basis at isolated points in time. For regulated utilities, this may often coincide with the finalisation of a price determination which provides a degree of short-term certainty on revenues and returns.

The fact that sales are initiated and concluded at particular, idiosyncratic points in time means there is a significant selection bias in choosing the time of the transaction. An expected MAR in excess of 1 must be realised otherwise the seller would rationally wait for a better opportunity in order to avoid reporting a loss. This means the sample is statistically biased through the existence of only successful transactions at prices sellers are willing to accept for what are generally long-term holdings.

The ability of private transactions' MAR data to explain the fundamentals of a particular asset, including the regulatory price control parameters determining its cash flows, is therefore significantly compromised and do not satisfy the objective or transparency criteria.

3.2.3 Inefficiencies related to public markets

Public stock markets benefit from many participants and transactions, resulting in reasonable liquidity. Transactions are completed instantly and with minimal commission, and details for each stock are readily available. There are also specific rules and regulations related to the frequency of reporting and information transparency of the listed companies. These features enhance efficiency of public markets compared to the private ones.

Empirically, this could be observed through the difference in the traded MARs and MARs derived from the recent transactions. The average MARs of the listed companies, Severn Trent and United Utilities, were around 1.22-1.33 during the last eighteen months, while the MARs from the UK water sector transactions during the same period were around 1.44-1.51 (Bristol Water, Northumbrian Water). The RCV premiums derived from private transactions are c. 1.5-2.0 times higher than those coming from public markets. This is before any correction for the differences in the operational and financial performance of these companies, which would further increase the gap, as both United Utilities and Severn Trent reported sector-leading performance in FY2021.

Although public stock markets are more efficient than the private ones, their overall ability to reflect assets' fair values is a subject of academic debate. Empirical evidence suggests that even the most competitive markets are not strictly efficient. Price histories can be used to predict near future returns with a probability better than random chance. Many markets can be considered as favourable games, in the sense that there is a small probabilistic edge that smart speculators can exploit.[51] There are investors who have beaten the market, such as Warren Buffett, whose investment strategy focused on undervalued stocks made billions and set an example for numerous followers. There are portfolio managers who have better track records than others, and there are investment houses with more renowned research analysis than others.

There are factors that, according to the academic literature, contribute to public markets being less than the semi-strong form efficient. The factors are supply-demand imbalances, economic and market cycles, low aggregate and demand elasticity and behavioural biases.

Supply-demand imbalances and asset bubbles

Public shares are subject to the basic laws of supply and demand. When demand is greater than supply, prices rise, and when supply is greater than demand, prices fall. The major factors that impact the demand for stocks are economic data, interest rates, and corporate results but supply and demand can also be reflecting behavioural factors that are not related to companies' fundamentals. The supply of stock tends to change at a slower pace than the demand, which can pick up or drop in response to corporate news or other one-time events.

Imbalances in stock supply and demand could be caused by a myriad of factors and could significantly impact stock prices. As a result, market prices would be only partially explained by the fundamentals, with stocks being significantly over or under-valued. This could be observed empirically and is documented in the academic research exploring asset price distortions.[52]

In extreme cases, stock price deviation from its fair values could lead to asset bubbles. During a bubble, investors continue to bid up the price of an asset beyond any real, sustainable value. This occurs when investors think that there is not enough supply of a given asset. Eventually, the bubble“"burst”" when prices crash and demand falls, for example, as was the case with the 1987 stock market crash, when the Dow Jones Industrial Average fell by over 20% in a single day.

[51] Zhang, Y.-C. (1999), Toward a theory of marginally efficient markets, Physica A 269(1), 30–44.
[52] The Journal of Finance • Vol. LXV, No. 4 • August 2010, “Presidential Address: Asset Price Dynamics with Slow-Moving Capital” by Darrell Duffie

Bubbles are hard to distinguish in real-time because investors cannot easily judge if the market pricing reflects the prediction of future values or merely collective enthusiasm.

Economic and market cycles

Supply-demand imbalances could result from macroeconomic conditions and changes in global markets,[53] as these represent one of the major demand drivers. All markets go through the same phases and are cyclical. They rise, peak, dip, and then bottom out. When one market cycle is finished, the next one begins. It is extremely difficult to accurately predict the end of the current market phase and the start of the next one. That is why realised returns are especially poor indicators of expected returns prior to turning points in the business cycle.[54]

Economic cycles could explain capital flows in and out of entire asset classes. An example of a booming demand in the infrastructure asset class in the last decade is relevant as it includes regulated utilities. A long period of ultra-low interest rates and large-scale asset purchases by central banks between 2009 and 2021 have led to an abundance of cheap money. This excess liquidity inflated the valuations of financial assets, leading to near all-times high equity markets and near historic low sovereign bond yields in the developed economies. The search for yield remained the norm for over a decade and led to a strong demand for infrastructure as an asset class given its defensive characteristics, driving up valuations.

The attractiveness of the infrastructure asset class relative to other equities and lower yielding bonds is shown in Table 1. Infrastructure assets have a higher Sharpe ratio than equities despite being lower risk, indicating a lower variability in their returns and hence greater certainty which is attractive to certain classes of investors who require stable, predictable returns even if lower than theoretically achievable elsewhere (such as pension funds and insurance companies).

Table 1: Comparison of Preqin infrastructure index with equities and bonds (USD returns) for 2008-2019[55]

Asset class	Return	Risk	Sharpe ratio[56]
Preqin infrastructure index	8.0%	7.0%	1.15
Equities	11.7%	16.5%	0.71
Bonds	2.7%	5.7%	0.48

Changes in the global markets and macroeconomic environment could lead to other asset classes, for example fixed income or property, to become more attractive to investors, triggering a decrease in the valuation multiples in the infrastructure space. In fact, rising interest rates have already led to higher sovereign and corporate bond yields[57] and have also surged to the top of the list of challenges for infrastructure investors.[58]

[53] Fama and Kenneth French (1988) found that stock returns could be impacted by the economic cycles
[54] November 2004 Financial Review 39(4):527-547, “Stock Returns and the Business Cycle” by Michael DeStefano
[55] Preqin, Datastream: Equities (Russel 3000), Bonds (Bloomberg Barclays Aggregate), all quarterly total returns in USD; Preqin data is net of fees; Period: Q2 2008 – Q4 2019
[56] The Sharpe ratio is a measure of the performance of an investment compared to a risk-free asset after adjusting for its risk, calculated as the ratio of the investment’s returns over the risk-free rate and the standard deviation of its returns.
[57] The Big Picture, Global Asset Allocation 2022 Q3 Quarterly update from Invesco’s Global Market Strategy Office
[58] Preqin investor outlook: alternative assets, H2 22

Overall, these market drivers are related to a specific point in the economic cycle and have little to do with the asset fundamentals, yet they could have a significant bearing on asset valuations and, in the case of regulated utilities, MAR.

Low aggregate demand elasticity

The ability of the public stock markets to provide robust pricing signals has been disputed since the 1960s, with the new academic research, such as the Inelastic Market Hypothesis (IMH),[59] taking the debate further. While the traditional asset pricing model does not expect any impact on the asset pricing from the mere fact of an investor making an investment, the IMH proves that this assumption is deeply flawed, both theoretically and empirically.

IMH demonstrates that when an investor sells one unit worth of bonds and buys one unit worth of stocks, the market's aggregate value goes up by about five times. That means that the demand's aggregate elasticity is around 0.2: if the price of the equity market portfolio goes up by 5%, demand falls by only around 1%.

The direct implication of the IMH is that stock market prices reflect not only the fundamentals, but the overall level of investment, and so could not be entirely relied upon to measure asset fair values.

Behavioural biases

In some circumstances, markets do not determine the correct value of assets because of behavioural biases. Behavioural science literature suggests that markets are not always rational or price assets with perfect accuracy. Asset price is an indication of how investors perceive the enterprise value, but that could vary from the 'true' theoretical value, whether above or below.

The reason for the difference includes path dependence or over-extrapolating, which places a strong emphasis on past growth or to depend on previous outcomes rather than current conditions. Path dependence explains the continued use of an investing approach based on historical preference or use. An investor may persist in using a known strategy even if newer, more efficient alternatives are available. Path dependency occurs because it is often easier or more cost-effective to continue along an already set path than to create an entirely new one. The other behavioural biases could include overoptimism or simply equating a good investment with a well-run company irrespective of price.

Empirical evidence has identified another systemic pattern of expectation errors, which excessively tied past to future growth.[60] This seminal paper on this topic notes the following:

'Individual investors might focus on glamour strategies for a variety of reasons. First, they may make judgement errors and extrapolate past growth rates of glamour stocks, even when such growth is highly unlikely to persist in the future. Putting excessive weight on recent past history, as opposed to rational prior, is a common judgement error in psychological experiments and not just in the stock market' [61]

Given that there are many factors that could influence the MAR, several of which are very difficult to measure (such as behavioural biases), it is not possible to strip out the effects of all these other factors on the MAR and isolate the implied cost of equity completely away from other factors, meaning that MAR is unlikely to satisfy the targeted criterion.

Summary

Empirical and academic evidence suggests that public stock markets could exhibit varying degrees of inefficiency due to supply-demand imbalances, exposure to economic and market

[59] "In Search of the Origins of Financial Fluctuations: The Inelastic Markets Hypothesis" by Xavier Gabaix and Ralph S.J. Koijen, May 12, 2022
[60] J Lakonishok, A Shleifer and Robert W. Vishny, Contrarian Investment, Extrapolation and Risk, 1994.
[61] Ibid

cycles, low demand elasticity and behavioural biases. It is near-impossible to determine to which extent the stock price at a particular point in time is affected by these factors.

Drawing conclusions from it about a particular driver of cash flows, or in the case of MAR, about a discount rate assumed by an investor, may not be sufficiently robust without other supporting evidence that triangulates the cost of equity ranges.

For a MAR to be consistent with the theoretical model, it would be necessary to measure, capture and remove the impact of traded MAR elements not related to the fundamental value drivers to obtain a clean MAR. Only then traded MAR would express a firm's true value.

Predicting the power of MAR could be overestimated. Research suggests that the fact that companies have a high MAR does not necessarily mean that these companies will outperform their current performance into the future or that the allowed rate of return is different from actual rate of return for regulated companies. There may be expectation errors. It was observed that high MAR companies subsequently underperform analysts' expectations and low MAR companies outperform. This could also be observed in analysts' report, which values MAR and the underlying component parts. There is a further discussion of the analyst valuations in Section 4.3.

4 Quantifying the determinants of MARs

The purpose of this section is to rely on quantitative analysis to provide further considerations of whether MARs meet the criteria for a reasonable cross-check. This section explores:

- the extent to which the various regulatory drivers can affect a company's MAR, individually and in conjunction with each other, compared to the corresponding impact on MAR of a reasonable range for the equity discount rate. This will illuminate the extent to which MARs can be considered a targeted and incentive compatible cross-check. A stylised decomposition, based on a bottom-up sensitivity analysis, is used to show how different assumptions for regulatory inputs can impact company valuations, supporting the "one equation and many unknowns" premise.
- whether MARs observed in private transactions can be considered free from potential biases, and hence objective as a cross-check for the cost of equity. This is examined by observing MARs in private transactions, which sets out the range of headline UK regulated utility transaction MARs since 2020.
- to what extent equity analysts' valuations support the conclusion that the decomposition of MARs informs the required rate of return compared with the regulatory allowance. It also examines whether that can be objective and lead to clear results that enable the impact of allowed returns on price to be clearly isolated, i.e., whether the use of MARs is transparent. This is tested by reviewing the variation in equity analysts' assumptions on value components of the traded water companies, and the resultant impact on the observed traded MARs, which helps to confirm some of the previous known limitations of MARs, that the values are subjective and can be influenced by a number of variables.

4.1 Stylised sensitivity analysis

This section sets out a sensitivity analysis for how a range of factors (such as company's performance, discount rate and terminal values) affect MAR based on a discounted cash flow (DCF) valuation model.[62]

The analysis was done on a stylised basis. It is designed to explore the sensitivity of MARs to a potential reasonable range of assumptions around regulatory drivers. As various factors could be varying at the same time or in opposite directions, depending on when MAR is observed, the analysis investigates:

- whether a MAR range due to changes in various regulatory or valuation levers has a similar quantum compared to the range derived from changes to discount rate only; and
- whether MAR could be greater than 1, even when the discount rate is higher than allowed cost of equity due to the impact of other variables, while relying on plausible assumptions / valuation parameters.

If it is possible to generate MAR values consistent with these two questions then the use of MARs as a cross-check will fail the consistency, transparency and objectivity criteria.

[62] The model relies on standard regulatory modelling assumptions and all input assumptions are based on publicly available information.

Assumptions

The assumptions that were used in the analysis are set out in Table 2 below. All the assumptions are based on standard regulatory assumptions, historical performance or final determination allowances that were adopted in PR19.

Table 2: Assumptions used in the stylised sensitivity analysis

Issue	Assumption	Rationale
Valuation period	April 2021 – March 2048	Considers a reasonable period of 27 years, which incorporates the impact of multiple AMPs, consistent with the CMA decision of having regard to long-term cashflow rather than one or two price control periods only.[63]
PAYG rate	50%	Consistent with the PR19 regulatory determination.[64]
Allowed totex	PR19 allowed totex (constant over the valuation period)	PR19 regulatory determination.
WACC	PR19 final determination	PR19 regulatory determination.
Sharing factor	50%	Standard regulatory assumption
Notional gearing	60%	Standard regulatory assumption
Terminal Value	The range is between 1.1 – 1.4	Subjective value estimated by investors. The range is based on previous TV values that bidders have incorporated in past valuations.[65]
RoRE range	The range is between -2.5% to 2.5%	Consistent with the observed range of performance in 2015-2021.[66] This is a conservative assumption as there are actual observed values that are higher and lower than this range.[67]
Equity discount rate	The base case is 7.0%. The range is incremental between 5.0 – 9.0%	Subjective value estimated by investors.

Variance due to regulatory and valuation levers

This section explores the combined effect of outperformance and terminal value assumptions to test what a plausible range for MAR values might be when the allowed cost of equity is equal to investors' discount rate.

Investors acquiring an underperforming business will generally assume they can improve it and make it at least average and investors acquiring an outperforming business might assume that they can keep it in that position (e.g., assume 1% operational performance). This asymmetry in assumptions may show a degree of the control premium but it may nonetheless drive valuations. The effect of RoRE out and under-performance combines all various aspects of operational and financial performance, including totex, ODIs, financing, retail costs, business plan incentives and revenue incentive mechanisms.

[63] CMA (2021), PR19 Final Report (CGL2/7), para. 9.1360
[64] Ofwat, PR19 final determination – aligning risk and return technical appendix, p.64.
[65] The range was also informed by Societe Generale's equity analyst reports (March 2021 to June 2022) for the traded water companies in the DCF valuations where they assume a TV as a premium to the final year RCV ranging between 15% and 26%. However, the sensitivity analysis tested the impact beyond this range.
[66] Ofwat, monitoring financial resilience report 2020-21, 30 November 2021 and Ofwat, monitoring financial resilience report 2019-2020, 2 December 2021.
[67] For example, the average RoRE performance for Portsmouth was 3.1% over 2015-2020 and the average RoRE performance for Southwest was -5.6% over 2015-2020. Ofwat, monitoring financial resilience report 2019-2020, 2 December 2021.

In addition, valuation models usually assume a certain valuation period. Beyond this, assumptions are made for a terminal value (TV), typically through an EV / RCV multiple. The presence of a terminal value assumption greater than 1 could reflect a range of factors including: path dependency by which previous outcomes influence future expectations, the value of any non-regulated businesses, and an expectation of gaining a control premium in a potential future sale or a combination of all these factors. It should be noted that TV assumptions concern expectations for company performance far into the future, well beyond the immediate price control periods.

The analysis tested a symmetrical RoRE performance combined with incremental terminal values to explore the sensitivity of MAR to these scenarios. The results are shown in Table 3. The variance due to the combined change in RoRE and TV is between 0.90 and 1.15.

The assumed RoRE under and out-performance of +/- 2.5% is a conservative value and is based on historical performance,[68] as such, the deduced MAR range could be even greater if the maximum under and out-underperformance values over the 2015-2020 regulatory years are used.

Table 3: Impact of performance and TV assumptions on MAR

Scenario	RoRE change Δ	Equity discount rate	Terminal Value	MAR
Base	0%	7.0%	1.0	**1.00**
Scenario 1.1	+2.5%	7.0%	1.0	**1.10**
Scenario 1.2	+2.5%	7.0%	1.2	**1.13**
Scenario 1.3	+2.5%	7.0%	1.4	**1.15**
Scenario 1.4	-2.5%	7.0%	1.4	**0.96**
Scenario 1.5	-2.5%	7.0%	1.2	**0.93**
Scenario 1.6	-2.5%	7.0%	1.0	**0.90**

Source: KPMG analysis

Variance observed due to equity discount rate

This section reports how sensitive the MARs are to the difference between the allowed rate of return and the assumed equity discount rate.

An incremental change to the discount rate between 5% to 9% results in a MAR range between **0.92** and **1.12**, as shown in Table 4.

The derived MAR range, due to the change in discount rate assumptions, is consistent with the outcomes derived from Scenarios 1.1 to Scenarios 1.6 above (meaning the impact of other regulatory and valuation levers). This increases the doubt as to whether MAR is a targeted indicator.

By using MAR, without knowing the exact contributors at the time of an observation, one could be making inference on the allowed cost of equity, when the observed premia could be due to investors' assumptions (such as TV assumption and/or assumed medium- or long-term outperformance assumptions). This suggests that the use of MAR is unlikely to meet the targeted criterion.

[68] For example, the average RoRE performance for Portsmouth was 3.1% over 2015-2020 and the average RoRE performance for Southwest was -5.6% over 2015-2020. Ofwat, monitoring financial resilience report 2019-2020, 2 December 2021.

Table 4: Impact of equity discount rate on MAR

Scenario	RoRE change Δ	Equity discount rate	Terminal Value	MAR
Base	0%	7.0%	1.0	**1.00**
Scenario 2.1	0%	5.0%	1.0	**1.12**
Scenario 2.2	0%	6.0%	1.0	**1.05**
Scenario 2.3	0%	8.0%	1.0	**0.96**
Scenario 2.4	0%	9.0%	1.0	**0.92**

Source: KPMG analysis

Combined outperformance and discount rate

An additional consideration to the outcome of changes in RoRE, discount rate and terminal values at the same time, is that, in practice, it is unlikely for one variable to change in isolation, but rather the observed MARs will be a result of the variables changing simultaneously.

Without explicitly considering behavioural type effects, which may not be quantifiable, or the impact of non-regulated businesses (including the retail portion), the analysis derives a MAR that ranges from **0.85** to **1.28**. A number of these regulatory inputs and assumptions could be up or down at any given point, as it could also depend on investors' assumptions, specifically for variables such as equity discount rate and terminal values.

Scenario 3.7 and Scenario 3.8, as shown in Table 5, show that a MAR could be greater than 1, even when the discount rate is greater than the allowed cost of equity. This indicates that the use of MAR as a cross-check is unlikely to meet the targeted criterion as it may not be able to isolate the effect in question from other factors and would not give accurate results.

It also indicates that the use of MAR would not be incentive compatible. Specifically, if it is of concern that any outperformance—whether in totex, ODIs, or financing—that pushed the company's MAR above 1 would subsequently result in a further reduction in the allowed cost of equity, it would introduce the 'ratchet effect'. This would further dampen incentives for improved performance as companies may fear that any rewards gained during a price control will be clawed back at the next price control through a reduced cost of equity.

Table 5: Combined outperformance and discount rate[69]

Scenario	RoRE change Δ	Equity discount rate	Terminal Value	MAR
Base	0%	7.0%	1.0	**1.00**
Scenario 3.1	-2.5%	5.0%	1.2	**1.05**
Scenario 3.2	-2.5%	6.0%	1.2	**0.98**
Scenario 3.3	-2.5%	8.0%	1.2	**0.89**
Scenario 3.4	-2.5%	9.0%	1.2	**0.85**
Scenario 3.5	+2.5%	5.0%	1.2	**1.28**
Scenario 3.6	+2.5%	6.0%	1.2	**1.20**
Scenario 3.7	+2.5%	8.0%	1.2	**1.07**
Scenario 3.8	+2.5%	9.0%	1.2	**1.02**

[69] The terminal value assumed was consistent with equity analyst reports.

Source: KPMG analysis

Summary

The sensitivity analysis tests the impact of key regulatory variables on MARs to quantify some of the determinants of value in a stylised setting. The analysis demonstrates that investors' assumptions, whether they are correct or not, will have a very significant impact on MARs. This is consistent with the premise of one equation and many unknowns, that there are many factors that might affect the EV, which are estimated with uncertainty in future periods. Isolating the contribution of assumed outperformance from the allowed cost of equity is inherently difficult and needs to be interpreted with caution, consistent with regulatory precedent.

Overall, the sensitivity analysis has derived a MAR range that is between **0.85 and 1.28** which supports the uncertainty over the potential underlying assumptions that could be associated with the observed premia from traded or transactions MAR. In addition, the sensitivity analysis has identified that:

- it is possible to have MAR above 1 even if the discount rate exceeds the allowed cost of equity, with other variables contributing to the upward valuation. This suggests that the use of MAR as a cross-check is neither targeted nor incentive compatible.
- estimating the impact of cost of equity assumptions on MAR is not possible with any degree of accuracy, unless there is clarity about all the other assumptions related to company performance, which is forecast into the medium and long term. Some of the determinants of the observed premia (such as behavioural biases which have been discussed in this report) may not be quantifiable.
- MAR is sensitive to the subjective terminal values that are assumed by investors. As terminal values are usually assumed as a multiple of the RCV, it is asymmetric and consistently contributes to MAR being above 1, rather than below 1.

4.2 Transaction MARs

This section examines publicly available information on recent transactions in UK regulated utilities to assess whether it is possible to obtain a clear signal about company valuations in the context of the efficient market principles laid out in Section 3.2, and whether the observed MARs can be reliably used as a cross-check on the implied return on equity in particular against the transparent, objective and targeted criteria.

There have been five private transactions involving UK water companies since the start of 2020: the takeover of Bristol Water by Pennon, a majority equity injection in Southern Water by Macquarie, and sales of minority stakes in Thames Water, Anglian Water and Northumbrian Water. Transactions' activity tends to follow the price control cycles.

In the wider regulated utility space, there have been a further three transactions in this timeframe: National Grid's purchase of an electricity distribution network operator (DNO), Western Power Distribution, and later sale of a majority stake in the national gas transmission network operator (National Grid Gas Transmission), and the sale of a 50% ownership stake in a gas distribution network (GDN), Scotia Gas Networks.

Details of the water transactions based on public reports are listed in Table 6 below.

Table 6: UK water company transactions since 2020

Target	Buyer	Date	Stake	Transaction Value, £m	Implied EV, £m	RCV, £m	MAR (EV/RCV)

Target	Buyer	Date	Stake	Transaction Value, £m	Implied EV, £m	RCV, £m	MAR (EV/RCV)
Bristol Water	Pennon	Jun 21	100%	425	814	556	1.44 [70]
Southern Water	Macquarie	Aug 21	majority stake	1,073	-	5,111	-
Thames Water	USS	Dec 21	8.8%	Undisclosed	-	15,025	-
Anglian Water	OTPP	Jan 22	15.6%	Undisclosed	-	7,943	-
Northumbrian Water	KKR	Jul 22	25%	867	6,866	4,548	1.51

Notes: RCV and net debt (for the implied EV) have been taken as of the date of the transaction (i.e. at the previous March financial year-end).
Source: Company press releases; KPMG analysis.

This review of the most recent transactions involving UK water companies highlights the various factors arising in private transactions as discussed above.

Few participants and low frequency of trades

An efficient market will usually require liquidity through a large enough number of buyers and sellers such that the pricing information robustly reflects both the underlying market conditions and the individual company fundamentals.

With just eight transactions over the past two-and-a-half years, there is a very limited opportunity for investors to participate in this space, with this scarcity thus having the potential to drive up prices for assets when they do come to market.

The high barriers to entry (high initial costs, relatively large amounts of capital required, expert levels of knowledge of the regulatory framework needed to assess assets, high transaction costs compared to investing in public markets) restrict the number of potential buyers. Nonetheless, there is still a relatively large pool of investors for whom regulated utilities are an attractive asset class, notably pension funds, infrastructure funds and sovereign wealth funds, and as parties have demonstrated successful investment returns from the sector, others have also been attracted.

On the other side, the characteristics of regulated utilities mean that the majority of investors have a medium- to long-term investment horizon, sometimes due to the nature of the corresponding liabilities they manage (e.g., pension funds and insurance companies), which results in an infrequent availability of these assets.

This combination of a limited set of potential buyers and sellers for these transactions suggests that they could be subject to many behavioural biases and specific circumstances which are less likely to result in an efficient price. Given that a seller has a choice about selling, the inefficiency is likely to be reflected in a selling price implying a MAR premium.

Timing or selection bias

Linked to the previous point is the fact that existing owners choose when to put their assets on the market, and that they will do so when the price expectation is at its highest so the observed transactions are subject to a material selection bias. A transaction will only conclude when the seller is satisfied with the price offered, and sale processes are paused or terminated when bids do not meet the seller's requirements.

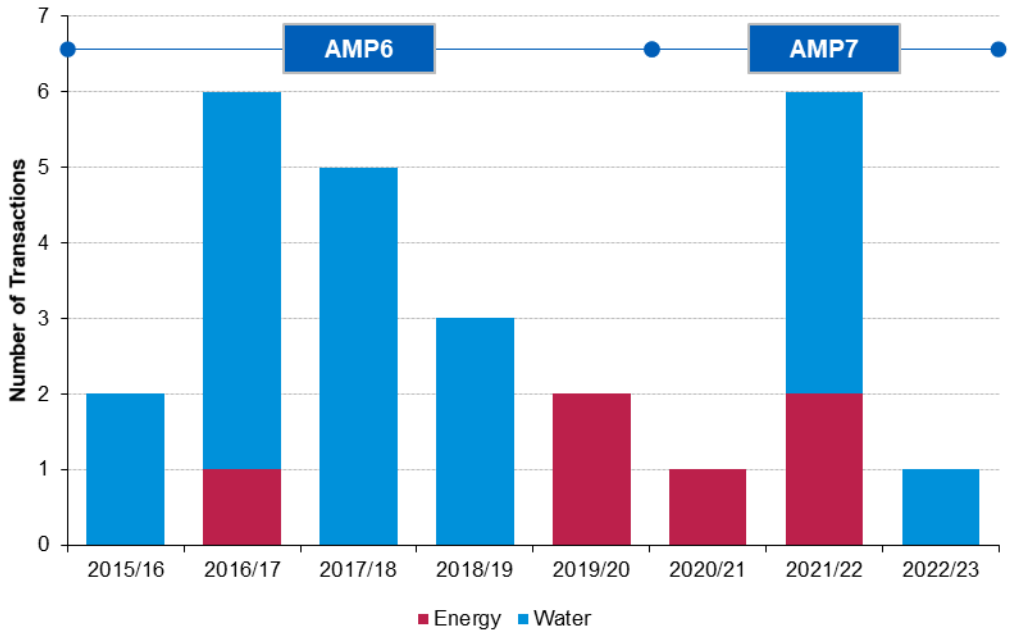
This implies that completed transactions will normally take place at the point of greater certainty and the highest valuation and it would be expected that only sales with a MAR in excess of 1 will be observed. Public information is only available on the concluded

[70] Acquisition of the Bristol Water Group and proposed Special Dividend and Share Consolidation | Pennon Group PLC (pennon-group.co.uk)

transactions which, owing to the choices available to the sellers, means that a biased sample of cases only where the MAR is greater than 1 is available.

Transactions in regulated utilities will typically coincide with the conclusion of price reviews when there is an element of certainty about the short-term returns which can help facilitate a clearer mutually acceptable valuation. This is illustrated by Figure 2 below which shows the number of transactions in regulated energy and water companies annually since the start of AMP6 (the sixth Asset Management Plan period) in April 2015:

Figure 2: Transactions in UK regulated utilities since April 2015



Source: KPMG analysis.

There were numerous water company transactions in the first four years of the previous price control period when the regulatory regime was known and performance reliable. However, as the PR19 consultation began in early 2019 and the price review process progressed including an appeal to the CMA in February 2020, transaction activity ceased during 2019/20 and 2020/21 while there was uncertainty over what the companies' returns would look like going forward. Only once the CMA concluded its enquiry and published its final determinations in March 2021 did acquisitions resume, with both potential buyers and sellers having the confidence to be able to reliably value assets.

These transactions therefore can be thought of as showing the "peaks of the mountains" of the full spectrum of valuations over a limited time period rather than the entire continuous range of company valuations that would be characteristic of an efficient market.

Capacity to reflect broad sector fundamentals

The transactions also cover a small subset of the assets of the sector as a whole. Whether the subset is representative will depend on the characteristics of the transactions that take place. Considering the proportion of assets that are represented by the sales will help to inform the representativeness of the price information derived from these transactions and consequently its reliability.

The five water company transactions comprise a traded RCV of approximately £7bn (estimated since the exact stake involved in the Southern Water transaction is not in the public domain), of the total 17 companies in the sector. As shown in Table 7, the transactions

in 2021/22 related to only c.7.7% of the total sector RCV. while the one transaction so far in 2022/23 covers only 1.4% of the total RCV.

Table 7: Water sector transactions since 2020

	2021/22				2022/23			
	No of deals	RCV traded, £m	Total RCV (March 2021), £m	Share of 2021 RCV	No of deals	RCV traded, £m	Total RCV (March 2022), £m	Share of 2022 RCV
Water and Sewerage Companies (WaSCs)	3 (of 11)	c.5,400	73,133	c7.3%	1	1,137	79,555	1.4%
Water only Companies (WoCs)	1 (of 6)	556	4,077	13.6%	-	-	4,493	-
Total sector	**4 (of 17)**	**c.5,900**	**77,210**	**c7.7%**	**1**	**1,137**	**84,048**	**1.4%**

Note: The total RCV transacted in 2021/22 is an estimate as the exact ownership stake in Southern Water involved has not been publicly disclosed, stated only as "majority".
Source: Ofwat 'Regulatory Capital Values 2022'[71]; KPMG analysis.

This is a very limited sample from which to draw conclusions about the valuation assumptions for the sector as a whole. Especially as the prices paid in each of these transactions will have been driven by unique characteristics specific to the individual companies and winning bidders' demand, which are not necessarily representative of the underlying valuation basis of the sector as a whole.

Successful transactions inherently represent a statistically biased sample of the sector's valuation. The fact that sales are willingly transacted by buyer and seller means that an expected MAR in excess of 1 must exist otherwise the seller can wait for a better opportunity (unless forced to sell by external circumstances).

Summary

In summary, the information which can be obtained from observed transaction MARs is limited by:

- involving a small number of participants and low frequency of trades;
- a selection bias on the part of sellers, and cyclical timing of opportunities; and
- not being representative of the sector as a whole, and inherently comprising a statistically biased sample.

These various limitations indicate that the suitability of MARs observed from private transactions to explain the fundamentals of a particular asset, including individual regulatory price control parameters determining its cash flows, is significantly compromised. There is no continuous, efficient market for these assets, and the observed transactions are point-in-time valuations that are prone to biases rather than efficient pricing signals that could inform the level of return at which the market would commit capital to the sector in general.

4.3 Equity analysts' reports on traded water companies

This section examines the extent to which equity analysts' valuations of public companies allow for a decomposition of observed traded MARs in a transparent manner that would

[71] Ofwat 'Regulatory Capital Values 2022' available here.

support the conclusion that a clear relationship can be assumed between the MARs and rate of return.

A review of equity analysts' sum-of-the-parts valuations on the traded water companies, SVT and UU, since March 2021 shows a wide range of assumptions about the contribution to each company's total enterprise value from different sources, including an estimated/assumed premium to RCV, the non-regulated and retail businesses, and any pension surplus or deficit.

Reports by Credit Suisse, Exane BNP Paribas, HSBC, Investec, Jefferies, JP Morgan, and Morgan Stanley published between March 2021 and August 2022 were reviewed for this assessment, 18 covering Severn Trent and 19 on United Utilities, with the results from each summarised in Table 8 and Table 9 below.

Differing approaches are taken to estimating a company's value: some use a discounted cash flow (DCF) analysis of forecast cash flows with a terminal value, others assume a premium over the current/forward RCV as a starting point, while a few explicitly estimate company outperformance (totex, ODIs, and financial). The value of non-regulated and retail businesses is typically added on through assumed EV/EBITDA or EV/EBIT multiples or as the book value, with pension valuations further impacting overall EV.

Table 8: Equity analysts' estimates of Severn Trent value components

Analyst report	Date	Non-regulated	Retail	Pension surplus / (deficit)	Premium to regulated RCV
JP Morgan	28 Jun 22	1.2%		-2.1%	15.0%
Investec	16 Jun 22	3.7%	0.3%	-0.6%	25.0%
Credit Suisse	20 May 22	6.9%		-1.4%	17.7%
Jefferies	22 Feb 22	2.1%		-3.8%	16.4%
Morgan Stanley	17 Feb 22	4.1%		-1.4%	28.6%
JP Morgan	24 Nov 21	1.3%		-3.3%	30.0%
Credit Suisse	25 Oct 21	6.2%		-1.4%	16.9%
JP Morgan	15 Oct 21	1.5%		-3.5%	30.0%
Investec	08 Oct 21	3.6%	0.4%	-2.5%	31.0%
Jefferies	08 Oct 21	1.5%		-3.6%	33.7%
JP Morgan	24 Sep 21	1.7%		-3.7%	30.0%
HSBC	21 Sep 21	5.8%			9.0%
Exane BNP Paribas	25 Jun 21	10.8%		-3.4%	10.8%
Credit Suisse	24 Jun 21	7.1%		-1.7%	17.9%
Investec	04 Jun 21	3.7%	0.4%	-2.5%	32.0%
HSBC	27 May 21	5.8%			9.0%
JP Morgan	29 Apr 21	1.7%		-3.7%	30.0%
Exane BNP Paribas	20 Apr 21	11.4%		-2.4%	5.5%
Range of estimates		**1.2% – 11.4%**	**0.3% – 0.4%**	**-3.8% – -0.6%**	**5.5% – 33.7%**

Source: KPMG calculations based on analysts' reports on dates indicated.

Table 9: Equity analysts' estimates of United Utilities value components

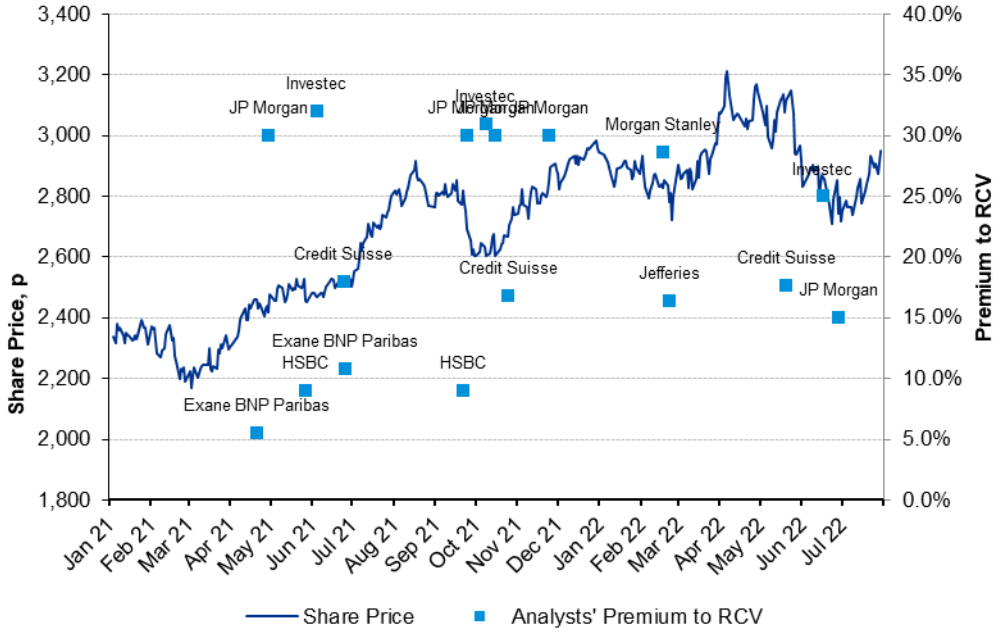
Analyst report	Date	Non-regulated	Retail	Pension surplus / (deficit)	Premium to regulated RCV
Credit Suisse	2 Aug 22	0.7%		2.4%	15.4%

Analyst report	Date	Non-regulated	Retail	Pension surplus / (deficit)	Premium to regulated RCV
JP Morgan	28 Jun 22	0.5%		0.0%	10.0%
Investec	16 Jun 22	0.1%	0.3%	5.2%	20.0%
Credit Suisse	13 Apr 22	1.6%		3.8%	13.7%
Investec	28 Mar 22	0.0%	0.3%	4.4%	26.0%
Jefferies	22 Feb 22	0.5%		5.0%	8.6%
Morgan Stanley	17 Feb 22	0.1%		0.0%	14.8%
JP Morgan	24 Nov 21	0.5%		0.0%	19.0%
HSBC	29 Oct 21	2.3%			4.4%
Credit Suisse	22 Oct 21	1.6%		3.8%	15.5%
Investec	08 Oct 21	0.0%	0.4%	4.5%	31.0%
Jefferies	08 Oct 21	0.5%		4.7%	21.7%
JP Morgan	28 Sep 21	0.5%		0.0%	19.0%
Exane BNP Paribas	25 Jun 21	8.5%		0.0%	7.4%
Credit Suisse	18 Jun 21	1.7%		3.9%	13.9%
Investec	04 Jun 21	0.0%	0.4%	4.5%	32.0%
JP Morgan	29 Apr 21	1.1%		0.0%	19.0%
Exane BNP Paribas	20 Apr 21	10.5%		0.0%	4.4%
Investec	26 Mar 21	0.0%	0.4%	4.5%	20.0%
Range of estimates		**0.0% – 10.5%**	**0.3% – 0.4%**	**0.0% – 5.0%**	**4.4% – 32.0%**

Source: KPMG calculations based on analysts' reports on dates indicated.

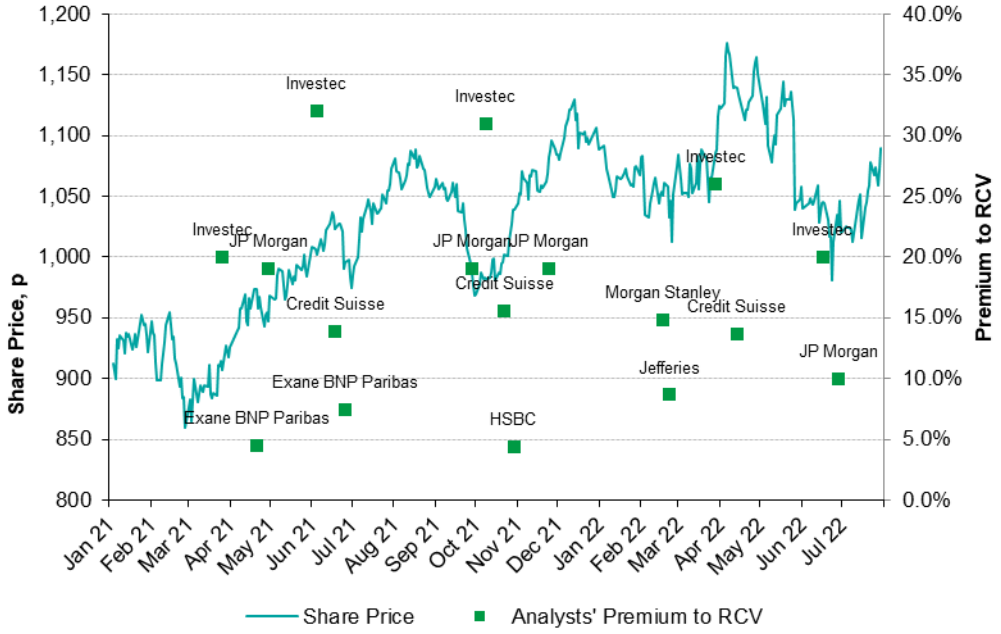
It also appears that there is no obvious relationship between estimated premium to RCV and the actual share price performance of the company with a wide variance between analysts' estimates even at similar times, as seen in Figure 3 and Figure 4 below:

Figure 3: Severn Trent share price against analysts' estimated premia to RCV



Source: Refinitiv; KPMG analysis.

Figure 4: United Utilities share price against analysts' estimated premia to RCV



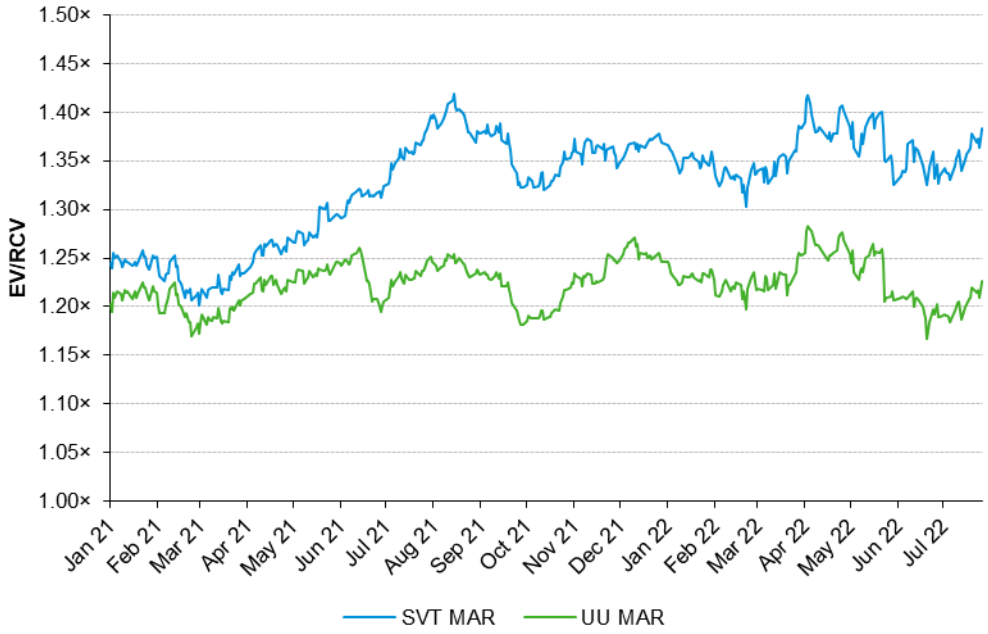
Source: Refinitiv; KPMG analysis.

