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# APPENDIX SES046

**COST OF DEBT AND  
COST OF EQUITY AND  
INFERENCE ANALYSIS  
CROSS CHECK ON  
ALLOWED RETURNS**

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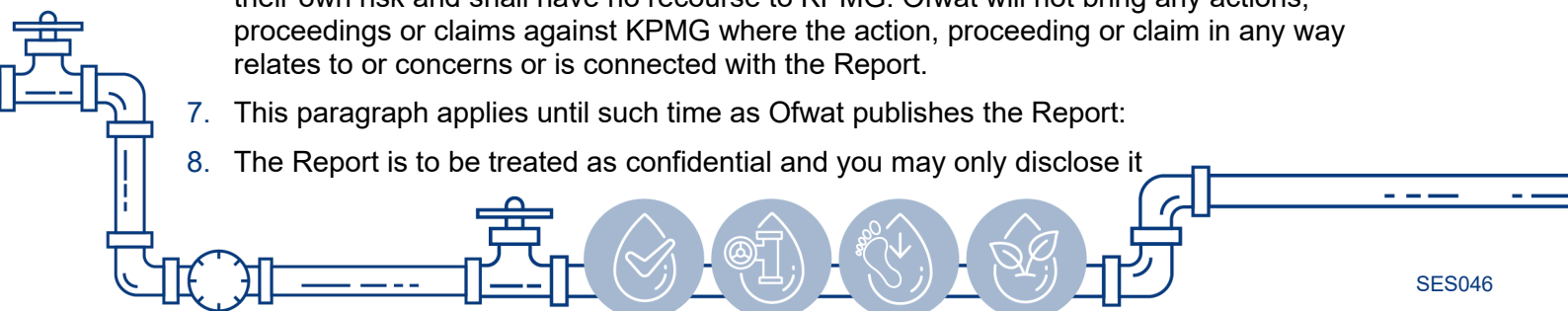
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# APPENDIX SES046 COST OF DEBT AND COST OF EQUITY AND INFERENCE ANALYSIS CROSS CHECK ON ALLOWED RETURNS

## A. Cost of Debt – Club Project Outputs

1. This statement provides important information regarding the above confidential report dated September 2023 (the “**Report**”) prepared by KPMG LLP (“**KPMG**”).
2. KPMG has agreed that we may disclose the Report to you on the basis set out in this statement. KPMG has also agreed that we may disclose the Report to the Water Services Regulation Authority (Ofwat) and that Ofwat may publish the Report on their website.
3. KPMG has further agreed that you may refer to the Report in your response to Ofwat on the Final Methodology for setting the cost of debt allowance for PR24 and that you may append such Report in full only to any submission to Ofwat.
4. We are required to inform Ofwat as follows:
  - (a) KPMG’s work was designed to meet Water UK’s agreed requirements and the engagement activities were determined by Water UK’s needs at the time. The Report should not be regarded as suitable to be used or relied on by any party other than Water UK for any purpose or in any context; and
  - (b) In consenting to the disclosure of the Report to Ofwat, KPMG does not assume any responsibility to Ofwat in respect of its work in connection with the Report. To the fullest extent permitted by law, KPMG accepts no liability in respect of any such matters to Ofwat. If Ofwat relies on the Report or any part of it, it does so at its own risk.
5. Please be advised that: The Report has been prepared by KPMG to meet specific requirements agreed by us and KPMG and the engagement was determined by our needs at the time. Accordingly:
  - (a) KPMG does not warrant or represent that any facts or matters in the Report are suitable for your purposes.
  - (b) KPMG’s work and the Report were commissioned by, and prepared for, Water UK and not in contemplation, or for the purpose, of your interests or needs. The Report may not meet your requirements or objectives and should not be regarded as suitable to be used or relied on by any party other than Water UK for any purpose or in any context.
6. KPMG does not assume any duty or responsibility to Ofwat in respect of its work for us, for the Report, or for any judgments, conclusions, opinions, findings or recommendations that KPMG may have formed or made. To the fullest extent permitted by law, KPMG accepts no liability (whether in contract or in tort or under statute or otherwise) in respect of any such matters to Ofwat. If Ofwat rely on the Report or any part of it, Ofwat do so at their own risk and shall have no recourse to KPMG. Ofwat will not bring any actions, proceedings or claims against KPMG where the action, proceeding or claim in any way relates to or concerns or is connected with the Report.
7. This paragraph applies until such time as Ofwat publishes the Report:
8. The Report is to be treated as confidential and you may only disclose it



- (a) where disclosure is required by law, regulation or court order,
  - (b) if required or requested by a competent authority with whose requirements you are legally bound to comply provided that, unless prohibited by law or regulation, you will first inform KPMG (or, if not reasonably practicable to do so, promptly thereafter),
  - (c) to your appointee(s) on the Water UK Working Group Members and
  - (d) to your professional advisers for the purposes of seeking advice in relation to the Report; provided that in the case of (d) you inform them that they receive the Report only to support or advise you and in the case of (c) and (d) you inform them that:
    - (i) the Report is to be treated as confidential and they may not disclose it without the prior written consent of Water UK and KPMG and
    - (ii) to the fullest extent permitted by law KPMG accepts no responsibility or liability to them in connection with the Report.
9. This statement confers benefits on KPMG.
10. This Statement is governed by English law and the Courts of England and Wales have exclusive jurisdiction in respect of any dispute arising out of it or in connection therewith.





# Initial commentary on the Balance Sheet Cost of Debt Model and implications for the cost of embedded debt

September 2023





## 1 Important notice

This Note been prepared by KPMG LLP ('KPMG', 'we' or 'our') for Water UK on the basis of the engagement contract between Water UK and KPMG (the "Engagement Contract"). Water UK commissioned the work to inform in its deliberations concerning the cost of debt (CoD) estimates included by the Water Services Regulation Authority (Ofwat) in the Final Methodology for the upcoming PR24 price control.

This Note is for the benefit of Water UK only. It has not been designed to be of benefit to anyone except Water UK. In preparing this Note we have not taken into account the interests, needs or circumstances of anyone apart from Water UK. We have prepared this Note for the benefit of Water UK alone.

This Note is not suitable to be relied on by any party wishing to acquire rights against KPMG (other than Water UK) for any purpose or in any context. Any party other than Water UK that obtains access to this Note or a copy and chooses to rely on this Note (or any part of it) does so at its own risk. To the fullest extent permitted by law, KPMG does not assume any responsibility or liability in respect of our work or this Note to any party other than Water UK.

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

Information in this Note is based upon publicly available information and reflects prevailing conditions as of the date of the Note, 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 Note. We have satisfied ourselves, where possible, that the information presented in this Note 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.

The findings expressed in this Note are (subject to the foregoing) those of KPMG and do not necessarily align with those of Water UK.

This engagement is not an assurance engagement conducted in accordance with any generally accepted assurance standards and consequently no assurance opinion is expressed.

This Note should not be copied, referred to or disclosed, in whole or in part, without our prior written consent, except as specifically permitted in the Engagement Contract.



## 2 Context and scope

Ofwat in the PR24 Final Methodology ('FM') has set a single allowance for the cost of embedded debt primarily based on projected actual debt costs for WaSCs and large WoCs over AMP8. This is, in principle, in line with the CMA's PR19 Final Determination ('FD'). Ofwat has published a Balance Sheet Cost of Debt Model ('Model') which outlines how it has calculated projected actual debt costs for the sector over AMP8, supplemented by commentary in the FM.

Water UK has commissioned KPMG to develop an estimate for the cost of embedded debt based on company business plans, latest market data and 2023 APRs. The analysis will be submitted to Ofwat in November.

This Note sets out initial commentary on the methodology applied in the Model and implications for the cost of embedded debt, ahead of the submission of the analysis. It covers (1) refinancing; (2) amortisation and accretion; (3) modelling of debt balances; (4) model functionality and methodological considerations; (5) inclusion criteria; and (6) initial analysis of the potential impact of updating the Model for latest market data.

## 3 Refinancing

- a) The Model does not include debt required to finance projected RCV growth between 31 March 2022 and the end of AMP7. Additional debt issuance required to finance RCV growth over the remainder of AMP7 should be captured. For context, at the sector level around £1.5bn in additional debt needs to be raised to finance RCV growth at 60% notional gearing over the remainder of AMP7<sup>1</sup>. As the cost of new debt is at present higher than the cost of embedded debt, inclusion of additional debt in AMP7 could increase the cost of embedded debt. For illustration, iBoxx A/BBB 10+ yields were 5.89% over June 2023 which compares to 2.31% over the first two years of AMP7.
- b) The Model refinances fixed and index linked debt maturing in AMP7<sup>2</sup> at Ofwat's cost of new debt assumption for AMP8<sup>3</sup>. This is based on a 1m trailing average of iBoxx A/BBB 10+ yields less a 15bps benchmark index adjustment. However, the CMA determined for AMP7 that there was insufficient evidence to apply an outperformance adjustment<sup>4</sup>. Moreover, debt issuance in the sector for the remainder of AMP7 may not in practice support application of an outperformance adjustment. Careful analysis of recent debt issuances in the sector is warranted to assess whether there is robust evidence to support an outperformance adjustment. Removing the 15bps outperformance adjustment would increase the cost of embedded debt.
- c) The Model refinances floating rate debt maturing in AMP7 at an all-in rate comprised of the floating rate benchmark as at September 2022 and the margin on the existing instrument. However, it may be more appropriate for the margin used for refinancing to reflect the latest market conditions and be applied on a sector-wide basis in line with the approach used for fixed rate and index linked debt<sup>5</sup>.
- d) The Model does not refinance fixed and index linked debt maturing on the last day of AMP7 (i.e. 31 March 2025). Refinancing debt maturing on this day at Ofwat's cost of new debt assumption has a relatively significant impact on the cost of embedded debt<sup>6</sup>.

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<sup>1</sup> Based on projected nominal RCV values as at 31 March 2022 and 31 March 2025 from the PR19 FD models

<sup>2</sup> In this Note 'debt maturing in AMP7' refers to debt maturing between 31 March 2022 and the end of AMP7

<sup>3</sup> Fixed and index linked instruments that are assigned a refinancing case of 1 in column AZ of <Mastertab> mature in AMP7 and are refinanced at Ofwat's cost of new debt assumption

<sup>4</sup> CMA (2021), PR19 FD, para. 90

<sup>5</sup> The formula in column CH of <Mastertab> refinances floating rate debt maturing in AMP7 and AMP8 at an all-in rate comprised of the floating rate benchmark as at September 2022 and the margin on the existing instrument. The floating rate benchmark used for the refinancing is the same as that for the existing instrument i.e. existing debt linked to 6m SONIA is refinanced with new debt linked to 6m SONIA. However, it may be more appropriate for all floating rate debt in the sector to be refinanced with reference to a single floating benchmark plus a single, sector-wide margin

<sup>6</sup> The formula in column AZ of <Mastertab> should assign a refinancing case of 1 to fixed and index linked instruments with years to maturity of exactly 3 years. Amending the formula in column AZ for this (while holding all else equal) increases the cost of embedded debt by 5bps from 2.34% to 2.39% in CPIH real terms



- e) Ofwat provides separate allowances for embedded debt and new debt raised over AMP8. However, the Model refinances embedded debt maturing in AMP8 with new debt and includes the cost of this new debt in the cost of embedded debt. In particular, the Model refinances embedded fixed and index linked debt maturing in AMP8 at Ofwat's cost of new debt assumption<sup>7</sup>, and floating rate debt at the all-in rate noted above. As a result, the Model partially double-counts the cost of new debt raised over AMP8 in the cost of embedded debt. Removing the double-count is likely to reduce the cost of embedded debt.
- f) Relatedly, given the scale of refinancing and the capital programme in AMP8, Ofwat will need to carefully evaluate the share and cost of new debt for AMP8.
- g) The Model excludes swaps and intercompany debt<sup>8</sup>. The Model implements this by excluding the cost of existing swaps/intercompany debt and any refinancings<sup>9</sup>. This implicitly assumes that swaps/intercompany debt will be refinanced with the same category of debt. This may not necessarily be the case in practice and consequently it may not be appropriate to exclude swap/intercompany debt refinancings as a starting point. For example, Ofgem at ED2 *"excluded intercompany loans from embedded debt costs but assumed they are refinanced at their maturity with 20-year fixed rate debt raised at the forecast benchmark rate for that year"*<sup>10</sup>. Including these swap/intercompany debt refinancings could increase the cost of embedded debt.

#### 4 Amortisation and accretion

- a) The Model adjusts principal balances as at 31 March 2022 for amortisation and accretion until the end of AMP7<sup>11</sup>. However, it does not adjust for amortisation and accretion over AMP8. As a result, interest costs projected for AMP8 may be misstated.
- b) The Model assumes that all amortising debt in the sector is amortised on a straight-line basis from issuance. In particular, the Model calculates an average annual amortisation rate from issuance to 31 March 2022, and applies the same rate to the remainder of AMP7<sup>12</sup>. However, most amortising debt has an initial period of no amortisation and is then amortised straight-line until maturity (particularly EIB debt which is widely present across the sector). As a result, the current approach to modelling amortisation risks under-statement of amortisation.
- c) The Model includes a check to assess whether amortisation is calculated accurately. Specifically, the check identifies cases of over-amortisation i.e. where the amortisation adjustment results in a negative principal balance for an instrument, the check forces a zero balance<sup>13</sup>. However the check does not identify cases of under-amortisation i.e. where an instrument in practice matures, it may have a non-zero balance in the Model due to under-amortisation. Given that the Model checks for over- but not under-amortisation, this could amplify the risk of under-amortisation.
- d) The Model assumes for index linked debt that principal balances as at 31 March 2022 are linked to March 2022 inflation index values<sup>14</sup>. However, in practice, principal balances are likely to be linked to index values from several months earlier. For example, in March 2022, an instrument may be linked to the July 2022 index value (8 month lag). Older issuances of index linked debt in the sector typically have a lag of 8-10 months whereas more recent issuances tend to have shorter lags. These lags should be taken into account in the modelling of accretion for AMP7 and (when included) AMP8.

<sup>7</sup> Fixed and index linked instruments that are assigned a refinancing case of 2 in column AZ of <Mastertab> mature in AMP8 and are refinanced at Ofwat's cost of new debt assumption

<sup>8</sup> The formula in column CM of <Mastertab> excludes swaps and intercompany debt (as well as other categories of debt)

<sup>9</sup> Includes (1) refinancing intercompany debt and balance sheet accretion on index linked swaps with new debt; and (2) replacing swaps with new debt

<sup>10</sup> Ofgem (2022), RIIO-ED2 DD – Finance Annex, para. 2.59

<sup>11</sup> Using 'Step 4 - Amortisation adjustment' and 'Step 5 - Accretion adjustment' in <Mastertab>

<sup>12</sup> The formula in column BM of <Mastertab> calculates an average annual amortisation rate from issuance to 31 March 2022. The formula in column BN then applies this same rate to the remainder of AMP7

<sup>13</sup> The formula in column BR of <Mastertab> checks for over-amortisation and the formula in column BS forces a zero balance where there is over-amortisation

<sup>14</sup> The formulas in cells F14-15 of <Inputs> imply that principal balances as at 31 March 2022 are linked to March 2022 inflation index values



- e) The Model refinances debt maturing in AMP7 at the interest rates noted above. However, for debt maturing in AMP7 that is amortising, the balance is in many cases amortised to a value close to zero at maturity in AMP7 and is not then refinanced before AMP8 i.e. the balance stays close to zero over AMP8<sup>15</sup>. In consequence, the interest rates assumed for refinancing are paired with balances which are close to zero.

## 5 Modelling of debt balances

- a) The calculation of the cost of embedded debt should incorporate interest costs and debt balances that are (1) on a consistent basis; and (2) capture all relevant adjustments such as issue discounts/premia (and wrapping fees). In relation to (1), the Model calculates interest costs using an effective interest rate approach<sup>16</sup>, but uses principal outstanding balances as the relevant debt balance<sup>17</sup> which is not consistent with an effective interest rate approach. In relation to (2), the effective interest rate approach used to calculate interest costs appropriately reflects any issue discounts/premia, but the principal outstanding balances used as the relevant debt balance do not<sup>18</sup>. These issues could result in misstatement of the cost of embedded debt.
- b) The Model seeks to directly estimate an average cost of embedded debt over AMP8, instead of modelling debt balances and interest costs on an annual basis over AMP8 and then calculating an average cost of embedded debt. The approach adopted in the Model reduces the transparency of projected costs and limits scope to sense check results.
- c) The Model effectively calculates interest costs in each financial year by multiplying interest rates with debt balances at the financial year end position<sup>19</sup>. This means that all instruments are assigned an interest cost of zero in their financial year of maturity<sup>20</sup>. This only holds where an instrument matures at the beginning of the financial year, however this is unlikely to be the case in practice and so a majority of instruments will incur interest costs in their financial year of maturity. It follows that, by disregarding each instrument's actual maturity date, the Model may be distorting the cost of embedded debt.

## 6 Model functionality and methodological considerations

- a) The Model has been populated with company data from 2022 APRs and market data from September 2022. The Model will need to be updated on an ongoing basis for the latest APR and market data. The potential impact of using market data until June 2023 is discussed in 8(a)-(c).
- b) The Model has not been set up with scenario functionality to consider the impact of different macroeconomic sensitivities. As such, the FM does not include sensitivities for inflation and interest rates. In consequence, it is not clear whether the allowance will reasonably cover company costs under a range of plausible macroeconomic conditions. This is particularly important for AMP8 since inflation and interest rates have generally been on upwards trajectory in the recent past and remain volatile. For context, iBoxx A/BBB 10+ yields increased by over 2.5x between the first two years of AMP7 (2.31%) and June 2023 (5.89%). Ofgem at ED2 stress tested its cost of debt allowance under a range of macroeconomic and totex scenarios<sup>21</sup>.
- c) The cost of embedded debt is based on the median cost of debt across WaSCs and large WoCs. To inform the selection of the averaging measure, the FM considers the distribution of the cost of

<sup>15</sup> This can be observed in columns BT-BV of <Mastertab> after filtering both column BG by 'TRUE' and column BH by '1.00'

<sup>16</sup> The formulas in columns AJ-AL of <Mastertab> calculate effective interest rates which are then used to derive the interest costs in column AP. This is only applied for fixed and index linked debt. For floating rate debt, the coupon as reported in the APR is used as the relevant interest rate. This may be reasonable as there are only a few floating rate instruments not issued at par and hence in the majority of cases, the effective interest rate is equal to the coupon (where wrapping fees are omitted)

<sup>17</sup> The formula in column F of <Company benchmarking> calculates the cost of debt as interest cost / principal outstanding

<sup>18</sup> Principal outstanding balances are based on an issue price of 100

<sup>19</sup> This is not immediately apparent from the Model because it does not model debt balances and interest costs on an annual basis as noted in 5(b). However this treatment is implied by the formula in, for example, column AP of <Mastertab> which calculates interest costs by multiplying effective interest rates with principle outstanding balances as at 31 March 22

<sup>20</sup> This is not immediately apparent from the Model because it does not have separate rows for an existing instrument and its refinancing. This can be seen from the formula in, for example, column BB of <Mastertab> which for fixed and index linked debt maturing in AMP8, calculates a weighted average interest rate for AMP8 across the existing instrument and its refinancing

<sup>21</sup> Ofgem (2022), RIIO-ED2 FD – Finance Annex, para. 2.84



debt among the sampled companies. This approach appears reasonable and will need to be re-evaluated taking into account updated market and APR data as well as the results of macroeconomic scenarios.

- d) The cost of embedded debt is calculated by assigning equal weight to (1) 'All-in' cost which is a weighted average interest rate across a company's instruments; and (2) 'Actual-notional' cost which is a weighted average of a company's interest rates for fixed rate and index linked debt<sup>22</sup>. The CMA at PR19 triangulated its allowance in part on the basis that the approaches it considered – i.e. 'All-in', 'Actual-notional' and one based on fixed and index linked debt costs only – implied consistent estimates for the cost of embedded debt. The 'All-in' approach appears to be inherently most relevant as a primary basis for calculating the cost of embedded debt as it directly reflects the costs actually incurred by the sector.

## 7 Inclusion criteria

- a) The Model currently excludes swaps, junior debt, intercompany debt and liquidity facilities<sup>23</sup>. The treatment of these categories of debt is discussed below.

### 7.1 Treatment of swaps

- a) The Model currently excludes all swaps apart from cross-currency swaps. The key rationale set out in the FM<sup>24</sup> for this treatment is considered below.
- b) The FM recognises that interest rate swaps can be used to synthetically replicate debt instruments (e.g. index linked debt), but notes that this is not the sole function for which these instruments have been used. The FM considers that other functions of interest rate swaps (e.g. risk management) are not intrinsic to debt financing and therefore including them would (1) venture beyond the regulatory objective of remunerating efficient debt interest costs; and (2) make the cost of debt allowance less relevant for the notional company.
- c) Interest rate swaps should be included because (1) risk management is inherent to any debt issuance and so swaps cannot be distinguished from 'pure debt' on this basis; (2) where swaps are used to synthetically replicate 'pure debt', they may be more efficient than direct issuance; (3) swaps are used extensively by the sector and so a notional company based on sector dynamics would be expected to use them; (4) the exclusion of swaps would imply an ex post change to treasury policies which is likely to misstate all-in costs; and (5) this position is supported by recent CMA precedent. These reasons are covered in turn below.
- d) Distinguishing between swaps and 'pure debt' as risk management tools: The FM recognises that swaps may be used for risk management. However, it considers that the benefit of swaps used for risk management accrue in the first instance to shareholders and not customers, and thus such swaps should not be included.
- e) Assuming that only swaps are used for risk management introduces an artificial distinction between these instruments and 'pure debt'. Risk management is inherent to 'pure debt' issuance as well as swaps. Issuance of 'pure debt' involves adopting a risk management position in relation to, *inter alia*, tenor, currency, debt type. Different options would imply varying degrees of exposure to interest rate, currency, inflation, and wider cost of debt performance risk in the context of prevailing and expected future market conditions and regulatory policy. Companies implement risk management policies using a combination of swaps and 'pure debt' to achieve holistic risk management objectives.

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<sup>22</sup> Weights of 67% : 33% are applied to interest rates for fixed rate debt : index linked debt respectively. This is in line with the debt mix for the notional company set out in the FM

<sup>23</sup> It also excludes debenture stock because these typically have equity-like characteristics, and preference shares because these are hybrid instruments which may be more debt or equity-like. Ofwat notes that it may potentially include preference shares at DD/FD, specifically, it will consider evidence that these instruments are more 'debt-like' on a case-by-case basis

<sup>24</sup> Ofwat (2022), PR24 FM, Appendix 11 – Allowed return on capital, p. 62



- f) Swaps can be a useful tool for facilitating management of risk exposures implied by the dynamics of the regulatory regime. For example:
- Index linked swaps can be used to manage inflation risk including the asset liability mismatch and the real nominal mismatch in cashflows (the difference between returns set on a real basis and nominal debt costs).
  - The full transition to CPIH at AMP8 and the nascent nature of the market for direct CPI/CPIH-linked issuance are both fully outside company control. To this end, basis swaps can be used to manage the risk of mismatch between CPIH-linked assets and RPI-linked debt.
- g) Exclusion of swaps from the cost of embedded debt could disincentivise companies from using these instruments to facilitate risk management. This could potentially result in a suboptimal toolkit available for risk management, which in turn could adversely impact on the cost of debt funded by customers over the long term.
- h) The use and impact of swaps for synthetic replication of 'pure debt': The FM recognises that synthetic replication of direct issuance is a valid function of swaps. However, it does not acknowledge that issuing synthetic debt has been more efficient than issuing equivalent 'pure debt' at different times in the past. For example, companies' current portfolios include index linked swaps that were entered into during times of illiquidity in the index linked bond/debt market, such as during the global financial crisis.
- i) Consistency between actual and notional company use of swaps: A cost of debt policy based on sector costs implicitly assumes that it represents a good benchmark for the efficient cost incurred by the notional company. Swaps are extensively used in the sector by companies with different financing strategies and policies and so are an integral part of the sector's financing. All else equal, this suggests that a notional company based on sector costs would be expected to use swaps. Exclusion of swaps would imply that notional company financing would not match the economic reality of financing observed across the sector.
- j) Potential impact from ex post changes to the sector's treasury policies: Exclusion of swaps from company debt portfolios would imply a retrospective change to treasury policies. This is because it implicitly assumes that if, in a counterfactual scenario, a company had not entered into swaps, it would have issued the same 'pure debt' as in the factual scenario without reconsidering its approach to 'pure debt' issuance in light of its risk management objectives. Whilst the counterfactual cannot be known with certainty, the assumption that companies would have issued 'pure debt' on an unchanged basis in combination with an exclusion of corresponding swaps is likely to misstate all-in costs for AMP8.
- k) Implications of CMA precedent: The FM considers that the analysis carried out by the CMA as part of its PR19 re-determinations which reflected companies' post-swap cost of debt does not represent a valid reason to include swaps. The FM suggests that the CMA's approach may have been out of necessity – as the only available up-to-date information source at the time was expressed on a post-swap basis – and does not indicate that the CMA would consider that these instruments warrant inclusion in sector costs where pre-swap data is available. This does not appear to be consistent with the CMA's recent position on cost of debt, which recognises that swaps may warrant inclusion in sector costs. For example:
- In addition to basing its cost of debt allowance on the post-swap position, during the PR19 re-determination the CMA commented that "*the companies may reasonably expect that if issuing straight debt plus a swap instrument were economically equivalent but more flexible than issuing index-linked debt (at any particular moment) these two approaches should be treated equivalently in any assessment of actual costs*"<sup>25</sup>.
  - In the RII0-2 FD, the CMA noted that "*in theory, it may be useful to count some derivative instruments when calculating an average actual cost of debt for a regulated sector. The most useful derivative instruments to count would seem to be those that are used to synthetically replicate debt instruments, such as index-linked debt – particularly when such approaches*

<sup>25</sup> CMA (2021), Water Redeterminations 2020, Cost of Debt – Working Paper, para. 176



are used when useful debt instruments such as index-linked debt are not readily available in the size or tenor required"<sup>26</sup>.

- l) It is possible for swaps to be used for other functions aside from synthetically replicating direct issuance and risk management. These other functions could potentially result in a distortion of embedded debt costs for AMP8 due to reprofiling of financing costs over time. It may be appropriate to exclude or make adjustments for such swaps. However, it does not appear appropriate to exclude almost all swaps as in the FM.
- m) Overall, the exclusion of all swaps could result in a material under-statement of the all-in cost of debt for an efficient notional company. An appropriate starting position for the calculation of the cost of embedded debt based on sector costs would be to include all swaps and make exclusions and adjustments where these are warranted based on the nature of specific instruments.

## 7.2 Treatment of junior debt

- a) The key rationale in the FM for excluding junior debt is (1) its low-ranking repayment priority which could result in a sub-investment grade rating; and (2) its association with companies with highly-g geared structures. The FM considers that these features make junior debt less relevant for a notionally-structured company.
- b) Junior debt may have resulted in an overall reduction in the net cost of financing. Specifically, junior debt may have supported the enhanced credit quality of senior tranches, which in turn would have lowered the yield on these senior tranches and offset the higher yield attached to junior tranches. The exclusion of junior debt could present a misleading picture of financing costs by reflecting the benefits of junior debt – i.e. in form of senior tranches issued at lower yields – whilst excluding corresponding costs. To accurately capture the all-in cost of debt, either:
  - Junior debt should be included; or
  - The impact of excluding junior debt on the rating and pricing of other structurally related but more senior instruments would need to be understood. This could be used to inform the specification of a counterfactual scenario where junior debt was not issued. It is necessary to demonstrate that costs in the counterfactual scenario would have been lower than costs in a scenario which excludes junior debt to support the assumption that junior debt can be excluded from sector costs as implied by the FM.
- c) The calculation of the cost of embedded debt based on sector costs is agnostic to companies' actual gearing levels. The exclusion of junior debt on the grounds of its association with companies with highly-g geared structures implies that different weight should be attached to instruments based on the structures of issuing companies.

## 7.3 Treatment of intercompany loans

- a) The Model provisionally excludes intercompany loans to ensure that projected sector costs do not include costs associated with shareholder loans, as these instruments could have equity-like characteristics. Ofwat has signalled its intention to undertake further engagement to understand the nature and purpose of intercompany lending.
- b) Where intercompany loans have been issued on a *pari passu* basis with an external issuance at a rating equivalent to or higher than the OpCo's, these instruments would be no different from those directly issued by the notional company and should be included in the calculation.
- c) The FM notes that the inclusion of intercompany debt has negligible impact on the cost of embedded debt based on 2022 APR data. The sensitivity of the cost of embedded debt to the inclusion of intercompany debt will need to be analysed based on 2023 APR data and under different macroeconomic scenarios.

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<sup>26</sup> CMA (2021), RII0-2 FD, Volume 3: Individual grounds, para. 14.250

#### 7.4 Treatment of liquidity facilities

- a) The Model excludes costs associated with liquidity facilities, overdrafts, and RCFs as these are accounted for in the allowance for issuance and liquidity costs. This approach is appropriate where such facilities are used entirely for day-to-day liquidity management as is the case with the majority of facilities in the sector.
- b) However, there appear to be several facilities which are at least in part used for RCV financing. The component of these facilities used for RCV financing should in principle be included in the calculation of the cost of embedded debt to accurately capture the cost of RCV financing across the sector. It follows from this that the inclusion of such facilities would need to be considered on a case-by-case basis.

### 8 Initial analysis of the potential impact of updating for latest market data

- a) At this stage the Model has been updated for market data available as at June 2023 but not 2023 APRs. No changes have been made to the calculation methodology.
- b) The Model has three categories of inputs that would require updates to reflect the latest market data: (1) refinancing assumption for fixed and index linked debt; (2) inflation assumptions used for accretion up to the end of AMP7; and (3) calculation of the floating rate adjustment. These inputs have been updated in the following manner:
  - The refinancing assumption in cell C7 of <Inputs> has been updated based on the average yield over June 2023 on iBoxx A/BBB non-financials 10+ index less a 15bps benchmark index adjustment. These rates were sourced from Refinitiv Datastream.
  - The RPI and CPI values in cells C14-E15 of <Inputs> that feed into the calculation of compound inflation used for accretion on index linked instruments until the end of AMP7 have been updated based on March 2023 forecasts from the Office of Budget Responsibility.
  - The floating rate adjustment calculation in column CG of <Mastertab> has been updated based on base rate and SONIA rates from June 2023. These rates were sourced from Refinitiv Datastream.
- c) Updating each of these inputs to reflect a cut-off of June 2023 (and continued use of APR 2022 debt inputs) results in an increase in the cost of embedded debt from 2.34% to 2.50% in CPIH real terms. This is based on assigning equal weight to 'All-in' and 'Actual-notional' costs, however the cost of embedded debt based solely on the 'All-in' cost would be 2.59% in CPIH real terms.

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## B. Cost of Equity – Club Project Outputs





Ofwat  
Centre City Tower  
7 Hill Street  
Birmingham  
B5 4UA

**SES Water**  
London Road  
Redhill, Surrey,  
RH1 1LJ  
Telephone: 01737 772000  
Facsimile: 01737 766807  
Website: [www.seswater.co.uk](http://www.seswater.co.uk)  
Email: [contactus@seswater.co.uk](mailto:contactus@seswater.co.uk)

Dear Ofwat

### **Report on the Estimating the Cost of Equity for PR24**

We attach a copy of the above confidential report dated September 2023 the (“Final Report”) prepared by KPMG LLP (“KPMG”). The Final Report was solely prepared for Wessex Water Services Limited, South East Water Limited, Thames Water Utilities Limited, Anglian Water Services Limited, Southern Water Services Limited, Affinity Water Limited, Northumbrian Water Limited, Yorkshire Water Services Limited, Sutton & East Surrey Plc and South Staffordshire Water Plc (“the Companies”).

KPMG has agreed that we may disclose the attached Final Report to you, on the basis set out in this letter, to enable you to verify that a report has been commissioned by us and issued by KPMG in connection with the estimation of required cost of equity for the PR24 business plans, and to facilitate the discharge by you of your regulatory functions subject to the remaining paragraphs of this letter to which your attention is drawn. KPMG has also agreed that you may publish the Final Report (in full only) on your website pages.

KPMG’s work was designed to meet our agreed requirements and the engagement activities were determined by our needs at the time. The Final Report should not be regarded as suitable to be used or relied on by any party other than us for any purpose or in any context.

In consenting to the disclosure of the Final Report to you, KPMG does not assume any responsibility to you in respect of its work for us or for the Final Report. To the fullest extent permitted by law, KPMG accepts no liability in respect of any such matters to you. If you rely on the Final Report or any part of any of them, you do so at your own risk.

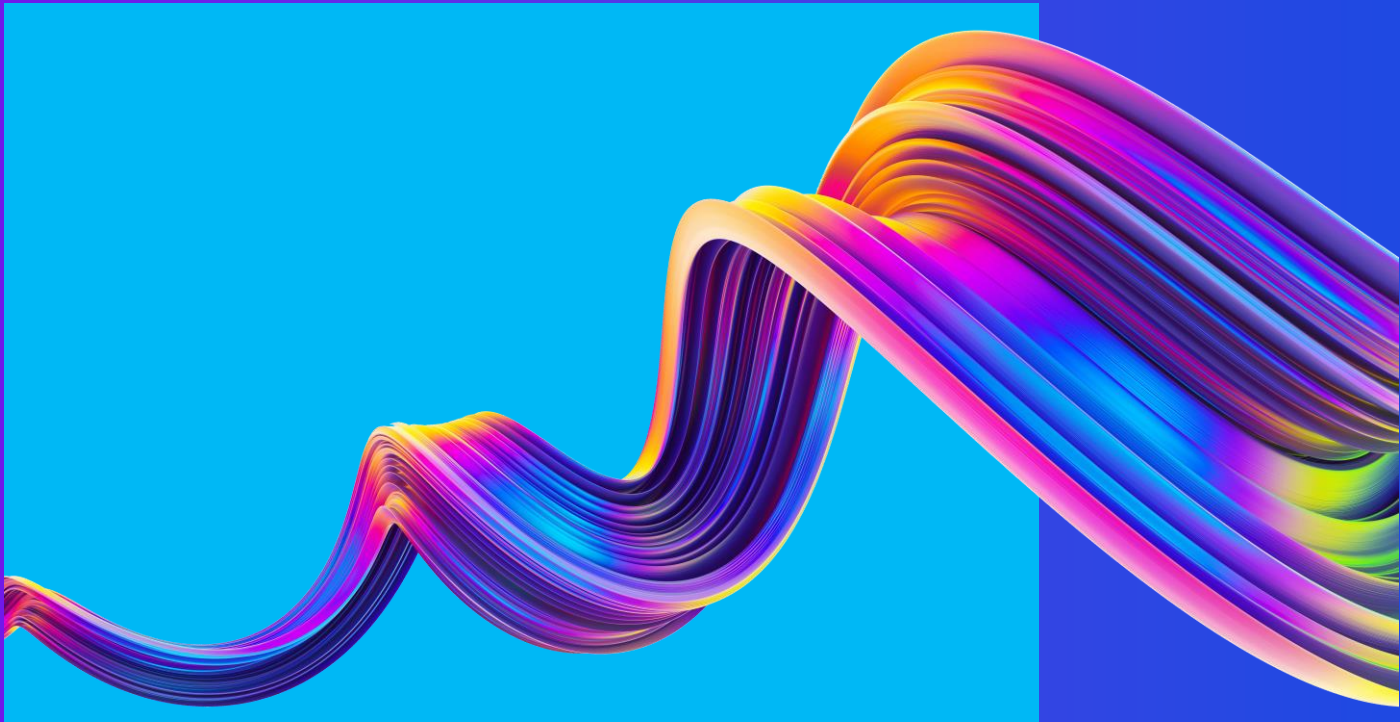
Yours faithfully

Paul Kerr  
Chief Financial Officer



# Estimating the Cost of Equity for PR24

September 2023





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# 1 Important notice

This Report has been prepared by KPMG LLP ('KPMG', 'we' or 'our') for Wessex Water Services Limited, Northumbrian Water Limited, South East Water Limited, Thames Water Utilities Limited, Anglian Water Services Limited, Southern Water Services Limited, Yorkshire Water Services Limited, Affinity Water Limited, Sutton & East Surrey Plc and South Staffordshire Water Plc ('group of companies') on the basis of an engagement contract dated 20 June 2023 between the group of companies and KPMG (the "Engagement Contract").

The group of companies commissioned this work to aid in their deliberations concerning the cost of equity (CoE) estimates included by the Water Services Regulation Authority (Ofwat) in the Final Methodology for the upcoming price control (PR24). The agreed scope of work is included in section 3.2 of this Report. The group of companies should note that our findings do not constitute recommendations as to whether or not the group of companies should proceed with any particular course of action.

This Report is for the benefit of the group of companies only. It has not been designed to be of benefit to anyone except the group of companies. In preparing this Report we have not taken into account the interests, needs or circumstances of anyone apart from the group of companies, even though we may have been aware that others might read this Report. We have prepared this Report for the benefit of the group of companies alone.

This Report is not suitable to be relied on by any party wishing to acquire rights against KPMG (other than the group of companies) for any purpose or in any context. Any party other than the group of companies that obtains access to this Report or a copy and chooses to rely on this Report (or any part of it) does so at its own risk. To the fullest extent permitted by law, KPMG does not assume any responsibility or liability in respect of our work or this Report to any party other than the group of companies.

In particular, and without limiting the general statement above, since we have prepared this Report for the benefit of the group of companies 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 other 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.

You should be aware that KPMG, including members of the engagement team, delivers other advisory services to individual companies who are within the group of companies.

KPMG has not made any decisions for the group of companies, nor for any individual company within the group of companies, on any aspect of their business plans or responses to the Final Methodology CoE estimates. KPMG has not assumed any responsibility for what the group of companies, or any individual company within the group of companies, decides, or has decided to, include in its response(s).

This engagement is not an assurance engagement conducted in accordance with any generally accepted assurance standards and consequently no assurance opinion is expressed.

This Report should not be copied, referred to or disclosed, in whole or in part, without our prior written consent, except as specifically permitted in the Engagement Contract.



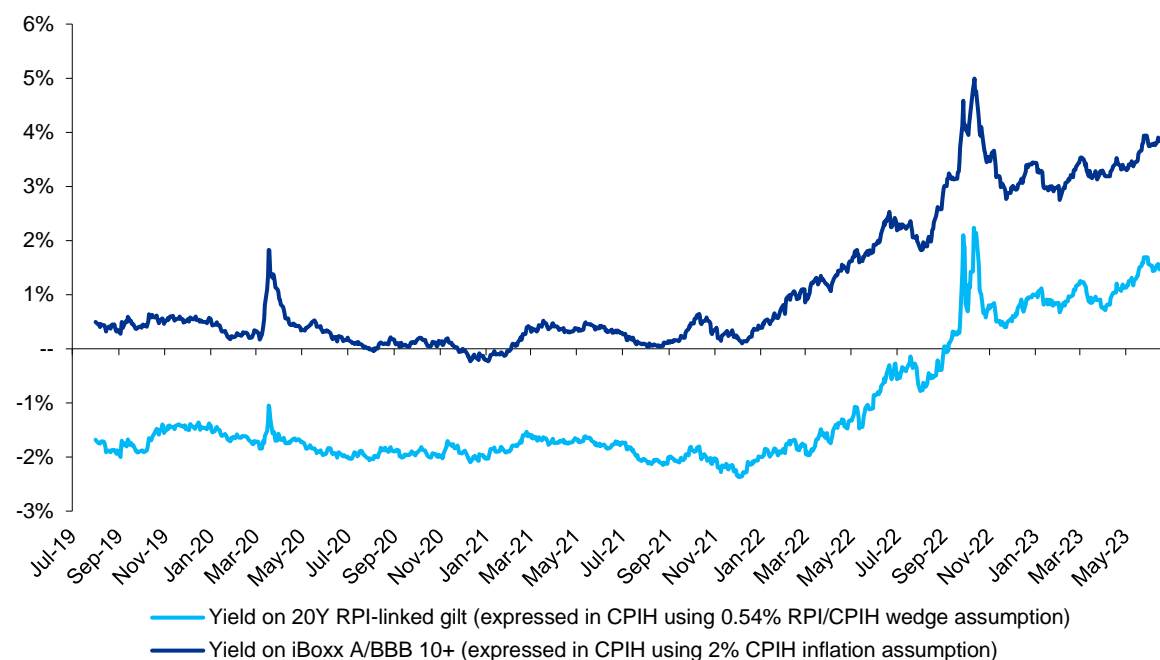
## 2 Executive summary

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

There are several factors which differentiate PR24 from previous price controls and underpin the importance of adopting a tailored approach to the estimation of evidence-based, balanced and risk-reflective CoE.

First, there has been significant shift in macroeconomic conditions which has resulted in, *inter alia*, a marked increase in interest rates. Regulatory methodologies for allowed returns that were developed during 'lower for longer' macroeconomic conditions may no longer be appropriate in the current environment.

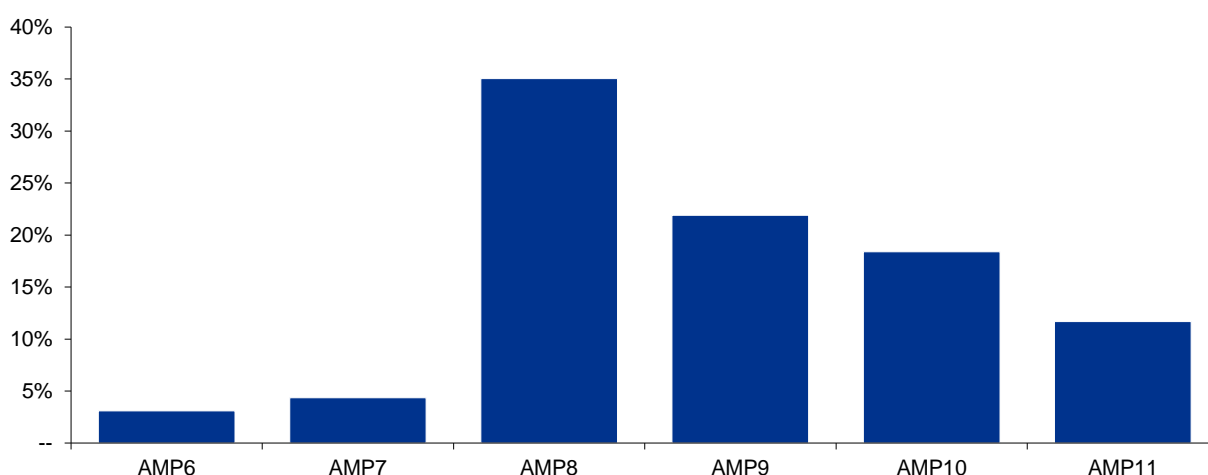
**Figure 1 Evolution of interest rates since PR19**



Source: KPMG analysis and data from Refinitiv Datastream

Second, there is an unprecedented step change in the scale of required investment, driven by environmental obligations. The figure below illustrates the potential scale of difference between investment in AMPs 6 and 7 and capital expenditure projected for AMP8 and beyond.

**Figure 2 Evolution of capital investment / opening RCV by price control (AMPs 6 – 11)**



Source: KPMG analysis

It will be necessary for the notional firm to attract significant new equity capital to fund this investment, which will be contingent on an alignment between allowed returns and forward-looking risk exposure.

Third, forward-looking risk exposure is expected to increase driven by delivery risks associated with the step change in capital intensity. The table below illustrates key drivers of changes to business and regulatory risk at PR24.

**Table 1 Changes in forward-looking risk exposure and their implications for pricing**

Risk category	Expected change relative to PR19	Key drivers of change in risk	Implications for pricing
Systematic	↑	<ul style="list-style-type: none"> <li>The scale of the capital programmes for AMP8 and beyond is likely to be the primary driver of changes in systematic risk</li> <li>The scale of capital programmes is likely to exacerbate exposure to risk factors – including <i>inter alia</i>, higher complexity of capital activity, higher uncertainty in ex ante cost forecasts, supply chain risk, input price risk, delivery risk – and increase risk exposure relative to returns</li> </ul>	<ul style="list-style-type: none"> <li>Future capital programmes differ from the business-as-usual (BAU) investment undertaken by companies in the past in terms of scale, complexity, and associated risks</li> <li>Capital programmes and associated risks faced in previous price controls are not a good guide for the forward-looking risk exposure</li> <li>As a result, beta estimates calculated from historical listed water company data are unlikely to price forward-looking risk. Additional comparators are required to derive estimates that reflect changes in systematic risk on a forward-looking basis</li> </ul>
Asymmetric	↑	<ul style="list-style-type: none"> <li>The proposed design of regulatory mechanisms, in particular the calibration of ODI targets and rates, removal of caps and collars and the introduction of PCDs, will likely represent a key determinant of asymmetric exposure</li> </ul>	<ul style="list-style-type: none"> <li>The CAPM does not inherently price asymmetric risk and so the required remuneration will need to be priced in to the selection of the CoE point estimate</li> </ul>

Source: KPMG analysis



The requirement for significant new equity capital, against the backdrop of increasing business risk and macroeconomic volatility, underscores the importance of the AMP8 CoE as a mechanism to attract and retain equity capital within the sector. Estimation of a CoE that facilitates the achievement of the policy objectives for the sector requires a balanced consideration of available evidence for each parameter and a careful selection of a point estimate.

## 2.1 Beta

Beta should be estimated such that it captures underlying systematic risk over the forward-looking investment horizon consistent with that used to estimate other CAPM parameters. For PR24 there are events that require bespoke treatment in the estimation of a beta consistent with this principle.

First, the increases in systematic risk associated with the step up in capital intensity imply that additional comparators are needed to capture forward-looking risk dynamics for PR24 and beyond. This is reflected in this Report by including National Grid (NG) in the list of comparators at the upper bound of the range as (1) regulatory frameworks across water and energy networks are relatively similar and (2) NG's historical RCV growth better reflects levels of growth expected for water going forwards.

Second, as recognised by Ofwat, the change in the regulatory regime at PR14<sup>1</sup> materially affected water sector betas, rendering earlier data less reflective of BAU fundamental risk. Given this and the superiority of longer-term beta estimates, a long-term estimation window which captures data from 2014 onwards is adopted for the estimation of beta for PR24 (both upper and lower bound of the range).

Third, there has been a material reduction in water company betas since the inception of the Covid19 pandemic and the Russia-Ukraine war. The changes appear to be a function of the 'flight to safety'<sup>2</sup> 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. These behavioural factors are temporary *by nature*<sup>3</sup> and are not driven by fundamentals. As a result, the upper bound of the beta range is adjusted to exclude the impact of Russia-Ukraine war and assume a reoccurrence of a Covid19-like pandemic once in every 20 years.

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<sup>1</sup> c. October 2014.

<sup>2</sup> On the impact of Covid19, see for example, [Interim Financial Stability Report May 2020 \(bankofengland.co.uk\)](https://www.bankofengland.co.uk/interim-financial-stability-report-may-2020) 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](#).