The variation in published reasonings and views highlights the range of unknown assumptions and expectations behind investors' valuations:

- For example, in April 2021 Exane BNP Paribas estimated the lowest premium to RCV among the reports reviewed for both companies: £561m on an RCV of £10,178m (5.5%) for Severn Trent on the basis that the company's impressive track record on outperformance was already *"fully priced-in"*, while they also *"struggle[d] to find catalysts for a further re-rating"* following United Utilities' *"very decent share price performance year-to-date"* with a £514m outperformance estimate on a forecast £11,592m RCV (4.4%).
- JP Morgan though at the same time assumed a 30% premium to forecast RCV for Severn Trent and 19% for United Utilities, with the latter deemed to be trading at a level that underappreciated *"the company's potential for RoRE outperformance beyond AMP7, especially with a strong track record of financing outperformance."*
- In June 2021 Investec estimated a 32% premium to RCV for both companies, the highest level for United Utilities and close to the highest for Severn Trent in the review, based on expected improved outperformance and the outcome of the CMA appeals being *"a longer-term positive for the broader water industry."*

Implied MARs from the share price movements of the two companies over this same period are shown in Figure 5 below:

Figure 5: Water companies' implied traded MARs since January 2021

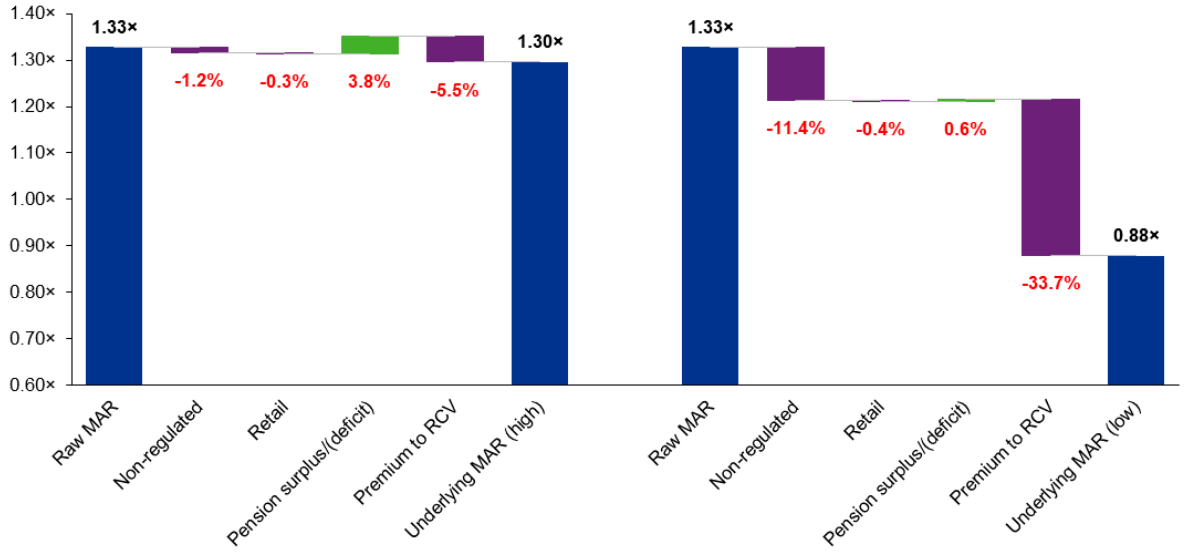


Source: KPMG calculation based on Eikon (enterprise value) and Ofwat (RCV) data.
Note: Daily traded MARs have been calculated assuming RCV and net debt change linearly through the year.

Over this period, the implied traded MAR for Severn Trent has ranged between 1.20 and 1.42 with an average of 1.33, while that for United Utilities has varied between 1.17 and 1.28 with an average of 1.22. These are generally lower than the raw MARs observed from the private transactions.

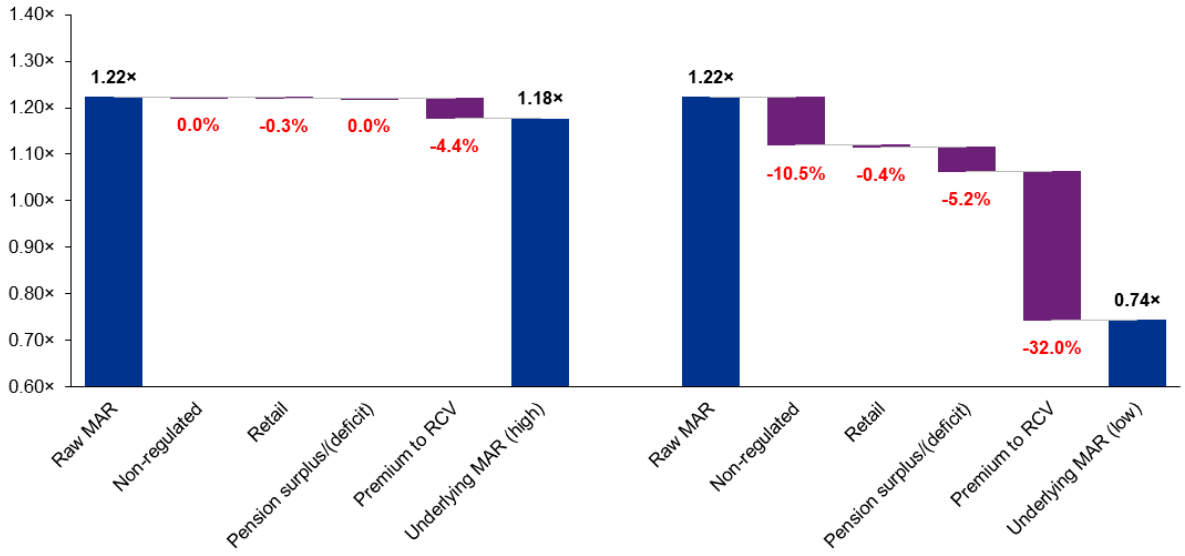
By applying the ranges of equity analysts' estimates for the various value components to these observed implied average traded MARs, it is possible to decompose an underlying value for the pure MAR of the regulated business. This is shown for each of SVT and UU in Figure 6 and Figure 7 respectively below, with each component – non-regulated business activities, retail, pension surplus/deficit, and the estimated premium to RCV – removed from the observed MAR:

Figure 6: Decomposition of MAR for Severn Trent



Source: KPMG analysis.

Figure 7: Decomposition of MAR for United Utilities



Source: KPMG analysis.

As seen, decomposing the average observed MAR with the range of these components indicates that the underlying regulatory MAR could vary between **0.88 and 1.30** for SVT and from **0.74 to 1.18** for UU. This range of MARs mirrors that derived from the previous sensitivity analysis.

This broad range of the potential valuation of the underlying regulated business compared to the RCV, indicates that it is very difficult to draw any meaningful conclusions about specific investor assumptions on individual aspects of the regulatory settlement from implied MARs of the traded water companies.

In addition, it should be noted that Severn Trent and United Utilities are among the best performing companies in the sector, as evidenced by their most recent RoRE performance as previously shown in Figure 1 above.

Therefore, it is even less reliable to attempt to draw conclusions for the sector as a whole from the share price performance of these two companies.

5 Conclusions

Based on all the research and analysis in the report, this section assesses MAR against the cross-check criteria that are set out in Section 2 of this report. This section also provides a high-level evaluation of other cross-checks against the criteria, for comparative analysis purposes and to test whether there are better alternatives to MAR. Finally, this section sets out some key conclusions on the use of MAR in price control determinations.

5.1 Evaluation of the use of MAR against criteria

The use of MAR is assessed against the cross-check criteria to explore how it fares against the principle of being transparent, targeted, objective, incentive compatible, and consistent with precedent and academic literature.

5.1.1 Transparent: whether the approach uses widely observed information which gives replicable results

The information to calculate traded MARs—equity market value and net debt, which makes up the EV, and the RCV—often appear available. However, such figures do not necessarily reflect the MAR for the regulated business alone as listed companies undertake other activities beyond the regulated ones. In practice, it appears that the value decomposition cannot be effectively carried out. This is highlighted by the review of equity analysts' reports for the traded water companies, which shows that there is a wide range of estimates of the relative value of the regulated and unregulated businesses. This means that it is very difficult to reliably and consistently separate out the cost of capital as a driver of the underlying regulated MAR.

Transaction MARs are in fact not as readily available, especially those involving private companies. Often specific details of the transaction are not publicly disclosed (including sale price, ownership stake, transaction boundary, etc.), and even when they are it can be unclear exactly what the transaction value refers to.

Overall, therefore, MARs appear to only partially fulfil the criterion of transparency.

5.1.2 Targeted: whether the indicator can accurately isolate the desired effect from other factors

The target of the cross-check in this instance is to assess and provide a measure of whether the allowed return on equity is sufficient, but not excessive. However, as highlighted in Section 3, in order to be able to conclude that the 'true' rate of return assumed by an investor is different from the allowed return based on MAR, many long-term assumptions on the future cash flows, operational performance and others would need to be made with a high degree of certainty.

Additionally, it is important to consider the market and the point in the global economic cycle, which could contribute to some asset classes being over or under valued due to supply and demand imbalances that aren't reflective of the underlying valuation fundamentals.

There are many unknowns in the determination of a company's value, and the calculated MAR cannot be solely attributed to a difference in investors' assumed return of equity from the allowed return.

This untargeted nature of MAR, particularly as it is difficult to isolate the cause of the premium from the 'noise', is inconsistent with the principles of better regulation introduced by the Better Regulation Taskforce. These principles, and the building block approach, are

designed to avoid a situation where untargeted regulatory mechanisms produce unintended consequences.

Overall, therefore, inferences from MARs **do not meet the criterion for targeted regulation** as they cannot reliably isolate the required information from other factors.

5.1.3 Objective: whether the cross-check can be relied upon as an unbiased indicator

Transaction MARs are by their nature biased towards the winning bidder's aims, assumptions, and strategic advantages. The issues highlighted regarding transactions in Section 3.2 and hence inefficiency, investors' expectations and biases, winner's curse, unique individual circumstances, etc, mean that by their very nature these are not unbiased indicators of a company's value.

Conversely, traded MARs (when taken in aggregate rather than one individual assessment) do reflect a much broader set of market expectations and assumptions for the company and companies in the sector and could thus be considered to having a wider, more informed view of the various valuation assumptions. Traded MARs also suffer from certain problems and limitations as efficient market signals but less so than private transactions.

In this regard, it would suggest that MARs do **partially meet the objective criterion** but they also vary significantly over time and face the same limitations in linking observed or derived value to the allowed rate of return as a driver so they **cannot be considered an unbiased indicator of the required return.**

5.1.4 Incentive compatible: whether the indicator could distort regulatory incentives

Incentive based regulation is based on a series of carefully calibrated incentive mechanisms applying to costs and service levels. Each of these incentives is designed to provide an economic motivation for companies to apply additional effort where the cost of that effort is less than the benefit to consumers. This aligns incentives between consumers and network companies to promote overall welfare gains for both. For example, the incentive rate applied to an ODI might be related to consumers' willingness to pay for a unit of service improvement. This would ensure that the company is incentivised to apply effort up to the value of that willingness to pay if it can deliver the associated improvement.

The application of MARs by Ofwat to revise the allowed cost of equity (whether up or down) could cause regulated companies to behave in ways which were not intended and not in the best interests of consumers. Specifically, if it was feared that any outperformance – whether in totex, ODIs, or financing – which pushed the company's MAR above 1 (as explored in the stylised sensitivity analysis above) would subsequently result in a further reduction in the allowed cost of equity and the introduction of the 'ratchet effect'. This would further dampen incentives for improved performance as companies may fear that any rewards gained during a price control will be clawed back at the next price control through a reduced cost of equity.

A disincentive to outperform on totex allowances and/or ODIs, if not adequately controlled for when relying on MAR, will thus also have adverse consequences for consumers, through the potential disincentive that it may create, such as higher costs and/or worse customer service.

This potential ratchet effect would tend to suggest that MARs **are not incentive compatible as a cross-check**.

5.1.5 Consistent: whether the indicator is consistent with economic theory, established regulatory precedent and academic research

MARs have been adopted and accepted as a cross-check on a varying basis over time by regulatory authorities, as detailed in Section 1.3. The CMA accepted that Ofgem did not err is using MARs as one of a set of cross-checks. However, its use on its own was deemed not be reliable.

Academic literature and research has been generally clear that MAR cannot be used to observe cost of equity without controlling for other factors which influence companies' values. There is significant 'noise' in both traded markets and private transactions that cannot be directly controlled (behavioural biases, winners' curse, empire building mindsets, etc.) which directly influence the MAR. It is notable that the academic studies on this subject do not look at the effect of the cost of equity as there are so many more important drivers of a company's valuation (such as quality of management, economic outlook) that the cost of equity has a relatively small effect – when a company's stock price goes or down, it's due to a news announcement (e.g. a management change), changes in the company's expected future profits, etc., not changes in the company's beta and hence cost of equity.

On this basis, while MARs have been occasionally used by regulators as a cross-check, such usage was only deemed reliable when part of wider set of indicators, and the academic dismissal of them as a basis for the cost of equity would suggest that they **partially** meet the consistency standard.

5.2 High-level comparison against other cross-checks

A comparison of MARs against other potential cross-checks for the cost of equity, specifically multi-factor models (MFMs),financeability tests, hedge ratios and quantification of risk exposure has also been undertaken based on the same criteria.

It is important to acknowledge that any cross-check is subject to limitations, and it is unlikely that a single cross-check would fully satisfy all five elements of the criteria. The criteria are intended to guide the assessment and ensure that a given cross-check is as robust and effective as possible.

A wholesale detailed analysis of the suitability of the other cross-checks, with reference to theory and in practice, was out of scope for this report, therefore, this section explores only at a high level how other cross-checks perform against the cross-check criteria. All of the chosen cross-checks have the same apparent benefit as MARs, namely relying on independent publicly available market data.

Table 10 below presents an overall summary of how each of the five cross-checks performs against the criteria. Further discussion and the individual assessments for other cross-checks are shown in Table 11 to Table 14. It is relevant to note that the design of financeability test, which is discussed below, is assumed to be based on the CMA's approach for the PR19 determination.

Table 10: A high level assessment of potential cross-checks against criteria

Criterion	MARs	Multi Factor Models	Financeability (per the CMA)	Hedge ratios	Analysis of risk exposure
Transparent					
Targeted					
Objective					
Incentive					
Consistent					

Note: Green indicates that the cross-check meets the criterion well; Amber that is partially does so; and Red that it does not do so.

Table 11: Assessment of multi-factor models (MFMs) against cross-check criteria

Criterion	Assessment of MFMs	Suitability
Transparent	MFM use publicly available observed data and prescriptive methodologies set out in seminal academic papers. They require limited judgment and are not dependent on assumptions regarding the future (as they rely on past data only). The only judgement required is on how to tailor the factor construction approaches to the UK market (e.g., the frequency of accounting reporting) but this can, to an extent, be informed by existing academic papers which apply MFM to the UK market and only affects limited number of parameters.	Partial
Targeted	MFMs are fully targeted as they assess the required returns directly based on the risks faced. MFM are based on the same core underlying principle as CAPM and describe the return on an asset in terms of the risk of the asset with respect to a set of factors. MFMs ultimately represent extensions of CAPM i.e., they augment CAPM (which is based on the market factor only) with additional explanatory factors.	Good
Objective	MFMs have been proven to be statistically robust based on extensive empirical analysis, with better empirical performance than the CAPM across several statistical tests. In fact, the genesis of MFMs was the consistent finding from academic research of a series of empirical shortcomings in CAPM to explain observed returns. By design, MFMs are a more unbiased estimator of required returns than CAPM.	Good
Incentive compatible	MFMs imply at least the same degree of compatibility with incentives and regulatory objectives as CAPM and additionally provide statistically more robust evidence of the required returns for a given level of risk of the asset with respect to a set of factors.	Good
Consistent	MFMs are well established and are the standard asset pricing model used in academia and by practitioners to explain and estimate excess returns (over and above the risk-free rate). MFMs have been used as the preferred asset pricing model for over thirty years. Standard corporate finance textbooks position MFMs as the mainstream model for measuring risk for both academics and practitioners. Large assets managers, including those who have historically invested in regulated utilities, use MFMs to explain returns and manage risk across their portfolios. In the regulatory context, UKRN and CMA have recognised the stronger explanatory power of MFMs compared to CAPM, however some regulators have previously dismissed them as too complex to apply and interpret.	Partial

Table 12: Assessment of financeability tests (as per CMA's approach) against cross-check criteria

Criterion	Assessment of Financeability tests	Suitability
Transparent	Financeability tests are undertaken based on the price control models published by the regulators and are directly based on the proposed parameters for the price control. Debt financeability tests should be applied following the prescriptive guidance provided by rating agencies. There may be greater judgement in designing equity financeability tests, but these can be grounded in Corporate Finance theory.	Good
Targeted	The financeability cross-check diagnoses the calibration of the whole price control across WACC, cost allowance and other regulatory mechanisms such as incentives. However, as noted by the CMA at PR19, WACC is the primary driver of financeability suggesting that the impact of other factors is relatively limited.	Partial
Objective	Financeability test performed by the CMA at PR19 acted as an unbiased indicator of whether the allowed WACC is sufficient. However, it should be noted that the results of the financeability test can be distorted where their logical sequencing is reversed, and they become contingent on assumptions being made by a regulator (e.g., on notional gearing). However, this does not need to be the case.	Partial
Incentive compatible	Financeability tests are a unique cross-check as they are explicitly linked to the regulator's financing duty and so by design are incentive compatible and underpinned by core principles of UK regulation and years of precedent.	Good
Consistent	These tests tend to be applied in a regular, prescribed fashion.	Good

Table 13: Assessment of hedge ratios against cross-check criteria

Criterion	Assessment of Hedge ratios	Suitability
Transparent	Hedge ratios focus on checking if the gap between the cost of equity and the cost of debt is sufficiently high to compensate for the additional risk inherent in equity financing (i.e. the lower priority of equity relative to debt in terms of claims on cash flows) in order to promote equity investment. Hedge ratios use publicly available observed data and regulatory decisions in previous periods and are based on corporate finance principles. They require limited judgment and are not dependent on assumptions regarding the future (as they rely on past data only).	Good
Targeted	Hedge ratios are based on the delta between the risk premium on the assets of a company and the risk premium on the debt of the same company. The delta is expected to be positive since equity is more risky than debt. The Hedge ratio cross check considers how large the delta should be based on (1) an implied risk premium on debt derived using market data and (2) an estimated risk premium on assets derived from a mixture of market data and regulatory precedent. This can then be compared with the delta based on the regulator's determination of the allowed cost of debt and cost of equity. As a result, Hedge ratios are specifically targeted at assessing the return on equity relative to the cost of debt.	Good
Objective	Hedge ratios are calculated based on data calibrated from market information, and hence may be influenced by various inefficiencies in markets. External drivers beyond fundamentals may have an influence on observed values. Hedge ratios also effectively assume that regulatory decisions from previous periods appropriately priced the parameters used in the calculation. To the extent that this is not the case (e.g. total market return was understated), the results of the cross-check could be distorted.	Partial
Incentive compatible	The premise underpinning Hedge ratios as a cross-check is that the allowed return is commensurate with the return that investors can earn on investments of comparable risk and so is sufficient to ensure adequate equity investment in a company. This should therefore ensure that the regulator's objectives of securing capital required for investment which is in customers' interests.	Good

Criterion	Assessment of Hedge ratios	Suitability
Consistent	While Hedge ratios have been suggested for use as a cross-check on the cost of equity, there is not a widely established regulatory precedent for use of hedge ratios as a cross check. Hedge ratio analysis is also relevant to the assessment of financeability as it is comparable to coverage ratios such as AICR and PMICR applied by rating agencies. Both hedge ratios and coverage metrics consider returns on assets relative to the return on debt.	Partial

Table 14: Quantification of risk exposure against cross-check criteria

Criterion	Quantification of risk exposure	Suitability
Transparent	The quantification of risk as a cross check compares financial risk exposure based on historical business evidence and macroeconomic data to the financial buffer available for management of risk. While the returns achieved can be readily measured from publicly available information, the quantification of different types of risk on a forward-looking basis may not always be observable but instead based on simulations and scenario analysis.	Partial
Targeted	Risk analysis captures the full spectrum of risk (i.e. systematic and asymmetric) and hence can cross check holistically whether the allowed returns are commensurate with the risk exposure faced by the regulated companies. Risk analysis is fully targeted as it assesses the required returns directly based on the risks faced based on the calibration of the price control and risks allocated to companies. Risk analysis reflects water company obligations and incentives— some of the most important risks that water companies face include non-compliance with regulatory standards, health & safety risks, response costs, inability to identify significant events quickly. Risk analysis also checks whether equity returns provide sufficient buffer for companies to manage significant events and risks.	Partial
Objective	Quantification of different categories of risk can sometimes be somewhat subjective and requires judgment, particularly where risks are new or changing.	Partial
Incentive compatible	Quantification of risk is linked directly to calibration of regulatory mechanisms and incentives and hence can sense check that design of regulatory mechanisms does not introduce perverse incentives (for example setting allowed returns below required returns on a mean expected basis) or undermine the ability of the sector to attract capital.	Good
Consistent	Risk analysis has long formed part of standard price control processes – most notably in stress testing projected credit metrics and RORE analysis as part of financeability and financial resilience assessments.	Good

The assessment presented in the tables above suggests that there are better options than MARs for use as cross-checks on the allowed cost of equity in regulatory price control determinations. There is a risk that if MARs are used to inform the allowed cost of equity, mainly based on the most recent private transactions or from listed utilities in GB, this may be incentive incompatible and may result in biased estimates.

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A5 Relative risk analysis and beta estimation – report by KPMG

Relative risk analysis and beta estimation for PR24

Report prepared for Water UK

September 2022

Contents

1 Important notice

This Report has been prepared by KPMG LLP ('KPMG', 'we' or 'our') for Water UK on the basis of an engagement contract between Water UK and KPMG (the "Engagement Contract"). Water UK commissioned the work to assist Water UK in its considerations regarding the Water Services Regulation Authority's (Ofwat) draft methodology consultation for the next price control in the water sector (PR24). The agreed scope of work is included in Appendix 1 of this Report. Water UK should note that our findings do not constitute recommendations as to whether or not Water UK should proceed with any particular course of action.

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In particular, and without limiting the general statement above, since we have prepared this Report for the benefit of Water UK alone, this Report has not been prepared for the benefit of any other person or organisation who might have an interest in the matters discussed in this Report, including for example water companies or regulatory bodies.

Information in this Report is based upon publicly available information and reflects prevailing conditions as of the date of the Report, all of which are accordingly subject to change. Although we endeavour to provide accurate and timely information, there can be no guarantee that such information is accurate as of the date it is received or that it will continue to be accurate in the future. Information sources and source limitations are set out in the Report. We have satisfied ourselves, where possible, that the information presented in this Report is consistent with the information sources used, but we have not sought to establish the reliability or accuracy of the information sources by reference to other evidence. We relied upon and assumed without independent verification, the accuracy and completeness of information available from public and third-party sources. KPMG does not accept any responsibility for the underlying data used in this report.

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2 Executive summary

2.1.1 This Report was commissioned by Water UK to estimate beta and consider whether Ofwat's proposed approach to determine beta would result in estimates reflective of the systematic risk exposure faced by water companies at PR24.

2.1.2 The Report estimates beta based on relevant financial literature, regulatory principles, and market evidence. The estimation of beta involves several steps to select the right methodology and to inform the approach to derive unbiased estimators. The key steps are set out below:

- Assessment of how risks are expected to change at PR24 relative to PR14 and PR19
- Analysis of structural breaks[1] arising from SARS-CoV2/Covid19 (hereafter "Covid19" or "Covid") and the Russia-Ukraine war
- Approaches to de- and re-levering beta
- Estimation of beta

2.2 Analysis of structural breaks arising from Covid19 and the Russia-Ukraine war

2.2.1 Covid19 and the Russia-Ukraine war – which have had a very material impact on the global and UK economies – represent statistically significant structural breaks for water company betas. In consequence a key question for estimation of beta at PR24 is how the beta estimation should take into account observed structural breaks related to these events.

2.2.2 To explore this, the Report considers:

- The relevant investment horizon for beta estimation, as the cost of capital is time varying over short time horizons. This is because interest rates, the risk-free rate observed from proxy instruments and rolling, and spot betas can change materially when estimated over short or long horizons.[2] The specified time horizon can therefore be an important input into the estimation of WACC.
- The methodology for estimation of returns based on an *unconditional* CAPM used in regulation, which estimates required return on an equity investment over a single

[1] A structural break is an observable change over time in the parameters of regression models, which can lead to forecasting errors and unreliability of the model.

[2] In theory, the TMR also changes for different time horizons, as the time period for averaging annual returns differs for different time horizons.

period or investment horizon[3].

— Interpretation of structural breaks relating to Covid19, and the Russia-Ukraine war based on a long-run investment horizon and for the purpose of setting an unconditional beta.

Setting beta based on a long-run investment horizon

2.2.3 It is appropriate for the investment horizon for estimating the forward-looking cost of equity in regulatory price controls to be long run. This is because both debt and equity investors in regulated utilities make long-term financing decisions. On average debt instruments used by regulated utilities have a very long tenor, one of the longest of all industries. Similarly the equity payback period in utilities is very long due to the way cashflows are structured, in line with the asset lives of the underlying infrastructure.

2.2.4 The adoption of a long run horizon is consistent with Wright et al (2018)[4], who recommend use of a long-run time horizon because regulatory assets tend to be long-lived. This Report assumes an investment horizon of at least 15Y in line with the horizon reflected in Ofwat's draft methodology.[5]

2.2.5 The chosen time horizon should be specified clearly and the estimation of each parameter in the WACC should be carried out through the lens of the chosen time horizon, as far as possible, as otherwise the WACC estimate is not a true expected return over the chosen time horizon. This is a key requirement as reflecting short term variation in betas – such as variation observed in relation to Covid19 and the war – may not be reflective of risks and return requirements over the selected long-run investment horizon, would not be consistent with the basis for estimation of other parameters such as the risk-free rate and in turn might not attract long-run capital to the sector.

Setting returns based on an *unconditional* CAPM

2.2.6 As noted by Ofwat in the PR24 draft methodology consultation, the version of CAPM used by regulators estimates the required return on an equity investment over a single period or investment horizon[6].

2.2.7 This *unconditional* version of CAPM does not distinguish between different potential future states of the world and does not consider that beta will vary over time. For example, the assumption underpinning the CAPM based on a 15Y investment horizon is that beta would not vary on average across this period. In other words short term

[3] Appendix-11-Allowed-return-on-capital-appendix.pdf (ofwat.gov.uk) p. 3

[4] See, for example, Recommendation 2 in Estimating the cost of capital for implementation of price controls by UK Regulators

[5] Ofwat also refers to 15Y Gilts in the context of the risk-free rate, which all else equal, suggests an investment horizon of at least 15 years. Appendix-11-Allowed-return-on-capital-appendix.pdf (ofwat.gov.uk), p. 5

[6] Ibid, p. 3

fluctuations in beta, for example due to Covid, are 'noise' which the unconditional CAPM 'looks through' to estimate beta over the long term.

2.2.8 By contrast Ofwat assumes that systematic risk events such as Covid19 *change* beta. This is not consistent with an unconditional CAPM. Where systematic risk events change beta, the corollary is that returns should be estimated based on a *conditional* CAPM which assumes that betas vary over time and captures short-term variation in different economic climates.

2.2.9 This Report focusses on estimating an *unconditional* beta for the selected investment horizon. For this a measure of a constant, long run beta is required. As a result the Report considers whether and how recent structural breaks arising from Covid19, and the war should be taken into account in estimation of beta on an *unconditional* basis which is not sensitive to different economic scenarios.

Interpretation of Covid19 and Russia-Ukraine war structural breaks

2.2.10 Covid19 and the war have had a material impact on water company betas measured over shorter-term estimation windows. To assess the weight that should be given to the affected data in the context of setting long-run unconditional betas for PR24, this Report considers:

- *How likely is it that pandemics with similar impact to Covid19 will occur over the (at least) 15Y investment horizon assumed by Ofwat?*
- *Is the impact of the Russia-Ukraine war likely to be temporary or protracted, relative to the investment horizon implied by the PR24 WACC?*

2.2.11 There have been several studies which have sought to estimate the likely frequency of pandemics which are comparable to Covid19. Ofwat's draft methodology is predicated on a paper which considers the potential frequency of pandemics which are comparable to Covid19 in terms of severity and duration. This paper estimates the base probability of experiencing a comparable pandemic as 0.38 to 0.76 in 100Y[7], which suggests that the likelihood that another pandemic event occurs in the estimation window is low.

2.2.12 The CMA recognised that a global pandemic with comparable impact to Covid19 is relatively rare and was likely to be over-weighted in the CMA's beta estimates, which covered the last 2-, 5- and 10-year periods[8]. An analysis of the CMA's approach suggests that only c. 3.7% of data used to derive PR19 beta estimates could have been Covid-affected. In the context of the 20-year investment horizon employed by the CMA, this corresponds to an assumption that a pandemic of a similar scale as experienced

[7] Intensity and frequency of extreme novel epidemics | PNAS

[8] CMA PR19 FD, para. 9.493

during the first ten months of Covid19 would occur during c 0.74 years out of 20. As a result, the CMA's range for beta is relatively unaffected by Covid19 estimates.

2.2.13 Notably, the Civil Aviation Authority in its Final Proposals for the H7 price control for Heathrow set a beta assuming that a pandemic-like event would occur once in every 20 or 50 years. [9]

2.2.14 As a result, attaching material weight to the data from the Covid19 period (c. 2 years) within the evidence used to set beta estimates for PR24 risks assuming that a pandemic of a similar scale occurs more frequently or lasts longer than justified by the available evidence.

2.2.15 Forecast inflation – the chosen proxy to quantitatively evaluate the timing of reversion to 'normal' economic conditions following the war – is expected to revert to long-term target levels ahead of the start of the PR24 price control. In combination with the actions being undertaken to mitigate the economic impact of the war on Europe (for example via increasing self-supply of energy)[10], available evidence implies that the impact of the war could reverse in the next couple of years and is not likely to be relevant for setting the allowed returns for PR24 over the investment horizon.

2.2.16 The change in short-term water company betas following the pandemic and the war appears to be a function of the 'flight to safety'[11] phenomenon whereby in times of market turbulence investors respond by switching their holdings away from higher risk investments into investments which are perceived to be low risk. In March 2020, the flight to safety in financial markets even became an abrupt and extreme 'dash for cash' in which investors sold off even safe assets such as long-term government bonds in order to obtain short-term highly liquid assets.[12] The effect of the flight to safety behaviour is to simultaneously (1) raise the price and reduce the return of lower risk assets and (2) lower the price and increase the expected return on higher risk assets.

2.2.17 These behavioural factors such as flight to safety or dash for cash are temporary *by nature*[13] and are a feature of a specific set of economic conditions rather than driven by

[9] Economic regulation of Heathrow Airport Limited - H7 Final Proposals Section 3: Financial issues and implementation (caa.co.uk), section 9

[10] REPowerEU (europa.eu) implied increases in the self-generated supply of renewable energy and the decrease in the reliance on Russian exports can reasonably be expected to mitigate the price pressures arising from the war.

[11] On the impact of Covid19, see for example, Interim Financial Stability Report May 2020 (bankofengland.co.uk) p. i; Learning from the dash for cash – findings and next steps for margining practices - speech by Sir Jon Cunliffe | Bank of England; UK investment Management Industry: A Global Centre p. 16

On the impact of the Russia-Ukraine war, see for example, The Fed - The Effect of the War in Ukraine on Global Activity and Inflation (federalreserve.gov), Western credit markets are holding up remarkably well | The Economist

[12] Interim Financial Stability Report May 2020 (bankofengland.co.uk) p. i

[13] See for example, "*when investors pile into government bonds because they are looking for safe and liquid assets, such as in the summer of 2011, demand temporarily increases, pushing up prices and driving down yields*". Bond scarcity and the ECB's asset purchase programme (europa.eu)

fundamentals. All else equal this indicates that attaching material weight to economic conditions in a period of market distress would likely distort a beta estimated on an unconditional basis and for a long-run investment horizon.

2.2.18 This Report focuses on (1) estimates which exclude all data from 1 March 2020 onwards, and (2) estimates which attach low weight to Covid19 data in order to avoid introducing a transitory and downward bias in the beta estimates which are intended to reflect expected returns over long-run holding periods (10 – 20 years), consistent with the remaining parameters in the CAPM framework (e.g. the tenor chosen for the risk-free rate).

2.2.19 There is nonetheless some inherent uncertainty in relation to whether the impact of a major shock is temporary and whether betas will mean revert. The Report therefore carries out relative risk analysis to assess whether systematic risk exposure is *expected to change* at PR24.

2.3 Assessment of how risks are expected to change at PR24 relative to PR14 and PR19

2.3.1 The CAPM is predicated on a positive and linear relationship between risk and return (the higher the risk, the higher the return). The cost of equity based on CAPM therefore directly estimates the return water sector investors can expect to achieve relative to the market portfolio, if they take on risk exposures of the sector relative to the market.

2.3.2 UKRN highlights in its principles for setting the cost of capital that returns should be "*risk reflective*" such that "*the reward will reflect the allocation of risk in the regulatory framework and sectors*"[14]. It is important that beta should reflect systematic risk in full. Regulated companies must be also compensated for any downside risk exposure on expected basis[15].

2.3.3 The Report considers the key risks for water companies and how these are likely to evolve at PR24, taking into account changes to the design of the regulatory framework. It also undertakes a relative risk assessment between CMA PR19 and PR24 (as well as between PR14 and PR24) to determine whether changes to water company risk exposure could impact on beta.

"*Using only daily data on bond and stock returns, we identify and characterize flight to safety (FTS) episodes for 23 countries. On average, FTS days comprise less than 3% of the sample* [the dataset consists of daily stock and 10-year government bond returns for 23 countries over the period January 1980 till January 2012]*, and bond returns exceed equity returns by 2.5 to 4%*". Flight to Safety, Finance and Economics Discussion Series Divisions of Research & Statistics and Monetary Affairs Federal Reserve Board, Washington, D.C

[14] UKRN cost of capital principles

[15] See for example, the CMA's approach to remunerating residual asymmetric risk on ODIs at PR19.

2.3.4 The risk assessment delineates between (1) systematic risks which are relevant for beta estimation and (2) risks which require compensation, due to a shortfall in mean expected cashflows, *in addition to* the remuneration for risk reflected in the beta.

2.3.5 The analysis indicates that are a number of risks which are likely to *increase* on a forward-looking basis, which is likely to result in an increase in systematic risk, all else equal. These increases stem from, *inter alia*, step changes in investment to meet environmental obligations for example in relation to storm overflows, population growth, the transition to Net Zero (which all increase deliverability risks), increased competition (which increase the risk of asset stranding) and more stretching performance targets (which increase the risk of regulatory penalties).

2.3.6 Analysis of relative risk across recent price controls indicates that – based on underlying dynamics of risk allocation implied by the regulatory framework – risk is at least as high as at PR19 and is likely to be *higher* at PR24. This finding is consistent with Ofwat's analysis that based on its current policy its "*overall package at PR24 is likely to put at least as much return at risk as at PR19"*[16].

2.3.7 Beta as a measure of systematic risk would be expected to be flat or increasing based on the analysis in this Report, assuming that the increasing risks have a systematic component. As the holistic assessment of risk factors which drive systematic risk for water companies indicates that risk exposure is *increasing*, the short-term impacts of Covid19 and the Russia-Ukraine war on beta can be seen as specific to prevailing economic conditions which, all else equal, should not be reflected in a long-run estimate of beta for PR24 which is reflective of systematic risk.

2.3.8 Some risks also result in 'uncovered' asymmetric downside exposure which would need to be compensated for separately from remuneration for systematic risk. Asymmetric exposure will not be priced in through beta, which prices in a risk premium (relative to the risk-free asset) without any skew. Unmitigated downside risk exposure that results in expected negative cashflows must be compensated for separately.

2.3.9 Importantly there is a lack of clarity around the calibration of certain aspects of the PR24 price control – such as incentive targets and full specification of the approach to cost assessment – and the assessment of relative risk and implications for systematic risk may need to be updated in due course when the framework is more fully specified. However, it is clear from the initial assessment set out in the table below (where red denotes higher risk exposure at PR24 than in previous price controls) that risk exposure for PR24 is likely to be higher than in previous price controls.

[16] Draft-methodology-main-document-3.pdf (ofwat.gov.uk), page 88

Table 1 Summary of relative risk analysis – PR24 compared to PR19 CMA outcome and PR14

Risk category	PR24 vs PR19 CMA	PR24 vs PR14
Demand risk i.e. volume risk *Systematic*	For PR24 Ofwat is proposing to remove certain developer services from the price review. This will likely affect the volatility of the revenue recovered by companies that contributes towards the overall revenue controls. This in turn, may affect how companies perform in relation to the revenue forecasting incentives (RFIs) compared to PR19.	PR14 had fewer disaggregated revenue correction mechanisms – it was set at a wholesale water / wastewater level. Greater aggregation meant that there was more scope for offsetting / netting off within the overall wholesale revenue forecasting incentive mechanism than at PR19 and at PR24.
Cost risk on Totex performance *Asymmetric*	The CMA used an upper quartile efficiency benchmark[17]. Ofwat is proposing to use a more stretching efficiency challenge. This increases the scope for underperformance. Ofwat is also proposing for significant performance improvements to be delivered from base expenditure allowances. These may act as an additional efficiency challenge on companies.	At PR14, the efficiency challenge used was upper quartile[18]. There was a complex menu arrangement for cost sharing that was not well understood. Ofwat is proposing an efficiency challenge that goes beyond upper quartile. All things being equal, this should lead to a more stretching efficiency challenge, and greater scope for underperformance.
Performance risk Outcome Delivery Incentives *Asymmetric*	Ofwat is proposing: - fewer but stronger incentives (less scope for a portfolio effect); - removal of caps, collars and deadbands including for penalty-only measures; - removal of exclusions for exogeneous factors (such as severe weather); and - increased use of common measures and reduction in the use of bespoke measures. All of the above create a more negatively asymmetric package for water companies.	At PR14 there were few common measures across the sector with companies more able to control where there were financial incentives. At PR24 the scope for use of bespoke measures is much reduced.
Financing risk arising from interest rate volatility and policy *Systematic*	Ofwat is proposing to index the cost of new debt (as per PR19). Use of the sector average as the primary methodology for estimation of the cost of debt allowance may create additional exposure to financing strategies adopted by other companies.	Ofwat introduced an indexation approach for the cost of new debt at PR19 which reduces risk. On the other hand, the use of sector average at PR24 may increase risk. At PR14 both cost of debt and cost of equity reflected historical yields as the risk-free rate was set assuming some

[17] CMA PR19 FD, para. 36

[18] det_pr20141212wholesale.pdf (ofwat.gov.uk)

		reversion to the long-term mean. On balance, the exposure is likely to be broadly comparable between PR14 and PR24.
Performance risk sharing on Outcome Delivery Incentives *Asymmetric*	At PR19 there was an overall reward cap. For PR24 Ofwat proposes to remove the overall reward cap. This increases the scope for potential upside, should companies earn >3% RoRE. However, on a mean-expected basis this change is likely to be neutral for risk exposure as the impact of the removal of the cap is likely to be limited in practice and it is not clear that performance beyond the cap is a plausible outcome.	At PR14, Ofwat had a five-year aggregate cap of +/- 2% RoRE – i.e., the new proposals increase risk (upside and downside) outside of the previous range.
Regulatory risk *Asymmetric* *Intervention risk is skewed to the downside.*	Greater media focus on water companies following coverage on storm overflows, FFT investigations, and drought restrictions.	Greater media focus on water companies following coverage on storm overflows, FFT investigations, and drought restrictions.

2.4 Approaches to de- and re-levering beta

2.4.1 The current regulatory approach to gearing, as determined in PR19, involves Ofwat setting a notional level of gearing based on a number of principles and estimating what a company's weighted average cost of capital ("WACC") would be at this notional gearing level. In this context, the notional equity beta is derived by estimating the raw equity beta for listed comparators and transforming it into a notional equity beta using the Harris-Pringle equation, observed EV gearing and assumed notional gearing and debt beta.

2.4.2 Mason and Wright (MW) argue in their paper on financial resilience and gearing[19] that this approach leads to a WACC that is *increasing* with gearing, which they consider is contrary to Modigliani and Miller (1958[20], "MM"). MW propose a number of remedies to this apparent problem. Ofwat also appears to consider that this dynamic is a problem, and proposes to "*set debt beta at the level which would make the CAPM-WACC calculation fully invariant to gearing*."[21]

2.4.3 Overall, the Report finds that there is not a clear problem with a WACC that is increasing with gearing. The MW analysis indicates that a primary driver of this dynamic might be that the cost of debt is set too high, but it is not clear that this is the case as there are multiple sources of imperfection which could impact on debt costs, such as illiquidity and

[19] Mason and Wright - A report on financial resilience, gearing and price controls - Ofwat

[20] Modigliani, Franco, and Merton H. Miller. "The Cost of Capital, Corporation Finance and the Theory of Investment." *The American Economic Review*, vol. 48, no. 3, 1958, pp. 261–97.

[21] Appendix-11-Allowed-return-on-capital-appendix.pdf (ofwat.gov.uk), page 20

regulatory intervention. There is no expectation that MM should hold *precisely* due to market frictions and distortions. As a result, whether WACC is increasing with gearing or not should not represent the sole criterion used to assess whether the current regulatory approach is correct.

2.4.4 Absent clear isolation of the specific frictions or regulatory interventions which are driving the dynamic of WACC increasing with gearing, caution is required to avoid introducing *additional* distortions into the estimation of WACC for regulatory price setting. Where specific frictions are identified, whether an adjustment is required for regulatory price setting should be assessed on merit. The commentary above – for example in relation to market frictions such as liquidity costs – indicates that it might not be appropriate to intervene.

2.4.5 While assuming the MM principle – that WACC should be invariant to gearing – is reasonable for the purposes of estimating cost of capital in a regulatory context, in practice as long as deviations are not very large, trying to strictly enforce MM is:

- difficult to apply objectively, including which parameter should be adjusted and by how much. An approach which forces invariance to gearing is trying to arrive at a combination of parameters that is ultimately not known, for example the resulting WACC is no longer a combination of parameters that were ex-ante determined to represent appropriate inputs into the estimation of allowed returns.
- can introduce new distortions (because it is not clear which level of WACC it might be correct to hold constant at different levels of gearing). Variance with gearing could be driven by a methodology for a different parameter which has been set too low. This does not appear to have been considered in the draft methodology at this stage. In this case hard-wiring debt beta – which all else would result in lower returns – could *compound* an existing issue which is already resulting in under-estimation of required returns.
- does not recognise that there might be various other factors affecting the cost of capital that might cause departures from MM

2.4.6 To avoid compounding or introducing additional distortions into the WACC, focus should be on the calibration of each parameter which all have margin of error which could be significantly larger than the variance to gearing highlighted in the draft methodology. This is consistent with the methodology applied by the CMA at PR19, which noted *small* increases in WACC with gearing[22] – which is in line with expectations that WACC at different gearing levels would be *broadly* unchanged.

[22] CMA PR19 FD, paras. 9.529 – 9.530

2.4.7 First Economics[23] show that, if the regulator uses a too-low risk-free rate, this leads to a WACC that is increasing in leverage. If the risk-free rate is calculated correctly, then the WACC is no longer increasing in leverage. Thus, to the extent that the regulator considers that it is a problem that WACC is increasing slightly in leverage, a superior solution is to ensure the risk-free rate is calculated correctly. In short, a WACC that increases with gearing may arise from risk-free rate being too low; it is not necessarily correct to reach the conclusion that it must be caused by an inconsistency between the cost of debt and debt beta parameters.

2.4.8 Assuming invariance of cost of capital:

- does not recognise that the observed effect is partly due to assumptions around and actual values of various other factors including cost of debt. Moreover, the approach of backing out the implied debt beta is not only wrong, but unnecessary. The cost of debt is simply what the cost of debt is – if investors require a return of 3% to hold a company's bonds, then this is the cost of debt. A company will be unable to persuade investors to accept a lower return by claiming that the implied debt beta is higher than what would be achieved through direct estimation. Not only may investors have different estimates for the risk-free rate and market risk premium, but they may also demand a higher return due to for example illiquidity costs. The debt beta is only one input into the cost of debt – and the *assumption* of a higher debt beta will not translate into the cost of debt which is based on observed yields for water companies.

- implies that the cost of debt has a high systematic risk component which is unlikely to be the case for utilities. The debt beta implied by Ofwat's preferred Option 2 is significantly higher than the 0.075 estimated by the CMA at PR19, and also higher than the upper bound of the CMA's range (0.10). Academic evidence on debt beta further indicates that the debt beta implied by Ofwat's preferred solution would be consistent with sub investment grade credit ratings. The approach of hard-wiring debt beta into the CAPM therefore appears to result in an implausible parameter and the objective to achieve a theoretically 'right' solution appears to risk introducing a distortion into another parameter.

- arbitrarily chooses one principle to hold and not others. For example hedge ratios imply that the cost of equity is too low compared with the cost of debt. It is not clear why regulatory policy would adhere to MM but ignore inconsistencies according to evidence from hedge ratios.

2.4.9 The option to set the notional gearing equal to listed companies' market gearing appears to undermine the rationale for setting notional gearing. The reason for the concept of

[23] First Economics Risk Free Rate

notional gearing is so that companies do not benefit from inflating their actual gearing. Otherwise, companies could choose an actual gearing that led to a high WACC, and thus be set a high allowed return. To set notional gearing to a company's actual gearing is effectively to depart from the concept of notional gearing, and to base the allowed WACC on actual gearing. Furthermore, the enterprise value gearing is not the relevant and appropriate measure of notional gearing for the sector in the first place. Frontier Economics has recently considered on what basis notional gearing could be set in the context of PR24.[24]

2.4.10 As a result, the preferred approach based on the analysis in this Report is to retain the current approach to de- and re-levering.

2.5 Beta estimates for PR24

2.5.1 This Report estimates a range of **0.28-0.30** for the unlevered beta for PR24 based on the following evidence:

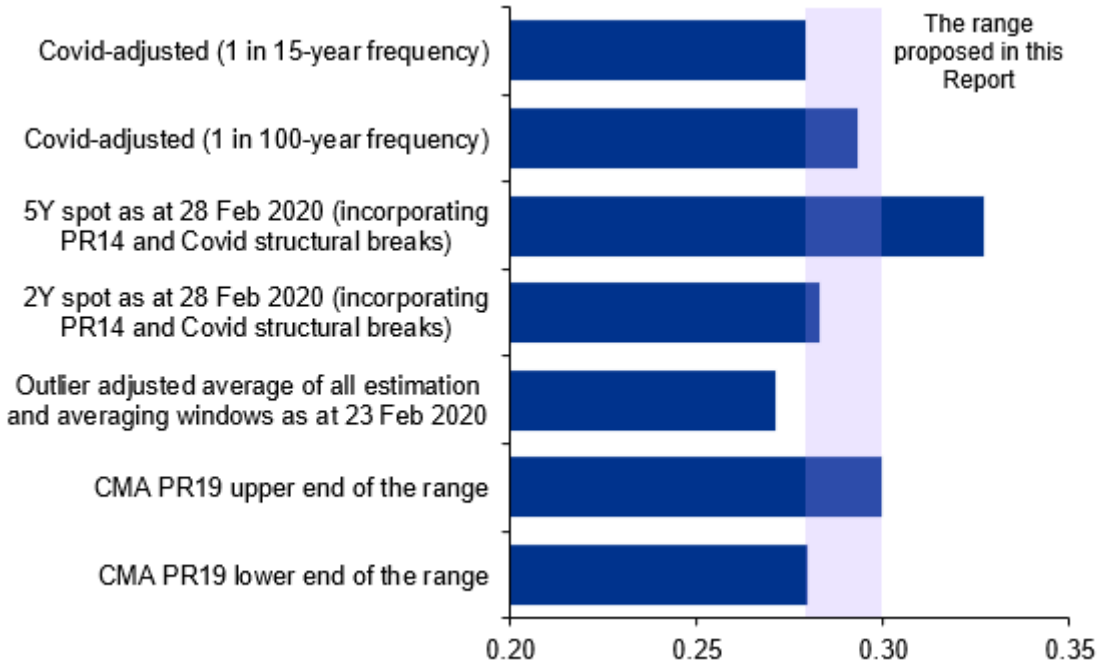
- The upper bound of the range is based on the equally weighted average of spot estimates of 2- and 5-year betas as at 28 February 2020 **(0.304).** The use of the 28 February cut off is informed by the inference that the CMA placed no or very limited weight on Covid-affected estimates. The use of 2- and 5-year betas reflects the evidence of a structural break around PR14 which implies that as at February 2020 estimation windows longer than 5 years would not be reflective of fundamental business risk going forwards.
- The lower bound of the range assigns some weight to the Covid-affected data such that the resulting beta estimate assumes that a c. 2-year pandemic of a similar scale as Covid occurs once in 15 years **(0.280).** This 15-year horizon is consistent with the tenor of 15Y Gilts referred to by Ofwat in the draft methodology

2.5.2 The unlevered beta range does not reflect any impact due to the Russia-Ukraine war as the evidence set out in this Report indicates that the beta estimates from the war-affected period are not likely to be relevant for setting the allowed returns for PR24.

2.5.3 Figure 1 sets out a comparison between the unlevered beta range proposed in this Report and estimates implied by the different approaches considered in the Report and by the CMA at PR19.

[24] Frontier Economics Setting Notional Gearing

Figure 1 Summary of unlevered beta estimates



Source: KPMG analysis.

2.5.4 The qualitative and quantitative evidence set out in this Report indicates that the range of **0.28-0.30** for the unlevered beta is best supported by the evidence provided by relevant financial literature and regulatory principles.

2.5.5 Table 2 combines the unlevered beta estimates with a debt beta of 0.075 and notional gearing of 60% using the preferred approach to de- and re-levering in order to derive the notional equity beta range for PR24.

Table 2 Notional equity beta range for PR24

	Lower bound	Upper bound
Unlevered beta	0.280	0.304
Asset beta	0.320	0.345
Debt beta	0.075	0.075
Notional gearing	60%	60%
Notional equity beta	0.687	0.750

Source: KPMG analysis.

2.5.6 The proposed equity beta range is consistent with the range of 0.69 – 0.74 determined by the CMA for PR19.[25]

[25] CMA PR19 FD, Table 9-19

3 Context and scope

3.1 Context

3.1.1 Water companies are due to submit their final business plans for the next price control ('PR24') which will cover the five-year period to 31 March 2030 on 2 October 2023. The final plans will include the companies' estimates of the required cost of equity for the upcoming price control.

3.1.2 In the draft methodology for PR24, Ofwat set out its approach for setting the baseline allowed return on equity. The focus of this Report is the CAPM beta parameter within the cost of equity which reflects an asset's (or a portfolio of assets') exposure to systematic (or common) risks relative to the broader market.

3.1.3 Ofwat's approach to beta estimation at PR19[26] can be summarised as follows:

- Ofwat relied on a report by Europe Economics in order to inform its beta estimate. Europe Economics estimated composite equity betas for Severn Trent ('SVT') and United Utilities ('UUW') for 1-year, 2-year and 5-year horizons, using daily, weekly, and monthly frequencies.
- Ofwat focused on values of 2-year and 5-year daily betas over time and as of September 2019. It derived a raw equity beta range of 0.58 to 0.66 and a point estimate of 0.63.
- Ofwat used the simple average of 2 year and 5-year daily Enterprise Value gearing, notional gearing of 60% and a debt beta of 0.125 to derive a notional equity beta of 0.71.

3.1.4 The CMA in its PR19 re-determination based its estimate on[27]:

- *Estimation windows of 2, 5 and 10 years.* The CMA recognised the potential presence of 'noise' in short term estimates and considered that short-term windows should be used along with longer periods and frequencies to provide the most robust data from which to estimate equity betas. By including longer periods in its approach the CMA aligned the implied horizon more closely with the long-term investment horizon used to set the WACC for regulated companies and the approach used to set the total market return and the risk-free rate.
- *Daily, weekly, and monthly frequencies.* The CMA saw merit in considering a wide range of evidence for estimation of beta despite noting that monthly estimates have higher standard errors and could be 'noisier' as a result. The weight placed on

[26] PR19 final determinations: Allowed return on capital technical appendix - Ofwat

[27] CMA PR19 FD

monthly estimates was reduced as a result of the CMA's approach to identify and exclude outliers.

- *OLS calculations*. The CMA does not employ a Vasicek adjustment or use the GARCH method. In particular, the CMA noted that it had not received evidence that GARCH statistical calculations would materially improve estimates versus the widely used OLS methodology.

- *Spot betas and 1-year, 2-year, 5-year rolling averages*. Whilst the CMA acknowledged shortcomings in rolling averages, it considered that this evidence could be useful to highlight trends in betas.

- *Debt beta of 0.075.* The CMA's overall view on debt beta was that it is difficult to measure and has a relatively small effect on the overall WACC. As a result, the choice of the debt beta should be set at a level which is consistent as far as possible with the overall framework for the WACC, without acting contrary to financial market evidence (e.g. from decomposition approaches).

3.1.5 CMA also considered whether it should estimate beta based on a longer time horizon: for example, using the full run of available data for the listed firms from 1991 onwards. CMA did not attach weight to this approach as it would capture beta from periods where water companies owned material non-regulated businesses.

3.1.6 The CMA highlighted that the SARS-CoV2/Covid19 (hereafter "Covid19" or "Covid") pandemic resulted in a sharp decline in water company betas and considered that Covid represented a systematic risk event which should be taken into account in its estimates. However, the CMA also determined that pandemics as severe as Covid19 represented rare events which – absent adjustment – could be over-weighted in 2Y, 5Y and 10Y averaging windows, and placed low weight on data from this period. The CMA's approach to identifying and excluding outliers further reduced the weight placed on Covid-affected data.

3.1.7 Ofwat's proposed approach to beta estimation at PR24 based on the draft methodology is as follows:

- To place most weight on data from well-established 'pure-play' water companies SVT and UUW but to review whether to use Pennon ('PNN') in the final methodology, noting that reflecting this data would not be straightforward due to difficulties in accounting for cash holdings arising from the disposal of Viridor. Ofwat is not proposing to consider beta estimates from networks regulated by Ofgem as part of its PR24 approach.

- To rely on daily beta estimates given that weekly and monthly values tend to be more volatile, are based on fewer observations and are subject to the 'reference

day effect[28]'.

— To not apply any bespoke weights to Covid-affected data, which Ofwat considers to be an example of a systematic risk event. Ofwat does not propose to use structural break[29] analysis to inform its beta range. However, Ofwat recognises that focusing excessively on a period dominated by Covid19 may result in a beta estimate that is not reflective of the 2025-30 period. Ofwat is proposing to address this issue is through relying on evidence from a range of estimation periods (of 2, 5, and 10 years),

— Ofwat does not comment on the weight it would assign to spot and rolling estimates of beta.

— To set debt beta such that forward-looking WACC does not vary with gearing (0.216 is the holding assumption based on PR19 FD WACC) rather than one based on empirical analysis.

3.2 Scope of work

3.2.1 This Report was commissioned by Water UK to consider whether Ofwat's proposed approach to determine beta would result in estimates reflective of the systematic risk exposure faced by water companies at PR24 and is best supported by the evidence provided by relevant financial literature, regulatory principles, and market evidence.

3.2.2 This Report considers the risk exposure and the beta estimate at PR24 in four steps:

— First, it considers the key drivers of risk for water companies going forwards, given the trajectory of policy in the sector and evolution in the regulatory landscape.

— Second, it undertakes a relative risk assessment between PR14 and PR24 and PR19 and PR24 based on changes in exposure to cost, performance, financing, regulatory finance, and regulatory risks taking into account the interaction between inherent risk exposure and regulation.

— Third, it considers the methodological issues for the estimation of the notional equity beta for PR24 based on corporate finance theory and relevant precedent and assesses the de- and re-levering proposals set out by Ofwat in its draft methodology.

— Fourth, it considers the implications of the findings in steps 1, 2 and 3 for the asset beta estimate for PR24.

[28] Beta estimates can differ materially depending on the day of the week or month chosen

[29] A structural break is an observable change over time in the parameters of regression models, which can lead to forecasting errors and unreliability of the model.

3.2.3 The scope of this work does not include company-specific analysis. All the analyses and commentary set out in this Report is reflective of the circumstances of a notional water company over the PR24 price control period.

3.3 Structure of the Report

3.3.1 The Report is structured as follows:

- Section 4 sets out the evolution of the regulatory landscape and implications for risk;
- Section 5 establishes a framework for the relative risk assessment and undertakes the assessment based on qualitative evidence;
- Section 6 considers methodological issues for estimation of beta at PR24;
- Section 7 undertakes an assessment of the de- and re-levering proposals set out by Ofwat in its draft methodology; and
- Section 8 considers the implications of the analyses set out in the Report for the beta estimate for PR24.

4 Evolution of the risk landscape for PR24

4.1 Introduction

4.1.1 UKRN highlights in its principles for setting the cost of capital that returns should be "*risk reflective*"[30] such that "*the reward will reflect the allocation of risk in the regulatory framework and sectors.*"[31] This Report agrees with the principle that the cost of capital in general and beta in particular should be reflective of the business risk faced by the notional operator and undertakes a relative risk assessment to assess the impact of any changes in systematic risk exposure between PR24 and latest price controls.

4.1.2 Risk exposure in the water sector changes over time. This can be driven by macro factors (such as climate change and the economy), and sector-specific factors, such as statutory requirements, and the regulatory framework.

4.1.3 The section below describes some of the key drivers for change in the sector since the CMA's PR19 re-determination that will have an impact on risk exposure at PR24.

4.1.4 This section considers in turn four dimensions of risk facing water companies across AMP8.

- The first relates to the technical planning and investment challenges that face the sector due to its role in responding to population growth and the country's Net Zero ambition.
- The second relates to the major changes in environmental obligations.
- The third relates to the evolving regulatory environment for the sector. This conveys its own risk characteristics and will have implications for regulatory regime design and regulatory processes.
- The fourth relates to the introduction of competition as a driver of increasing risk.

4.1.5 An indicate assessment of the relative size and direction of potential changes in risk is presented below.

4.2 Industry drivers of change

I. Demand

4.2.1 Population growth (and climate change) are placing increased demand on services. This will result in companies having to invest in new resource schemes, as well as further

[30] UKRN cost of capital principles

[31] Ibid.

capacity in their networks. Information from the 2021 census[32] shows that the population of England and Wales grew by 6.3% since the 2011 census.

4.2.2 Large scale water resource schemes represent a new set of challenges for the sector – no major reservoir has yet been built since privatisation.[33]

4.2.3 To the extent that the risks associated with supply schemes differ in nature from risks associated with the types of projects that companies have been delivering to date, this may change the risk profile of companies' investment schemes and programmes.

4.2.4 Increased population density arising from growth can also have implications for how many customers are affected by isolated asset failures. This can manifest through more volatile performance commitment performance and hence financial exposure for companies.[34]

II. Transition to Net Zero

4.2.5 The pathway to reaching operational Net Zero by 2030 will fundamentally change how water companies operate. The market structures of a low carbon future remain uncertain. There is a lack of evidence on whether current technology solutions will help deliver the emission reductions water companies are aiming for; uncertainty over how emissions will be regulated in the long-term and the extent to which movements in baseline emissions will impact on incentives and penalties. Water companies need to prepare for significant investment in the construction of new infrastructure assets with high capital and operational carbon costs whilst also streamlining business-as-usual activities.

4.2.6 Water companies face the need to explore new Net Zero opportunities to decarbonise their operations whilst often competing for resources in a constrained market. Water companies will also be competing in a scarce resource pool against other companies from infrastructure sectors which will inevitably drive a 'war for low carbon skillsets'. Upskilling employees incurs additional labour costs, for which ultimately the benefit may not be realised for many years. This cost burden is likely to reside entirely with water companies.

4.2.7 The decarbonisation of water company operations is inextricably linked to the energy system and will require close and careful coordination with this sector to ensure that a lack of systems thinking does not create challenges for water companies in reaching Net

[32] Population and household estimates, England and Wales: Census 2021 - GOV.UK (www.gov.uk). This is a comparable growth rate to that between the 2001 and 2011 censuses.

[33] Severn Trent Water's Carsington Reservoir was the most recently completed large raw water reservoir. It was opened in 1991, but planning and most of construction was pre-privatisation in 1989.

[34] This issue was recognised by Ofwat in its conditional cost allowance to Thames Water to mitigate risk to water supplies in Northeast London which is heavily reliant on one treatment works. See p.4 of Ofwat, 2019, 'Final determinations Thames Water Cost efficiency additional information'

Zero. This includes the need for water companies to balance connections to intermittent renewable energy sources whilst minimising disruption for customers.[35]

4.2.8 Water companies will need to plan to make investments into technologies, particularly to reduce process emissions,[36] that are not yet commercially available to meet Net Zero by 2030, despite the risk that some of the investments may eventually become stranded assets.

4.3 Environmental drivers of change

I. Storm overflows

4.3.1 Storm overflows are "safety valves" on the wastewater network, which release diluted untreated wastewater when the capacity of the network is exceeded to minimise wastewater escapes into homes, gardens, and open areas. They are designed to discharge only when flows of wastewater exceed the defined volumes that must be treated by the treatment works. However, these valves will also operate in cases they have not been designed for, such as when there are operational issues on the network, including sewer blockages and pumping station failures. Without intervention, the frequency of discharges from storm overflows increases due to the increases in rainfall intensity brought about by climate change, and with additional population and housing growth. Companies are legally obliged to accept connections to the sewerage network which are likely to increase the frequency of storm overflows discharging.

4.3.2 Over the last decade wastewater companies have progressively installed monitors on storm overflows that log when they are discharging. The data from the monitors demonstrates that many storm overflows are discharging more frequently, and for longer duration, than expected. Additional investment into treatment works and into the network to provide storage and treatment capacity at high priority sites has occurred or is planned.

4.3.3 However, the discharge of untreated wastewater into the environment has become a topic of concern and interest to politicians, stakeholders and the wider public. It is no longer considered acceptable to discharge untreated wastewater into rivers and seas at the current frequency, even where there is not conclusive evidence of environmental harm from doing so. The government has confirmed comprehensive targets for the frequency of discharges from storm overflows as part of the Environment Act.

4.3.4 Considerable investment will be required to meet these targets. Ofwat challenged companies to reduce spill frequency before 2025 without allowing any specific additional

[35] See Ofwat, August 2022, 'Ofwat's regulatory framework and net zero'

[36] Jacobs, August 2022, 'Net Zero Technology Revew', p.14, figure 7, shows that apart from emissions associated with grid electricity, process emissions are the biggest challenge for water companies to address to get to net zero.

funding, beyond additional spend recoverable through the PR19 cost sharing mechanism, stating that operational issues can and should be resolved by companies first[37]. However, considerable additional investment will be required in AMP8 and beyond, estimated by Defra to be £56 billion over 25 years[38]. Such a level of investment is more than double the £4.8bn five-year environment enhancement programme allowance at PR19 for each of the next five AMPs.

4.3.5 Such large scale and dispersed investment to meet the high-level targets are inherently uncertain and is likely to remain more uncertain than most other investment proposals that are being developed for AMP8. This uncertainty increases the risk of misalignment between the eventual investment needs and PR24 cost allowances given that on an ex-post basis the efficient costs of required investments can be materially different from the ex-ante cost allowance set through the PR24 process. These increased risks of divergence between allowances and efficient spend lie with both companies and customers, depending on whether outturn costs are higher or lower than allowances.

4.3.6 The deliverability of such investment programmes across the whole sector is also unclear and untested. Without investing in increasing the supply chain capacity now, when the needs are still not well defined, companies are at risk of supply chain constraints both locally and nationally in the future. Such programmes mean a larger ratio of capex to companies' operational costs than have been seen before, meaning a potential change in risk profile.

II. Wastewater environmental targets

4.3.7 To enable it to meet the 25-year Environment Plan, the UK government has also consulted on a range of additional environmental targets, including one to reduce the nutrient levels discharged in treated wastewater effluents[39]. Although there have been successive nutrient removal investment activities in the sector since the introduction of the EU's Urban Wastewater Treatment Directive in 1991, the draft target of reducing phosphorus loads in wastewater effluent from their 2020 level by a further 80% by 2037 will require a step increase in investment to meet the strictest possible treatment conditions in many locations.

4.3.8 These nutrient removal requirements are in addition to those for storm overflows and will compound the issue of deliverability of the large wastewater capacity investment programmes. The PR19 cost allowance for phosphorus removal was around £2.4 billion and it was reducing the phosphorus load for 16 million population equivalents[40]. A simple pro rata calculation suggests that by 2037 at least a further £4.4bn will need to

[37] Ofwat, June 2022, ' Response to wastewater company river water quality action plans', p.1
[38] Defra, August 2022, 'Storm overflow discharge reduction plan', p.7
[39] Defra, May 2022, 'Consultation on environmental targets', p.17
[40] https://www.ofwat.gov.uk/wp-content/uploads/2019/12/FM_E_WWW_p-removal_FD.xlsx

be spent on phosphorus removal to meet this target, to remove phosphorus from the load produced by 80% of the 56.5 million population of England.

III. Abstraction reduction and improved drought resilience

4.3.9 The Environment Agency has an increasing ambition to protect the environment by restricting some water abstractions,[41] which means that companies have to seek new sources of water. Although not a big issue for every company, for those affected, the investment required to replace sources is considerable, may require collaboration with neighbouring companies and requires concerted stakeholder engagement, particularly where water recycling, desalination or large reservoir construction is being considered. The scale of the required investment may be further increased by the need to improve resilience to a once-in-500-year drought.[42] The urgency of meeting increased drought resilience has been brought sharply into focus with many parts of England and Wales under drought conditions and increasing temporary use bans in place during recent months. Investment to mitigate such risks has been shown to be needed more immediately than anticipated, and companies will be expected to put forward deliverable investment plans as part of their PR24 business plans.

4.3.10 Large and regional water resources solutions are likely to be candidates for Direct Procurement for Customers (DPC), which can reduce risk to companies by transferring risks of large-scale investment into a contract with a third-party infrastructure provider. However, all companies with such schemes will need to manage complex procurement processes that may be beyond their current capabilities, and incumbent water companies may be exposed – pending contracts with third parties – to residual risks in relation to assets which are not captured within regulated assets.

4.3.11 DPC involves complex interactions for the procuring water companies, with contractual arrangements required for what would otherwise be normal operational management of a set of assets delivering the services companies provide to their customers. Such contracts are particularly challenging since the water companies cannot pass all their statutory duties onto the third-party infrastructure provider.[43] In addition rating agencies such as Moody's[44] have highlighted that DPC could have potential implications for financeability as it DPC will increase leverage and hence financial risk. DPC may therefore increase risk for companies from managing the interactions and remaining

[41] Environment Agency, March 2020, Water Resources National Framework, Appendix 4: Longer term environmental water needs.

[42] Environment Agency, March 2020, Meeting our Future Water Needs: a National Framework for Water Resources, p.10.

[43] See Ofwat, PR19 methodology, Appendix 9: Direct procurement for customers, p.14, that says "For the avoidance of doubt, we have written into the principles that appointees remain ultimately responsible for ensuring their statutory and licence responsibilities are fulfilled."

[44] Moody's (2022), United Utilities Water Limited/United Utilities PLC, Regular update reflecting reported performance YTD 2021/22 "*Depending on the gearing profile of the project SPV, this approach may result in a modest loss of financial flexibility for UUW and the UU group with respect to Moody's ratio guidance".*

responsible for services to customers. Overall, it is hard to conclude on the net impact of DPC on risk exposure which may vary for different projects.

IV. Farming Rules for Water and the EA's sludge strategy

4.3.12 The Environment Agency has been reviewing the application of its Farming Rules for Water to the activity of spreading bioresources products to agricultural land. Although it has relaxed its guidance from its original intention, there remains a real risk that concerns over nutrients washing off into waterways from bioresources recycling could make such recycling activities more difficult and expensive, due to restrictions in periods when recycling is permitted.[45] Current guidance is to be reviewed no later than September 2025, which means there is a risk material changes could occur very early in the AMP8 period. With no cost sharing proposed for the bioresources price control, companies are more exposed to such risk than if it impacted wastewater network plus activities.

4.3.13 The Environment Agency is also producing a Sludge Strategy which is reviewing the Sludge (use in agriculture) Regulations with a view of updating them and aligning with its approach to regulating other organic waste management activities through Environmental Permitting Regulations.[46] Such a change may introduce additional charges but will level the playing field between water and waste management activities, which may make co-digestion of bioresources and other organic waste easier since the two materials will be within the same environmental regulatory framework.

4.4 Business drivers of change

I. Bad debt

4.4.1 The Covid19 pandemic had a number of impacts on the water sector, including a reduction in non-household consumption and an increase in household consumption due lockdowns and working from home[47]. This, combined with macro-economic challenges, has led to a number of challenges for water companies regarding debt collection.

4.4.2 Inflation is also expected to reach 13%,[48] which would be the highest level since the water sector was privatised and may represent an affordability challenge unlike anything the industry has experienced to date.

[45] Environment Agency, June 2022, Applying the farming rules for water.

[46] Environment Agency, July 2020, 'Environment Agency strategy for safe and sustainable sludge use'

[47] Hybrid working has to a large extent replaced office-based working that was the norm before the pandemic and has continued after all restrictions were lifted.

[48] Bank of England (2022) 'Monetary Policy Report: August 2022'

4.4.3 While inflation is forecast to return to normal levels around the start of the next control period (which we expand on in section 6.4), all forecasts contain a degree of uncertainty. In addition, it is not clear whether a prolonged period of high customer default will result in sustained behaviours of non-payment.

4.5 Regulatory drivers of change

4.5.1 The regulatory framework is one of the biggest determinants of risk and value for water companies. Ofwat's draft methodology for the 2025-30 period contains several significant changes from the previous control period including:

Change in cost sharing rates

4.5.2 At PR19, Ofwat set cost sharing rates in the range of 32%:75%[49] (companies gain from 32% of any outperformance, sharing the rest with customers, while companies bear 75% of any underperformance, sharing the rest with customers) to 50%:50%. For PR24, Ofwat is proposing to make cost sharing rates more symmetric, with rates sitting in the range of 40%:60%, to 50%:50%. This is more closely aligned to the rates applied by the CMA at PR19[50].

Reforms to outcome delivery incentives

4.5.3 Ofwat is proposing major changes to companies' outcome packages. This includes:

- setting fewer financial performance measures (this may have an effect of reducing the current 'portfolio' effect that companies experience by having a large pool of measures);
- introducing new performance measures (for example, serious pollution incidents and business demand);
- changing how incentive rates are calculated (by moving to an approach that primarily uses marginal benefits);
- removing incentive deadbands, caps and collars;
- removing exclusions for events outside of companies' control (for example exclusions for extreme weather); and
- introducing a new aggregate out / under performance sharing mechanism when ODI performance passes outside of predetermined thresholds (specified in terms of return on regulated equity).

[49] PR19-final-determinations-Securing-cost-efficiency-technical-appendix.pdf (ofwat.gov.uk), p.140
[50] CMA PR19 FD, para. 6.107

4.5.4 The above changes have the effect of fundamentally changing the overall risk profile of companies' incentive packages. Further clarity on this overall level of change will be gained when the performance commitment levels are set.

Removal of aspects of developer services from the price control

4.5.5 Ofwat is proposing to remove certain developer services from the price review. This will affect the volatility of the revenue recovered by companies that contributes towards the overall revenue controls. This in turn, may affect how companies perform in relation to the revenue forecasting incentives (RFIs).

Change of bioresources controls

4.5.6 Ofwat is proposing to move from a standard regulatory building block approach that incorporates an efficiency challenge of companies' expenditure, to benchmarking revenues, which includes a different approach for post 2020 RCV. This is a new approach for asset-heavy services. Ofwat has not yet consulted on its modelling framework and so the full implications of this regulatory change are not yet known. The changes are aligned to a market-based approach for bioresources services which is described below.

Removal of bilateral entry adjustment mechanism

4.5.7 In the 2020-25 period, the framework included an adjustment mechanism to adjust downwards water resources' revenue to reflect bilateral market entry. This mechanism will not apply in the 2025-30 period. While there has been no bilateral market entry to date, this change to the framework may impact within-period revenue risk going forward.

Full transition to CPIH

4.5.8 Prior to 2020, companies' RCVs and revenues were linked to RPI. During the 2020-25 period, revenues have been linked to CPIH, while the RCV has been linked to a blend of RPI and CPIH (50% of the opening balance linked to RPI, with the remaining balance and additions linked to CPIH). Going forwards, Ofwat has proposed that everything should be linked to CPIH. The strength of correlation between RPI and CPIH has varied over time. Companies and investors have raised concerns that CPIH-linked assets risks creating a mismatch with the RPI-linked debt that many companies hold. Ofwat is not proposing at this stage to provide for costs associated with hedging RPI-CPIH basis risk.

4.6 Competition drivers of change

4.6.1 The government is continuing to promote markets in the sector, in particular in bioresources services and in the provision of large infrastructure projects. The provision of infrastructure through direct procurement for customers is discussed above.

4.6.2 At PR24, Ofwat's approach to setting allowed revenues for bioresources services introduces more market-type risks, such as volume risk, but also presents opportunities to optimise efficiency across company borders, expand into other companies' areas by selling bioresources services through non-regulated business, or potentially gain benefits from co-digestion of bioresources with other organic waste materials.

4.7 Key conclusions

4.7.1 Table 3 below sets out the drivers of change discussed in this section along with an assessment of their potential impact on the sector risk is provided.

Table 3 Overview of the impact of PR24 changes on risk exposure

Change driver	Parties affected by driver	Change in risk since PR19	Commentary
Demand	All UK water sector	No change	Forecasting of population growth is relatively straightforward and companies are used to planning for growth
Transition to net zero	All UK water sector	Increasing	Ways of reducing process emission are not well-established, making Net Zero planning uncertain.
Storm overflows	English wastewater companies	Increasing	Large and under-developed investment programmes are difficult to cost out accurately.
Wastewater environmental targets	English wastewater companies	Increasing	Increasing pace of investment in treatment processes is needed to meet ambitious goals.
Abstraction reduction and drought resilience	English water companies	Increasing	Gives rise to large, complex DPC programmes requiring coordination between companies.
Farming rules for water and EA sludge strategy.	English wastewater companies	Increasing	Increasing uncertainty over the previously stable route for using bioresources products.
Bad debt	All UK water sector	Increasing	Cost of living crisis means bad debt increasing and more intransigent.
Change in cost sharing rates	English & Welsh (E&W) water sector	Decreasing	Companies more able to share any cost overruns with customers.
Reforms to outcome delivery incentives	E&W water sector	Increasing	Removal of exclusions, caps and collars risks higher downside in extreme weather events
Removal of aspects of developer services from price control	E&W water sector	Decreasing	Reduced volatility of revenue collected and considered through forecasting incentives
Change of bioresources controls	E&W wastewater companies	Increasing	New approach means revenue at risk which was not present before

Change driver	Parties affected by driver	Change in risk since PR19	Commentary
Removal of bilateral entry adjustment mechanism	E&W water sector	Decreasing	Reduced in-period revenue risk.
Full transition to CPIH	E&W water sector	Increasing	Increases potential shortfall in the allowance for RPI-linked debt.
Competition drivers of change - DPC	E&W water sector	Unclear	Higher DPC threshold and DPC by default both change risks but overall position unclear.
Competition drivers of change -bioresources	E&W wastewater companies	Unclear	Bioresources market offers both risks and opportunities.

Source: KPMG analysis

4.7.2 There are material changes to the landscape in which the water companies operate. The changes are driven by factors both external to and within the PR24 methodological approach and are seen across diverse factors, including the challenges of responding to population growth and the country's Net Zero ambition, changes in environmental obligations, regulatory changes and increasing competition.

4.7.3 Many of these factors have the potential to change and increase the risks that companies in the sector face. Table 3 above illustrates the indicative position that the changes facing the sector appear to be increasing risk in the run up to PR24 and that this would need to be reflected in beta, assuming that the increasing risks have a systematic component.

4.7.4 Apart from regulatory changes proposed by Ofwat, the external changes that have the greatest potential to increase risk and asymmetry for PR24 are driven by uncertainty in the detail of large investment programmes which increase deliverability risk. Such investment programmes include those to meet Net Zero targets and those to meet wastewater targets in both storm overflow discharge frequency and phosphate load reductions.

5 Assessment of relative risk for PR24 – qualitative evidence

5.1 Introduction

5.1.1 This section considers in qualitative terms the evolution of the systematic risk exposure faced by water companies and the implications for beta estimation for PR24. In order to address this question, this section first sets out a framework for pricing risk, covering systematic risk and asymmetric risk; then it undertakes a detailed relative risk assessment; and concludes on the implications of the relative risk assessment for PR24 beta estimation.

5.2 Framework for pricing systematic risk and relative risk assessment

5.2.1 The CAPM model is the most common asset pricing model used in the UK and internationally for the purpose of setting regulatory allowed return. Under this framework, the asset is priced according to the risk it contributes to a well-diversified market portfolio, assumed to be held by the investor pricing the asset. Under the CAPM, only systematic, or market-correlated risk is priced, as this risk is unavoidable through diversification. By contrast, sector-, company- or project-specific risks are assumed to be diversifiable, and not requiring remuneration, as they can be mitigated through appropriate diversification.

5.2.2 Beta measures the exposure to systematic risk of the firm or sector in question. Systematic risk is risk that impacts a diversified market as a whole. If the shares of a firm are frequently traded, beta can be observed relative to a suitably representative market index as follows:

$$\beta = (\mathrm{Cov}(R_a, R_m))/(\mathrm{Var}(R_m))$$

Where β is observed Beta, R_a and R_m denote Asset return and Market return respectively

5.2.3 Where the firm/(s) are listed, price movements in the shares of the firm itself can be used to measure the asset return. However, where the firm/(s) are not listed, betas cannot be directly observed, but they may be estimated with reference to traded shares of firms with comparable systematic risk exposure.

5.2.4 The primary means of capturing equity risk for an unlisted firm, when applying the CAPM, is therefore identifying appropriate comparators to estimate beta, which are the listed pure-play water companies.

5.2.5 The framework used in this report for the relative risk assessment considers the underlying sources of business and regulatory risks of the sectors which jointly determine overall cashflow risk, and then considers whether these risk factors should be priced into equity returns based on standard corporate finance principles.

5.2.6 All regulated businesses considered in this assessment face underlying business and regulatory risks which impact the volatility of returns to varying degrees. Regulation in general, including the specific regulatory mechanisms proposed for PR24 in particular, interact with the underlying business risks and either exacerbate or mitigate their impact on the volatility of equity returns.

5.2.7 The Report considers the following types of inherent risks for the water companies:

- **Demand risk**, covering within price control volume risk (i.e., short-term demand risk) and long-term demand risk including possible asset stranding risk;
- **Cost risk**, covering the underlying volatility in Totex risk, regulatory discretion risk and input price risk;
- **Performance risk**, associated with outcomes, outputs and licence requirements;
- **Financing risk**, i.e., risk associated with uncertain market interest rates;
- **Performance risk sharing**, which captures risk to the overall returns (in addition to the inherent risks set out above) from the application of regulatory finance mechanisms;
- **Regulatory risk**, including political and wider societal influences on regulatory judgments.

5.2.8 The Report then considers whether each of the identified risks can be classified into one (or more) of the following two categories which affect expected returns, based on standard corporate finance principles and theory:

- **Systematic risks**, priced through observed betas;
- **Asymmetric risks**, requiring adjustments to the cost of equity to compensate investors for downside risks that have an expected loss, which can be incorporated via an explicit uplift to the allowed return.

Systematic risk

5.2.9 The CAPM prices the systematic component of equity risk on the assumption that investors hold a diversified portfolio and do not therefore need compensation for idiosyncratic (or specific) risk. CAPM considers that the correlation of returns with equity markets is a sufficient proxy for exposure to systematic risk, which means that to the extent that companies are exposed to other systematic risks, CAPM will understate the required return.

Asymmetric risk

5.2.10 The typical implicit assumption in the regulatory model is that investors have a mean expectation of earning the CAPM derived cost of equity.

5.2.11 Under certain circumstances, however, a business might be exposed to downside risk that does not have a commensurate upside i.e., there is asymmetric risk. If the assumed cashflows are not appropriately adjusted for such downside events, the un-adjusted cost of equity will not be adequate and will have to be appropriately uplifted to reflect expected losses on a mean probability-weighted expected basis[51].

5.3 Systematic risk exposure at PR24 relative to previous price reviews

5.3.1 This section sets out detailed analysis of the risk exposure faced by water companies at PR24 resulting from the interaction of a range of inherent risks, including as appropriate those explored in previous sections, with relevant regulatory mechanisms, as well as detailed benchmarking against PR14 and PR19. The detailed benchmarking identifies key differentiating factors, from a systematic risk perspective, which are relevant to determining the appropriate beta for PR24.

5.3.2 The analysis set out in this section considers holistically the risk exposure faced by water companies and provisionally classifies each individual risk exposure as either systematic or asymmetric. The analysis recognises that some exposures may be asymmetric and not relevant for the setting of the beta for PR24. However, whether the risk is systematic or asymmetric is contingent on how regulatory mechanisms interact with inherent risks which will become clearer once the price control calibration is further progressed.

[51] See for example, the CMA's approach to remunerating residual asymmetric risk on ODIs at PR19.

The table below sets out the risks facing water companies, the nature of the risk (i.e., systematic or asymmetric), an assessment of how that risk is likely to be exacerbated or mitigated by regulation and how the exposure to that risk is likely to differ between PR24 and PR14 and the CMA's re-determination for four disputing companies at PR19 (which represents the most recent determination on beta in the sector). Although the risks identified here will need to be kept under review as the detail of the PR24 package becomes clearer, the qualitative assessment set out below clearly indicates that the sector will be higher risk at PR24 relative to previous price controls. Red denotes higher risk exposure at PR24 than in previous price controls.

Table 4 Risk comparisons between PR24 draft methodology and approaches used in previous price reviews

Risk category	Risk	Description	Impact of regulation	Classification	PR24 vs PR19 CMA	PR24 vs PR14
Demand risk	Volume risk	The risk associated with deviations between actual and forecast revenues within the regulatory period, either due to differences in volume forecasts and actuals or timing and resulting volatility of cashflows.	**Mitigates materially** Demand risk (pre-regulatory intervention) relatively low. Some higher consumption in dry years. Some lower consumption from businesses in recessions. The regulatory framework sets total revenue controls. If companies under or over recover in any given year, there is a true up in the future. For large deviations (+/- 2%) the regulator applies a penalty to incentivise accurate forecasting.	**Systematic** The ability (and willingness) to pay for the use of the services in question is often linked to the economic outlook – in bad states of the world, sales volumes (and prices, in competitive markets) reduce.	For PR24 Ofwat is proposing to remove certain developer services from the price review. This will likely affect the volatility of the revenue recovered by companies that contributes towards the overall revenue controls. This in turn, may affect how companies perform in relation to the revenue forecasting incentives (RFIs) compared to PR19.	PR14 had fewer disaggregated revenue correction mechanisms – it was set at a wholesale water / wastewater level. Greater aggregation meant that there was more scope for offsetting / netting off within the overall wholesale revenue forecasting incentive mechanism than at PR19 and at PR24.
Cost risk	Totex performance	This risk relates to the cash flow mismatch arising from the differences between expected and outturn total expenditure. It is impacted by the scale of the capital programme as well as the complexity and uncertainty of the investment programme, and operational risks (such as weather events and power price increases). Cost distribution generally is not symmetric for Totex. This is because there is a limit to how much costs can be constrained to generate outperformance relative to expectation, whereas there are many foreseeable as well as unforeseeable ways in which costs could increase, leading to cost overruns.	**Exacerbates materially** Cost risk (pre-regulatory intervention) is medium. Risk is exacerbated by a regulatory framework that only allows a proportion of overspend to be passed onto customers. The sector is capital intensive, infrastructure projects sometimes overspend[52]. Further, the sector is somewhat sensitive to weather events causing asset failures.	**Asymmetric** An efficiency challenge that goes beyond upper quartile is likely to result in an asymmetric risk exposure. The sharing rates can be designed to be either symmetric or asymmetric. For PR24, Ofwat is proposing to make cost sharing rates more symmetric, with rates sitting in the range of 40%:60%, to 50%:50%.	For PR24 Ofwat is proposing an efficiency challenge that goes beyond upper quartile. All things being equal, this should lead to a more stretching efficiency challenge, and greater scope for underperformance. At PR19 the CMA applied an upper quartile efficiency challenge[53]. PR19 framework applied asymmetric cost sharing rates (out/underperformance is shared with customers). This rate varies by company. This rate varies by company. Best case: 60%:50% (company retains 60% of any Totex outperformance and bears 50% of any underperformance) to 32%:75%[54]. This compares to the CMA's calibration of 45:55%[55].	At PR14, the efficiency challenge used was upper quartile[56]. There was a complex menu arrangement for cost sharing that was not well understood[57], however, the range of available sharing rates is broadly comparable between PR24 and PR14. Ofwat's proposal for PR24 should lead to a more stretching efficiency challenge, and greater scope for underperformance.
Performance risk	Outcome Delivery Incentives	This risk relates to the incentives to meet defined levels of performance. PR24 will feature a number of performance commitments. Failure to meet the PC level requirements or underperform incentive targets can have a sizeable impact on the company.	**Exacerbates** Based on Ofwat's draft methodology, it is expected that nearly all water companies will have outcome delivery incentives with more downside than upside due to the calibration of the incentives.	**Asymmetric** Some incentives are downside-only or have downside risk that does not have a commensurate upside. Ofwat is proposing to remove penalty caps, and deadbands on penalty-only measures.	For PR24, Ofwat is proposing fewer but stronger incentives (less scope for a portfolio effect), the removal of deadbands including for penalty-only measures, removal of penalty caps, and removal of exclusions for exogeneous factors (such as severe weather). It is also proposing to make measures	At PR14 there were few common measures across the sector with companies more able to control which areas were had financial incentives. At PR24 the scope for use of bespoke measures is much reduced.

[52] See for example, National Audit Office, 2019, Completing Crossrail
[53] CMA PR19 FD, para. 36
[54] PR19-final-determinations-Securing-cost-efficiency-technical-appendix.pdf (ofwat.gov.uk)
[55] CMA PR19 FD, para. 6.107
[56] det_pr20141212wholesale.pdf (ofwat.gov.uk)
[57] Companies could make menu choices in relation to Totex that would determine their allowed revenue and Totex cost sharing rate and provide wider incentives for accurate and realistic forecasting. The available rates ranged between 45-59% across enhanced and non-enhanced companies. det_pr20141212wholesale.pdf (ofwat.gov.uk)

Risk category	Risk	Description	Impact of regulation	Classification	PR24 vs PR19 CMA	PR24 vs PR14
		The strength of those incentives and PC targets and the plausible outcomes will impact the risk faced by the water companies.		Performance risk is likely to be predominantly idiosyncratic, either at a company level or a sector level.	common across the sector and reduce the use of bespoke measures.	
Financing risk	Uncertain market interest rates	The interest rate environment is a significant source of exposure to the wider economy.	**Mitigates partially** Financing risk (pre-regulatory intervention) medium. Water companies are capital intensive, so are heavily exposed to changes in interest rates. However, all incumbent companies hold investment grade credit ratings. The regulatory framework includes indexation for the cost of new debt, and this is expected to be set with reference to iBoxx indices. Risk-free rate is expected to be based on the current yield, without a forward uplift.	**Systematic** As noted in the UKRN cost of capital study, the disconnect between a gradualism-based cost of debt and a spot-based cost of equity could distort investment decisions. It is unclear whether those distortions could include systematic risk factors.	Ofwat is proposing to index the cost of new debt (as per PR19). Use of the sector average as the primary methodology for estimation of the cost of debt allowance may create additional exposure to financing strategies adopted by other companies.	Ofwat applies an indexation approach for the cost of new debt at PR24 which reduces risk. On the other hand, the use of sector average for setting embedded debt costs at PR24 may increase risk. At PR14 both cost of debt and cost of equity reflected historical yields as the risk-free rate was set assuming some reversion to the long-term mean. On balance, the exposure is likely to be broadly comparable between PR14 and PR24.
Performance risk sharing	Outcome delivery incentives	This captures the risk to the overall returns (in additional to the inherent risks set out above in this table) arising from the application of regulatory finance mechanisms.	**Uncertain** There is sharing of ODI rewards and penalties beyond 3% of RoRE. Rewards and penalties are further reduced beyond +/-5%.	**Idiosyncratic – Asymmetric** The incentive by itself may be skewed to the upside but likely neutral when combined with the rest of the incentive package as it is not clear that performance beyond the cap is plausible..	At PR19 there was an overall reward cap. For PR24 Ofwat proposes to remove the overall reward cap. This increases the scope for potential upside, should companies earn >3% RoRE. However, on a mean-expected basis this change is likely to be neutral for risk exposure as the impact of the removal of the cap is likely to be limited in practice and it is not clear that performance beyond the cap is a plausible outcome.	At PR14, Ofwat had an overall five-year aggregate cap of +/- 2% RoRE[58] – i.e., the new proposals increase risk (upside and downside) outside of the previous range.
Regulatory risk	Regulatory risk	The prospects for returns for regulated companies beyond a current price control period are highly dependent on the regulatory environment, the factors that influence and inform decisions by regulators and legislators. It is appropriate for regulators to be informed by societal concerns. The longer-term sustainability of regulation itself may depend on the regulator maintaining society's confidence in its processes. The transmission mechanisms for systematic risk will be principally through the exercise of discretion in the design and implementation of policy. It will be largely conveyed through periodic price control decisions, but also through broader legislative initiatives and wherever discretion is exercised in-period.	**Exacerbates** Risk exists for regulators / government to intervene outside of the price review process, particularly in areas of high political interest (for example, there are ongoing discussions regarding a windfall tax in the energy sector).	**Asymmetric** Intervention risk is skewed to the downside.	Greater media focus on water companies following coverage on storm overflows, FFT investigations, and drought restrictions. Significant exercise of regulatory discretion reflected in draft methodology, including material departures from the CMA's methodology at PR19 for setting allowed returns.	Greater media focus on water companies following coverage on storm overflows, FFT investigations, and drought restrictions.