<sup>3</sup> 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.](#)

**Table 2 Initial unlevered beta range**

	Lower	Upper
Basis of derivation	<ul style="list-style-type: none"> <li>Based on an equally weighted portfolio of PNN<sup>4</sup>/SVT/UUW</li> <li>Daily betas based on the October 2014 – June 2023 estimation window</li> <li>Spot values used</li> </ul>	<ul style="list-style-type: none"> <li>Based on a weighted<sup>5</sup> portfolio of water companies and NG</li> <li>Daily betas based on the October 2014 – February 2020 estimation window (i.e. before the inception of the pandemic), adjusted to assume reoccurrence of a Covid19-like pandemic once every 20 years based on data from March 2020 – February 2022 (i.e. before the inception of the war)</li> <li>Spot values used</li> </ul>
Observed gearing	52.20%	49.27%
Unlevered beta	0.29	0.33

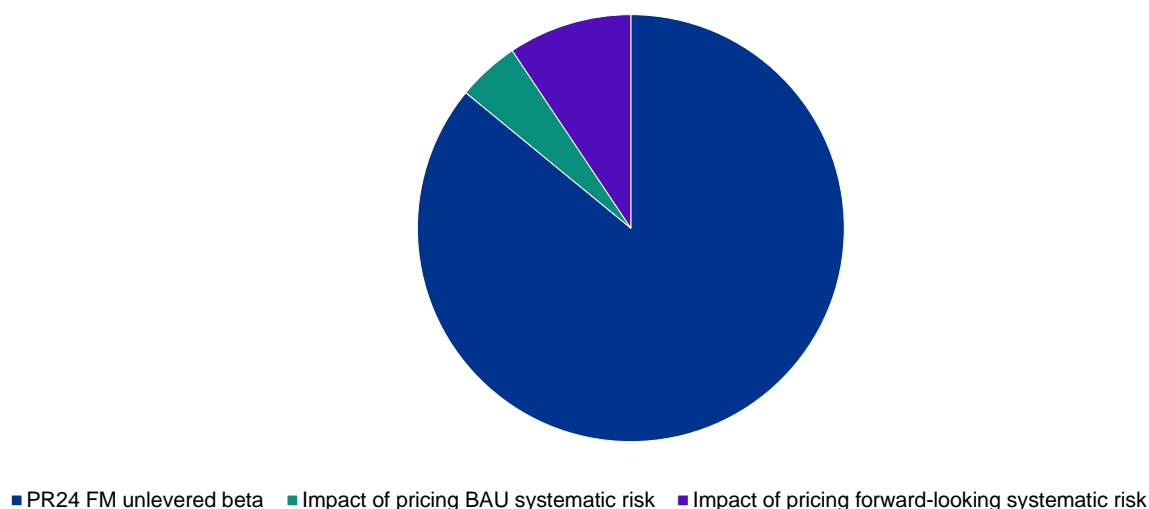
Notes: The observed gearing values have been derived on consistent basis in relation to cut off estimation windows and comparator set as the unlevered betas at the lower and upper ends of the range  
Source: KPMG analysis

The Report attenuates the overall range above to reflect the upper half of the range only – which attaches weight to NG betas – and adopts a beta range of 0.31 to 0.33 given that:

- The anticipated material increases in systematic risk, attributed to the projected unparalleled step-up in capital intensity, suggests that beta estimates based solely on historical data from the water sector might lead to a significant underestimation of future risk
- The estimate at the lower bound of the range is conservative as it attaches weight to data since 2020 which is affected by temporary distortions due to Covid19 and the war

The figure below sets out a reconciliation between the PR24 FM unlevered beta of 0.28 and the point estimate of 0.32 in this Report.

**Figure 3 Comparison of the unlevered beta estimate to PR24 FM**



Source: KPMG analysis

Estimates of the impact of the step change in capital programmes on beta and returns will need to be carefully evaluated based on final business plan submissions.

<sup>4</sup> As pure play beta information is not available for PNN for longer estimation windows, this Report incorporates PNN into the beta estimate by adjusting the SVT/UUW betas from October 2014 – June 2023 by the differential between the 2-year betas of PNN/SVT/UUW and SVT/UUW portfolios (as at June 2023).

<sup>5</sup> 67% weight assigned to SVT/UUW, adjusted to include PNN and 33% weight assigned to NG.

## 2.2 Total market return (TMR)

The TMR range in this Report is based on historical ex post and ex ante approaches. Historical ex post estimate informs the upper end of the range (6.96%) and the ex ante estimate the lower end of range (6.33%).

The mid-point of this range is 22bps higher than Ofwat's in the PR24 FM<sup>6</sup>, driven primarily by ex ante estimates<sup>7</sup>. The key methodological issues with the ex ante estimates from the PR24 FM and how they are addressed in this Report are set out in Table 3.

**Table 3 Ex ante TMR estimates**

Category	Methodological issues	Cumulative change in the ex ante point estimate relative to the FM
Use of international data	Ofwat has relied on world data in several approaches without, for example, taking into account that different legal systems of constituent countries affect return expectations. Estimates based on international data are not included in this Report.	7bps
Application of serial correlation adjustments	The application of serial correlation adjustments is inconsistent with the principles laid out in the literature upon which these methodologies are based and risk introducing distortions in the estimates or invalidating the models being used. Investors would not assume serial correlation is present in their <i>expected</i> return. Serial correlation adjustments are not included in this Report.	28bps
Assumption of dividend growth repeatability	Ofwat imputes the degree of repeatability of real dividend growth based on statements in the DMS Yearbook, the derivation and justification of which are unclear. Applying the same approach to 2023 data results in an unreasonable expectation of <i>negative</i> real dividend growth. These estimates are disregarded in this Report.	30bps
Use of flawed data sets	The Barclays Equity and Gilt study is not reliable and contains well publicised issues. A constructed data set <sup>8</sup> based on academic research has been substituted in its place for estimation of ex ante TMR using the Fama-French DGM approach in this Report.	39bps

Source: KPMG analysis

The mid-point of the ex ante TMR range post adjustment is 39bps above the FM estimate and is broadly consistent with the mid-point of the CMA's ex ante range for PR19<sup>9</sup>. This translates into an increase of 22bps in the overall estimate relative to the FM.

The KPMG range of 6.33 – 6.96% is fully encompassed within the CMA's PR19 range, as illustrated in Figure 4.

<sup>6</sup> The methodologies used for deriving the ex post estimate are different in terms of the averaging techniques used. The FM uses overlapping estimators of 10- and 20-year holding periods are used as the primary basis for estimation. This Report adopts the arithmetic average as the relevant and appropriate primary basis for estimating the ex post TMR based on corporate finance theory and empirical finding that there is not statistically significant evidence of serial correlation of returns.

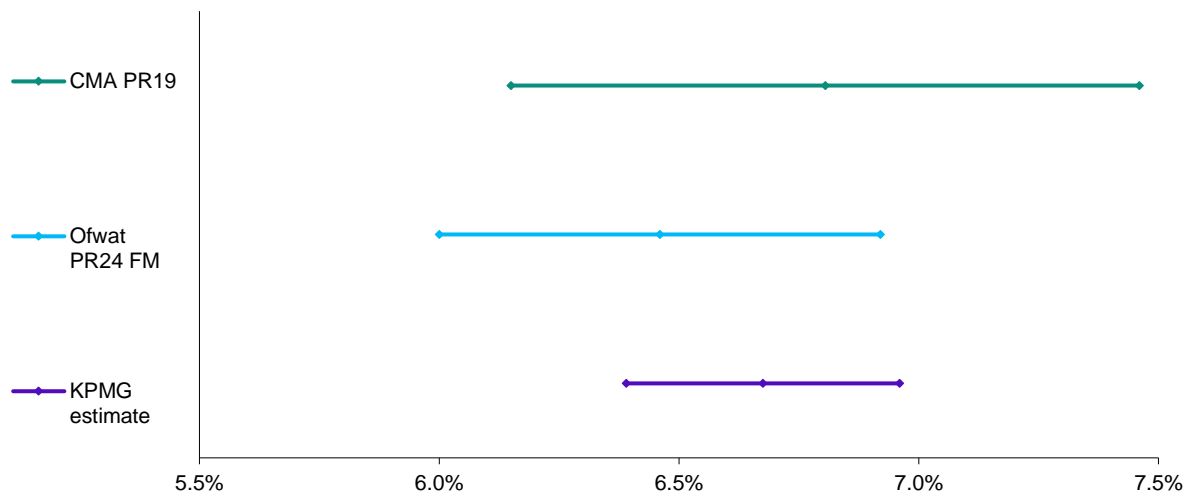
<sup>7</sup> The 6.96% ex post estimate is 4bps higher than Ofwat's in the PR24 FM. This translates to a 2bps impact on the overall mid-point (from the total 22bps difference).

<sup>8</sup> Using the following sources (1) Campbell et al up to 1929, (2) Global Financial Data from Gregory (2011) from 1930 onwards and (3) later years are updated using the FTSE All-Share Index.

<sup>9</sup> CMA (2021), PR19 Final Determination, para. 9.361. 5.2 – 5.7% RPI-real translated into CPIH using the CMA's wedge of 0.9%.



**Figure 4 The comparison of the KPMG TMR range to CMA PR19 and PR24 FM**



Source: KPMG analysis, PR24 FM and CMA PR19 FD

In UK regulation, it is generally assumed that TMR is a relatively stable parameter<sup>10</sup>, and this implies that TMR estimates developed in quick succession should be broadly consistent with one another. In line with this principle, the point estimate implied by the KPMG range is consistent with CMA's estimate at PR19, albeit slightly lower primarily due to movements in market data since the CMA's decision. By contrast Ofwat's estimate is 35bps lower than the CMA's estimate, driven by the inclusion of novel ex ante approaches.

### 2.3 Risk-free rate (RFR)

The approach adopted in the Report for RFR estimation and how this compares to the PR24 FM and the CMA PR19 FD are set out in the table below.

<sup>10</sup> See, for example, UKRN (2023), Guidance for regulators on the methodology for setting the cost of capital, p. 16 or CMA (2021), PR19 Final Determination, para. 9.387 and footnote 2473.

**Table 4 Outline of approach and key methodological issues**

Component of RFR	Outline of approach	Point estimate	Consistency of approach with:	
			PR24 FM	CMA PR19 FD
Starting point: ILG yields	<p>1m trailing average of 20Y RPI index-linked gilts (ILGs), converted into CPIH terms using Ofwat's RPI-CPIH wedge of 0.54%.</p> <p>Given that Ofwat sets a real cost of capital, it is a more direct approach to rely on real estimators of the risk-free rate like ILG yields.</p> <p>20Y tenor is in line with the investment horizon for the sector and 1m average reflects that interest rates remain volatile. If this volatility persists, companies will need to consider how to capture this in the CoE e.g. through indexation of the risk-free rate. Ofwat's RPI-CPIH wedge will need to be updated as the 2030 UKSA RPI reform draws closer.</p>	1.48% CPIH-real	Consistent with Ofwat's approach in all respects, but uses June 2023 data.	The CMA relies on 20Y ILG yields.
Lower bound adjustment to ILG yields: CY(ILG)	<p>Gilts and other government bonds provide additional benefits for investors (such as their superior collateral value vs other safe assets) which push their yield below the risk-free rate. The difference is the convenience yield (CY).</p> <p>Academic literature estimates that CY for 2Y nominal gilt (NG) is 38bps and Ofwat uses this to derive an estimate of CY(ILG) for 2Y ILG of 7bps. There are weaknesses in Ofwat's analysis which once resolved imply that CY(ILG) for 2Y ILG is 11bps and could be higher at longer tenors (based on academic literature for CY(NG) and cross-checks for CY(ILG)).</p> <p>The Report adopts a point estimate for CY(ILG) at the midpoint of 11bps and 38bps which recognises that (1) the determinants of CY referenced in academic literature apply similarly for NGs/ILGs but NGs may be more liquid; and (2) the 11bps and 38bps will be higher under current market conditions based on recent data and academic literature.</p>	24.5bps	Ofwat considers making CY adjustment but ultimately does not adjust for CY.	The CMA considers that its decision captures CY. This Report captures CY more explicitly.
Upper bound adjustment to ILG yields: AAA-ILG difference	<p>Where investors' borrowing rate is higher than their saving rate (as is the case in practice), the appropriate risk-free rate for the CAPM lies between the two rates, per Brennan (1971).</p> <p>The risk-free saving rate is the ILG yield + CY(ILG) of 24.5bps i.e. the lower bound above.</p> <p>The estimate of the risk-free borrowing rate used in this Report is the AAA corporate borrowing rate (but this is an underestimate of the true investor borrowing rate). Thus the upper bound adjustment to ILGs is the difference in yield between AAA corporate bonds and ILGs.</p> <p>The AAA-ILG difference implied by approaches based on CMA PR19 FD, CAA H7 FD and RPI AAA bonds is 41-75bps. A point estimate of 66bps is selected based on RPI AAA bonds as this is the most direct approach for deriving the AAA-ILG difference.</p>	66bps	Ofwat has not included AAA corporate bonds as an upper bound.	The CMA uses AAA corporate bonds as an upper bound and considers this is in line with Brennan (1971).
Overall estimate of RFR	<p>Brennan (1971) does not specify where in the range the appropriate risk-free rate for the CAPM should lie. The Report adopts a point estimate for the adjustment to ILG yields slightly below the midpoint of 24.5bps and 66bps (45bps).</p> <p>Combining the ILG yield of 1.48% CPIH-real with the 45bps adjustment implies an overall estimate for the risk-free rate of 1.93% CPIH-real.</p>	1.93% CPIH-real	Ofwat does not provide any adjustment to ILGs.	The CMA adopts the midpoint of its range based on ILGs and AAA corporate bonds. This Report applies ILG + CY(ILG) for the lower bound.

Source: KPMG analysis, PR24 FM and CMA PR19 FD

## 2.4 Notional gearing

The proposed reduction in notional gearing to 55% is not supported by robust market evidence or corporate finance principles.

- All companies in the sector have gearing which is higher than 55%, with average gearing significantly higher
- Assuming a lower notional gearing cannot improve the notional company's overall financial position if business risk has increased – assuming lower gearing in practice reallocates risk from debt to equity. Where there is a marked increase in business risk on a forward-looking basis, the efficient market outcome would be a higher return to price in changes in risk (as reflected in the beta estimates in this Report)
- A reduction in notional gearing also will increase the scale of equity capital which needs to be attracted to the sector to fund the step change in investment and could exacerbate equity financeability challenges

## 2.5 Retail margin adjustment (RMA)

The FM WACC includes the RMA to avoid double counting compensation for systematic retail risks. Whilst the remuneration for retail risks is provided separately using a margin approach, the appointee beta (and hence the appointee CoE) implicitly reflect retail as well as wholesale risks, potentially resulting in a double count of remuneration.

There are conceptual and methodological issues in the FM which imply that this adjustment is not warranted:

- The adjustment may imply spurious accuracy given the inherent imprecision in beta estimation
- The inclusion of creditor balances in the annual working capital requirement is not appropriate as these are offset by wholesale debtors at the consolidated appointee level<sup>11</sup>
- The utilisation of a 3.06% working capital financing rate assumption from 2018 in the RMA calculation may be inappropriate due to (1) potential divergences in the basis of derivation suggested by the degree of variation in working capital rates among different companies<sup>12</sup>, and (2) misalignment between the cut-off dates for cost of financing fixed assets (i.e. the FM WACC based on September 2022 data) and working capital financing rates

When the latter two flaws are corrected, the implied adjustment reduces to 0-1 bps and so the RMA is not applied in this Report.

## 2.6 Selection of a point estimate

A 15bps uplift – in line with the CMA's decision at PR19<sup>13</sup> – relative to the mid-point of the CoE range is deemed to represent the minimum necessary to prevent discouraging substantial investments projected for AMP8 and beyond in the context of parameter uncertainty. This is consistent with the CMA's position that the need to provide sufficient financial incentives for investment would be more acute in case of a step change in required investment<sup>14</sup>.

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<sup>11</sup> Retail creditor balances represent amounts owed to the wholesale business and are offset by an equivalent debtor balance within the wholesale business. The intra-appointee balances effectively cancel out at the consolidated appointee level. The consolidated position is the relevant one as beta is estimated at the appointee level and is de- and re-levered based on gearing which reflects appointee-level cash flows and movements in working capital.

<sup>12</sup> The financing rates range from 0.21% to 5% excluding outliers of 0% and 7% (three companies did not report a working capital financing rate).

<sup>13</sup> The CMA does not provide an explicit split of the 25bps adjustment into that related to investment incentives and to asymmetry. However, the CMA does comment that the 15bps adjustment indicated by Ofwat as "*sufficient if we were to make any adjustment to the mid-point at all*" in the context of parameter uncertainty is insufficient to address all the concerns that have informed the CMA's decision to aim up. Furthermore, the CMA's estimate of structural asymmetry was 0.1-0.2% RoRE. In this context, it is not unreasonable to assume that 15bps of the 25bps adjustment related to investment incentives and 10bps to asymmetry.

<sup>14</sup> CMA (2021), PR19 Final Determination, para. 9.1391



**Table 5 Other factors relevant for the selection of the CoE point estimate**

Input to selection of point estimate	Proposed approach
There is likely to be material asymmetry, driven by the proposed design of regulatory mechanisms set out in the PR24 FM.	As the business plan information is not yet publicly available and it is not possible to undertake company-specific notional analysis of asymmetry across the sector, this Report recommends that each company undertake this analysis based on the FM and their business plan and apply an adjustment when selecting a point estimate from the CoE range implied by the analysis in this Report.
MFM evidence indicates that the point estimate for the allowed CoE for PR24 should be 0.39 – 2.96% <sup>15</sup> higher than the mid-point of the CAPM-derived CoE range to address the structural underestimation of systematic risk for water companies in the CAPM.	Further refinement of MFM analysis and implications for returns is warranted to reflect the impact of the latest market data, ensure consistency with the beta estimation windows outlined in this Report and explicitly consider the impact of the step up in the scale and complexity of capital programmes in AMP8 and beyond.

Source: KPMG analysis

## 2.7 CoE estimate for PR24

The table below summarises the estimated range for the required CoE at PR24. This range reflects:

- An estimate of the market-based CoE based on a balanced evaluation of current market data, academic literature, and relevant regulatory precedent; and
- The uplift required to attract and retain equity capital given high levels of investment projected for AMP8 and beyond

**Table 6 KPMG estimates of the PR24 CoE**

Component (CPIH)	KPMG (June 2023 cut-off, 60%)		KPMG (June 2023 cut-off, 55%)	
	Lower bound	Upper bound	Lower bound	Upper bound
Gearing	60%		55%	
RFR	1.93%		1.93%	
TMR	6.39%	6.96%	6.39%	6.96%
Observed gearing	50.79%	49.38%	50.79%	49.38%
Unlevered beta	0.31	0.33	0.31	0.33
Debt beta	0.10	0.10	0.10	0.10
Asset beta	0.36	0.38	0.36	0.38
Equity beta	0.75	0.80	0.68	0.72
CoE before aiming up, appointee	5.28%	5.95%	4.96%	5.56%
Aiming up for estimation uncertainty	0.15%		0.15%	
CoE, appointee	5.43%	6.10%	5.11%	5.71%
RMA	0.00%		0.00%	
CoE, wholesale	5.43%	6.10%	5.11%	5.71%

Source: KPMG analysis and PR24 FM

The CoE range above is presented pre and post aiming up for parameter uncertainty. On a 60% gearing basis – i.e. reflecting the notional gearing assumption adopted in this Report – the CoE range is 5.28 – 5.95% pre aiming up for parameter uncertainty, and 5.43 – 6.10% post aiming up.

<sup>15</sup> The variance in returns implied by the two models can be viewed in the context of the extensive academic research which explored empirical shortcomings and contradictions of the CAPM, which has limited power to explain observed returns (which ultimately led to the genesis of MFMs). The q-factor model has been shown to have stronger empirical performance than CAPM based on UK data, and the variances set out in the table above should be considered in this context.

The range also does not include an adjustment to address asymmetric risk exposure at this stage as the Report recommends that this adjustment should be applied where required on a company specific basis to reflect analysis of expected loss and negative skewness based on business plan submissions. At this stage the range also does not reflect the evidence from the q-factor analysis that the CAPM materially under-prices the systematic risk exposure for water companies, pending further updates to the analysis.

The CoE estimate in this Report is presented below on a 55% notional gearing basis to enable like-for-like comparison with Ofwat's PR24 FM initial estimate. This implies a CoE range of 4.96 – 5.56% pre aiming up for parameter uncertainty and 5.11 – 5.71% post aiming up. This compares to the FM range updated for June 2023 cut-off of 3.88 – 4.87%.

**Table 7 Comparison of the KPMG estimate (55% gearing basis) to the FM and Ofwat's estimate based on June 2023 cut-off**

Component (CPIH)	Ofwat (September 2022 cut-off)		Ofwat (June 2023 cut-off)		KPMG (June 2023 cut-off, 55%)	
	Lower bound	Upper bound	Lower bound	Upper bound	Lower bound	Upper bound
Gearing	55%		55%		55%	
RFR	0.47%		1.48%		1.93%	
TMR	6.00%	6.92%	5.83%	6.95%	6.39%	6.96%
Observed gearing	55.3%	51.4%	53.68%	53.54%	50.79%	49.38%
Unlevered beta	0.26	0.29	0.25	0.28	0.31	0.33
Debt beta	0.15	0.05	0.15	0.05	0.10	0.10
Asset beta	0.34	0.32	0.33	0.31	0.36	0.38
Equity beta	0.58	0.64	0.55	0.62	0.68	0.72
CoE before aiming up, appointee	3.67%	4.60%	3.88%	4.87%	4.96%	5.56%
Aiming up for estimation uncertainty	0.00%		0.00%		0.15%	
CoE, appointee	3.67%	4.60%	3.88%	4.87%	5.11%	5.71%
RMA	0.13% <sup>16</sup>		0.13%		0.00%	
CoE, wholesale	3.54%	4.47%	3.75%	4.74%	5.11%	5.71%

Source: KPMG analysis and PR24 FM

The key drivers of difference between the KPMG CoE estimate (on a 55% gearing basis) and the PR24 FM (updated for June 2023 cut-off) are as follows:

- **Market movements since the PR24 FM:** Movements in market data between June 2023 and the September 2022 cut-off used in the PR24 FM. The impact on CoE is primarily driven by an increase in the RFR, which is partially offset by reductions in beta and TMR based on latest market data and Ofwat's methodologies
- **Risk free rate:** The difference relates to the inclusion of adjustments to reflect the convenience yield in index-linked gilts and that investors' risk-free borrowing rate is higher than their risk-free saving rate. These adjustments are not applied in the PR24 FM
- **Total Market Return:** The difference in the TMR is primarily driven by the adjustments made to the PR24 FM approach to address methodological issues in ex ante TMR estimates set out in the PR24 FM
- **Beta:** The difference relative to the FM reflects 1) the inclusion of NG as an additional comparator to price the change in forward-looking risk arising from the significant increase in capital intensity for AMP8 and beyond, (2) full exclusion of the impact of Russia-Ukraine war, and (3) reduction in

<sup>16</sup> 0.06% RMA on the WACC corresponds to 0.13% on the CoE.

the weight assigned to data affected by the Covid19 such that the resulting estimate assumes a reoccurrence of a similar pandemic once in every 20 years

- **Aiming up:** A difference of 15bps relates to aiming up. The adjustment for aiming up is required to avoid disincentivising levels of investment required for AMP8 and beyond in the context of parameter uncertainty
- **Retail margin adjustment:** The removal of the RMA reflects conceptual and methodological issues for the adjustment in the FM and results in a difference of 13bps

The CoE estimate derived in this Report is consistent with several principles implied by the CMA's determination of the allowed CoE at PR19, supporting consistency with the outcomes of previous price control whilst recognising the new challenges faced by the sector. These principles are important for investor confidence and availability of capital given the long-term financing commitments made by investors in regulated infrastructure. The majority of drivers of difference between the CoE estimate in this Report and the PR24 FM stem from the application of these principles.



# 3 Context and scope

## 3.1 Context

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

Ofwat's Final Methodology for PR24 (FM) sets out a point estimate for the allowed appointee CoE of 4.14% CPIH-real based on a September 2022 cut-off and a 55% notional gearing level. This return on equity is lower than the 4.73% determined by the CMA at PR19, implying a reduction of 21bps<sup>17</sup> on a like-for-like basis (i.e. 60% gearing).

There have been several important developments in the forward-looking risk landscape for water companies and the wider macroeconomic environment which represent important inputs into the calibration of allowed returns.

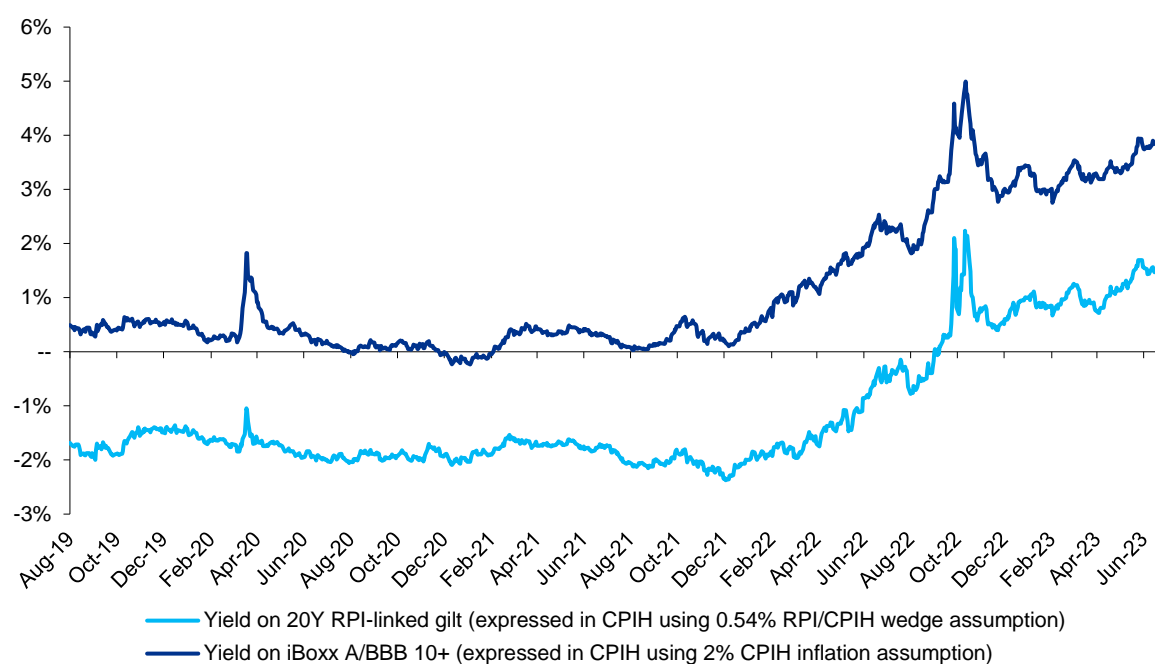
- First, there is a significant and unprecedented step up in the scale of capital programmes expected for AMP8 and beyond. Companies have a series of environmental obligations including on the use of storm overflows, transition to Net Zero, environmental targets, abstraction reduction and resilience. The scale of Water Resource Management Plans (WRMPs), Drainage and Wastewater Management Plans (DWMPs) and the additional investment required into Water Industry National Environment Programme (WINEP) all indicate that there is likely to be an unprecedented step up in the size of capital programmes for the sector. This has been recognised by Ofwat who notes that "*early indications of the potential scale of the investment programme in 2025-30 suggest that companies are expected to face substantial investment needs at PR24 and beyond*"<sup>18</sup>
- Second, there has been a significant shift in the macroeconomic landscape, marked by rising interest rates, high inflation, and heightened volatility. Regulatory methodologies for allowed returns that were developed during 'lower for longer' macroeconomic conditions may no longer be appropriate in the current environment. The figure below illustrates the step change in interest rates across the last 12 months

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<sup>17</sup> Appointee level.

<sup>18</sup> Ofwat (2022), PR24 Final Methodology, Appendix 10 – Aligning risk and return, p. 29

**Figure 5 Evolution of interest rates since PR19**



Source: KPMG analysis and data from Refinitiv Datastream

All else being equal, these factors would be expected to exert upwards pressure on allowed CoE relative to the CMA's estimate for PR19. As recognised by the CMA, regulatory CoE needs to be sufficient to provide incentives for firms to meet investment requirements<sup>19</sup>. The CMA considered that the need for sufficient financial incentives would be particularly acute “if Ofwat required a step change in investment to meet changing resilience requirements in the face of climate change challenges or other stresses on existing infrastructure”<sup>20</sup>. In this context, it is important to set an evidence-based, balanced and risk-reflective allowance for the CoE to attract and retain equity investment in the sector. This Report explores academic literature, relevant regulatory precedent and market evidence to estimate returns required to attract and retain the required equity investment in the context of a significant increase in capital programmes.

### 3.2 Scope and structure of the Report

KPMG has been engaged by a group of water companies to develop an estimate of a risk-reflective regulatory CoE for PR24 which is best supported by the evidence derived from pertinent financial literature, regulatory principles, and the most up-to-date market data.

The Report derives the CoE estimate for PR24 based on following steps:

- First, it establishes the purpose, overarching framework, and methodology employed to estimate the allowed CoE within a regulatory context (section 4)
- Second, it considers the key risk drivers for water companies in the future, considering policy trajectories, regulatory landscape changes, and conducting a relative risk assessment between PR24 and PR19 (section 7)
- Third, it develops an estimated range for each CoE parameter based on methodologies best supported by finance literature, relevant regulatory precedent, and the latest market evidence. To the extent that the Report identifies that the FM approach has been unbalanced or inconsistent with relevant and robust evidence, it includes commentary to shed light on the reasons behind these findings (sections 5, 6, 8)

<sup>19</sup> CMA (2021), PR19 Final Determination, para. 9.1236

<sup>20</sup> Ibid., para. 9.1391

- Fourth, it considers the appropriate assumptions for notional gearing (section 9) and the retail margin adjustment (section 10)
- Fifth, it sets out the framework for the selection of the point estimate of CoE (section 11) and comments on the appropriate risk-reflective point estimate for the allowed return on equity for PR24. This estimation stems from a comprehensive and balanced evaluation of evidence, drawing on finance literature, relevant precedents, and the latest market data (section 12)

### 3.3 Authors

This Report has been written in conjunction with Professor Alan Gregory, a Director in AGRF limited, and Professor Alex Edmans, who are sub-contractors of KPMG LLP.

Professor Gregory is a Professor Emeritus in Corporate Finance at the University of Exeter. His research interests are in the general area of market-based empirical research, including the empirical estimation of cost of capital and the long-run performance of company acquisitions. From September 2001 to September 2009 he was a Reporting Panel Member of the UK Competition Commission (CC) where he was involved in a number of inquiries, including the merger investigation of two potential European takeover bids for the London Stock Exchange, and the groceries or “supermarkets” market investigation.

Professor Gregory was a member of the CC’s cost of capital panel from 2009 to 2017 and continues to provide advice to the Competition and Markets Authority (CMA). In addition to more than thirty papers in peer-reviewed academic journals, he has contributed to an OECD Roundtable publication on Excessive Prices and is the author of the Financial Times book ‘Strategic Valuation of Companies’.

Professor Edmans is Professor of Finance at London Business School (LBS). Professor Edmans’ research interests are in corporate finance and behavioural finance. He is a Director of the American Finance Association and a Fellow of the Financial Management Association. From 2017-2022 he was Managing Editor of the Review of Finance, the leading academic finance journal in Europe. Professor Edmans has spoken at the World Economic Forum in Davos, testified in the UK Parliament, presented to the World Bank Board of Directors as part of the Distinguished Speaker Series, and given the TED talk What to Trust in a Post-Truth World and the TEDx talks The Pie-Growing Mindset and The Social Responsibility of Business. Alex was named Professor of the Year by Poets & Quants in 2021 and has won 25 teaching awards at Wharton and LBS.

Professor Edmans’ book, Grow the Pie: How Great Companies Deliver Both Purpose and Profit, was featured in the Financial Times Best Business Books of 2020 and won the Financial Times award for Excellence in Sustainable Finance Education. He is a co-author of the 14th edition of Principles of Corporate Finance (with Brealey, Myers, and Allen). The UK government appointed him to conduct one study on the alleged misuse of share buybacks and a second one the link between executive pay and investment.



# 4 Framework for setting the CoE

This section sets out the purpose, overarching framework and methodology for the estimation of allowed CoE at PR24.

## 4.1 The purpose of the allowed return on equity

Setting an appropriate, evidence-based, allowance for the CoE is essential to retain and attract equity capital in the sector. An appropriate allowance for the CoE is one that reflects the return that investors can earn on investments of comparable risk (i.e. reflects the opportunity cost of capital) and remunerates investors for probability-weighted losses (or gains). Only where the CoE meets this criterion can the investment be deemed financeable, i.e. be able to attract sufficient equity (and debt) capital on reasonable terms, consistent with what is priced in the allowance.

This criterion is intended to mirror the decision-making process in a competitive setting, where investors make capital investment decisions only if they expect to earn a return equivalent to or above the investment's cost of capital, where the latter is a function of the asset's cashflow risks. In a competitive market, when the expected return is below the investment's cost of capital, the investment would not occur, as capital providers would be unwilling to accept earning an expected return that is not commensurate with the level of risk or is inconsistent with what they could achieve by deploying capital in other assets with similar risk exposure.

As the CoE is a forward-looking, unobservable measure of the expected or required return on investment, regulatory determinations have to rely on a balanced, unbiased and comprehensive assessment of the body of market data and risk dynamics. This includes ensuring that CoE parameters are based on methodologies consistent with the financial literature and best regulatory practice and that the overall CoE allowance is risk-reflective.

A consistent approach over time, i.e. between price controls, is important for investor confidence given the long-term financing commitments made by investors in regulated infrastructure. For example:

- The Government has recognised that *“the predictability of the price control process is fundamental to maintaining a stable regulatory environment for investment... Additionally, a key element to encouraging investment is providing a stable and predictable environment for investors and consumers...”*<sup>21</sup>
- In Bristol Water (2015) the CMA stated *“an important part of this analysis [of the Weighted Average Cost of Capital (“WACC”)] is the application of a consistent approach to setting the assumptions which form the basis of the calculation of the cost of capital. Both debt and equity investors make long-term financing decisions, including debt financing of up to 30 years’ maturity. This reflects investors’ expectations not just in respect of the immediate regulatory period, but of a consistent approach over the longer term...the financing environment is influenced by the stable approach to the estimation of the cost of capital, applied by both sector regulators and also in previous CC/CMA decisions”*<sup>22</sup>
- Equally, in its PR19 Final Determination, the CMA reinforced the importance of consistency of methodology through time, and the need to be cautious in responding too quickly to market fluctuations: *“regulation should create a **supportive long-term investment environment**. The long-term investors in infrastructure that the companies need to attract to support a long-term low cost of capital will not be attracted if there are frequent sharp changes to the way regulator determine the cost of capital. An approach which is both **cautious in responding too quickly to market fluctuations and is consistent over time** should ultimately deliver benefits to both investors and, through a low cost of capital, to customers”*<sup>23</sup>

The regulatory allowance for CoE will be particularly significant for AMP8 and beyond in the context of the unprecedented step change in the scale of required capital investment. To attract significant new

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<sup>21</sup> Department for Energy Security and Net Zero (2022), Economic Regulation Policy Paper

<sup>22</sup> CMA (2015), Bristol Water plc, A reference under section 12(3)(a) of the Water Industry Act 1991, paras.10.6 to 10.7

<sup>23</sup> CMA (2021), PR19 Final Determination, para. 9.1388


equity, the CoE must provide returns that adequately compensate for the risks and opportunity cost of capital. Ensuring a well-calibrated CoE becomes particularly important to attract and retain the capital required to support investment. In practice, this requires a balanced consideration of available evidence for each parameter and a careful selection of a point estimate, explicitly considering whether it can facilitate the achievement of the policy objectives for the sector.

However, as set out in the table below, across multiple areas the FM differs from the methodologies applied by the CMA for its re-determination of CoE. These differences have a material impact on the CoE estimate.

**Table 8 Overview of the PR24 FM approach for CoE estimation**

Parameter	Ofwat PR24 FM approach	Consistency with CMA PR19 principles		
		Low	High	Commentary
Risk-free rate	<ul style="list-style-type: none"> <li>Estimate derived based on the yield on 20-year maturity index-linked gilts (ILGs)</li> <li>Ofwat considered that there is insufficient evidence to support adding a convenience yield (CY) to RPI-linked gilt yields</li> </ul>			<ul style="list-style-type: none"> <li>By contrast to the Ofwat approach, the CMA applied an upwards adjustment to the ILG yield for CY and differing saving and borrowing rates. The adjustment applied by the CMA was equivalent to 29bps</li> </ul>
Total market return	<ul style="list-style-type: none"> <li>Ex post estimate derived based on 10- and 20-year non-overlapping averages</li> <li>In the FM Ofwat uses four ex ante approaches to derive five estimates. Two of these were replications of the CMA PR19 approach. The other ex ante approaches were Ofwat's own, new methodologies. The ex ante range was formed based on the smallest and largest of the estimates from these five approaches</li> <li>The lower bound of Ofwat's range was based on the mid-point of the ex ante range and the upper bound on the mid-point of the ex post range</li> </ul>			<ul style="list-style-type: none"> <li>Ofwat has retained some of the approaches used by the CMA, for example, reliance on ex post and ex ante estimates</li> <li>However the overall TMR estimate is not consistent with the CMA's overarching assumption of a stable TMR<sup>24</sup>, which implies that estimates developed in quick succession should be broadly consistent with one another</li> <li>The TMR estimated by Ofwat in September 2022 is 35bps lower than the CMA's estimate from March 2021</li> <li>The difference is driven primarily by the inclusion of new ex ante approaches in the PR24 FM</li> </ul>
Unlevered beta	<ul style="list-style-type: none"> <li>Beta range derived based on Severn Trent and United Utilities data</li> <li>Spot, 1-, 2- and 5-year averages of daily, weekly, and monthly betas based on 2-, 5- and 10-year</li> </ul>			<ul style="list-style-type: none"> <li>Ofwat assigns significantly greater weight to the data affected by temporary distortions than the CMA. The CMA recognised that the macroeconomic effects of Covid were likely to be</li> </ul>

<sup>24</sup> See for example, CMA (2021), PR19 Final Determination, para. 9.387 and footnote 2473.

Parameter	Ofwat PR24 FM approach	Consistency with CMA PR19 principles		
		Low	High	Commentary
	<ul style="list-style-type: none"> <li>estimation windows considered</li> <li>No bespoke weighting adopted for structural breaks such as Covid or the Russia-Ukraine war. Ofwat considered that due caution around recent volatility should be captured by using longer estimation periods and trailing averages of beta compared to PR19</li> <li>Unlevered beta range formed based on: (1) 2- and 5-year averages of 5-year daily beta and; (2) 2- and 5-year averages of the 10-year daily beta</li> </ul>			over-weighted in the CMA's beta estimates, which covered the last 2-, 5- and 10-year periods <sup>25</sup> . Overall, the CMA's range for beta was relatively unaffected by observations from the Covid period <sup>26</sup>
Notional gearing	<ul style="list-style-type: none"> <li>A reduction in notional gearing from 60% to 55% proposed based on following considerations: (1) greater role for equity in the notional structure, (2) scale and nature of investment needs, (3) evolution of gearing for European stocks (excluding financials), (4) reduction in actual gearing due to inflation, (5) best interests of current and future customers</li> </ul>			<ul style="list-style-type: none"> <li>The CMA did not consider there was evidence to justify an alternative level of gearing<sup>27</sup> or that another level of notional gearing would better serve customers<sup>28</sup></li> </ul>

<sup>25</sup> Ibid., para. 9.493

<sup>26</sup> The CMA's final range of asset beta (0.28-0.30 on a zero debt beta basis) was fully encompassed within the range of evidence that resulted from estimates being calculated with a pre-Covid cut-off. Ibid., Tables 9-16.

<sup>27</sup> Ibid., para. 9.530

<sup>28</sup> Ibid., para. 9.44



Parameter	Ofwat PR24 FM approach	Consistency with CMA PR19 principles		
		Low	High	Commentary
Cross-checks	<ul style="list-style-type: none"> <li>Evidence from Market-Asset-Ratios applied as the sole cross-check.</li> <li>Departure from the mid-point of the CoE range when setting the point estimate not deemed necessary based on this evidence</li> </ul>			<ul style="list-style-type: none"> <li>The CMA rejected the MAR as cross-check, noting the difficulty of correctly interpreting MAR data, particularly in determining suitability of a relatively minor adjustment</li> <li>The CMA applied financeability as a cross-check on the selection of a point estimate for CoE</li> <li>The CMA considered investment incentives, asymmetric risk and financeability supported selecting a point estimate above the mid-point</li> </ul>
Retail margin adjustment	<ul style="list-style-type: none"> <li>6bps deduction applied at the overall WACC level to avoid double counting compensation for systematic retail risks given that allowed returns are set at the appointee level considering risk from all controls (including retail)</li> </ul>			<ul style="list-style-type: none"> <li>The CMA adopted the same conceptual basis for applying the retail margin adjustment</li> </ul>

Source: KPMG analysis, PR24 FM and CMA PR19 FD

## 4.2 The methodology used to estimate the CoE

The WACC and the CoE are estimated for a firm with a notional financial structure because they can be influenced by a given firm's approach to financing<sup>29</sup>. Setting the WACC based on a notional financial structure allows firms to make their own decisions regarding their actual financing structure, whilst ensuring customers fund no more than the efficient cost of capital for the notionally structured company.

The Capital Asset Pricing Model (CAPM) is the asset pricing model used most commonly in the UK and internationally for the purpose of setting regulatory allowed return. Under this framework, an 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.

The CAPM is described by the following equation:

$$CoE = RFR + \beta(TMR - RFR)$$

Where:

- RFR is the risk-free rate, which is the return from investing in a risk-free asset i.e. an asset with zero risk
- TMR is the total market return, which is the return from investing in the market portfolio
- $\beta$  is the equity beta, which 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

<sup>29</sup> For example, if a firm has high gearing, the CoE is higher.

The CAPM prices the systematic component of equity risk on the assumption that investors hold a diversified portfolio and do not require compensation for idiosyncratic (or specific) risk. The primary means of capturing equity risk, when applying the CAPM, is therefore identifying appropriate comparators to estimate beta.

The CAPM assumes that returns are normally distributed, i.e. they are clustered around the mean with a symmetric distribution. As a result, the CAPM does not inherently account for asymmetric risk which can take two forms in practice:

- *Expected loss*: This occurs when financial projections on average imply a return lower than the required return. An expected loss can be a feature of any framework with mechanisms that imply downside exposure and no or limited upside. To incentivise investment, investors must have a reasonable expectation of earning the required return, but this would not be the case where asymmetry gives rise to expected loss. The CAPM's pricing mechanism focuses on the variance around the expected mean but does not account for an expected mean return below the required return
- *Skewness*<sup>30</sup>: This occurs when the overall distribution of returns is not normal, but does not necessarily imply an expected loss<sup>31</sup>. Investors are not indifferent between positively and negatively skewed assets with the same mean and variance. Risk-averse investors typically prefer positively skewed distributions, as negatively skewed ones may include tail risks of very low returns. However, the standard CAPM model focuses only on the first and second moments (mean and variance) of returns and does not compensate for skewness

If the assumed cashflows resulting from allowed revenues are not adjusted for such downside events, the allowed CoE will be insufficient and will require adjustments to account for asymmetric risk. Additional compensation will be required to ensure these investments are considered a 'fair bet'.

To ensure the appropriate pricing of equity risk, including the accounting for asymmetric risk, consideration of the distribution of expected returns is therefore required.

In its principles for setting the cost of capital (WACC), the UK Regulators' Network (UKRN) highlights that returns should be "*risk-reflective*"<sup>32</sup> such that "*the reward will reflect the allocation of risk in the regulatory framework and sectors*"<sup>33</sup>. To derive risk-reflective returns for PR24, a robust analysis is required to assess the sector's anticipated risk dynamics, considering the evolution of various risk drivers and their implications for both systematic and asymmetric risk.

### 4.3 The relevant investment horizon

WACC varies with the assumed investment horizon. This is predominantly because the RFR observed using various market instruments and short-term betas change over time<sup>34</sup>. The specified investment horizon can represent a key determinant of the calculated CoE estimate.

It is appropriate for the investment horizon for estimating the forward-looking CoE 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<sup>35</sup>, reflecting the asset lives of the underlying infrastructure into which they are investing. This is supported by the reasonable expectation that investors will, on average, be able to recover their efficiently incurred financing costs and reflects expectations not just in respect of the immediate regulatory period, but of a consistent

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<sup>30</sup> Skewness measures the lack of symmetry in a distribution. If the distribution is negatively skewed, it means that there is a longer left tail, and extreme negative returns are more likely to occur. Conversely, if the distribution is positively skewed, it means that there is a longer right tail, and extreme positive returns are more likely.

<sup>31</sup> The presence of skewness – and in particular, negative skewness – does not necessarily imply an expected loss on average. The expected return is calculated as the weighted average of all potential outcomes, taking into account their respective probabilities. While the negatively skewed distribution may indicate a higher probability of losses and a lower probability of gains, the overall expected return could still be positive. This means that, on average, investors can still expect to make a profit from the investment, despite the negative skewness of the return distribution.

<sup>32</sup> UKRN (2016), UKRN cost of capital principles, para 1.3

<sup>33</sup> Ibid.

<sup>34</sup> In theory, the short-term total market return will also vary with time.

<sup>35</sup> CMA (2015), Bristol Water Price Determination, Final Report, para. 10.6

approach over the longer term<sup>36</sup>. In order to attract investment, a forward-looking CoE over that same long-run horizon is required. The view that a long-run investment horizon should be used when estimating the allowed CoE, does not appear to be controversial. For example:

- The UKRN CoE Study (2018)<sup>37</sup> 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 data at or close to 20-year maturities. We note this horizon is longer than the 15 years used by Ofwat*”<sup>38</sup>
- 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*”<sup>39</sup>. In the FM, Ofwat also uses 20Y index-linked Gilts to set the RFR, which all else equal, suggests an investment horizon of at least 20 years. Ofwat also considers a 25Y for investment planning through its new Long Term Delivery Strategy framework (LTDS)<sup>40</sup>

Using a short-term horizon to estimate the regulatory WACC would not be appropriate as the associated estimates would be susceptible to fluctuations and volatility in the financial markets and could lead to distortions in the WACC estimate for long-term investment planning and decision-making. Furthermore, a short-term approach may not capture the true risk and return dynamics associated with the long-term nature of these investments.

The investment horizon should be clearly specified and estimation of each parameter in the CoE should be developed consistently with this investment horizon, as far as possible, as otherwise the CoE estimate would be internally inconsistent.

The above is in line with the position adopted by the CMA<sup>41</sup> and each of the authors<sup>42</sup> of the UKRN CoE Study, where the authors stated:

*“... 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”*<sup>43</sup>.