[58] Setting price controls for 2015-20 Final price control determination notice: policy chapter A2 – outcomes, p. 94

5.4 Key conclusions

5.4.1 The risk assessment delineates between (1) systematic risks which are relevant for beta estimation and (2) risks which require compensation, due to a shortfall in mean expected cashflows, *in addition to* the remuneration for risk reflected in the beta.

5.4.2 The analysis indicates that are a number of risks which are likely to *increase* on a forward-looking basis, which is likely to result in an increase in systematic risk, all else equal. These increases stem from, *inter alia*, step changes in investment to meet environmental obligations for example in relation to storm overflows, population growth, the transition to Net Zero (which all increase deliverability risks), increased competition (which increases the risk of asset stranding) and more stretching performance targets (which increase the risk of regulatory penalties).

5.4.3 There are some changes that Ofwat proposes at PR24 which are likely to decrease risk compared to previous price review regimes, but they are mostly limited in scope and not material. The most material of these is the narrowing of cost sharing rates from those applied at PR19. However, the sharing rates could remain symmetrical at best and for many companies are likely to be asymmetric, with companies bearing a larger proportion of cost risk than customers.

5.4.4 The change in risk arising from changes in performance targets is not possible to assess at this stage, as the levels are not discussed within the draft methodology. However, Ofwat expects companies to meet their 2024-25 targets set at PR19 unless there are clear external factors that were unknown at the time of the PR19 final determinations. This is the starting assumption for the levels that companies will be expected to improve from through the 2025-30 period. Performance in the first two years of AMP7 reveals more companies are failing to meet their performance targets than are meeting them.

5.4.5 At the same time, the changes to the application of incentives proposed at PR24 are highly likely to increase risks. Restricting bespoke performance commitments, and removing exclusions, deadbands, caps and collars leaves companies exposed to more performance risk, particularly in case of penalty-only compliance measures. Although Ofwat proposes to mitigate the risk to some degree by introducing an ODI sharing mechanism which will apply once aggregate ODI payments reach 3% of RoRE, the proposed changes make it more likely that the ODI-sharing will be triggered due to underperformance than outperformance and companies will be exposed to higher downside risk. The value of the deadbands in AMP6 for two compliance measures, water compliance risk index and wastewater treatment works compliance, are at sector

level c.-2% of RoR[59]E, a greater level of negative asymmetry than the CMA modelled at PR19.

5.4.6 Analysis of relative risk across recent price controls indicates that – based on underlying dynamics of risk allocation implied by the regulatory framework – risk is at least as high as at PR19 and is likely to be *higher* at PR24. This finding is consistent with Ofwat's position that based on its current policy its "*overall package at PR24 is likely to put at least as much return at risk as at PR19"*[60].

5.4.7 All else equal beta as a measure of systematic risk would be expected to be flat or increasing, assuming that the increasing risks have a systematic component. As the holistic assessment of risk factors which drive systematic risk for water companies indicates that risk exposure is *increasing*, all else equal, it would be expected that the beta estimate for PR24 would reflect this increase in risk.

5.4.8 Some risks also result in 'uncovered' asymmetric downside exposure which would need to be compensated for separately from the remuneration for systematic risk. Asymmetric exposure will not be priced in through beta, which prices in a risk premium (relative to the risk-free asset) without any skew. Unmitigated downside risk exposure that results in expected negative cashflows must be compensated for separately.

5.4.9 Importantly there is a lack of clarity around the calibration of certain aspects of the PR24 price control – such as incentive targets and full specification of the approach to cost assessment – and the assessment of relative risk and implications for systematic risk may need to be updated in due course when the framework is more fully specified. However, it is clear from the initial assessment set out in the table below (where red denotes higher risk exposure at PR24 than in previous price controls) that risk exposure for PR24 is likely to be higher than in previous price controls.

[59] KPMG analysis of the 2020/21 Service Delivery Report

[60] Draft-methodology-main-document-3.pdf (ofwat.gov.uk), page 88

6 Estimation of beta at PR24 – methodological considerations

6.1 Introduction

6.1.1 This section evaluates the technical approach to beta estimation proposed by Ofwat for PR24 against finance theory and regulatory precedent. This assessment considers a number of the key methodological decisions required to estimate beta in turn:

- Listed comparator set
- Frequency of data
- Treatment of significant events affecting returns or volatility
- Estimation windows
- Averaging windows

6.2 Listed comparator set

6.2.1 An equity beta which is sufficiently representative of the business and financial risk of the notional firm represents a key input into the determination of the allowed return. The financial risk of the notional firm stems from the gearing assumption determined by the regulator, whereas the assessment of business or asset risk is inferred from the asset betas of chosen listed comparators.

6.2.2 As the regulatory allowed return is determined for the regulated element of the water company business, the notional water company is assumed to be a pure play operator. In other words, the notional company is not assumed to have any non-regulated business whose asset risk may be materially different from that of a pure play regulated company.

6.2.3 In practice, water companies can and do also undertake non-regulated activities although the scale and nature vary from company to company. Given the availability of listed water companies to inform the determination of asset beta by the regulator, the exam question is how to best proxy the business risk of the pure play operator, whilst also ensuring that all relevant and useful data is taken into account such that the calculation is representative of business risk and robust.

6.2.4 Regulated activities have comprised the majority of Severn Trent (SVT) and United Utilities' (UUW) businesses[61] since c. 2007-2008 following the sale of UUW's telecoms

[61] Regulated activities comprised c. 93% of 2021/22 revenues for SVT and c. 96% for UUW according to annual reports.

business[62] and the demerger of SVT's waste management business[63]. In contrast, PNN has in the past had a material unregulated business (related to recycling, energy recovery and waste management services) until its sale of Viridor in 2020[64]. The timing of the sale means that previous ownership of the waste management business is likely to constrain the extent to which weight can be placed on its data at PR24.

6.2.5 Ofwat has proposed to review whether to include PNN data in beta estimation in the final methodology and has noted that reflecting this data would not be straightforward due to difficulties in accounting for cash holdings from the disposal of Viridor with gearing.

6.2.6 Given the limited number of listed companies in the sector (3 out of 17), the inclusion of additional data from the period since the sale of the Viridor business would be helpful to increase the statistical robustness and representativeness of the beta estimate used to set allowed returns for the notional company. The following considerations would inform the treatment of PNN data in the derivation of the PR24 asset beta.

- **Availability of sufficient pure play data for different beta estimators:** As the sale of Viridor was announced in March 2020[65], currently only the spot 2-year estimates could be assumed to reflect the pure play PNN. Assuming that PR24 beta is estimated in September 2024, a similar cut-off date to PR19, an additional two years of data would enable the calculation of pure play 2-year betas using spot, 1-year, and 2-year averaging windows whereas 5-year spot betas would include a non-negligible proportion of data incorporating the risk of the non-regulated business.

- **The cut-off date used for beta estimation:** For example, the CMA used two cut off dates in its analysis of the PR19 beta and none of the estimators as at February 2020 would have included pure play information for PNN. The selection of cut-off date(s) for beta estimation in this Report will reflect the results of the structural break analysis and the requirement to set a beta reflective of the systematic risk for a notional water company over a long-term investment horizon. The extent to which PNN data will warrant inclusion based on the selected cut-off date will be considered separately.

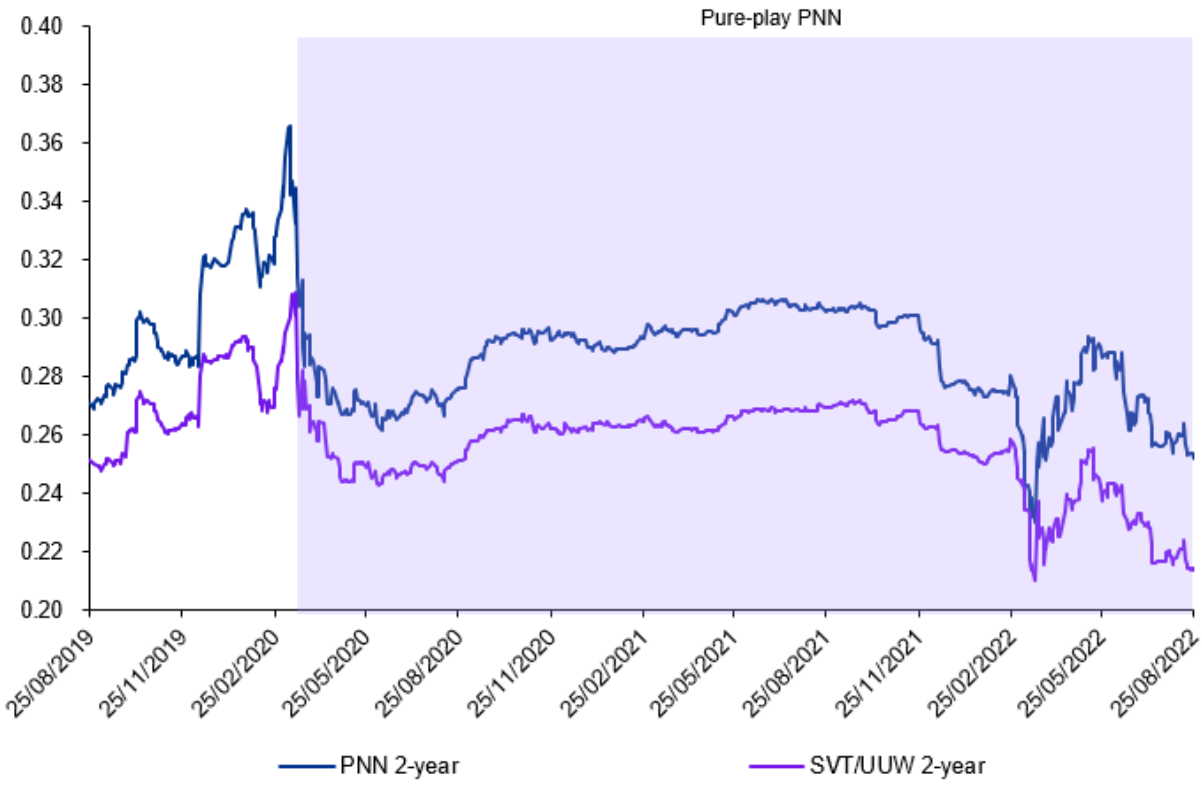
- **The impact of the sale on gearing:** The impact of the sale of Viridor on cash balances, and consequently on gearing and asset beta, was constrained to a single financial year and could be normalised with reference to net debt balances held

[62] United Utilities (companieshistory.com)
[63] Biffa looking forward after 100 years
[64] Disposal of the Viridor Business | Pennon Group PLC (pennon-group.co.uk)
[65] Ibid.

during recent periods before and after the sale.

6.2.7 The chart below contrasts the 2Y unlevered beta of PNN (normalised for the impact of the sale of Viridor[66]) to that of a value-weighted portfolio of SVT/UUW and shows that unlevered beta of PNN has continued to materially exceed the beta of the SVT/UUW portfolio even after the sale of Viridor.

Figure 2 Comparison of 2Y daily rolling asset betas (unlevered) for PNN and SVT/UUW value-weighted portfolio



Source: KPMG analysis of Thomson Reuters Eikon data as of 25 August 2022.

6.2.8 Table 5 illustrates that the inclusion of PNN in the value-weighted water portfolio results in a small increase in the 2Y spot unlevered beta. All else equal, this suggests that a beta based solely on SVT and UUW data may under-remunerate the systematic risk exposure for the notional water company.

[66] In Thomson Reuters Eikon, the sale of Viridor affects the EV gearing of PNN from 25/11/2020 to 30/11/2021 (the dates at which the Net Debt values from Half Year results of respective years were reflected in the Eikon database). EV gearing has been normalised by effectively replacing values between 25/11/2020 – 30/11/2021 with the average observed gearing during (1) the one-year window before gearing went negative and (2) the period between 01/12/2021 – 25/08/2022.

Table 5 The impact on 2Y spot beta of the inclusion of PNN in the value-weighted portfolio of water stocks

	2Y spot unlevered beta as at 25 Aug 2022
SVT/UUW	0.2540
PNN/SVT/UUW	0.2586
Difference	0.0046

Source: KPMG analysis of Thomson Reuters Eikon data as of 25 August 2022.

6.2.9 This Report does not include PNN in beta estimates as there is insufficient pure play data as at the two cut off dates used in the Report. (28 February 2020 and 23 February 2022 as per section 8.1.4). However, should the inclusion of PNN continue to result in higher betas as more pure play data becomes available for PNN, this may indicate that estimates based on SVT and UUW alone *understate* beta for the water sector. Ofwat should carefully consider how the evidence from PPN should be taken into account, particularly in the context of having a very limited number of listed comparators available for the sector.

6.3 Frequency of data

6.3.1 Typical frequencies used in the estimation of betas include daily, weekly, and monthly. In practice, there is a trade-off between observation frequency and statistical accuracy, insofar as higher frequency of data increases the precision of estimates through lowering of the standard errors, but may bias estimates in the presence of asynchronous trading (a situation where the stock in question does not trade with the same frequency as the overall market portfolio As a result there is a mismatch between the time when new signals are assimilated in the stock vs the market price), or where stocks are subject to any of "opacity", liquidity and size considerations.[67]

6.3.2 For liquid stocks that are unlikely to suffer from asynchronous trading, we consider daily frequency to be an appropriate starting position for development of point estimates. This is consistent with the approach proposed by Ofwat in the draft methodology.

6.3.3 During the PR19 re-determination the CMA placed weight on different frequencies of data to form their range of estimates. This approach is similar to CMA's analysis in the Bristol PR14[68] and NATS/CAA Determinations[69]. However, as shown by the CMA's PR19 FDs, the estimates based on weekly frequency of data are not materially different

[67] See Gilbert et al (2014) and Gregory et al (2018):
Gilbert, T., Hrdlicka, C., Kalodimos, J. and Siegel, S. (2014). Daily data is bad for beta: Opacity and frequency-dependent betas. *The Review of Asset Pricing Studies*, 4(1), pp.78-117, and
Gregory, A., Hua, S. and Tharyan, R. (2018), In search of beta, *The British Accounting Review*, 50(4), pp.425-441
[68] Bristol FD, p.325
[69] CMA NATS, p.151

from those based on daily data (in the case of UK water stocks) whereas monthly estimates are more volatile and sensitive to outliers.[70]

6.3.4 Given that all the comparators considered in this Report are liquid, the Report considers that daily frequency represents a good starting point for assessing betas in a UK regulatory context, consistent with Ofwat's proposed approach.

6.4 Treatment of significant events impacting on returns or volatility

I. Framework for determining the appropriate treatment of significant events affecting returns or volatility

6.4.1 The appropriate treatment of significant events affecting returns or volatility should be informed by the investment horizon implied in the regulatory WACC and the specification of the CAPM used to estimate cost of equity.

The relevant investment horizon

6.4.2 The cost of capital varies with the assumed investment horizon. This is predominantly because the risk-free rate observed using various market instruments and short-term betas change over time.[71] The specified investment horizon can represent a key determinant of the calculated cost of equity estimate.

6.4.3 It is appropriate for the investment horizon for estimating the forward-looking cost of equity in regulatory price controls to be long run. This is because both debt and equity investors in regulated utilities make long-term financing decisions, including debt financing of up to 30 years' maturity[72], reflecting the asset lives of the underlying infrastructure. In order to attract investment, a forward-looking cost of equity over that same long-run horizon is required. The view that a long-run investment horizon should be used when estimating the allowed cost of equity, does not appear to be controversial. For example:

- The UKRN Cost of Equity Study (2018) [73] recommended the use of a long-run investment horizon because regulatory assets tend to be long-lived.
- At PR19 the CMA noted that "*the **very long-life assets and long-horizon investment decisions** that are likely to be based on our cost of capital estimates. As a result, we suggest that **a 20-year investment horizon would closely match the reality of decision-making** within the sector and so use gilt and other market*

[70] CMA PR19 FD, Tables 9-8 and 9-11
[71] In theory, the short-term total market return will also vary with time.
[72] CMA PR14 FD (Bristol), para. 10.6
[73] See, for example, Recommendation 2 in Estimating the cost of capital for implementation of price controls by UK Regulators

data at or close to 20-year maturities. We note this horizon is longer than the 15 years used by Ofwat.[74]"

— In the draft methodology consultation for PR24 Ofwat noted that "*the CAPM is a model for estimating the market required return on an equity investment over a single period, or investment horizon. We consider this should be long-term, or around 10-20 years*"[75]. Ofwat also refers to 15Y Gilts in the context of the risk-free rate, which all else equal, suggests an investment horizon of at least 15 years[76]. Ofwat also considers a 25Y for investment planning through its new Long Term Delivery Strategy framework[77].

6.4.4 The investment horizon should be specified clearly and estimation of each parameter in the cost of equity should be developed through the lens of this investment horizon, as far as possible, as otherwise the cost of equity estimate would not represent a true expected return over the long run investment horizon. This is consistent with the position adopted by the CMA[78] and each of the authors[79] of the Wright et al (2018) paper, where the authors stated:

6.4.5 *"However, we are in agreement on a key caveat: that,* ***whichever horizon is chosen, the components of the cost of capital should, as far as practically possible, be estimated in a way that is consistent with the chosen horizon,*** *since without this consistency we cannot view our CAPM-WACC estimate as a true expected return. We shall argue that this has not always been the case for the choices made by UK regulators."*[80]

6.4.6 Nevertheless, for horizons which are appropriate for regulatory price control purposes, e.g. 15 or 20 years, isolating the impact on the allowed cost of equity of moving from (say) 15 to 20 years is difficult. The purpose of the requirement to adopt a consistent investment horizon is primarily to ensure that a long-run cost of equity is estimated. Retaining a long-run approach to estimating the parameters and applying this consistently ensures short-term market movements or volatility are not introduced into the long-run cost of equity estimate.[81] All else equal attaching weight to short term volatility is likely to introduce distortions in the long-run cost of capital.

[74] CMA PR19 FD, para. 9.128

[75] Appendix-11-Allowed-return-on-capital-appendix.pdf (ofwat.gov.uk) p. 3

[76] Ibid, p. 5

[77] PR24-and-beyond-Final-guidance-on-long-term-delivery-strategies_Pr24.pdf (ofwat.gov.uk)

[78] See, for example, CMA PR19 FD, paras. 9.330 and 9.551

[79] The phrase 'each of the authors' is used as they do not agree on all of their recommendations.

[80] Estimating the cost of capital for implementation of price controls by UK Regulators, p.29

[81] It should be noted that fundamentally, the parameters using in the cost of equity estimates are expectations of forward-looking outcomes over a long-run investment horizon, for which it may be appropriate to rely wholly or partially on historical data.

6.4.7 The above implies that the objective is to estimate a beta that will apply over a horizon consistent with that used in the estimation of the other CAPM parameters, i.e. at least 15 years. This Report assumes an investment horizon of *at least* 15Y. This is a key assumption as reflecting short term variation in betas – such as variation observed in relation to Covid19 and the war – may not be reflective of risks and return requirements over the selected long-run investment horizon, would not be consistent with the basis for estimation of other parameters such as the risk-free rate and in turn might not attract long-run capital to the sector.

Specification of CAPM used to set allowed cost of equity

6.4.8 As noted by Ofwat in the draft methodology consultation, the standard version of CAPM used by regulators estimates the required return on an equity investment over a single period or investment horizon[82].

6.4.9 This *unconditional* version of CAPM is the standard model and does not distinguish between different potential future states of the world under different scenarios. The unconditional model assumes any variation in the stock beta and the market risk premium is effectively 'noise' which could distort long-run estimates of beta.

6.4.10 This CAPM is effectively *unconditional* and is not contingent on time-variation in the market risk premium and beta. For example, the assumption underpinning the CAPM used to set allowed returns for a 15-year investment horizon is that beta would not vary across time and business cycles during this 15-year forward-looking period.

6.4.11 This contrasts with an alternative, *conditional* CAPM which assumes betas and the market risk premium vary over time. In consequence a conditional beta would capture potentially transient shifts in the relationships between daily returns or differences in betas in different economic climates. These transient shifts are not reflected in the long-run beta which abstracts from variance between different potential economic states of the world.

6.4.12 Overall, as the CAPM used in the regulatory process is an unconditional CAPM, an estimate of the unconditional beta is the relevant and appropriate input into the calculation of allowed cost of equity. The unconditional beta reflects the fundamental systematic risk of a company, in other words, some sort of "normal" beta to which one might expect a water company's beta to revert to despite short-term fluctuations.

6.4.13 Absent adoption of a conditional CAPM – which would represent a significant departure from use of the unconditional CAPM as the primary methodology for setting returns – a

[82] Appendix-11-Allowed-return-on-capital-appendix.pdf (ofwat.gov.uk) p. 3

key question becomes how to estimate a long-run, unconditional beta which takes into account underlying business risk over the assumed investment horizon.

6.4.14 UKRN's cost of equity study noted that:

- *if we are concerned to assess the nature of systematic risk at long horizons, we should ensure that our estimation techniques are consistent with that horizon.*
- *But **for regulators, who deliberately pick long horizons**, it appears at first sight to be **distinctly counterintuitive to use such a short samples of high frequency data** to assess the systematic component of equity returns over long horizons.*
- *We would ideally like to **estimate the unconditional (or "long-run") beta**, which is the ratio of the unconditional covariance to the unconditional variance of the market return. It is **long-run beta that will determine the impact of systematic risk over the horizons relevant to regulators.**[83]*

6.4.15 All else equal the adoption of a beta which is materially influenced by a specific, short-term economic cycle is not likely to reflect an unconditional, long-run beta as significant weight would be attached to a period which might be transient and 'noisy'.

6.4.16 This is consistent with the position adopted by the CMA in its PR19 re-determination, which noted that its estimates should be calibrated such that limited weight is attached to specific economic cycles[84].

Treatment of structural breaks

6.4.17 Beta captures the expected change in return associated with a systematic risk event, be that positive or negative, *but the beta itself does not change.* During the PR19 appeal Professor Alan Gregory et al (2020, 2021)[85] submitted that in case of systematic risk events, the returns on water companies should move in line with market returns, proportionate to their betas, and that the unconditional CAPM specifically predicts the degree of the relative movement.

6.4.18 One would not expect the unconditional beta itself to change in case of such an event, because if it does, then this implies a break in the econometric relationship between the

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[83] Estimating the cost of capital for implementation of price controls by UK Regulators, p. 147

[84] CMA PR19 FD, para. 9.477

[85] Gregory, A., Harris, R., and Tharyan, R. (2021), The Evolution of Beta Through the Covid Crisis, (referred to as 'Prof Alan Gregory et al (January 2021)');
Gregory, A., Harris, R., and Tharyan, R. (2020). A response to the CMA's Provisional Findings on Water and the Estimation of Beta, (referred to as 'Prof Alan Gregory et al (October 2020)');
Gregory, A., Harris, R., and Tharyan, R. (2020), A Response to "Further Comments Regarding Beta" by Europe Economics, (referred to as 'Prof Alan Gregory et al (June 2020)');
Gregory, A., Harris, R., and Tharyan, R. (2020). A Report on the Estimation of Beta for Regulatory Charge Control Purposes, (referred to as 'Prof Alan Gregory et al (April 2020)')

water industry and the wider market. Should such an event occur, Gregory et al posit that the obvious question is whether this is an example of a permanent state of affairs, or a temporary hiatus in the relationship. The exam question then becomes whether this structural break is representative of a "new normal" in which case the affected should be legitimately included in the calculation of beta. If, however, the effect is transitory, it should be excluded.

6.4.19 In this context Ofwat recognises the relevance of structural breaks for beta estimation, noting for example that "***regulatory reforms can change a sector's systematic risk.*** *For example, before 2015, our determinations were set as controls on tariffs, but since PR14 we have set total revenue controls for wholesale activities, with an accompanying reduction in revenue risk."*[86]

6.4.20 At the same time Ofwat also notes that "*we propose not to use structural break analysis to inform the estimation period*[87]*".* It is not clear that these two positions are consistent as Ofwat's approach recognises that there are factors which can impact on systematic risk which might not be relevant to setting a long-run, unconditional beta. Ofwat's position that PR14 represents a structural break is consistent with the position adopted in this report and the evidence developed by Gregory et al that PR14 represents a clear structural break event[88]. Importantly, changes to regulation can have a material impact on the systematic risk for regulated companies and it is reasonable to estimate beta based on data which captures the most relevant dynamics of regulation and so best proxies the framework under which companies will be operating across the forward-looking investment horizon.

6.4.21 There are equally structural breaks in the data related to economic periods which are transitory in nature, do not reflect an enduring change to underlying business risk and hence do not represent a robust proxy for estimation of long-run beta. In this context Ofwat's intention to avoid setting a beta which is dominated by data from the Covid19 pandemic and the recognition that this could distort beta are welcome. However, the approach proposed by Ofwat is likely to attach weight to beta which is disproportionate to the likelihood of a pandemic recurring within the investment horizon.

6.4.22 In order to evaluate this issue both a statistical and economic investigation of structural breaks should be undertaken. This is consistent with recommendations from Gregory et al during the PR19 CMA appeals as well as from the authors of the Indepen report, commissioned by Ofgem, who noted that "*in an ideal world the estimation of equity β would be based upon all available information back to the date of listing. However,* ***given the likelihood of structural breaks due to company specific, regulatory or***

[86] Appendix-11-Allowed-return-on-capital-appendix.pdf (ofwat.gov.uk), p. 15
[87] Ibid.
[88] As reflected in the papers set out in footnote 85.

***market wide factors, the data used for estimation may be restricted**. If structural breaks affect relative risk, it will be important to know whether an event had a significant effect or not and **whether the effect is permanent or transitory.**" [89]*

6.4.23 In case of permanent structural breaks, the relevant input into the calculation of regulatory cost of equity is the data since the most recent break as this would accurately reflect the systematic risk going forwards. In case of temporary breaks, caution is required as reflecting the affected data in forward-looking beta estimates over the chosen investment horizon may over-weight the impact of such events in beta estimates.

6.4.24 In this context, Gregory et al note that "*our view on how these breaks should be treated depends upon the nature of the break. In common with Indepen (p.6-7), we would agree that **if the break induces a permanent change** (as PR14/RIIO would appear to have done)[90], then the **appropriate approach is to use the full data period since the break**, but that if the break is of a temporary disruptive nature (as may be the case with the financial crisis and Covid-19) then one would want to estimate beta using data before and after the break point, but not during the period of disruption*".[91]

6.4.25 The following overarching principles emerge based on the above:

- The estimation of allowed cost of equity requires an estimate of an unconditional beta that will apply over the long-term investment horizon implied in the regulatory WACC.
- Changes in the unconditional beta imply a break in the econometric relationship between the stock and the market and would need to be carefully evaluated to determine whether they are temporary or permanent. This will inform how the break event should be treated in forward-looking beta estimates. All else equal it would not be expected that material weight would be attached to transitory effects in estimation of unconditional beta over a long-run horizon.

II. Analysis of significant events affecting returns or volatility ahead of PR24

6.4.26 Two significant events have a significant impact on the global and UK economies, namely: Covid19 and the Russia-Ukraine war[92].

6.4.27 Covid19 resulted in a sudden and severe global recession as a result of lockdowns and major disruptions to everyday life that is unique across multiple dimensions.

[89] Indepen (2019), 'Beta Study–RIIO-2, Main Report', p.7

[90] The analysis undertaken by Gregory et al during the PR19 appeals found a structural break for the UK water sector around the PR14 period. This is discussed in greater detail in section 8.5.

[91] Prof Alan Gregory et al (June 2020)

[92] UK Economic Outlook, KPMG (2020-2021 editions)

- The pandemic was an exogenous crisis that did not have an economic origin.
- It created significant uncertainty for businesses, individuals and governments as its scale and duration were dependent on unpredictable non-economic factors, such as the speed at which vaccines could be developed and rolled out.
- Its impact was global in the sense that it affected all countries and all sectors, although the impact varied significantly.

6.4.28 The Covid19 pandemic represented both a shock to demand, as people adjusted their behaviour to reduce the risk of exposure to the virus and conform with mandated lockdowns (a highly atypical feature of this event); and a shock to supply, as the effect of factory closures reduced the productive capacity of the world economy.

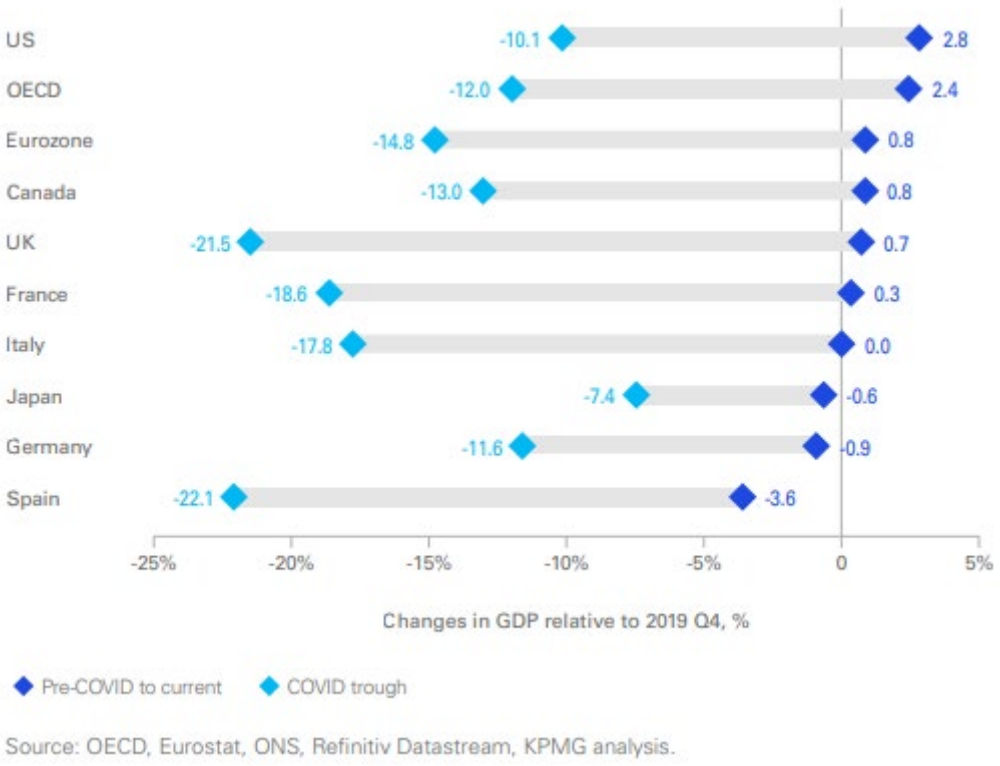
6.4.29 The speed, scale, and scope of the policy response was also unique, resulting in substantive monetary and fiscal policies with support schemes for businesses and individuals. The KPMG Economic Outlook paper in June 2020 highlighted that "*the UK economy is in the midst of the most severe economic downturn in modern times. The nature of lockdown and social distancing restrictions has curtailed the ability of businesses to operate*…

6.4.30 *Over the past three months, COVID-19 has become one of the most significant global pandemics in history. By early June, the pandemic had spread to 213 countries and territories…The latest data points to one of the deepest economic recessions on record, with a record fall in GDP in the second quarter of 2020".*[93]

6.4.31 More recently the global economy has been recovering from the Covid19 pandemic, although the bounce-back has been uneven across countries. Overall, GDP across the OECD countries is now 2.4% above its pre-pandemic level, with the US economy 2.8%, the Eurozone 0.8%, and the UK 0.7% higher than in the fourth quarter of 2019. However, a number of countries are yet to reach that threshold, including Spain, Germany, and Japan.

[93] UK Economic Outlook June 2020 - Hard Times (assets.kpmg)

Figure 3 Uneven recovery from Covid19 across countries[94]



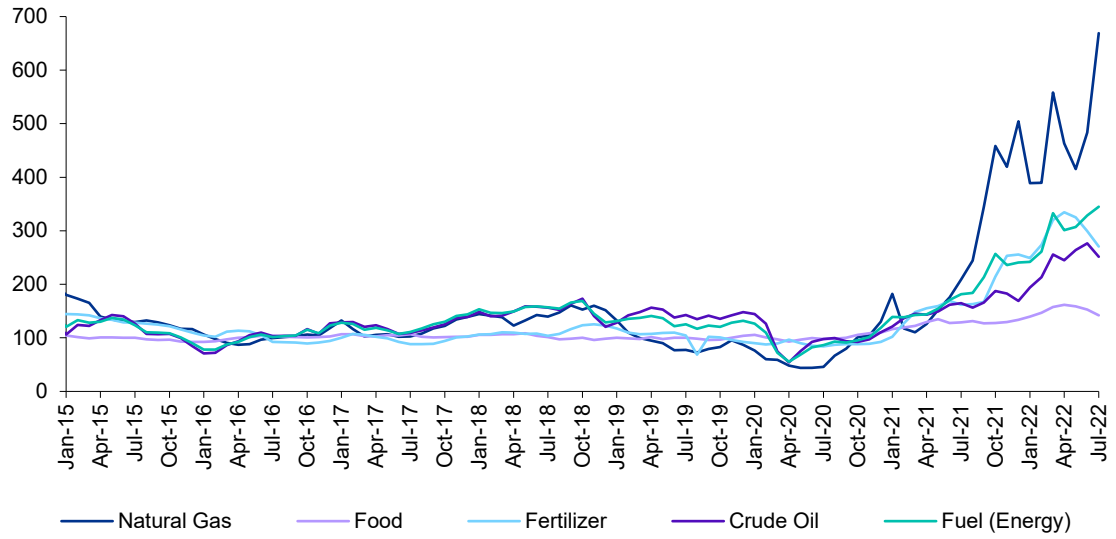
Source: OECD, Eurostat, ONS, Refinitiv Datastream, KPMG analysis.

6.4.32 As the global economy was re-opening in early 2022, with many parts of the world lifting restrictions, and a number of economies returning to their pre-Covid19 size, a second, very rare, shock with a significant impact on global and in particular European economies materialised. Whilst localised, the conflict between Russia and Ukraine has had broad implications for economies around the world as these countries account for a large share of global energy exports, as well as exports of a range of metals, food staples and agricultural inputs.

6.4.33 The risk of the Russia-Ukraine conflict escalating further appears to have diminished, but the war has left tangible side-effects on the global commodity markets. For example, global gas prices are now around six times higher than their pre-pandemic average, while oil prices are twice their average levels (as set out in the figure below).

[94] UK Economic Outlook - June 2022 (assets.kpmg)

Figure 4 The rise in global commodity prices post Covid19 and Russia-Ukraine war



Source: KPMG analysis of IMF Primary Commodity Prices

6.4.34 The prices of many of the commodities exported by Russian and Ukraine were already high, and stocks low, as the Covid19 pandemic had caused production to slow, and demand accelerated quickly when economies reopened. The escalation of the conflict, which resulted in a number of sanctions on Russia and paused most production in Ukraine caused prices to rise further and exacerbated supply chain pressures for a number of industries.

6.4.35 The significant impact that Covid19 *and* the war have had on the global and UK economies suggests that a statistical investigation is warranted to assess their impact on water company betas. Gregory et al undertook several iterations of structural break analyses during the PR19 appeal – albeit with less than 12 months of affected data[95] – and found that Covid19 had a significant negative impact on water betas.

6.4.36 The Report carries out additional structural break analysis. Dummy variables corresponding to potential structural break dates are incorporated into the regression of daily returns for the water portfolio (SVT, UUW) against the returns of the benchmark index. The analysis covers the period from 1 October 2014[96] through to 25 August 2022. Where the change in beta associated with a given dummy variable is material and statistically significant, this is indicative of a structural break.

Covid19

[95] The latest version of the analysis included data up to 31 December 2020

[96] Gregory et al identified a structural break for the water sector coinciding with the PR14 price control.

6.4.37 In this context 28 February 2020 is selected as the structural break date for Covid19 as (1) the CMA used this date as the cut off for estimating betas not affected by the pandemic, (2) by mid-March UK was starting to gear up to impose restrictions[97], and (3) it is clear from the chart below that there is evidence of material stock market movements in March.

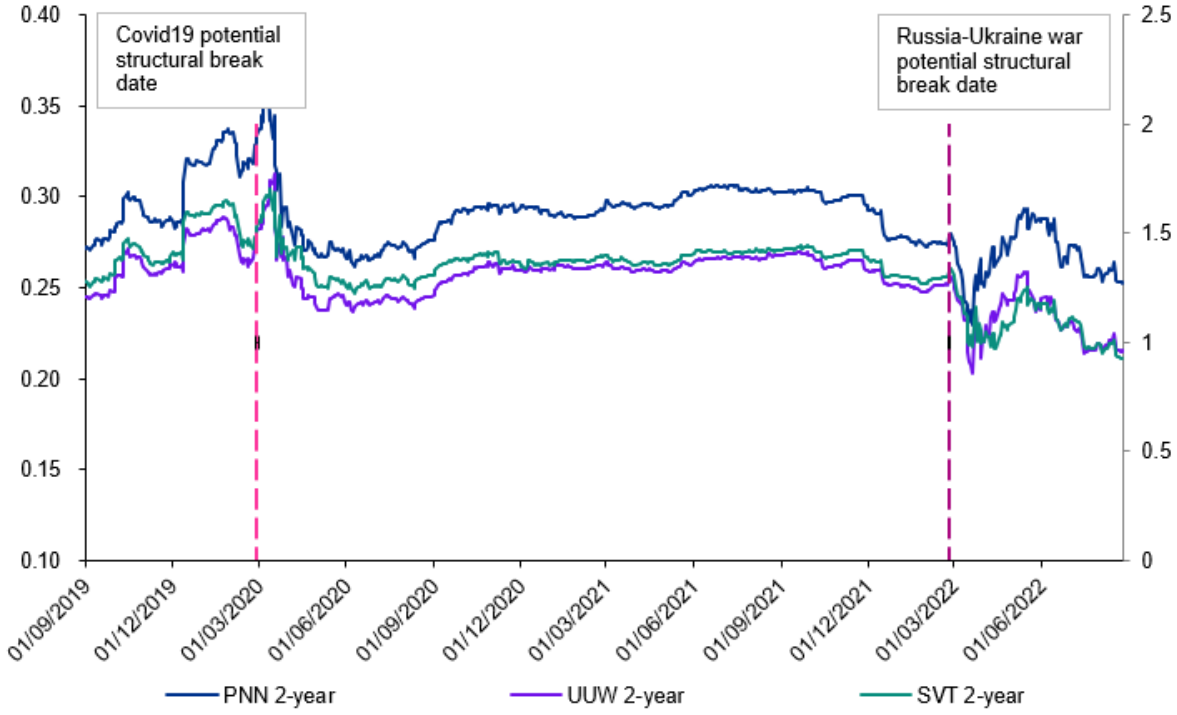
6.4.38 The assumed end date for the pandemic corresponds with the removal of the remaining Covid19 international travel restrictions for all passengers on 18 March 2022[98] (all restrictions amending UK residents and domestic travel had been removed some months prior to this date).

Russia-Ukraine war

6.4.39 24 February 2022 is selected as the structural break for the Russia-Ukraine war as the date at which Russia invaded Ukraine. The impact of the war is assumed to apply to all subsequent data, i.e. up to the cut-off of 25 August 2022.

[97] Timeline of UK government coronavirus lockdowns and restrictions | The Institute for Government
[98] All COVID-19 travel restrictions removed in the UK - GOV.UK (www.gov.uk)

Figure 5 2Y daily rolling asset betas (unlevered) for water companies



Source: KPMG analysis of Thomson Reuters Eikon data as of 25 August 2022[99].

6.4.40 The table below indicates that both Covid19 and the war have had significant negative impacts on water company equity betas. Table 6 indicates that the Covid19 has resulted in a statistically significant reduction in the equity beta for the pure play water portfolio of c.0.14, whereas the impact of the war has so far been equivalent to a reduction of c.0.27.

[99] Please refer to footnote 66 for an explanation of the methodology for normalising PNN EV gearing for the impact of the sale of Viridor.

Table 6 Results of the structural break analysis

	Coefficients	Standard Error	t Stat	P-value
Intercept	0.0002	0.0003	0.7477	0.4547
Base beta (SVT/UUW, equity)[100]	0.6795	0.0375	18.1114	0.0000***
Change in equity beta associated with the Covid	**-0.1446**	0.0523	-2.7657	0.0057***
Covid dummy variable[101]	0.0001	0.0006	0.1984	0.8427
Change in equity beta associated with the war	**-0.2669**	0.0951	-2.8068	0.0051***
Russia-Ukraine war dummy variable[102]	0.0003	0.0011	0.2531	0.8002

Source: KPMG analysis of Thomson Reuters Eikon data as of 25 August 2022.
Note: * is significant at the 10% level, ** at the 5% level and *** at the 1% level.

6.4.41 To assess the weight that should be given to the data affected by Covid19 and the war in the context of setting long-run unconditional betas for PR24, this Report considers:

- How likely is it that pandemics with similar impact to Covid19 will occur over the (at least) 15Y investment horizon likely to be assumed by Ofwat?
- Is the impact of the Russia-Ukraine war temporary or protracted, relative to the investment horizon in the PR24 WACC?

How likely is it that pandemics with similar impact to Covid19 will occur over the investment horizon?

6.4.42 In relation to this question, it is important to consider the frequency of comparable pandemics in future (will a pandemic of similar magnitude happen every 20Y, 50Y or 100Y?)

6.4.43 Forecasting each of these variables is inherently highly uncertain. The last comparable pandemic was approximately 100Y ago in a significantly different environment in terms of geographical integration (i.e. the ease of travel), medical and technological advancement and the tools available to deal with economic crises.

6.4.44 There have been several studies which have sought to estimate the likely frequency of pandemics which are comparable to Covid19. Ofwat's draft methodology is predicated on a paper which considers the potential frequency of pandemics which are comparable to Covid19 in terms of severity and duration.