For horizons which are appropriate for regulatory price control purposes, e.g. 15 or 20 years, isolating the impact on the allowed CoE 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 CoE 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 CoE estimate<sup>44</sup>. All else equal attaching weight to short term volatility is likely to introduce distortions in the long-run WACC.

This Report adopts an investment horizon of 20 years which aligns with, *inter alia*, the long-term financing decisions made by typical investors in regulated utilities, the asset lives of the underlying infrastructure, the horizon use by the CMA during the PR19 appeal, the tenor of ILGs used by Ofwat to estimate the RFR and, broadly, with the period considered in the LTDS.

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<sup>36</sup> Ibid.

<sup>37</sup> See, for example, recommendation 2 in the UKRN CoE Study.

<sup>38</sup> CMA (2021), PR19 Final Determination, para. 9.128

<sup>39</sup> Ofwat (2022), PR24 Final Methodology, Appendix 11 – Allowed return on capital, p. 3

<sup>40</sup> Ofwat (2022), PR24 and beyond: Final guidance on long-term delivery strategies, p. 14

<sup>41</sup> See, for example, CMA (2021), PR19 Final Determination, paras. 9.330 and 9.551.

<sup>42</sup> The phrase ‘each of the authors’ is used as they do not agree on all of their recommendations.

<sup>43</sup> UKRN CoE Study, p. 29

<sup>44</sup> It should be noted that fundamentally, the parameters using in the CoE 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.



## 4.4 Specification of the CAPM used to set allowed CoE

The standard version of CAPM used by regulators estimates the required return on an equity investment over a single period or investment horizon.

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 that beta and market risk premium remain constant over time and are not influenced by different economic states or scenarios. For example, the assumption underpinning the CAPM used to set allowed returns for a 20-year investment horizon is that beta and market risk premium would not vary across time and business cycles during this 20-year forward-looking period. This means that the model treats any variation in beta and the market risk premium as random noise or measurement error. Under the unconditional CAPM, expected returns are solely determined by the relationship between beta and the market risk premium, without considering changes in economic conditions.

This contrasts with an alternative, *conditional* CAPM which assumes betas and the market risk premium vary over time under different potential economic states of the world. The conditional CAPM considers different scenarios or states of the world and allows for time-varying risk premiums and betas. The conditional CAPM is a more complex model which requires additional analysis and assumptions to categorize different economic states and estimate time-varying betas and market risk premiums.

In the context of PR24, the specification of the CAPM used to set allowed CoE is pertinent to the estimation of beta and its relevance is explored in greater detail in section 8.

## 4.5 Market-based CoE and the allowed return on equity

In this Report, the CoE required by investors to hold a regulated water investment, based on the best estimate from market data over a specified time horizon and representing the 50th percentile, is referred to as the market-based CoE.

Having established the best estimate of the market-based CoE over the specified time horizon, there should be explicit consideration as to whether adjustments are required (1) for policy reasons and (2) to account for evidence from robust cross-checks.

The primary policy considerations are whether:

- In the presence of uncertainty about the underlying true market-based CoE (given that the true CoE can never be known but only estimated with error), regulators should select an estimate above the mid-point of the range, recognising the asymmetric risk on either side of the trade-off between enabling investment versus keeping bills low; and
- Investors face expected losses as a result of asymmetric sector-specific downside risks that should receive a level of compensation to ensure that the investment is a 'fair bet' i.e. there is a mean expectation of earning the market based CoE

The primary considerations for cross-checks are whether they are transparent, targeted, objective, incentive compatible, and consistent with regulatory precedent and academic literature<sup>45</sup>. Cross-checks that meet these criteria can, in principle, be effective in increasing the reliability and robustness of the CoE estimate derived based on the CAPM.

In this Report, the allowed return on equity is the aggregate return that takes account of the aforementioned regulatory policy considerations and is the device used by regulators when setting regulatory price controls. Under this framework, an estimation of the forward-looking market based CoE is therefore an intermediate stage when setting the allowed return on equity<sup>46</sup>.

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<sup>45</sup> KPMG (2022), Use of Market-to-asset ratios (MARs) as a cross-check in the context of regulatory price controls

<sup>46</sup> Consistent with UKRN CoE Study, p. 7

# 5 Total Market Return

This section derives the TMR range for PR24 based on latest market data and the evaluation of methodologies implied by finance theory, relevant regulatory precedent, and Ofwat's FM.

TMR is the expected return on a market portfolio that represents the investment opportunity set of a well-diversified investor considering adding the asset in question to her portfolio. The asset's return is defined in relation to the relative risk that this asset contributes to the well-diversified market portfolio. TMR is not directly observable, as it is a forward-looking estimate of investors' expectations of return for taking on equity market risk. As a result, it requires estimation.

The section is structured as follows:

- First, it sets out a summary of the methodology and the estimate adopted in the FM
- Second, it sets out the available approaches for TMR estimation and evaluates their relevance and reliability to inform the proposed methodology for PR24
- Third, it comments on the practical implementation of each proposed approach and presents the resulting estimates
- Fourth, it derives an overall TMR range based on the estimates implied by each approach

The section also comments on the approaches deployed and estimates derived by Ofwat in the FM.

## 5.1 Ofwat's approach to and estimate of TMR

The FM sets out a TMR range of 6.00 – 6.92% CPIH-real. The methodology used for deriving this range can be summarised as follows:

- TMR is estimated using historical ex post and historical ex ante approaches, with no weight placed on forward-looking evidence. Historical ex post and historical ex ante approaches are assigned equal weight
- Historical ex post TMR is estimated on a CPIH-deflated basis using the 2022 back-cast series<sup>47</sup>. Overlapping estimators of 10- and 20-year holding periods are used as the primary basis for estimation. A cross-check is applied based on an approach which calculates an arithmetic average directly from the whole-period geometric average by making an adjustment which takes into account the volatility of returns ('geometric-plus-conversion-factor approach'). The cross-check value is adjusted downwards to account for serial correlation<sup>48</sup>
- Historical ex ante TMR is estimated based on four approaches which are used to derive five estimates. Two approaches – the adapted DMS decompositional approach and the implementation of the Fama-French dividend discount model (DGM) using Barclays Equity Gilt study data – are consistent with those adopted by the CMA. The other two approaches – Ofwat decompositional approach and DMS<sup>49</sup> decompositional approach applied to UK data – utilise DMS data on World returns and assumptions about the repeatability of certain factors driving historical returns. Three of the resulting estimates also incorporate a serial correlation adjustment
- The lower bound of Ofwat's overall range is based on the mid-point of the ex ante range and the upper bound on the mid-point of the ex post range

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<sup>47</sup> Available at [ONS \(2022\), Consumer price inflation, historical estimates and recent trends, UK: 1950 to 2022](#)

<sup>48</sup> Serial correlation (or autocorrelation) refers to the degree of correlation of variables between two (or more) different observations. The presence of serial correlation would indicate variables are not random and hence would need to be adjusted to reflect the 'true' market return.

<sup>49</sup> Refers to: Dimson, Marsh, and Staunton (2023), Global Investment Returns Yearbook and associated data. This publication is referred to hereafter as 'DMS Yearbook' with associated data references as 'DMS dataset'.

## 5.2 The methodology for estimating TMR

This Report adopts historical ex post and ex ante approaches for TMR estimation as the balance of evidence suggests that these approaches are the most robust. Forward-looking approaches are not used in this Report due to reliance on and sensitivity to assumptions and volatility of the resulting estimates. The same focus on historical ex post and ex ante approaches as adopted by Ofwat in the FM and the CMA for its PR19 redetermination.

In UK regulation, three approaches to estimating TMR have generally been considered:

*Historical ex post returns:* this approach assumes that returns achieved by equity investors in the long-run past are a good proxy for forward-looking expectations of returns. An estimate of the forward-looking TMR is therefore derived by calculating average returns (dividends and share price appreciation) achieved over the very long run, being 1900 to the present day<sup>50</sup>.

It is evident that the historical ex post returns are a proxy for future expected returns because the achieved returns can be split into an expected return and unexpected return using the following equation:

$$\text{Realised return} = \text{Expected return} \pm \text{“surprise”}$$

The rationale for assuming that historical ex post returns are a good proxy for a forward-looking TMR is that over the long run, the surprises cancel out, such that the realised return is equivalent to the expected return.

*Historical ex ante returns:* this approach utilises long-run historical data to estimate forward-looking expectations, aiming to distinguish genuine investor ex ante expectations from good or bad luck (the “surprise” component of the above equation). Regulators generally deploy two methods for estimation of ex ante TMR: dividend discount models<sup>51</sup> and decomposition<sup>52</sup> approaches. These methods are broadly similar in that they aim to make appropriate adjustments when certain elements of returns are considered non-repeatable.

*Forward-looking approaches:* these approaches typically employ two methods:

- *Dividend discount models:* this method estimates TMR based on the implied return from current share prices and dividend forecasts. The approach assumes that investors in listed firms value the shares based on discounting future cashflows, in the form of dividends, to their present value. The approach then ‘solves’ for the discount rate which equates the future expected cashflows to equity holders, in net present value terms, to the current market value of equity. The discount rate adopted across the market portfolio is the expected return for holding equities, or the TMR
- *Survey models:* this method examines the results of surveys of investors, academics, and other market participants. This approach is likely to give the broadest estimates, and as a result has typically been treated with a higher degree of caution

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<sup>50</sup> The start date of 1900 is chosen simply for convenience, as it is the longest run of data that is comprehensively available across markets.

<sup>51</sup> For example, Fama and French use a dividend growth model to break-down historic returns into an underlying expected return, equal to the average dividend yield plus the average dividend growth rate, and an unexpected return, (comprising capital gain in excess of the rate of dividend growth). Fama, E. and French, K. (2002), ‘The Equity Premium’.

<sup>52</sup> Dimson, Marsh, and Staunton seek to infer the TMR by breaking down the historical equity premium into elements that correspond to investor expectations and elements of non-repeatable good or bad luck. These elements are the mean dividend yield, the growth rate of real dividends, the expansion of the price/dividend ratio, and change in real exchange rate.

## 5.2.1 Recent precedent on the selection of TMR approaches

The most relevant recent precedent on the selection of approaches for TMR estimation is the CMA's re-determination of the PR19 price control which reflects the CMA's conclusions on the most robust approaches. The CAA's H7 Final Decision (Heathrow Airport)<sup>53</sup> endorsed the CMA's PR19 methodology, which favoured the historical ex post and historical ex ante approaches:

- The CMA "*continue[d] to believe that it is appropriate to place most weight on the historic TMR estimates, which should be right on average over longer time periods even if they may be too high/low at particular points in time*"<sup>54</sup>
- The CMA noted that historical ex ante approaches could provide a useful cross-check<sup>55</sup>. Equally, the CMA did not place weight on forward-looking approaches in the derivation of the TMR range. This was driven by reservations about the 'robustness of the forward-looking evidence'<sup>56</sup> and the high year-on-year volatility implied by these estimates<sup>57</sup>, which is contrary to the standard regulatory assumption that TMR should be relatively constant and long-run stable over time

This is broadly in line with previous CMA (or CC) cases. For example, the CC in the NIE<sup>58</sup> case used historical approaches (both ex ante and ex post) as the primary basis for estimating TMR.

The CMA's PR19 approach is consistent with the approach proposed by the UKRN CoE Study which considers that the expected market return should be based on long-run historical averages (i.e. the historical ex post approach).

In contrast, Ofgem's TMR methodology for RIIO2 calculated an estimate based on long-run historical returns (i.e. the historical ex post approach), but also considered estimates from forward-looking models and forecasts before arriving at its final estimate of the range and point estimate for TMR. Ofgem appears to have placed more weight on survey based forward-looking TMR estimates, as the dividend growth model ("DGM") developed by CEPA does not feature in RIIO2 documents post May 2019.

The weight placed by Ofgem on forward-looking evidence is not fully clear:

- For GD&T2, Ofgem used this evidence to narrow the ex post TMR range<sup>59</sup> without affecting the point estimate
- For ED2, Ofgem referenced low survey based TMR estimates as a rationale not to increase its TMR estimate, despite new CPIH backcast implying higher ex post values than Ofgem's original estimate based on CPI<sup>60</sup>

The CMA considered Ofgem's GD&T2 FD approach to TMR estimation and did not find it to be 'wrong'. However, this should not be interpreted as an endorsement of Ofgem's approach as in its re-determination at PR19 the CMA did not find forward-looking evidence sufficiently robust to incorporate directly in the TMR range.

## 5.2.2 Selection of approaches for TMR estimation for PR24

This Report considers that historical ex post and ex ante approaches are the most appropriate to utilise for TMR estimation for PR24. Whilst historical ex post returns provide the most reliable method for estimating TMR, historical ex ante estimates can provide a useful cross-check on the ex post figures to ensure the range is appropriately calibrated, consistent with the view adopted by the CMA and UKRN. Ofwat relied on these two approaches to estimate the TMR in the FM.

Forward-looking approaches are not used in this Report due to reliance and sensitivity to assumptions and volatility of resulting estimates. TMR estimates generated by DGM can vary as much as 1:1 with

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<sup>53</sup> At the time of writing, the CAA's H7 final decision is subject to an appeal to the CMA by Heathrow and a number of airlines (though not on any grounds which specifically relate to the total market return).

<sup>54</sup> CMA (2021), PR19 Final Determination, para. 9.390

<sup>55</sup> *Ibid.*, para. 9.394

<sup>56</sup> *Ibid.*, para. 9.394

<sup>57</sup> *Ibid.*, para. 9.379

<sup>58</sup> CMA (2017), SONI Limited v Northern Ireland Authority for Utility Regulation Final Determination

<sup>59</sup> Ofgem (2019), RIIO-2 Sector Specific Methodology Decision - Finance, paras. 3.47-3.49

<sup>60</sup> Ofgem (2022), RIIO-ED2 Final Determinations Finance Annex, para. 3.44



changes in dividend growth assumptions<sup>61</sup>, and as the UKRN CoE Study notes<sup>62</sup> during the financial crisis the Bank of England Dividend Discount Model implied an ERP of 12% and a real TMR in excess of that, since the real RFR was positive at the time. Survey approaches are recognised to be informed by the particular risk assessment of the fund manager and typically produce wide ranges of estimates<sup>63</sup>, as estimates might be stated on different/non-comparable bases. Importantly, different fund managers have understandably different views on market returns. These estimates can also be volatile – as noted by the CMA the TMR estimated based on an established survey varied by as much as 1.4% over one year<sup>64</sup>.

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<sup>61</sup> Since the TMR is derived from the constant growth dividend discount model, which at the market level implies Market Capitalisation =  $(\text{Market Dividends} \times (1+g)) / (\text{TMR} - g)$ . Some versions of the model use specific forecasts for N years ahead, meaning that the model is highly sensitive to short-run and long-run growth estimates.

<sup>62</sup> UKRN CoE Study, p. 46-47

<sup>63</sup> CMA (2021), PR19 Final Determination, para. 9.377

<sup>64</sup> Ibid., para. 9.389

## 5.3 Estimation of TMR using the historical ex post approach

The derivation of real ex post TMR is based on historical returns data and requires the application of adjustments for deflation and averaging.

### Approach to deflating observed nominal returns

In 2022, the ONS published a new modelled CPIH series for the period 1950-1989. In combination with other data sources, this series can be used to construct a synthetic CPIH index. Given that (1) the new series addresses some of the weaknesses in the previously available CPI series and (2) CPIH is the indexation measure used PR24, this Report uses a synthetic CPIH series for deflation.

### Approach to averaging

The selection of appropriate averaging technique(s) is a two-step process as follows: (1) an assessment of whether there is robust evidence of serial correlation of returns and (2) a consideration of the perspectives<sup>65</sup> of both investors (the provider of capital) and capital budgeters (the users of capital). The latter is relevant as, in the context of expectation error<sup>66</sup> and uncertainty affecting TMR estimation, an investor and capital budgeter will apply inverse adjustments to estimate the 'true' expected market return. As a result, TMR estimates will differ depending on whether one or both perspectives are deemed to be relevant.

If returns are serially uncorrelated, then the arithmetic average represents the correct measure of long run forecast of expected returns. The empirical analysis undertaken in this Report indicates that there is no statistically significant evidence of serial correlation and hence there is no rationale for departing from the arithmetic average in the estimation of TMR. By contrast, the FM assumes that there is serial correlation present in the data.

Both investor and capital budgeter perspectives are relevant to the estimation of TMR. This is because the regulatory WACC serves a dual purpose: it facilitates investors in calculating the expected future value of their investments in regulated companies, and it assists regulated companies in determining present values for capital budgeting decisions. Given that both perspectives are relevant – as recognised by the CMA at PR19 – the correct approach is to provide a 'neutral' estimator of market return in the form of the long-run arithmetic average.

Assuming a neutral TMR rate in practice means not adopting a specific holding period to derive an unbiased and unadjusted rate for any investment timeframe. As a result, divergence from the arithmetic average to reflect a specific holding period is not required.

The use of an arithmetic average based on annual data is considered most robust due to its alignment with market practice (from corporates and investors) and neutrality in terms of holding periods and reinvestment assumptions.

The Report adopts the arithmetic average as the relevant and appropriate primary basis for estimating the ex post TMR for PR24. This implies a historical ex post TMR of 6.96%. This estimate is broadly consistent with the mid-point of the FM range based on the historical ex post approach of 6.92%.

Two adjustments are required to historical returns data to derive the real TMR used in the calculation of allowed CoE in a regulatory setting:

- *Deflating observed nominal returns*: For regulatory price controls the CoE needs to be estimated in real terms<sup>67</sup>. However, historical ex post returns are observed in nominal terms, and therefore need to be deflated using an inflation index over the same historical period to derive a real TMR
- *Averaging*: The historical returns are calculated annually and require the application of an averaging technique to derive a single value from annual returns of multiple periods. Whilst there

<sup>65</sup> In this context, 'perspectives' refers to the way investors and capital budgeters would use the TMR, i.e. an investor would use the TMR to calculate the future value of their expected return, whereas a capital budgeter would instead be calculating the present value of the capital available to them.

<sup>66</sup> Expectation error refers to the difference between the actual return achieved and the expected return predicted or estimated for a particular investment or asset.

<sup>67</sup> As the RCV is indexed to inflation, so a real return is applied to the inflated RCV, to avoid double counting the allowance for inflation.

are a range of averaging approaches available for the derivation of TMR<sup>68</sup>, at the headline level the choice is between geometric and arithmetic averages. The arithmetic average is a simple average of the annual returns<sup>69</sup>, whereas the geometric average<sup>70</sup> is the annualised compound rate of return achieved over the entire period of the dataset (123 years<sup>71</sup>)

These issues are considered in turn in the following sections.

### 5.3.1 Deflating observed nominal returns

The source for historical TMR data is the Dimson, Marsh, and Staunton Global Investment Returns Yearbook<sup>72</sup> (DMS Yearbook). DMS is widely accepted as the most reliable source of UK and international stock market data. Updated versions of DMS are published annually.

The DMS publication expresses historical returns in nominal and real terms. In principle it could be appropriate to rely directly on the real returns included in the publication if these were derived using the relevant index and on a consistent basis, however, this does not appear to be the case.

For PR24 both revenues and RCV will be fully indexed to CPIH, as a result CPIH is the relevant measure for deflating observed nominal returns. There is ONS-published actual CPIH data available from 1989 onwards and additional data for the earlier periods which can be used to construct a synthetic CPIH index for the full historical period. Given that DMS 2023 does not appear to use a CPIH index and given that previous iterations of the dataset used inconsistent inflation series<sup>73</sup>, it is appropriate to source nominal returns from DMS and convert them to real values.

In 2022, the ONS published a new modelled CPIH series for the period 1950-1989. In combination with other data sources, this series can be used to construct a synthetic CPIH index as set out in the following table.

**Table 9 Data sources for historical CPIH series**

Period	Source
1899 – 1949	BoE CPI millennium data set. There is no equivalent series available for CPIH so the wedge between CPI and CPIH is assumed to be zero for this period. Each observation period is taken to be June to June.  There are two series available from this dataset: the original and the preferred. The original series is considered more appropriate given it is based on spending by all private and institutional households, whereas the preferred series focuses on working class households only <sup>74</sup> .
1950 – 1988	ONS modelled ('backcast') data <sup>75</sup>
1989 onwards	Published, actual data for CPIH <sup>76</sup>

Source: KPMG analysis

There is no direct precedent on the use of a synthetic CPIH series for the estimation of TMR given that (1) only the most recent price controls (in some sectors) have used CPIH for indexation and (2) until the publication of the modelled CPIH series, it was not possible to construct such an index.

The use of modelled CPI series was considered in detail during both PR19 and GD&T2 appeals. At PR19 the CMA concluded that it would be appropriate to use the CPI series in combination with RPI

<sup>68</sup> An explanation of each is provided in Appendix 1: Averaging approaches applied to historical TMR.

<sup>69</sup>  $Arithmetic\ mean = \frac{1}{n} \sum_{i=1}^n a_n = (a_1 + a_2 + \dots + a_n)/n$

<sup>70</sup>  $Geometric\ average = \sqrt[n]{(a_1 a_2 \dots a_n)}$

<sup>71</sup> Based on DMS 2023 dataset.

<sup>72</sup> This report utilises the 2023 dataset.

<sup>73</sup> During the PR19 appeal, it was argued that DMS did not use a consistent inflation series. DMS publications dated after 2016, used a combination of CPI from 1988, an ONS back-cast estimate of CPI from 1949 to 1987, and before that the cost-of-living index, referred to as the COLI. This meant that the real DMS numbers available at the time of the appeal could have been distorted.

<sup>74</sup> The series are identical apart from 1900-1914 where the preferred series uses estimates by Feinstein (1991). According to Feinstein, the objective of the estimates of the cost-of-living index was to "investigate one crucial aspect of these trends in living standards from 1870 to the First World War: the changes in the price of goods and services purchased by working-class households".

<sup>75</sup> Available at [ONS \(2022\), Consumer price inflation, historical estimates and recent trends, UK: 1950 to 2022](#)

<sup>76</sup> Available at [ONS \(2022\), CPIH Annual Rate 00: All Items 2015=100](#)

data given that both series had relevant strengths and weaknesses<sup>77</sup>. Some of the known weaknesses in the modelled CPI series existing at the time of the appeal have been addressed during development of the new CPIH series. For example, the new series improves upon the previous data by using more accurate divisional modelling by sub-sector<sup>78</sup> and an all-items headline rate which now correctly uses weights which sum to one.

Based on the above, this Report utilises the synthetic CPIH series for the calculation of the real TMR. Ofwat has used the same sources in its calculation, however its approach adopts the BoE millennium data – which reflects year-on-year movements observed in June – ‘as is’ and combines this with year-averages<sup>79</sup> from the subsequent data. This creates a degree of internal inconsistency as well as inconsistency with the returns data which is based on observations from December.

To ensure that the inflation series is (1) internally consistent throughout the whole period and (2) consistent with the returns data, it is appropriate to (1) rebase the BoE data to December year-end and (2) use the December increases from 1950 onwards.

The correction of these factors does not materially change the index values and hence does not create material discrepancies in the calculated real returns. However, adoption of these changes ensures consistency of data and increases the robustness of the results.

### 5.3.2 Averaging

There are several averaging techniques available for the derivation of the TMR estimate. The selection of appropriate averaging technique(s) is a two-step process which includes (1) an assessment of whether there is robust evidence of serial correlation of returns and (2) a consideration of the perspectives<sup>80</sup> of both investors (the provider of capital) and capital budgeters (the users of capital, or the company). The assessment of serial correlation should be undertaken first as the findings from this step would affect the choice of averaging techniques irrespective of the consideration of different perspectives.

If returns are serially uncorrelated, then the arithmetic average represents the best estimate of expected returns in any randomly selected year and the correct measure of long run forecast of expected returns. However, when serial correlation is present, the arithmetic average would no longer be suitable as a long-run forecast. To take an extreme example, suppose that returns were entirely deterministic, such that one good year was always followed by a bad year. Under such circumstances the long-run geometric average would provide a more accurate indication of expected returns, as it accounts for the compounding effects of serially correlated returns over time.

It is not implicit that serial correlation is present in long-run datasets, and it must be statistically established whether serial correlation is present. It is therefore crucial to undertake robust statistical analysis to evaluate whether serial correlation is present in the returns data being used to estimate the TMR.

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<sup>77</sup> CMA (2021), PR19 Final Determination, para. 9.304

<sup>78</sup> Known as ‘Classification of Individual Consumption according to Purpose’ (COICOP).

<sup>79</sup> i.e. reflecting the average increase from one year to the next.

<sup>80</sup> In this context, ‘perspectives’ refers to the way investors and capital budgeters would use the TMR, i.e. an investor would use the TMR to calculate the future value of their expected return, whereas a capital budgeter would instead be calculating the present value of the capital available to them.



It is relatedly important to consider the relevant perspective for TMR estimation given that an investor and capital budgeter will apply inverse adjustments to the calculated rate to account for expectation error<sup>81</sup> and uncertainty. While both perspectives use the TMR for the same fundamental purpose, an investor would use it to calculate the *future value* of their expected return, whereas a capital budgeter would instead be calculating the *present value* of the capital available to them<sup>82</sup>. Different averaging techniques are designed to adjust the arithmetic and geometric averages to cater to these different perspectives<sup>83</sup>. In consequence, TMR estimates will differ depending on whether one or both of these perspectives are deemed to be relevant.

### Recent precedent on averaging

At PR19, the CMA considered that the theoretically correct measure of return to use in deriving the cost of capital is the arithmetic mean, however, where returns are serially correlated and investors have a holding period of more than a year, the arithmetic mean return for a single year would be an upwards-biased estimator of returns<sup>84</sup>. The CMA concluded that there was evidence of serial correlation based on the difference between the highest and lowest overlapping and non-overlapping estimates<sup>85</sup> calculated under the historical ex post approach. As a result, the CMA based its estimate on arithmetic returns over longer, 10- and 20-y holding periods. The same approach was adopted by the CAA for Heathrow's H7 price control.

The approach adopted by Ofwat in the PR24 FM is similar to the CMA's but excludes non-overlapping averages due to small number of datapoints and the volatility of the estimators. The CMA also recognised the small number of observations available for non-overlapping estimators and their sensitivity to outliers, however considered that "*it is more appropriate to take into account all of the above estimates, i.e. both 10- and 20-year overlapping and non-overlapping estimates, in coming to a view on the range of reasonable TMR estimates, rather than to exclude some of these estimates as to do so may risk 'cherry-picking' data*"<sup>86</sup>.

The CMA also considered and rejected the approach which calculates an arithmetic average directly from the whole-period geometric average by making an adjustment which takes into account the volatility of returns ('geometric-plus-conversion-factor approach'). The CMA considered the variance of log real returns in the UK from the DMS data set over holding periods from 1 year to 15 years. The estimates across different holding periods varied significantly plus estimates had been calculated using a standard variance formula which does not consider the fact that the overlapping observations are not independent of one another. Based on this and the general "*controversy*"<sup>87</sup> of these uplifts, the CMA did not rely on geometric plus conversion factor approach.

Ofgem's historical ex post approach for RII02 was based on a geometric average, with the arithmetic average expressed using a volatility uplift of 1-2% applied to the geometric return. The scale of this adjustment was informed, *inter alia*, by similar analysis<sup>88</sup> as considered by the CMA during the PR19 appeal.

### Consideration of serial correlation

Determining the presence or absence of serial correlation is primarily an empirical question. Various statistical tests are available to identify and assess the existence of serial correlation within the data.

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<sup>81</sup> Expectation error refers to the difference between the actual return achieved and the expected return predicted or estimated for a particular investment or asset.

<sup>82</sup> Steven Schaefer, Comments on CMA views on Estimating Expected Returns (2020)

<sup>83</sup> An adjusted average from the investor's perspective would necessitate a downwards adjustment to the arithmetic average, and hence sit somewhere between the arithmetic and geometric means (Blume (1974), JKM (2005)). However, from the capital budgeter's perspective the inverse is true, and the adjusted average would be calculated as an *upwards* adjustment to the arithmetic mean (Cooper (1996)).

<sup>84</sup> CMA (2021), PR19 Final Determination, para. 9.329

<sup>85</sup> i.e. the highest between 10- and 20Y overlapping and non-overlapping averages vs the lowest between 10- and 20Y overlapping and non-overlapping averages.

<sup>86</sup> CMA (2021), PR19 Final Determination, para. 9.333

<sup>87</sup> *Ibid.*, para. 9.338

<sup>88</sup> Ofgem (2022), RII0-ED2 Final Determinations Finance Annex, para. 3.89

Ofwat (and the CMA at PR19) do not undertake statistical testing of the returns data but assume that the arithmetic return exceeding long-term compounded returns (i.e. overlapping and non-overlapping returns) is indicative of serial correlation. Conceptually, it is not correct to attribute the difference between the arithmetic return and long-term compounded returns to serial correlation in the absence of robust statistical evidence that the latter exists. The Blume<sup>89</sup> and JKM<sup>90</sup> adjustments imply that the arithmetic average will be higher than 20-year compounded returns if the annual returns are normally distributed. One would therefore expect to see a difference between these averages even in the complete absence of serial correlation as a matter of course.

To illustrate this, the Report undertakes a simulation study with 50 replications based on the full 123-year dataset (i.e., 6,150 data points), using the empirically observed arithmetic mean and standard error. It is assumed the annual returns are normally distributed. By construction, such a series is free of serial correlation. The patterns observed in the 20-year simulated compound returns are close to those suggested by the Blume and Cooper adjustments (which represent an investor and a capital budgeter perspective respectively).

This Report employs both the Cumby-Huizinga test<sup>91</sup> and the Portmanteau test<sup>92</sup> to assess whether there is statistically significant evidence of serial correlation. The analysis finds that:

- At a 10-year horizon there is no evidence of serial correlation
- The Cumby-Huizinga test shows that at a 20-year horizon there is some evidence of serial correlation, but only at lags of 15 and 19 years. However, further investigation reveals that results can be attributed to three pairs of years only<sup>93</sup>. Consequently, if the sample is split into sub-periods that do not span these years (through dividing the data set into 61- and 62-year sub-periods) any evidence of autocorrelation disappears entirely at the 5% significance level
- The Portmanteau test – which considers serial correlation on an aggregated basis across the full 20-year lagged dataset rather than with reference to individual lags – indicates that there is no serial correlation in this data at the 5% significance level

Overall, this empirical analysis indicates that the 5% significance level there is no statistically significant evidence of serial correlation and there is no rationale for departing from the arithmetic average in the estimation of TMR, given that it represents the correct measure of long run forecast of expected returns in the absence of serial correlation.

### Consideration of the relevance of investor and capital budgeter perspectives for estimation of TMR

The sensitivity of TMR estimates to which of the perspectives – investor, capital budgeter, or both – are deemed to be relevant stems from the fact that TMR is not directly observable, and its measurement is subject to both theoretical debate and statistical uncertainty.

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<sup>89</sup> Blume varies the weight between the arithmetic average and geometric average, according to the time period for which observations are available and the time horizon assumed. For shorter horizons, more weight is placed on the arithmetic average, and the opposite for longer horizons. When the time horizon assumed is one year, the estimator will be close to the arithmetic mean. However, for longer horizons, the estimator will progressively fall below the arithmetic mean, and the gap will increase as the time horizon becomes longer.

<sup>90</sup> The Jacquier, Kane, and Marcus (JKM) estimators adjust the arithmetic mean of log returns by including half the variance of log returns, with the impact of this adjustment being weighted according to the assumed holding period. As the holding period increases, the weight assigned to the variance adjustment decreases, causing the value of the estimator to decrease as well. When the time horizon assumed is one year, the estimators will be close to the arithmetic mean. However, for longer horizons, the estimators will progressively fall below the arithmetic mean, and the gap between them and the arithmetic mean will increase as the time horizon becomes longer.

<sup>91</sup> The Cumby-Huizinga test focuses on evaluating whether there is serial correlation in the squared returns, providing additional insights into the volatility dynamics and potential patterns in the return series.

<sup>92</sup> Portmanteau test is a statistical test used to determine if there is any significant correlation or pattern in the sequence of return data over time. The test examines multiple lagged correlations to assess whether there is any meaningful relationship between past and current returns, providing insights into the presence or absence of serial correlation.

<sup>93</sup> Pairs being 1953 and 1954, 1958 and 1959, and 1973 and 1974. The final pair is responsible for apparent negative autocorrelation, with real returns being -30.9% and -55.4% respectively.

If the expected return could be predicted perfectly – i.e., the expected return would be exactly the return a market participant would get – then there would not be any difference in the estimates derived with reference to different perspectives. However, as it cannot and estimation error exists<sup>94</sup>, market participants may make their own adjustments to estimate the ‘true’ expected return on the market in the CAPM formula. The direction of such an adjustment will depend on the perspective of the market participant; investors will require a downwards adjustment to the arithmetic mean<sup>95</sup>, and capital budgeters *vice versa*.

The allowed WACC set by regulators serves a dual purpose: it facilitates investors in calculating the expected future value of their investments in regulated companies, and it assists regulated companies in determining present values for capital budgeting decisions. This regulatory WACC is essential for both parties and plays a significant role in guiding investment and financial planning within the regulated environment. Given that both perspectives are equally relevant, the regulator’s determination of the TMR should give equal consideration to both.

The CMA recognised this point at PR19, noting that “*there is no reason to conclude that one perspective, either that of the capital budgeter or of the portfolio investor, is ‘correct’*”<sup>96</sup>.

In this context, the correct approach in a regulatory setting – as noted by Schaefer (2020)<sup>97</sup> – is to provide a ‘neutral’ estimator of market return in the form of the long-run arithmetic average. Capital budgeters will then make positive adjustments, while compounders will make negative adjustments, to obtain unbiased figures for their specific requirements. If the rate provided is *not* neutral, there is a risk of rate distortion when applied from the opposite perspective.

Implicit in the assumption of a neutral TMR rate is the absence of any specific holding period. In not assuming any particular time horizon, the neutral TMR rate remains unbiased and unadjusted for any particular investment timeframe. This allows investors and capital budgeters to apply the rate to their respective scenarios. The inference is therefore that divergence from the arithmetic average on the grounds of holding periods is not required<sup>98</sup>.

This position is not consistent with the estimation of a ‘neutral’ rate.

The appropriate horizon is not ‘clear cut’ given that what is relevant for the estimation of the TMR is the horizon for capital budgeters and investors across the market. From a capital budgeting perspective, the appropriate horizon will vary in accordance with the expected life of the asset into which capital is being invested. Investor holding periods – as well as investor appetite in general – will also vary within a given market.

In this context, the use of annual data appears to be robust. This is because:

- Market participants widely use annual data. Corporates typically follow annual planning cycles for, *inter alia*, budgeting, forecasting, resource allocation and financial management. Investors in turn are likely to model cash-flows and company performance on an annual basis<sup>99</sup>
- Annual data is neutral in terms assumptions on holding periods and reinvestment patterns, which in turn allows investors to implement time value for money adjustments appropriate to their specific purpose in valuations. In contrast, the Blume, JKM, and compound estimates assume that that realisation of return is expected only at the end of the holding period, which inherently incorporates an assumption of continual re-investment and may not be reflective of the circumstances of all investors

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<sup>94</sup> If estimation error did not exist, the distinction between historical ex post and historical ex ante would not be relevant.

<sup>95</sup> As reflected in the JKM and Blume estimators.

<sup>96</sup> CMA (2021), PR19 Final Determination, para. 9.328

<sup>97</sup> Steven Schaefer, Comments on CMA views on Estimating Expected Returns (2020)

<sup>98</sup> This is different from the approach adopted by the CMA for PR19 appeal where it considered “*that it is appropriate to consider returns over a relatively long time-horizon, reflecting both the relatively long holding periods of investors in UK water companies, as well as to ensure consistency with the other elements of the cost of capital, such as the maturities of ILGs used to benchmark the risk-free rate. Therefore, we have considered returns over a 10 to 20 year holding period*” (CMA (2021), PR19 Final Determination, para. 9.330). Ofwat similarly focused on 10- and 20-year holding periods in the FM.

<sup>99</sup> In extremis, a case could even be made that six-monthly returns are preferable, given reporting requirements and capital payments (interest and dividends) are semi-annual, though this is not practical.

- Longer horizon returns used by the CMA (both overlapping and non-overlapping) and Ofwat (overlapping) have shortcomings and can be materially contingent on assumptions in practice. For example:
  - Non-overlapping estimates bring two issues; first, that there is a very limited number of observations (twelve for ten year holding periods, six for twenty). Further, the number of observations based on latest DMS data (123) is indivisible by ten and twenty, meaning that judgement is required on whether to exclude earliest or latest data<sup>100</sup>
  - Overlapping estimates incorporate multiple observations of the same data points and assign different weighting to observations from the beginning and the end of the observation period. This can introduce potential errors or distortions in the calculated averages, impacting the reliability and representativeness of the results. Relatedly, outliers in overlapping averages can have a prolonged influence due to their presence in multiple overlapping periods

### **Selection of averaging techniques for TMR estimation for PR24**

The evidence presented in this section implies that the arithmetic average is the relevant and appropriate primary basis for estimating the ex post TMR for PR24. This approach recognises that (1) there is no statistically significant evidence of serial correlation and (2) both investor and capital budgeter perspectives are relevant which requires the estimation of a 'neutral' TMR.

The evidence presented in this section also suggests two approaches that could be appropriate to cross-check the arithmetic average:

- The geometric-plus-conversion-factor approach applied as a cross-check by Ofwat in the FM can be a valid input into the estimation of TMR, if calibrated properly. This is because this approach simply represents an alternative way of deriving an arithmetic average and so is not biased towards either of the two perspectives. This Report derives the TMR estimate for this approach by adding half the variance of log returns to the geometric average, without making any deductions for serial correlation<sup>101</sup>
- The arithmetic average directly estimates the 'neutral' rate, but an indirect estimation is also possible by combining various averaging techniques that cater to both the investor and capital budgeter perspectives. Although these estimators are not 'neutral' in isolation, an average of estimates for both perspectives approximates the 'neutral' rate and so can be compared to the unadjusted arithmetic average as a cross-check. The available estimators for this purpose include Blume and JKM from the investor perspective and Cooper from the capital budgeter perspective<sup>102</sup>

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<sup>100</sup> The impact of excluding either the earliest three years or the latest three years is significant.

<sup>101</sup> Given that it has been statistically established no meaningful serial correlation is present.

<sup>102</sup> There is limited academic research or published methodology which examines the question of averaging from a capital budgeting perspective. Only Cooper (1996) is an established authority.



### 5.3.3 TMR estimate from historical ex post approaches

Table 10 sets out the results from the primary approach and the cross-checks applied in the derivation of a CPIH-real ex post TMR estimate. The primary approach implies a CPIH-real TMR of 6.96%<sup>103</sup>, and cross-check evidence suggests a TMR range of 6.91 – 6.99%. As a result, 6.96% ex post TMR is taken forward to derive the overall TMR range. This estimate is broadly consistent with the mid-point of the FM range of 6.92%. The estimate of 6.96% is also broadly consistent with the mid-point of the CMA's range of 6.55 – 7.46%<sup>104</sup> at PR19.

**Table 10 Ex post TMR estimates**

CPIH-real	Estimate
Primary approach	6.96%
Cross-check 1	6.91%
Cross-check 2 <sup>105</sup>	6.68% – 6.99%

Source: KPMG analysis and data from DMS 2023

<sup>103</sup> The equivalent arithmetic average using Ofwat's methodology and DMS 2023 data would be 6.99%, with the three-basis point delta driven only by the differences in the construction of CPIH index.

<sup>104</sup> CMA (2021), PR19 Final Determination, para. 9.334. 5.6 – 6.5% RPI-real translated into CPIH using the CMA's wedge of 0.9%.

<sup>105</sup> Cross-check 1 takes an average of Cooper/Blume and Cooper/JKM. Cross-check 2 takes an average of Cooper/JKM MSE and is responsible for the lower-bound figure. The JKM MSE is designed to minimise errors whilst exhibiting 'robustness' to serial correlation. It is by design a lower estimator than others, and no equivalent estimator exists for the alternate perspective. The average of this estimator and Cooper would therefore be expected to be lower. In any case, these estimators are used only as a cross-check are not appropriate to use for setting the expected return (TMR), as has been discussed.

## 5.4 Estimation of TMR using the historical ex ante approach

### 5.4.1 The approach to calculating ex ante TMR

Regulators generally employ two methods for estimation of ex ante TMR: dividend discount models<sup>106</sup> (most notably the Fama-French DGM) and decomposition<sup>107</sup> approaches. In the FM Ofwat uses four ex ante approaches to derive five estimates. Three of these approaches represent variations of the decomposition approach, and one the dividend discount approach.

There are several overarching methodological issues affecting Ofwat's ex ante estimates.

**Use of international data:** Ofwat has relied on world data in several approaches without, for example, taking into account that the different legal systems of constituent countries affect return expectations. These estimates are disregarded in this Report.

**Application of serial correlation adjustments:** The application of serial correlation adjustments is inconsistent with the principles laid out in the literature upon which these methodologies are based and risk introducing distortions in the estimates or invalidating the models being used. Investors would not assume serial correlation is present in their *expected* return. Such adjustments are therefore disregarded.

**Assumption of dividend growth repeatability:** Ofwat imputes the degree of repeatability of real dividend growth based on statements in the DMS Yearbook, the derivation and justification of which are unclear. Applying the same approach to 2023 data results in an unreasonable expectation of negative real dividend growth. Furthermore, this imputation approach also relies on international data. These estimates are disregarded in this Report.

**Use of flawed data sets:** The Barclays Equity and Gilt study is not reliable and contains well publicised flaws. A constructed data set<sup>108</sup> based on academic research has been substituted in its place when estimating ex ante TMR using the Fama-French DGM approach in this Report.

Overall, two approaches are taken forward for the estimation of ex ante TMR, the adapted DMS decompositional approach and the implementation of the Fama-French DGM using an alternative data source. These approaches are consistent with those used by the CMA at PR19 with the differences related to the removal of serial correlation adjustments and use of an alternative data source rather than the Barclays Equity Gilt study to implement the Fama-French DGM approach.

This Report derives an ex ante TMR range of 6.33 – 6.45% CPIH-real. This compares to the FM range of 5.80 – 6.20% with differences primarily driven by the exclusion of several ex ante TMR approaches used in the FM, removal of serial correlation adjustments and the use of an alternative data source rather than the Barclays Equity Gilt study to implement the Fama-French DGM approach.

Regulators generally employ two methods for estimation of ex ante TMR: dividend discount models and decomposition approaches. In the FM Ofwat has relied on four approaches, with three representing variations of the decomposition approach, and one the dividend discount approach. These four approaches were used to derive five ex ante TMR estimates.

Table 11 presents the descriptions of ex ante approaches used in the FM along with key associated methodological issues which are discussed in greater detail in the remainder of this section.

<sup>106</sup> For example, Fama and French use a dividend growth model to break-down historic returns into an underlying expected return, equal to the average dividend yield plus the average dividend growth rate, and an unexpected return, (comprising capital gain in excess of the rate of dividend growth). Fama, E. and French, K. (2002), 'The Equity Premium'.

<sup>107</sup> Dimson, Marsh, and Staunton seek to infer the TMR by breaking down the historical equity premium into elements that correspond to investor expectations and elements of non-repeatable good or bad luck. These elements are the mean dividend yield, the growth rate of real dividends, the expansion of the price/dividend ratio, and change in real exchange rate.

<sup>108</sup> Using the following sources (1) Campbell et al up to 1929, (2) Global Financial Data from Gregory (2011) from 1930 onwards and (3) later years are updated using the FTSE All-Share Index.

**Table 11 Overview of the ex ante approaches deployed in the FM and key associated methodological issues**

Approach	Description	Application of a serial correlation adjustment	Reliance on international data	Reliance on Barclays Equity Gilt study	Assumptions on non-repeatability of past dividend growth
Ofwat decompositional approach	The lower bound is derived as World ERP <i>plus</i> world RFR <sup>109</sup> from DMS. The upper bound is derived as the lower bound <i>plus</i> the difference between UK and World ex post TMRs.	x	✓	x	✓ <sup>110</sup>
CMA approach 1: adapted DMS decompositional approach	Combines the UK-specific geometric mean dividend yield and real dividend growth assumptions from DMS with adjustments for (1) geometric-to-arithmetic-mean conversion, (2) differences between COLI-CED inflation <sup>111</sup> and (3) serial correlation <sup>112</sup> .	✓	x	x	x
CMA approach 2: Fama-French DGM	Combines the UK-specific geometric mean dividend yield and real dividend growth assumptions from Barclays Gilt data with adjustments for (1) geometric-to-arithmetic-mean conversion, (2) differences between COLI-CED inflation <sup>113</sup> , (3) RPI-CPIH wedge and (4) serial correlation <sup>114</sup> .	✓	x	✓	x

<sup>109</sup> As proxied by returns on US T-bills.

<sup>110</sup> This approach implicitly incorporates an assumption on non-repeatability of past dividend growth as its starting point is the arithmetic ex ante World TMR cited by DMS.

<sup>111</sup> This adjustment is to reflect that the DMS data uses COLI in the early years, which is viewed as a less robust dataset than the CED equivalent. For example, there are known issues with the weightings used for different categories of consumer expenditure. These are discussed and addressed in O'Donoghue et al (2004), within which the CED is derived. The value of the adjustment is based on the CMA's PR19 decision.

<sup>112</sup> Calculated as the 10Y to 1Y difference on the arithmetic average.

<sup>113</sup> This adjustment is to reflect that the DMS data uses COLI in the early years, which is viewed as a less robust dataset than the CED equivalent. For example, there are known issues with the weightings used for different categories of consumer expenditure. These are discussed and addressed in O'Donoghue et al (2004), within which the CED is derived. The value of the adjustment is based on the CMA's PR19 decision.

<sup>114</sup> Calculated as the 20Y to 1Y difference on the arithmetic average.

Approach	Description	Application of a serial correlation adjustment	Reliance on international data	Reliance on Barclays Equity Gilt study	Assumptions on non-repeatability of past dividend growth
DMS decompositional approach applied to UK data	<p>Ofwat imputes the degree of repeatability of real dividend growth based on World data as a balancing figure between (1) geometric TMR implied by DMS' assessment of ex ante ERP and RFR for the World and (2) geometric mean dividend yield<sup>115</sup>.</p> <p>The imputed degree of repeatability of real dividend growth is then applied to UK data (the same data as used in CMA approach 1) alongside adjustments for (1) geometric-to-arithmetic-mean conversion, (2) differences between COLI-CED inflation and (3) serial correlation<sup>116</sup>.</p>	✓	✓	x	✓

Source: KPMG analysis

<sup>115</sup> This analysis assumes that change in real exchange rates and expansions in price/dividend (P/D) ratio are non-repeatable. The argument behind this approach is that in equilibrium the expected valuation changes and changes in the foreign exchange rate would not be expected to continue, but if (based on rational expectations) equity prices reflect the present value of future dividends, then the expected return should reflect the mean dividend yield on equities plus the historical rate of dividend growth.

<sup>116</sup> Calculated as the 20Y to 1Y difference on the arithmetic average.