[100] Value-weighted
[101] The dummy variable is 1 between 01/03/2020 – 18/03/2022
[102] The dummy variable is 1 24/02/2022 onwards

6.4.45 "*Using the number of epidemic occurrences observed in the past 20 y (i.e., 2000 to 2019) in the MEVD model, this intensity corresponds to an average recurrence time of 59 y (95% CI 55 to 64 y). This value is much lower than intuitively expected. However, in many countries, drastic nonpharmaceutical interventions, contact tracing, and quarantine have significantly reduced the number of deaths that could have otherwise occurred. Detailed modelling work suggests that unconstrained epidemic spread would have led to as much as eight times the number of deaths that actually occurred in some countries (20). Assuming this amplification factor, one obtains an intensity of 2.63 ‰/year, which corresponds to an average recurrence time of 209 y.*"[103]

6.4.46 The paper estimates the base probability of experiencing a comparable pandemic as 0.38 to 0.76 in 100Y.

6.4.47 This suggests that the likelihood that another pandemic event occurs in the estimation window is low. All else equal this would not justify the weight that is implied by a 2Y or 5Y beta including the Covid19 period. Implicitly the latter assumes a similar event is a near certainty in the PR24 period.

6.4.48 This contrasts with the position set out by Ofwat in its PR24 draft methodology, which considers that irrespective of the proximity of Covid19 to the PR24 decision date that it is not necessary to estimate an unconditional beta which is not disproportionately affected by structural changes in beta arising from the pandemic:

6.4.49 "*Our current preference to address this issue is through relying on evidence from a* ***range of estimation periods (of 2, 5, and 10 years),*** *ensuring that our approach encompasses data from unaffected periods and a reasonable span of years.* ***We do not propose to apply bespoke weights to the Covid-affected data****, as we note that a selective treatment of just one of many sources of systematic risk might miscalibrate weightings for alternative sources of risk that are more relevant to the 2025-30 period*"[104].

6.4.50 This approach does not appear to consider whether observed effects on beta are likely to be transitory and hence could distort estimates of the long-run, unconditional beta. An approach which reflects transitory impacts on beta effectively reduces the approach to a conditional beta methodology which (1) is not consistent with the unconditional CAPM model used by the regulators, (2) is not consistent with the investment horizon and calibration of other parameters which are estimated over the long run and (3) is likely to attach weight to data from a period which is not reflective of underlying risk exposure, which is expected to increase at PR24. Importantly, there is not robust evidence to indicate that a conditional model would substantively improve as a basis for estimation

[103] Intensity and frequency of extreme novel epidemics | PNAS

[104] Appendix-11-Allowed-return-on-capital-appendix.pdf (ofwat.gov.uk)

of returns implied by an unconditional, long run model – however a conditional model would add significant volatility into estimation of returns and reduce stability of estimates of required returns in the sector.

6.4.51 In contrast, the CMA recognised that this type of economic crisis is relatively rare and was likely to be over-weighted in the CMA's beta estimates, which covered the last 2-, 5- and 10-year periods[105]. Overall, at PR19 the CMA placed very limited weight on the evidence on beta estimates from December 2020 (that include the Covid19 period) than on observations pre-February 2020 (i.e. before the Covid19 period). The CMA's final range of asset beta estimates of 0.28-0.30 (zero debt beta basis) was fully encompassed within the range of evidence that results from estimates being calculated with pre-Covid cut-off[106]. As a result, the CMA's range for beta is relatively unaffected by Covid19 estimates.

6.4.52 The chart below illustrates the relative weight placed by the CMA on the data from the period affected by the pandemic for each estimation window based on its approach to (1) use cut off dates from both February and December 2020, (2) test and exclude outliers and (3) place less weight on estimates from December 2020.

6.4.53 It is unclear exactly what weight the CMA placed on outlier-adjusted estimates from December 2020, therefore the figures in the chart have been derived as an average of the following upper and lower bounds for the proportion of Covid-affected data reflected in the estimates.

- The lower bound assumes that the CMA placed no weight on Covid19-affected estimates given that its final range was fully encompassed within the range of evidence that results from estimates being calculated with pre-Covid cut-off[107]. The result is 0% weight attached to Covid19-affected data at the lower end of the range.
- The upper bound calculates the overall weight attached to the data from the period affected by the pandemic for each estimation window as an average across the two cut off dates. It indicates that c. 7.4% of the data reflected in the estimates could be Covid-affected. This analysis takes into account the exclusion of certain estimates from December 2020 by the CMA as outliers but does not reflect the CMA's additional decision to place less weight on outlier-adjusted December 2020 estimates[108]. As a result, it somewhat overstates the potential upper end of the range for proportion of Covid-affected data reflected in the estimates.

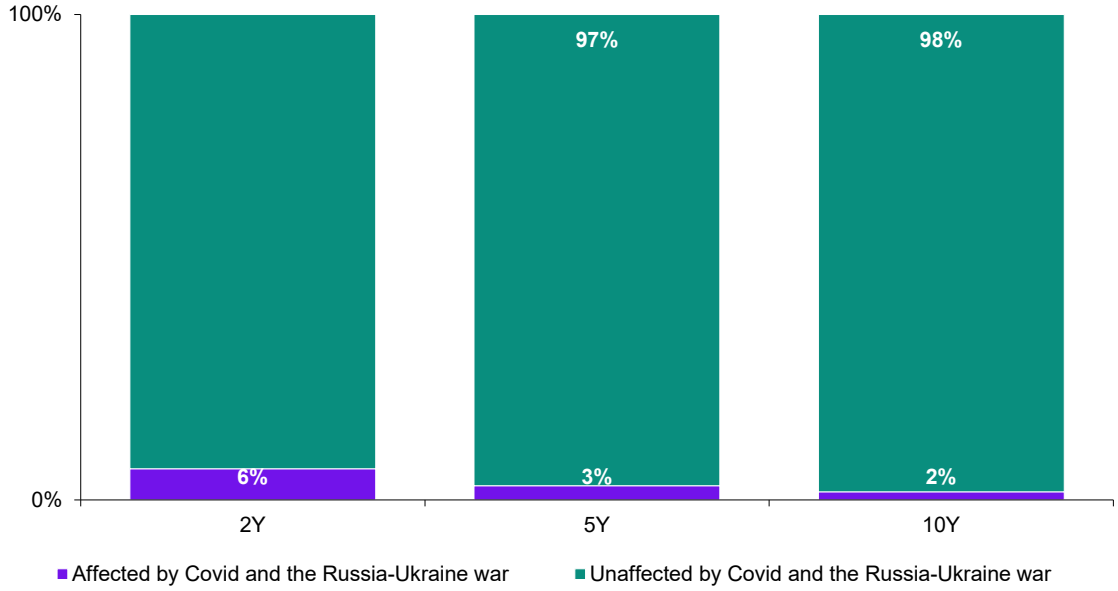
[105] Ibid., para. 9.493

[106] CMA PR19 FD, Table 9-16

[107] CMA PR19 FD, Table 9-16

[108] CMA PR19 FD, para 9.493: "*Therefore, we have placed less weight on the lower estimates from the dataset to December 2020".*

Figure 6 Weight attached by the CMA to the data affected by Covid19



Source: KPMG analysis.

6.4.54 This analysis suggests that c. 3.7% (midpoint of the 0 – 7.4% range) of data used to derive PR19 beta estimates could have been Covid-affected. In the context of a 20-year investment horizon employed by the CMA, this corresponds to an assumption that a pandemic of a similar scale as experienced during the first ten months of Covid19 would occur during c 0.74 years out of 20.

6.4.55 Relatedly, the Civil Aviation Authority ('CAA') in the Final Proposals for the H7 price control for Heathrow set a beta assuming that a pandemic-like event would occur once in every 20 or 50 years and last 17 or 30 months[109].

Is the impact of the Russia-Ukraine war likely to be temporary or protracted, relative to the investment horizon implied by the PR24 WACC?

6.4.56 The Russia-Ukraine war has also had a significant and continued (as evident from Figure 5) impact on water company betas. The extent to which this impact should be taken into account in the setting of allowed returns for PR24 depends on whether it is temporary or protracted, relative to the investment horizon in the PR24 WACC.

6.4.57 The conflict is still ongoing as of August 2022 and it is not possible to arrive at a robust and well-justified conclusion regarding the potential end date. However, the length of the economic impact of the war on Europe and the UK is unlikely to be perfectly correlated

[109] Economic regulation of Heathrow Airport Limited - H7 Final Proposals Section 3: Financial issues and implementation (caa.co.uk), section 9

with the duration of the war itself and is likely to vary between short-, medium- and long-term windows.

6.4.58 In the short-term the global supply of both energy and non-energy commodities will be disrupted, translating into price and inflationary pressures and challenges for businesses to manage shortages and bottlenecks in their supply chains. In the medium to longer term businesses and governments can find ways to limit disruption by, for example, diversifying suppliers of commodities, building flexibility into the procurement processes to accommodate longer lead times, etc.

6.4.59 Europe has already started developing plans to increase energy autonomy and thereby reduce the exposure to market disruptions such as those caused by the war. On May 18 the European Commission presented the REPowerEU Plan, its response to the hardships and global energy market disruption caused by Russia's invasion of Ukraine. The plan addresses energy savings, diversification of energy supplies, and accelerated roll-out of renewable energy to replace fossil fuels in homes, industry, and power generation. The Commission proposes to increase the headline 2030 target for renewables from 40% to 45%[110].

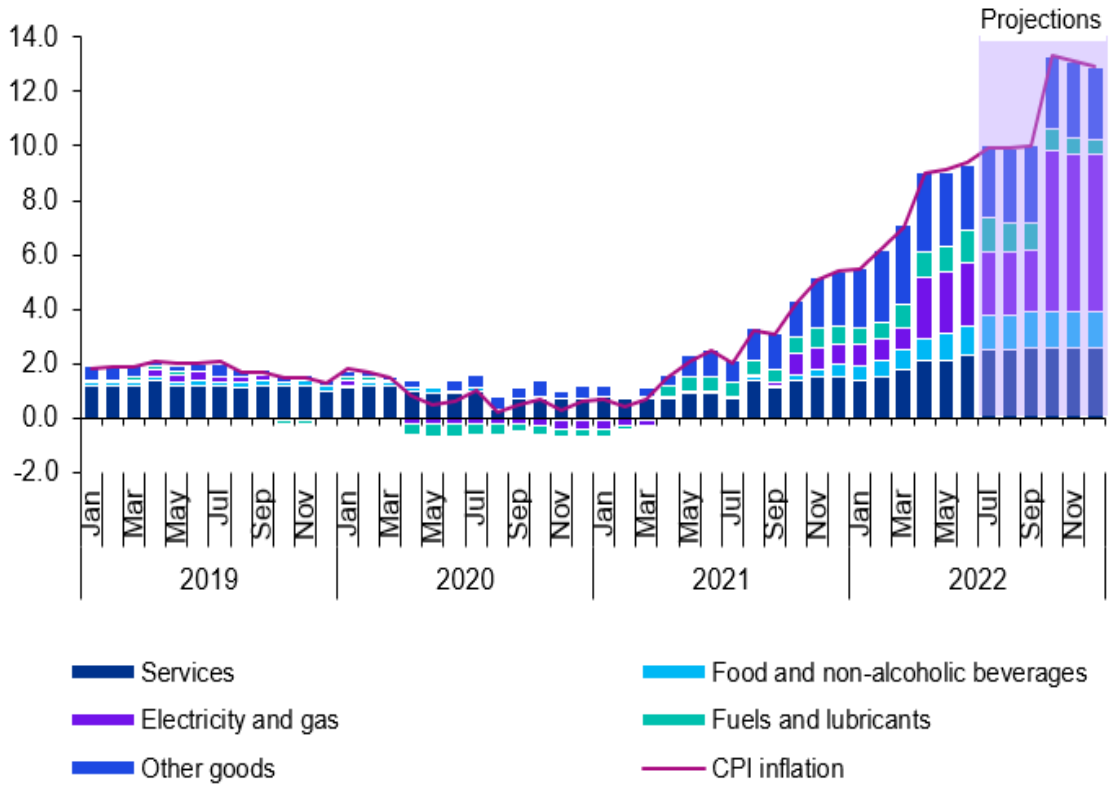
6.4.60 According to McKinsey[111] this includes plans to almost *double* European biomethane production and *triple* capacity of green hydrogen via production increases and imports by 2030, a massive deployment of 510 gigawatts of installed wind and 600 gigawatts of installed solar photovoltaic power by 2030 (and doubling of existing capacity by 2025[112]), the installation of around 30 million heat pumps, the enhancement of domestic manufacturing capability, and a substantial simplification of approval and permitting processes for renewable generation and infrastructure development projects, all over the next eight years. All else equal, these increases in the self-generated supply of renewable energy and the decrease in the reliance on Russian exports can reasonably be expected to mitigate the price pressures arising from the war.

6.4.61 Quantitative evaluation of the potential speed of reversion to the 'normal' economic conditions extant prior to the war and Covid19 requires a leading proxy measure that can capture and reflect the main channels via which the war is affecting the economy. This Reports adopts forecast UK CPI inflation as a proxy based on the view from Bank of England ('BoE') that "*the main channel through which the Russian invasion of Ukraine affects the UK economy is through higher energy and non-energy commodity prices, which push up UK inflation materially in 2022 and 2023".*[113]

[110] REPowerEU (europa.eu)
[111] The net-zero transition in the wake of the war in Ukraine: A detour, a derailment, or a different path? | McKinsey
[112] REPowerEU (europa.eu)
[113] Bank of England Monetary Policy Report May 2022

6.4.62 According to the BoE, the bulk of the high short-term inflation stems from the direct impact of high energy and tradable goods prices as well as their indirect impact via higher transport, production and utility costs for firms supplying non-energy goods and services. BoE notes that "*the rise in energy prices has been significantly exacerbated by the build-up to and Russia's subsequent invasion of Ukraine. Higher global goods prices reflect various factors including: the economic recovery from the worst of the pandemic; the rotation of consumer spending towards goods and away from services, most notably in the United States; and supply constraints in certain sectors*"[114]. The Bank notes, however, that domestic factors have also contributed to high inflation, notably the strength in pay growth due to the tight labour market

Figure 7 Bank of England analysis of contributors to CPI inflation



Source: Monetary Policy Report - August 2022 | Bank of England

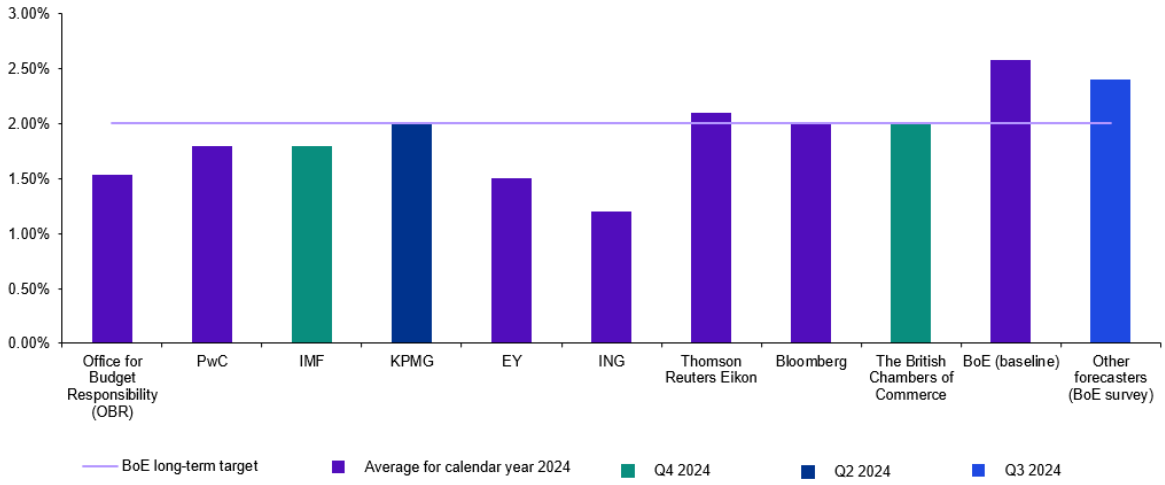
6.4.63 The implication from the above is that the level of inflation forecasts is largely, but not entirely, driven by the impact of the war and that the reversion of inflation to the long-term target can be indicative of a broader normalisation of the economic environment.

6.4.64 As evidenced from the chart below, inflation is expected to normalise ahead of the start of the PR24 price control which would suggest that the impact of the war could reverse in the next couple of years. In combination with the actions being undertaken to mitigate

[114] Monetary Policy Report - August 2022 | Bank of England

the economic impact of the war on Europe, this evidence implies that the beta estimates from the war-affected period are not likely to be relevant for setting a long run, unconditional beta for PR24.

Figure 8 Forecast inflation for 2024 (sorted by timing of the projection, from earliest to most recent projections)



Source: Inflation - Office for Budget Responsibility (obr.uk), UK Economic Outlook April 2022 (pwc.co.uk), United Kingdom and the IMF, UK Economic Outlook - June 2022 (assets.kpmg), ey-item-club-summer-forecast.pdf, Forecasts | ING Think, Britishchambers.org.uk, Monetary Policy Report - August 2022 | Bank of England, Charts and data for the Monetary Policy Report- August 2022

How much weight should be given to the data affected by Covid19 and the war, for the purposes of estimating a long-run, unconditional beta?

6.4.65 The nature and scale of Covid19 impacts on the economy distorted normal cyclical patterns because of mandated shutdowns of entire industries. Mandated shutdowns amplify the betas of those industries that are directly affected, and industries that supply these industries.

6.4.66 Overall, the Covid19 lockdowns have had a significant impact on estimates of beta. The most likely explanation for the reductions implied in the water company betas are the short-term changes in the market portfolio. In other words, that the behaviour of the market portfolio has changed during the lockdowns, such that the covariance of water company stocks with the market changed.

6.4.67 In consequence attaching significant weight to data affected by the Covid19 would suggest that the resulting beta estimate would not be reflective of the long-run beta of water companies. For example, if the beta estimates are based on 2Y, 5Y and 10Y spot estimation windows as set out in the draft methodology, this would effectively be assuming that 100% (2Y/2Y) or 40% (2Y/5Y) weight should be attached to the Covid19 period.

6.4.68 Similarly, attaching material weight to the data affected by the war would be tantamount to assuming that its impact will continue during the PR24 period and beyond. Whilst there is uncertainty around the timing of reversion to pre-war economic conditions, the evidence considered in this Report implies that the beta estimates from the war-affected period are not likely to be relevant for setting a long run, unconditional beta for PR24.

6.4.69 The change in short-term water company betas following these events appears to be a function of the 'flight to safety'[115] phenomenon whereby in times of market turbulence investors respond by switching their holdings away from higher risk investments into investments which are perceived to be low risk. In March 2020, the flight to safety in financial markets even became an abrupt and extreme 'dash for cash' in which investors sold off even safe assets such as long-term government bonds in order to obtain short-term highly liquid assets.[116] The effect of the flight to safety behaviour is to simultaneously (1) raise the price and reduce the return of lower risk assets and (2) lower the price and increase the expected return on higher risk assets.

6.4.70 These behavioural factors such as flight to safety or dash for cash are temporary *by nature*[117] and are a feature of a specific set of economic conditions. All else equal this indicates that attaching material weight to economic conditions in a period of market distress would likely distort the unconditional beta.

6.4.71 There is nonetheless some inherent uncertainty in relation to whether the impact of a major shock is temporary and betas will mean revert, or whether it reveals new information about business risk which is priced in by the market. The relative risk analysis carried out in this Report indicates that there is no change to fundamentals which could, on balance, drive reductions in business risk. As there are no clear reductions to risk factors which affect systematic risk for water companies, data affected by Covid19 and the Russia-Ukraine war can be seen as specific to prevailing economic conditions which, all else equal, should not be reflected in an unconditional, long run beta estimate.

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[115] On the impact of Covid19, see for example, Interim Financial Stability Report May 2020 (bankofengland.co.uk) p. i; Learning from the dash for cash – findings and next steps for margining practices - speech by Sir Jon Cunliffe | Bank of England; UK investment Management Industry: A Global Centre p. 16

On the impact of the Russia-Ukraine war, see for example, The Fed - The Effect of the War in Ukraine on Global Activity and Inflation (federalreserve.gov), Western credit markets are holding up remarkably well | The Economist

[116] Interim Financial Stability Report May 2020 (bankofengland.co.uk) p. i

[117] See for example, "*when investors pile into government bonds because they are looking for safe and liquid assets, such as in the summer of 2011, demand temporarily increases, pushing up prices and driving down yields*". Bond scarcity and the ECB's asset purchase programme (europa.eu)

"*Using only daily data on bond and stock returns, we identify and characterize flight to safety (FTS) episodes for 23 countries. On average, FTS days comprise less than 3% of the sample* [the dataset consists of daily stock and 10-year government bond returns for 23 countries over the period January 1980 till January 2012]*, and bond returns exceed equity returns by 2.5 to 4%*". Flight to Safety, Finance and Economics Discussion Series Divisions of Research & Statistics and Monetary Affairs Federal Reserve Board, Washington, D.C

6.4.72 This Report focuses on (1) estimates which exclude all data from 1 March 2020 onwards, and (2) estimates which attach low weight to Covid19 data based on the assumed frequency of a future pandemic with a similar impact and duration in order to avoid introducing a transitory and downward bias in the beta estimates which are intended to reflect expected returns over long-run holding periods (10 – 20 years), consistent with the remaining parameters in the CAPM.

6.5 Estimation windows

6.5.1 Consistent with the UKRN (2018) recommendations[118], and with the submissions by Prof Alan Gregory et al (April 2020, October 2020, January 2021)[119], for the purpose of setting the regulatory cost of equity allowance, what is needed is an estimate of the long-run beta, which should be estimated based on the longest available period of data *absent structural breaks.* This balances the need to use the longest possible information set to achieve statistical robustness of the estimates, with the need to include the most relevant set of data that reflects the current underlying asset risk.

6.5.2 As submitted by Prof Alan Gregory et al (2020, 2021)[120] on behalf of the water companies in the PR19 appeals, evidence from the UK water sector suggests the existence of a structural break for the UK water sector around the PR14 period, which suggests that data from 2014 onwards is most relevant to set cost of equity for PR24. This is consistent with the findings of the Indepen report which notes that *"significant changes in regulatory regime, like the shift from RPI-X to RIIO in the energy sector or the implementation of the Future Price Limits changes at PR14 in the water sector, suggest that the assumption of a constant equity β is likely to be untenable."*[121]

6.5.3 Notably, using this cut-off in combination with spot estimates of beta (discussed in the next section), would also exclude the period where SVT and UUW has material non-regulated business and the Global Financial Crisis.

6.6 Averaging windows

6.6.1 When interpreting beta evidence from different estimation windows there is a choice around the relative weight placed on spot estimates and averages of 'rolling betas'. For a given estimation window, spot estimates reflect solely the market data from each window, whereas rolling averages incorporate market data from periods before the start of the estimation window. This is because rolling averages require beta estimates that

[118] Wright et al (2018), p. 52-53, *"there is therefore a quite strong prima facie case to use all available data to estimate, beta, not just a relatively short recent sample".*

[119] Prof Alan Gregory et al (January 2021), Prof Alan Gregory et al (October 2020), Prof Alan Gregory et al (April 2020).

[120] Ibid.

[121] Indepen (2019), 'Beta Study–RIIO-2, Main Report', p.7

reflect the chosen estimation window at each date of the averaging horizon. For example:

- a spot estimate of a daily 2-year beta as at 30 September 2023[122] would reflect the relationship between water stocks and the market based on returns data for each working day during the 2-year estimation window i.e. from 30 September 2021 to 30 September 2023
- a 1-year rolling average of the daily 2-year beta as at 30 September 2023 would require beta estimates for each working day during the averaging window between 30 September 2022 and the cut-off date of 30 September 2023. The 2-year daily beta as at 30 September 2022 would reflect the relationship between water stocks and the market based on returns during the 2 years between 30 September 2020 and 30 September 2022. In total, this approach would cover 3-years' worth of data.

6.6.2 Ofwat has not signalled the weight it would assign to spot and rolling estimates of beta, however, use of rolling betas has several flaws:

6.6.3 First, when the rolling betas are 'averaged' across the years, the weight placed on the different data observations differs relative to the weight given to market observations under a simple 'spot' OLS regression using the same period of data. In a simple OLS regression, each data point (i.e. market and asset return pair) receives equal weighting. However, in the case of rolling regressions which are averaged, the first day's data gets used once, the second twice, and so on, such that more recent data (within the middle of the estimation window) receives greater weight than data on both ends of the sample.

6.6.4 This issue was recognised at the PR19 appeal by the CMA who noted that "*rolling averages place different weight on the various underlying data points and that this can give rise to potential distortions in the figures*"[123].

6.6.5 The UKRN Cost of Equity Study (2018) further noted that *"the econometric basis for this approach is actually fairly shaky: in particular all parameter standard errors are invalidated by this methodology"*[124].

6.6.6 Second, in the presence of structural breaks, rolling window estimates will place some weight on the evidence prior to the break, which introduces bias in the data to the extent that earlier data no longer reflects current pricing of risk. This has been recognised by several parties during the PR19 re-determination:

- The CMA noted that using a 5-year averaging window in combination with a 10-

[122] 30 September was the cut off used in the PR19 FD.
[123] CMA PR19 FD, para. 9.473
[124] Wright et al (2018). Estimating the cost of capital for implementation of price controls by UK Regulators, p.50 footnote 67

year estimation window would assign some weight to the data from early 2006 when SVT and UUW had material non-regulated business (which has been recognised by the CMA to be a structural break)[125].

— A similar position was adopted by Ofwat, who did not agree with the use of rolling averages noting that its consideration of the issues around final determinations led it not to favour a 'rolling average' approach to estimating betas as such an approach would result in assigning weight to data as far back as 2009, which Ofwat did not consider to be especially relevant to informing investor expectations[126].

— On behalf of the water companies Gregory et al (2020)[127] outlined several flaws in the rolling average approach and submitted evidence of a structural break for the UK water sector around the PR14 period[128] (c. October 2014), which suggests that data from 2014 onwards is most relevant for estimating a forward-looking beta for the sector. Beta estimates that reflect data from the previous 9 years or more (via the combination of estimation and averaging windows)[129] as at 30 September 2024 will incorporate information before the structural break and will not be representative of the systematic risk going forward.

6.6.7 Third, rolling beta estimates based on the same estimation window might considerably vary, rendering the 'average' difficult to interpret.

6.6.8 Professors Wright and Mason – Ofwat's advisers during the PR19 appeal – consider that rolling beta estimates are a legitimate diagnostic tool for addressing the issue of whether the true (and unobservable) beta is stable over time, however, if the true beta is assumed not to be stable over time, rolling betas have a number of problems as estimators of this time-varying value at any point in time – and most notably standard errors (whether OLS or heteroscedastic-consistent) are spurious[130].

6.6.9 For these reasons, while this Report considers that rolling beta estimates might be useful for visual inspection of the data, and to indicate possible changes in risk and structural breaks in the data, 'averaging' across the estimates is not an appropriate interpretation of the data. This is because conceptually the average rolling beta estimate does not result in any more 'relevant' estimate of the current pricing of risk than a spot

[125] CMA PR19 FD, para. 9.461

[126] Reference-to-the-PR19-final-determinations-Risk-and-return-–-response-to-common-issues.pdf (ofwat.gov.uk), para. 3.58

[127] Prof Alan Gregory et al (October 2020)

[128] Prof Alan Gregory et al (January 2021), Prof Alan Gregory et al (October 2020), Prof Alan Gregory et al (April 2020).

[129] For example, 10-year betas or 5-year averages of 5-year betas

[130] Comments prepared for Ofwat on the CMA's Provisional Findings Anglian Water Services Limited, Bristol Water plc, Northumbrian Water Limited and Yorkshire Water Services Limited price determinations: Cost of capital considerations, para. 5.6

estimate, whilst introducing arbitrary weighting of the underlying pricing signals within the sample under consideration.

6.6.10 Notably, the CMA relied on rolling averages estimates, along with spot estimates, to set the beta during the PR19 appeal. The CMA noted that "*the additional information provided by the rolling averages, in terms of highlighting trends in betas is useful in coming to an in the round assessment of the appropriate beta value, particularly in light of the material changes in the 2-year and 5-year beta estimates over the period*"[131].

6.6.11 The material changes highlighted by the CMA are to a large extent driven by the impact of Covid19 on beta estimates[132]. The table below sets out the summary data considered by the CMA in making its decision. It is clear that for beta estimates from the Covid-affected period (i.e. December 2020 cut off) the choice of averaging window has a material impact. Spot and shorter-term averages yield low estimates relative to the longer-term averages. In contrast, for the period not affected by Covid19 (i.e. February 2020 cut off) the values across all averaging windows are broadly consistent.

Table 7 Summary of CMA analysis of Severn Trent and United Utilities unlevered equity betas by timeframe per the PR19 CMA FD

Average by timeframe	Spot	1-year average	2-year average	5-year average
February 2005 to February 2020	0.29	0.28	0.29	0.30
January 2006 to December 2020	0.26	0.26	0.27	0.30

Source: CMA PR19 FD, Table 9-16

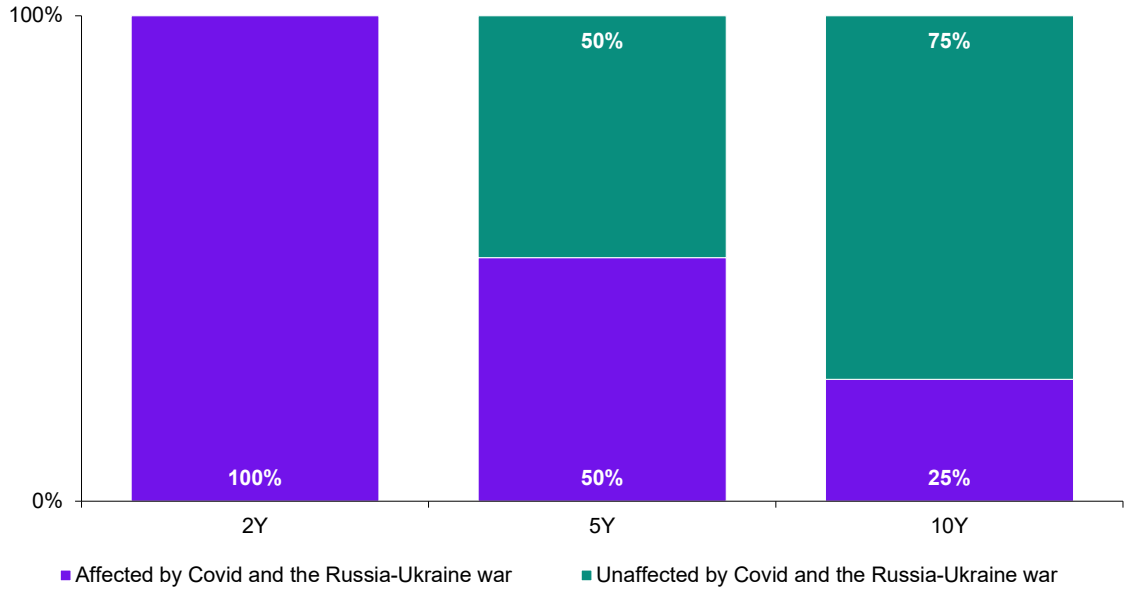
6.6.12 Intuitively this dynamic is in line with expectations – because the longer-term rolling averages incorporate more of the historical data not affected by Covid19, the impact of the pandemic is 'averaged out' and normalised to an extent. Relatedly, because the period between February 2005 and February 2020 does not reflect one-off events which affect beta in the same way as Covid19, different averaging windows yield similar results. In combination with placing less (but not zero) weight on beta estimates from December 2020 and excluding outliers[133] from this period, by using rolling averages the CMA[134] further reduced the impact of the pandemic on PR19 beta estimates.

6.6.13 The charts below illustrate the difference in the weight attached to the period affected by Covid19 and the Russia-Ukraine war in each estimation window where the existence of temporary structural breaks is not explicitly factored into the analysis and (1) only

[131] CMA PR19 FD, para. 9.473
[132] Ibid. para. 9.493
[133] Ibid. para. 9.482
[134] Ibid. para. 9.493

equally weighted spot estimates are used to estimate beta or (2) equally weighted spot and rolling averages are used to estimate beta.

Figure 9 Weight attached to the data affected by Covid19 and the Russia-Ukraine war when using spot estimates only

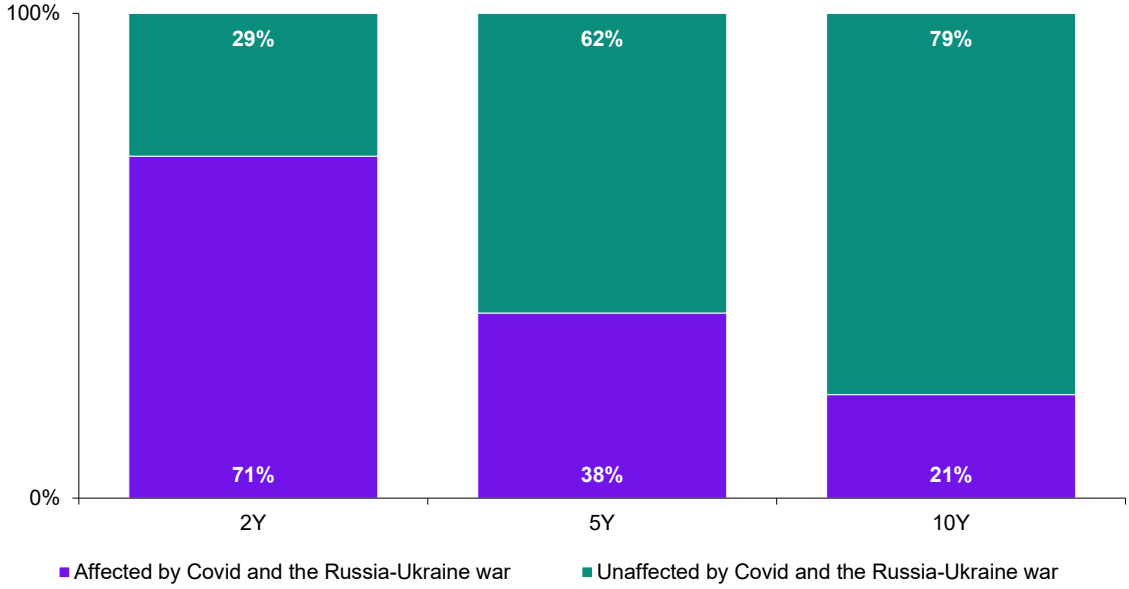


Note: As at 31 August 2022.

6.6.14 Where equal weight is placed on each averaging window to derive the point estimate, the proportion of the underlying data affected by Covid19 and the war is.c.58%[135].

[135] 1/3x100%+1/3x50%+1/3x25%=58%

Figure 10 Weight attached to the data affected by Covid19 and the Russia-Ukraine war when using both spot and rolling average estimates



Note: As at 31 August 2022.

6.6.15 The inclusion of rolling averages alongside spot estimates, all else equal, reduces the proportion of the underlying data affected by Covid19 and the war to. 43%[136].

6.6.16 The above implies that where the data affected by the temporary structural breaks – whose inclusion in the beta estimates would overweight the impact of one-off events on PR24 beta estimates – is not explicitly excluded from estimation, the use of rolling averages can partially mitigate the risk of misstating beta, particularly if used in combination with bespoke weights for the affected period.

6.7 Key conclusions

6.7.1 The Report considers SVT and UU as primary comparators on the basis that long-run beta data is available for both companies as pure play water companies. Given that all of the comparators considered in this Report are liquid, daily frequency represents a good starting point for assessing betas in a UK regulatory context, consistent with Ofwat's proposed approach. Spot estimates of daily betas are found to be the most robust input into setting the allowed return.

6.7.2 Covid19 and the Russia-Ukraine war – which have had a very material impact on the global and UK economies – represent statistically significant structural breaks for water company betas. In consequence a key question for estimation of beta at PR24 is how the beta estimation should take into account observed structural breaks.

[136] 1/3x71%+1/3x38%+1/3x21%=43%

6.7.3 To explore this the Report considers key inputs to this question including:

The relevant investment horizon for beta estimation

6.7.4 A long-run investment horizon of 15Y is adopted in this Report. The use of a long-term investment horizon for the water sector is consistent with the long useful lives of underlying assets, the long-term financing decisions made the investors in the sector, the recommendations of Wright et al (2018), the approach followed by the CMA and the 15Y investment horizon implied in Ofwat's draft methodology.

6.7.5 The chosen time horizon should be specified clearly and estimation of each parameter in the WACC should be carried out through the lens of the chosen time horizon, as far as possible, as otherwise the WACC estimate is not a true expected return over the chosen time horizon. This is a key assumption as reflecting short term variation in betas – such as variation observed in relation to Covid19 and the war – may not be reflective of risks and return requirements over the selected long-run investment horizon, would not be consistent with the basis for estimation of other parameters such as the risk-free rate and in turn might not attract long-run capital to the sector.

Setting returns based on an *unconditional* CAPM

6.7.6 As noted by Ofwat in the Draft Methodology consultation, the version of CAPM used by regulators estimates the required return on an equity investment over a single period or investment horizon[137].

6.7.7 This *unconditional* version of CAPM does not distinguish between different potential future states of the world and does not consider that beta will vary over time. For example, the assumption underpinning the CAPM based on a 15Y investment horizon is that beta would not vary on average across this period. In other words short term fluctuations in beta for example due to Covid are 'noise' which the unconditional CAPM 'looks through' to estimate beta over the long term.

6.7.8 By contrast Ofwat assumes that systematic risk events such as Covid19 *changes* beta. This is not consistent with an unconditional CAPM. Where systematic risk events change beta, the corollary is that returns should be estimated based on a *conditional* CAPM which assumes that betas vary over time and captures short-term variation in different economic climates.

6.7.9 This Report focusses on estimating an *unconditional* beta for the selected investment horizon. For this a measure of a constant, long run beta is required. As a result the Report considers whether and how recent structural breaks arising from Covid19 and the war should be taken into account in estimation of beta on an *unconditional* basis

[137] Appendix-11-Allowed-return-on-capital-appendix.pdf (ofwat.gov.uk) p. 3

which is not sensitive to different economic scenarios. This is particularly challenging for very rare events such as global pandemics which shut down large parts of the economy as the timeline used to estimate betas may be too short to include all relevant variations.

Interpretation of Covid19 and Russia-Ukraine war structural breaks

6.7.10 Covid19 and the war have had a material impact on water company betas measured over shorter-term estimation windows. To assess the weight that should be given to the data affected by Covid19 and the war in the context of setting long-run unconditional betas for PR24, this Report considers:

- *How likely is it that pandemics with similar impact to Covid19 will occur over the (at least) 15Y investment horizon assumed by Ofwat?*
- *Is the impact of the Russia-Ukraine war likely to be temporary or protracted, relative to the investment horizon implied by the PR24 WACC?*

6.7.11 To answer the first question, the Report considers evidence from the paper which considers the potential frequency of pandemics which are comparable to Covid19 in terms of severity and duration and the approaches adopted by the CMA at PR19 and the CAA in its recent final proposals for Heathrow. The Report finds that the likelihood that another pandemic event occurs in the estimation window is low. For example, the analysis of the CMA's approach suggests that c. 3.7% of data used to derive PR19 beta estimates could have been Covid-affected, which corresponds to c 0.74 years out of 20-year horizon being affected. As a result, attaching material weight to the data from the Covid19 period (c. 2 years) within the evidence used to set beta estimates for PR24 risks assuming that a pandemic of a similar scale occurs more frequently or lasts longer than justified by the available evidence.

6.7.12 To answer the second question, the Report – supported by the view from BoE[138] – chooses forecast inflation as a proxy to quantitatively evaluate the timing of reversion to 'normal' economic conditions following the war. It finds that forecast inflation is expected to revert to long-term target levels ahead of the start of the PR24 price control. In combination with the actions being undertaken to mitigate the economic impact of the war on Europe (for example via increasing self-supply of energy)[139], this evidence implies that the impact of the war could reverse in the next couple of year and is not likely to be relevant for setting the allowed returns for PR24.

[138] According to the BoE, the bulk of the high short-term inflation stems from the direct impact of high energy and tradable goods prices as well as their indirect impact via higher transport, production and utility costs for firms supplying non-energy goods and services.

[139] REPowerEU (europa.eu) implied increases in the self-generated supply of renewable energy and the decrease in the reliance on Russian exports can reasonably be expected to mitigate the price pressures arising from the war.

6.7.13 The change in short-term water company betas following these events appears to be a function of the 'flight to safety' which is temporary *by nature* and is a feature of a specific set of economic conditions rather than driven by fundamentals. All else equal this indicates that attaching material weight to economic conditions in a period of market distress would likely distort a beta estimated on an unconditional basis for a long-run investment horizon.

6.7.14 This Report focuses on (1) estimates which exclude all data from 1 March 2020 onwards, and (2) estimates which attach low weight to Covid19 data in order to avoid introducing a transitory and downward bias in the beta estimates which are intended to reflect expected returns over long-run holding periods (10 – 20 years), consistent with the remaining parameters in the CAPM framework (e.g. the tenor chosen for the risk-free rate).

6.7.15 There is nonetheless some inherent uncertainty in relation to whether the impact of a major shock is temporary and as a result betas will mean revert. The Report therefore carries out relative risk analysis to assess whether systematic risk exposure is *expected to change* at PR24.

7 The methodology to estimate beta for PR24 – de and re-levering betas

7.1 Introduction

7.1.1 This section considers treatment of de- and re-levering betas at PR24 based on the options set out in Ofwat's draft methodology.

7.1.2 The current regulatory approach to gearing, as determined in PR19, involves Ofwat setting a notional level of gearing based on a number of principles and estimating what a company's weighted average cost of capital ("WACC") would be at this notional gearing level. This is to avoid attaching undue weight to a particular capital structure adopted by an actual company and the associated WACC that this implies. In particular, this approach prevents a company from benefiting from choosing a suboptimal capital structure that could lead to an unnecessarily high WACC.

7.1.3 A key in estimating the WACC at the notional gearing level is to estimate the notional equity beta at this gearing level. To do so, regulators first un-lever the raw equity beta from listed comparators, to strip out the component of the beta that comes from the company's actual gearing, and then re-lever the asset beta by applying the notional gearing level and assumed debt beta.

7.1.4 Mason and Wright (MW) argue in their paper on financial resilience and gearing[140] that this approach leads to a WACC that is increasing with gearing, which they consider is contrary to Modigliani and Miller (1958[141], "MM"). MW propose a number of remedies to this apparent problem. Ofwat also appears to consider that this dynamic is a problem, proposes to "*set debt beta at the level which would make the CAPM-WACC calculation fully invariant to gearing*."[142]

7.1.5 In order to address this question, the rest of this section proceeds as follows:

- First, it provides an overview of Modigliani-Miller theory
- Second, it evaluates key arguments and evidence which underpin MW and Ofwat specification of a problem with the current approach to de- and re-levering
- Third, it sets out high level estimates for debt beta, drawing on CMA PR19 and academic research
- Fourth, it evaluates the options identified by Ofwat to de- and re-lever betas at

[140] Mason and Wright - A report on financial resilience, gearing and price controls - Ofwat

[141] Modigliani, Franco, and Merton H. Miller. "The Cost of Capital, Corporation Finance and the Theory of Investment." *The American Economic Review*, vol. 48, no. 3, 1958, pp. 261–97.

[142] Appendix-11-Allowed-return-on-capital-appendix.pdf (ofwat.gov.uk), p20

PR24.