## 5.4.2 Assumptions on non-repeatability of past dividend growth

Estimation of ex ante TMR requires an evaluation of observed historical returns to identify which elements are repeatable. This evaluation aims to discern the portion of historical returns that were genuinely expected by investors. By distinguishing between expected and unforeseeable components, the estimate can, in principle, better reflect future returns that investors can reasonably anticipate.

In this context, it is important to recognise that changes in the foreign exchange rate and expansions of the Price/Dividend (P/D) ratio are typically not expected to be repeatable over the long term. This is because, in an equilibrium state, market forces would eventually act to correct such fluctuations<sup>117</sup>. This concept aligns with the principle of rational expectations, where individuals and investors base their decisions on all available public information, leading to asset prices reflecting these expectations as accurately as possible.

Under rational expectations, equity prices are believed to reflect the present value of future dividends, which are directly linked to a company's fundamental performance. Consequently, the expected return should primarily encompass the mean dividend yield on equities, as well as the historical rate of dividend growth. These factors, rooted in a company fundamentals, are expected to be more stable and reliable indicators of future returns, unlike the short-term fluctuations in the foreign exchange rate and the P/D ratio.

There could, in principle, be a case for assuming some real growth in dividend yield is non-repeatable. This is because past growth could be driven by a combination of sustainable factors related to fundamental performance, and non-repeatable elements driven by short-term market dynamics. For example, DMS assume that "*the historical real growth rate of dividends on the world index was at least partly attributable to past good fortune*"<sup>118</sup> which, in combination with the assumption that changes in the real exchange rate and expansion in the P/D ratio are fully non-repeatable, lead DMS to infer that investors expect an annualised long-run equity premium (relative to US bills) of 'around' 3½% for the world on a geometric basis, or 5% on an arithmetic basis. DMS note that they "*report this [the prospective premium on the World index] as 3½% rather than 3.5% as a reminder that our estimate is imprecise*"<sup>119</sup>.

Ofwat uses the 3½% ex ante ERP from DMS alongside (1) World RFR data and (2) decomposed ex post ERP for the World to impute the degree of repeatability of real dividend growth which it uses to derive a UK-specific ex ante ERP.

The imputation of the degree of repeatability of real dividend growth is set out in the table below which shows:

- Outturn returns and values based on the decomposition of outturn returns in green
- Assumptions on ex ante World ERP, repeatability of the expansion in P/D ratio and change in real exchange rate sourced directly from DMS 2022 in light blue
- Ofwat's calculated values for TMR (geometric) and growth rate in real dividends based on (1) and (2) in purple

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<sup>117</sup> For example, if equity prices are expected to increase or decrease significantly over time, market participants would adjust their investment decisions, accordingly, eventually leading to a state where expected valuation changes are reflected in asset prices, and equilibrium is restored.

<sup>118</sup> DMS Yearbook (2023), p. 67

<sup>119</sup> Ibid.

**Table 12 Imputation of the degree of repeatability of real dividend growth (World data)**

	Ex post	Ex ante
Geometric mean dividend yield	4.00%	4.00%
Growth rate of real dividends	0.58%	0.22%
Expansion in P/D ratio	0.69%	0.00%
Change in real exchange rate	0.00%	0.00%
TMR (geometric)	5.27%	4.22%
RFR	0.72%	0.72%
ERP (geometric)	4.55%	3.50%

Source: KPMG analysis and data from DMS 2022

In Ofwat's calculation the growth rate of real dividends is effectively imputed to balance the equation between the decomposed ex post returns and the ex ante ERP assumed by DMS. Using 2022 DMS data, this balancing adjustment is 22 bps, implying that c. 40% of the observed growth in real dividends is repeatable. Ofwat apply the imputed 40% ratio to UK Data to derive an ex ante estimate of 4.84%<sup>120</sup>. Using the 2023 DMS data the same approach implies a forward-looking reduction in dividend growth in real terms. This is set out in the table below.

**Table 13 Comparison of the degree of repeatability of real dividend growth (World data) implied by 2022 and 2023 DMS**

	2022	2023
Ex ante ERP (geometric)	3.50%	3.50%
RFR	0.72%	0.45%
TMR (geometric)	4.22%	3.95%
Geometric mean dividend yield	4.00%	3.99%
Implied ex ante growth rate of real dividends	0.22%	(0.04%)
Ex post growth of real dividends	0.58%	0.48%
Degree of repeatability of real dividend growth	40%	(8%)

Source: KPMG analysis and data from DMS 2022 and DMS 2023

This approach is not sufficiently robust to serve as an input into TMR estimation for PR24 on the basis that:

- First, DMS is clear that the estimation of ex ante TMR is 'imprecise' in general, as is their estimate of 3.5% ex ante World ERP<sup>121</sup>. Furthermore, DMS is effectively making a downwards adjustment of 50bps to the ex ante ERP to account for non-repeatability of dividend growth<sup>122</sup>. This is a material adjustment whose exact derivation and justification are not explained by DMS
- Second, as set out in section 5.4.4, TMR estimates derived using world data may not be sufficiently representative of return expectations for investors in the UK market. This is driven by context of different jurisprudence, particularly the variation in the degree of investment protections present in common law countries versus codified counterparts

<sup>120</sup> By reducing the observed UK ex post growth rate of real dividends from 69bps to 28bps.

<sup>121</sup> DMS Yearbook (2023), p. 67

<sup>122</sup> i.e. 4.02% less 3.5% on the basis of the following quote: "when the same adjustments are made to the world index, the world equity premium shrinks from 4.58% to 4.02%. We noted above that the end-2022 yield on the world index was 2.3%, well below the long-run historical average. If we assume that the historical real growth rate of dividends on the world index was at least partly attributable to past good fortune, then the prospective premium on the world index declines to 3½% per year".

- Relatedly, Ofwat's approach of imputing the degree of repeatability implies sensitivity to data revisions for countries other than the UK. For 2023, DMS made revisions to US bill returns to include the latest updates to the Centre for Research in Security Prices (CRSP) data<sup>123</sup>. These result in a lower ex ante TMR for the World and mechanically reduce the imputed degree of repeatability of growth of real dividends
- Lastly, the CMA at PR19 1) did not challenge or reduce the real dividend growth assumptions when estimating the ex ante TMR using DMS data and 2) dismissed approaches which were highly subjective or heavily reliant on assumptions<sup>124</sup>

### 5.4.3 Application of serial correlation adjustments to ex ante data

Ofwat applied a downwards adjustment for serial correlation to two ex ante approaches, the adapted DMS decomposition approach and the Fama-French DGM approach. These are the same adjustments as applied to ex post TMR and have been calculated as differences between 1Y and 10Y or 20Y arithmetic averages<sup>125</sup>. At PR19 the CMA also applied a downwards adjustment for serial correlation, though followed a slightly different approach<sup>126</sup>.

As set out in section 5.3.2 Ofwat's justification for applying a serial correlation adjustment to *ex post* data is flawed *ab initio*<sup>127</sup> – if returns are normally distributed, then the annualised 20 year returns will be below the 1 year return as a matter of course. Determining the presence or absence of serial correlation is primarily an empirical question and empirical analysis indicates that there is no statistically significant evidence of serial correlation in the DMS returns data used to estimate ex post TMR.

However, whether it is appropriate to apply adjustments to ex ante data *at all* is an altogether distinct question conceptually.

Ex ante approaches are, by their nature, rational expectation models which assume that individuals use all available information to form their expectations of future outcomes, and do not expect historical patterns, such as serial correlation, to persist indefinitely into the future. When seeking to rely on established, peer reviewed methodologies such as Fama and French (2002) or Dimson et al (2006) to set such rational expectations, it is imperative that they are used as designed and intended. The application of serial correlation adjustments is inconsistent with the principles laid out in the literature upon which these methodologies are based and risk introducing distortions in the estimates or invalidating the models being used.

The following considerations apply to the specific ex ante approaches used by Ofwat:

- DGMs are designed to generate *unconditional* estimates of expected return<sup>128</sup>. If serial correlation was expected to be present in these estimates, it would contradict the unconditional nature of the DGM approach. In such a scenario, the estimated returns would be conditional on past returns, leading to time-varying estimates that depend on historical data. As a result, an assumption that serial correlation is present would render the DGM methodology inappropriate as it violates the fundamental principle underpinning this approach

<sup>123</sup> DMS Yearbook (2023), p. 67

<sup>124</sup> The CMA applied this criticism in its dismissal of forward-looking approaches. CMA (2021), PR19 Final Determination, para. 9.367.

<sup>125</sup> Ofwat's adjustment is based on the DMS dataset in both cases.

<sup>126</sup> The CMA applied a serial correlation adjustment based on the difference between the highest and lowest overlapping and non-overlapping estimates calculated under the historical ex post approach. CMA (2021), PR19 Final Determination, para. 9.361.

<sup>127</sup> It is to be expected that the longer the horizon, the lower the average annualised returns. In extremis, a single 123-year return period would show an arithmetic average return equal to the geometric average return. It does not follow that the difference between this 123-year average and the annual average implies serial correlation over the 123-year period.

<sup>128</sup> Fama, E. and French, K. (2002), 'The Equity Premium'

- The DMS decomposition approach is designed to calibrate investor expectations by delineating between repeatable and non-repeatable elements of observed returns. If an assumption is made that serial correlation will persist, it must be included as part of the 'repeatable' element. The decomposition approach assumes that only geometric mean dividend yield and growth rate of real dividends are repeatable (the latter perhaps to a more limited extent). However, if serial correlation existed due to market irrationality (i.e. markets showing a degree of over-correction in both directions) then it would most likely be reflected in the expansion (or contraction) of the price-dividend ratio, or possibly in changes in the real exchange rate<sup>129</sup>. Neither of these factors is assumed to be repeatable, thus invalidating the basis for making this adjustment

It is, therefore, inappropriate to apply any serial correlation adjustments in the derivation of the ex ante TMR.

#### 5.4.4 Use of international evidence ('World Data') in the estimation of ex ante TMR

In the FM Ofwat placed material weight on World data from DMS, which is used on an adjusted and unadjusted basis in the derivation of a UK-specific ex ante TMR. This is set out in the table below.

**Table 14 Ofwat decompositional approach to ex ante TMR**

	Value	Formula
Ex ante World ERP (relative to US bill)	5.00% <sup>130</sup>	a
World risk-free rate (US bills)	0.80%	b
Ex ante World TMR (lower-bound)	5.80%	a + b
Ex post UK TMR	7.20%	c
Ex post World TMR	6.80%	d
Ex ante 'UK' TMR (upper-bound)	6.20%	(a+b) + (c-d)

Source: KPMG analysis and PR24 FM

The returns which are reflected in the World index encompass a diverse range of economies as well as a wide variety of legal systems, which offer varying degrees of investor rights and protections.

The degree of protection of investor rights implied in the legal system may materially affect returns. Robust legal protections can enhance the potential for fair treatment and equitable resolution of disputes, provide recourse in case of corporate malfeasance or misconduct, and support sound corporate governance practices thereby reducing the risk of value destruction in investments. In contrast, weaker legal protection may expose investors to increased risks and challenges in seeking redress, potentially affecting their returns negatively.

La Porta et al note that *"How well legal rules protect outside investors varies systematically across legal origins. Common law countries have the **strongest protection** of outside investors – both shareholders and creditors – whereas French civil law countries have the weakest protection. German civil law and Scandinavian countries fall in between, although comparatively speaking they have stronger protection of creditors, especially secured creditors. In general, differences among legal origins are best described by the proposition that some countries protect all outside investors better than others, and not by the proposition that some countries protect shareholders while other countries protect creditors"*<sup>131</sup>.

<sup>129</sup> Whether 'market irrationality' exists is contentious and not a settled question in academic literature. Many approaches for calculating TMR assume full market rationality. If the market were irrational, it could result in stock prices deviating from their underlying fundamentals. This could cause the price-dividend ratio to deviate from its long-term average, reflecting periods of over-valuation or under-valuation. Alternatively, exchange rates could also fluctuate beyond their fundamental levels driven, for example, by global events or changes in economic conditions. These fluctuations may subsequently impact the returns of internationally exposed companies. Many approaches for calculating TMR assume full market rationality, and in a rational market, these factors would equalise, and they are hence deemed non-repeatable.

<sup>130</sup> This estimate is an arithmetic equivalent of the 3.5% ex ante TMR discussed in the previous section.

<sup>131</sup> La Porta, R. et al. (2000), 'Investor protection and corporate governance', p. 3-27



The CMA has also recognised that it is difficult to draw strong conclusions on UK TMR based on international data. For example, the CMA noted that “it is not clear to us that bringing in non-UK data would add significantly to the accuracy of our calculations, while the properly considered application of such an approach would likely bring its own complications”<sup>132</sup>. The CMA also considered that using US dollar returns on the UK market as a cross-check would rely on purchasing power parity (PPP) holding, which is a strong assumption<sup>133</sup>. La Porta et al (1998, Table 2) provide a comprehensive list of countries subject to different legal systems, together with their shareholder protection arrangements<sup>134</sup>. In tandem with the DMS data, indices can hence be constructed in order to compare returns across different legal systems.

First, the countries listed in DMS Table 12 are categorised according to the broad systems used by La Porta et al: French civil law, German civil law, Scandinavian civil law, and common law. The ERP for US investors is taken for each country to ensure comparability.

In order to compute a representative equity risk premium (ERP)<sup>135</sup> for each legal system, value weighting of individual country returns is necessary. However, when constituents are countries instead of companies, the typical market value approach for index construction is not feasible. As an alternative, International Monetary Fund (IMF) PPP estimates<sup>136</sup> of GDP are used to estimate the appropriate weighting. For the avoidance of doubt, this Report does not support the direct use of PPP evidence in the estimation of TMR, consistent with the CMA’s position at PR19. Instead, PPP estimates are solely utilised for weighting to illustrate the differences in returns across legal systems in the absence of other suitable evidence. This calculation yields the following ERPs for different legal systems:

**Table 15 PPP GDP weighted returns by legal system<sup>137</sup>**

Legal System	PPP GDP (intl dollars)	Raw average ERP	Weighted average ERP
French Civil Law	10,265	2.87%	2.57%
German Civil Law	11,801	2.66%	3.14%
Scandinavian Civil Law	1,688	4.80%	4.83%
Common Law	23,315	5.23%	5.68%

Source: KPMG analysis

The analysis suggests that there is structural difference between the returns to investors in common and civil law countries. The implication is that returns data from the World index are unlikely to be sufficiently representative of UK returns, given the UK’s status as a common law country<sup>138</sup>. Consequentially, this could result in mis-calibrated ex ante TMR estimates.

Ofwat also presents an ex ante UK TMR calculation based on an adjusted version of an ante World TMR which it uplifts by the difference between ex post returns for the UK and the World index (Ex ante ‘UK’ TMR (upper-bound) in Table 14). This approach is not robust as it relies on the strong assumption that historical differences between World and UK markets will persist unchanged in the future. Ex post differences between UK and World returns are influenced by specific historical events and market conditions that may not persist in the future. This approach is also internally inconsistent because it (1) assumes there are limitations in the ability of past returns to predict future returns (which is the rationale for considering ex ante evidence in the first place) and at the same time (2)

<sup>132</sup> CMA (2021), PR19 Final Determination, para. 9.193

<sup>133</sup> Ibid., para. 9.392

<sup>134</sup> La Porta, R. and Lopez-de-Silanes, F. (1998), ‘Capital markets and legal institutions. Beyond the Washington consensus: Institutions matter’, p. 73-92

<sup>135</sup> Relative to US bills as reported in Table 12 of the 2023 DMS Yearbook.

<sup>136</sup> IMF (2023), World Economic Output - GDP, Current Prices

<sup>137</sup> DMS (2023): Table 12 presents the decomposed ERP for a variety of countries for a USD investor, calculated as: Geometric mean dividend yield + growth Rate of real dividends + expansion of P/D ratio + change in real exchange rate – US risk free rate. These ERPs are taken, grouped by legal system, and weighted according to the PPP implied weighting. The weighted ERPs are summed to produce the ERP for the legal system overall.

<sup>138</sup> The UK does not have one distinct legal system but has three; one each for England & Wales, Scotland, and Northern Ireland. They are considered as one and the same for these purposes.

assumes that past differences between UK and World performance are an adequate predictor of future expectations.

#### 5.4.5 Use of Barclays Equity Gilt study data in the estimation of ex ante TMR

Ofwat has used the Barclays Equity Gilt Study data<sup>139</sup> to implement the Fama-French DGM for estimating the ex ante TMR. However, this data has well documented and material flaws that render it unsuitable for the derivation of a robust TMR estimate. The Barclays' Study calculates equity returns between 1899 and 1935 based on an index constructed by Barclays consisting of the 30 largest shares by market capitalisation in each year; between 1935 and 1962, they are calculated from the FT 30 Index, and from 1962 onward, they are derived from the FTSE All-Share Index<sup>140</sup>.

It is challenging to undertake a case-by-case basis evaluation of the constituents of the Barclays' index between 1899 and 1935 given limitations in data accessibility<sup>141</sup>. However, it is possible to benchmark these constituents against data included in reputable academic research.

First, Foreman-Peck and Hannah (2011, 2013)<sup>142</sup> provide the data on the nominal capitalisation of all UK companies in 1911. An appendix to that paper is available which lists all UK companies on all exchanges with a nominal capitalisation of more than £1m. Whilst there is a 12-year timing difference between the 1911 list from Foreman-Peck and Hannah and the 1899 list from Barclays (the closest comparator available by date of publication), the degree of variance between implied constituents is materially greater than is explainable by the passage of time. Railway companies dominate the list of large companies in 1911, yet none appear in the Barclays list.

Second, the research by Campbell, Grossman, and Turner (2021)<sup>143</sup> has also found that *"in 1870, the largest firms were railways (London and North Western, North-Eastern, Lancashire and Yorkshire, Midland, Great Western) with a few banks in the top ten (London and Westminster and the Bank of Scotland)... Some firms were in this index for just a single year, but the others were there for almost the entire sample period. These were primarily railways, such as the Great Western (93 years), the Midland (83 years), and the London & North Western (76 years), but also included some banks, namely the London and Westminster (74 years) and the National Provincial (69 years)"*.

In addition, Campbell et al have constructed a 'Blue Chip' index which is conceptually equivalent to the Barclays' index for 1899-1935 given that both indices select constituents based on market capitalisation. It is possible to compare (1) the membership of the Blue Chip index in 1929<sup>144</sup> to the membership of the Barclays index in 1934<sup>145</sup> and (2) the membership of the Blue Chip index in 1870<sup>146</sup> to the membership of the Barclays index in 1899<sup>147</sup>. In each case the constituents are materially different. Railway companies are included in the Blue Chip index in both 1870 and 1929, consistent with Foreman-Peck and Hannah. In contrast, railway companies are absent from the Barclays list in both 1899 and 1934.

The research undertaken by Foreman-Peck and Hannah and Campbell, Grossman, and Turner is published in highly respected, peer-reviewed journals. The significant divergence between the Barclays' selection of largest companies and that implied by these publications raises concerns about potential material flaws in Barclays' data. Moreover, the lack of clarity from Barclays regarding the index construction and the sourcing of market capitalisation data further challenges the robustness of the data.

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<sup>139</sup> DMS data cannot be used for this approach as a time series of capital gains and dividend returns is not provided.

<sup>140</sup> Barclays (2022), Equity Gilt study 2022, p. 103

<sup>141</sup> Barclays note that their data is based on the largest companies by Market Cap. Copies of the FT retrieved from Guildhall library contain incomplete information and the Stock Exchange data is extremely difficult to thoroughly contextualise without a clear definition of 'Market Cap' from Barclays, which is not provided.

<sup>142</sup> Foreman-Peck, J. and Hannah, L. (2011), 'Extreme divorce: the managerial revolution in UK companies before 1914' and Foreman-Peck, J. and Hannah, L. (2013), 'Some consequences of the early twentieth-century British divorce of ownership from control'

<sup>143</sup> Campbell, G., Grossman, R. and Turner, J. (2021), 'Before the cult of equity: the British stock market, 1829–1929'

<sup>144</sup> Ibid., Online Appendix 1

<sup>145</sup> Barclays (2022), Equity Gilt study 2022, p. 103

<sup>146</sup> Campbell, G., Grossman, R. and Turner, J. (2021), 'Before the cult of equity: the British stock market, 1829–1929', Online Appendix 1

<sup>147</sup> Barclays (2022), Equity Gilt study 2022, p. 103

The data included in the appendix of Campbell et al – namely the total returns and dividend yield figures – can serve as a robust input into ex ante TMR estimation based on the Fama-French DGM instead of the Barclays data. There are two distinct datasets in the Campbell appendix, both of which can be used to derive TMR estimates:

- A Blue Chip index, which represents 30 companies and is most comparable to the Barclays data, though with important differences in membership noted above
- An all UK index which represents ~100 companies and is most comparable to the DMS data<sup>148</sup>

Gregory (2023)<sup>149</sup> has recently developed an updated analysis<sup>150</sup> of the ex ante UK TMR based on the Fama-French DGM using (1) the data from Campbell et al<sup>151</sup> and (2) a synthetic CPIH index (as discussed in section 5.3.1). Gregory obtained an ex ante arithmetic average return of 6.32% from the Blue Chip Index, and 6.45% from the All UK Index<sup>152</sup>. Given that Gregory has calculated the returns using a synthetic CPIH index, it is not necessary to apply a 35bps adjustment for COLI-CED conversion.

#### 5.4.6 Selection of approaches for ex ante TMR estimation

The table below summarises the findings from the evaluation of the approaches employed by Ofwat for the estimation of ex ante TMR. It also indicates whether and how these approaches are utilised in this Report.

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<sup>148</sup> DMS 2023 p. 252 comments: “The period from 1899-1954 presented a different challenge. Here, we painstakingly collected share prices from old issues of the Financial Times (FD from 1899 onward. This enabled us to calculate an index of the returns from the top 100 companies from 1900-54. The Index resembles the FTSE 100 in its method of construction and is free of survivorship bias”.

<sup>149</sup> Gregory, A. (2023), ‘The Expected Cost of Equity in the UK Revisited’

<sup>150</sup> The 2023 paper is effectively an update to Gregory, A. (2011), ‘The expected cost of equity and the expected risk premium in the UK’.

<sup>151</sup> Gregory (2023) covers the period between 1899 to 2022 by merging three data sources: (1) Campbell et al up to 1929, (2) Global Financial Data from Gregory (2011) from 1930 onwards and (3) later years are updated using the FTSE All-Share Index.

<sup>152</sup> Gregory (2023) uses the preferred CPI index from BoE Millennium dataset, where this Report uses the original series. The difference between estimates using each series is negligible.

**Table 16 Selection of approaches for ex ante TMR estimation**

Approach	Key limitations / flaws	Proposed treatment in this Report
Ofwat decompositional approach	This approach estimates the ex ante TMR based on (1) a World index which is unlikely to be sufficiently representative of UK returns and may result in mis-calibrated ex ante TMR estimates, and (2) an adjustment to translate World data into UK returns which is reliant on assumptions and results in an internally inconsistent approach to ex ante TMR.	Not used.
CMA approach 1: adapted DMS decompositional approach	In principle this approach is appropriate, however, application of a serial correlation is fundamentally inconsistent with the principles underpinning the estimation of ex ante TMR.	Used – with the serial correlation adjustment removed and updated based on latest DMS data.
CMA approach 2: Fama-French DGM	In principle this approach is appropriate, however, (1) application of a serial correlation is fundamentally inconsistent with the principles underpinning the estimation of ex ante TMR and (2) the use of a flawed data source for the calculation is liable to introduce distortions in the calculated TMR values.	Used – with the serial correlation and COLI-CED conversion adjustments <sup>153</sup> removed, and the Barclays data replaced by the more robust Campbell et al data.
DMS decompositional approach applied to UK data	This approach is heavily reliant on assumptions which are not well justified and materially affect the ex ante TMR estimate. It is also reliant on world data which may not be sufficiently representative of return expectations for investors in the UK market.	Not used.

Source: KPMG analysis

The two approaches taken forward in this Report result in an ex ante TMR range of 6.33 – 6.45% CPIH-real. This compares to the FM range of 5.80 – 6.20% with differences primarily driven by the exclusion of several ex ante TMR approaches used in the FM, removal of serial correlation adjustments and the use of an alternative data source rather than the Barclays Equity Gilt study to implement the Fama-French DGM approach.

The mid-point of the 6.33 – 6.45% range is consistent with the mid-point of the CMA’s ex ante range of 6.15 – 6.55% for PR19<sup>154</sup>.

**Table 17 Ex ante TMR estimates**

CPIH-real	Estimate
CMA approach 1: adapted DMS decompositional approach <sup>155</sup>	6.37%
CMA approach 2: Fama-French DGM (using data from Campbell et al and Global Financial Data)	6.33 – 6.45%
<b>Overall ex ante TMR range</b>	<b>6.33 – 6.45%</b>

Source: KPMG analysis

<sup>153</sup> Given that the estimates are derived on a CPIH-adjusted basis.

<sup>154</sup> CMA (2021), PR19 Final Determination, para. 9.361. 5.2 – 5.7% RPI-real translated into CPIH using the CMA’s wedge of 0.9%.

<sup>155</sup> The difference between the estimate from this report and the FM primarily relate to the removal of the serial correlation adjustment and the use of DMS 2023 data.



## 5.5 Derivation of the TMR range for PR24

This Report derives a TMR range of 6.39 – 6.96% CPIH-real versus the FM range of 6.00 – 6.92%. The key drivers of differences with the FM range are ex ante estimates, where this Report excludes several ex ante TMR approaches used in the FM, removes of serial correlation adjustments, and uses an alternative data source rather than the Barclays Equity Gilt study to implement the Fama-French DGM approach.

The TMR range estimated in this Report is slightly lower than the CMA PR19 range, reflecting the movement in market data since the CMA's final decision. This is in line with the standard regulatory assumption that the TMR is a relatively stable parameter.

Table 18 sets out the results from the different estimation approaches applied in this Report. These represent the approaches best justified based on a balanced evaluation of the most current market data, pertinent financial literature, and relevant regulatory precedent.

**Table 18 Summary of TMR evidence**

CPIH-real	Lower bound	Upper bound
Ex post		6.96%
Ex ante	6.33%	6.45%

Source: KPMG analysis

Table 19 sets out the TMR estimates implied by two potential approaches for deriving the overall range as employed by the CMA at PR19 and Ofwat in the PR24 FM:

- The lower bound of the CMA's range was based on the lowest ex ante estimate and the upper bound on the highest ex post estimate
- The lower bound of Ofwat's range was based on the mid-point of the ex ante range and the upper bound on the mid-point of the ex post range

The ranges implied by both of these approaches are presented in the table below.

**Table 19 Overall TMR range**

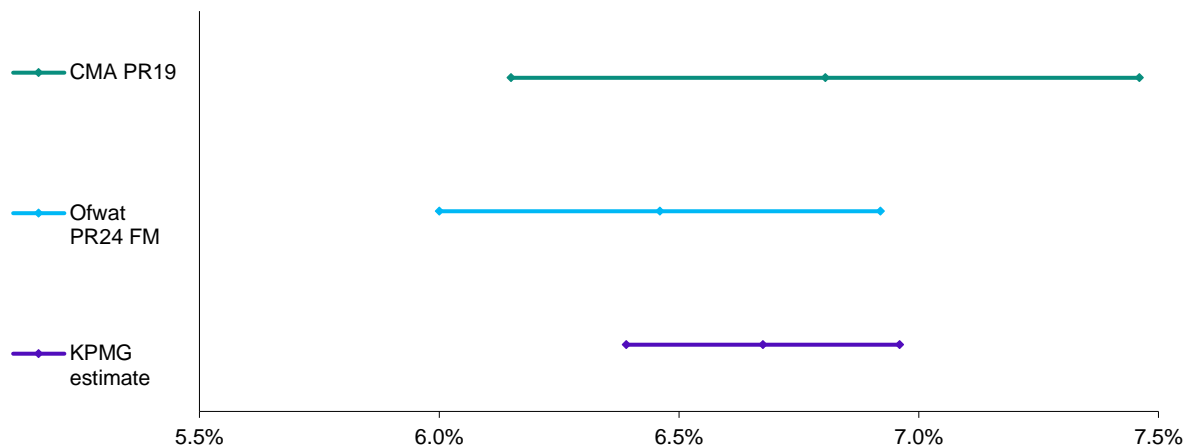
CPIH-real	Lower bound	Upper bound
CMA PR19 approach	6.33%	6.96%
Ofwat PR24 FM approach	6.39%	6.96%

Source: KPMG analysis

Given that the ranges implied by both approaches are largely aligned, this Report adopts the PR24 FM methodology and takes forward a TMR range of 6.39 – 6.96% CPIH-real.

Figure 6 below compares the KPMG TMR range to the CMA PR19 and PR24 FM ranges.

**Figure 6 The comparison of the KPMG TMR range to CMA PR19 and PR24 FM**



Source: KPMG analysis, PR24 FM and CMA PR19 FD

The KPMG estimate is fully encompassed within the CMA's PR19 range. This is in line with the standard regulatory assumption that the TMR is a relatively stable parameter and that estimates developed in quick succession should be broadly consistent with one another. The upper end of the KPMG range is lower than the CMA's primarily due to the movement in market data since the CMA's final decision. The lower end of the KPMG range is slightly higher than the CMA's reflecting primarily the removal of serial correlation adjustments from ex ante estimates and use of a more robust data source to implement the Fama-French DGM approach.

By contrast the Ofwat approach implies TMR estimates in the lower half of the CMA's range, driven by the inclusion of new ex ante TMR approaches used in the FM.

# 6 Risk-free rate

The risk-free rate in the CAPM represents the rate of return expected by investors for holding a risk-free asset, i.e. an asset with zero risk. This section is structured as follows:

- First, it sets out Ofwat’s approach to and estimate of the risk-free rate
- Second, it introduces key concepts and precedents for estimating the risk-free rate
- Third, it evaluates Ofwat’s starting point for the risk-free rate based on gilt yields
- Fourth, it explores the drivers of the convenience yield
- Fifth, it considers the implications of different risk-free borrowing and saving rates
- Sixth, it examines whether an adjustment to gilt yields is required and different approaches to quantifying the adjustment. On this basis it sets out an overall estimate for the risk-free rate

## 6.1 Ofwat’s approach to and estimate of the risk-free rate

Ofwat set a point estimate for the risk-free rate in the PR24 FM of 0.47% CPIH-real. This point estimate is based on the assumptions set out in the table below.

**Table 20 Ofwat’s approach to risk-free rate**

Parameter	Assumption
Risk-free rate proxy	Yield on RPI index-linked gilts (ILGs)
Cross-checks	No cross-checks for ILG yields have been used. Ofwat considers that SONIA swaps and nominal gilts (NGs) are in principle informative cross-checks for ILGs, however recent high inflation complicates inferences which can be drawn from these instruments
Tenor	20Y ILGs but tenors of 10-20Y are considered
Averaging period	1m average of 20Y ILG yields using data over September 2022
RPI-CPIH wedge	0.54% based on the RPI-CPI wedge implied by inflation swaps and HMT forecasts. This wedge is applied to ILG yields to convert from an RPI to a CPIH basis
Adjustments	No adjustments have been applied to 20Y ILG yields

Source: KPMG analysis and PR24 FM

## 6.2 Introduction

In the UK, a common approach - as applied by Ofwat in the PR24 FM - is to use ILG yields as a proxy for the risk-free rate. However the appropriate risk-free rate for the CAPM is likely to lie above ILG yields because (1) ILGs benefits from the convenience yield; and (2) most investors cannot borrow at ILG yields. For these reasons, the CMA at PR19 determined the appropriate risk-free rate to lie between the yield on ILGs and AAA corporate bonds. By contrast, Ofwat in the PR24 FM has departed materially from the CMA PR19 approach by providing no adjustment for either (1) or (2).

This section provides an introduction to the risk-free rate and the key factors relating to the estimation of the risk-free rate.

### 6.2.1 Conceptual framework for risk-free rate estimation

The yields on government bonds are often used as a proxy for the risk-free rate because government bonds are generally perceived to be safe assets. In the UK, a common approach - as applied by Ofwat in the PR24 FM - is to use the yield on ILGs as a proxy for the risk-free rate. However, the appropriate risk-free rate for the CAPM is likely to lie above the yield on ILGs for two reasons:

First, it has long been acknowledged in academic literature that government bonds possess special properties which push their yield below the ‘true’ risk free rate due to a convenience yield. Thus the ‘true’ risk-free rate can only be derived from the yield on ILGs after removing the convenience yield.

Second, the CAPM assumes that investors can borrow and save at the same risk-free rate. However, in the real world most investors must pay a significantly higher rate to borrow than they receive from saving. In other words, the risk-free borrowing rate is in practice higher than the risk-free saving rate. Academic literature has found that, where the risk-free borrowing and saving rates differ, the appropriate risk-free rate for the CAPM lies in between.

The risk-free saving rate for investors can be proxied by the yield on ILGs after adjusting for the convenience yield. The risk-free borrowing rate for investors can be proxied by the yield on the highest quality corporate bonds, though this could represent a conservative estimate.

The first reason is explored in more detail in section 6.4 and the second in section 6.5.

## 6.2.2 Consistency with CMA PR19

The rationale set out above is conceptually consistent with the CMA’s rationale at PR19 for basing the risk-free rate on yields on both ILGs and AAA corporate bonds.

The CMA concluded that the appropriate risk-free rate is likely to lie above the ILG yields because (1) ILGs benefit from the convenience yield; and (2) most investors cannot borrow at ILG yields<sup>156</sup>. It also argued that AAA corporate bond yields are very close to risk-free and closer to representing a rate that is available to all (i.e. non-government) investors than ILG yields<sup>157</sup> but may lie above the appropriate risk-free rate<sup>158</sup>. As a result, the CMA deemed that the appropriate risk-free rate for the CAPM sits between the yields on ILGs and AAA corporate bonds. This methodology was designed to achieve the CMA’s overarching objective of arriving at a risk-free rate that represented a rate at which all relevant investors could borrow<sup>159</sup>.

The CMA is not alone in adjusting allowances for (1) and (2). The German federal network agency, Bundesnetzagentur (BNetzA), has implicitly provided adjustments for (1) and (2) for regulated energy networks since 2005<sup>160</sup>. BNetzA does not estimate the risk-free rate using government bonds, but instead it uses an index containing bank, corporate and public sector bonds from domestic issuers. More recently, the CAA at H7 made upward adjustments to ILG yields to derive the risk-free rate<sup>161</sup>.

By contrast, Ofwat in the PR24 FM has departed materially from the CMA’s PR19 FD. First, whilst Ofwat initially considered providing an adjustment for the convenience yield, it ultimately decided not to provide an adjustment. Second, Ofwat has effectively disregarded the argument that most investors cannot borrow at ILG yields although this was a key factor in the CMA’s determination. In consequence, Ofwat assumes the yield on ILGs is exactly the risk-free rate.

Key differences between Ofwat’s approach and CMA PR19 are discussed in more detail in sections 6.4.2 and 6.5.5 respectively.

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<sup>156</sup> CMA (2021), PR19 Final Determination, para. 9.264

<sup>157</sup> Ibid., paras. 9.92, 9.104, 9.146-9.149 and 9.159

<sup>158</sup> Ibid., paras. 9.151 and 9.158

<sup>159</sup> Ibid., para. 9.104

<sup>160</sup> [https://www.bundesnetzagentur.de/DE/Beschlusskammern/BK04/BK4\\_74\\_EK\\_Zins/BK4\\_Beschl\\_EK\\_Zins.ht](https://www.bundesnetzagentur.de/DE/Beschlusskammern/BK04/BK4_74_EK_Zins/BK4_Beschl_EK_Zins.ht)

<sup>161</sup> CAA (2022), H7 Final Proposals, Section 3: Financial issues and implementation, paras. 9.247-8



### 6.3 ILG yields as a starting point for estimating the risk-free rate

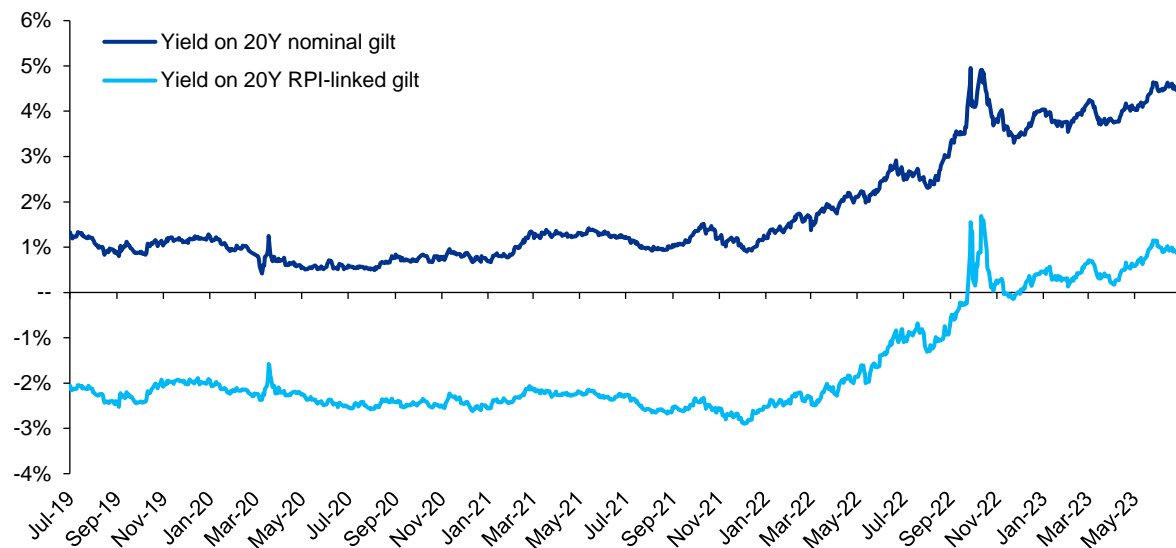
Ofwat's starting point for the risk-free rate is the 1m trailing average of 20Y ILG yields, converted into CPIH terms using an RPI-CPIH wedge of 0.54%. Given that Ofwat sets a real cost of capital, it is a more direct approach to rely on real estimators of the risk-free rate like ILG yields. Ofwat's use of 20Y tenor is in line with the investment horizon for the sector. Ofwat's use of 1m trailing average reflects that current data is likely to better predict forward-looking yields than longer term data in a volatile macroeconomic environment. If this recent volatility persists, companies will need to consider how to capture this in the cost of equity e.g. moving from an ex-ante trailing average to indexation. Ofwat's RPI-CPIH wedge will need to be revisited as the 2030 RPI reform draws closer. Updating Ofwat's approach for data over June 2023 implies a starting point for the risk-free rate of 1.48% CPIH-real.

Ofwat's starting point for the risk-free rate is the 1m trailing average of yields on 20Y ILGs. This section considers whether Ofwat's starting point is appropriate.

Given that Ofwat sets a real cost of capital, it is a more direct approach to rely on real estimators of the risk-free rate like the yield on ILGs. Ofwat's consideration of 10-20Y tenors and focus on 20Y for ILGs is in line with investment horizon for the sector which is discussed in section 4.3.

Interest rates have in the recent past been volatile and on an upwards trajectory which is illustrated by the change in yields on 20Y gilts in the figure below. This has primarily been driven by the BoE's increases to base rates to achieve its monetary policy objective of low and stable inflation.

**Figure 7 Evolution of 20Y gilt yields**



Source: KPMG analysis and data from Refinitiv Datastream

In this context, a shorter trailing average as adopted by Ofwat is likely to better predict the future evolution of ILG yields over PR24 than longer trailing averages (which precede recent increases to base rates). In other words, recent data is likely to better predict forward-looking yields than longer term data in a volatile macroeconomic environment. This view is shared by the CAA which also set a 1m trailing average for H7<sup>162</sup>.

<sup>162</sup> Ibid., para. 9.249

If volatility persists over the price review process, companies will need to consider how to capture this in the cost of equity. For example, indexation of the risk-free rate may be an appropriate mechanism to adjust returns to reflect changes in market conditions during the price control. By contrast, the use of an ex-ante trailing average provides an estimate of the risk-free rate at a point in time, but this may quickly become out of date under current market conditions.

This Report adopts Ofwat's assumption for the RPI-CPIH wedge of 0.54%. However this assumption will likely need to be revisited at draft or final determination based on more recent data as the 2030 UKSA RPI reform draws closer.

Overall, Ofwat's starting point for the risk-free rate based on ILG yields seems appropriate at this stage. Updating Ofwat's approach for data over June 2023 implies a starting point for the risk-free rate of 1.48% CPIH-real.

## 6.4 Convenience yield

Gilts and other government bonds provide additional benefits for investors which push their yield below the risk-free rate. The difference is the convenience yield. These additional benefits include *inter alia* the liquidity of government bonds and their superior collateral value relative to other safe assets. Ofwat in the PR24 FM recognises estimates of the convenience yield for NGs from academic literature but has not provided an adjustment for the convenience yield on ILGs. A qualitative analysis of the determinants of the convenience yield referenced in academic literature implies that the majority apply similarly to NGs/ILGs (and may apply more strongly to ILGs owing to their inflation protection) but NGs may be more liquid than ILGs. This suggests that the convenience yield for NGs may be a good benchmark for ILGs. In consequence, Ofwat's decision to not provide a convenience yield adjustment for ILGs does not appear to be appropriate.

This section considers whether a convenience yield exists on government bonds, in particular for ILGs, and whether this means the return on government bonds needs to be adjusted to estimate the 'true' risk-free rate for the CAPM. Importantly, this adjustment would be necessary even in a world where investors can borrow and save at the same risk-free rate, as assumed in this section.

### 6.4.1 What is a convenience yield?

Gilts and other government bonds tend to have low returns due to two factors:

- They reflect the borrowing rate for a sovereign and thus are 'risk-free' (i.e. zero chance of default)
- They provide additional benefits for investors which push their yield below the 'risk-free' rate

These benefits include the liquidity of government bonds (Krishnamurthy and Vissing-Jørgensen, 2012<sup>163</sup>) and the ease at which they can be traded by uninformed agents, posted as collateral, satisfy regulatory capital requirements, or perform other roles similar to that of money (van Binsbergen et al., 2022<sup>164</sup>). This is similar to how physical cash (notes and coins) has a lower return than cash held in a bank account<sup>165</sup>, even though both are risk-free. This is because physical cash has a superior ability to perform money-like roles as it can be spent immediately.

These benefits create additional demand for government bonds which depresses their return below the risk-free rate. The difference is the convenience yield (CY).

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<sup>163</sup> Krishnamurthy, A. and Vissing-Jørgensen, A. (2012), 'The Aggregate Demand for Treasury Debt'

<sup>164</sup> Van Binsbergen, J., Diamond, W., and Grotteria, M. (2022), 'Risk-free interest rates'

<sup>165</sup> Physical cash earns no return whereas cash held in a bank account earns the deposit rate.

There are two approaches to estimating the return on the benchmark asset in the CAPM. The first is to estimate the risk-free rate by taking the return on government bonds and adding back CY. The second is to estimate the return on a zero-beta asset that does not have the convenience properties of government bonds. Indeed, Black (1972)<sup>166</sup> shows that for cases in which the risk-free rate cannot be identified, the CAPM holds where the return on a zero-beta asset is used in place of the risk-free rate. Such cases may occur either if there is no risk-free asset, or if the risk-free asset bears CY which cannot be estimated.

A zero-beta asset is one that bears no systematic risk. An example is a corporate bond (or stock) whose return is uncorrelated with the market. Since corporate bonds do not have the convenience properties of government bonds (e.g. they are not perfectly liquid and can only be posted as collateral at a discount), they do not benefit from CY and so no adjustment is necessary. Importantly, the return on a zero-beta corporate bond will be higher than the return on a government bond as the latter bears no risk, while the former bears idiosyncratic risk.

In sum, both approaches to estimating the return on the benchmark asset in the CAPM imply a rate that is higher than the government bond yield.

#### **6.4.2 Commentary on Ofwat's treatment of CY in the PR24 FM**

Ofwat estimates the risk-free rate rather than the return on a zero-beta asset. To estimate the risk-free rate, Ofwat starts with the return on ILGs and considers making an adjustment for CY(ILG).

Ofwat recognises estimates of CY for NGs from academic literature. However, Ofwat argues that estimates of CY for ILGs are ambiguous as it is not aware of academic studies into CY(ILG) and CY for NGs cannot be assumed to apply directly to ILGs<sup>167</sup>. Further, Ofwat considers that CY(ILG) is at a minimum materially smaller than CY(NG)<sup>168</sup>. Ultimately, Ofwat does not provide an adjustment for CY(ILG) and hence assumes that the return on ILGs is equivalent to the risk-free rate.

First, if Ofwat considers that it is not possible to estimate CY(ILG) robustly and thus the risk-free rate, it could instead estimate the return on the zero-beta asset. In the PR24 FM, Ofwat acknowledges the possibility of using a zero-beta asset in the CAPM<sup>169</sup>.

Second, academic literature has highlighted that there are multiple factors that drive CY. However, Ofwat has not assessed whether these factors apply to ILGs to the same extent as NGs. An analysis of CY factors cited in academic literature is set out below and implies that the vast majority of CY factors apply to both NGs/ILGs. This suggests that there is CY in ILGs and CY(NG) may be a good benchmark for CY(ILG). Indeed, this is fully consistent with Ofwat's position that NGs could be used as a cross-check for ILGs<sup>170</sup>. In consequence, Ofwat's conclusion that no adjustment is required for CY(ILG) does not appear to be appropriate.

#### **6.4.3 Qualitative analysis of difference between CY(NG) and CY(ILG)**

This section analyses whether CY(NG) and CY(ILG) differ based on CY factors cited in academic literature. CY factors considered in the analysis are: (1) liquidity; (2) money-like roles; (3) collateral; (4) regulatory; and (5) safety.

##### **1. Liquidity (ability to be traded without moving the market price)**

- Both NGs and ILGs have narrow bid-ask spreads relative to other safe assets, though the spreads on ILGs may be wider than for NGs
- As NGs and ILGs are both riskless assets, uninformed agents are not at an informational disadvantage and are thus willing to trade them, increasing market liquidity

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<sup>166</sup> Black, F. (1972), 'Capital Market Equilibrium with Restricted Borrowing'

<sup>167</sup> Ofwat (2022), PR24 Final Methodology, Appendix 11 – Allowed return on capital, p. 15-16

<sup>168</sup> Ibid., p. 96-97. Ofwat indicates that at 2Y maturity, CY(NG) = 38bps whereas CY(ILG) = 7bps.

<sup>169</sup> Ibid., p. 13 and 93

<sup>170</sup> Ibid., p. 12-14

- NGs and ILGs are important instruments for hedging interest rate risk; for example, a buyer of a corporate bond can short gilts to remove such risk. However, ILGs also provide an inflation hedge, which may increase the trading of ILGs relative to NGs, and thus their liquidity

## 2. Money-like roles (ability to store value and act as a medium of exchange)

- Both NGs and ILGs can be used as a medium of exchange as they are widely accepted. ILGs may serve as a better medium of exchange than NGs given the value of ILGs move in line with price inflation for goods
- In the same vein, ILGs may serve as a better store of value as their purchasing power is not eroded by inflation like with NGs
- Sectors with inflation-linked liabilities, such as pensions, may have special demand for ILGs over NGs given their inflation protection<sup>171</sup>. This is a reasonable extension of this argument in the US academic literature: “...investors such as defined-benefit pension funds have a special demand for certain long-term payoffs to back long-term nominal obligations. The same motive may apply to insurance companies that write long-term policies” (Krishnamurthy and Vissing-Jørgensen, 2012)

## 3. Collateral (ability to be used as security in financial transactions)

- Both NGs and ILGs are superior forms of collateral over other safe assets. This leads to additional demand for both types of gilt, in turn lowering their yields
- Counterparties need to pledge collateral to banks in order to engage in a range of transactions such as borrowing money, trading derivatives, entering into security financing transactions with banks (for example, entering into repos<sup>172</sup>). Banks require collateral to mitigate the credit risk generated by undertaking these transactions
- The collateral value of an asset is derived by applying a haircut to its current market value to account for valuation uncertainty<sup>173</sup>. The size of the haircut depends on the type and credit quality of the asset. Collateral in the form of NGs/ILGs face significantly lower haircuts than corporate bonds; for example, they are half the size of the haircuts applied to AAA corporate bonds<sup>174</sup>. There are also conditions under which their haircut is zero<sup>175</sup>
- Similarly, the superiority of NGs and ILGs as collateral means that they allow the owner to borrow money at lower rates than the general collateral repo rates. Feldhütter and Lando (2008)<sup>176</sup> states that this ‘repo specialness’ contributes to a convenience yield that “...distinguishes the Treasury rate from the riskless rate”

<sup>171</sup> <https://www.ipe.com/liability-driven-investment-banks-and-the-linkers-market/10002006.article>

<sup>172</sup> A repo is a repurchase agreement that is generally short-term. In a repo, the ‘seller’ sells an asset to the ‘buyer’ for cash and agrees to repurchase the asset for a higher price at a later date, typically overnight. A repo is economically equivalent to a secured loan because (1) the difference between the asset’s initial price and its repurchase price is akin to the interest paid on a loan and is known as the repo rate; and (2) the asset effectively acts as collateral for the ‘buyer’. From the perspective of the ‘seller’ the transaction is a repo and for the ‘buyer’ it is a reverse repo.

<sup>173</sup> The value of the non-cash asset may not be fixed. It may differ over time as a result of changes in market conditions or the perceived credit quality of the issuer of the bond/equity.

<sup>174</sup> Article 224 illustrates the haircuts that have to be applied to the current market value of assets to derive their collateral value. NGs/ILGs fall in the category Article 197(1)(b) whereas AAA corporate bonds fall in the category Article 197(1)(c) and (d) based on Article 197. NGs/ILGs and AAA corporate bonds are both of credit quality step 1 based on the EBA mapping table. Hence, based on Article 224, for an NG/ILG of  $\leq 1$  remaining maturity and used for a transaction with a 10-day liquidation period, its collateral value is 0.5% less than its current market value. In contrast, the haircut for an AAA corporate bond under equivalent conditions is 1%. This relationship whereby the haircut on NGs/ILGs are half that for AAA corporate bonds holds throughout Article 224, but the difference between the two in absolute terms becomes larger at higher residual maturities and liquidation periods. The liquidation periods that apply for different types of transactions are explained in Article 224(2). Articles can be found [here](#) and the EBA mapping table can be found [here](#).

<sup>175</sup> Article 227 sets out conditions under which a 0% haircut can be applied for collateral. NGs/ILGs may qualify for a 0% haircut because they satisfy the condition in 227(2)(a) that collateral must be “cash or debt securities issued by central governments or central banks” and “eligible for a 0% risk weight” based on Article 197(1)(b) and Article 114. In the same vein, there are no conditions under which a 0% haircut can be applied for corporate bonds. Articles can be found [here](#).

<sup>176</sup> Feldhütter, P. and Lando, D. (2008), ‘Decomposing swap spreads’

#### 4. Regulatory (ability to be used to satisfy regulatory requirements)

- Owning gilts (both NGs and ILGs) requires banks and insurance companies to hold less regulatory capital than owning other safe assets. As a result, banks and insurance companies may have additional demand for NGs/ILGs
- Banks do not require capital to support an investment in NGs/ILGs but do to support an investment in corporate bonds due to their credit risk. For AAA corporate bonds, banks must hold capital equal to their current market value multiplied by either 0.25%, 1% or 1.25% depending on their remaining maturity (higher capital charge for longer maturities). For NGs/ILGs, the capital charge is nil regardless of their maturity because government bonds are risk-free<sup>177</sup>
- Banks are subject to the liquidity coverage ratio (LCR). This ratio imposes a hypothetical gap between a bank's cash inflows and outflows, in particular, that cash inflows are only 75% of cash outflows. The bank should at all times have a sufficient liquid asset buffer to meet this hypothetical gap. Banks are required to monitor their LCR on a daily basis. The value of assets in this liquid asset buffer depends on their liquidity and credit quality. NGs/ILGs are considered level 1 assets and therefore face no haircut to their current market value in the liquid asset buffer. In contrast, AAA corporate bonds are considered level 2A assets and thus face a 15% haircut. Further, there is a cap on the amount of level 2A assets that can contribute to the liquid asset buffer whereas the contribution of level 1 assets is unlimited<sup>178</sup>
- Banks are also subject to the Net Stable Funding Ratio (NSFR). The NSFR requires that at all times the bank's funding requirement can be met by stable funding sources. Banks monitor their NSFR on a daily basis, like LCR. Investments in NGs/ILGs and corporate bonds are considered assets that require stable funding. For the same reasons as under LCR, the funding required for unencumbered<sup>179</sup> NGs/ILGs is nil whereas it is 15% of the current market value for unencumbered AAA corporate bonds<sup>180</sup>
- Insurance companies are required to hold capital against investments in corporate bonds for spread risk, but not for investments in NGs/ILGs. Spread risk refers to the risk that the value of investments may fall with a widening of credit spreads. For an AAA corporate bond, the capital charge for spread risk is the current market value multiplied by 0.9% for a residual duration of 1Y<sup>181</sup>, this increases to >12% for a residual duration of >20Y<sup>182</sup>

#### 5. Safety

- It might be argued that safety does not lead to CY as CY is the difference in return between two assets with identical cash flows i.e. that are equally safe. However, CY might still exist if the yield of a perfectly safe asset is significantly different from the yield of an asset that is almost perfectly safe and thus almost identical

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<sup>177</sup> When a bank buys a bond, it is assumed that the bond is held in the bank's 'trading book'. The capital requirements relating to credit risk for a bank's trading book assets are governed by Article 336. This says that a bond with a 0% risk weight does not require capital to be held. It also says that a bond with a 20% risk weight requires capital to be held equal to the bond's current market value multiplied by 0.25% (residual maturity of < 6m), 1% (residual maturity of 6-24m) or 1.6% capital charge (residual maturity of >24m). NGs/ILGs have a 0% risk weight based on Article 114 and AAA corporate bonds have a 20% risk weight based on Article 122 and the EBA mapping table. Articles can be found [here](#) and the EBA mapping table can be found [here](#).

<sup>178</sup> <https://www.prarulebook.co.uk/rulebook/Content/Part/392857/20-07-2023>; <https://www.bankofengland.co.uk/-/media/boe/files/prudential-regulation/regulatory-reporting/banking/corep-liquidity.xlsx>

<sup>179</sup> The PRA Rulebook defines unencumbered assets as assets which are not subject to any legal, contractual, regulatory, or other restriction preventing the institution from liquidating, selling, transferring, assigning or, generally, disposing of those assets via an outright sale or a repurchase agreement.

<sup>180</sup> <https://www.prarulebook.co.uk/rulebook/Content/Part/392857/20-07-2023>

<sup>181</sup> Residual duration here refers to modified duration. Modified duration is the weighted average time (by present value of cashflow) for a bondholder to receive a bond's remaining cashflows. It is typically shorter than residual maturity.

<sup>182</sup> The Standard Formula capital charges for corporate bonds are set out in the EU Solvency II Delegated Act as modified by the UK "Solvency 2 and Insurance (Amendment, etc.) (EU Exit) Regulations 2019". Article 180 says that "Exposures in the form of bonds and loans to the following shall be assigned a risk factor stress; of 0 %... United Kingdom central government and Bank of England denominated and funded in pounds sterling". In other words, there is a capital charge of 0% for NGs/ILGs. Article 176 shows the capital charges for corporate bonds in 176(3). AAA corporate bonds are of credit quality step 0 based on the EIOPA mapping table. Hence the capital charge for an AAA corporate bond with e.g. 12Y residual duration is 7% + 0.5% \* (12Y - 10Y) = 8% multiplied by its current market value. Articles in the EU Solvency II Delegated Act can be found [here](#), modifications to this act for the UK can be found [here](#) and the EIOPA mapping table can be found [here](#).



- If there were no CY, then as the risk of the asset falls, its yield would fall in a smooth manner. In reality, as the risk of the asset falls from very small to zero, its yield drops discontinuously. Thus, there is something particularly 'convenient' about an asset being perfectly risk-free, beyond the cash flow effect
- This additional demand may stem from the reasons above, such as perfect safety allowing an asset to be posted as collateral and satisfy regulatory capital requirements. However, there may be additional reasons, e.g. the 'zero-risk bias' meaning that investors view a perfectly safe asset as markedly different from an almost perfectly safe one
- As Krishnamurthy and Vissing-Jørgensen (2012) note: *"The safety explanation for low Treasury yields is distinct from that suggested by any of the standard representative agent model explanations of high risk premia in asset markets. This literature has demonstrated how altering the preferences of a representative agent to feature high risk aversion can produce low riskless interest rates and high risk premia. Thus, in the representative agent model there will be a negative relation between the price of a bond and its default risk. However, the quantity of convenience assets is unrelated to asset prices in the representative agent model. A way to think about how safety demand works is that the relation between price and default risk is very steep near zero default risk, over and above the negative relation implied by the representative agent model. Furthermore, the slope of this curve near zero default risk decreases in Treasury supply. This latter prediction generates a negative relation between the corporate Treasury bond spread and Treasury supply (at a given level of corporate bond default risk) and is how to distinguish the safety explanation from a standard risk-based explanation"*
- Both NGs and ILGs bear no risk of default because the government can in practice always print money to honour its GBP debt obligations, and so both exhibit the safety element of CY. The CMA recognised the safety of NGs and ILGs in the PR19 FD: *"The UK government enjoys a very strong credit rating...and as a sovereign nation has monetary and fiscal levers to support debt repayment that are not available to commercial lenders"*<sup>183</sup>

## 6.5 Differing risk-free borrowing and saving rates

In the textbook CAPM, it is assumed that investors can borrow and save at the same risk-free rate. Where the risk-free borrowing rate is higher than the risk-free saving rate (as is the case in the real world), the appropriate risk-free rate for the CAPM lies between the two rates in line with Brennan (1971). The CMA viewed its decision at PR19 to base the risk-free rate on the yields on both ILGs and AAA corporate bonds as an application of Brennan (1971). The Report considers that (1) the yield on AAA corporate bonds is a conservative upper bound as it is a conservative estimate of the investor borrowing rate; and (2) a better estimate for the lower bound (i.e. risk-free saving rate) is the yield on ILGs adjusted for CY. Ofwat has not captured that investors have different borrowing and saving rates despite this being a key factor in the CMA's PR19 FD.

This section considers how the CAPM changes when the risk-free borrowing rate is higher than the risk-free saving rate, which is the case in practice. It first considers the case in which these rates are the same, as in the textbook CAPM, and then shows how the cost of equity changes when they differ.

### 6.5.1 Same borrowing and saving rates

In the CAPM, an investor can invest their wealth in the market portfolio (beta of 1) and the risk-free asset (beta of 0).

Let  $x$  be the proportion of their initial wealth that they invest in the market portfolio. Assume they start by investing their initial wealth entirely in the market portfolio, i.e.  $x = 1$  and so  $\beta = 1$ :

- A conservative investor can reduce their risk by moving some of their initial wealth out of the market portfolio and into the risk-free asset, i.e. saving at the risk-free rate. Their final portfolio has  $x$  of 0-1 and therefore  $\beta$  of 0-1

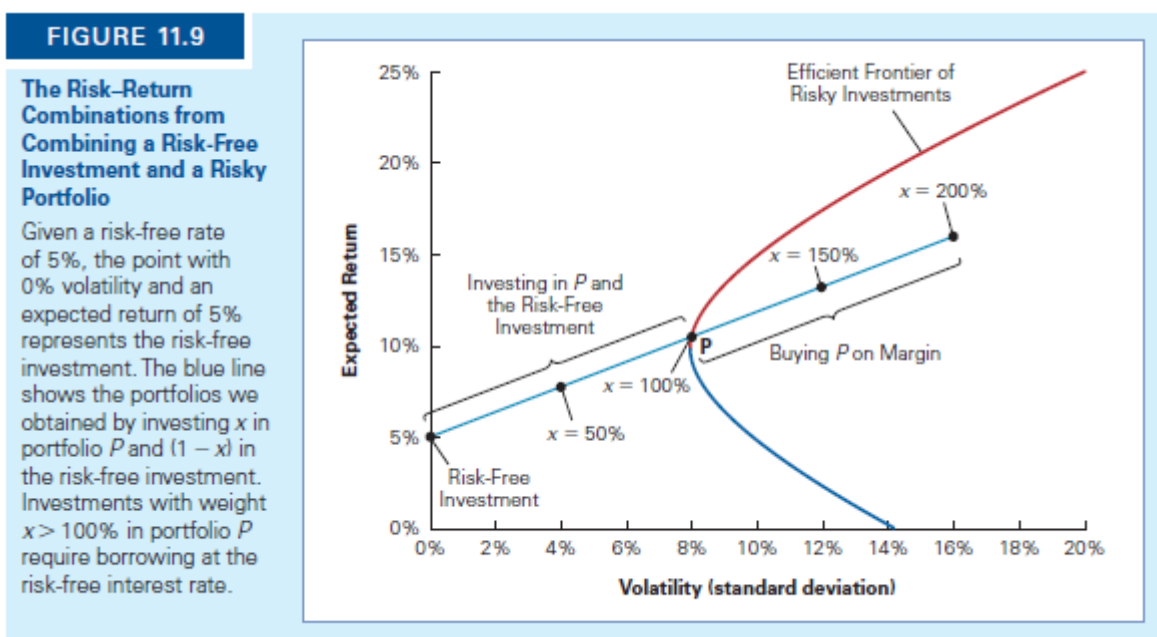
<sup>183</sup> CMA (2021), PR19 Final Determination, para. 9.103

- An aggressive investor can increase their risk by short selling the risk-free asset, i.e. borrowing at the risk-free rate, and investing more than their initial wealth in the market portfolio ( $x > 1$ ). Their final portfolio has  $x > 1$  and therefore  $\beta > 1$ <sup>184</sup>

Importantly, whilst the aggressive investor seeks a portfolio with a  $\beta > 1$ , they are willing to hold the market portfolio even though its  $\beta$  is only 1. The market portfolio contains some stocks with  $\beta < 1$  (such as utilities) and others with  $\beta > 1$  (such as tech), leading to an overall  $\beta$  of 1. The aggressive investor achieves a  $\beta > 1$  not by selling utilities and holding only tech, but by borrowing to invest more than their initial wealth in the market portfolio.

This relationship is illustrated in the following figure from Berk and DeMarzo (2014).

**Figure 8 The risk–return combinations from combining a risk-free investment and a risky portfolio**



Source: Berk and DeMarzo (2014)

## 6.5.2 Different borrowing and saving rates

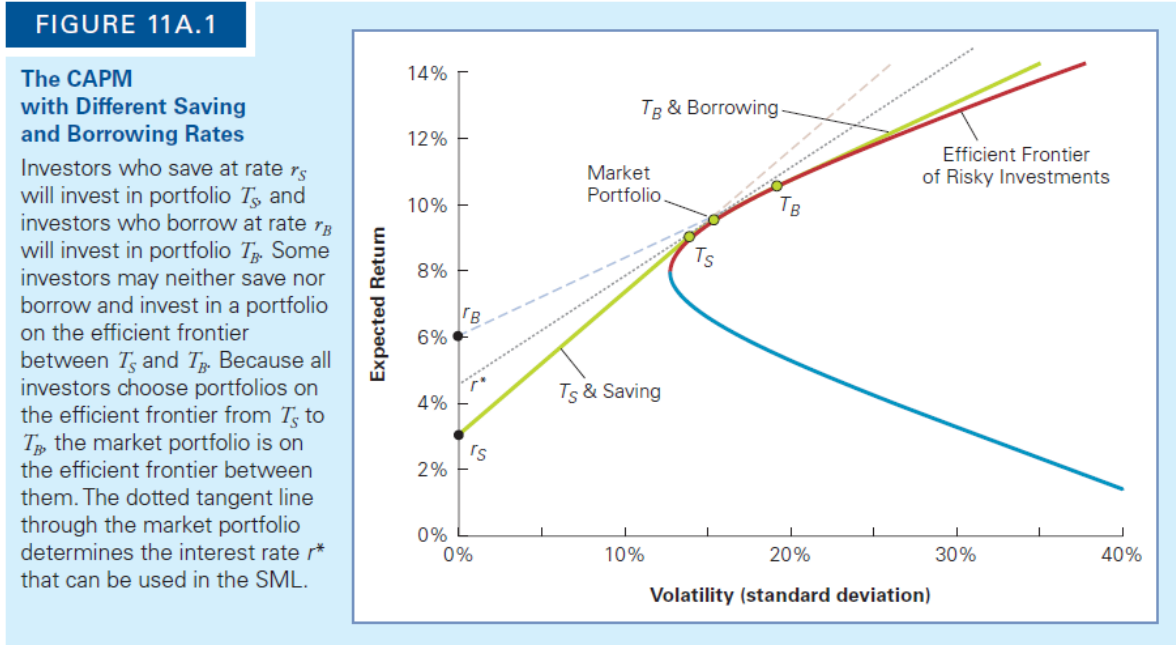
The textbook CAPM assumes that all investors can borrow and save at the same risk-free rate. This section considers the case in which the risk-free borrowing rate ( $r_B$ ) is higher than the risk-free saving rate ( $r_S$ )<sup>185</sup>. This is formally analysed in Brennan (1971)<sup>186</sup>; the following figure from Berk and DeMarzo (2014) illustrates his findings:

<sup>184</sup> This leveraged investment in the market portfolio has higher risk than investing in the market portfolio using only the investor's own wealth because leverage amplifies the impact of returns/losses on the market portfolio to the investor.

<sup>185</sup> Note  $r_S$  is equal to the risk-free rate in the previous section where it is assumed that investors borrow and save at the same risk-free rate. However, now  $r_B$  increases above  $r_S$ .

<sup>186</sup> Brennan, M. (1971), 'Capital Market Equilibrium with Divergent Borrowing and Lending Rates'

Figure 9 The CAPM with different saving and borrowing rates



Source: Berk and DeMarzo (2014)

As shown in the figure, the risk-free rate in the CAPM formula,  $r^*$ , is a weighted average of the borrowing rate  $r_B$  and the saving rate  $r_S$ . This is because some investors in the market portfolio are conservative investors who save and face a risk-free rate of  $r_S$ ; others are aggressive investors who borrow and face a risk-free rate of  $r_B$ . As Brennan (1971) writes:

*“...the only difference in the market equilibrium condition introduced by divergence of borrowing and lending rates is that the intercept of the capital market line is shifted. This intercept represents the expected rate of return on a security with a return which has zero covariance with the return on a value-weighted market portfolio of all securities and may be referred to as the market's equivalent risk-free rate.*

*It is apparent...that this market equivalent risk-free rate of interest is a weighted average of the individual investor's equivalent risk-free rates...Thus the market equivalent risk-free rate is constrained to lie between the borrowing rate  $b$  and the lending rate  $l$ ”.*

To understand why  $r^*$  is the appropriate risk-free rate for the CAPM, assume the CAPM were instead based on the risk-free saving rate of  $r_S$ . Then the return on a utilities stock,  $r_U$ , would be given by:

$$r_U = r_S + \beta \times (r_M - r_S)$$

Since  $r_B > r_S$ , borrowing is relatively expensive. Aggressive investors respond by reducing their borrowing. Given their reduced borrowing, aggressive investors can now only achieve a  $\beta > 1$  by deviating from the market portfolio. In particular, they will invest more in  $\beta > 1$  stocks such as tech and less in  $\beta < 1$  stocks such as utilities. Selling out of utilities decreases their stock price and increases their expected return<sup>187</sup> until it becomes:

$$r_U = r^* + \beta \times (r_M - r^*)$$

<sup>187</sup> A lower current stock price means a higher future expected return.

Market clearing implies that all assets have to be held by someone. Thus, if utilities are not held by aggressive investors, they must be disproportionately held by conservative investors. Such investors overweight utilities compared to the market portfolio and hence are not fully diversified – they bear the idiosyncratic risk of the utilities sector. The only way that they are willing to do so is if utilities offer a return of  $r^* + \beta \times (r_M - r^*)$  rather than  $r_S + \beta \times (r_M - r_S)$ .

In sum, where  $r_B > r_S$ , utilities are less attractive to investors and so investors require a higher return to hold them.

This analysis highlights a key flaw in an argument made by Ofwat and its advisers at PR19 that the marginal investor in utilities is a net lender (e.g. pension fund) and therefore only  $r_S$  is relevant for estimating the required return for a utilities investor<sup>188</sup>. The higher cost of capital is not due to pension funds facing the borrowing rate  $r_B$  themselves, but no longer being fully diversified. Indeed, the CMA ultimately decided that it is was not necessary to define the exact nature of the marginal investor and the rate at which they borrow<sup>189</sup>.

### 6.5.3 Borrowing and saving rates in the real world

The last two sections demonstrate that the appropriate risk-free rate for the CAPM depends on whether borrowing and savings rates are the same or different. This section discusses which of the two cases applies in the real world.

It is well established that, in the real world, most investors borrow at a higher rate than they save:

- Berk and DeMarzo (2014): “*The risk-free interest rate in the CAPM model corresponds to the risk-free rate at which investors can both borrow and save. We generally determine the risk-free saving rate using the yields on U.S. Treasury securities. Most investors, however, must pay a substantially higher rate to borrow funds*”<sup>190</sup>
- CMA PR19 FD: “*Rather, we are trying to calibrate our estimate of the RFR acknowledging that the ILG rate is available to all lenders but only one borrower, and that even the highest quality borrowers in the country could not access this rate*”<sup>191</sup>. The CMA asserted repeatedly throughout the FD that the ILG rate was below the rate at which most investors could in practice borrow

Ofwat’s advisers at PR19 suggested that, even if all investors cannot literally borrow at the risk-free savings rate, they can effectively do so by shorting the risk-free asset: “*Europe Economics stated that in shorting a government bond, the investor takes on a negative obligation of government bonds instead of being owed an amount of money. Europe Economics stated that what is required by the CAPM is that investors can owe risk-free assets as well as hold risk free assets. Europe Economics stated that there is a range of ways that investors can short government debt, including shorting a bond exchange-traded fund (ETF), purchasing ETF put options or government bond put options, or trading in bond futures*”<sup>192</sup>. This logic is flawed for two reasons.

First, whilst there is no real differentiation between borrowing at the risk-free rate and shorting the risk-free asset in theory, in practice it is more expensive to short-sell. This is because there are higher transaction costs and more stringent collateral requirements associated with short-selling. For example, generally only financial assets can be posted as collateral for short-selling whereas both financial and non-financial assets can be used for borrowing. Indeed, the CMA recognised at PR19 that “*...excluding the costs and collateral requirements from such a transaction make it an impractical consideration when trying to assess a reasonable level of the RFR in the ‘real world’*”<sup>193</sup>.

Second, this logic may misunderstand the CAPM. In the CAPM, aggressive investors borrow to obtain more money that they can invest in the market portfolio. However, if an investor were to buy options, they would have less money as they have bought the options; nor does buying the options allow them to finance the purchase of more shares. The same concerns apply to trading in bond futures.

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<sup>188</sup> CMA (2021), PR19 Final Determination, paras. 9.127-8 and 9.247

<sup>189</sup> Ibid., paras. 9.159 and 9.265

<sup>190</sup> Berk, J. and DeMarzo, P. (2014), Corporate Finance, p. 404

<sup>191</sup> CMA (2021), PR19 Final Determination, para 9.159

<sup>192</sup> Ibid., paras. 9.73-4

<sup>193</sup> Ibid., para. 9.105

## 6.5.4 CMA's application of Brennan (1971) at PR19

The CMA views its decision to base the risk-free rate on the yields on both ILGs and AAA corporate bonds as an application of Brennan (1971)<sup>194</sup>. Brennan (1971) showed that  $r^*$  lies in between  $r_S$  and  $r_B$ . CMA used the yield on ILGs as a proxy for  $r_S$  and thus a lower bound on  $r^*$ , and the yield on AAA corporate bonds as a proxy for  $r_B$  and thus an upper bound on  $r^*$ .

The CMA's interpretation of the figure from Berk and DeMarzo is also consistent with this application of Brennan (1971). The CMA's "...interpretation of Berk and DeMarzo analysis is that in order to achieve an accurate estimate of the 'market rate' for the RFR, we need to find proxies that... are available to relevant market participants. We can then best estimate the RFR by using a level that takes account of rates suggested by these close proxies. We consider below the relevance of ILGs and high quality corporate bonds as proxies on that basis"<sup>195</sup>.

Whilst the CMA's decision to use estimates of  $r_S$  and  $r_B$  as bounds for  $r^*$  is in line with Brennan (1971), it is important to examine whether the CMA used the best possible estimates of  $r_S$  and  $r_B$ .

First, the CMA justified its use of the yield on AAA corporate bonds as the upper bound because:

- CMA PR19 FD: "...the risk of loss resulting from default on these bonds is exceptionally low..."<sup>196</sup> and "...non-government bonds with the highest possible credit rating provide an input that is both very close to risk free (issuers with a higher credit rating than the UK government, but with some inflation and default risk) and is at least closer to representing a rate that is available to all (relevant) market participants"<sup>197</sup>
- Berk and DeMarzo (2014): "...practitioners sometimes use rates from the highest quality corporate bonds in place of Treasury rates in Eq. 12.1 [CAPM]"<sup>198</sup>

However, what matters is the rate at which investors borrow, not the rate at which companies borrow, since it is investors who provide capital to companies. The AAA corporate borrowing rate is a conservative estimate of the investor borrowing rate since corporates are backed by hard assets whereas investors are backed by securities whose prices can significantly fluctuate. Thus, the true upper bound might be higher than the yield on AAA corporate bonds.

Second, the CMA used the ILG yield as its estimate of  $r_S$ . However, as discussed in section 6.4, CY(ILG) needs to be added on to obtain the 'true' risk-free saving rate.

In conclusion, the appropriate risk-free rate for the CAPM lies between the CY-adjusted return on ILGs and at least the yield on AAA corporate bonds. This conclusion is consistent with Brennan (1971) and the substantial academic literature on CY.

## 6.5.5 Ofwat's treatment of borrowing and saving rates in the PR24 FM

Ofwat in the PR24 FM acknowledged that "several companies argued that index-linked gilt yields understated the 'true' risk-free rate...because market participants could not borrow at this rate"<sup>199</sup>. However Ofwat does not respond to the argument or mention it any further. In effect, Ofwat has dismissed this key factor in the CMA's decision on risk-free rate without providing rationale as to why.

## 6.5.6 Appropriate risk-free rate for the CAPM under all states of the world

The sections above assume that the risk-free saving rate can be identified and thus explain the second column in the table below. This section also explores situations where the risk-free saving rate cannot be identified (the third column in the table below).

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<sup>194</sup> Ibid., para. 9.263

<sup>195</sup> Ibid., para. 9.94

<sup>196</sup> Ibid., para. 9.146

<sup>197</sup> Ibid., para. 9.149

<sup>198</sup> Berk, J. and DeMarzo, P. (2014), Corporate Finance, p. 404

<sup>199</sup> Ofwat (2022), PR24 Final Methodology, Appendix 11 – Allowed return on capital, p. 12



**Table 21 Bounds for the appropriate risk-free rate in the CAPM**

Bounds for $r^*$	$r_s$ can be identified	$r_s$ cannot be identified
Lower bound for $r^*$ ( $r_s$ )	ILG yield + CY(ILG)	Zero-beta return
Upper bound for $r^*$ ( $r_B$ )	AAA corporate bond yield	Zero-beta return + shorting costs

Notes: AAA corporate bond yield captures ILG yield + an adjustment based on the difference in yield between ILGs and AAA corporate bonds  
Source: KPMG analysis

The risk-free saving rate may not be identified either if there is no risk-free asset, or the risk-free asset bears CY which cannot be estimated. In this case,  $r_s$  is replaced by the return on the zero-beta asset. The only way that an investor can borrow is by shorting the zero-beta asset and thus  $r_B$  is the return on the zero-beta asset *plus* shorting costs. Then  $r^*$  lies between 'zero beta return' and 'zero beta return *plus* shorting costs' i.e. it becomes the zero beta return *plus* a proportion of shorting costs.

## 6.6 Quantitative analysis of the risk-free rate

The lower bound adjustment to ILGs is based on CY(ILG) and the upper bound adjustment is based on the difference in yields between ILGs and AAA corporate bonds.

CY(ILG): Academic literature estimates that CY(NG) for 2Y NG is 38bps and Ofwat uses this to derive an estimate of CY(ILG) for 2Y ILG of 7bps. Ofwat considers that this 7bps may not hold at longer tenors and ultimately decides not to provide CY adjustment. There are issues in Ofwat's analysis which once resolved imply that CY(ILG) for 2Y ILG is 11bps and could be higher at longer tenors (based on academic literature for CY(NG) and cross-checks for CY(ILG)). The Report adopts a point estimate for CY(ILG) at the midpoint (24.5bps) of 11bps and 38bps which recognises that (1) the determinants of CY apply similarly for NGs/ILGs but NGs may be more liquid; and (2) the 11bps and 38bps will be higher under current market conditions based on recent data and academic literature.

AAA-ILG difference: Approaches based on CMA PR19 FD, CAA H7 FD and RPI AAA bonds imply estimates of 41-75bps. The Report adopts the estimate from RPI AAA bonds of 66bps as the point estimate as it represents the most direct approach for deriving the AAA-ILG difference.

Overall range and point estimate for the risk-free rate: The risk-free saving rate is the ILG yield + 24.5bps and the risk-free borrowing rate is the ILG yield + 66bps. Brennan (1971) does not specify where in this range the appropriate risk-free rate for the CAPM should lie. The CMA in its application of Brennan (1971) at PR19 determined the risk-free rate to be the midpoint of its estimates of the risk-free saving and borrowing rates. The Report adopts the same approach and so concludes that the required adjustment to ILG yields is 45bps (slightly below the midpoint). This is conservative since the use of AAA corporate bonds at the upper end underestimates the true investor borrowing rate.

Combining the ILG yield under Ofwat's approach of 1.48% CPIH-real with the point estimate for the adjustment of 45bps implies an overall estimate for the risk-free rate of 1.93% CPIH-real.

This section estimates the adjustment required to ILG yields to arrive at the appropriate risk-free rate for the CAPM as per Table 21.

### 6.6.1 Ofwat's estimate of CY(ILG) adjustment in the PR24 FM

Ofwat in the PR24 FM estimates CY(ILG) for a 2Y ILG. Ofwat starts with CY(NG) of 38bps for a 2Y NG from Diamond and Van Tassel (2021)<sup>200</sup>. It then applies the following from Liu et al. (2015)<sup>201</sup>:

$$CY(NG) - CY(ILG) = \text{Gilt BEI} - \text{Swap BEI} \quad (1)$$

<sup>200</sup> Diamond, W. and Van Tassel, P. (2021), 'Risk-Free Rates and Convenience Yields Around The World'

<sup>201</sup> Liu, Z., Vangelista, E., Kaminska, I. and Relleen, J. (2015), 'The informational content of market-based measures of inflation expectations derived from government bonds and inflation swaps in the United Kingdom'

Ofwat finds that the difference between 2Y gilt BEI (breakeven inflation rate) and 2Y swap BEI to be 31bps<sup>202</sup> and thus derives a CY(ILG) for a 2Y ILG of 7bps.

Ofwat argues that this level of CY(ILG) may not hold at longer tenors: *“This short maturity implies good liquidity for these instruments but poses a challenge in applying their findings to our specific context where we assume a CAPM investment horizon between 10 and 20 years”*<sup>203</sup>. Ofwat concludes that there is insufficient evidence to warrant an adjustment for CY(ILG).

There are three methodological issues implied by Ofwat’s approach.

First, Ofwat attributes the entire gap between gilt BEI and swap BEI to the greater liquidity of NGs relative to ILGs, and thus a higher CY for NGs. However, the difference could also be due to the illiquidity of inflation swaps, as the following discussion will make clear.

Ofwat implicitly assumes that:

$$\text{Swap BEI} = \text{expected inflation} + \text{inflation risk premium} \quad (2)$$

i.e. that the swap BEI arises *only* because of expected inflation and the inflation risk premium.

However, if inflation swaps are illiquid in reality, then the inflation seller will demand a higher rate to compensate for this illiquidity. As a result, the true swap BEI is given as follows:

$$\text{Swap BEI} = \text{expected inflation} + \text{inflation risk premium} + \text{inflation swap illiquidity premium} \quad (3)$$

and so:

$$\text{CY(NG)} - \text{CY(ILG)} = \text{Gilt BEI} - \text{Swap BEI} + \text{inflation swap illiquidity premium} \quad (4)$$

Comparing (4) with (1) shows that Ofwat has ignored the inflation swap illiquidity premium. Due to this premium, the 31bps difference between the gilt BEI and swap BEI could be because inflation swaps are illiquid, rather than because NGs are liquid.

Christensen and Gillan (2012)<sup>204</sup> confirm that the gap between gilt BEI and swap BEI is due not only to the liquidity of NGs relative to ILGs, but also to the illiquidity of swaps. They comment *“...in a world without frictions to trade, BEI should equal the inflation swap rate. However, in reality, the observed BEI and inflation swap rates are not the same. We attribute the difference between the two to non-negative liquidity premiums in both the TIPS and inflation swap markets that reflect the distance these markets are from the ideal frictionless outcome”*. They explicitly refer to *“...our measure of the sum of TIPS and inflation swap liquidity premiums...”*, affirming that the difference between gilt BEI and swap BEI does not measure the liquidity of NGs relative to ILGs alone.

Practitioner articles suggest that short-dated inflation swaps in the UK (e.g. 2Y inflation swap that Ofwat relies on for swap BEI) may be illiquid: *“One of the downsides is that the sterling inflation swap market is less liquid than the sterling interest rate swap market,” agrees Philip Rose, head of ALM at Redington Partners. “Liquidity is concentrated in the longer 20-to-50-year tenors, while short-dated inflation swaps - below 10 years - are relatively illiquid”*<sup>205</sup>.

The swap illiquidity premium for Ofwat’s 2Y inflation swap (excluding dates in Ofwat’s estimation window where 2Y ILG data is not available) is 4bps<sup>206</sup>. This data has been obtained from Refinitiv Eikon. Taking account the inflation swap illiquidity premium of 4bps in (4) reduces the difference between CY(NG) and CY(ILG) from 31bps to 27bps. This implies CY(ILG) of 11bps.

As a result, at a minimum an allowance for CY(ILG) of 11bps should be provided.

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<sup>202</sup> Ofwat (2022), PR24 Final Methodology, Appendix 11 – Allowed return on capital, p. 97. Ofwat uses an estimation window of 18/06/2007 to 27/07/2020 to broadly align with the Diamond and Van Tassel (2021) estimation window (01/02/2004 to 27/07/2020). Ofwat is not able to exactly mirror the Diamond and Van Tassel window due to data availability issues.

<sup>203</sup> Ibid., p. 95

<sup>204</sup> Christensen, J. and Gillan, J. (2012), ‘Could the U.S. Treasury Benefit from Issuing More TIPS?’

<sup>205</sup> <https://www.ipe.com/inflation-buyers-using-swaps/28413.article>

<sup>206</sup> Bid and ask for an inflation swap relates to the fixed leg. The bid represents the yield the ‘buyer’ of the swap is willing to pay whereas the ask represents the yield the ‘seller’ of the swap is willing to accept. Half of the difference between the two (i.e. bid-ask spread) in absolute terms is the inflation swap illiquidity premium. It is only half the difference because the ‘true’ rate (with perfect liquidity) would be the midpoint. Thus, the penalty suffered from having to receive the bid or pay the ask is the difference between e.g. the ask and the midpoint.

Second, CY(ILG) could be higher than 11bps at longer tenors than 2Y. Indeed, Diamond and Van Tassel (2021) shows that CY(NG) in the UK appears to increase at longer tenors. For example, CY(NG) at 3m tenor is 22bps but increases to 38bps at 2Y tenor<sup>207</sup>.

Given these observations in the academic literature and the absence of data to the contrary, it is reasonable to assume that CY(ILG) of at least 11bps continues to hold at longer tenors. Moreover, it is well known that pension funds and insurance companies have significant demand for index-linked debt at longer tenors given they have long-dated, inflation-linked liabilities. This may put upwards pressure on CY(ILG) at longer tenors.

Third, Diamond and Van Tassel find that *"a country's average convenience yield increases 15 basis points with a 1% rise in nominal interest rates"*. Diamond and Van Tassel's analysis was between 2004 and 2020. However, interest rates have since risen significantly, so their estimate of 38bps for CY(NG) would likely be significantly higher under current market conditions. Relatedly, updating (4) for data until 16/03/2023 implies a difference between CY(NG) and CY(ILG) of 26bps, slightly lower than the 27bps above based on data until 27/07/2020. All else equal, this suggests that the 11 bps for CY(ILG) is likely to be understated in current market conditions.

In conclusion, CY(ILG) is likely to lie between the 11bps derived above and the 38bps estimate of CY(NG) from Diamond and Van Tassel (2021). This recognises that the majority of CY factors cited in academic literature appear to apply similarly to NGs/ILGs but NGs may be more liquid than ILGs, based on the analysis in section 6.4.3.

The 38bps may be considered a conservative upper bound as CY(ILG) is likely to be higher under current market conditions. Further, CY(ILG) could be higher than 38bps at longer tenors based on (1) the term structure of CY in the UK from Diamond and Van Tassel; and (2) cross-checks for CY(ILG) at longer time horizons, which are set out in section 6.6.5.

The 11bps may also be considered a conservative lower bound as it uses the same 38bps as a starting point (which is likely to be higher under current market conditions) and the difference between CY(NG) and CY(ILG) is marginally lower with the inclusion of more recent data.

On balance, it does not appear appropriate to place excessive weight on the lower bound. As such the midpoint of the range of 24.5bps is selected as the point estimate for CY(ILG).

As shown in Table 21, adding CY(ILG) to the ILG yield gives a lower bound for the appropriate risk-free rate. This is because it takes into account CY, but not the difference in borrowing and saving rates. The next sections estimate the upper bound for the appropriate risk-free rate by using the return on AAA corporate bonds as a proxy for investors' borrowing rate.

## 6.6.2 Application of CMA's PR19 approach based on AAA corporate bonds

The CMA estimated the risk-free rate for the CAPM as the midpoint of ILG and AAA bond yields. The CMA estimated the AAA bond yield in CPIH terms as follows:

- Average the yield on the iBoxx non-Gilts AAA-rated 10+ years and 10-15 years indices
- Deflate the resultant yield using a 2% long-term CPIH assumption
- Average the deflated yield over a 6m estimation window (01/07/2020 to 31/12/2020)

The CMA estimated the ILG yield in CPIH terms as follows:

- Inflate the yield on a 20Y ILG index using a 0.9% RPI-CPIH wedge assumption
- Average the inflated yield over the same 6m estimation window

The resulting ILG and AAA bond yields can be compared like-for like. This is because over the CMA's estimation window the average tenor of the combined iBoxx index was c.19Y which is in line with the 20Y tenor of the ILG index. The difference between the two yields was 58bps.

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<sup>207</sup> Estimates of CY(NG) in the US imply that, even in the worst case, CY is independent of maturity. Diamond and Van Tassel (2021) comment that *"US bonds have an average convenience yield of roughly 35 basis points, with a nearly flat term structure of convenience yields"* across maturities of 3m to 2Y. Van Binsbergen et al. (2022) comment that *"the average difference between the SPX implied rate and the government bond rate (i.e., the convenience yield), is 35-37 basis points per year, with very little variation across maturities"* of 6m to 18m.

The CMA estimated the upper bound of the adjustment required to ILGs using a 6m estimate of AAA bond yields. Based on the 6m to 30/06/2023, the difference between ILG yields in CPIH terms and AAA bond yields in CPIH terms was 82bps. As the AAA bond indices comprise only a small sample size of instruments, the yield on the indices may be unstable over a short time horizon. Thus it may be appropriate to take a longer window to calculate the upper bound adjustment required to ILGs. This is consistent with Ofwat's approach to CY, the basis of the lower bound adjustment required to ILGs.

To this end, updating the CMA's analysis for Ofwat's CY estimation window (18/06/2007 to 27/07/2020) implies an upper bound adjustment to ILGs of 75bps. This result is not sensitive to the inclusion of more recent data. The average tenor of the combined iBoxx index was c.16Y over this estimation window which is shorter than 20Y tenor of the ILG index. Under a normal yield curve, this could imply that 75bps may be an underestimate of the required adjustment.

### 6.6.3 Application of CAA's H7 approach based on AAA corporate bonds

The CAA estimates its view of CY(NG) by comparing the yield on each of the iBoxx non-Gilts AAA-rated 10+ years and 10-15 years indices to the yield on NGs of the closest maturity:

- Compares iBoxx non-Gilts AAA-rated 10+ years index to NGs of 20Y tenor
- Compares iBoxx non-Gilts AAA-rated 10-15 years index to NGs of 12.5Y tenor
- Averages the difference in yields over a 1m estimation window (01/03/2022 to 31/03/2022) as 1m represents the trailing average length for the CAA's estimate of risk-free rate

The result of the CAA's calculation is an adjustment of 32bps. The CAA then directly applies this adjustment based on NGs to ILGs which are basis of its risk-free rate estimate. Hence it implicitly assumes that adjustments based on NGs are a good proxy for equivalent ILG adjustments.

Whilst the CAA refers to the 32bps adjustment as CY (which would imply that it is a lower bound for the adjustment required to ILG yields), instead it should be thought of as relating to the upper bound. This is because CY is the difference in yields between two equally safe assets, and AAA rated bonds are less safe than NGs. However, as shown in Table 21, the AAA bond yield is the upper bound for the appropriate risk-free rate as this is the rate at which corporates can borrow (if investors can only borrow at a higher rate, then the upper bound is even higher).

Updating the CAA's analysis for Ofwat's CY estimation window implies an upper bound adjustment to ILGs of 41bps. This result is not sensitive to the inclusion of more recent data.

### 6.6.4 Estimate of AAA corporate bond adjustment based on RPI AAA bonds

The upper bound of the adjustment for ILGs can be estimated directly by comparing the yield on RPI-linked AAA bonds to the yield on maturity-matched ILGs. This approach is conceptually consistent with those adopted by CMA and CAA but different in that those approaches rely on nominal bonds.

The approach is carried out as follows:

- Download the daily yield, daily market value, issue date and maturity date for RPI-linked bonds which have consistently been rated as AAA throughout their life<sup>208</sup>
- Compare the daily yield on each AAA RPI-linked bond to the daily yield on a maturity-matched ILG where data is available
- Calculate a daily market value-weighted average of the AAA-ILG difference across the AAA RPI-linked bonds
- Average this market value-weighted average over the estimation window (02/07/2018 to 30/06/2023)

The result of this calculation implies an upper bound adjustment to ILGs of 66bps.

There are on average 8 AAA RPI-linked bonds with a remaining maturity of 10.3Y over the estimation window. These bonds are all from the financial sector and are not asset-backed securities.

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<sup>208</sup> Restricted to GBP denominated debt (but no restriction on issuers' domicile), includes active and matured instruments.

It was previously argued at PR19 that a weakness of the iBoxx AAA indices is that these mostly comprise financial sector issues. However, the CMA noted that “...most of the ‘financial sector’ bonds in the indices are sub-sovereign bonds issued either by government backed agencies or by supranational organisations with multiple sovereign sponsors”<sup>209</sup>. This also applies in the case of AAA RPI-linked bonds which have all been issued by either: the European Investment Bank, the European Bank for Reconstruction and Development, the International Bank for Reconstruction and Development or the Nordic Investment Bank. This means that the bonds are effectively very low risk, which is the key consideration for risk-free rate, not the sector of issue.

The estimation window for the analysis was selected to optimise for data availability. This is in line with Ofwat’s approach to CY analysis whereby it adopts an estimation window that it is not entirely consistent with Diamond and Van Tassel (2021) due to data availability issues.

### **6.6.5 Cross-check of CY(ILG) adjustment based on AAA corporate bonds**

CY can in theory be estimated by adjusting the yield on AAA corporate bonds for risk and then finding the difference between the resultant yield and the yield on gilts. Estimates of CY using this approach serve as a cross-check for estimates of CY based on academic literature, set out in section 6.6.1.

In the PR24 FM, Ofwat endorses this approach for estimating CY: “The CAA’s 32bp estimate of the convenience yield is derived by comparing the yield of the nominal gilt closest in tenor to the CMA’s AAA-rated corporate bond index with that index. It has the advantage of being derived via a simple and easily-reproducible approach, but the estimate is likely to capture other risk premia (eg default and complexity risk) in AAA rated gilts alongside the convenience yield”<sup>210</sup>.

Ofwat comments that the yield on AAA corporate bonds may be affected by three types of risk:

- Default risk
- Complexity risk
- Illiquidity risk

#### **Default risk**

AAA corporate bonds bear very low risk but are not risk-free in the same way as gilts. This means that the yield on these bonds may reflect a default premium.

The default premium can be estimated by multiplying the annualised default rate for AAA rated corporate issuers by the loss rate for senior unsecured bonds<sup>211</sup>. Default studies undertaken by rating agencies provide cumulative default rates and recovery rates which can be used to derive annualised default rates and loss rates. The data from these default studies are set out in the tables below.

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<sup>209</sup> CMA (2021), PR19 Final Determination, para. 9.150

<sup>210</sup> Ofwat (2022), PR24 Final Methodology, Appendix 11 – Allowed return on capital, p. 15

<sup>211</sup> This approach estimates the default premium for corporate bonds but not for structured finance bonds.