7.2 Modigliani-Miller theorem – theory and practical application in a regulatory context

I. The theory behind the MM theorem

7.2.1 This section starts with a brief overview of the theory behind the MM theorem. MM showed that, in a perfect capital market, the WACC of a company is independent of gearing. This is known as *MM's Proposition I.*

7.2.2 To understand the significance of this result, it is useful to first understand the context. The WACC of a company is given by the following formula:

$$r^* = D/V * rD + E/V * rE \ (1)$$

where r is the WACC, rD is the cost of debt, rE is the cost of equity, D is the market value of debt, E is the market value of equity, and V = D + E is aggregate value.*

7.2.3 Since rD < rE, conventional wisdom at the time was that companies could reduce their WACC by increasing their gearing. In equation (1), if D rises and E falls, and all other variables are held constant, then r* falls because the company is placing more weight on the cheaper source of financing.

7.2.4 MM's key insight is that rD and rE are *endogenous* variables, not *exogenous* parameters – they cannot be held constant when changing gearing. In particular, the cost of equity rE depends on two factors:

- The first is *business risk*, which is the risk of the company's assets and stems from how cyclical they are – a luxury goods firm has more business risk than a consumer goods firm. Since business risk depends on a firm's assets, and the assets a firm has are independent of gearing, business risk is independent of gearing. Business risk is denoted rA, and is the cost of capital for an unlevered firm – the cost of capital that the firm would have if it were all-equity-financed. It is also known as the company cost of capital.
- The second is *financial risk*. Since equity holders are junior to debtholders, they bear a disproportionate share of the firm's business risk. Thus, even though gearing does not change business risk, it increases financial risk because it makes equity holders even more junior.

7.2.5 MM's Proposition II shows mathematically how the cost of equity changes with gearing:

$$rE = rA + D/E * (rA - rD) \ (2)$$

*where rA, the unlevered cost of capital, represents business risk, while the second term on the right-hand side, D/E * (rA – rD), represents financial risk. When gearing increases, D rises and E falls, thus augmenting financial risk.*

7.2.6 Since rE is increasing with gearing, it is no longer the case that firms can reduce their WACC by increasing their gearing. In equation (1), while increasing D and reducing E places more weight on the cheaper source of financing, it is exactly offset by the fact that the cost of equity rises. Thus, the WACC is constant.

7.2.7 It is important to note two points:

MM do not assume a constant cost of debt

7.2.8 The MM results, that WACC is independent of gearing (*MM Proposition 1*), and that the cost of equity is increasing with gearing (*MM Proposition 2*) hold regardless of whether a constant cost of debt is assumed or not.

7.2.9 MM first derive their result assuming a constant cost of debt for simplicity. Then, they consider the case in which the cost of debt is increasing with gearing and show that the result still holds. MM write:

"*Economic theory and market experience both suggest that the yield demanded by lenders tend to increase with the debt-equity ratio of the borrowing firm…*

Proposition I is actually unaffected in form and interpretation by the fact that the rate of interest may rise with gearing; while the average cost of borrowed funds will tend to increase as debt rises, the average cost of funds from all sources will still be independent of gearing…

Although Proposition I remains unaffected … the relation between common stock yields and gearing will no longer be the strictly linear one given by the original Proposition II. If rD increases with gearing, the yield rE will still tend to rise as D/E increases, but at a decreasing rather than constant rate."[143]

7.2.10 Equation (2) above continues to apply, but if rD rises with gearing, then rE = rA + D/E * (rA – rD) is lower than it would otherwise be if rD were constant. However, it remains the case that rE is increasing with gearing.

7.2.11 Thus, the assumption of whether the cost of debt increases with gearing or is independent of gearing does not matter; the WACC is independent of gearing regardless. Indeed, the irrelevance of the constant debt assumption is very well understood. See, for example, the classic textbook "Principles of Corporate Finance"[144]

[143] The only changes made are to harmonise notation

[144] Brealey, Myers, Allen, and Edmans, 2022

which cover both cases and shows that, in both, the rA line is horizontal and independent of gearing:

"*Suppose the firm changes its capital structure by issuing more debt and using the proceeds to repurchase stock. The implications of MM's Proposition 2 are shown in Figure 16.2. The required return on equity increases with the debt-equity ratio (D/E). Yet, no matter how much the firm borrows, the required return on the package of debt and equity, rA, remains constant at 12.75%. How is it possible for the required return on the package to stay constant when the required return on the individual securities is changing? Answer: Because the proportions of debt and equity in the package are also changing. More debt means that the cost of equity increases but at the same time the proportion of equity declines...*"[145]

Figure 11 MM's proposition 2 under constant rD

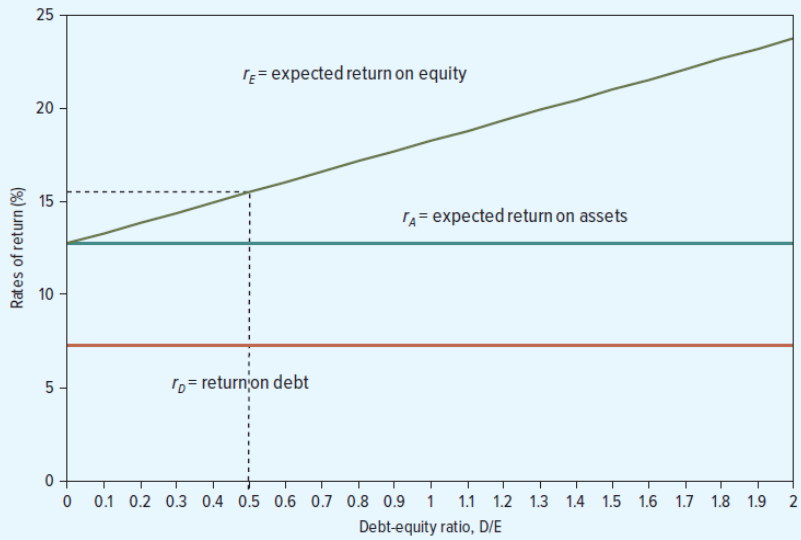


FIGURE 16.2
MM's Proposition 2 predicts that if debt is risk-free, the required return on equity, r_E, increases linearly with the debt-equity ratio, but the return on the package of debt and equity does not change.

"*In Figure 16.2, we have drawn the rate of interest on the debt as constant no matter how much the firm borrows. This is not wholly realistic. It is true that most large, conservative companies could borrow a little more or less without noticeably affecting the interest rate that they pay. But at higher debt levels, lenders become concerned that they may not get their money back, and they demand higher rates of interest to compensate. Figure 16.3 modifies Figure 16.2 to account for this. You can see that as the firm borrows more, the risk of the debt slowly increases. Proposition 2 continues to predict that the expected return on the package of debt and equity does not change. However, the slope of the rE line now tapers off as D/E increases. Why? Essentially*

[145] Ibid.

because holders of risky debt begin to bear part of the firm's operating risk. As the firm borrows more, more of that risk is transferred from stockholders to bondholders."[146]

Figure 12 MM's proposition 2 under increasing rD

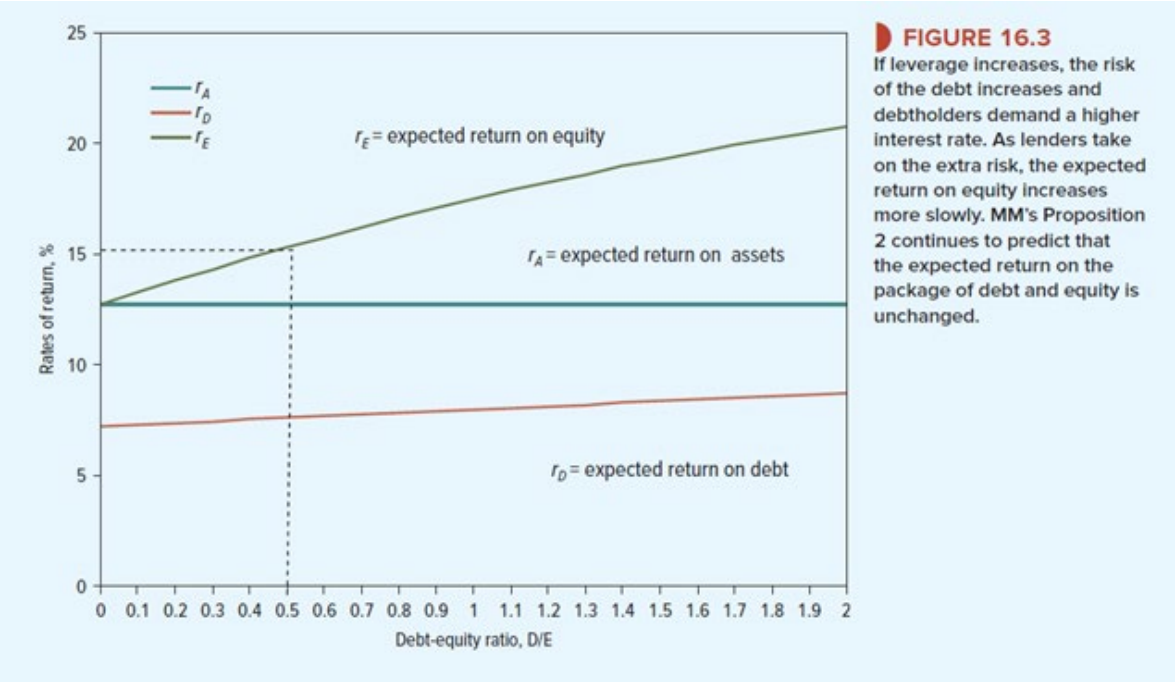


FIGURE 16.3
If leverage increases, the risk of the debt increases and debtholders demand a higher interest rate. As lenders take on the extra risk, the expected return on equity increases more slowly. MM's Proposition 2 continues to predict that the expected return on the package of debt and equity is unchanged.

7.2.12 In summary, the MM results apply regardless of whether rD is constant or increasing with gearing. However, what is required is for the application to be internally consistent. If rD is constant in the real world (e.g. because low levels of leverage make the debt close to risk-free), then the rD's that included in the formulas should be constant. If rD is increasing with gearing in the real world, then the rD's included the formulas should be increasing with gearing.

MM Proposition I only holds in a perfect capital market

7.2.13 MM stressed that Proposition I holds in a perfect capital market. This is one in which there are no market frictions such as taxes, transaction costs, or inefficiencies, nor regulatory distortions. They explicitly show that, in the presence of taxes, WACC will be unambiguously decreasing with gearing, since debt benefits from interest tax shields. MM also state that, if "*there are lags and frictions in the equilibrating process – a feeling we certainly share*"[147], then Proposition I will not hold, as long as the frictions are not short-lived.

[146] Ibid.

[147] Modigliani and Miller, Corporate Finance and the Theory of Investment, The Americal Economic Review, Vol.48, p. 281

7.2.14 However, it always remains the case that rE is increasing with gearing. Regardless of whether there are taxes, transactions costs, market inefficiencies, or regulatory intervention, it will always be true that increasing debt makes equity even more junior, and thus increases financial risk. The formula used to calculate how rE increases with gearing might change if there are taxes, but the if company always rebalances its debt so that D/V is a constant ratio ("debt rebalanced"), then equation (2) still applies. If there are taxes, and the company keeps the amount of debt D fixed in absolute terms ("debt fixed"), then the formula becomes:

$$rE = rA + D/E * (rA - rD) * (1 - tc) \quad (3)$$

where tC is the corporate tax rate.

7.2.15 However, even though the precise formula changes, the key insight that rE is increasing with gearing still holds.

7.2.16 This Report considers the case of either no taxes, or taxes plus debt rebalanced so that equation (2) holds. This avoids setting out two sets of formulas, one using equation (2) and another using equation (3).

II. Practical application of the theorem

7.2.17 The most important implication of MM for real-world finance is that the cost of equity must always take gearing into account. *Any approach to estimating the cost of capital that assumes a constant cost of equity is "textbook wrong"*, such as using the raw equity beta (Option III in MW).

7.2.18 This implication is widely recognised in corporate finance. For example, when estimating the cost of equity based on comparable companies, it is not correct to simply take the cost of equity of a peer firm, even if that peer firm has exactly the same business risk. Identical business risk only means an identical rA, but equation (2) shows that rE depends not only on rA but financial risk, and the peer firm may have different gearing. Thus, de-levering and re-levering are fundamental principles of corporate finance.

7.2.19 The following example illustrates this point. Company A has a cost of equity of 7.8%, a cost of debt at 5%, and has a gearing ratio (D/V) of 40%. Company B has a gearing ratio of 60% and a cost of debt of 5.5%. To use Company A's cost of equity to estimate Company B's, it is necessary to:

- De-lever A's rE, i.e. strip out its 40% gearing to move from its rE to rA. Using the formula rA = D/V * rD + E/V * rE (which is simply a rearrangement of (2)), this gives: rA = 0.4 * 5% + 0.6 * 7.8% = 6.68%. This rA is also B's rA, since they have the same business risk.
- Re-lever B's rA, i.e. add in its 60% gearing to move from rA to rE. The same

formula gives: 6.68% = 0.6 * 5.5% + 0.4 * rE, which yields rE = 8.45%.

7.2.20 One practical challenge of using equation (2), or its rearrangement, is that it requires estimation of how rD changes as leverage changes. Company A's rD of 5% does not automatically apply to Company B, and – unlike for rE – there is no formula that can be used to calculate how rD changes with leverage. In the above example, it was assumed that Company B's cost of debt could be observed and that it was 5.5%. However, it may be that the historical cost of debt is not the same as the current cost of debt. Alternatively, it may be that Company B is considering a change with gearing from its current 60% level. In both cases, an estimation of the cost of debt is required in order to re-lever the cost of equity.

7.2.21 What this means is that *practitioners almost never assume a constant cost of debt when applying the MM formulas*. "Almost never" is used because, in some cases, practitioners might assume a constant cost of debt for simplicity – for example, if the gearing change being considered is not large. However, practitioners are aware that this is a simplifying assumption, rather than one that is correct, since the cost of debt increases with gearing in practice.

III. Decomposition of the underlying drivers of observed variance of WACC to gearing

7.2.22 WACC will vary with gearing for a number of reasons, all linked to capital market imperfections. These effects cause the WACC to be U-shaped with gearing. All academics and practitioners agree that WACC is U-shaped with gearing where markets are imperfect. As a result, it is widely recognised that the WACC should not be independent of gearing. There are several other reasons why the WACC may not be independent of gearing, all related to market imperfections. For example:

- If illiquidity leads to a debt premium and thus a cost of debt that is "too high", then WACC will be increasing with gearing.
- If debt is cheap relative to equity, e.g. due to a frothy debt market, then the WACC will be decreasing with gearing (all else equal) and *vice versa*.

7.2.23 In summary, WACC should not be expected to be independent of gearing, due to capital market imperfections.

7.3 Evaluation of the arguments and evidence for specification of a problem

7.3.1 MW's paper on financial resilience and gearing (Section 5) argues that the current regulatory approach to adjusting equity beta for gearing is flawed as it leads to a WACC that is increasing with gearing, whereas MM show that WACC should be independent of gearing.

7.3.2 This section explores two potential specifications of the problem based on MW's paper:

- the cost of debt is independent of gearing; and
- the estimated cost of debt is too high

I. Potential MW specification of the problem: cost of debt is independent of gearing

7.3.3 A material concern set out in MW's paper appears to be that the current method for de-levering and re-levering beta assumes a constant cost of debt, i.e. one that is not increasing with gearing. For example, in paragraph 5.3, MW argue that there is an inconsistency due to the "*partial application of the CAPM*" – the CAPM is used to estimate the cost of equity, which is increasing with gearing, but the cost of debt is taken from market data which MW argue is independent of gearing. Indeed, MW comment that WACC(g) = grD + (1-g)rE(g), where the contrast between rD and rE(g) highlights how, according to MW, the approach assumes that rD is independent of g but rE depends on g.

7.3.4 Two interpretations of the MW argument are considered below.

MM assume a cost of debt that is independent of gearing

7.3.5 The first interpretation is that MW are arguing that it is MM who assume a constant cost of debt. However, in reality, practitioners need to estimate the cost of debt from market data. The market cost of debt is not invariant of leverage – the market charges a higher cost of debt to more levered firms. MM derive their result, that the WACC is independent of leverage, because they assume the cost of debt is independent of leverage. But if, in reality, the cost of debt is increasing in leverage, then WACC will now be increasing in leverage.

7.3.6 This argument does not appear to be correct, since MM explicitly allow the cost of debt to be non-constant, as explained above.

Practitioners assume a cost of debt that is independent of gearing

7.3.7 The second interpretation is that MW are arguing that it is practitioners who assume a constant cost of debt when applying MM: for example, MW comment that "*βD … is typically assumed to be a constant and small (an assumption that the regulated companies have the incentive to support)*".

7.3.8 However, practitioners do not assume that rD is constant; it is higher in more geared firms. MW emphasise that practitioners use the market cost of debt (since it is difficult to apply the CAPM to debt) – however the market cost of debt is automatically increasing with leverage, as the market charges a higher cost of debt to more highly-geared

companies. Thus, a market-based approach to estimating D is likely to mean that rD will depend on g. All else equal this is inconsistent with MW's assumption that rD is independent of g, which they require to obtain their result that WACC'(g) = rD – (RF + βDERP).

II. Potential MW specification of the problem: the estimated cost of debt is too high

7.3.9 MW also set out concerns with the *level* of rD rather than whether it varies or does not vary with g. Specifically, they are concerned that, in practice, the level of rD estimated is too high. Indeed, the MW equation WACC'(g) = rD – (Rf + βDERP) argues that WACC is increasing with gearing if the estimated level of rD is greater than the Rf + βDERP that would be implied by the CAPM. MW argue that the estimated level of rD is too high in practice because the market-based cost of debt includes a debt premium, and because regulators give an allowance for embedded debt (currently higher than the market cost of debt).

7.3.10 However, MM does not apply in the presence of market frictions or regulatory distortions. Ofwat highlighted a number of these frictions in the recent PR19 CMA appeal.[148] As a result, there is no contradiction that the MM prediction of gearing-independent WACC might not hold, since MM should not apply in the first place. Examples follow below:

- **Market frictions leading to constant cost of debt.** As explained above, if the cost of debt should be increasing with gearing in the real world, but practitioners assume a constant cost of debt (i.e. they do not take into account the fact that debt becomes riskier as gearing rises, so debt is incorrectly priced), then this is a market friction and so MM would not be expected to hold.
- **Market frictions leading to high cost of debt.** The cost of debt may be higher than in an MM world due to market frictions assumed away by MM, such as illiquidity (leading to the market cost of debt containing a debt premium). Indeed, if illiquidity costs mean that the cost of debt is high, then more highly geared firms are particularly penalised by this premium, and so a WACC that is increasing with gearing is exactly what would be expected.
- **Regulatory distortions.** If there is a regulator and regulatory policy depends on gearing, then firm value will depend on gearing; thus, the cost of capital must also depend on gearing as it is inversely related to firm value. For example, if the regulatory allowance for embedded debt exceeds the cost of new debt, then regulatory policy is non-neutral to gearing, and so the cost of capital will also be

[148] CMA PR19 FD, para. 9.1166

non-neutral to gearing.

7.3.11 One might argue that the cost of debt is "too high" relative to an MM world. However, if so, the issue is exactly that – that the cost of debt is high, rather than this leading to a WACC that is increasing with gearing. The latter is not the issue, but a symptom of the issue, and not a symptom that should necessarily cause concern as the symptom is not observed in an MM world.

7.3.12 Moreover, there is no reason to believe that the cost of debt is too high. A high cost of debt (relative to MM) may arise from two sources.

- The first is **market frictions**. However, market frictions lead to the cost of debt being justifiably high, not excessively high. The real world involves liquidity concerns, and so debtholders rationally demand a debt premium to compensate for liquidity. Thus, market frictions do not warrant regulatory intervention.
- The second is **regulatory distortions**, such as giving an allowance for embedded debt that is different from the market cost of debt. However, there is no evidence that this allowance is too high; instead the cost of debt is set based on prevailing regulatory policy which is currently based on either an estimate of sector average costs or benchmark indices in line with for example the CMA's approach at PR19. Indeed, embedded debt is justifiably high due to long-dated financing raised before the financial crisis when interest rates were relatively high. In other macroeconomic environments, the regulatory allowance for embedded debt could turn out to be too low, e.g. if embedded debt were raised in a low interest rate environment.

7.3.13 While assuming the MM principle – that WACC should be invariant to gearing – is reasonable as a starting point for estimating cost of capital in a regulatory context, importantly the allowed return is not set in the frictionless capital markets assumed by MM. Absent clear isolation of the particular specific market frictions or regulatory interventions which are solely driving the dynamic of WACC increasing with gearing *and* warrant regulatory intervention, caution is required before intervening to 'force' invariance to gearing avoid introducing *additional* distortions into the estimation of WACC for regulatory price setting. Where specific frictions are identified, whether an adjustment is required for regulatory price setting should be assessed on merit.

7.4 Debt beta

7.4.1 Debt beta measures the covariance of returns to debt investors with the market and captures the systematic risk of debt, following the same theory as for equity betas. The debt beta influences the overall equity beta because it impacts the size of the gearing adjustment from the asset beta to the equity beta.

7.4.2 There are several empirical approaches that could be used to estimate debt beta but as noted by the CMA there is no one approach to estimating debt betas that dominates all others. This is borne out by the different methods used in studies and the different weights regulators have given to different evidence sources[149].

7.4.3 The CMA's overall view is that debt beta is difficult to measure and has a relatively small effect on the overall WACC so should be set at a level which is consistent as far as possible with the overall framework for the WACC, without acting contrary to financial market evidence[150].

7.4.4 Ofwat has not proposed to empirically estimate debt beta, instead it would set debt beta such that forward-looking WACC does not vary with gearing. Based on the PR19 FD WACC assumptions this would yield a debt beta of 0.216 is the holding assumption.

7.4.5 The resulting debt beta significantly exceeds PR19 debt beta estimates from both Ofwat (0.12) and the CMA (0.075 point estimate and the 0.10 upper bound applied by the CMA) as well as estimates that from academic literature or in use among practitioners for a company with investment grade credit rating. For example, under Schwert and Strebulaev's methodology debt betas of 0.21 and above correspond to BB-CCC credit rating[151]. This is inconsistent with the credit rating assumed in the cost of debt allowance and actual water company financing.

7.4.6 At PR19 the CMA also cross-checked its debt beta estimate by recalculating the appointee WACC using the observed 54.2% gearing used within beta calculations as the notional level of gearing – thus removing the need to consider a debt beta.[152] The CMA noted that this analysis implied some variance of WACC with gearing but that this was not material at 4bps and did not adjust its approach or assumptions.

7.4.7 The debt beta estimate from the PR19 re-determination (0.075) was a result of a detailed consideration and challenge of empirical evidence from different potential estimation approaches. At this stage there is no robust and compelling evidence to depart from the CMA's findings.

7.5 Evaluation of the options proposed by Ofwat

[149] CMA PR19 FD, para. 9.518

[150] Ibid. para. 9.517

[151] Available at: Capital Structure and Systematic Risk by Michael Schwert, Ilya A. Strebulaev :: SSRN, short summary of findings:

Rating	AAA	AA	A	BBB	BB	B	CCC
L_M	0.10	0.21	0.32	0.37	0.50	0.66	0.74
β_D	0.04	0.05	0.05	0.10	0.24	0.31	0.43
σ_D	0.07	0.05	0.06	0.10	0.14	0.21	0.31
ρ_{ED}	-0.03	-0.02	0.06	0.16	0.28	0.36	0.37

[152] CMA PR19 FD, paras. 9.529 – 9.530

7.5.1 This section evaluates the alternative approaches proposed by Ofwat – notwithstanding conclusions from previous sections that it is not clear that there is a problem since the MM assumptions do not hold in the real world due to market frictions.

7.5.2 It is important that the search for theoretically correct relationships in all WACC parameters does not override consideration of the validity of inputs and outputs. There is little value in estimating the cost of capital parameters that meet one theoretical criterion precisely but are ultimately in themselves implausible. In other words it is important to be careful that in trying to make the theoretical equation work perfectly as to achieve this can result in implausible specification of CAPM parameters. It is critical to strike the right balance between meeting theoretical requirements and estimating of plausible parameters.

7.5.3 As a result this section considers whether parameters implied by MW options meet market tests and market evidence, and hence are plausible and make economic sense.

7.5.4 Ofwat propose three approaches, as follows: (1) maintaining the PR19 approach, (2) setting the debt beta at a level which would make the CAPM-WACC calculation invariant to gearing and (3) changing the notional gearing to align with the EV gearing of listed companies.

7.5.5 The preferred approach based on the analysis in this Report is (1), since there is not a clear problem that requires a solution.

7.5.6 Option 2 seeks to "*hard-wire*" the debt beta to give a CAPM-implied cost of debt which equals the actual expected cost of new debt. In other words, it backs out the debt beta from the observed cost of debt using the formula $rD = RF + \beta D * (rM - rF)$. This approach might be reasonable in theory; however, the justification for adoption of this approach would typically not be to make the WACC invariant to gearing, but because the CAPM is a poor model for debt returns.

7.5.7 While assuming the MM principle – that WACC should be invariant to gearing – is reasonable for the purposes of estimating cost of capital in a regulatory context, in practice as long as deviations are not very large, trying to strictly enforce MM is:

- difficult to apply objectively, including which parameter should be adjusted and by how much. An approach which forces invariance to gearing is trying to arrive at a combination of parameters that is ultimately not known i.e. the resulting WACC is no longer a combination of parameters that were ex-ante determined to represent an appropriate input into the estimation of allowed returns.
- can introduce new distortions (because it is not clear which level of WACC it might be correct to hold constant at different levels of gearing). Variance with gearing could be driven by a methodology for a different parameter which has been set too

low. This does not appear to have been considered in the draft methodology at this stage. In this case hard-wiring debt beta – which all else would result in lower returns – could *compound* an existing issue which is already resulting in under-estimation of required returns.

— does not recognise that there might be various other factors affecting the cost of capital that might cause departures from MM.

7.5.8 Option 2 assumes that hard-wiring debt beta will address an underlying problem (invariance of WACC to gearing) which in Ofwat's view is driven by the cost of equity being set too high under current levels of notional gearing. However equally the market friction or distortion which underpins invariance could be driven by a methodology for a different parameter which has been set too low. To avoid compounding or introducing additional distortions into the WACC, focus should be on the calibration of each parameter which all have margin of error which could be significantly larger than the variance to gearing highlighted in the draft methodology. This is consistent with the methodology applied by the CMA at PR19, which noted *small* increases in WACC with gearing[153] – which is in line with expectations that WACC at different gearing levels would be *broadly* unchanged.

7.5.9 In this context whilst an approach based on hard-wiring debt beta is reasonable in theory, in practice it is very difficult to implement. In particular, the formula rD = RF + βD * (rM – RF) requires us to estimate two parameters: the risk-free rate (RF) and the equity risk premium (rM – RF). If the regulator uses a risk-free rate that is too low for example, then the implied debt beta would much higher than what would be achieved through direct estimation (e.g. regressing historic debt prices on historic market returns).

7.5.10 First Economics[154] show that, if the regulator uses a too-low risk-free rate, this leads to a WACC that is increasing in leverage. If the risk-free rate is calculated correctly, then the WACC is no longer increasing in leverage. Thus, to the extent that the regulator considers that it is a problem that WACC is increasing slightly in leverage, a superior solution is to ensure the risk-free rate is calculated correctly. In short, WACC'(g) > 0 may arise from RFR being too low; it is not necessarily correct to reach the conclusion that it must be caused by an inconsistency between the rD and βD parameters.

7.5.11 The equity risk premium (which is a function of rM (the Total Market Return) and the risk-free rate) is also difficult to estimate. The approach in regulatory charge controls is predicated on the Total Market Return (rather than direct estimation of the equity risk premium, which is also difficult to estimate, with a number of available approaches for estimation (such as historical ex post returns, historical ex ante returns), for deflation

[153] CMA PR19 FD, paras. 9.529 – 9.530

[154] First Economics Risk Free Rate

and for averaging historical returns. As a result, any implied debt beta will be highly contingent upon the assumptions for the risk-free rate and the equity risk premium.

7.5.12 In addition to two key parameters in the CAPM being very difficult to estimate, the CAPM itself may not hold. It is very well-known that the CAPM does not hold for equity returns – for example, the effect of beta on equity returns is significantly lower than what CAPM implies. This may be due to market frictions that CAPM assumes away, such as illiquidity.

7.5.13 In addition, assuming invariance of cost of capital:

- does not recognise that the observed effect is partly due to assumptions around and actual values of various other factors, including cost of debt. The approach of backing out the implied debt beta is not only wrong, but unnecessary. The cost of debt is simply what the cost of debt is – if investors require a return of 3% to hold a company's bonds, then this is the cost of debt. A company will be unable to persuade investors to accept a lower return by claiming that the implied debt beta is higher than what would be achieved through direct estimation. Not only may investors have different estimates for the risk-free rate and market risk premium, but they may also demand a higher return due to for example illiquidity costs. The debt beta is only one input into the cost of debt – and the *assumption* of a higher debt beta will not translate into the cost of debt which is based on observed yields for water companies.

- implies that the cost of debt has a high systematic risk component which is unlikely to be the case for utilities. The debt beta implied by Ofwat's preferred Option 2 is significantly higher than the 0.075 estimated by the CMA at PR19, and also higher than the upper bound of the CMA's range (0.10). Academic evidence on debt beta further indicates that the debt beta implied by Ofwat's preferred solution would be consistent with sub investment grade credit ratings. The approach of hard-wiring debt beta into the CAPM therefore appears to result in an implausible parameter and the objective to achieve a theoretically 'right' solution appears to risk introducing a distortion into another parameter.

- arbitrarily chooses one principle to hold and not others for example hedge ratios imply that the cost of equity is too low compared with the cost of debt. It is not clear why regulatory policy would adhere to MM but ignore inconsistencies according to evidence from hedge ratios.

7.5.14 The specification of Option 3 appears to undermine the rationale for setting notional gearing. The reason for the concept of notional gearing is so that companies do not benefit from inflating their actual gearing. Otherwise, companies could choose an actual gearing that led to a high WACC, and thus be set a high allowed return. To set notional

gearing to a company's actual gearing is effectively to depart from the concept of notional gearing, and to base the allowed WACC on actual gearing. Furthermore, the enterprise value gearing is not the relevant and appropriate measure of the gearing for the sector in the first place. Frontier Economics has recently considered on what basis notional gearing could be set in the context of PR24.[155]

7.6 Key conclusions

7.6.1 Overall, this Report finds that there is not a clear problem with a WACC that is increasing with gearing. For example the MW analysis considers that a primary driver of this dynamic might be that the cost of debt is set too high, but it is not clear that this is the case as there are multiple sources of market friction which could impact on debt costs, such as illiquidity, as well as distortions driven by regulatory intervention. There is no expectation that MM should hold *precisely* due to market frictions and distortions. As a result, whether WACC is increasing with gearing or not should not represent the sole criterion used to assess whether a given regulatory approach to estimation of required returns is correct.

7.6.2 Absent clear isolation of the specific frictions or regulatory interventions which are driving the dynamic of WACC increasing with gearing, caution is required to avoid introducing *additional* distortions into the estimation of WACC for regulatory price setting. Where specific frictions are identified, whether an adjustment is required for regulatory price setting should be assessed on merit. The commentary above – for example in relation to market frictions such as liquidity costs – indicates that it might not be appropriate to intervene.

7.6.3 Relatedly it is important that the search for theoretically correct relationships in all WACC parameters does not override consideration of the validity of inputs and outputs. There is little value in estimating the cost of capital parameters that meet one theoretical criterion precisely but are ultimately in themselves implausible. In other words, trying to make the theoretical equation work according to theory can result in implausible specification of other CAPM parameters. It is critical to strike the right balance between meeting theoretical requirements and estimating plausible parameters.

7.6.4 To avoid compounding or introducing additional distortions into the WACC, focus should be on the calibration of each parameter which all have margin of error which could be significantly larger than the variance to gearing highlighted in the draft methodology. This is consistent with the methodology applied by the CMA at PR19, which noted *small* increases in WACC with gearing[156] – which is in line with expectations that WACC at different gearing levels would be *broadly* unchanged.

[155] Frontier Economics Setting Notional Gearing
[156] CMA PR19 FD, paras. 9.529 – 9.530

7.6.5 First Economics[157] show that, if the regulator uses a too-low risk-free rate, this leads to a WACC that is increasing in leverage. If the risk-free rate is calculated correctly, then the WACC is no longer increasing in leverage. Thus, to the extent that the regulator considers that it is a problem that WACC is increasing slightly in leverage, a superior solution is to ensure the risk-free rate is calculated correctly. In short, a WACC that increases with gearing may arise from risk-free rate being too low; it is not necessarily correct to reach the conclusion that it must be caused by an inconsistency between the cost of debt and debt beta parameters.

[157] First Economics Risk Free Rate

8 Estimation of beta for PR24

8.1 Introduction

8.1.1 This section considers the implications of the qualitative and quantitative analysis presented in this Report for the beta estimate for PR24.

8.1.2 A key methodological decision in specifying the beta range for PR24 is the appropriate treatment of the data affected by Covid19 and Russia-Ukraine war in the context of the (at least) 15Y investment horizon expected to be assumed in the PR24 WACC. The following principles and evidence developed in this Report will be used to inform this decision:

- The estimation of allowed cost of equity requires an estimate of an *unconditional* beta that will apply over the long-term investment horizon implied in the regulatory WACC.
- Changes in the unconditional beta imply a break in the econometric relationship between the stock and the market and would need to be carefully evaluated for whether they are temporary or permanent to assess how the break event should be treated in forward-looking beta estimates.

8.1.3 Both Covid19 and the war have had significant negative impacts on water company betas. Covid19 has resulted in a statistically significant reduction in the equity beta for the pure play water portfolio of c.0.14, whereas the impact of the war has so far been a reduction equivalent to 0.27.

- There is inherent uncertainty in assessing the nature of the events but the impact of both is assumed to be predominantly transitory as outlined in section 6.4 and arising from current economic conditions, rather than representative of unconditional, long-run beta.
- According to the study on pandemics cited by Ofwat, the likelihood that another pandemic event occurs in the estimation window is very low, therefore an approach which attaches material weight to data from the Covid19 window is likely to result in distortions.
- An analysis of the CMA's approach suggests that only c. 3.7% of data used to derive PR19 beta estimates could have been Covid-affected. In the context of the 20-year investment horizon employed by the CMA, this corresponds to an assumption that a pandemic of a similar scale as experienced during the first ten months of Covid19 would occur during c 0.74 years out of 20. As a result, the CMA's range for beta is relatively unaffected by Covid19 estimates.
- Relatedly, the Civil Aviation Authority ('CAA') in the Final Proposals for the H7 price

control for Heathrow set a beta assuming that a pandemic-like event would occur once in every 20 or 50 years and last 17 or 30 months[158].

— All else equal this suggest attaching low weight to Covid19 data for estimation of beta over a long run, 15Y investment horizon. This Report considers (1) excluding all data from the Covid19 period (2) attaching low weight to Covid data based on the the assumed frequency of a future pandemic with a similar impact and duration.

— Forecast inflation – the chosen proxy to quantitatively evaluate the timing of reversion to 'normal' economic conditions following the war – is expected to revert to long-term target levels ahead of the start of the PR24 price control which would suggest that the impact of the war could reverse in the next couple of years. In combination with the actions being undertaken to mitigate the economic impact of the war on Europe (for example via increasing self-supply of energy), this evidence implies that the beta estimates from the war-affected period are not likely to be relevant for setting the allowed returns for PR24.

8.1.4 The above suggests that beta values as two cut off dates are the relevant input into the consideration of the appropriate beta range for PR24:

— **28 February 2020**: consistent with the CMA's approach at PR19 and the finding of a statistically significant structural break after 28 February 2020 due to Covid.

— **23 February 2022**: consistent with the finding of a statistically significant structural break after 24 February 2022. Using this cut-off date would assign weight to Covid-affected data based on the assumed frequency of a future pandemic with a similar impact and duration but would not assume that the impact of the war would continue at a similar scale or reoccur during the assumed investment horizon.

8.1.5 The remainder of this section first presents beta estimates for proxy companies under different estimation and averaging windows and cut off dates and then derives the asset beta range for PR24 based on a holistic consideration of the evidence presented in this report.

8.2 Analysis of beta estimators from proxy companies (to February 2020 and February 2022)

8.2.1 Beta estimates for the proxy companies presented in this section have been derived using an approach broadly comparable to that employed by the CMA at PR19. The focus on beta estimates derived using daily returns information – consistent with the

[158] Economic regulation of Heathrow Airport Limited - H7 Final Proposals Section 3: Financial issues and implementation (caa.co.uk), section 9

approach proposed by Ofwat – is the primary divergence from the CMA's approach (which is based on daily, weekly, and monthly frequencies).

8.2.2 Consistent with the CMA's PR19 re-determination, estimates are presented for value-weighted pure play water portfolio under spot, 1-, 2- and 5-year averaging windows. The pure play portfolio is assumed to include SVT and UUW only. Given the amount of time that has passed between the announcement of the sale of Viridor and the February 2022 cut-off date, there is insufficient pure play return data for PNN. As noted in section 6.2, the inclusion of PNN data in the value-weighted water sector portfolio results in a small increase in the 2Y spot beta. If this dynamic persists as more pure play data becomes available for PNN, it may indicate that estimates based on SVT and UUW alone *understate* beta for the water sector and would suggest that Ofwat should carefully consider how the evidence from PPN should be taken into account, particularly in the context of having a very limited number of listed comparators available for the sector.

8.2.3 The CMA's analysis of the asset beta for PR19 included a step to identify and exclude outliers using a statistical rule based on the interquartile range (IQR).[159] The IQR is the difference between the 75th percentile (or third quartile) and the 25th (or first quartile) percentile in a dataset. It measures the spread of the middle 50% of values. An observation is considered an outlier where it is either 1.5 times the interquartile range (IQR) greater than the third quartile or 1.5 times the IQR less than the first quartile.

8.2.4 The CMA appears to have undertaken outlier by applying the interquartile range rule to (1) underlying beta estimates (e.g. individual data points from the weekly beta dataset) and (2) headline beta estimates across different frequencies and averaging and estimation windows (e.g. 10-year monthly, 5-year monthly). Outlier identification and exclusion appears to have been performed at the equity beta level separately for each cut-off date used by the CMA (28 February 2020, 31 December 2020).

8.2.5 The CMA did not identify any outliers for the beta estimates as at 28 February 2020 (i.e. pre-Covid) but excluded both individual data points and headline estimates from the 31 December 2020 estimates as outliers.

8.2.6 Beta estimates from February 2022 set out below have been tested for outliers following a similar approach to that employed by the CMA. Several outliers were identified in individual data points and are excluded from the betas presented below. The headline beta values for the 2Y spot and 5Y5Y estimators were also identified as outliers relative to the other estimators from 23 February 2022. Beta estimates from February 2020 have not been tested for outliers given the CMA's findings that there were none in this data.

[159] CMA PR19 FD, para. 9.474

Table 8 Beta evidence from the water portfolio (to February 2020 and February 2022)

Estimation window	Averaging window	Raw equity beta (28 Feb 2020)	Unlevered beta (28 Feb 2020)	Raw equity beta (23 Feb 2022)	Unlevered beta (23 Feb 2022)
2-year	Spot	0.65	0.28	0.54	0.25
2-year	1-year	0.61	0.27	0.58	0.27
2-year	2-year	0.62	0.28	0.57	0.26
2-year	5-year	0.67	0.33	0.60	0.28
5-year	Spot	0.69	0.33	0.56	0.26
5-year	1-year	0.67	0.32	0.58	0.26
5-year	2-year	0.68	0.33	0.59	0.27
5-year	5-year	0.64	0.31	0.64	0.31
10-year	Spot	0.59	0.28	0.60	0.28
10-year	1-year	0.56	0.26	0.59	0.28
10-year	2-year	0.57	0.27	0.59	0.28
10-year	5-year	0.59	0.29	0.59	0.28

Source: KPMG analysis of Thomson Reuters Eikon data as of 25 August 2022.
Purple highlights indicate that the headline estimate is an outlier relative to the other equity beta values in the table.

8.2.7 The comparison of beta values estimated using data up to 23 February 2022 to those estimated using the data unaffected by Covid19 and reveals a significant reduction in 2- and 5-year betas across all averaging windows. In contrast, 10-year betas have remained broadly stable. A similar dynamic can be observed from the comparison of February and December 2020 daily betas in the CMA PR19 FD[160].

— As at 28 February 2020, the 5-year betas materially exceed 10-year betas, reflecting the presence of a structural break in 2014 which signalled an increase in systematic risk exposure for water stocks. 10-year betas in 2020 take into account the betas before this structural break and so are lower than the 5-year betas.

— As at 23 February 2022, 10-year betas exceed 5-year betas because they are less affected by the pandemic – given the reliance on materially greater quantum of unaffected data – and incorporate less of the data from before the PR14 structural break than 2020 estimates. Notably, the CMA did not take into account the presence of the structural break at PR14 when deriving its beta range for PR19.

8.2.8 The **equally weighted average for the spot betas as at 28 February 2020 is 0.296** per Table 8, whereas the **outlier-adjusted average as at 23 February 2022 is 0.271.**

[160] CMA PR19 FD, tables 9-8, 9-11

8.2.9 As discussed in section 6.6, a rolling average approach has some statistical shortcomings and does not result in any more 'relevant' estimate of the current pricing of risk than a spot estimate, whilst introducing arbitrary weighting of the underlying pricing signals within the sample under consideration. As a result, this Report focuses on deriving an asset beta range using spot values which appropriately take into account structural breaks.

8.3 Assessment of the weighting assumed for Covid-affected data

8.3.1 In order to derive an asset beta for PR24, this Report first considers an approach that attaches some weight to data from the Covid period consistent with assumptions around likely recurrence of a comparable pandemic event. This is consistent with the approach adopted by the CMA at PR19 which appears to have assigned some weight to the Covid-affected data as discussed in 6.4.

8.3.2 The comparable event is assumed to last approximately 2 years in line with the Covid19 duration implied by structural break analysis to (1) allow for the delineation between the impacts of the pandemic and the war and (2) avoid judgement regarding the length of potential future pandemics.

8.3.3 Two options are considered in terms of the frequency of pandemic events of a comparable scale and duration as Covid19.

- 1 in 15-year frequency – for consistency with tenor of 15Y Gilts referred to by Ofwat in the draft methodology. All else equal this is likely to *overstate* the frequency of future pandemics.
- 1 in 100-year frequency – consistent with (1) the gap between Covid19 and the last pandemic of a comparable scale, (2) the recognition that Covid19 is once-in-a-century event[161] and (3) the more conservative estimate from the study cited by Ofwat which suggests a range of c.70Y to 210Y for recurrence of a pandemic of comparable magnitude to Covid-19.

8.3.4 Assuming that a pandemic lasting c. 1.98 years occurs once in 15 years implies that c. 13.2% of the investment horizon would be affected, whereas for a once in 100-year occurrence, only 2% of the data would be affected. This information is combined with the following assumptions to estimate the relative weight that should be assigned to beta estimates from February 2020 and 2022 to arrive at values that incorporate the same amount of Covid-affected data:

- Only spot beta estimates are used in the analysis;

[161] For example, the chief of the World Health Organization (WHO) said that the Covid-19 pandemic. is "a once-in-a-century health crisis."

— 2-year spot value as at February 2022 are not included at this data is identified as an outlier; and

— Beta estimates under 2-, 5- and 10-year estimation are assigned equal weight relative to one another.

Table 9 Assumed Covid19 weightings to simulate a 1 in 15-year frequency

	Estimation window			Overall
	2-year average	5-year average	10-year average	
Proportion of the data affected by Covid as at 23 February 2022	0%	40%*	20%	
Proportion of the data affected by Covid as at 28 February 2020	0%	0%	0%	
Proportion of Covid-affected data	0%	26%	13%	13.2%**

Source: KPMG analysis.