**Table 22 Cumulative and annualised default rates for AAA rated corporate issuers**

Default study	Time period	Region	Time horizon	Cumulative default rate	Annualised default rate
Moody's Apr 2021 <sup>212</sup>	1985-2020	Global	10Y	0.03%	0.00%
		Europe	10Y	0.04%	0.00%
Moody's Feb 2022 <sup>213</sup>	1920-2021	Global	10Y	0.68%	0.07%
			20Y	1.30%	0.07%
	1970-2021	Global	10Y	0.35%	0.04%
			20Y	0.72%	0.04%
	1983-2021	Global	10Y	0.13%	0.01%
			20Y	0.13%	0.01%
	1998-2021	Global	10Y	0.02%	0.00%
			20Y	Data not published	
Fitch Mar 2023 <sup>214</sup>	1990-2022	Global	10Y	1.35%	0.13%
		EMEA	10Y	--	--
S&P Apr 2023 <sup>215</sup>	1981-2022	Global	10Y	0.69%	0.07%
			15Y	0.89%	0.06%
		Europe	10Y	0.00%	0.00%
			15Y	Data not published	

Notes: (1) Cumulative default rates are issuer-weighted; (2) Annualised default rate = cumulative default rate / time horizon  
Source: KPMG analysis and data from Moody's, Fitch, and S&P

The default studies indicate that AAA rated corporate issuers have very low default rates, ranging between 0% and 0.13% on an annualised basis. Interestingly, the annualised default rates across different time horizons differ only marginally i.e. are effectively the same.

The CMA at PR19 also cited default studies, namely the 2019 S&P study, in coming to its view that AAA corporate bonds were exceptionally low risk<sup>216</sup>. The 2019 S&P study showed that the 15-year cumulative average default rate was 0.91%. The most recent S&P study suggests that this rate has declined to even lower levels, specifically to 0.89% as illustrated in the table above. In other words, AAA corporate issuers have become slightly less risky since the CMA formed its view at PR19.

**Table 23 Recovery and loss rates for senior unsecured bonds**

Default study	Time period	Region	Recovery rate	Loss rate
Moody's, Apr 2021 <sup>217</sup>	1985-2020	Global	37.62%	62.38%
		Europe	36.75%	63.25%
Moody's, Feb 2022 <sup>218</sup>	1983-2021	Global	38.00%	62.00%

Notes: (1) Recovery rates are issuer-weighted; (2) Loss rate = 1 – recovery rate  
Source: KPMG analysis and data from Moody's

<sup>212</sup> Moody's (2021), Default and recovery rates of European corporate issuers, 1985-2020, Exhibit 15

<sup>213</sup> Moody's (2022), Annual default study: After a sharp decline in 2021, defaults will rise modestly this year, Exhibits 39-43

<sup>214</sup> Fitch (2023), 2022 Transition and Default Studies, Tab "Global CF Default Rates"

<sup>215</sup> S&P (2023), Default, Transition, and Recovery: 2022 Annual Global Corporate Default And Rating Transition Study, Tables 24-25

<sup>216</sup> CMA (2021), PR19 Final Determination, para. 9.147

<sup>217</sup> Moody's (2021), Default and recovery rates of European corporate issuers, 1985-2020, Exhibit 16

<sup>218</sup> Moody's (2022), Annual default study: After a sharp decline in 2021, defaults will rise modestly this year, Exhibit 6

The default studies indicate that the loss rate for senior unsecured bonds ranges between 62% and 63.25%. Berk and DeMarzo (2014) notes that the average loss rate for unsecured debt is about 60% which is broadly in line with the range from the default studies<sup>219</sup>.

The overall range for default premium is therefore 0bps to 9bps<sup>220</sup>. A point estimate of 5bps has been selected which is slightly above the midpoint of the range. This point estimate recognises that AAA corporate bonds are not risk-free but are very low risk.

### Complexity risk

Ofgem at PR19 commented that “...the Broadgate Financing bond (due 2033, 2.33% of the AAA 10+ year index and 6.74% of the AAA 1015yr index), which is a commercial property securitisation and although rated ‘AAA’ has a ‘structured finance’ suffix to the rating which means it trades with a significant complexity premium compared to a ‘natural’ AAA”<sup>221</sup>.

First, Ofgem’s analysis implies that the Broadgate Financing bond is under 5% (average of 2.33% and 6.74%) of the combined iBoxx AAA index. This does not appear to be material.

Second, in the case of the Broadgate Financing bond, it may be that there is a yield premium. However, in general, structured finance bonds could trade at a premium or discount to corporate finance bonds with the same rating. This depends on the quality of the asset backing the structured finance bond. Hence it should not be assumed that all structured finance bonds trade with a premium.

As a result, it does not appear reasonable to assume that iBoxx indices carry a complexity premium.

### Illiquidity risk

CY should capture the superior liquidity of gilts over AAA corporate bonds but importantly exclude any illiquidity present in AAA corporate bonds. To this end, it is appropriate to consider whether AAA corporate bonds could be viewed as illiquid.

In the CAPM, investors choose stocks based on only their risk and return. Since liquidity is not a factor in the investor’s decision, the CAPM assumes that all stocks are equally liquid. Put differently, all stocks in the CAPM have liquidity in line with the market average. This means that the ‘benchmark’ for liquidity is the market average and a stock is only illiquid if its liquidity is below the market average.

Applying this rationale to AAA corporate bonds suggests that these assets could only be illiquid if their liquidity is below the market average<sup>222</sup>. This is highly unlikely as AAA corporate bonds are only one notch below the risk-free asset in terms of safety/liquidity.

### Conclusion

The total estimate for the default, complexity and illiquidity risk premia embedded in AAA corporate bond yields is 5bps. This suggests that estimates of CY(ILG) can be obtained by reducing the AAA-ILG differences in the sections above by 5bps. The result is a range for CY(ILG) between 36-70bps.

These estimates of CY serve as a cross-check to those derived from academic literature and provide an indication of what CY may look like at the longer tenors on which the risk-free rate is based. The cross-check could be considered to exert upwards pressure on estimates of CY from academic literature such as the 38bps from Diamond and Van Tassel (2021).

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<sup>219</sup> Berk, J. and DeMarzo, P. (2014), Corporate Finance, p. 412

<sup>220</sup> Lower bound = 0% annualised default rate \* 62% loss rate; upper bound = 0.13% annualised default rate \* 63.25% loss rate.

<sup>221</sup> CMA (2021), PR19 Final Determination, para. 9.138

<sup>222</sup> There is no unambiguous agreement for what the benchmark liquidity should be, but one approach would be the average liquidity in the market.

## 6.6.6 Overall range and point estimate for the risk-free rate

The starting point for the risk-free rate is the 1m average of 20Y ILG yields. Data for 20Y ILG yields over June 2023 adjusted for Ofwat's RPI-CPIH wedge of 0.54% imply a starting point for the risk-free rate of 1.48% CPIH-real, as explained in section 6.3.

This section sets out estimates for the upper and lower bound adjustments required to ILG yields using the analysis above and on this basis, an overall estimate for the risk-free rate.

### Lower bound adjustment: CY(ILG)

It is challenging to estimate CY(ILG) as there is no academic literature that explores CY(ILG). Existing academic literature focuses only on CY(NG). The key academic study for the UK is Diamond and Van Tassel (2021) which estimates a CY(NG) of 38bps.

Ofwat has sought to adjust this estimate of CY(NG) to derive an estimate of CY(ILG) by finding the difference between CY(NG) and CY(ILG). Ofwat's approach arrives at an estimate for CY(ILG) of 7bps. However, Ofwat's analysis has to be amended to resolve for a key methodological issue (omission of swap illiquidity). This amendment results in a higher estimate for CY(ILG) of 11bps.

This Report considers that CY(ILG) is likely to lie between the 11bps derived from the modified Ofwat analysis and the 38bps estimate of CY(NG) from Diamond and Van Tassel. This recognises that the majority of CY factors cited in academic literature appear to apply similarly to NGs/ILGs but NGs may be more liquid than ILGs.

The 38bps may be considered a conservative upper bound as CY(ILG) is likely to be higher under current market conditions based on commentary from Diamond and Van Tassel. Further, CY(ILG) could be higher than 38bps at longer tenors based on (1) the term structure of CY in the UK from Diamond and Van Tassel; and (2) cross-checks for CY(ILG) at longer time horizons.

The 11bps may also be considered a conservative lower bound as it uses the same 38bps as a starting point (which is likely to be higher under current market conditions) and the difference between CY(NG) and CY(ILG) is marginally lower with the inclusion of more recent data.

On balance, it does not appear appropriate to place excessive weight on the lower bound. As such the midpoint of the range of 24.5bps is selected as the point estimate for CY(ILG).

### Upper bound adjustment: AAA-ILG difference

The AAA-ILG adjustment has been estimated using approaches based on CMA PR19 FD, CAA H7 FD and AAA RPI-linked bonds. These estimates are set out in the table below.

**Table 24 Range of AAA-ILG adjustments for ILGs**

Approach	Start date	End date	AAA-ILG difference
CMA PR19 FD	18 Jun 07	27 Jul 20	75 bps
CAA H7 FD	18 Jun 07	27 Jul 20	41 bps
RPI AAA bonds	02 Jul 18	30 Jun 23	66 bps

Source: KPMG analysis

The required upper bound could in practice be higher than implied by the yield on AAA bonds as the AAA corporate borrowing rate is a conservative estimate of the investor borrowing rate. This is because corporates are backed by hard assets whereas investors are backed by securities whose prices can significantly fluctuate.

In addition, Berk and DeMarzo (2014) notes that *“in practice, investors receive a lower rate when they save than they must pay when they borrow. For example, short-term margin loans from a broker are often 1–2% higher than the rates paid on short-term Treasury securities. Banks, pension funds, and other investors with large amounts of collateral can borrow at rates that are generally within 1% of the rate on risk-free securities, but there is still a difference”*<sup>223</sup>. This suggests that even collateral-rich investors have to borrow at a premium over government rates that is above that implied by the AAA corporate borrowing rate (41-75bps).

The estimate from RPI AAA bonds of 66bps is adopted as the point estimate for the upper bound adjustment for ILGs. This estimate could be considered more robust than others as it directly estimates CY(ILG) using index linked bonds instead of inferring this from nominal bonds.

### Overall range and point estimate for the risk-free rate

Based on Table 21,  $r_S$  is the ILG yield *plus* 24.5bps and  $r_B$  is the ILG yield *plus* 66bps. However, as noted above, the 66bps upper bound adjustment to ILG yields based on the AAA corporate borrowing rate underestimates the true investor borrowing rate.

Brennan (1971) states that  $r^*$  is a weighted average of the borrowing and saving rates however it does not specify the weight which should be assigned to each rate. The CMA in its application of Brennan (1971) at PR19 decided it was not necessary to assess the precise balance of borrowers and savers<sup>224</sup>. The CMA ultimately determined  $r^*$  to be the midpoint of its estimates of  $r_S$  and  $r_B$ <sup>225</sup>. In this context, it appears reasonable to select a point estimate of 45bps for the adjustment to ILG yields which is slightly below the midpoint. This is conservative since it is not likely that  $r^*$  is the same as  $r_S$  but it could be the same as  $r_B$  given that the estimate of  $r_B$  in this Report is below the true investor borrowing rate.

Combining the ILG yield of 1.48% CPIH-real with the point estimate for the adjustment of 45bps implies an overall estimate for the risk-free rate of 1.93% CPIH-real.

Separately, Ofwat may consider it is not possible to estimate CY(ILG) based on the available evidence. If this is the case, Ofwat should estimate the lower bound adjustment based on the ‘zero-beta return’ and the upper bound adjustment based on the ‘zero-beta return *plus* shorting costs’ as indicated in Table 21. However, this range based on the zero-beta return would likely imply a higher adjustment to ILGs than the range set out in this Report.

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<sup>223</sup> Berk, J. and DeMarzo, P. (2014), Corporate Finance, p. 398

<sup>224</sup> CMA (2021), PR19 Final Determination, para. 9.263

<sup>225</sup> Ibid., para. 9.265

# 7 Evolution in risk relative to PR19 and implications for pricing

This section considers in qualitative terms the evolution of risk exposure – systematic and asymmetric – faced by water companies compared to PR19 and implications for the estimation of allowed returns for PR24. The section is structured as follows:

- First, it comments on the importance of relative risk assessment for the estimation of risk-reflective returns
- Second, it sets out a framework for pricing expected PR24 risk dynamics in allowed returns
- Third, it explores how risks in the sector have evolved relative to PR19
- Fourth, it considers potential implications of the risk assessment for estimation of allowed returns at PR24

## 7.1 What is the role of relative risk assessment?

A relative risk assessment can inform whether there are differences in risk exposure at PR24 compared to previous controls and the suitability of historical beta estimates for pricing risk on a forward-looking basis.

Ofwat has not carried out a relative risk assessment as part of its PR24 FM and has implicitly assumed that the PR19 risk landscape continues to apply at PR24. This is unlikely to be an appropriate assumption as (1) a substantial and unprecedented step change in capital programmes is likely to introduce new risks and amplify existing ones; and (2) there are significant changes to regulatory mechanisms set out in the FM, including more stretching ODIs and the introduction of Price Control Deliverables (PCDs).

UKRN and Ofwat recognise the importance of allowed returns being reflective of the risk exposure faced by companies. For example, Ofwat has noted that “*companies need to be remunerated for the risk associated with their investment; customers should expect that the returns investors receive are no more than is reasonable to compensate for that risk*”<sup>226</sup> and that its “*aim is to set an allowed return that reasonably remunerates investors for the risks associated with investing in the water sector*”<sup>227</sup>.

A relative risk assessment is a critical input into the determination of risk-reflective returns and is required to facilitate:

- An understanding of whether and how risk exposure at PR24 might differ in comparison to previous price controls
- A robust evaluation of the extent to which beta estimates based on historical data can sufficiently price forward-looking systematic risk exposure at PR24

There are multiple precedents for regulators undertaking relative risk assessment to inform their determination of allowed returns, *inter alia*:

- Ofgem considered the relative risk differences between energy sectors when setting asset betas in RIIO-1 (GD1/T1)<sup>228</sup>. Ofgem compared the cash flow risks for GDNs and TOs, primarily based on the scale of investment and the degree of divergence between actual expenditure and allowances. Ofgem determined the highest asset beta for SHETL on the basis that its capex-to-RAV ratio exceeded that of NGET and other energy networks

<sup>226</sup> Ofwat (2017), Delivering Water 2020: Consulting on our methodology for the 2019 price review, p. 191

<sup>227</sup> Ofwat (2022), PR24 Final Methodology, Appendix 10 – Aligning risk and return, p. 8

<sup>228</sup> Ofgem (2012), RIIO-T1: Final Proposals for National Grid Electricity Transmission and National Grid Gas, para. 3.11 onwards



- Ofcom also carried out extensive relative risk analysis between BT/Openreach’s broadband services (FTTP vs. FTTC). In WFTMR 2021<sup>229</sup>, Ofcom attributed the differences between the systematic risk exposure of the two services to (1) systematic demand risk; and (2) operating leverage. Ofcom determined the FTTP service to be riskier than FTTC/Copper-based service because of uncertainty in FTTP product pricing and significant upfront costs in rolling out FTTP networks

Ofwat has not carried out a relative risk assessment (in comparison to previous price controls) as part of its PR24 FM and has not considered whether there are potential changes in the risk landscape as part of its estimation of the allowed CoE. Implicitly this assumes that PR24 represents a continuation of risk dynamics PR19, which appears to be consistent with Ofwat’s view that its “*approach to PR24 is an evolution of previous reviews*”<sup>230</sup>. The changes in the industry and evolution of risk exposure imply that this is not an appropriate assumption as:

- There is a significant and unprecedented step change in the scale of capital programmes expected for AMP8 and beyond. The scale of required investment reflects a series of environmental obligations, including on the use of storm overflows, transition to Net Zero, environmental targets, abstraction reduction and resilience. All else equal, a step change in the scale of investment would be expected to exacerbate the exposure to existing risks and/or create exposure to new risks
- There are material changes to the specification of regulatory mechanisms set out in the FM. Notable examples include ODIs – where targets and rates are becoming more stringent – and the expected increased prevalence of PCDs which are, by design, asymmetric<sup>231</sup>

## 7.2 Framework for pricing expected risk dynamics in allowed returns

A two-stage framework is applied to assess whether changes in capital intensity are likely to affect systematic risk and returns. Stage 1 evaluates whether the PR24 capital programme deviates from typical business-as-usual investment. Stage 2 determines whether changes in risk are systematic (reflected in beta), asymmetric (reflected in CoE point estimate), or idiosyncratic (not priced).

The potential impact of the regulatory mechanisms in the FM is also examined using a mean-variance framework, which considers the impacts of key changes on risk, represented by the range or variance of potential outcomes, and on the symmetry of returns.

### 7.2.1 Framework for pricing the impact of increased capital intensity

It is important to carefully assess whether changes in the scale of investment are likely to affect systematic risk and returns.

Striking the right balance between risk and reward is a prerequisite for the successful delivery of large capital programmes. This is, *inter alia*, to ensure that projected cashflows can support the financial resilience and viability of the project and attract the equity capital required to underpin the investment.

A two-stage framework is adopted to assess whether differentiated risks associated with PR24 capital programmes should be priced in. Stage 1 applies gateway criteria to evaluate whether the PR24 capital programmes differ from the business-as-usual (BAU) investment typically undertaken by companies and could, as a result, create differentiated risk exposure. Where the Stage 1 assessment finds that PR24 capital programmes differ substantively from BAU investment, Stage 2 then considers whether the associated differentiated risks should be priced based on whether they are systematic (reflected in beta), asymmetric (factored into the point estimate for CoE), or idiosyncratic (not considered in pricing).

Regulators have, in the past, considered different options to allocate risk for large capital programmes and implications for pricing. These precedents can be used to inform the gateway criteria used in the Stage 1 assessment. These criteria are set out in the table below and are applied to PR24 capital programmes in section 7.3.1.

<sup>229</sup> Ofcom (2021), WFTMR 2021-26 Final Decision – Annexes 1-26, para. A21.47 onwards

<sup>230</sup> Ofwat (2022), PR24 Final Methodology, Appendix 10 – Aligning risk and return, p. 23

<sup>231</sup> PCDs imply an unlimited downside and no upside.

**Table 25 Criteria for identifying capital programmes with differentiated risks**

Criterion	Regulatory precedents which support application of the criterion
Is the step change in capital intensity large in scale compared to total assets?	<ul style="list-style-type: none"> <li>• Ofgem RIIO-T1: At RIIO-T1 Ofgem regarded the scale of investment as the most significant differentiator of risk affecting both the asset beta (and, therefore, the cost of equity) and the appropriate level of notional gearing<sup>232</sup></li> <li>• CAA Q4: In the Q4 Decision for Heathrow Airport, the CAA recognised that “large investment projects tend to be risky in a number of ways”<sup>233</sup></li> <li>• Thames Tideway Tunnel (TTT) specification notice: The Secretary of State recognised that the scale of a project relative to the size of undertaker’s business is relevant risk factor<sup>234</sup></li> </ul>
Is the step change in capital intensity atypical compared to typical, BAU investment?	<ul style="list-style-type: none"> <li>• CAA Q4: As part of its Q4 final decision, the CAA set the equity beta for Heathrow at the upper end of its range (0.8 to 1.0) in recognition of the risks associated with the construction of Terminal 5. Explicit pricing of the risks associated with T5 was suggested by the CC which considered that there were four special factors<sup>235</sup> linked to T5 which could affect BAA’s<sup>236</sup> cost of capital. These special factors differentiated T5 from Heathrow’s other investments</li> <li>• TTT specification notice: The Secretary of State recognised that whether the spend was typical or atypical was a relevant consideration, noting that the capital programmes of WaSCs typically involve assets of lesser scale than the TTT, and with limited and well understood technical risks<sup>237</sup></li> </ul>
Does the step change in capital intensity affect the alignment of risk and return?	<ul style="list-style-type: none"> <li>• CAA Q4: As set out in Q4 Decision for Heathrow Airport, the CAA commented that the scale of Terminal 5 would increase BAA’s risks, not only with respect to construction risk but also risks of uncertain demand and risks associated with the Terminal 5 triggers<sup>238 239</sup></li> <li>• UKRN has noted that “services in sectors that have greater operating leverage (i.e. require significant upfront investments or have a higher proportion of fixed costs) may be more exposed to systematic risk and thus have higher asset betas. However, this effect may be more relevant to new projects rather than ongoing investment in existing projects, and depend also on the form of regulation or other regulatory protections in place which could serve to reduce exposure to systematic risk than might otherwise be the case”<sup>240</sup></li> </ul>

Source: KPMG analysis

<sup>232</sup> Ofgem (2012), RIIO-T1: Final Proposals for National Grid Electricity Transmission and National Grid Gas, paras. 3.15 and 3.19

<sup>233</sup> CAA (2003), Economic Regulation of BAA London Airports Heathrow, Gatwick, and Stansted 2003 – 2008 CAA Decision, para. 4.67

<sup>234</sup> The Secretary of State (Jun 2014), Specification of the Thames Tideway Tunnel project: reason notice, paras. 22-24

<sup>235</sup> Competition Commission (2002), BAA plc, A Report on the economic regulation of the London airports companies (Heathrow Airport Ltd, Gatwick Airport Ltd and Stansted Airport Ltd), Financial performance and cost of capital, para. 4.71

<sup>236</sup> BAA operated Heathrow, Gatwick, and Stansted airports.

<sup>237</sup> The Secretary of State (Jun 2014), Specification of the Thames Tideway Tunnel project: reason notice, para. 25

<sup>238</sup> i.e. mechanism under which the level of permitted airport charges would increase only when the specified construction landmarks had been met.

<sup>239</sup> CAA (2003), Economic Regulation of BAA London Airports Heathrow, Gatwick, and Stansted 2003 – 2008 CAA Decision, para. 4.67

<sup>240</sup> UKRN (2023), Guidance for regulators on the methodology for setting the cost of capital

## 7.2.2 The approach for pricing the impact of proposed regulatory mechanisms

The approach for assessing and pricing the impact of changes to regulatory mechanisms at PR24 is informed by the following considerations:

- Investors typically seek certainty in returns and expect higher compensation for larger fluctuations in returns. Asset pricing models assume that all one-sided exposures – such as downside risks – are adequately factored into probability-adjusted cash flows which constitute expected returns. The variation in returns around the mean-expected outcome is therefore a relevant dimension to consider in the assessment of risk exposure implied by regulatory mechanisms. Material increases in the volatility of returns would, all else equal, be expected to affect systematic risk by alternating the relationship between water company returns and that of the market portfolio. As a result, increases in volatility would typically increase beta
- Investors are not only concerned with the magnitude of potential fluctuations in returns but also with the distribution of returns and the mean-expected outcome. The second relevant dimension of risk is whether there is asymmetry driven either by a skew in the distribution of returns or mean-expected out- or under-performance. As the CAPM model assumes normal (and symmetric) distribution of outcomes, it does not inherently price asymmetry. As a result, material asymmetry would need to be reflected in the selection of the point estimate for the CoE

The potential impact of the regulatory mechanisms in the FM is assessed using a mean-variance framework, considering their expected influence on risk, represented by the range or variance of potential outcomes, as well as on returns, encompassing skewness and the mean-expected result. This framework is applied to the regulatory mechanisms proposed for PR24 in section 7.3.2.

## 7.3 Assessment of relative risk at PR24

The capital programmes for PR24 and beyond are:

- Large in scale compared to the existing asset base – projected spend implies capital programmes equivalent to a 35% increase in net RCV across AMP8
- Atypical relative to the investments in previous price controls. This is due to the scale of investment as well as increased complexity arising from investment into new, untested, and unfamiliar areas and areas where the scope of investment is subject to uncertainty
- Likely to exacerbate exposure to several risk drivers – *inter alia*, higher complexity of spend, higher uncertainty in ex ante cost forecasts supply chain risk, input price risk – and increase risk exposure relative to returns

These risk drivers have a systematic component as they are linked to economy-wide factors. As a result, the step change in capital intensity is likely to increase systematic risk and will need to be taken into account in beta estimation.

The calibration of regulatory mechanisms at PR24 imply an increase in both risk *and* downward asymmetry which needs to be reflected in returns. The calibration of ODI targets and rates, removal of caps and collars and introduction of PCDs will represent key determinants of asymmetric exposure.

## 7.3.1 Analysis of the impact of increased capital intensity

### Drivers of increased capital intensity

There are material changes to investment requirements for water companies, driven by changes in environmental obligations, storm overflows, the transition to net zero, population growth and asset resilience, summarised below:

- **Storm overflows**<sup>241</sup>: The Environment Act has set comprehensive targets for storm overflow discharge frequency, necessitating substantial investment, estimated at £56 billion over 25 years in England by Defra<sup>242</sup>. This investment is more than double the £4.8bn five-year environment enhancement programme allowance at PR19 for each of the next five AMPs
- **Wastewater environmental targets**: To enable it to meet the 25-year Environment Plan, the UK government has also consulted on a range of additional environmental targets, including an 80% reduction in phosphorus loads by 2038 from the 2020 level<sup>243</sup>. Additional cost for phosphorus removal to meet this goal could exceed £4.4 billion by 2038<sup>244</sup>
- **Abstraction reduction and improved drought resilience**: The Environment Agency's (EA's) heightened environmental protection efforts are leading to constraints on water abstractions<sup>245</sup>, necessitating significant investment into new water sources for some companies, which may be further increased by the need to improve resilience to a once-in-500-year drought<sup>246</sup>. To the extent that the associated investments are delivered via Direct Procurement for Customers (DPC), incumbents may face complexities, residual risks and increases in leverage and hence financial risk
- **Demand**: Population growth and climate change are driving increased demand for services. Large-scale water resource schemes pose new challenges as there has not been major reservoir construction post-privatisation<sup>247</sup>. Higher population density can result in more volatile performance commitment performance and hence financial exposure for companies<sup>248</sup>. The nutrient neutrality requirements proposed in the current draft of the Levelling Up and Regeneration Bill<sup>249</sup> add complexity, demanding stringent nutrient removal levels by 2030, heightening treatment demands and compliance challenges
- **Transition to Net Zero**: The path to achieving operational Net Zero by 2030 will reshape water companies' operations, but uncertainties persist in, *inter alia*, the low-carbon market structures, technology solutions, the long-term regulation of emissions. Water companies will need to plan to make investments into technologies which are not currently commercially viable, particularly to reduce process emissions<sup>250</sup>. This carries the potential risk of certain investments later becoming stranded assets

These factors have the potential to substantively increase the scale and the risks of the capital programme in AMP8 and beyond. Ofwat recognises that “*early indications of the potential scale of the*

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<sup>241</sup> Storm overflows serve as “safety valves” on wastewater networks, releasing diluted untreated wastewater during network capacity surges to prevent spills into homes 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. They often discharge beyond intended scenarios due to operational issues and climate change-induced rainfall.

<sup>242</sup> Defra (2022), [Storm overflow discharge reduction plan](#), p. 7

<sup>243</sup> Defra (2022) [Consultation on environmental targets](#), p. 17

<sup>244</sup> The PR19 cost allowance for phosphorus removal was around £2.4 billion and it was reducing the phosphorus load for 16 million population equivalents. A simple pro rata calculation suggests that by 2038 at least a further £4.4bn will need to be spent on phosphorus removal to meet this target.

<sup>245</sup> Environment Agency (2020), [Water Resources National Framework, Appendix 4: Longer term environmental water needs](#).

<sup>246</sup> Environment Agency (2020), [Meeting our Future Water Needs: a National Framework for Water Resources](#), p. 10.

<sup>247</sup> 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.

<sup>248</sup> This is because higher population density can also have implications for how many customers are affected by isolated asset failures. 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](#).

<sup>249</sup> July 2023 version, p. 184 onwards.

<sup>250</sup> Jacobs (2022), [Net Zero Technology Review](#), 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.

investment programme in 2025-30 suggest that companies are expected to face substantial investment needs at PR24 and beyond<sup>251</sup>.

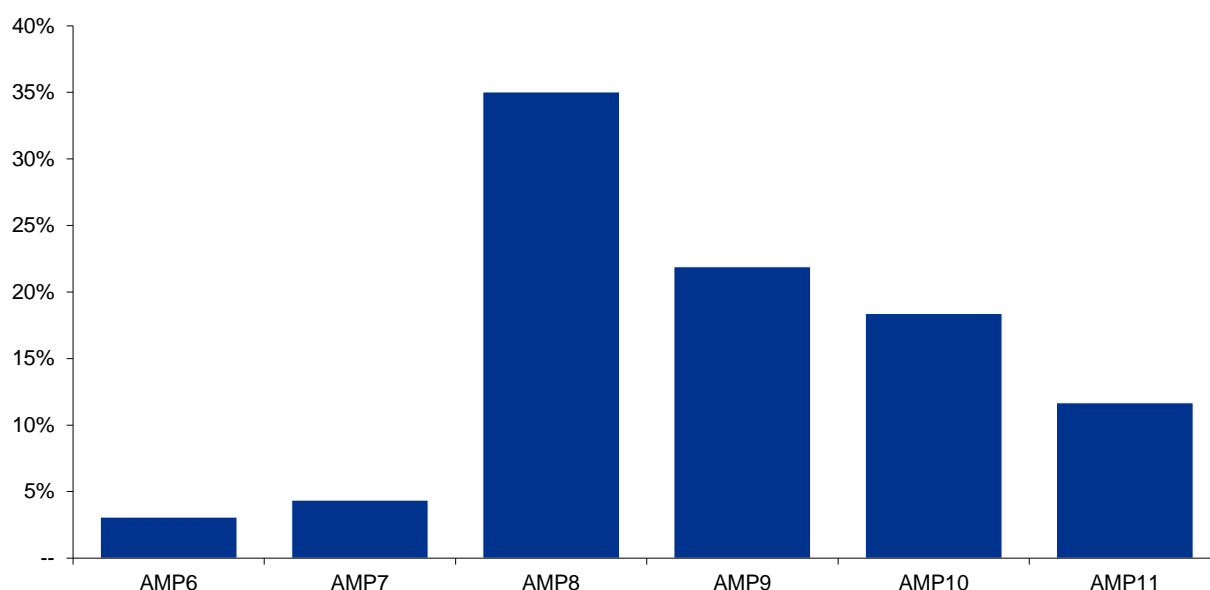
### Stage 1 assessment of risks associated with the PR24 capital programmes

The Stage 1 assessment applies gateway criteria to evaluate whether the PR24 capital programmes differ from BAU investment undertaken by companies in previous periods and could, as a result, create differentiated risk exposure.

#### I. Is the step change in capital intensity large in scale compared to total assets?

The scale of the step change in investment is illustrated in the figure below which sets out the difference between the scales of net RCV growth over the period used for beta estimation and the indicative scale of growth for AMP8-11.

**Figure 10 Evolution of capital investment / opening RCV by price control (AMPs 6 – 11)**



Source: KPMG analysis

The calculation of the ratio between (1) investment within a price control (proxied by net RCV additions) and (2) opening RCV for the price control is based on outturn RCV values up to 2020, projected RCV values from the PR19 FD models and the rolled forward RCV values which reflect the future investment programmes<sup>252</sup> and an assumed 4.5% run-off rate<sup>253</sup>.

The chart shows that there is a significant difference between the scales of investment programmes in recent regulatory periods and the indicative scale of growth for AMP8 and future price controls. Notably, the step up in investment intensity is not constrained to AMP8 – whilst the indicative scale of investment during AMP9-12 is lower than that of AMP8, for these periods there is a significant

<sup>251</sup> Ofwat (2022), PR24 Final Methodology, Appendix 10 – Aligning risk and return, p. 29

<sup>252</sup> The indicative investment profile for AMP8-12 has been derived by collating data from three public sources:

- Ofwat PR19 FD which sets out the base and enhancement Totex allowed by Ofwat for AMP7. It is assumed that water companies will maintain the same level of base investment during AMP8 and future AMPs – this could be seen to be conservative assumption given, for example, expected growth and increased capital maintenance requirements – while doubling the AMP7 enhancement Capex to meet statutory requirements
- WRMPs published by water companies which encompass most of the anticipated enhancement Capex in the water network for each price control during AMP8 and beyond
- DWMPs published by WaSCs, which set out current estimates of planned enhancement Capex on the wastewater network for each price control during AMP8 and future AMPs. DWMPs cover both base and enhancement spend for wastewater which suggests that there might be some overlap between DWMPs and AMP7 base costs. To avoid double counting these overlapping costs, a 1/3 adjustment factor is applied to DWMP data such that only 2/3 of the costs included in the plan are included in the estimate of the Capex profile for AMP8 and beyond.

<sup>253</sup> Informed by the 4.5% upper limit on run-off rates as per the FM.



increase from the business-as-usual level of investment from AMP6-7. At the same time, investment requirements for AMP9-12 may increase over time due to, for example, new statutory requirements.

### **PR24 capital programmes are very large in scale compared to past investment and existing assets.**

#### **II. Is the step change in capital intensity atypical compared to typical, BAU investment?**

There are two primary ways in which investment programmes for PR24 and beyond can be seen as atypical to relative to the historical investment in the sector. The first relates to the scale of investment. The second relates to the complexity of investment.

The step up in investment complexity is related to new, untested, unfamiliar, and uncommon investments and investment into areas where requirements are uncertain<sup>254</sup>.

Uncertainty regarding the practical requirements and scope of solutions presents an additional risk factor. For example, storm overflows are a major driver of capex, but the exact requirements are unclear as they are based on mathematical sewer models rather than empirical spill volume measurements. As a result, major programmes of work are being planned based on models which may not be fully robust and are sensitive to assumptions. Furthermore, the impact of climate change on the frequency of storm overflow discharges remains uncertain, making it challenging to assess whether planned interventions will effectively meet future targets.

### **The scale and complexity of capital programmes at PR24 and beyond are likely to be atypical relative to the investments in previous price controls.**

#### **III. Does the step change in capital intensity affect the alignment of risk and return?**

The significant increase in capital intensity is likely to exacerbate exposure to several risk factors and thereby affect whether risks are aligned to returns.

First, large and complex programmes can present inherent difficulties in budgeting and planning. Cost forecasts may be affected by optimism bias<sup>255</sup>, leading to estimates that fail to capture the full spectrum of potential expenditure outturns. These factors can contribute to increased propensity for cost overruns and project delays.

Second, the step up in investment programmes could constrain supplier capacity, leading to delays, quality issues, higher prices, or the need for new suppliers. There is significant concurrent investment in other infrastructure sectors, for example HS2, energy network investment. There will likely be competition for resources between water and other infrastructure projects.

Third, increasing spend implies greater sensitivity of outturn returns to input price volatility. To the extent that input cost increases are not well proxied by the changes in the CPIH index, this could create additional pressure absent regulatory protections. A notable example is energy costs<sup>256</sup>.

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<sup>254</sup> Examples of investments into these areas include:

- For water and wastewater, companies are being encouraged to drop tried and tested, traditional solutions in favour of nature-based solutions which are relatively new and may require working in partnership with others
- For wastewater, there are currently few sites with Nitrogen removal (as evidenced, by the immaterial allowance provided to two companies (Southern and Wessex) in the PR19 N-removal model) however this will have to be rolled out more widely in the future
- For wastewater, companies are being asked to achieve technically achievable limits (TAL) on increasing number of their sites for the Phosphorus removal programme.

<sup>255</sup> [GreenBook\\_optimism\\_bias.doc \(publishing.service.gov.uk\)](#)

<sup>256</sup> Energy costs represent approximately 11% of base costs according to Ofwat's PR24 base cost dataset. Ofwat assesses the efficiency of power costs as part of its base econometric models, which use costs that are adjusted for inflation through CPIH for modelling. Additionally, cost allowances are set in real terms and indexed to CPIH. While CPIH captures some movements in energy prices, the extent to which these movements are reflected in overall inflation is limited. The energy component of CPIH is 4.5% of the total (as of Dec-22), of which electricity, gas and other fuels make up 2.9%, with the rest largely relating to petrol. Energy prices have grown significantly faster than CPIH in recent years (35% above CPIH in Q2 2022). Ofwat's base cost models, based on historical information, will likely generate allowances for the future that are insufficient to meet the efficient energy costs actually incurred by companies. This is because Ofwat's dataset includes 11 years of data until 2021-22. The recent spike in energy prices is only captured by the last two years of the data, 2020-21 and 2021-22. More than 80% of the sample period reflects a lower energy price scenario. See KPMG (2023), Treatment of energy costs in base models.

Fourth, areas into which significant investment is projected to be made are subject to a high level of regulatory and government scrutiny, particularly given the deliverability and affordability challenges associated with this scale of investment. Non-delivery or delays could attract increased scrutiny of costs incurred and recovery thereof.

Fifth, there are important financing risks which are exacerbated by the step up in the capital intensity due to factors such as increased debt and equity capital requirements<sup>257</sup>. Companies may need to raise substantial debt capital at elevated interest rates, which in turn could exert downwards pressure on debt metrics. It will also be necessary for the notional firm to attract equity capital to fund investment, which will in turn be contingent on the alignment of allowed returns with forward-looking risk exposure.

**An increase in capital intensity is likely to exacerbate exposure to several risk factors and increase risk exposure relative to returns.**

### **Stage 2 assessment of risks associated with PR24 capital programmes**

The Stage 2 assessment determines the appropriate pricing approach for changes in risks identified in Stage 1 analysis depending on whether each risk is systematic (to be captured in beta), asymmetric (factored into the point estimate for CoE), or idiosyncratic (not reflected in pricing).

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<sup>257</sup> Water companies could be seen as becoming more like growth stocks, i.e. limited returns through dividends and higher returns through RCV growth. The duration of cashflows is, in consequence, increasing.

**Table 26 Overview of the Stage 2 assessment**

Risk dimension	Risk classification	Commentary
Scale and complexity of investment	Systematic and asymmetric components	<p>The impact of the change in scale and complexity of investment is likely to have both systematic and asymmetric elements. The exposure to asymmetric risk stems from fact that construction projects, including those in the infrastructure sector, have typically experienced cost overruns and delays<sup>258</sup>.</p> <p>Regulatory precedent has recognised the relevance of the scale and atypicality of spend (amongst other factors) to the estimation of allowed returns and regulatory regime design. For example, as part of the Q4 final decision, the CAA set the equity beta for Heathrow at the upper end of the range (0.8 to 1.0) in recognition of the atypical risk factors associated with the construction of Terminal 5.</p>
Supply chain	Systematic with some asymmetric components	<p>Supply chain risks are likely to be systematic as they are driven by external factors that affect multiple companies across various sectors, making them inherent to the broader economic and business environment. They are also likely to create additional costs which would create asymmetric risk exposure unless compensated for in cost allowances.</p>
Input price risk	Systematic with some asymmetric components	<p>Input price volatility stems from macroeconomic factors – such as global supply chain disruptions, geopolitical events, and economic shocks – that impact a wide range of companies and industries within an economy. Input prices are also likely to create additional costs which would create asymmetric risk exposure unless compensated for in cost allowances.</p>
Regulatory and political risk	Systematic and idiosyncratic components	<p>Regulatory and political risk is likely to have a systematic risk component. This is because regulatory and political scrutiny is linked to government policies, environmental regulations, and societal expectations which themselves stem from economy-wide factors.</p>
Financing risk	Systematic	<p>Financing risk contains systematic elements given its link to broader macroeconomic conditions. Companies' ability to attract capital will reflect wider market dynamics as well as alignment between risks to which investors are exposed and returns.</p>

Source: KPMG analysis

The scale and complexity of investment at AMP8 is expected to significantly exceed that for AMPs 6 and 7. All else equal, this would be expected to exacerbate exposure to each of the identified risk factors. The Stage 2 assessment suggests that the drivers of differentiated risk exposure for AMP8 capital programmes include systematic and asymmetric components which would need to be captured in allowed returns.

Analysis of recent equity analyst commentary corroborates that the scale and complexity of capital programmes is likely to represent a key risk factor affecting required returns.

<sup>258</sup> For example, 37% of the respondents to KPMG's 2023 Global Construction Survey responded that they had missed budget or schedule targets over the previous 12 months. Also see, for example, Institution of Civil Engineers, Reducing the gap between cost estimates and outturns for major infrastructure projects and programmes or Mckinsey, The construction productivity imperative.

**Table 27 Equity analyst commentary on the potential impact of investment programmes**

Comment	Source
<p>We believe investors will need to see <b>regulatory and political support</b> for higher bills to fund <b>higher investment and higher returns</b> before turning positive on the sector.</p> <p>While we believe that the government and regulator acknowledge that higher investment in the sector will be needed, there are still risks to the sector that mean we are not yet outright positive on the outlook for the stocks themselves. Primarily, we believe that customers will push back on increasing bills, which would be needed to fund additional investment, which means more scrutiny on allowed returns.</p>	<p>UK Water: Too early to say implications of Thames failure on the rest of the sector, but limited direct impact today, JP Morgan (June 2023)</p>
<p>The risk is twofold: (i) companies end up investing substantially more without either a fair return, or under the totex sharing mechanism (where companies incur c50% of the cost); and (ii) fines could lead to financial pressure and de facto nationalization of a private company with high leverage, especially if combined with OFWAT's agenda to replace debt with equity.</p> <p><b>We view the cost of equity as elevated and dividend flows in doubt. We would also argue that the allowed return needs to rise from the current 2.96% CPIH-real (April 2020-March 2025) up to something closer to the 3.9% that electricity distribution earns (at the moment, OFWAT is at 3.29% and in particular is using a low beta)... We are surprised that unlike in past situations – e.g. with OFGEM's TIRG in 2005 where there was a 200bps premium – there is not a higher return to ensure that the spend is undertaken</b> <sup>259</sup>.</p>	<p>UK Water: Cost of equity has moved higher, Credit Suisse (April 2023)</p>
<p>We believe <b>no other industry invests significant levels of capex at cost of capital, but at a hurdle rate incorporating a premium</b>. We believe if capex levels are to rise then returns need to be commensurate with reduced FCF metrics and to ensure (efficient) companies are financeable – in line with one of Ofwat's legal duties.</p> <p>We also believe using the outdated Ofwat cost of capital numbers in the business plans is at best inaccurate and at worst could imply additional risk. Cost of capital has risen significantly since summer 2022 and using Ofwat's lower assumed cost of capital could lead to inaccurate assumptions of financeability, particularly if water company capex were to rise significantly from here.</p>	<p>UK Water: positive hydrostatic pressure, Barclays (March 2023)</p>

Source: KPMG analysis

### 7.3.2 Analysis of the impact of PR24 regulatory mechanisms

The estimated indicative effect of regulatory mechanisms set out in the FM is set out in Figure 11 below in a mean-variance framework in terms of their expected impact on risk (horizontal axis) and returns (vertical axis). This analysis is necessarily indicative given that several mechanisms have not been fully specified at this stage.

The framework captures changes to levels of return as well as risk. It is important to consider how evolution of returns – driven by, *inter alia*, changes in methodology for estimation – compares to the evolution of business and regulatory risk.

The following are considered for each mechanism:

- **Significance:** indicative magnitude of the impact as reflected in the relative size of the circles
- **Asymmetry:** the extent to which the impact on allowed revenues and returns is skewed downwards the upside or downside
- **Variance:** the range of potential impacts on allowed revenues and returns
- **Category:** which of the four categories set out in Table 28 the mechanism belongs to

<sup>259</sup> Refers to £1.6 billion investment brought forward to speed up vital water infrastructure projects (announced 3 April 2023).

**Table 28 Categories of regulatory mechanisms affecting risk and return**

Category	Description
1	Mechanisms that affect returns regardless of how other variables (controllable and uncontrollable) evolve over the course of the price control.
2	Mechanisms whose impact on returns depends on variables that are external to the company. These mechanisms determine the allocation of risk between customers and companies in respect of variables that neither party can control, such as the evolution of interest rates.
3	Mechanisms that affect returns either by (1) informing the ex ante calibration of cost allowances or (2) implementing an ex post adjustment based on outturn spend / delivery.
4	Mechanisms that affect returns either by (1) informing the ex ante calibration of performance incentives or (2) implementing an ex post adjustment based on outturn level of the company's performance against targets determined by Ofwat.

Source: KPMG analysis

A mechanism depicted in the figure at the intersection of the dotted lines is expected to have no effect on the expected risk or returns relative to the current CMA PR19 regulatory framework.

Mechanisms on the vertical axis between quadrants III and IV unconditionally reduce the return companies can earn regardless of how other variables evolve over the course of the price control. For example, the departure from CMA PR19 principles on the elements of allowed return (beta, TMR, RFR) unconditionally reduces the return relative to an increasing risk exposure. Other mechanisms in quadrants III and IV introduce downwards asymmetry and either increase (quadrant IV) or decrease (quadrant III) the range of potential outcomes and hence the risk.

Mechanisms on the horizontal line affect risk but do not create positive or negative asymmetry, whereas mechanisms on the vertical axis between quadrants I and II are upward asymmetric.

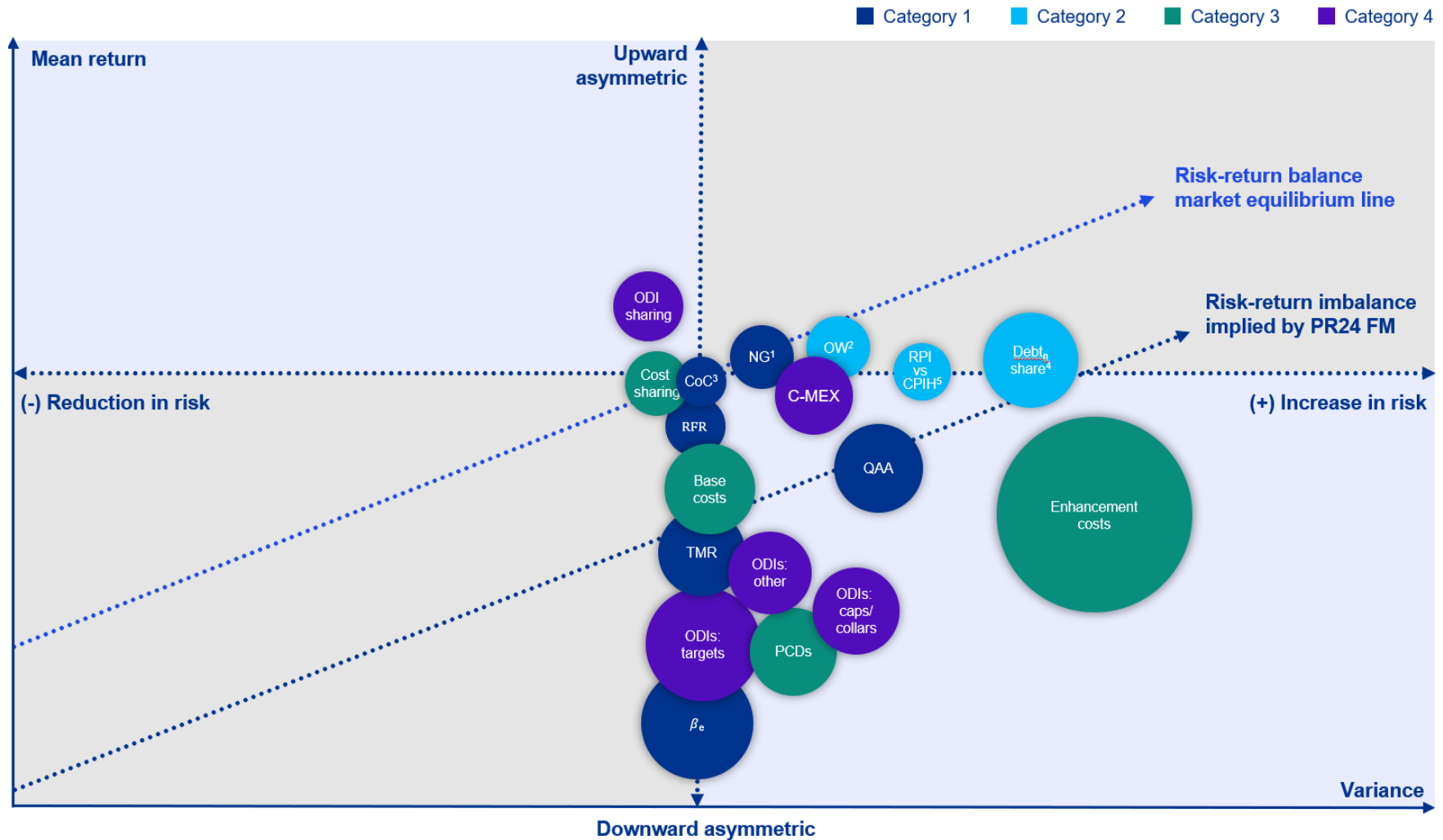
Overall, mechanisms are largely concentrated in quadrant IV suggesting that there is an increase in both risk *and* downward asymmetry which contrasts with the reduction in returns implied by the PR24 FM. The assessment indicates that the scale of the capital programme is likely to be the primary driver of changes in variance and hence systematic risk, whilst the calibration of ODI targets and rates, removal of caps and collars and PCDs in relation to enhancement expenditure will represent a key determinant of asymmetric exposure.

The figure also considers the position of each mechanism relative to the market equilibrium line: risk-reward combinations that approximate an efficient market outcome. The changes to the suite of regulatory mechanisms for PR24 suggest that the risk-return balance at PR24 is materially below the market equilibrium line and that risk and returns are out of balance.

Appendix 2 includes more detailed commentary on the impact of each mechanism relative to the arrangements under the current price control, including whether it affects asymmetry, variance or both.



Figure 11 Mean variance framework to illustrate the impact of changes and regulatory risk



Notes: <sup>1</sup> Notional gearing, <sup>2</sup> Outperformance wedge, <sup>3</sup> Additional borrowing costs: cost of carry, <sup>4</sup> Share of new debt, <sup>5</sup> RPI-CPIH mismatch  
 Source: KPMG analysis

## 7.4 Implications of expected PR24 risk dynamics for allowed returns

There is an increase in both systematic risk and downward asymmetry which need to be reflected in returns:

- The step up in capital intensity is unprecedented in the sector and is likely to increase systematic risk. Beta estimates calculated from historical listed water company data are unlikely to price forward-looking risk. Additional comparators are required to derive estimates that reflect changes in systematic risk on a forward-looking basis
- Asymmetry implied by the proposed design of regulatory mechanisms – in particular, ODIs and PCDs – will need to be priced in the selection of the CoE point estimate

The scale of the capital programme is likely to be the primary driver of changes in systematic risk.

- Capital programmes for PR24 and beyond differ from the BAU investment undertaken by companies in previous periods in terms of scale, complexity, and associated risks. The implication is that risks faced in previous price controls are not a good proxy for future risk as they do not reflect the impact of the scale and complexity of the PR24 capital programme
- The differentiated risk exposure associated with AMP8 capital programmes is likely to have a systematic component

Beta estimates based on listed water company return data from previous price do not capture forward-looking risk dynamics for PR24 and beyond. The exam question when estimating beta for PR24 is how to supplement water sector data with additional comparators to derive estimates that reflect the changes in systematic risk exposure for the sector on a forward-looking basis. This issue is considered in detail in section 8.2.

The proposed design of regulatory mechanisms, in particular the calibration of ODI targets and rates, removal of caps and collars and increased prevalence of PCDs, will likely represent a key determinant of asymmetric exposure. As the CAPM does not inherently price asymmetric risk, the associated remuneration will need to be priced in the selection of the CoE point estimate. This issue is considered in section 11.2.

Future investment in the water sector is subject to material uncertainty. Ofwat's guidance on LTDS explicitly recognises the following drivers of uncertainty which are reflected in the common reference scenarios: climate change, technology, demand, and abstraction reductions. At the same time, the guidance recognises that the common reference scenarios are not intended to be comprehensive or exhaustive<sup>260</sup>. Ofwat provides examples of other potentially relevant factors such as customer affordability and vulnerability, government and regulatory policy, availability of skills, input costs, supply chain capacity, etc<sup>261</sup>.

It is relevant to explore what real options theory<sup>262</sup> might imply for the investment decision-making in the sector. Real options theory has been considered by some regulators in the context of estimation allowed returns and investment-decision making.

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<sup>260</sup> Ofwat (2022), Final guidance on long-term delivery strategies, section 4.2

<sup>261</sup> The full list of factors is as follows: socioeconomic factors, such as economic growth and changes in household incomes; government and regulatory policy; the activities of other water companies and sectors, such as their contribution towards long-term targets; the condition of the natural environment; consumer behaviour and attitudes; customer affordability and vulnerability; the costs of inputs; the availability of skills; the capacity of the supply chain; levels of asset health and resilience; innovation within the company; cost efficiencies; and progress towards key long-term outcomes.

<sup>262</sup> Real options theory is widely used in finance and investment decisions to optimise choices in the presence of uncertainty. It extends the traditional financial options concept, such as call and put options, to real assets and investment opportunities. Unlike financial options, which involve rights to buy or sell financial instruments, real options involve the right to make strategic business decisions based on future events or market conditions.

One example of a real option is the option to 'wait and see', i.e. for those investments whose payoffs depend on the resolution of uncertainty in the future, investors hold an option to wait for the resolution of uncertainties before committing to an investment. Another example is an expansion option i.e. an option to expand an existing project or investment if certain conditions or opportunities arise, enabling the company to capitalise on potential growth.

- The Department of Energy & Climate Change (DECC) has previously awarded a 'novelty premium', based on real options theory, in the context of the implementation of the Contract for Difference ('CfD') regime<sup>263</sup>
- Ofgem has also considered the impact of real options on investment decision-making in the past, focusing on the bias in the Net Present Value framework which does not take into account real options<sup>264</sup>
- For the Q4 price control, the CC considered real options as one of the special factors<sup>265</sup> linked to T5 which could affect BAA's<sup>266</sup> cost of capital

The uncertainties associated with the factors reflected in common references scenarios could give rise to real options that would be pertinent for investment decision-making in the water sector<sup>267</sup>. There is merit in exploring the impact of real options further through quantifying the value of the options and their impact on PR24 allowed returns and developing case studies for specific water projects.

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<sup>263</sup> See for example, [Annex H - Modelling Assumptions.pdf \(publishing.service.gov.uk\)](#) and NERA (2013), Changes in Hurdle Rates for Low Carbon Generation Technologies due to the Shift from the UK renewables Obligation to a Contracts for Difference Regime, for DECC

<sup>264</sup> [Ofgem \(2012\), Real Options and Investment Decision Making](#)

<sup>265</sup> Competition Commission (2002), BAA plc, A Report on the economic regulation of the London airports companies (Heathrow Airport Ltd, Gatwick Airport Ltd and Stansted Airport Ltd), Financial performance and cost of capital, para. 4.71

<sup>266</sup> BAA operated Heathrow, Gatwick, and Stansted airports.

<sup>267</sup> For instance, the impact of climate change on the reliability of past weather patterns as indicators of future conditions and the resulting required levels of resilience within the water sector can prompt the emergence of real options to postpone investments, allowing for a more certain evaluation of evolving environmental conditions and the most appropriate solutions; technological advancements may create real options for companies to wait and adopt more efficient or cost-effective solutions in the future; uncertainty regarding the practical requirements and solutions (such as for storm overflows) can lead to real options to wait until the solutions have been validated through testing before committing to investment on a larger scale.

# 8 Estimation of beta

This section develops a beta estimate that reflects the systematic risk of the sector over the forward-looking 20Y investment horizon. It is structured as follows:

- First, it sets out a summary of the methodology and the estimate adopted in the FM
- Second, it considers which estimation windows and comparators most closely reflect the underlying systematic risk for the sector on a forward-looking basis
- Third, it comments on available data frequencies and averaging techniques and their relevance and reliability for the estimation of PR24 beta
- Fourth, it considers the estimate for debt beta
- Fifth, it derives an overall beta range for PR24

## 8.1 Ofwat's approach to and estimate of beta

The FM sets out an equity beta range for the notional firm of 0.58 – 0.64. The methodology used for deriving this range can be summarised as follows:

- Beta is derived based on data from Severn Trent (SVT) and United Utilities (UUW). Pennon (PNN) has been excluded due to a temporary reduction in its gearing, which resulted from the retention of substantial cash reserves on its balance sheet after the sale of its waste management business. Ofwat signalled its intention to re-evaluate the inclusion of PNN's data at the draft and final determinations when more pure play data with undistorted gearing becomes available
- Daily frequency betas are stated to be the primary basis of estimation, however, Ofwat appears to have attached some weight to weekly and monthly beta estimates as it notes that the daily datapoints generate a higher beta estimate relative to lower frequency estimates
- “*Due caution around recent volatility*” due to Covid19 and the Russia-Ukraine is reflected in estimates by using longer estimation periods and trailing averages of beta compared to its approach at PR19. Ofwat's rationale for this approach is that:
  - Whilst macroeconomic events such as the pandemic and the war may impact on betas for the water sector, “*it far from obvious that such data should be eliminated from the data series*” and reweighting data to reflect assumptions about future recurrence of systematic risk events may not be appropriate given the inherent uncertainty and subjectivity of such adjustments. Instead it is more appropriate to recognise that recent, more volatile data presents a case to revisit the trade-off between longer and shorter estimation periods
  - The use of an unconditional CAPM – which implies that periods of transient volatility do not reflect the fundamental risk of the business – would constitute a departure from standard regulatory practice, where betas are set for the period of the price control rather than over the long-term CAPM investment horizon
  - The case for using structural break analysis is unproven. The analysis is sensitive to the specification of breakpoints. Furthermore, the issue of structural breaks was discussed extensively at the PR19 appeals and the evidence submitted by the various experts demonstrated that different specifications of the statistical test can identify different breakpoints
- The unlevered beta range and the observed gearing are estimated based on (1) 2- and 5-year averages of 5-year daily beta and (2) 2- and 5-year averages of the 10-year daily beta
- 0.05 – 0.15 debt beta was adopted based on empirical analysis undertaken by FTI
- The Harris-Pringle approach was used to derive the notional equity beta range

## 8.2 Capturing underlying systematic risk in beta estimates

As recognised in the UKRN CoE study<sup>268</sup>, the CAPM used in the regulatory process is an unconditional CAPM. This means that the unconditional beta – which reflects the fundamental systematic risk of a company – is the relevant input into the estimation of allowed CoE.

Beta should be estimated such that it captures underlying systematic risk over the forward-looking investment horizon consistent with that used to estimate other CAPM parameters. Estimation of betas based on data which is affected by short-term fluctuations could result in an internally inconsistent CoE which does not reflect the required return over the investment horizon.

The unconditional beta is not expected to change in case of systematic risk events. Consequently, any alterations in the unconditional beta would be indicative of a structural break<sup>269</sup> in the econometric relationship between the water industry and the wider market. The treatment of such events in beta estimation should be informed by the assessment of whether the break represents a temporary distortion or a permanent change.

The structural breaks relevant for the estimation of PR24 betas are: (1) recent significant events that have impacted global and UK economies (i.e. Covid19 and the Russia-Ukraine war) and responses to these events; (2) changes in the regulatory regime at PR14; and (3) the significant step up in investment intensity which could permanently alter the relationship of water company returns with the market.

This Report applies a two-step approach to capture underlying systematic risk in beta estimates given these breaks; the first step considers the appropriate approach for the estimation of the BAU, backward-looking, beta and the second step considers the estimation of a forward-looking beta which reflects changes in forward-looking risk driven by the step change in capital intensity.

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 level of notional gearing assumed, whereas the assessment of *business or asset* risk is based on the asset betas of selected listed comparators.

For the allowed CoE to represent a true expected return over the chosen investment horizon, beta should be estimated such that it is expected to apply over a forward-looking period consistent with that used to estimate other CAPM parameters. The exam question when estimating beta is therefore how to use available comparators and estimation techniques to derive estimates that best reflect the underlying systematic risk over the assumed forward-looking investment horizon.

As discussed in section 4.4, 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 CoE. The unconditional beta reflects the fundamental systematic risk of a company, in other words, a “normal” beta consistent with forward-looking risk to which one might expect a water company’s beta to revert to despite short-term fluctuations.

This contrasts with *conditional* betas which 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 economic states of the world.

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’. 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<sup>270</sup>.

<sup>268</sup> UKRN CoE Study, p. 147

<sup>269</sup> In econometrics and statistics, 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. In the case of beta measurement, the most obvious structural break would come from a distinct and meaningful change to the gearing at companies being measured.

<sup>270</sup> CMA (2021), PR19 Final Determination, para. 9.477



In the FM Ofwat considered that the use of an unconditional CAPM would constitute a departure from standard regulatory practice, where betas are set for the period of the price control rather than over the long-term CAPM investment horizon. There are two key issues with assuming that betas are not set based on a long-term investment horizon.

First, assuming a shorter horizon for beta would signal that the CAPM applied in the FM is internally inconsistent.

This is because the *investment horizon* implied by other CAPM parameters based on the FM is 20 years. As a result, for the CoE to represent a true expected return over this long run horizon, beta should capture the expected relationship between individual water company stock returns and the market return over a 20-year horizon<sup>271</sup>. Ofwat's statement that "*betas are set for the period of the price control rather than over the long-term CAPM investment horizon*" implies that the implementation of CAPM (and the WACC) is internally inconsistent as the horizon implied effectively be shorter than for other parameters. This means that the allowed return is not the true required return over the investment horizon.

Second, the use of unconditional CAPM forms the basis of standard regulatory practice. This is consistent with commentary in the UKRN CoE study which 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***<sup>272</sup>

During the PR19 appeal Professor Alan Gregory et al (2020, 2021)<sup>273</sup> 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.

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 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.

Permanent structural breaks may relate to past changes – for example, regulatory regimes can differ and affect the underlying risk environment in historical periods. Equally structural breaks could relate to future events – for example, due to material future changes in business activities or characteristics – that can reasonably be expected alter the relationship between water stocks and the wider market.

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<sup>271</sup> Note that this does not suggest that estimation windows should align with forecast horizon used for the implementation of the CAPM.

<sup>272</sup> UKRN CoE Study, p. 147

<sup>273</sup> 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)')

In the FM Ofwat does not consider that structural breaks should be adjusted for due to the sensitivity of results to different specifications of breakpoints and lack of alignment between the breaks identified by various experts during the P19 appeal which was also noted by the CMA.

First, the analysis of structural breaks should not be solely reliant on empirical tests for structural breaks. Instead, it should begin by considering conceptual economic fundamentals to determine if there are events that could cause structural breaks, followed by statistical analysis to confirm or reject the formulated hypotheses. Ensuring that there is clear economic rationale for each structural break being tested means that the results can be robust and not sensitive to testing methodologies.

Second, Ofwat has previously recognised the relevance of structural breaks for beta estimation, noting 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”**<sup>274</sup>. Ofwat’s position that PR14 represents a structural break is consistent with the position adopted in this Report. Ofwat’s recognition that there are factors which can impact on systematic risk which might not be relevant to setting a long-run, unconditional beta is not consistent with the approach used in the FM.

Third, the relevance of structural break analysis is recognised by a range of experts:

- On behalf of the water companies in the PR19 appeals Professor Alan Gregory et al noted 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/RIO would appear to have done)<sup>275</sup>, 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”**<sup>276</sup>
- This is consistent with recommendations set out by the authors of the Indepen report, commissioned by Ofgem, who noted that **“in an ideal world the estimation of equity  $\beta$  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 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”**<sup>277</sup>

Fourth, whilst the CMA did not explicitly rely on structural break analysis, it recognised (1) that some structural breaks – such as those related to the changes in business mix – are relevant for beta estimation<sup>278</sup>, and (2) assigned limited weight to Covid-affected data which implicitly recognises that the pandemic caused a temporary structural break.

Overall, structural break analysis has an important role to play in beta estimation provided that all specified breaks have a clear economic rationale. This is the approach adopted in this Report.

In the case of permanent structural breaks that affect historical data, the relevant input into the calculation of the regulatory CoE is data since the most recent break as this would more accurately reflect the fundamental systematic risk going forwards. In the case of permanent structural breaks that can reasonably be expected to affect systematic risk going forwards, a bespoke approach may be required to derive estimates that best reflect the underlying systematic risk over the assumed forward-looking investment horizon. Where both types of permanent structural breaks apply, a combination of these two approaches would be appropriate.

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<sup>274</sup> Ofwat (2022), PR24 Final Methodology, Appendix 11 – Allowed return on capital, p. 15

<sup>275</sup> The analysis undertaken by Gregory et al during the PR19 appeals found a structural break for the UK water sector around the PR14 period (c. October 2014).

<sup>276</sup> Gregory, A., Harris, R., and Tharyan, R. (2020), ‘A Response to “Further Comments Regarding Beta” by Europe Economics’, (hereafter referred to as ‘Prof Alan Gregory et al (June 2020)’)

<sup>277</sup> Indepen (2019), Beta Study–RIO-2, Main Report, p. 7

<sup>278</sup> CMA (2021), PR19 Final Determination, para. 9.461

Two categories of breaks are relevant for the estimation of betas for PR24. The first category comprises recent significant events that have impacted global and UK economies, namely: Covid19 and the Russia-Ukraine war, and crucially responses to these events. The second category comprises the specific factors that affect the fundamental business risk of water companies and the relationship with the market – namely changes in the regulatory regime at PR14 and the significant step up in investment intensity going forwards. The following sections consider each category of structural break in turn.

## 8.2.1 Estimation of Business-As-Usual (BAU) beta

There has been a material reduction in water company betas since the inception of the Covid19 pandemic and the Russia-Ukraine war. The changes appear to be a function of the ‘flight to safety’<sup>279</sup> 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. These behavioural factors are temporary *by nature*<sup>280</sup> and are a feature of a specific set of economic conditions rather than driven by fundamentals.

Attaching significant weight to betas affected by temporary or transient effects may not be reflective of risk over the long-run investment horizon, would not be consistent with the basis for estimation of other parameters such as the RFR and in turn might not attract long-run capital to the sector.

A long-term estimation window which captures data from 2014 onwards is adopted for beta estimation. This reflects, *inter alia*, the structural break at PR14 and the superiority of longer-term beta estimates.

There are relatively few listed water companies in the sector – until recently there have been only two pure play comparators (UUW and SVT). Recently, PNN has also become a pure play comparator following its disposal of the Viridor business. The inclusion of additional data from PNN could increase the statistical robustness and representativeness of the beta estimate used to set allowed returns for the notional company.

As pure play beta information is not available for PNN for longer estimation windows, this Report incorporates PNN into the beta estimate by adjusting the SVT/UUW betas for the differential between the 2-year betas of PNN/SVT/UUW and SVT/UUW portfolios (as at June 2023).

As a result, the BAU beta for the sector (before taking into account changes in risk on a forward-looking basis) is estimated as follows:

- **The lower bound of the BAU beta range (0.29)** is based on SVT/UUW data for the estimation window between October 2014 – June 2023, adjusted to include the impact of PNN. This estimate is conservative as it attaches weight to data since 2020 which is affected by temporary distortions due to Covid19 and the war
- **The upper bound of the BAU beta range (0.32)** is based on SVT/UUW data from October 2014 onwards adjusted to (1) include the impact on PNN and (2) exclude the impact of Russia-Ukraine war and assume a reoccurrence of a Covid19-like pandemic once in every 20 years. The assumption of reoccurrence of a Covid19-like pandemic is consistent with academic research on frequency of similar pandemics and recent regulatory precedent from the CMA and the CAA. The exclusion of the impact of the war reflects an expectation that betas will mean revert over the next couple of years as macroeconomic conditions stabilise

<sup>279</sup> On the impact of Covid19, see for example, [Interim Financial Stability Report May 2020 \(bankofengland.co.uk\)](https://www.bankofengland.co.uk/interim-financial-stability-report-may-2020) 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](#).

<sup>280</sup> 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.](#)

The analysis undertaken by KPMG<sup>281</sup> and Professor Gregory et al<sup>282</sup> has found that both Covid19 and the war have had significant negative impacts on recent water company betas.

**Figure 12 Evolution of 5Y unlevered betas (SVT/UUW equally weighted portfolio) during October 2014 – June 2023**



Source: KPMG analysis and data from Refinitiv Eikon and Refinitiv Datastream

Although Ofwat acknowledges the potential influence of the pandemic and the war on water sector betas, it argues that these events do not merit bespoke weighting in beta estimation. Ofwat posits that caution around recent volatility should be reflected in estimates by using longer estimation periods and trailing averages of beta compared to PR19. However, this approach does not appear to consider whether the weight that will be effectively placed on data affected by Covid19 and the war is appropriate given (1) the transitory impacts of these events which do not reflect an enduring change to underlying business risk and (2) the requirement to estimate the underlying, fundamental systematic risk of water companies.

By contrast, in the ED2 Final Determinations<sup>283</sup>, Ofgem's beta assumption was based on the data up to October 2020 on the basis that the underlying systematic risk of energy networks was unlikely to have changed. As a result, the regulator did not reflect temporary distortions resulting from the Russian-Ukraine war and continued impacts of Covid19 (between November 2020 – October 2022) in its beta estimate.

The change in short-term water company betas following the pandemic and the war appears to be a function of the 'flight to safety'<sup>284</sup> 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. 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.

<sup>281</sup> See, for example, KPMG (2022), Relative risk analysis and beta estimation for PR24.

<sup>282</sup> Prof Alan Gregory et al (January 2021); Prof Alan Gregory et al (October 2020); Prof Alan Gregory et al (April 2020)

<sup>283</sup> Ofgem (2022), RII0-ED2 Final Determinations Finance Annex, para. 3.85

<sup>284</sup> On the impact of Covid19, see for example, [Interim Financial Stability Report May 2020 \(bankofengland.co.uk\)](https://www.bankofengland.co.uk/interim-financial-stability-report-may-2020) p. i; [Learning from the dash for cash – findings and next steps for margining practices - speech by Sir Jon Cunliffe | Bank of England](https://www.bankofengland.co.uk/learning-from-the-dash-for-cash-findings-and-next-steps-for-margining-practices); [UK investment Management Industry: A Global Centre](https://www.globeurope.com/en/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 \(federalreserve.gov\)](https://www.federalreserve.gov/), [Western credit markets are holding up remarkably well | The Economist](https://www.economist.com/finance-and-economics/2022/05/12/western-credit-markets-are-holding-up-remarkably-well).

These behavioural factors such as flight to safety are temporary *by nature*<sup>285</sup> and are 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 and for a long-run investment horizon.

In the context, the Report considers the following evidence to inform the treatment of Covid19 in the derivation of beta estimates:

- There have been several studies which have sought to estimate the likely frequency of pandemics which are comparable to Covid19. This includes the study referenced in the draft methodology which estimated the base probability of experiencing a comparable pandemic as 0.38 to 0.76 in 100Y<sup>286</sup>. This suggests that the likelihood that another pandemic event occurs in the estimation window is low
- KPMG's<sup>287</sup> 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
- The CAA in the Final Decision 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<sup>288</sup>

As a result, estimates informing the upper end of the beta range derived in this Report assume a reoccurrence of a Covid19-like pandemic once in every 20 years.

KPMG has also undertaken an assessment<sup>289</sup> of whether the impact of Russia-Ukraine war should be taken into account based on whether it is temporary or protracted, relative to the investment horizon. This assessment is updated based on latest data in Appendix 3.

Forecast inflation – the chosen proxy to quantitatively evaluate the timing of reversion to 'normal' economic conditions following the war – is expected to normalise ahead of the start of the PR24 price control as reflected in the chart below. This indicates that the economic impact of the war could reverse over the next couple of years and is not likely to be relevant for setting the allowed returns for PR24 over the long-run investment horizon. Consequently, the impact of the war has been fully excluded in the derivation of estimates informing the upper end of the beta range.

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<sup>285</sup> 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.](#)

<sup>286</sup> PNAS (2021), Intensity and frequency of extreme novel epidemics

<sup>287</sup> KPMG (2022), Relative risk analysis and beta estimation for PR24

<sup>288</sup> CAA (2023), Economic regulation of Heathrow Airport Limited: H7 Final Decision, Section 3: Financial issues and implementation, para 9.83 and CAA (2023), Economic regulation of Heathrow Airport Limited: H7 Final Decision, Section 3: Financial issues and implementation, section 9

<sup>289</sup> Ibid.



The Report considers the following evidence to inform the starting point of the estimation window used to derive PR24 betas.

- Consistent with the UKRN (2018) recommendations<sup>290</sup>, and with the submissions by Prof Alan Gregory et al (April 2020, October 2020, January 2021)<sup>291</sup>, for the purpose of setting the regulatory CoE allowance, what is needed is an estimate of the long-run unconditional 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
- There is agreement between various parties (Ofwat, KPMG, Indepen, Gregory et al) regarding the presence of a structural break at PR14
- Longer-term estimates have several benefits from a statistical perspective. They provide a larger sample size which reduces the impact of random variations and allows for more precise and reliable parameter estimation. Longer time periods also help smooth out short-term fluctuations and noise in the data. This smoothing effect reduces the influence of idiosyncratic events or temporary market conditions that may distort the estimation of beta over shorter time frames
- In the FM, Ofwat to an extent recognised the superiority of longer-term estimates by forming the beta range based on “*longer estimation periods and longer trailing averages*”. Ofgem adopted a similar approach for RII02 where it placed greater weight on beta estimates using relatively long periods of historical data (10-year estimation windows), or long-term averages of rolling betas estimated based on shorter windows<sup>292</sup>

As a result, the Report adopts a long-term estimation window which captures data from 2014 onwards.

There are three listed water companies which can underpin the determination of asset beta reflective of BAU systematic risk exposure by the regulator. Regulated activities have comprised the majority of SVT and U UW’s businesses<sup>293</sup> since c. 2007-2008 following the sale of U UW’s telecoms business<sup>294</sup> and the demerger of SVT’s waste management business<sup>295</sup>. PNN has been a pure play water company following its disposal of Viridor (its waste management subsidiary) in July 2020<sup>296</sup>.

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 effect of the sale of Viridor on cash balances and its subsequent influence on gearing and asset beta was limited to a single financial year and could be normalised with reference to net debt balances held during recent periods before and after the sale. To achieve this normalisation, this Report utilises the average gearing observed one year before the sale of Viridor and another year after PNN utilized the retained cash on its balance sheet.

The table below illustrates that the inclusion of PNN in the equally 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 U UW data may under-remunerate the BAU systematic risk exposure for the notional water company.

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<sup>290</sup> UKRN CoE Study, 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*”.

<sup>291</sup> Prof Alan Gregory et al (January 2021), Prof Alan Gregory et al (October 2020), Prof Alan Gregory et al (April 2020).

<sup>292</sup> Ofgem (2020), RII0-2 Final Determinations for Transmission and Gas Distribution network companies and the Electricity System Operator – Finance Annex REVISED, paras. 3.74

<sup>293</sup> Regulated activities comprised c. 93% of 2021/22 revenues for SVT and c. 96% for U UW according to annual reports.

<sup>294</sup> [United Utilities \(companiesshistory.com\)](https://www.companiesshistory.com)

<sup>295</sup> [Biffa looking forward after 100 years](#)

<sup>296</sup> [Pennon’s announcement of disposal of the Viridor Business](#)

**Table 29 The impact on 2Y spot beta of the inclusion of PNN in the equal-weighted portfolio of listed water companies**

	2Y spot unlevered beta as at 30 June 2023
SVT/UUW	0.225
PNN/SVT/UUW	0.234
Difference	0.008

Source: KPMG analysis and data from Refinitiv Eikon as of 30 June 2023

Given that pure play beta information is not available for PNN for longer estimation windows, this Report incorporates PNN into the beta estimate by assuming that the differential from Table 29 would have applied over the historical window (i.e. 2014 onwards) used for beta estimation.

The overall approach for the derivation of the BAU beta for the sector (i.e. before taking into account the impact of the step up in the scale of capital programmes) can be summarised as follows:

- The lower bound of the BAU beta range (0.29) is based on SVT/UUW data for the estimation window between October 2014 – June 2023, adjusted to include the impact of PNN. This estimation window reflects (1) Ofwat’s rejection of structural breaks for Covid19 and Russia-Ukraine war, (2) KPMG analysis and Ofwat’s recognition of the structural break for PR14 and (3) Ofwat’s recognition that the long-term estimates are the most robust. This estimate can be interpreted as the absolute minimum appropriate beta for the water sector which does not take into account any increase in the forward-looking risk profile
- The upper bound of the BAU beta range (0.32) is based on SVT/UUW data from October 2014 – February 2020 (i.e. before the inception of the pandemic), adjusted to (1) include the impact on PNN and (2) exclude the impact of Russia-Ukraine war and assume a reoccurrence of a Covid19-like pandemic once in every 20 years based on data from March 2020 – February 2022 (i.e. before the inception of the war). This approach avoids introducing a transitory and downward bias in the beta estimates which are intended to reflect expected returns over a long-run investment horizon, consistent with the other parameters in the CAPM

## 8.2.2 Pricing in forward-looking systematic risk exposure

Historical betas do not reflect forward looking risk associated with the unprecedented step up in the scale of investment in the sector. As a result, pricing in forward-looking systematic risk exposure for PR24 requires selection of relevant comparators which reflect this risk.

### **Primary evidence: Investment intensive UK regulated sectors with comparable regulatory risk**

Inclusion of NG in the list of comparators could better reflect the forward-looking risk exposure for the water sector as (1) regulatory frameworks across the two sectors are relatively similar and (2) NG's historical RCV growth better reflects levels of growth expected for water.

The beta for a weighted<sup>297</sup> portfolio of water companies and NG based on data from October 2014 – February 2020 (i.e. before the inception of the pandemic), adjusted to assume reoccurrence of a Covid19-like pandemic once every 20 years based on data from March 2020 – February 2022 (i.e. before the inception of the war) is 0.33. This could be a conservative estimate given that the scale of investment – and consequently the likely step up in risk – is higher for PR24 than for NG across RII01-2. The impact of pricing forward-looking systematic risk exposure is to increase the beta range from 0.29 – 0.32 to 0.29 – 0.33. Companies with particularly significant step changes in capital programmes may need to select beta point estimates at or above the upper end of the range set out in this section.

### **Cross-check evidence: Sectors with significant exposure to construction activities in infrastructure**

The activities of UK construction and engineering firms with exposure to the water sector could provide a useful cross-check as they reflect the nature and scale of construction activity that water companies are expected to undertake at PR24.

The differences between construction and water company betas are likely to be driven by a combination of competition, the absence of regulatory risk protections, different risk sharing and contractual arrangements as well as exposure to other sectors beyond water. To avoid distortions in the cross-check for these additional differentiating factors, a weighted-average beta is calculated based on a combination of water and construction betas where the weight assigned to the latter is reduced by 50% to proxy the impact of regulatory protections. The resulting beta corroborates the estimate derived based on weighted portfolio of water companies and NG.

The allowed CoE is estimated on a forward-looking basis and, for consistency, the notional equity beta should also reflect the expected systematic risk exposure for a sector on a forward-looking basis. The relative risk assessment undertaken in this Report indicates that the systematic risk exposure of the water sector is increasing, primarily attributed to the significant step-up in the investment intensity. The estimation of a beta that reflects the underlying systematic risk of the water sector over the assumed forward-looking investment horizon based on historical data from listed water companies poses a challenge as:

- The step up in the scale of investment is unprecedented even using conservative estimates of spend required to meeting statutory obligations. The most relevant historical period for beta estimation – i.e. 2014 onwards – does not reflect the associated risks as the scale of spend and complexity of capital activity during this period was significantly lower
- In principle, it is reasonable to expect the market to price in the impact of additional risks into water company betas once the information regarding the scale of investment and corresponding regulatory policy becomes sufficiently widely disseminated and understood. If this were the case, one could argue that a bespoke approach for pricing these risks should not be required as they will already be reflected in betas. In practice, the scale of required investment has become clear only relatively recently as reflected in equity analysts' commentary. Additionally, the associated impact may be reflected in very short-term beta estimates only which are highly volatile, lack statistical robustness and are distorted by Covid19 and Russia-Ukraine war

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<sup>297</sup> 67% weight assigned to SVT/UUW, adjusted to include PNN and 33% weight assigned to NG.

This implies that bespoke selection and weight assigned to comparators is required to adequately capture and price in the forward-looking systematic risks.

There might be a case for exploring capital investment-intensive UK regulated sectors with comparable regulatory risk to inform the appropriate pricing of forward-looking systematic risk exposure for the sector.

Betas of companies with significant exposure to construction activities in the infrastructure sector can provide a useful cross-check for the pricing of risks associated with large and complex capital programmes.

### The proposed approach to capture underlying systematic risk: primary evidence

It may be appropriate to place some weight on the evidence from other regulated sectors in the UK that have historically exhibited a more significant investment profile.

In principle, sectors like energy, aviation, and telecoms could serve as useful references for pricing in the risks associated with increased investment intensity. However, the regulatory regimes in the aviation and telecoms sectors differ significantly from that of the water sector, implying distinct exposures to regulatory risk<sup>298</sup>. This contributes to differences between water sector and aviation/telecoms betas and introduces challenges in isolating the impact of investment intensity on beta estimates.

By contrast, the regulatory frameworks for energy networks are more closely aligned to water, making National Grid (NG) a potentially appropriate benchmark for pricing the risk associated with substantial capital programs. The CMA noted at the GD&T2 appeal that “*both sectors enjoy extremely high levels of regulatory protections, in particular in relation to regulated asset bases, inflation protection, revenue certainty and the funding of operating and investment costs. We considered that the most powerful influence on water and energy network unlevered betas is likely to be the fact that they are UK regulated monopolies. As such, water companies are, in principle, reasonable and useful comparators when estimating the beta for the energy networks. This usefulness only increases when the lack of pure-play listed energy networks is taken into account*”. The CMA’s comment implies that it is reasonable to consider NG’s beta as a proxy. This is also in line with several recent analysts’ reports which indicate that water may now be as risky or even riskier than energy networks. For example:

- Barclays notes that “*we believe **risk in power networks**<sup>299</sup> **is lower than for water** (less commodity price exposure, higher margins, less political risk), which should come through cost of capital calculations as either higher asset betas and/or lower leverage in water versus regulated power names. This is not the case. **Ofwat used an asset beta of 0.33 versus Ofgem’s 0.35 and despite lower risk, put the sector on a lower gearing assumption. These assumptions are inconsistent in our view**<sup>300</sup>*”
- Credit Suisse notes that “*the last time borrowing costs were as they are now, the allowed return was c6% CPIH-real. We note **electricity distribution – where RAB growth might be similar – got a c3.9% CPIH-real return on capital in November 2022 (vs 2.9% for water in December 2019) with more extensive trackers on debt and equity costs. The 6.5% total market return and reluctance to ‘aim up’ is a limitation. Our view is that water has at least the same risk than distribution***<sup>301</sup>

The figure below compares the investment growth experienced by both the water sector and NG from the historical window used for beta estimation to the indicative growth projected for AMP8. While the indicative scale of growth for AMP8 significantly exceeds the historical RCV growth for both the water

<sup>298</sup> The key distinction between the regulatory regimes in the aviation sector (CAA) and the telecoms sector (Ofcom) compared to the water sector (Ofwat) lies in their pricing mechanisms. Both CAA and Ofcom regulate businesses by setting maximum price limits that companies can charge to customers, while Ofwat determines the revenue allowance for water companies. Consequently, regulated airports and telecoms are more susceptible to changes in customer numbers influenced by broader economic conditions, making them bear higher demand risk, leading to increased asset betas. Additionally, the CAA sets a lower cost-sharing rate, with zero sharing rate for Opex, for Heathrow Airport compared to Ofwat’s proposed 50% sharing rate in PR24 FM. Moreover, the presence of incentive regimes in the CAA and Ofcom regulations is less pronounced in comparison to Ofwat’s regulatory framework.

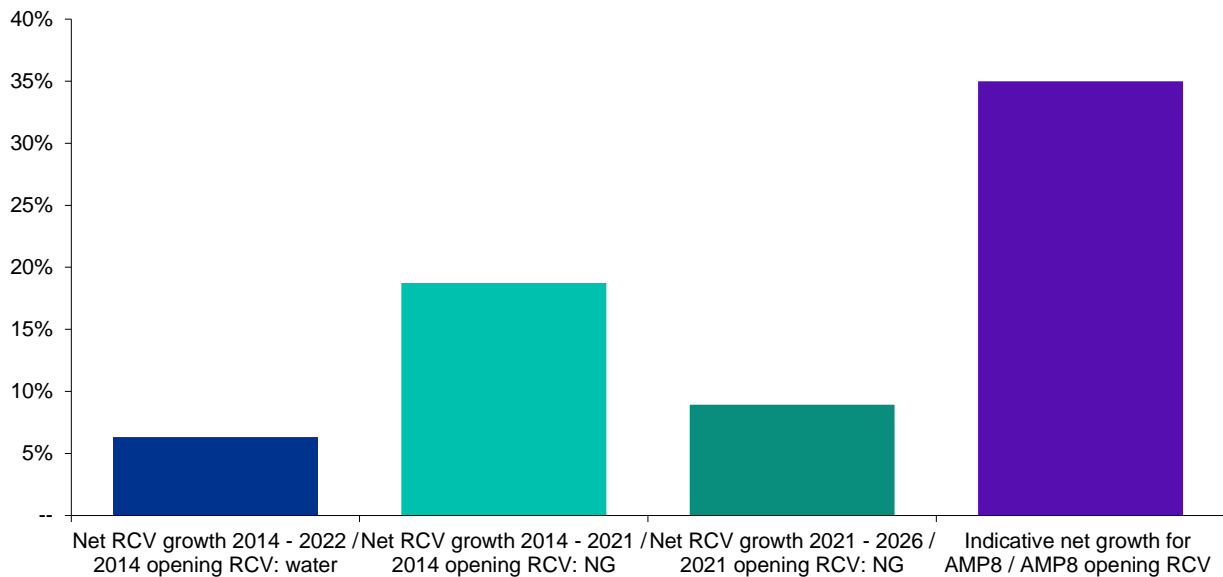
<sup>299</sup> Corrected from power “names”.

<sup>300</sup> Barclays (2023), UK Water: positive hydrostatic pressure

<sup>301</sup> Credit Suisse (2023), UK Water: Thames issues and what they mean for the industry

sector and NG, it is evident that NG's growth aligns more closely with the likely growth profile for the water sector AMP8. This observation suggests that beta data from NG could better reflect the forward-looking risk exposure for the water sector, even though it may not entirely capture the impact of the step change in levels of investment, given that NG's growth during 2014 – 2021 and projected for RIIO2 was lower than the AMP8 indicative growth for the water sector.

**Figure 13 A comparison of capital investment / opening RCV<sup>302</sup>**



Notes: The RCV of National Grid is calculated as the sum of the RCV from its gas transmission (NGGT) and electricity transmission (NGET) entities sourced from the final determination license models  
Source: KPMG analysis

The table below sets out the comparison of betas for (1) water, (2) weighted NG and water and (3) NG. It suggests that a beta based solely on water sector data may materially under-remunerate the systematic risk exposure for the water sector for future price controls.

<sup>302</sup> Over the primary window used for beta estimation (i.e. 2014 – 2020), NG's portfolio included regulated operations in the US, UK electricity transmission, gas transmission and gas distribution businesses, the latter of which was sold within the estimation window. The more recent purchase of the electricity distribution business and the sale of the gas transmission business are outside the estimation window so are not included in the analysis. The impact of the US business and of the sale of the gas distribution business are considered below.

Two perspectives exist regarding the influence of the US business on NG Group's beta. Ofgem effectively considers that the inclusion of the US business in the Group does not distort systematic risk pricing for pure play GB energy networks, a stance upheld at the energy CMA appeal. Contrarily, during the appeal networks argued that the higher beta of the UK business compared to the US business could lead the NG Group's beta to underestimate systematic risks for GB energy networks. These viewpoints imply that NG Group's beta either underestimates or properly prices systematic risks for GB energy networks. As both parties agree that NG Group beta does not overstate these risks, this Report deems it appropriate to utilise the Group beta for pricing forward-looking systematic risks in the water sector given that the resulting estimate may be conservative.

On 10 November 2015, NG announced it intended to sell majority shares in its gas distribution business. The Report considered whether the inclusion of Cadent's 2013 – 2015 RCV would materially affect the calculated ratio of capital investment / opening RCV for NG. The impact of this inclusion is not material (<3%), therefore, Cadent's RCV is not included in the ratio presented on Figure 13.



**Table 30 Differences between water, weighted NG and water, and NG unlevered betas (adjusted for a Covid19-like pandemic and Russia-Ukraine war)**

	Adjusted betas
SVT/UUW (equal weights), adjusted to include PNN	0.32
67% weight assigned to SVT/UUW, adjusted to include PNN and 33% weight assigned to NG	0.33
NG	0.36

Notes: Based on data from PR14 onwards adjusted to exclude the impact of Russia-Ukraine war and assume a reoccurrence of Covid19 once in every 20 years  
Source: KPMG analysis and data from Refinitiv Eikon as of 30 June 2023

The Report considers that it is appropriate to attach some weight to energy network betas to reflect the projected change in forward-looking risk profile driven by heightened capital intensity, whilst also assigning weight to long run betas for pure play water companies. A beta based on a weighted portfolio of water companies and NG may be the minimum required to appropriately price this forward-looking systematic risk exposure given that the scale of investment – and consequently the likely step up in risk – is higher for PR24 than projected for NG at RIIO1-2. Pricing in forward-looking systematic risk exposure increases the unlevered beta range from 0.29 – 0.32 to 0.29 – 0.33.

Companies with particularly significant step changes in capital programmes may need to select beta point estimates at or above the upper end of the range set out in this section.

### **The proposed approach to capture underlying systematic risk: cross-check evidence**

The activities of UK construction and engineering firms specialising in infrastructure could provide a close reflection of the nature and scale of construction activity that water companies are expected to undertake at PR24. The requirements and challenges of these firms in delivering infrastructure projects could closely align with those faced by water companies, making their data relevant and valuable for assessing the pricing of associated risk factors in the water sector.

The relevance and usefulness of construction company betas for pricing risks associated with large capital programmes has been recognised by regulatory precedent. For example, the upper end of Ofgem’s proposed beta range for the Hinkley-Seabank (HSB) electricity transmission project under the Competition Proxy Model was estimated based on construction companies<sup>303</sup>.

At the same time, it is important to recognise that these construction companies are exposed to different and additional risks such as competition and the regulatory framework for water companies incorporates mechanisms that substantively mitigate risks associated with construction projects carried out in unregulated sectors. For example, the Totex sharing mechanism partially mitigates exposure to the risk of cost overrun, indicating that unregulated construction comparators may face higher risks in this aspect. The differences between construction and water company betas are likely to be driven by a combination of competition, different risk sharing and contractual arrangements, and the absence of regulatory risk protections. Directly comparing these betas without accounting for the material impact of competition and regulation could potentially lead to an overestimation of the systematic exposure to construction risks. It is important to take into account these differences in risk when weighing the evidence derived from construction company data.

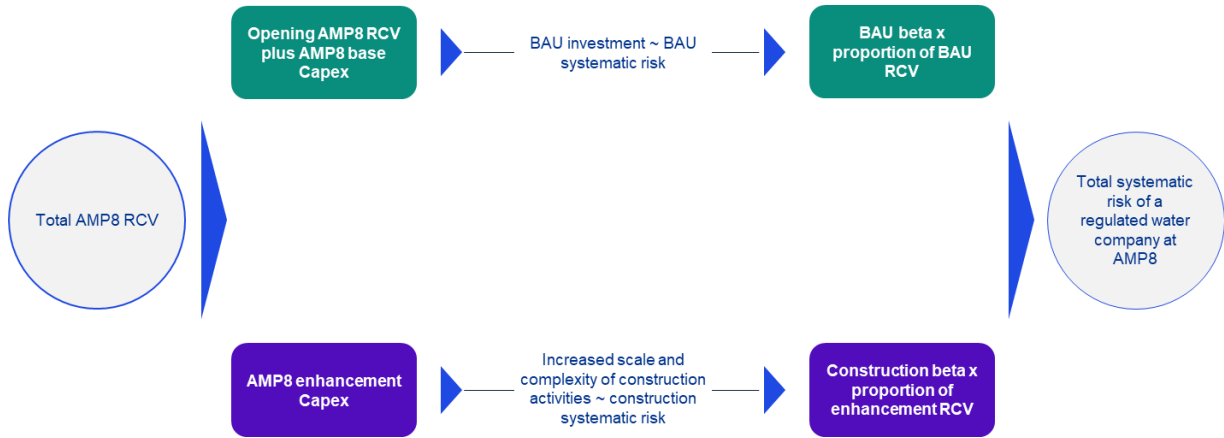
As a result, this Report uses construction beta evidence to derive a cross-check for betas implied by a combination of water and energy network evidence. The cross-check is based on a weighted-average of water and construction betas which is calculated as follows:

- Estimates the average proportion of net AMP8 RCV arising from new enhancement spend
- Estimates the average proportion of net BAU RCV comprised of (1) AMP8 opening RCV and (2) AMP8 base capex
- Calculates a weighted average beta for the business based on:
  - Applying a *lower* beta estimate based on pure play water companies to BAU RCV

<sup>303</sup> See, for example, Ofgem (2018), Update on the Competition Proxy delivery model, para. 1.20.

- Applying a *higher* beta based on construction comparators to 50% of net RCV arising from new enhancement spend. This adjustment reduces the weight assigned to construction betas in the derivation of the weighted-average beta in recognition of the fact that new enhancement spend would be subject to some regulatory protections which are not available to construction companies. The 50% assumption is based on the expected cost sharing rate at PR24

**Figure 14 Illustration of the split cost of capital approach**



Source: KPMG analysis

This Report focusses on construction betas for (1) companies with direct exposure to the UK water sector and (2) liquid companies with sufficient traded history. The approach for the determination of a robust and relevant sample of construction comparators is set out in Appendix 4. This approach resulted in 5 liquid companies<sup>304</sup> with exposure to the UK water sector.

The figure below sets out the outturn 5- and 10-year unlevered betas for the equally weighted portfolio of the selected construction comparators.

**Figure 15 Unlevered betas for the construction portfolio**



Notes: There are periods where some companies have negative net debt, i.e. debt less cash and cash equivalents is less than zero. In such cases, it is assumed that net debt (and hence gearing) is zero. The effect of this assumption is to suppress asset betas for such companies (relative to not imposing this constraint)

Source: KPMG analysis and data from Refinitiv Datastream

<sup>304</sup> Morgan Sindall Group plc, Renew Holdings plc, Kier Group plc, Galliford Try Holdings plc, Costain Group plc.

The betas for the construction portfolio – particularly the 10-year beta – appear to be broadly stable between 2010 and 2020, followed by a notable increase at the onset of Covid19. Betas have continued to increase steadily over the last three years. Notably, the construction sector, which is exposed to demand risk and lacking regulatory protections, might have been more susceptible to recent supply chain disruptions, labour availability challenges, and project delays or cancellations. These factors could have widened the gap between water sector and construction betas beyond what is typically observed during normal conditions. As a conservative measure, this Report assumes that these increases in betas are temporary and relies on pre-pandemic data to accurately capture the fundamental risk of an infrastructure construction business.