* For example, the 40% proportion of the data affected by Covid has been calculated as the proportion of the 01/03/2020 – 23/02/2022 Covid-affected period relative to the full 23/03/2017 – 23/02/2022 covered by the 5-year averaging window.

** The relative weight assigned to the Feb 2020 and Feb 2022 cut-offs has been calculated such that the overall proportion of Covid-affected data is 13.2% (1/3x0%+1/3x26%+1/3x13%)

Table 10 Assumed Covid19 weightings to simulate a 1 in 100-year frequency

	Estimation window			Overall
	2-year average	5-year average	10-year average	
Proportion of the data affected by Covid as at 23 February 2022	0%	40%	20%	
Proportion of the data affected by Covid as at 28 February 2020	0%	0%	0%	
Proportion of Covid-affected data	0%	4%	2%	2.0%*

Source: KPMG analysis.

* The relative weight assigned to the Feb 2020 and Feb 2022 cut-offs has been calculated such that the overall proportion of Covid-affected data is 2%.

8.3.5 Applying these weights to the equally weighted average for the spot betas as at 28 February 2020 (0.296) and the outlier-adjusted average as at 23 February 2022 (0.272) yields an unlevered beta estimate of **0.280 for 1 in 15-year** and **0.293 for 1 in 100-year frequencies.**

8.4 Deriving the beta range for PR24

8.4.1 The following evidence set out in this Report is considered in coming to a view on the asset beta range for PR24:

— The increased systematic risk exposure faced by the water companies at PR24

relative to PR19, predominantly driven by proposed changes to incentives and performance commitments, costs, changing environmental requirements and heightened pressure on the sector 'in the headlines' which, *inter alia,* increases regulatory risk. The relative risk analysis indicates *prima facie* that beta would be expected to increase somewhat relative to PR19 values due to changes in the systematic risk exposure faced.

- The analysis of structural breaks, which implies that water proxies react materially to Covid and Russia-Ukraine war but that these impacts are transitory. Betas affected by the pandemic are expected to mean-revert as Covid19 does not indicate a change in business fundamentals (the pandemic has not revealed new information or changed risk for the sector). The impact of the war could reverse in the next couple of years ahead of the PR24 price control, supported by *inter alia* plans to increase Europe's self-sufficiency from an energy supply perspective.

- The evidence submitted by Gregory et al on behalf of the water companies in the PR19 appeals on the existence of a structural break for the UK water sector around the PR14 period, which suggests that data from 2014 onwards is most relevant to set cost of equity for PR24. This is consistent with the findings of the Indepen report which notes that "*significant changes in regulatory regime, like the shift from RPI-X to RIIO in the energy sector or the implementation of the Future Price Limits changes at PR14 in the water sector, suggest that the assumption of a constant equity β is likely to be untenable*."

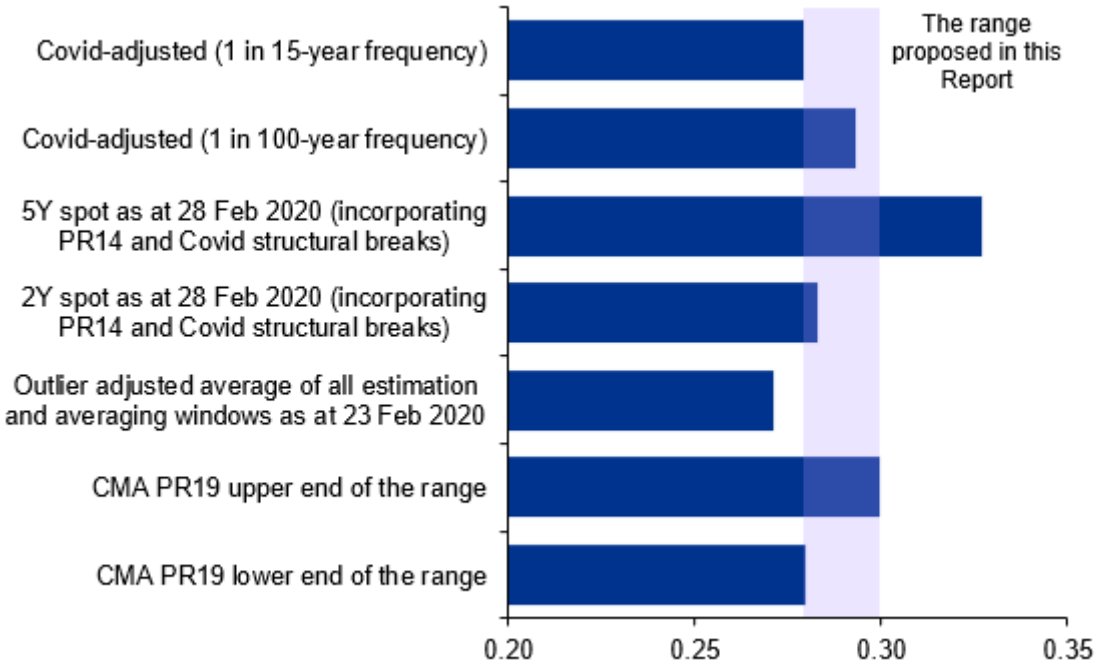
- The inference that the CMA potentially placed no weight on Covid affected estimates given that its final range was fully encompassed within the range of evidence that results from estimates being calculated with pre-Covid.

- The upper bound of the range takes into account (1) the evidence of the structural break around PR14 and (2) the inference that the CMA potentially placed no weight on Covid affected estimates. It is based on the equally weighted average of spot estimates of 2- and 5-year betas as at 28 February 2020 **(0.304).**

- The lower bound of the unlevered beta range is informed by the Covid-adjusted estimate which assumes that a c. 2-year pandemic of a similar scale as Covid occurs once in 15 years **(0.280).**

8.4.2 Figure 13 sets out a comparison between the unlevered beta range proposed in this Report and estimates implied by the different approaches considered in the Report and by the CMA at PR19.

Figure 13 Summary of unlevered beta estimates



Source: KPMG analysis.

8.4.3 The qualitative and quantitative evidence set out in this Report indicates that this range is best supported by the evidence provided by relevant financial literature and regulatory principles.

8.4.4 Table 11 combines the unlevered beta estimates with a debt beta of 0.075 and notional gearing of 60% using the standard approach to de- and re-levering in order to derive the notional equity beta range for PR24.

Table 11 Notional equity beta range for PR24

	Lower bound	Upper bound
Unlevered beta	0.280	0.304
Asset beta	0.320	0.345
Debt beta	0.075	0.075
Notional gearing	60%	60%
Notional equity beta	0.687	0.750

Source: KPMG analysis.

8.4.5 The proposed equity beta range is consistent with the range of 0.69 – 0.74 determined by the CMA for PR19.[162]

[162] CMA PR19 FD, Table 9-19

9 Appendix 1: Scope of work

9.1.1 Water UK has asked KPMG to develop a report on Relative Risk Analysis and Beta Estimation, to assist Water UK in its considerations regarding the PR24 draft methodology and, in particular, asset beta that is reflective of the systematic risk exposure faced by water companies and is best supported by the evidence provided by relevant financial literature, regulatory principles, and market evidence. The final report will be shared with Ofwat alongside Water UK's response to the draft methodology.

9.1.2 In order to develop a view on a beta that is reflective of the systematic risk exposure faced by water companies, the report will consider the risk exposure and the beta estimate for water companies in four steps:

- First, it considers the key drivers of risk for water companies going forwards given the trajectory of policy in the sector and evolution in the regulatory landscape.
- Second, it undertakes a relative risk assessment between PR19 and PR24 based on changes in exposure to cost, performance, financing, regulatory finance, and regulatory risks taking into account the interaction between inherent risk exposure and regulation.
- Third, it sets out a number of methodologies for quantifying the relative risk differential given that risk drivers identified in the previous steps. In particular, this Report considers evidence from observed data, analysis of structural breaks and implied volatility.
- Fourth, it considers the implications of the findings in steps 1, 2 and 3 for the asset beta estimate for PR24.

9.1.3 In addition the report considers the treatment of de and re-levering:

- First it considers the Modigliani-Miller theorem and practical application in a regulatory context
- Second it considers practical application of Modigliani-Miller theorem
- Third it decomposes the underlying drivers of the observed variance of WACC to gearing
- Fourth it evaluates the arguments and evidence put forward by Mason and Wright in relation to de- and -re-levering, based on the options set out in Ofwat's draft methodology.

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A6 RFR methodology for PR24 – report by Oxera

RFR methodology for PR24

Response to Ofwat PR24 consultation

Prepared for
Water UK

2 September 2022

Final

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Contents

Figures and tables

Executive summary

Ofwat has proposed a methodology for estimating the risk-free rate (RFR) for PR24. In this report we show the limits and some fallacies of Ofwat's proposal. We present an alternative methodology that is rigorous and aligned with previous decisions made by the Competition and Markets Authority (CMA) in its redetermination for the PR19 price control.

First we review the methodology proposed by Ofwat for PR24. For the RFR estimate, the regulator is proposing to draw on gilt yields as its primary source of evidence and to place no weight on AAA-rated bonds. Ofwat is considering employing long-term SONIA swap rates and nominal gilt yields as potentially useful cross-checks. It does not consider the inclusion of an uplift to the gilt yields to account for the presence of a convenience premium.

We then present our case for an alternative approach to that proposed by Ofwat. We begin by examining which proxies should be used to estimate the relevant RFR. Our position is in line with what the CMA proposed in its redetermination for PR19: 'zero-beta' assets represent valid proxies for the RFR. Consequently, we propose that the estimate of the RFR should be based on both index-linked gilts (ILGs) and AAA-rated bonds, rather than solely on ILGs. This approach is also consistent with that proposed by the CAA for the regulation of Heathrow Airport, and is conceptually similar to the approach adopted by Bundesnetzagentur, the German federal network agency, to estimate RFR, which uses a designated bond index that includes some corporate bonds and bank bonds.

We provide evidence for the existence of a convenience premium in the returns of gilts, which indicates that using gilt yields to estimate the RFR is likely to result in an underestimation of the 'true' rate. We also discuss the existence of a small risk premium and a liquidity premium in AAA bonds. This indicates that using yields on AAA bonds to estimate the RFR is likely to result in an overestimation. We consider the exact quantification of the convenience premium, risk premium and liquidity premium as potentially subject to estimation error and therefore refrain from providing an exact estimate of each of these factors.

Instead, we take a more practical approach that is consistent with the CMA's approach for the PR19 redetermination, whereby the RFR is estimated as an average between the yield on AAA bonds and the yield on gilts. Our empirical analysis on the historical betas of government bonds and AAA bond indices shows that both are equally valuable inputs to estimating the 'true' RFR.

We discuss the use of SONIA swaps as a cross-check for the RFR estimate based on gilts. We first observe that, in a theoretical frictionless world, the yield curve obtained from bootstrapping the bond yields is identical to that obtained from bootstrapping the swap rates. This implies that swap rates do not contain any new information that is not already embedded in the yield curve derived from bonds. In other words, in a theoretical frictionless world, using SONIA swaps as a cross-check is a futile exercise.

In the real world (where frictions do exist), historically we observe a non-zero swap spread, which means that there is a difference between swap and gilt rates. The spread tends to be positive on shorter maturities and negative on longer ones. This spread is caused by frictions, such as the convenience premium and excess demand, and its persistence over time is due to limits to arbitrage. These limits prevent profit-seeking arbitrageurs from using trading

strategies that would otherwise eliminate the spread and produce the 'frictionless' outcome in which there is only one yield curve. Thus, in practice, the yield curve derived from swaps is a 'noisy' proxy for one obtained from gilts. Using SONIA swap rates as a cross-check not only does not provide any additional information, but rather adds unnecessary noise to the estimate of the yield curve obtained from bonds.

Finally, we provide our estimates for the RFR for PR24, at between -1.22% and -0.96% (CPIH-real), with a midpoint of -1.09% as of July 2022. Specifically, we set the bottom of the range as the **six-month trailing average of the UK 20-year ILG,** and the top of the range **as the six-month trailing average of the iBoxx £ non-gilt AAA 10+ and 10-15 indices**, as of July 2022. As stated by the CMA, this approach is a more pragmatic and simpler way of estimating the RFR, which avoids quantifying the convenience premium in a bottom-up approach and adjustments to AAA bond yields in a top-down approach.[1] This updated approach also implicitly allows for the convenience premium by setting an RFR above the ILG yields.

Our updated RFR estimates are based on our estimate of the RPI-CPIH wedge, of 56bp. We show that Ofwat's proposed methodology for estimating the wedge, 'the official forecasts', significantly underestimates the RPI-CPIH wedge by omitting the CPI-CPIH wedge and overlooking the ongoing uncertainties surrounding the transition from RPI to CPIH planned for 2030. We present a more robust and **market-based estimate of the wedge based on RPI swap rates, CPI swap rates and the historical CPI-CPIH wedge.**

[1] Competition and Markets Authority (2021), Anglian Water Services Limited, Bristol Water plc, Northumbrian Water Limited and Yorkshire Water Services Limited price determinations: Final report, 17 March, para. 9.160. https://www.gov.uk/cma-cases/ofwat-price-determinations#final-report.

1 Introduction

In this report, we provide a methodology for estimating the risk-free rate (RFR) for the purpose of regulation in PR24 for the water sector. Our approach is intended as a response to Ofwat's proposals, as well as an opportunity to lay out a sound methodology that provides clarity on how to implement the capital asset pricing model (CAPM) in this context.

The most important issue in this regard is to decide which proxies should be used for estimating the RFR. The main candidates proposed by Ofwat are RPI-linked gilts, nominal gilts, SONIA swaps, and an index of AAA-rated bonds. The challenge in choosing the proxies for the estimation comes primarily from the fact that while, in the theoretical framework of the CAPM, there is only one RFR (the 'true' RFR), in practice the RFR could be proxied using the rates of several different assets. In order to choose which rates to use, objective criteria are needed.

The key requirement for a RFR proxy is to be a zero-beta asset. Hence our attention is focused on identifying which assets have zero-beta. Our search for such assets leads us to rely on the yields of gilts and AAA bonds as the main sources for estimating the RFR. This choice is in line with what the CMA has proposed in its redetermination for PR19, and with the CAA's June 2022 proposal for the regulation of Heathrow.[2] In this context, we also discuss why the argument on the nature of the marginal investor as 'net borrower' or 'net lender' is not helpful for identifying the best RFR proxies to use.

Ofwat proposes to use SONIA swaps as a possible cross-check on the rates provided by gilts. We first investigate this choice from a theoretical point of view and explain why looking at swap rates is a redundant exercise when the yield curve based on bond rates is available. We then discuss this problem in a more realistic setting in which there are limits to arbitrage and explain that SONIA swap rates only add 'noise' to the estimation of the yields based on government bonds. Hence, we conclude that SONIA swaps should not be used as a cross-check for the gilt rates.

Our methodology leads us to set the bottom of the range as the six-month trailing average of the UK 20-year index-linked gilt (ILG), and the top of the range as the six-month trailing average of the iBoxx £ non-gilt AAA 10+ and 10-15 indices, as of July 2022.

Ofwat has also discussed how to forecast inflation, in light of the planned RPI to CPIH transition scheduled for 2030. We show that Ofwat's proposed methodology for estimating the wedge, 'the official forecasts', significantly underestimates the RPI-CPIH wedge, which could in turn lead to an underestimated CPIH-real RFR. We provide a market-based estimate of the wedge, also taking into account the wedge between CPI and CPIH.

The report is structured as follows.

- Section 2 reviews Ofwat's position on key issues relating to the RFR estimation, including the convenience premium, RFR proxies, SONIA cross-checks, and inflation adjustments.

[2] CAA (2022), 'Economic regulation of Heathrow Airport: H7 Final' (henceforth 'CAA Final Proposals), https://www.caa.co.uk/commercial-industry/airports/economic-regulation/h7/consultations/final-and-initial-proposals-for-h7-price-control/..

- Section 3 discusses the possible proxies for the estimation of the RFR, showing that the yields on gilts should be used in conjunction with the yields on AAA bonds. Both types of assets satisfy the requirement of being 'zero beta' and are therefore eligible proxies for the RFR. We also discuss why SONIA swaps do not provide a good cross-check for the RFR.
- Section 4 highlights our concerns with the 'officials forecast' approach used by Ofwat to estimate the RPI-CPIH wedge, and proposes a market-based alternative estimate of the wedge based on RPI swap rates, CPI swap rates and the historical CPI-CPIH wedge.
- Section 5 presents Oxera's updated methodology for RFR estimation, which arrives at a CPIH-real RFR of -1.09% (as of July 2022).

2 Ofwat's proposed RFR methodology for PR24

In this section, we summarise Ofwat's proposed methodology for PR24 and its reasoning behind the proposals. This includes the regulator's views on various key issues in RFR estimation. We discuss these issues in more detail in later sections of this report.

2.1 Risk-free rate proxy

Ofwat proposes to draw on gilt yields as its primary source of evidence for the RFR, justifying its choice on the basis that ILGs have the desirable property for an RFR proxy in that they offer inflation protection, high liquidity and negligible default risk. Ofwat proposes to place no weight on AAA-rated corporate bonds to inform its RFR estimate.[3]

Ofwat acknowledges that the CMA's PR19 redetermination used an index of AAA-rated corporate debt to inform the upper end of its RFR range because the CMA's view is that the yield is a more relevant borrowing rate for market participants than ILGs. Nevertheless, Ofwat proposes to disregard an index of AAA-rated bonds on the basis that, as noted by the CMA in its RIIO-2 redetermination, such an index is difficult to use and defend owing to the limited number of index constituents. Furthermore, Ofwat considers the likely presence of liquidity, inflation and default risk components in the AAA-rated synthetic index yield as an additional challenge to estimating an RFR that should not be affected by such risks.[4]

Ofwat also acknowledges that many stakeholders, in responding to the consultation, argued against the use of ILG yields as an unadjusted proxy for the RFR, noting variously that: using gilt yields violates the CAPM requirement that the RFR should be a borrowing and a lending rate for market participants; and that RPI-linked yields are artificially depressed by a 'convenience premium' reflecting the liquidity and safety of the asset.[5]

Ofwat responds to these critiques by arguing that all proxies for the RFR are affected by potential distortions that drive a yield different to that which would apply for the hypothetical 'true' RFR. Calibrating the adjustment to account for these distortions is typically subject to uncertainty and forecast risk. Ofwat argues that there is therefore a risk that any adjustment may make the estimation worse rather than better.[6]

Ofwat is considering employing long-term SONIA swap rates and nominal gilt yields as potentially useful cross-checks. It acknowledges that, during the consultation, several respondents disagreed with the use of SONIA swap rates to inform the RFR because there was insufficient liquidity at longer horizons and other potential distortions reduced its validity as a risk-free proxy.[7]

Ofwat responds to these critiques by arguing that it does not consider these concerns sufficiently serious to disqualify SONIA swap rates as a useful datapoint. First, it notes that the Bank of England assesses the SONIA swap market as deep, liquid and transparent for durations of up to 50 years. Second, it notes that the Bank of England has recently started to publish Overnight Index Swap (OIS) spot curves up to 25 years (an increase from the previous

[3] Ofwat (2022), 'Creating tomorrow, together: Consulting on our methodology for PR24', Appendix 11, pp. 5–6. (Henceforth 'PR24 consultation')
[4] Ibid., Appendix 11, p. 6.
[5] Ibid., Appendix 11, p. 4.
[6] Ibid., Appendix 11, p. 5.
[7] Ibid., Appendix 11, p. 5.

five years), after evidence emerged of improving liquidity at longer tenors following the transition from LIBOR to SONIA. [8]

2.2 Convenience premium

Ofwat recognises that it has been argued that ILGs have special characteristics as an RFR proxy (safety and liquidity) which make them desirable to investors, increasing demand for ILGs and therefore potentially reducing their yield below that of a zero-beta asset.[9]

Nevertheless, Ofwat is not convinced that it would be appropriate to uplift ILG yields for a 'convenience premium'. First, it argues that as the zero-beta asset is a hypothetical asset without an observable traded yield, the direction of any correcting adjustment would be ambiguous. Second, it argues that even if there is a 'convenience premium', the process for adjusting RPI-linked gilt yields to correct for it is difficult, mainly due to the lack of recent, high-quality UK estimates that could be used to supply a point estimate for the adjustment. Where estimates have been made in the literature, these tend to relate to overseas studies and lie in a wide range.[10]

2.3 Inflation adjustment

In its December 2021 discussion paper Ofwat asked how best to convert RPI-linked yields to their CPIH-linked equivalents when deriving an RFR point estimate. This question was posed in response to the UK Statistics Authority's transition from RPI to CPIH expected in February 2030, which will result in RPI being effectively aligned to CPIH in data and methods.[11]

Some responses to Ofwat suggested that a time-varying RPI-CPIH wedge could be derived based on evidence from zero-coupon RPI and CPI inflation swap rates. Other responses argued that the impact of the 2030 RPI reforms was uncertain, with several responses citing market evidence on yields which seemed to contradict the premise that markets are pricing a zero RPI-CPIH wedge post-2030. These responses argued for the retention of a long-run RPI-CPIH wedge of approximately 1.0%. Some suggested it might be appropriate to use the estimate by the Office of Budget Responsibility (OBR) at the relevant future point(s) in time to cover the period up to 31 January 2030 and to assume a zero wedge based on full convergence for the last two months of PR24. Others suggested a cross-check starting from nominal gilt yields of similar duration and deflated using a long-term fixed CPIH assumption.[12]

Ofwat is currently considering an approach to convert RPI-linked yields to a CPIH basis based on the 'official forecasts'. Under this approach Ofwat would base the RPI-CPIH wedge on the OBR's RPI and CPI forecasts before 2030, and then assume that the RPI will be fully aligned with the OBR's long-term CPI forecast (i.e. assume an RPI-CPI wedge of zero) after 2030. The annualised geometric average wedge over the period would then be adopted.[13]

[8] PR24 consultation, Appendix 11, pp. 5–6.
[9] PR24 consultation, Appendix 11, p. 7.
[10] PR24 consultation, Appendix 11, p. 7.
[11] PR24 consultation, Appendix 11, p. 8.
[12] PR24 consultation, Appendix 11, pp. 8–9.
[13] PR24 consultation, Appendix 11, p. 9.

3 Risk-free rate proxies

In this section, we discuss the proxies that are appropriate for estimating the relevant RFR. Our position is broadly in line with that of the CMA in its redetermination for PR19, namely that the estimate of the RFR should be based on both the ILGs and the AAA-rated bonds. Our position is also in line with that of the CAA in its latest proposals for the regulation of Heathrow Airport, in which the ILG rates are augmented by a convenience premium that reflects the yield spreads of the AAA-rate bonds.[14]

We agree with the CMA that the RFR is the representation of the return required on a 'zero beta' asset within the CAPM. It is a measure of the rate of return that an investor can expect to earn without taking any systematic risk. To provide a correct application of the CAPM, Ofwat should look for assets that satisfy the zero-beta condition.

The CMA observes that ILGs closely match the key requirement of the RFR. The UK government enjoys a strong credit rating of AA/Aa3, and as a sovereign nation has monetary and fiscal levers to support debt repayment that are not available to commercial lenders.[15]

In considering whether highly rated, non-government bonds may improve the RFR estimation in the context of price controls, the CMA assessed the IHS iBoxx UK non-gilt AAA 10+ index and the IHS iBoxx UK non-gilt AAA 10-15 index.[16] The CMA concluded that the constituents of these indices are not 'risk-free' in the same way as government bonds denominated in the home country's currency are. This is because investors of these non-government bonds still bear liquidity risks, as well as the additional default risks associated with the issuer. That said, the CMA recognised that the default risks of these high-quality bonds are exceptionally low, and evidence from actual performance suggests that the expected loss is significantly lower than the debt premium.[17] As a result, the CMA concluded that the yields on AAA-rated non-government bonds are suitable inputs to the RFR estimation.[18]

In line with the decision of the CMA, the CAA Final Proposals conclude that it is appropriate to place a 50% weight on AAA-rated non-government bonds.[19] More specifically, the CAA states that:

> We remain of the view that ILGs may exhibit a "convenience yield" or other specific factors that mean that the yields on ILGs may underestimate the "true" risk free rate. Stakeholders' submissions to date have not included new evidence that has altered this view. We therefore consider that there is still a case for **placing weight on an alternative risk free rate benchmark that does not exhibit a convenience yield.** [emphasis added]

The CAA proposes to estimate the convenience premium embedded in gilts by comparing the returns on these gilts to the closest nominal gilt in maturity for each of the iBoxx non-Gilts AAA-rated 10+ years and 10-15 years indices. This approach is equivalent to using the AAA-rated bonds directly in the weighting formula for the RFR.

[14] CAA Final Proposals, section 3, para. 9.250.
[15] CMA redetermination, para. 9.103.
[16] CMA redetermination, para. 9.145.
[17] CMA redetermination, para. 9.146.
[18] CMA redetermination, para. 9.162.
[19] CAA Final Proposals, section 3, paras 9.247–9.250.

Specifically, the CAA proposes:[20]

> to estimate the risk free rate by placing equal weight on the following reference points:
>
> - the one-month trailing average yield on ILGs to 31st March 2022; and
> - the one-month trailing average yield on ILGs over the same period plus a convenience yield of 32bps, in line with the approach set out above.

The CMA acknowledges that the debate on the suitability of ILGs and AAA bonds has revolved around whether other market participants aside from the government can borrow at rates as low as those accessible to the government itself.[21] Part of this discussion revolves around the non-trivial issue of whether the marginal investor of the water companies is a 'net lender' or a 'net borrower'.

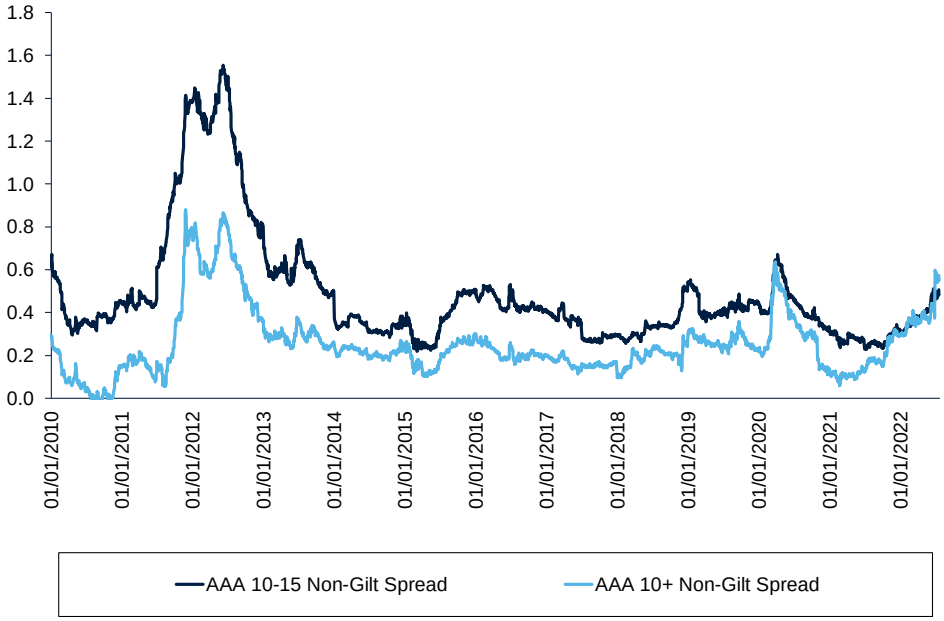
We consider that providing a definitive answer to the debate on the nature of the marginal investor as net borrower or lender is unnecessary for the practical point of assessing whether AAA bonds should be used as inputs in the estimation of the RFR. It suffices to say that as long as a representative investor can obtain a zero-beta risk exposure by investing in AAA bonds, the rate of AAA bonds is a valid proxy for the RFR. Assessing whether the marginal investor (or for that matter, any investor) can borrow at the same rate as the government is more of a test of the empirical validity of the CAPM than useful evidence on what represents a reliable proxy for the RFR. In practice, there are several rates that can be regarded as eligible RFRs, in the sense that they have zero beta. It is the case that only some borrowers (specifically the government) will be able to borrow at the lowest rates within the eligible range of RFRs. However, the perspective of the consumption CAPM is not that of the borrower but that of the investor (a representative investor). As long as a representative investor can invest in a given zero-beta asset, the return of that asset is a valid proxy for the RFR.

In contrast to AAA-rated non-government bonds, government bonds have special properties (noted in detail below) that create additional demand for these instruments. In other words, market participants have reasons to hold government bonds and these reasons go beyond the rate of return expected on these instruments. Bond yields and bond prices are inversely related, so when this additional demand pushes the price higher, the bond yield falls below a normal market-clearing price based solely on risk-free cash flows. These effects are collectively known as the 'convenience premium' and push the rate of return on government bonds below a 'true' RFR based on a zero-beta asset.

Figure 3.1 presents nominal spreads of the iBoxx £ AAA non-gilt 10+ and 10-15 indices. These yield spreads have consistently been positive over the past ten years.

[20] CAA Final Proposals, section 3, para.9.250.
[21] CMA redetermination, paras 9.91–9.93.

Figure 3.1 Nominal spreads of AAA bond indices



Note: The spreads are calculated by deducting yields on maturity-matching nominal gilts.

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

Thus, when using ILGs as a proxy for the RFR, a convenience premium must be added to the yield implied in the prices of ILGs in order to obtain a correct estimate for the RFR.

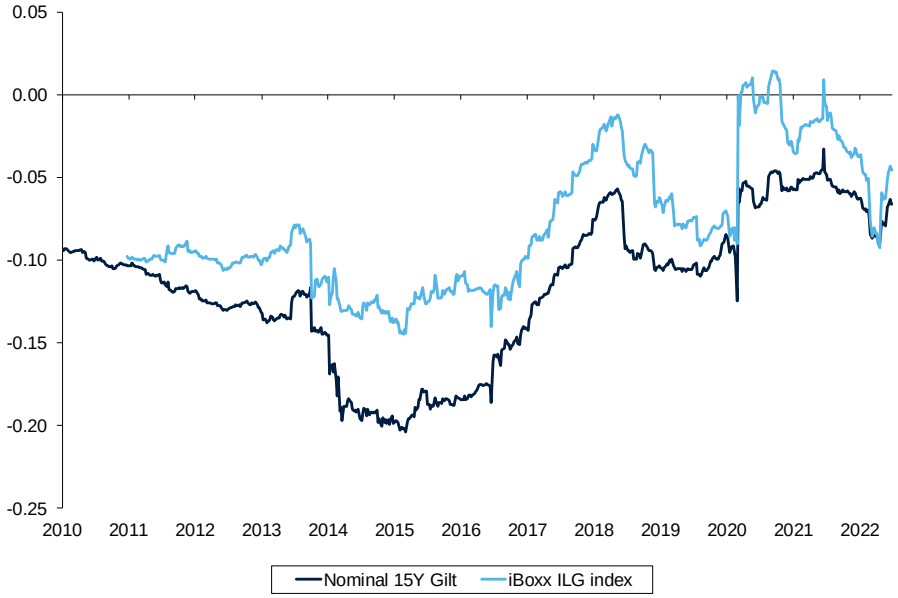
At the other end of the spectrum, the CMA acknowledges that illiquidity premiums, some default risk, and the unavailability of a 'perfect match' average-maturity benchmark all suggest that the yield on AAA non-government indices is likely to be an imperfect proxy for the RFR, and slightly above its 'true' level.[22]

To test whether the gilts and iBoxx AAA indices qualify for the zero-beta asset requirement, we implement five-year rolling regressions, regressing the weekly return of bond indices (for nominal gilt and ILG bond indices and the iBoxx AAA indices) against the weekly return of the equity market index (specifically, the FTSE All-share index). We find that government and AAA bond returns have consistently exhibited non-positive betas since 2010.

Furthermore, the estimated betas of both government bonds and AAA bonds follow similar trends. This is shown in Figure 3.2 and Figure 3.3. These empirical results show that government bonds and AAA bonds are equally valuable inputs for the estimation of a 'true' RFR for the CAPM.

[22] CMA redetermination, para. 9.151.

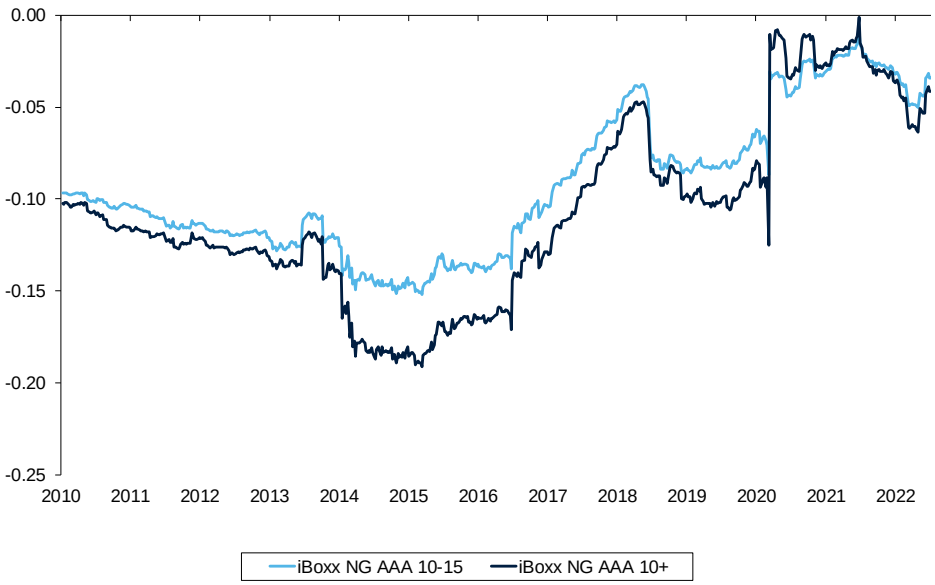
Figure 3.2 Coefficients for five-year rolling regression of returns of UK gilts against returns on FTSE All-share index



Note: These coefficients are calculated by regressing the weekly return on bond indices against the weekly return on the FTSE All-share index.

Source: Oxera analysis using data from Thomas Reuters Datastream and Markit iBoxx.

Figure 3.3 Coefficients for five-year rolling regression of returns of iBoxx £ non-gilt indices against returns on FTSE All-share index



Note: These coefficients are calculated by regressing the weekly return on bond indices against the weekly return on the FTSE All-share index.

Source: Oxera analysis using data from Thomas Reuters Datastream and Markit iBoxx.

In the next sections, we discuss the factors that affect the estimate of the RFR respectively using ILGs and AAA corporate bonds as starting points for the estimation. These factors include the convenience premium embedded in ILGs, and the risk premium and liquidity premium associated with AAA corporate bonds.

3.1 Convenience premium

As acknowledged by Ofwat in its PR24 consultation documents, a large body of academic literature supports the existence of a convenience premium.[23] Below, we examine the academic literature that discusses and/or empirically examines the convenience premium, including some of those cited by Ofwat.

3.2 Evidence on the convenience premium and its size

A substantial amount of evidence from the academic literature explicitly supports the use of an RFR for the CAPM that is higher than the yield on government bonds. For example, Krishnamurthy and Vissing-Jorgensen (2012) conclude that:[24]

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

Berk and DeMarzo (2014) also explain that:[25]

> practitioners sometimes use [risk-free] rates from the **highest quality corporate bonds** in place of Treasury rates. [Emphasis added]

According to Feldhütter and Lando (2008), the magnitude of the convenience premium varies over time and can range from 30 to 90bp.[26] They explain the convenience premium as follows:[27]

> **The premium is a convenience yield on holding Treasury securities arising from**, among other things, (a) repo specialness due to the ability to borrow money at less than the GC repo rates, (b) that Treasuries are an important instrument for hedging interest rate risk, (c) that Treasury securities must be purchased by financial institutions to fulfil regulatory requirements, (d) that the amount of capital required to be held by a bank is significantly smaller to support an investment in Treasury securities relative to other securities with negligible default risk, and to a lesser extent (e) the ability to absorb a larger number of transactions without dramatically affecting the price. [Emphasis added]

Similarly, Krishnamurthy and Vissing-Jorgensen (2012) estimate the average of the liquidity component of the convenience premium to be 46bp from 1926 to 2008.[28] Ofwat has also helpfully noted that Van Binsburgen et al. (2020) estimate a convenience premium of around 40bp on US government bonds over 2004–18.[29]

A Bank of England study finds that some investor groups in UK government bonds display the behavioural properties that theory associates with preferred habitat investors.[30] It concludes that these groups of investors, which comprises institutional investors such as life insurers and pension funds, are less sensitive to price movements than other investor groups. This empirical

[23] PR24 consultation, Appendix 11, p. 7.
[24] Krishnamurthy, A. and Vissing-Jorgensen, A. (2012), 'The Aggregate Demand for Treasury Debt', *Journal of Political Economy*, **120**:2, pp. 233–67.
[25] Berk, J. and DeMarzo, P. (2014), *Corporate Finance*, third ed., Pearson, p. 404.
[26] Feldhütter, P. and Lando, D. (2008), 'Decomposing swap spreads', *Journal of Financial Economics*, **88**:2, pp. 375–405.
[27] Ibid., p. 378.
[28] Krishnamurthy and Vissing-Jorgensen (2012), op. cit.
[29] Van Binsbergen, J. H., Diamond, W. F. and Grotteria, M. (2022), 'Risk-free interest rates' *Journal of Financial Economics*, 143:1, pp. 1–29.
[30] Giese, J., Joyce, M., Meaning, J. and Worlidge, J. (2021), 'Preferred habitat investors in the UK government bond market', Bank of England Research Paper Series, 10 September.

finding is consistent with the academic theories underlying the convenience premium, where investors have reasons to hold government bonds and these reasons go beyond the rate of return expected on these instruments. It also further supports the existence of a convenience premium in the UK.

Koijen and Yogo (2020) develop a pricing model to study sources of variation in exchange rates, long-term yields, and stock prices across 36 countries from 2002 to 2017.[31] Their model finds that, in the absence of special-status demand for US assets by foreign investors and foreign exchange reserves, the US long-term yield would be 215bp higher. In other words, the authors find evidence consistent with a significant convenience premium for US Treasuries between 2002 and 2017.

Longstaff (2004) also examines the 'flight to liquidity' premium in Treasury bond prices by comparing them with prices of bonds issued by the Resolution Funding Corporation (REFCORP), a US government agency, which are guaranteed by the US Treasury.[32] Using yield data from April 1991 to March 2001, Longstaff finds a premium in Treasury bonds relating to:

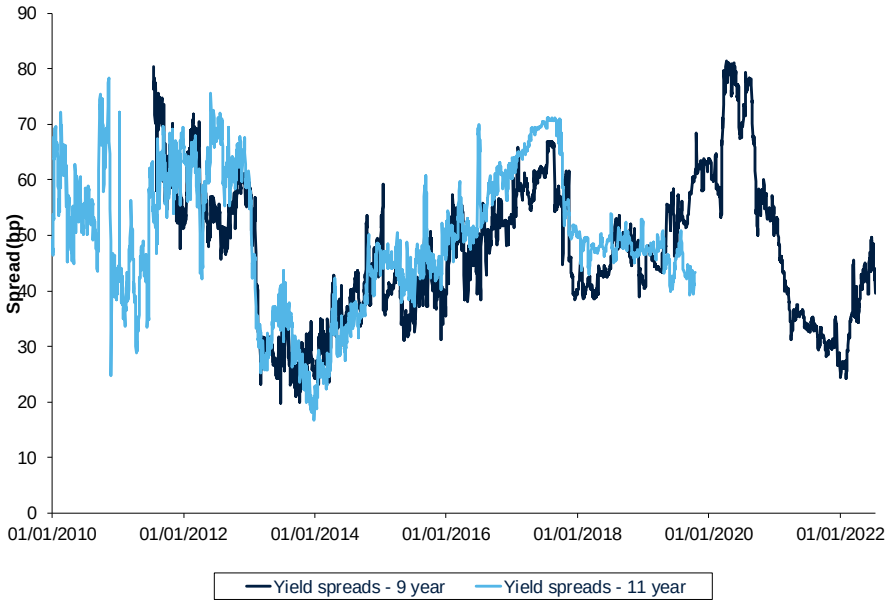
- changes in consumer confidence;
- the amount of Treasury debt available to investors;
- the flows into equity and money market mutual funds.

Longstaff concludes that these features of Treasury bonds directly affect their value.

Using a methodology that is broadly consistent with that set out in Longstaff (2004), we also estimate the size of this premium since 2010. Figure 3.4 below shows that the long-term convenience premiums implied by the spreads of 9- and 11-year REFCORP bonds from 2010 to date are on average 47bp and 50bp respectively.[33] It can be seen that the 11-year spreads reduced significantly in early 2020 when the COVID-19 pandemic began, but at the start of January 2022 this reversed and the spreads are currently trending upwards. These estimates are consistent with the upward adjustment of 50–100bp that we recommended in our May 2020 report,[34] which is added to the yield of 20-year ILGs to estimate the 'true' RFR for the CAPM.

[31] Koijen, R.S. and Yogo, M. (2020), 'Exchange rates and asset prices in a global demand system', No. w27342, National Bureau of Economic Research.
[32] Longstaff, F.A. (2002), 'The flight-to-liquidity premium in US Treasury bond prices', No. w9312, National Bureau of Economic Research.
[33] Due to data limitations, it is not possible to reconstruct times series of spreads for maturities longer than 11 years. For illustration, as of 1 January 2010, only six out of 41 outstanding REFCORP bond strips had maturities greater than or equal to 20 years. As of 19 October 2010, all outstanding REFCORP bond strips had maturities less than 20 years.
[34] See Oxera (2020), 'Review of the CMA PR19 provisional findings', 26 October, p. 14; and Oxera (2020), 'Are sovereign yields the risk-free rate for the CAPM?', 20 May, p. 2.

Figure 3.4 Evolution of yield spreads of 9- and 11-year zero-coupon REFCORP bonds strips since 2010



Note: Assumes a cut-off date of 1 July 2022. The yield spreads at a given point in time are calculated by averaging the daily spreads across all outstanding REFCORP bond strips that have maturities equal to the target maturities at that time (i.e. 9- and 11-year). The spreads are calculated based on the USD US Treasury bonds/notes (FMC 82) zero coupon yield curve, which has maturities available at yearly intervals between one and ten years, and also at 15 years, 20 years and 30 years. The gaps between these maturities are linearly interpolated.

The nine-year spreads series are not available until 20 July 2011, as before that date no REFCORP bond strips have maturities shorter than or equal to nine years. The 11-year spreads series are not available after 17 October 2019, as after that date no REFCORP bond strips have maturities longer than or equal to 11 years. Due to data limitations, it is not possible to reconstruct times series of spreads for maturities longer than 11 years. For illustration, as of 1 January 2010, only six out of 34 outstanding REFCORP bond strips had maturities greater than or equal to 20 years. As of 19 October 2010, all outstanding REFCORP bond strips had maturities less than 20 years.

Source: Oxera analysis using Bloomberg data.

The CAA, in its latest proposal for the regulation of Heathrow, reiterates that it remains of the view that ILGs exhibit a 'convenience premium' or other specific factors that mean that the yields on ILGs may underestimate the 'true' RFR. The CAA estimates the convenience premium as follows:

- identify the nominal gilt closest in maturity for each of the iBoxx non-gilt AAA-rated 10+ years and 10–15 year indices;
- deduct the yield on each gilt from the corresponding iBoxx index over the relevant averaging period; and
- average the difference in yields over this period.

The CAA's estimate of the convenience premium using this methodology is 32bp. The CAA observes that this approach addresses two issues:

- higher short-term inflation is likely to affect nominal gilts and AAA-rated corporate bonds to a similar extent, and so should not materially influence the estimate of the convenience premium or the RFR;

- by estimating the convenience premium by comparing the yield on two sets of fixed-rate instruments, the inflation risk premium is stripped out from the estimated convenience premium.

The allowance for convenience is also not a novel concept in the context of international energy regulation. For example, the German federal network agency, Bundesnetzagentur (BNetzA), has implicitly allowed for an adjustment for convenience premium since 2005.[35] Specifically, BNetzA, in its cost of capital determination for regulated energy networks, uses 'yields on debt securities outstanding issued by residents'[36] as a proxy for the RFR. The official regulatory consultation published in 2021 explained that this designated index includes some corporate bonds and bank bonds.[37]

3.3 Risk premium

Elton et al. (2001) consider actual default rates and bankruptcy recovery rates on corporate debt and show that a risk-neutral investor will require (at most) a 5bp default premium to invest in a ten-year AA-rated corporate bond.[38]

Berk and DeMarzo (2014) report data from Moody's that indicates an annual default rate of 0.0% for AAA corporate bonds over 1983–2011 based on a ten-year holding period.[39] The authors also report an average loss rate for unsecured debt of about 60%. This data is consistent with the expected loss component of the AAA corporate yield being close to zero over a ten-year horizon.

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

The authors report actual cumulative default probabilities of 0.87% and 1.71% for AAA-rated corporate bonds over 10- and 20-year horizons.[40] The default probabilities implied by the Black–Cox model are reported as 0.54% and 1.18% for these horizons. The annualised default probabilities are obtained by dividing these figures by the investment horizon. Multiplying by an average loss rate of 60% gives the annualised default premiums reported in Table 3.1.

Table 3.1 Estimates of default premiums

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

Source: Oxera analysis based on Feldhütter and Schaefer (2018), Table 8.

[35] Bundesnetzagentur (2021), 'Verordnung über die Entgelte für den Zugang zu Elektrizitätsversorgungsnetzen (Stromnetzentgeltverordnung - StromNEV)" , para. 7, https://www.gesetze-im-internet.de/stromnev/BJNR222500005.html.
[36] Official English translation by Bundesbank. 'Umlaufsrenditen inländischer Inhaberschuldverschreibungen / Insgesamt / Monatswerte' (in German).
[37] Bundesnetzagentur (2021), op. cit., para. 7 Abs. 6 StromNEV/GasNEV, https://www.bundesnetzagentur.de/DE/Beschlusskammern/BK04/BK4_74_EK_Zins/BK4_Beschl_EK_Zins.html, p. 5.
[38] Elton, E., Gruber, M., Agrawal, D. and Mann, C. (2001), 'Explaining the Rate Spread on Corporate Bonds', *The Journal of Finance*, **56:**1, February, Table 6.
[39] Berk, J. and DeMarzo, P. (2014), *Corporate Finance: Third Edition*, Pearson, Table 12.2.
[40] Feldhütter, P. and Schaefer, S. (2018), 'The Myth of the Credit Spread Puzzle', *The Review of Financial Studies*, **31**:8, August, pp. 2897–2942, Table 8.

In addition, Feldhütter and Schaefer (2018) account for the systematic risk premium in AAA corporate yields. Although it is rare for a bond to default when rated AAA, some bonds that default will have originally been rated AAA when they were issued. As the investment horizon increases, the cumulative default probability and the risk premium increase. The uncertainty of the estimate also increases, particularly given that defaults of bonds originally rated AAA at issue are rare.

Table 3.2 summarises the estimated spreads between AAA corporate yields and the underlying RFR, taking into account both default risk and the systematic risk premium. Both the actual and modelled spreads increase with the investment horizon. The divergence between actual and modelled spreads also increases with the investment horizon.

Table 3.2 Estimated spreads of AAA corporate bond yields to risk-free rate

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

Source: Oxera analysis based on Feldhütter and Schaefer (2018), Table 9.

The evidence presented in this section illustrates the following points with respect to estimates of the premium for expected loss on AAA corporate bonds.

- The estimates are based on long time series that average out any volatility in the premium for expected loss over short time horizons.
- There is a wide range of uncertainty around the estimates across the different estimation approaches.

This means that there is a risk of inconsistency when making such adjustments to any particular AAA-rated corporate bond or index. To the extent that such adjustments are appropriate in any specific circumstance, at a ten-year horizon a downward adjustment of approximately 5bp to the yields on AAA corporate bonds could be considered to control for expected loss. At a 20-year investment horizon, a larger downward adjustment of 5–20bp could be considered.

3.4 Liquidity premium

When using the yield on AAA corporate bonds to inform the estimate of the RFR for the CAPM, liquidity risks may need to be accounted for. This can be done by deducting a liquidity premium from the yield on AAA bonds. Below, we discuss the empirical evidence from the academic literature, as well as findings from our own empirical analysis.

Van Loon et al. (2015) decompose the credit spreads of the constituents of the iBoxx GBP Investment Grade Index from 2003 to 2014, and find that the median liquidity premium on AAA bonds fluctuated between c. –8bp and +48bp.[41] Excluding the periods of the global financial crisis (2007–08) and the height of the European debt crisis (2011–12), the median liquidity premium largely fluctuates between 0bp and +20bp. While this analysis relies on pre-

[41] Inferred from Figure 20 in Van Loon, P.R., Cairns, A.J., McNeil, A.J. and Veys, A. (2015), 'Modelling the liquidity premium on corporate bonds', *Annals of Actuarial Science*, **9**:2, pp. 264–89.

2014 data, it serves as a cross-check on our empirical analysis, which we present below.

While there are many proxy measures of liquidity, our empirical analysis focuses primarily on the bid–ask spread of the constituents of the iBoxx £ Corp AAA 15+ index. [42]

The bid–ask spreads are expressed in percentage terms, calculated as:

$\frac{(Ask\ price - bid\ price)}{Mid\ price}$. [43]

We calculate the six-month trailing averages of the percentage bid–ask spread preceding 1 July 2022 for each of the constituent of iBoxx £ non-gilts AAA 10-15 and iBoxx £ non-gilts AAA 10+ respectively.[44]

We obtain liquidity premia of 3.3bp and 5.5bp that are calculated by dividing the percentage bid–ask spreads over an assumed holding period of 20 years.

3.5 SONIA cross-checks

In this section, we consider Ofwat's proposal to use the SONIA swap rate as a proxy for the RFR in the CAPM, in the context of the PR24 consultations.

In its Final Determinations for RIIO-T2 and RIIO-GD2, Ofgem commented on the benchmarks that can be used to estimate the RFR in the CAPM. It considered the 20-year SONIA swap rate to be a potential measure of the nominal RFR. Ofwat agrees with Ofgem's use of SONIA swaps as an RFR proxy, and in its RFR estimation is minded to adopt SONIA swap rates as a cross-check on the ILG yields.[45]

3.5.1 The yield curve in a frictionless world and associated arbitrage

To shed some clarity on whether it is useful to use SONIA swaps as cross-checks, it is helpful to review how the yield curve is derived. The yield curve can be equivalently obtained by bootstrapping the bond yields or the swap rates over the different maturities. Smith (2014) illustrates how to infer the forward curve starting from swaps,[46] while Hull (2003) illustrates how to infer it from Treasury bonds. [47]

In a theoretical frictionless world, the two methods lead to the same exact yield curve. In other words, the term structure of SONIA swap rates and gilt yields should be perfectly aligned. If this were not the case, any misalignments would be eliminated by profit-seeking arbitrageurs. It then follows that, in a frictionless world, SONIA swap rates do not provide additional information that is not already contained in the yield curve obtained from gilts. This implies that carrying out a cross-check based on SONIA swaps is futile.

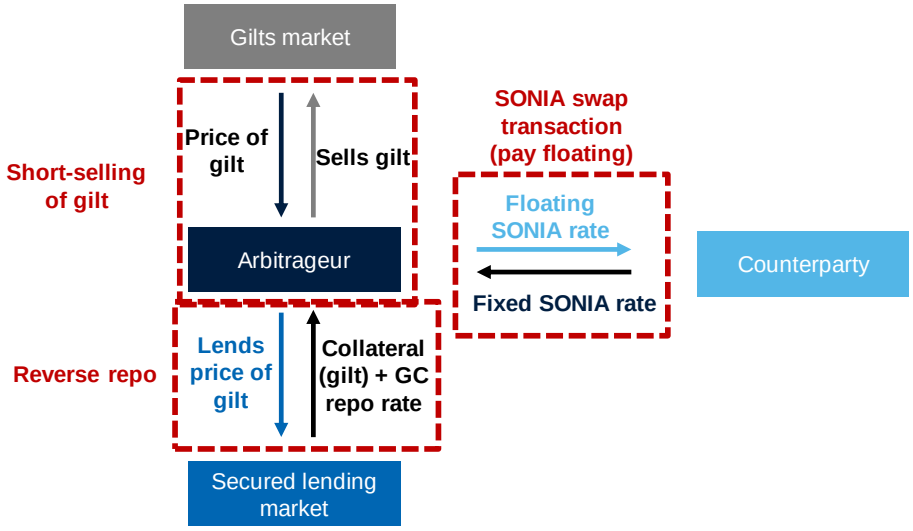
What follows is a description of how an arbitrage strategy would eliminate any difference between the yield curve obtained from gilts and that obtained from SONIA swaps.

[42] Oxera (2020), 'Adjusting AAA corporate bond yields for expected loss', 20 July, p. 2.
[43] The percentage bid–ask price may also be calculated using the ask price or the bid price as the denominator. In our analysis, we use the mid-price as the denominator following the definition set out in International Monetary Fund (2006), 'Financial Soundness Indicators Compilation Guide', para. 8.44.
[44] The iBoxx £ non-gilts AAA 10-15 and the iBoxx £ non-gilts 10+ indices had 5 and 14 constituents respectively, as at 22 July 2022.
[45] PR24 consultation, Appendix 11, p. 2.
[46] Smith, D.J. (2014), *Bond math: the theory behind the formulas, + website*, John Wiley & Sons, p. 181.
[47] Hull, J.C. (2003), *Options, futures and other derivatives*, Pearson Education India, section 4.5.

Consider first the case of a positive difference between the rate on the fixed leg of the SONIA swap and the corresponding yield on gilts. This case is known as 'positive swap spread'. In this case, investors can arbitrage this spread by going long on the SONIA swap and short on the gilt, and then lending to a third party the amount obtained from the short sale of the gilt.

More precisely, the long position on the swap implies that the investor pays the floating SONIA rate and receives the fixed rate. The short position on the gilt implies that the investor pays the fixed rate of the gilt. The arbitrage strategy is completed by lending the short-selling proceeds to a borrower in a reverse repurchase agreement (reverse repo) earning the general collateral (GC) repo rate, which is used to cover the payments of the floating rate of the SONIA swap.[48] This strategy is depicted in Figure 3.5 below.

Figure 3.5 Illustration of arbitrage strategy if SONIA swap spreads are positive



Source: Oxera.

The total cash flows that the investor receives are equal to the difference between the fixed leg of the swap rate and the gilt yield (swap spread), plus the difference between the GC repo rate (interest on the reverse repo) and the floating SONIA rate (if positive). Absent market frictions, investors can adopt this arbitrage strategy and generate positive profits until the swap spread is zero and the GC repo rate equals the SONIA rate.

Duarte, Longstaff and Yu (2007) provide an explanation of this strategy:

> The swap spread arbitrage strategy has two legs. First, an arbitrageur enters into a par swap and **receives a fixed coupon rate CMS [constant maturity Swap]** and pays the floating Libor rate Lt. Second, the arbitrageur **shorts a par Treasury bond** with the same maturity as the swap and invests the proceeds in a margin account earning the repo rate. The cash flows from the second leg consist of **paying the fixed coupon rate of the Treasury bond CMT [constant maturity Treasury]** and **receiving the repo rate** from the margin account rt. Combining the cash flows from the two legs shows that the arbitrageur receives a fixed annuity of SS = CMS − CMT and pays the floating spread St = Lt − rt. The cash flows from the reverse strategy are just the

[48] In a reverse repo transaction, the borrower and lender agree to a short-term agreement, whereby the lender agrees purchase securities in order to sell them back to the borrower at a slightly higher price. In the present case, investors are lenders in the reverse repo transaction, lending to the borrowers by purchasing gilts from them. When the reverse repo agreement unwinds, investors receive the initial purchase price plus an interest.

opposite of these cash flows. There are no initial or terminal principal cash flows in this strategy.[49] [emphasis added]

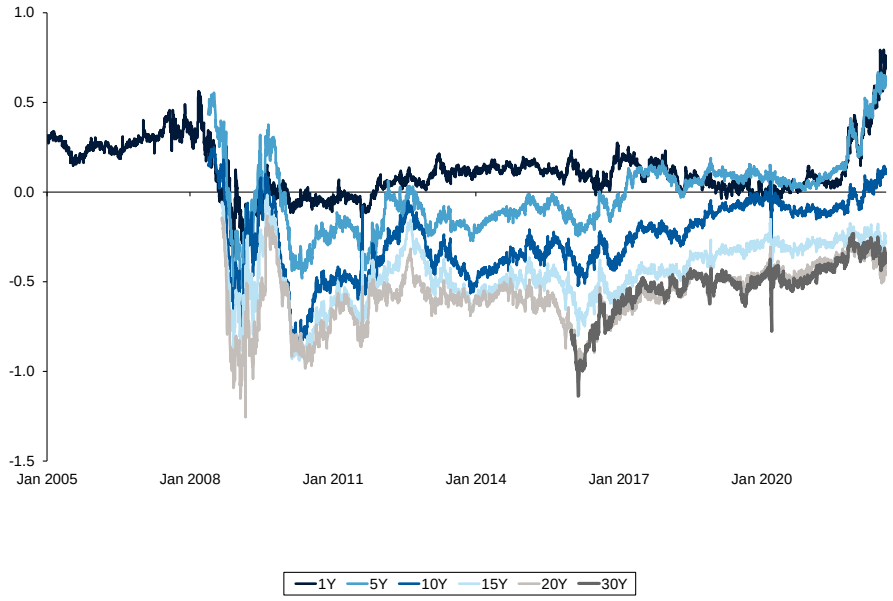
Conversely, if the swap rates are lower than the gilt yields (i.e. there is a negative swap spread), the arbitrage portfolio can be reversed such that investors short the swap spread instead of going long on it. The arbitrage trades will repeat until the swap spreads are pushed to zero.

3.5.2 Limits to arbitrage

The above discussion explains why the SONIA swap spread would be zero in a frictionless world. In practice, the swap spread is typically different from zero. Figure 3.6 presents the historical spreads of 1-, 5-, 10-, 15-, 20- and 30-year SONIA swap rates.

While the shorter maturities tend to have positive (or less negative) spreads especially since the start of the COVID pandemic, the longer maturities (10Y+) have had consistent negative spreads since the 2007–2008 financial crisis. Similar patterns are also observed in the USD market, as shown by Boyarchenko et al. (2018). These discrepancies in spreads are driven by various factors, which we discuss below in more detail.

Figure 3.6 Historical data on SONIA swap spreads



Source: Oxera analysis based on Bloomberg and Bank of England data.

Two main points need to be explained:

- why the swap spreads are generally positive at shorter maturities and negative at longer maturities;
- why these non-zero swap spreads are not arbitraged out (i.e. why they persist over time).

The starting point is to look at the persistence of positive spreads for shorter maturity swaps. As noted above, gilts carry a convenience premium at shorter

[49] Duarte, J., Longstaff, F.A. and Yu, F. (2007), 'Risk and Return in Fixed-Income Arbitrage: Nickels in Front of a Steamroller?', *The Review of Financial Studies*, 20:3, pp. 769–811, https://doi.org/10.1093/rfs/hhl026.

maturities due to their greater liquidity as well as other factors. Insofar as swap rates do not carry such premium, a positive swap spread will occur.

In theory, an arbitrage strategy like that discussed in the previous section and illustrated in Figure 3.5should lead to the elimination of the spread. In practice, for the strategy to be profitable, the difference between the GC repo rate and the SONIA floating rate must be sufficiently non-negative. Historically, GC rates have often been significantly below SONIA rates.

A similar pattern is observed in the USD market, in reference to which Agustin et.al. (2021) explain that, due to higher risk, uncollateralised interest rates (the equivalent of SONIA rates) are generally greater than collateralised rates (GC repo rates).[50] This fact is also noted by Boyarchenko et al. (2018), which observe that LIBOR generally exceeds the interest rate earned in the reverse repo transaction, making the overall trade uneconomical.

Overall, this evidence supports the claim that the reverse repo arbitrage illustrated in Figure 3.5 is typically not profitable, which is why we observe persistent positive swap spreads on shorter maturities.

We now discuss possible reasons why we observe negative swap spreads at longer maturities. The academic literature has attributed the existence of a negative spread primarily to 'excess' demand for hedging relative to supply (i.e. there is a convenience premium for swap rates). Since limits to arbitrage prevent the market from correcting these supply–demand imbalances, negative swap rates persist.

More precisely, Klinger and Sundaresan (2019) develop a model in which underfunded pension plans' demand for duration hedging creates demand for the fixed rate leg in swaps with long maturities. The authors explain that:[51]

> Pension funds have long-term liabilities in the form of unfunded pension claims and invest in a portfolio of assets, such as stocks, as well as in other long-term assets, like government bonds. They can balance their asset-liability duration by investing in long-term bonds or by receiving fixed in an IRS [interest-rate swap] with long maturity. Our theory predicts that, **if pension funds are underfunded, they prefer to hedge their duration risk with IRS rather than buying Treasuries**, which may be not feasible given their funding status. The preference for IRS to hedge duration risk arises because the swap requires only modest investment to cover margins, whereas buying a government bond to match duration requires outright investment. **This demand, when coupled with dealer balance sheet constraints [as set out in Boyarchenko et al. (2018), which we discuss below], results in negative swap spreads**. [Emphasis added]

Empirically, Klinger and Sundaresan (2019) also find that the aggregate funding status of defined-benefit pension plans is a significant explanatory variable of 30-year swap spreads in the USA. For the euro market, where the supply of interest rate swaps is lower than in the USA, Domanski et al. (2017) explain that the impact of demand-driven pressure on the swap spreads can be extremely significant:[52]

> [W]hen [the] long-term interest rate fell sharply in December 2008, Dutch pension funds' coverage ratios fell to about 95 percent, and their attempts to

[50] Augustin, P., Chernov, M., Schmid, L. and Song, D. (2021), 'Benchmark interest rates when the government is risky', *Journal of Financial Economics*, 140:1, pp. 74–100.
[51] Klingler, S. and Sundaresan, S.M. (2019), 'An explanation of negative swap spreads: Demand for duration from underfunded pension plans', *The Journal of Finance,* 74:2, pp. 675–710.
[52] Domanski, D., Shin, H.S. and Sushko, V. (2017), 'The hunt for duration: not waving but drowning?', *IMF Economic Review*, pp. 113–53.

> close their interest rate gaps via the use of swaps were associated with a **31 percent cumulative decline** in the 50-year swap rate in just two days (3-4 December). [Emphasis added]

This 'excess demand' cannot be met with additional supply due to limits to arbitrage. Boyarchenko et al. (2018) focus on limits to arbitrage resulting from the more stringent regulatory requirements for swap dealers. Specifically, they argue that higher capital requirements reduce incentives for market participants to enter into the relevant arbitrage trades.[53] The authors conclude that, given the balance sheet costs for the dealers, spreads must reach more negative levels to generate an adequate risk-adjusted return on equity for dealers. The authors' conclusions are supported by the observations of Chowdhury and Wurm (2017) on the UK swap market:[54]

> More puzzling, perhaps, the strong inversion of swap spreads across maturities and persistent, negative long-term swap spreads suggest the presence of unexploited arbitrage opportunities. Increased regulation motivating end-of-quarter bond sell-offs by banks and large-scale QE-induced tightness of the repo market, resulting in **costlier and thus unprofitable hedges**, are the most likely explanations for reduced **dealer appetite** to participate in such agreements. [Emphasis added]

Jermann (2020) develops a theoretical framework explaining long-term negative swap spreads under limited arbitrage. Consistent with explanations focusing on capital market inefficiencies, this theory assumes frictions limiting the size of dealers' fixed-income portfolios and derives negative swap spreads even in the absence of demand-side effects.[55]

3.5.3 Concluding remarks on SONIA swap rates as viable cross-checks

In conclusion, SONIA swap rates should theoretically be equal to the RFR in a theoretical frictionless world. This implies that, in a frictionless, world swap rates do not provide additional information with respect to a yield curve built on government bond yields (i.e. there should only be one yield curve).

In practice, a variety of distortions and market frictions lead to significant and persisting swap spreads. In particular, we observe persistent negative spreads for long-maturity SONIA swaps. Thus, in the real world, as opposed to a theoretical frictionless world, swap rates provide a noisy proxy for the yield curve based on government bond yields. The 'noise' is due to the fact that a variety of frictions distort swap rates, resulting in multiple non-perfectly overlapping yield curves.

Using SONIA swap rates as a cross-check for RFR only adds more noise and distortions to RFR estimation. Therefore, we do not consider the 20-year SONIA swap rate to be the appropriate proxy for the RFR in the context of the PR24 price control.

[53] Boyarchenko, N., Gupta, P., Steele, N. and Yen, J. (2018), 'Negative swap spreads', *Federal Reserve Bank of New York Economic Policy Review*.
[54] Chowdhury, S. and Wurm, M.A. (2017), 'Modelling and Forecasting Interest Rate Swap Spreads', *Moody's Analytics risk perspectives,* https://www.moodysanalytics.com/risk-perspectives-magazine/managing-disruption/principles-and-practices/modeling-and-forecasting-interest-rate-swap-spreads (accessed 30 June 2021).
[55] Jermann, U. (2020), 'Negative Swap Spreads and Limited Arbitrage', *Review of Finance*, pp. 212–38.

4 Estimation of the RPI-CPIH wedge

In November 2020, the Chancellor announced that the UK Statistics Authority could introduce its RPI to CPIH transition unilaterally from 2030. These planned reforms will align the Retail Price Index (RPI) with the Consumer Price Index including owner occupier housing costs (CPIH).[56]

Against this background, Ofwat is considering a number of methodologies for estimating the RPI/CPIH wedge in order to convert RPI-linked ILG yields into CPIH-real RFR estimates.

Ofwat's preferred method is the 'official forecasts' approach:[57]

> under this option we would base the RPI-CPIH wedge on the OBR's RPI and CPI forecasts before 2030, and then assume that the RPI will be fully aligned with the OBR's long-term CPI forecast (ie, we assume an RPI-CPI wedge of zero) after 2030. The annualised average wedge over the period would then be the geometric average of this series.

By construction, the official forecasts approach implicitly assumes that the RPI inflation rate implied by the ILGs will equal the CPIH inflation rate with 100% probability from 2030 onwards. This assumption is controversial. There is material uncertainty surrounding the RPI-CPIH transition.

Notably, the right to undertake a judicial review of the RPI-CPIH transition has been granted to some pension funds.[58] The court case, to be heard in summer 2022, challenges both the RPI reform and the Chancellor's decision not to compensate ILG holders. If compensations were to be paid to ILG holders in light of the judicial review, ILG prices would increase, resulting in lower yields. This would consequently increase the break-even RPI inflation implied by the nominal gilt yields and ILG yields, leading to a wider RPI-CPIH wedge. It is also not possible to rule out entirely a scenario whereby the RPI-CPIH transition gets delayed or even cancelled in light of the judicial review.

The uncertainties set out above will inevitably affect market expectations surrounding the break-even inflations implied in the ILGs. As a result, Ofwat's approach based on official forecasts is unlikely to provide a robust estimate of the RPI-CPIH wedge.

4.1 Alternative methodologies

In its consultation, Ofwat considers two alternative methodologies for estimating the RPI-CPI(H) wedge. The first, the 'Do minimum' approach, entails using a wedge of around 1%:[59]

> 'Do minimum' approach: This would involve adjusting RPI-linked gilt yields for the OBR's long-term RPI-CPI 'wedge' of around 1.0%, as we did for PR19 final determinations.

Ofwat argues that this methodology incorrectly assumes that the market is currently pricing gilts that mature after 2030 with no regard to the RPI-CPIH transition.

[56] UK Statistics Authority (2020), 'Response to the joint consultation on reforming the methodology of the Retail Prices Index', https://uksa.statisticsauthority.gov.uk/news/response-to-the-joint-consultation-on-reforming-the-methodology-of-the-retail-prices-index/
[57] PR24 consultation, p. 9.
[58] See Linklaters (2022), 'The High Court considers RPI replacement challenge', 22 June, https://www.linklaters.com/en/knowledge/publications/alerts-newsletters-and-guides/2022/june/22/the-high-court-considers-rpi-replacement-challenge#_ftn1.
[59] PR24 consultation, Appendix 11 [?], p. 9.

The second methodology considered by Ofwat is to estimate the wedge based on zero-coupon RPI and CPI swaps:[60]

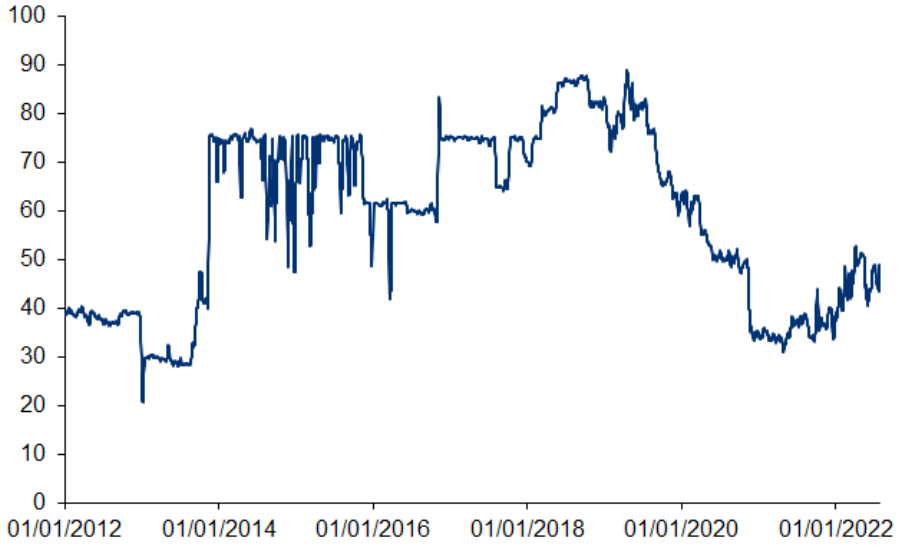
> 'Inflation swaps' approach: an alternative option would be to infer the market-implied long-term expectation of the RPI-CPIH wedge based on rates of zero-coupon RPI swaps and zero-coupon CPI swaps at our chosen CAPM investment horizon.

Ofwat prefers the official forecasts approach to the inflation swap approach, as it argues that the latter is subject to distortions from inflation risk premia and/or low liquidity.

Instead, we argue that there is merit in using the method based on the comparison between RPI and CPI swaps: to the extent that the two types of inflation swaps are affected by inflation risk premia and liquidity risk premia in similar ways, the levels of distortion can be reduced when estimating the RPI-CPI wedge from the difference between zero-coupon RPI swaps and zero-coupon CPI swaps.

Oxera's analysis using data from Bloomberg, shown in Figure 4.1, finds that the latest six-month average spread of RPI-CPI swap is around 46bp (as of July 2022).

Figure 4.1 Weekly average of 20-year RPI-CPI spread



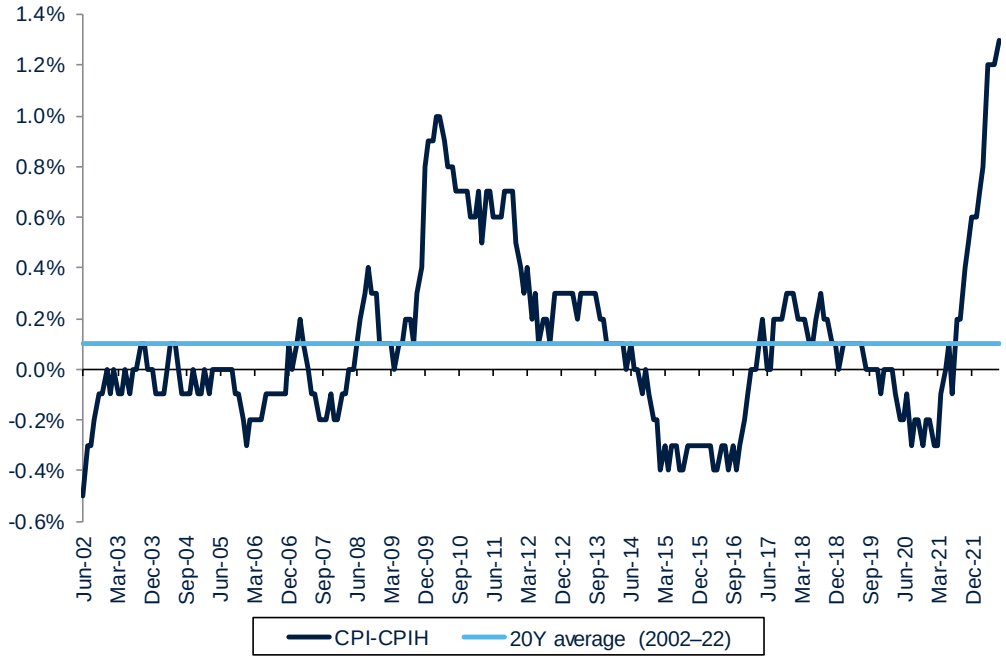
Note: Seven-day moving average.

Source: Oxera analysis using Bloomberg data.

To obtain the final estimate of the RPI-CPIH wedge, the RPI-CPI wedge set out above needs to be adjusted for a CPI-CPIH wedge. The 20-year long-run average CPI–CPIH wedge from June 2002 to June 2022 is approximately 10bp (see Figure 4.2).

[60] PR24 consultation, Appendix 11, p. 9.

Figure 4.2 Historical CPI-CPIH wedge, 2002 to 2022



Source: Oxera analysis using data from ONS.

The positive wedge between CPI and CPIH must be added to the RPI–CPI wedge implied by swap rates to obtain the RPI–CPIH wedge. This results in an RPI-CPIH wedge of **56bp** based on current market data (see Table 4.1).

Table 4.1 RPI-CPIH wedge projections over 20 years, as of July 2022

Component	Formula	bp
Six-month average of the RPI–CPI wedge implied by 20-year RPI and CPI swap rates	[A]	46
20-year average CPI–CPIH wedge	[B]	10
Estimate of the RPI–CPIH wedge for 20-year gilts	[C] = [A]+[B]	56

Source: Oxera analysis.

Table 4.2 provides a comparison of different CPIH-real estimates of the RFR based on different estimation methods for the RPI-CPIH wedge. The first estimate uses 'official forecasts', while the second uses an estimate of the RPI-CPIH wedge based on market data.

Table 4.2 CPIH-real gilt yields as of July 2022

	Formula	Ofwat's official forecasts approach	Oxera's estimate
20-year ILG yields, RPI-real, 6m average	[A]	-1.77%	-1.77%
20y RPI-CPIH Wedge	[B]	0.43%[1]	0.56%[2]
20y CPIH-real yield	[C] = (1+[A])*(1+[B])-1	-1.35%	-1.22%

Note: [1] See Appendix 1. [2] Oxera calculation in Figure 4.1.

Source: Oxera analysis of Bank of England, OBR and Bloomberg data.

5 Estimation of the real risk-free rate

In this section, we set out our latest RFR estimate using our updated methodology, based on an average of yields over the last six months.

The choice of six months as an averaging period is consistent with the CMA's decision for the PR19 appeals.[61] The CMA noted that 'a 6-month period would provide a suitable balance of ensuring the use of up-to-date data while avoiding the issues of short-term mark volatility.' As the CMA has already weighed the benefits of adopting shorter or longer averaging periods, we also adopt six months to achieve a consistent approach over time.

Our RFR estimate is the average of the CPIH-real iBoxx yields and the 20y CPIH-real ILG yields.

CPIH-real iBoxx yields are obtained by deflating the nominal yields of iBoxx £ Non-Gilt AAA indices using a CPIH inflation forecast, which is estimated by taking the breakeven RPI inflation implied by 20y nominal gilts and 20y ILGs, and subtracting the RPI-CPIH wedge of 56bp estimated by Oxera (see Table 4.1).

The RPI-real yields of ILGs are adjusted from RPI-real to CPIH-real by adding the 56bp RPI-CPIH wedge.

Table 5.1 below sets out Oxera's estimate of RFR as at July 2022.

Table 5.1 Oxera's estimate of RFR as of July 2022

	Formula	Six-month average
20y breakeven RPI inflation	[A]	3.90%
20y RPI-CPIH wedge	[B]	0.56%[1]
20y CPIH inflation	[C] = (1+[A])/(1+[B])-1	3.33%
iBoxx £ non-gilt AAA 10-15, nominal	[D]	2.49%
iBoxx £ non-gilt AAA 10+, nominal	[E]	2.27%
Average of AAA indices, CPIH-real	[F] = (1+AVG([D],[E]))/(1+[C])-1	-0.96%[2]
20y ILG, CPIH-real	[G]	-1.22%[3]
Oxera's RFR estimate	[H] = AVG([F],[G])	-1.09%

Note: [1] See Table 4.1. [2] The calculations set out in the table arrive at an estimate of -0.92%, which is an approximation. In practice, we deflate the nominal daily yields of iBoxx indices using the daily 20y CPIH inflation, which are derived based on the daily values of 20y breakeven RPI inflation. This arrives at the more precise estimate of -0.96% set out in the table. [3] See Table 4.2.

Source: Oxera analysis using data from Bloomberg and Bank of England.

[61] CMA redetermination, para. 9.208.

A1 RPI-CPI wedge estimated under the official forecasts approach

Table A1.1 sets out the RPI-CPI wedge estimated under the official forecasts approach, which amounts to **43bp** as of July 2022. The RPI and CPI inflation forecasts are based on the OBR's forecasts from 2022 to 2026, assumed to be the long-term Bank of England target from 2027 to 2029 and assumed to be 2% (the long-term CPI target) from 2030 onwards.

Table A1.1 RPI-CPIH wedge under the official forecast approach, as of July 2022

	RPI inflation	CPI inflation	RPI-CPI wedge (bp)
2022	9.8%	7.4%	240
2023	5.5%	4.0%	150
2024	2.3%	1.5%	80
2025	2.5%	1.9%	60
2026	2.7%	2.0%	70
2027	3.0%	2.0%	100
2028	3.0%	2.0%	100
2029	3.0%	2.0%	100
2030 – 2042	2.0%	2.0%	0
Geometric average			43

Source: Oxera analysis using data from Bank of England and the OBR.

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A7 Evidence on the appropriate retail margin adjustment – report by Economic Insight

EVIDENCE ON THE APPROPRIATE RETAIL MARGIN ADJUSTMENT

Legally privileged and commercially confidential | September 2023

Economic Insight

This paper for Wessex Water sets out evidence on the appropriateness of any retail margin adjustment to the appointee WACC at PR24. We find that profit margins for the household retail segment of companies' businesses have been negative across AMP7 to date. If that remains the case on a forward-looking basis, the implication is that it would be inappropriate to make a retail margin deduction from the appointee WACC at PR24.

1A. Rationale for a retail margin adjustment

Ofwat remunerates financing costs for the household retail control through a net retail margin. This is intended to provide an efficient company with a normal rate of return that is appropriate for the capital employed, and risks born, by a retailer.

A retail margin adjustment (deduction) to the appointee WACC may be appropriate to avoid double counting compensation for systematic retail risks. This is because the WACC is measured at an entity level (which includes retail). Hence, depending on the relative risk of retail (versus wholesale) activities, in principle there should be a deduction from the overall (appointee) WACC, to ensure the company is not compensated 'twice' for retail related activities.[1] In line with this, the CMA stated that "*there should be an allowed return reflecting a reasonable return on capital across the appointee businesses. If the notional retail margin of 1% for a separated retail business is different to the required allowance for a retail business as part of an integrated appointee, then this approach requires an adjustment to wholesale revenues*".[2]

Consistent with the above in principle point, at PR24 Ofwat is proposing a *deduction* of 0.06% from the appointee WACC for the retail margin adjustment, which it has calculated with reference to its proposed 1.0% net retail margin.[3]

Whilst the appropriateness of a retail margin adjustment may hold in principle, in practice this may not be the case. Specifically, if under Ofwat's PR24 determinations, it is not 'likely' that an efficient firm will generate profits in the household retail segment (i.e. will not earn the allowed net retail margin) then a retail margin

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1 *Specifically, if retail is 'riskier' than the average overall risk born at the appointee level, a 'downwards' adjustment to the appointee WACC is merited (in principle); and vice-versa.*

2 *Anglian Water Services Limited, Bristol Water plc, Northumbrian Water Limited and Yorkshire Water Services Limited price determinations Final Report – CMA (March 2021); para 9.1141*

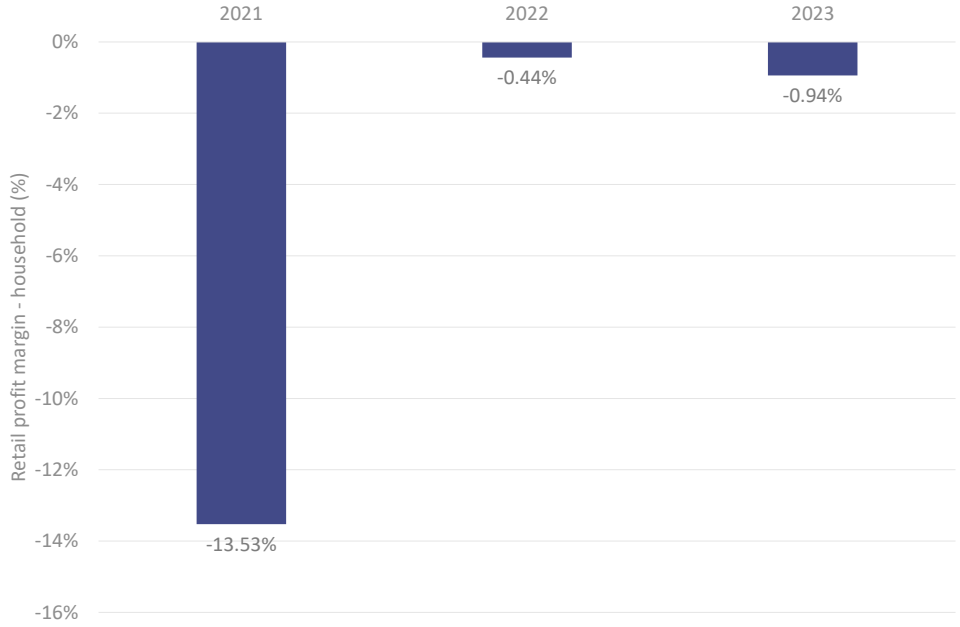
3 *Creating tomorrow, together: Our final methodology for PR24: Appendix 11 Allowed return on capital – Ofwat (December 2022); Section 5*

deduction would not be appropriate. In fact, arguably a 'negative' net margin deduction (i.e. an increase in the appointee WACC) would be needed to offset an expected loss in retail, for an efficient company.

1B. Returns in the household retail price control

In this section, we examine the evidence for whether firms have earned positive returns in the household retail price control over the course of AMP7. The figure below sets out the industry average profit margin for the household retail segment in each year of AMP7 to date. As can be seen, the industry (mean) average profit margin *has been negative in each year,* and was substantially negative in 2021. This does not suggest that companies are earning a positive return through the household retail segments of their businesses.

Figure 1: Industry average profit margin for household retail over AMP7



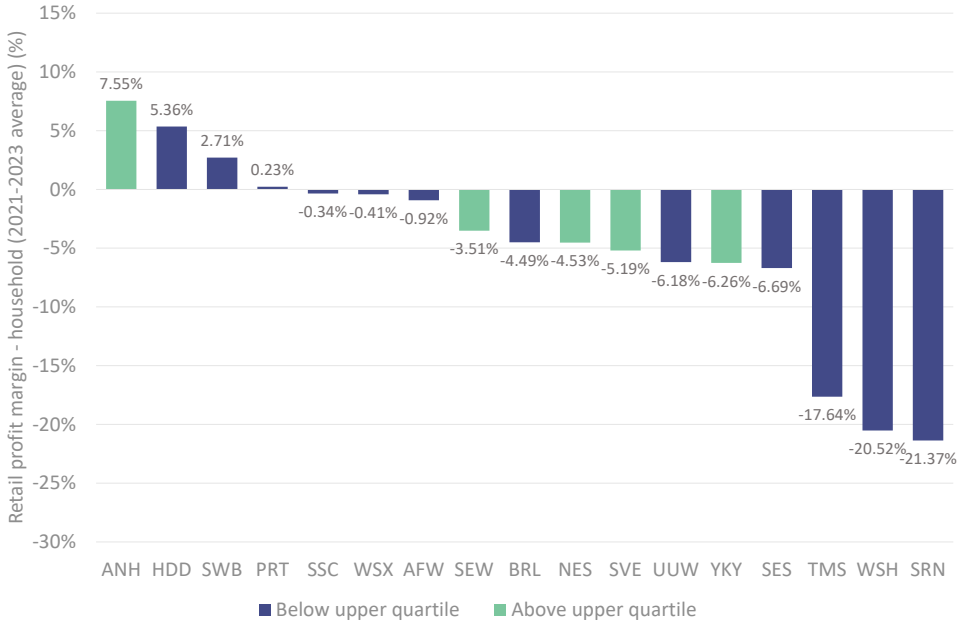
Note: For 2021, the profit margin for SES is recorded as -6,809%. We exclude this figure from the average as we consider it to be an outlier.
Source: APR data

We note that using the median average yields similar results, with margins of -14.51%; -0.13%; and 0.00% in 2021, 2022, and 2023 respectively. The use of the median ensures that the results are not unduly influenced by extreme values for only a small number of companies.

The next figure shows the average profit margin of each company for the household retail segment across the first three years of AMP7. This clearly shows that, during AMP7, the majority of companies have generated losses in their household retail businesses. The only exceptions to this are ANH, HDD, SWB, and PRT. Importantly, most companies that were found by Ofwat to be efficient (under its retail cost benchmarking models) have also been loss making over the course of AMP7. Of the companies that achieved, or exceeded, the upper quartile (on Ofwat's cost efficiency

assessment), only ANH has earned a positive profit margin on average (Ofwat's identified 'efficient firms' are denoted in green in the figure below).

Figure 2: Average profit margins for household retail over AMP7, by company



Note: We have denoted firms that performed at or above the upper quartile in Ofwat's PR19 retail modelling in green and companies that did not meet this threshold in dark blue. Again, we have omitted the 2021 figure for SES as we consider this to be an outlier.
Source: APR data

Furthermore, the median average profit margin across all companies is -4.49%; and the upper quartile is -0.34%. This indicates that the pattern of negative profit margins in retail over AMP7 is widespread across companies. In summary, the above means that the losses seen at an industry level cannot be readily explained by companies being 'inefficient' under Ofwat's own assessment. Rather, it is more consistent with the household retail price control being under-funded.

Given that the evidence from AMP7 suggests that companies have, on average, been subject to negative profit margins over the course of AMP7 to date (including efficient companies), this means that they have not earned their allowed return in household retail. Therefore, if that remains the case on a forward-looking basis, it would not be appropriate to make a retail margin deduction from the appointee WACC at PR24. In fact, in principle, a *negative* margin deduction would be required to offset the expected loss in household retail (i.e. the appropriate adjustment would be a small *increase* in the appointee WACC).

Thus, if Ofwat were to retain its existing approach to the household retail price control at PR24, a retail margin deduction from the appointee WACC is likely inappropriate (and an upwards adjustment may be needed instead). However, if Ofwat was to correct this at its determinations, and adjust its methodology such that an efficient company would likely earn an appropriate level of retail margin, then our assessment would, of course, change.