The Report focuses on 10-year betas given their greater statistical robustness and stability, particularly in case of construction betas. The 10-year unlevered beta as at 28 February 2020 for the infrastructure portfolio is 0.62<sup>305</sup>.

The analysis implies a beta of 0.33 which indicates that a beta based on weighted portfolio of water companies and NG could appropriately price in forward-looking systematic risk exposure implied by the scale of investment at PR24.

### 8.3 Frequency of data

The Report relies on daily betas which are more statistically robust for liquid stocks. No weight has been attached to weekly or monthly estimates as these have higher standard errors – consistent with the findings of Ofwat’s advisers – and are subject to a reference day effect.

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<sup>306</sup>.

For liquid stocks that are unlikely to suffer from asynchronous trading, the Report considers daily frequency to be appropriate for development of point estimates. Consistent with this, in the FM Ofwat states that daily beta estimates are the primary basis for estimation. At the same time, Ofwat appears to have attached some weight to weekly and monthly beta estimates as it expressed cautiousness that the daily datapoints generate a higher beta estimate relative to lower frequency estimates. This is despite:

- Ofwat’s commentary that they will maintain their initial approach and rely on daily beta for raw equity beta estimation, “*given the 'reference day' issue\* and the higher standard errors associated with weekly and monthly beta estimates*”
- FTI’s recognition that standard errors for weekly and monthly betas are higher than for daily betas

Lower frequency estimates are affected by the reference day selected for calculating beta, which has a marked effect on beta values, known as the “reference day risk.” This phenomenon is examined in detail by Acker and Duck (2007). It is not surprising that the “reference day risk” has a more significant influence on weekly betas, given the uneven impact of non-trading days throughout a week. For instance, bank holidays in the UK typically occur on a Monday or a Friday.

<sup>305</sup> It is assumed that unlevered beta is equal to raw equity beta given that the observed gearing for comparator group is <5%.

<sup>306</sup> 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

FTI considers that averaging weekly betas estimates for each working mitigates the reference day effect. This is however not sufficient to address the reference day effect as the incidence of bank holidays has a highly uneven impact on trading throughout a week. Furthermore, FTI's treatment of non-working days – whereby they assume zero returns – can cause further distortions in weekly betas.

During the PR19 re-determination the CMA placed weight on different frequencies of data to form their range of estimates. In practice, the CMA's range of 0.28 to 0.30 was primarily driven by daily estimates (for example none of the monthly estimates fall within the CMA's beta range)<sup>307</sup>.

As all the comparators considered in this Report are liquid, the Report considers that daily betas are the most robust basis for the estimation of beta for PR24.

## 8.4 Averaging windows

The Report does not rely on averages of rolling beta estimates as they introduce arbitrary weighting of the underlying pricing, potential bias from structural breaks, considerable variation in estimates, making the averages difficult to interpret consistently and reliably.

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 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<sup>308</sup> 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

Rolling betas have several flaws.

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.

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*"<sup>309</sup>. The UKRN CoE Study further highlighted that "*the econometric basis for this approach is actually fairly shaky: in particular all parameter standard errors are invalidated by this methodology*"<sup>310</sup>.

<sup>307</sup> Daily betas encompassed within the CMA's range: December 2020 cut-off - 10y spot, 5Y 1-year average, 10Y 1-year average, 10Y 5-year average, February 2020 cut-off - 2Y spot, 10Y spot, 2Y 2-year average, 10Y 5-year average  
Weekly betas encompassed within the CMA's range: December 2020 cut-off - 5Y 2-year average, 2Y 5-year average, February 2020 cut-off - 2Y 2-year average.

<sup>308</sup> 30 September was the cut off used in the PR19 FD.

<sup>309</sup> CMA (2021), PR19 Final Determination, para. 9.473

<sup>310</sup> UKRN CoE Study, p.50 footnote 67

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-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)<sup>311</sup>
- A similar position was adopted by Ofwat, which 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<sup>312</sup>
- On behalf of the water companies Gregory et al (2020)<sup>313</sup> outlined several flaws in the rolling average approach and submitted evidence of a structural break for the UK water sector around the PR14 period<sup>314</sup> (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)<sup>315</sup> as at 30 September 2024 will incorporate information before the structural break and will not be representative of the systematic risk going forward

Third, rolling beta estimates based on the same estimation window might considerably vary, rendering the 'average' difficult to interpret.

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<sup>316</sup>.

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 estimate, whilst introducing arbitrary weighting of the underlying pricing signals within the sample under consideration.

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*"<sup>317</sup>.

The material changes highlighted by the CMA are to a large extent driven by the impact of Covid19 on beta estimates<sup>318</sup>. 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.

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<sup>311</sup> CMA (2021), PR19 Final Determination, para. 9.461

<sup>312</sup> Ofwat (2020), Reference of the PR19 final determinations: Risk and return – response to common issues in companies' statements of case, para. 3.58

<sup>313</sup> Prof Alan Gregory et al (October 2020)

<sup>314</sup> Prof Alan Gregory et al (January 2021), Prof Alan Gregory et al (October 2020), Prof Alan Gregory et al (April 2020).

<sup>315</sup> For example, 10-year betas or 5-year averages of 5-year betas.

<sup>316</sup> Wright, S. and Mason, R. (2020), 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

<sup>317</sup> CMA (2021), PR19 Final Determination, para. 9.473

<sup>318</sup> Ibid., para. 9.493



**Table 31 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: KPMG analysis and CMA PR19 FD, Tables 9-16

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<sup>319</sup> from this period, by using rolling averages the CMA<sup>320</sup> further reduced the impact of the pandemic on PR19 beta estimates.

## 8.5 Estimation of debt beta

This Report adopts the same debt beta assumption as the FM, noting that (1) debt beta is difficult to measure and has a relatively small effect on the overall WACC and (2) the FM estimate is aligned with the 0.10 upper bound applied by the CMA and is marginally higher than the estimates from academic literature for a company with Baa1/BBB+ credit rating.

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. Where the actual gearing of listed beta comparators (based on market value) and notional gearing are not materially different, the impact of the debt assumption on the notional equity beta and therefore CoE is immaterial.

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<sup>321</sup>.

The CMA’s position at PR19 was 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<sup>322</sup>.

In the FM Ofwat adopted a debt beta range of 0.05 – 0.15 based on empirical analysis undertaken by FTI. This is different from the approach in the draft methodology which proposed to set the debt beta at a level which would make the CAPM-WACC calculation invariant to gearing (0.21)<sup>323</sup>. KPMG’s previous<sup>324</sup> analysis found that the draft methodology approach was not supported by a robustly evidenced specification of the problem and could introduce material distortions.

The retention of the Harris-Pringle approach to de- and re-levering betas<sup>325</sup>, coupled with the adoption of a debt beta assumption supported by empirical analysis, means that the debt beta estimate in the

<sup>319</sup> Ibid., para. 9.482

<sup>320</sup> Ibid., para. 9.493

<sup>321</sup> CMA (2021), PR19 Final Determination, para. 9.518

<sup>322</sup> Ibid., para. 9.517

<sup>323</sup> The draft methodology approach sought 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 backed out the debt beta from the observed cost of debt using the formula  $r_D = R_F + \beta_D * (r_M - r_F)$ .

<sup>324</sup> KPMG (2022), Relative risk analysis and beta estimation for PR24

<sup>325</sup> In practice Ofwat has still gone some way towards enforcing a WACC that is invariant to gearing. As noted by Ofwat in the draft methodology, setting the notional gearing equal to listed companies’ market gearing – which is in effect the approach in the FM – removes the need to make a de- and re-levering adjustment. However, the reduction in notional gearing is not appropriate as set out in section 9.

FM is more consistent with corporate finance theory and its practical application as well as empirical evidence. The resulting point estimate of the debt beta is aligned with the 0.10 upper bound applied by the CMA and is marginally higher than the estimates from academic literature for a company with Baa1/BBB+ credit rating. For example, under Schwert and Strebulaev's methodology debt betas of 0.10 correspond to a BBB credit rating, whereas debt betas of 0.05 correspond to an A rating<sup>326</sup>.

Based on the above and given the relatively small impact of debt betas on the overall CoE estimate, this Report adopts a debt beta assumption of 0.10 consistent with the mid-point of the FM range.

## 8.6 Derivation of the beta range for PR24

The table below sets out the overall beta range estimated in this Report.

The lower bound of the unlevered beta range (0.29) is based on the beta for an equally weighted portfolio of SVT/UUW during October 2014 – June 2023 adjusted by the difference between the betas of equally weighted SVT/UUW/PNN portfolio to that of SVT/UUW for the 2-year estimation window. This estimate is consistent with (1) Ofwat's rejection of structural breaks for Covid19 and Russia-Ukraine war; and (2) Ofwat's recognition that the long-term estimates are the most robust. This estimate can be interpreted as the absolute minimum appropriate BAU beta for the water sector which does not take into account any increase in the forward-looking risk profile.

The upper bound of the unlevered beta range (0.33) is based on weighted portfolio of water companies and NG from PR14 onwards and is adjusted to exclude the impact of Russia-Ukraine war and assume a reoccurrence of a Covid19-like pandemic once in every 20 years.

This range is encompassed within the unlevered beta range estimated by Ofgem for all energy sectors for RIIO2 of 0.29 – 0.34<sup>327</sup>. Ofgem's estimate for RIIO-2 in turn attached weight to water company betas.

**Table 32 Overall beta range**

Parameter	Lower	Upper
Observed gearing	52.20%	49.38%
Unlevered beta	0.29	0.33
Debt beta	0.10	0.10
Asset beta	0.34	0.38
Equity beta	0.71	0.79

Notes: The observed gearing values have been derived on consistent basis in relation to cut off estimation windows and comparator set as the unlevered betas at the lower and upper ends of the range  
Source: KPMG analysis

Overall, the Report finds that a material increase in systematic risk is likely in AMP8 and beyond as a result of a projected step-change increase in capital intensity which is unprecedented in the sector. As a result, beta estimates based on historical data could result in a material under-pricing of forward-looking risk. On this basis the Report attenuates the overall range above to reflect the upper half of the range only – which attaches weight to NG betas – and adopts a beta range of 0.31 to 0.33<sup>328</sup>.

<sup>326</sup> Available at: [Schwert, M. and Strebulaev, I. \(2014\). Capital Structure and Systematic Risk](#), 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
$\beta_D$	0.04	0.05	0.05	0.10	0.24	0.31	0.43
$\sigma_D$	0.07	0.05	0.06	0.10	0.14	0.21	0.31
$\rho_{ED}$	-0.03	-0.02	0.06	0.16	0.28	0.36	0.37

<sup>327</sup> Ofgem (2022), RIIO-ED2 Final Determinations Finance Annex, Table 12

<sup>328</sup> The observed gearing for the attenuated lower bound is 50.79%.

# 9 Notional gearing

The price controls for UK regulated firms incorporate an allowance for WACC, which represents the opportunity cost faced by debt and equity investors when investing in a firm with a "notional" financial structure, i.e. an assumed ratio of debt to RCV.

The estimation of the WACC is based on a notional financial structure to account for the potential influence of a firm's financing approach. This ensures that customers fund only the efficient cost of capital for the notional company while allowing firms flexibility in their actual financing decisions. This section considers the appropriate notional gearing assumption for PR24 and is structured as follows:

- First, it comments and analyses Ofwat's proposed approach for evaluation of the notional gearing assumption
- Second, it assesses whether a change in notional gearing is supported by market evidence
- Third, it concludes on the appropriate notional gearing assumption for PR24

## 9.1 Commentary on and analysis of Ofwat's approach to setting notional gearing

The proposed reduction in notional gearing to 55% is not supported by robust market evidence or corporate finance principles:

- All companies in the sector have gearing which is higher than 55%, with average gearing significantly higher
- Assuming a lower notional gearing cannot improve the notional company's overall financial position if business risk has increased – assuming lower gearing in practice reallocates risk from debt to equity. Where there is a marked increase in business risk on a forward-looking basis, the efficient market outcome would be a higher return to price in changes in risk (as reflected in the beta estimates in this Report)
- A reduction in notional gearing also will increase the scale of equity capital which needs to be attracted to the sector to fund the step change in capital programmes and could exacerbate equity financeability challenges

Ofwat has proposed a reduction in notional gearing from 60% applied at PR19 to 55% for PR24. The rationale<sup>329</sup> for the assumed reduction in the PR24 FM is set out below.

- 1 **Efficient financing choices:** Ofwat considers that there is a greater role for equity in the notional structure to support financial resilience and management of risk exposure and uncertainty. Ofwat notes that this would support effective operation of the incentive based regulatory regime, reflecting the levels of stretch that are driven by cost and performance incentives within the regulatory regime, as well as risks associated with external events and regulatory compliance
- 2 **Scale and nature of investment needs:** Ofwat recognises that companies are facing substantial investment requirements, and this will likely need to be in part equity financed. Ofwat notes that it is necessary for companies to maintain sufficient equity to ensure the capacity to borrow efficiently over the price control period
- 3 **Appropriate benchmarks:** Ofwat considers that actual structures within the sector do not represent a relevant consideration for setting notional gearing. Ofwat does not place significant weight on sector gearing as a benchmark as companies are responsible for their own financing decisions and reliance on this evidence could introduce circularity for regulatory decisions. Instead, Ofwat cites a 7% reduction in gearing between 2018 and 2021 for European stocks

<sup>329</sup> Ofwat (2022), PR24 Final Methodology, Appendix 10 – Aligning risk and return, section 4.3

(excluding financials) as supporting evidence for the 5% reduction in the notional gearing for UK regulated water

- 4 **Impact of inflation:** Ofwat highlights that reductions in gearing levels can be observed under actual financing structures in the sector, driven by recent high inflation, and that this evolution of observed gearing should be translated into the notional capital structure
- 5 **Best interests of current and future customers:** Ofwat also highlights that changes in notional gearing may act as a signalling mechanism to companies about the need to maintain financial resilience

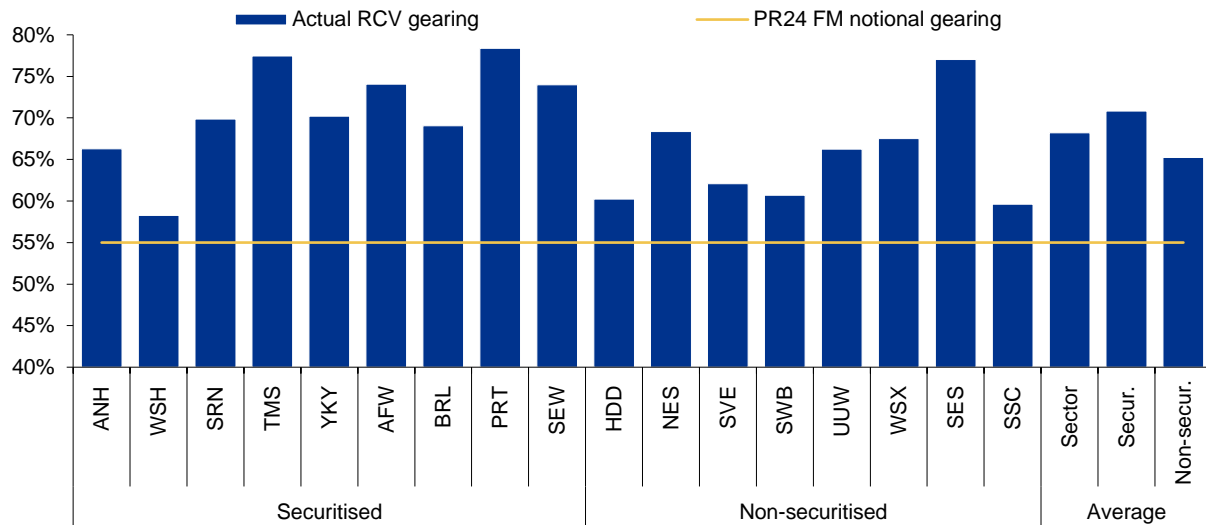
The Report comments on each rationale for a reduction in notional gearing at PR24 in turn:

- 1 **Efficient financing choices:** Ofwat supports an assumed reduction in notional gearing with reference to anticipated levels of risk and uncertainty at PR24 and the importance of the notional company having access to an equity buffer consistent with its risk exposure
  - Assuming a lower notional gearing cannot improve the company's overall financial position with the same level of business risk; rather it transfers risk exposure from debt to equity. Where financial headroom implied by a given level of returns is not adequate to support financial resilience or management of forward-looking risk, the efficient market outcome would be a higher required return on capital to reflect changes in business risks

In this context, Ofwat's estimate of beta is not supported by an evaluation of how systematic risk might evolve at PR24 and does not incorporate adjustments to price in higher risk

- Introducing a reduction in notional gearing to reflect, *inter alia*, higher risk without adequately pricing in changes in risk through beta could introduce a significant misalignment between risk and return. This approach is not appropriate in isolation as it assumes that a change in capital structure can sufficiently price in higher risk at the enterprise level for the notional firm
  - It may be appropriate for an increase in beta to be accompanied by an assumption of a change in the notional capital structure. However, the latter is not a substitute for appropriately pricing risks in the required returns in the first place
- 2 **Scale and nature of investment needs:** The scale of investment is likely to result in a material requirement for equity capital. The need to attract this scale of equity capital is unprecedented in the sector. It is likely to be challenging to secure commitment of new equity, particularly given the likely impact of sustained high capital investment on yields and payback periods. In this context, an assumed reduction in notional gearing will, all else equal, exacerbate the requirement for new equity capital and the scale of the equity financeability challenge. It is inherently more difficult to attract and retain equity capital and test whether such capital is available than debt capital. Consequently, assuming a higher requirement for equity capital appears to increase risk to customers in relation to financing of investment plans for AMP8 and beyond
  - 3 **Appropriate benchmarks:** Ofwat suggests there is a circularity in basing notional gearing on actual company structures and gearing levels, as such an approach could expose customers to actual company financing decisions. However, Ofwat bases other WACC parameters such as CoD predominantly on actual company costs as a proxy for efficient financing. Not attaching weight to actual gearing levels within the sector omits relevant evidence and introduces an inconsistency of approach compared to other WACC parameters. The figure below illustrates that as at 31 March 2023 that all water companies in the sector are geared above the proposed 55% notional gearing level and hence the assumed reduction is not supported by or consistent with market evidence from the sector

**Figure 16 Actual gearing for the water sector as at 31 March 2023**



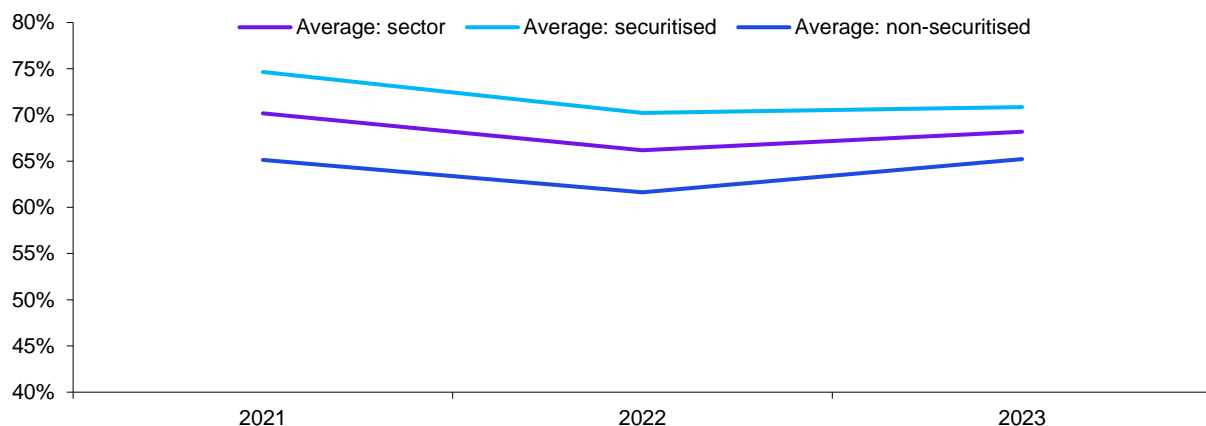
Source: KPMG analysis and data from 2023 annual performance reports

Gearing, along with coverage metrics such as AICR, typically plays a significant role in determining credit ratings based on Moody’s methodology. Assuming a 55% gearing level would typically imply an A3 rating according to Moody’s methodology, which is at least one notch higher than the rating achievable for the notional firm based on the PR24 FM. The reduction in notional gearing introduces an inconsistency between rating achieved for the notional company and expected rating based on rating methodologies for the sector

Finally, it is not clear that evidence from changes in gearing for European non-financial stocks is relevant to the selection of efficient capital structures for water companies. This evidence will include stocks with different activities and risks and may not be representative of changes in gearing which would be appropriate for companies operating in the UK market, in contestable infrastructure or in regulated utilities

- 4 **Impact of inflation:** Recent high inflation has reduced observed gearing in the sector and Ofwat considers that this supports an assumed reduction in notional levels of gearing. The figure below illustrates based on data from 2023 that a proportion of the reduction in gearing observed in 2022 has since reversed. Moreover, other factors are likely to exert upwards pressure on gearing across the sector across the investment horizon, such as the cashflow negative profile expected to arise from the scale of capital programmes in AMP8 and beyond

**Figure 17 Evolution in average gearing between 2021 and 2023**



Source: KPMG analysis and data from 2022 and 2023 annual performance reports



- 5 **Best interests of current and future customers:** The PR24 FM does not set out evidence to support the need to incentivise a reduction in gearing at the sector level, or analysis which indicates that a reduction in gearing over and above recent observed changes in sector gearing would be in the customer interest. Given the scale and nature of investment needs, reducing notional gearing increases the requirement for new equity and could disincentivise investment which is in the long-term customer interest. A reduction in gearing may also have unintended consequences such as increased agency costs<sup>330</sup> due to the dilution of the disciplinary effect of debt on managerial behaviour

## 9.2 Derivation of notional gearing

The PR24 FM approach to notional gearing appears to reverse the logical sequencing for assessment of whether the notional company is financeable by changing assumptions about the notional financial structure to accommodate risk and uncertainty, rather than first assessing the implications of changes in risk for returns. The use of notional gearing as a financeability lever risks masking underlying drivers of financeability constraints. This, in turn, could undermine the role of financeability as a meaningful cross-check on price control calibration and the alignment of risk and return.

This Report finds that a gearing assumption of 60% is appropriate for the notional firm, supported by evidence from observed gearing levels in the sector and rating agency methodologies for the target rating of the notional firm. The CMA similarly did not consider there was evidence to justify an alternative level of gearing than the 60% applied at PR19<sup>331</sup> or that another level of notional gearing would better serve customers<sup>332</sup>. As a result, this Report adopts a gearing assumption of 60%, which is consistent with Ofwat's gearing assumption at PR19.

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<sup>330</sup> Agency costs arise from the separation of ownership and control, creating conflicts of interest between shareholders (owners) and managers (agents) who make decisions on behalf of shareholders.

<sup>331</sup> CMA (2021), PR19 Final Determination, para. 9.530

<sup>332</sup> Ibid., para. 9.44

# 10 Retail margin adjustment

Ofwat has applied a retail margin adjustment (RMA) to the cost of capital for the appointee to avoid double counting compensation for systematic retail risks. However, there are conceptual and practical weaknesses in its derivation by Ofwat. When the flaws in Ofwat's calculation are corrected, the implied adjustment reduces to 0-1 bps and so is not applied in this Report.

Ofwat remunerates financing costs for the household retail price control with a net margin which is applied to retail cost-to-serve and wholesale revenues and funds financing costs. A margin approach is applied to this control as the asset-light nature of the retail business means traditional return on capital approaches are less suited to estimation of appropriate returns.

Ofwat has applied a retail margin adjustment (RMA) to the cost of capital for the appointee to avoid double counting compensation for systematic retail risks given that allowed returns are set at the appointee level taking into account risk from all controls (including retail).

This section evaluates the justification and robustness of the adjustment applied by Ofwat, both from a conceptual perspective and in terms of its practical calculation.

There may be a conceptual basis for the RMA provided that (1) the systematic risk of retail activities is *higher* than wholesale activities and (2) the risks attributable to retail activities are fully priced in by the allowed retail margin. However, an adjustment to allowed returns to exclude a portion of the systematic risk that is driven by retail activities in comparator firms may represent spurious accuracy. Beta estimation is inherently imprecise, and it is unlikely that the systematic risk of retail activities can be isolated relative to the activities of an integrated supplier.

There are also several flaws in the calculation of the 6bps adjustment set out in the FM which is set out in the table below.

**Table 33 Ofwat calculation of the retail margin adjustment**

Component (2020-25 average)	Calculation	Value	Notes
Fixed asset balance for retail controls	A	£384m	From PR19 FD financial models
Cost of financing fixed assets	B	5.35%	PR24 appointee 'early view' allowed return on capital
Required revenue for return on retail fixed assets	$C = A \times B$	£21m	-
Debtor balance	D	£1,050m	From PR19 FD financial models
Creditor balance	E	£473m	From PR19 FD financial models
Measured income accrual	F	£1,305m	From PR19 FD financial models
Advance receipts	G	£947m	From PR19 FD financial models
Annual working capital requirement	$H = (D + F) - (E + G)$	£935m	-
Working capital financing rate	I	3.06%	Trimmed average from PR19 resubmitted business plans
Required revenue for return on working capital	$J = H \times I$	£29m	-
Total retail-specific capital costs	$K = C + J$	£48m	-
Retail margin allowed revenue apportioned to households	L	£97m	From PR19 FD financial models
Required return for retail systematic risk	$M = L - K$	£47m	-
Average RCV (2020-25)	N	£83,554m	From PR19 FD financial models
Retail margin adjustment	$O = M / N$	0.06%	-

Source: KPMG analysis and PR24 FM

First, the inclusion of creditor balances in the calculation of the annual working capital requirement which can be attributed to the retail business is not consistent with the treatment of this balance at the appointee level. Retail creditor balances represent amounts owed to the wholesale business and are offset by an equivalent debtor balance within the wholesale business. The intra-appointee balances effectively cancel out at the consolidated appointee level. The consolidated position is the relevant one as beta is estimated at the appointee level and is de- and re-levered based on gearing which reflects appointee-level cash flows and movements in working capital. The exclusion of the creditor balance from the calculation reduces the adjustment from 6bps to 4bps.

Second, when considered against the appropriate working capital requirement, the retail margin provided by Ofwat implies a negligible difference (<0.01<sup>333</sup> in unlevered beta terms) in the systematic risk being priced for the appointee and retail businesses. This can be attributed to the low level of the retail margin and reaffirms that is unlikely that a cost of capital set at the appointee level could double count retail returns. On this basis assuming a double count could risk introducing distortions into the CoE estimate.

Third, an alternative perspective might be that the retail capital requirements and remuneration pricing are being set and evaluated for the retail business hence the consolidated working capital position is not relevant. However, the standalone pricing of retail capital requirements would necessitate the inclusion of all sources of capital that a standalone retailer might utilise in practice require. A review of credit arrangements for the non-household retail market<sup>334</sup> indicates that associated retailers

<sup>333</sup> With creditor balance excluded, working capital requirement in Table 5.1 of the FM becomes £1,408m and implies a total capital balance of £1,792m when combined with retail fixed assets. £97m margin implies nominal return on capital of 5.4%. Expressing this return in real terms and decomposing it using other FM WACC parameters yields an unlevered beta that is less than 0.01 higher than the appointee unlevered beta.

<sup>334</sup> KPMG (2018), Review of credit arrangements for the non-household retail market

operating on a standalone basis make extensive use of contingent forms of capital such as Parent Company Guarantees (PCGs) which are a form of contingent capital. A standalone household retail market operator would also likely require contingent capital to support financeability on a standalone basis. As a result, if the retail business is being evaluated on a standalone basis it would be necessary to include creditor balances and all contingent capital required to support the business. where creditor balances are included in the calculation of capital requirements for a standalone retailer, contingent capital should be included and price appropriately.

Fourth, the 3.06% assumption for the working capital financing rate is unlikely to be appropriate. This estimate is based on a simple average of the working capital rates taken from company business plans from 2018. There was considerable variation between working capital financing rates included by different companies<sup>335</sup> which suggests that the underlying estimates may not have been derived on a consistent basis and it may not be appropriate to average them to arrive at a financing rate for the sector.

More importantly, there is an inconsistency between the cut-off dates – and hence the market conditions captured – by the cost of financing fixed assets (i.e. the FM WACC based on September 2022 data) and the working capital financing rate based on data from 2018. This inconsistency results in an overstated RMA. To assess the impact of this inconsistency, this Report recalculates the RMA under two variants of the working capital financing rate:

- Approach 1 is based on the cost of debt allowance set out in the FM. This approach recognises in practice the financing used to manage retail working capital requirement may be indistinguishable from the rest of a company's debt portfolio as financing is managed at the appointee level. This approach further reduces the RMA adjustment from 4bps to 1bps
- Approach 2 is based on the average yield on the iBoxx Non-financials A/BBB 1-3 indices<sup>336</sup> during the month of September (5.22% nominal). This approach recognises that by nature working capital balances have a shorter life relative to the tenor of financing implied in the cost of debt allowance. This approach further reduces the RMA adjustment from 4bps to zero

The approaches set out above illustrate that where the RMA is estimated based on internally consistent financing rates – in this case both based on September 2022 data – the adjustment would be immaterial.

In summary, the application of the RMA is likely to represent spurious accuracy and is not supported by empirical evidence. In consequence, this Report does not apply an RMA and the appointee and wholesale cost of capital are assumed to be the same.

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<sup>335</sup> The financing rates range from 0.21% to 5% excluding outliers of 0% and 7% (three companies did not report a working capital financing rate).

<sup>336</sup> The same index was used by the CMA to inform pricing of floating rate debt, see para. 9.606 of the Final Determination.

# 11 Approach to selection of a point estimate

The preceding sections of this Report considered the estimation of each of the CoE parameters. This section considers the determination of the point estimate for allowed return on equity from a range constructed based on parameter-level estimates and, in particular, explores the potential application of an adjustment to the CoE to account for policy or sector-specific factors.

The CMA in its PR19 re-determination set the point estimate for CoE 25bps above the mid-point of the CoE range to address investment incentives amidst parameter uncertainty and asymmetric risk on ODIs. The CMA considered that:

- The need to promote investment should be a consideration in setting the point estimate for CoE, stating that *“there are risks of an exit of capital from the long-term investors in the sector, should the cost of capital be set too low”* and *“there are risks that there will be underinvestment in new assets, if the expected return on capital on new investment in AMP8 and beyond does not provide incentives to reinvest capital and maintain or grow the asset base over time”*<sup>337</sup>
- Setting a point estimate for the cost of capital should be considered ‘in-the-round’, and that this includes a view on the overall balance of the settlement. The CMA stated that *“if the package includes significant asymmetric incentives, such as large penalty-only incentives, then the expected return will be lower than the allowed cost of capital”*<sup>338</sup>

The CMA also commented on financeability as a relevant input to its decision on selecting a point estimate for CoE, noting that *“a decision to set a point estimate above the middle of the range will address the risks to financeability which would increase from setting the cost of equity at lower levels within the range”*<sup>339</sup>. This Report considers that, in line with the approach adopted by the CMA, financeability constraints are best identified and addressed by utilising a robustly calibrated<sup>340</sup> financeability analysis as a cross-check on the overall determination, in particular on the allowed CoE.

A cross-check based on the relationship between current pricing of new debt in the sector and equity pricing would also be relevant. This is because (1) debt and equity are both claims on the same underlying asset, and there should be a relationship between them and (2) the CoE cannot be observed whereas cost of debt can be observed. This is in line with Damodaran (2021) which considers that *“there should be a relationship across the risk premiums in these asset classes that reflect their fundamental risk differences... there is enough of a relationship here that we would suggest using this approach as a secondary one to test to see whether the equity risk premiums that we are using in practice make sense, given how risky assets are being priced in other markets”*<sup>341</sup>. As a result, observed debt pricing and the relationship between the CoE and the cost of debt could be used to infer the CoE which can be applied as a sense check to the CAPM-derived estimate.

The subsequent sections examine the two primary considerations that underpinned the CMA's decision to aim up when selecting the point estimate for PR19 CoE. It also comments on the findings from the multi-factor model (MFM) cross-check and implications for CoE.

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<sup>337</sup> CMA (2021), PR19 Final Determination, para. 9.1394

<sup>338</sup> Ibid., para. 9.1395

<sup>339</sup> Ibid., para. 9.1402

<sup>340</sup> This would involve, for example, using a reasonable, empirically supported notional structure set *ex ante* to test the adequacy of allowed returns and other regulatory parameters, rather than changing assumptions about the notional financial structure to justify the determination of the cost of capital.

<sup>341</sup> Aswath Damodaran, Equity Risk Premiums (ERP): Determinants, Estimation, and Implications – The 2022 Edition



## 11.1 Aiming up to maximise consumer welfare in the context of estimation uncertainty

There is inherent uncertainty in estimating the unobservable CoE and greater potential harm from underestimation of returns compared to overestimation. As a result, there is merit in setting the point estimate for the allowed CoE of essential service providers above the mid-point.

The CMA recognised the validity of this rationale when it aimed up on the PR19 CoE to maximise consumer welfare in the context of estimation uncertainty. The CMA's decision indicates that its concerns around incentives for investment and customer welfare would be particularly acute in case of a step change in investment. This Report considers that an adjustment of 15bps – in line with the CMA's decision at PR19 – is the minimum required to avoid disincentivising levels of investment required for AMP8 and beyond in the context of parameter uncertainty.

The core principle underpinning aiming up is to mitigate the greater welfare loss arising from under-estimation rather than over-estimation of the cost of capital. If the allowed return is set too high, customers end up paying more in their bills than they would have had the allowance been based on the true cost of capital. On the other hand, if the allowed return is set too low, companies are discouraged from making new investments or adequately maintaining existing ones, resulting in suboptimal levels of investment and a significant loss in consumer welfare. As the demand for most regulated services is driven by the essential nature of the services provided, the welfare loss from under-investment is substantial. Consequently, the detrimental impact on consumers is not symmetric when the allowed return deviates significantly from the true cost of capital.

This is in line with the UKRN CoE study, which demonstrates that the consumer welfare loss from under-investment is greater than the consumer welfare loss from marginally higher prices. The study notes that *“with relatively low elasticities, the reduction in consumer surplus from setting the RAR, and hence the regulated price, too high is relatively small. In contrast, the welfare loss from setting the RAR (and hence the price) too low is relatively large. This leads to considerable aiming up, as the optimal choice by the regulator”*<sup>342 343</sup>.

As the true CoE is unobservable and estimation carries uncertainty, aiming up above the estimated market based CoE is necessary to mitigate the risk of under-investment and maximize consumer welfare. This approach ensures that investors are adequately compensated for the risks to which they are exposed, maintains investor confidence, incentivizes investment, and ultimately protects consumer welfare in regulated sectors.

As acknowledged by the CMA and the UKRN CoE Study<sup>344</sup>, the primary objective of aiming up is not to promote excessive investment, but rather to address the risk of consumer detriment which could arise from setting the allowed return too low.

When considering the risks of not aiming up in the water PR19 re-determinations, the CMA identified two channels through which a cost of capital set too low could have adverse effects on investment levels. Firstly, a low allowed return over multiple periods would lead to an opex bias and a gradual reduction in investment, with limited RCV growth<sup>345</sup>. Secondly, a low WACC allowance discourages companies from identifying and proposing otherwise desirable investment projects<sup>346</sup>.

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<sup>342</sup> UKRN CoE Study, p. 72

<sup>343</sup> Whilst Wright et al (2018), also argues that aiming up is optimal for new investments, and not for investments that are sunk, this conclusion does not hold in a multi-period setting. In a multi-round setting, investment would only occur if the investment earned at least the (unknown true) cost of capital in future rounds. Therefore, in a multi-period setting, aiming up is also needed for existing investments, to ensure that investments are financeable.

<sup>344</sup> UKRN CoE Study

<sup>345</sup> CMA (2021), PR19 Final Determination, para. 9.1275

<sup>346</sup> Ibid., para. 9.1280

The CMA's overarching concerns around incentives for investment and customer welfare relate to the following two issues<sup>347</sup>:

- Regulation should create a supportive long-term investment environment. Both investors and customers benefit from an approach which does not respond too quickly to market fluctuations and is consistent over time
- The allowed return needs to be set in a way that encourages – by providing incentives to identify, develop and implement new programmes – the right level of investment without under or overinvestment

The CMA's rationale for aiming up to promote investment implies that these concerns might be particularly acute for PR24. For example:

- The CMA recognised that there are additional risks associated with new investment, noting that *“another way to address the risk of under-investment in future periods would therefore be through an alternative mechanism to **reward investors for the additional risk associated with new investments**”*<sup>348</sup>
- The CMA also commented that *“the current context of a material reduction in the cost of equity at the same time as a growth in investment points to a need to proactively address the risks associated with setting the cost of capital too low”*<sup>349</sup>. This point continues to be relevant for PR24 as the growth in investment is significantly higher than at PR19 and there is a material disconnect between the substantially increased market rates and the flat CoE
- The CMA considered that there would need to be sufficient financial incentives to ensure that appropriate capital projects were identified and designed at a desirable level and that this *“**would be particularly the case if Ofwat required a step change in investment to meet changing resilience requirements in the face of climate change challenges or other stresses on existing infrastructure**”*<sup>350</sup>. Given the substantial step up in investment at PR24 and beyond, this point is even more pertinent for the determination of the allowed CoE going forwards

In consequence, the Report considers that a 15bps adjustment for aiming up is the minimum required to maximise customer welfare in the context of parameter uncertainty and avoid disincentivising high levels of investment projected for AMP8 and beyond. This adjustment is broadly consistent with the adjustment applied by the CMA at PR19 for the same reason when selecting a point estimate for CoE<sup>351</sup>.

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<sup>347</sup> Ibid., para. 9.1388

<sup>348</sup> Ibid., para. 9.1283

<sup>349</sup> Ibid., para. 9.1281

<sup>350</sup> Ibid., para. 9.1391

<sup>351</sup> The CMA does not provide an explicit split of the 25bps adjustment into that related to investment incentives and to asymmetry. However, the CMA does comment that the 15bps adjustment indicated by Ofwat as *“sufficient if we were to make any adjustment to the mid-point at all”* in the context of parameter uncertainty is insufficient to address all the concerns that have informed the CMA's decision to aim up. Furthermore, the CMA's estimate of structural asymmetry was 0.1-0.2% RoRE. In this context, it is not unreasonable to assume that 15bps of the 25bps adjustment related to investment incentives and 10bps to asymmetry.

## 11.2 Aiming up for asymmetric risk

The presence of unremunerated asymmetric exposure can undermine the financeability of an investment. This is because investments with (1) expected returns materially below required returns (i.e. with expected loss) and (2) material negative skewness<sup>352</sup> may be deemed less attractive than other available opportunities with better risk-reward profiles. As a result, the distribution of expected returns is a relevant and important criterion for selection of a point estimate for CoE.

The analysis in section 7 indicates that the proposed calibration of regulatory mechanisms implies material asymmetry due to the presence of both expected loss and negative skewness. In practice, these factors are likely to affect different notional companies to varying degrees.

As the business plan information is not yet publicly available and it is not possible to undertake company-specific notional analysis of asymmetry across the sector, this Report recommends that each company undertake this analysis based on the FM and their business plan. Where companies identify the presence of expected loss or negative skewness, they should apply an adjustment when selecting a point estimate from the CoE range implied by the analysis in this Report.

The CAPM assumes that returns are normally distributed, i.e. they are clustered around the mean with a symmetric distribution. The CAPM does not inherently account for investors' exposure to asymmetric risk via the presence of expected loss, negative skewness, or both (see section 4.2). The presence of unremunerated asymmetric exposure can undermine the financeability of an investment. This is due to two reasons.

First, one of the fundamental principles of corporate finance is that investors will only invest capital where they have a reasonable expectation of earning the required return<sup>353</sup>. Where expected returns are materially below required returns (i.e. there is expected loss), the investment may be deemed less attractive than other available opportunities with better risk-reward profiles and may struggle to attract financing at competitive rates (or even at all).

The implication is that for an investment to be able to attract finance, an investor should expect to earn a return that covers its cost of capital. Some regulators have formulated this into a 'fair bet' principle. For example, Ofcom defines an investment "*a fair bet if, at the time of investment, the expected return is equal to the cost of capital*"<sup>354</sup>.

Regulatory precedent recognises the importance of the fair bet principle to investability and the importance of addressing any violations of the principle.

In the final determination for the PR19 appeal, the CMA concluded that "*in setting the allowed return, our duty is to consider whether investors in a notional company, acting efficiently, have a reasonable expectation of a return equal to its WACC. Our assessment is that those investors would also take into account structural asymmetry in the package of incentives when considering expected returns on investment*"<sup>355</sup>.

During SONI's appeal against the Northern Ireland Utility Regulator (UR), the CMA stated: "*the UR failed to have regard to asymmetric risk and that, as indicated by SONI's own analysis, this would result in expected returns being lower than the assumed WACC*"<sup>356</sup>.

The CMA concluded that this would lead to an expected loss. It stated that failure to account for this and make other necessary adjustments would: "*...materially affect the return required to remunerate SONI for the risks faced by investors*"<sup>357</sup>.

<sup>352</sup> Skewness measures the lack of symmetry in a distribution. If the distribution is negatively skewed, it means that there is a longer left tail, and extreme negative returns are more likely to occur. Conversely, if the distribution is positively skewed, it means that there is a longer right tail, and extreme positive returns are more likely.

<sup>353</sup> Where the required return reflects the cashflow risk of the investment in question as well as the opportunity cost of capital (i.e. the return that could be earned from investing capital in an alternative opportunity of similar risk).

<sup>354</sup> Ofcom (2021), Promoting competition and investment in fibre networks: Wholesale Fixed Telecoms Market Review 2021-26, Volume 4: Pricing remedies, para 1.115

<sup>355</sup> CMA (2020), PR19 Final Determination, para 9.1339

<sup>356</sup> CMA (2017), SONI Limited v Northern Ireland Authority for Utility Regulation Final Determination, para 7.371

<sup>357</sup> Ibid., para 7.376

Second, when an investment exhibits a greater negative skewness compared to available alternative opportunities, risk-averse investors might perceive it as less appealing due to the increased likelihood of unfavourable outcomes, potentially hampering its ability to secure financing and compete effectively with other opportunities.

Asymmetry is an important consideration for investors in a regulatory context because regulated companies cannot raise prices to balance downside risks on a mean-expected basis. Where companies are exposed to asymmetric downside risk they cannot mitigate or control (such as e.g. risks imposed on the company by the regulatory framework design and calibration of regulatory mechanisms), they will achieve a lower return than the required return on a mean-expected basis.

This means that the regulatory settlement needs to either (1) address the exposure at source or (2) set allowances to balance such risks to ensure these investments constitute a fair bet from an investor's perspective.

Consistent with this, the CMA considered that "*an adjustment to the cost of capital is not the only option to address asymmetry – this could be done in other ways, although the alternative which would change the balance of risk...would be instead to change to the structure of ODIs to reduce or remove the asymmetry in the financial incentives*"<sup>358</sup>.

The above suggests that consistency with the fair bet principle and the consideration of skewness are relevant and important criteria for selection of a point estimate for CoE.

The analysis in section 7 indicates that – based on the PR24 FM – there is likely to be material asymmetry, in the form of both expected loss and negative skewness, driven by the proposed design of regulatory mechanisms, in particular the calibration of ODI targets and rates, removal of caps and collars and PCDs in relation to enhancement expenditure. Companies will need to assess *on a company-specific and notional basis* expected performance against each regulatory mechanism in isolation and in the round. This is because, *inter alia*, the drivers of asymmetry may differ across the sector and affect different notional companies to varying degrees and the information from business plans required to undertake company-specific notional analysis is not yet publicly available. Where (1) companies *expect* to under-perform and (2) there is significantly higher scope for downside than upside exposure, companies should apply an adjustment for asymmetry when selecting a point estimate from the CoE range implied by the analysis in this Report.

### 11.3 Implications of the findings from the Multi-Factor Models (MFM) cross-check

MFM evidence – and namely the CoE derived using the q-factor model – should be considered a *primary* cross-check to the CAPM-derived CoE. This is because, *inter alia*, the q-factor model, one of the leading MFMs in academia, provides a more granular view of risk than the CAPM, improves upon the empirical performance of the CAPM based on US and UK data and has met the exceptionally high bar for statistical robustness applied in academic literature for the evaluation of asset pricing models.

This evidence suggests that the CAPM materially under-prices systematic risk for water companies. Further refinement of MFM analysis is warranted to inform the selection of the point estimate for PR24 CoE.

KPMG has previously developed analysis<sup>359</sup> to explore approaches to cross-check returns implied by the CAPM based on relevant financial literature, regulatory principles and empirical analysis.

In particular, the analysis considered whether MFMs could represent a robust cross-check for setting allowed returns at PR24. The rationale for exploring MFMs as a cross-check was as follows:

- CAPM is used by all UK regulators as the primary methodology for setting the allowed CoE for price controls, reflecting its simplicity, straightforward interpretation and ease of use. However, academic research has over time identified a number of empirical shortcomings in the CAPM to

<sup>358</sup> Ibid., para 9.1343

<sup>359</sup> KPMG (2022), Exploring Multi-factor Models as a cross-check on allowed returns at PR24

explain observed returns. These shortcomings are also acknowledged by sector regulators, the CMA and practitioners

- UKRN and the CMA have also recognised the stronger power of MFMs compared to the CAPM. Whilst MFMs have been considered in the past<sup>360</sup> by UK regulators (Ofwat, CAA, Ofgem, Ofcom) as a tool which could be used to estimate regulatory CoE, regulatory analysis of MFMs was predominantly concentrated in the early 2000s and has not been substantively revisited thereafter as MFMs have developed
- CAPM and MFMs both have the same starting point, namely stocks' observed return. MFMs explain observed returns with reference to multiple explanatory factors that, by design, are expected to provide a more granular view of and better captures the systematic risk associated with individual stocks than a single factor model like the CAPM, which relies on a simplifying assumption that all risks relevant to pricing can be captured by the single market factor
- The latest MFMs have been proven to be statistically robust and to materially improve on the empirical performance of the CAPM<sup>361</sup> based on US data<sup>362</sup>. In general, the explanatory power of MFMs has improved over time as MFMs have developed
- A review of academic literature, corporate finance textbooks and practitioners' asset pricing methodologies indicates that MFMs are increasingly prevalent as asset pricing models to measure risk and improve on the empirical performance of the CAPM

The starting point of KPMG's analysis were two of the leading MFMs in academic research, Hou et al's q-factor model (2015)<sup>363</sup> and Fama and French's five-factor model (FF5F) (2015)<sup>364</sup>. Both the q-factor model and the FF5F have been shown to have strong empirical performance based on US data. Both models were calibrated and tested based on UK data, although it was noted that there was some evidence that the q-factor model is a more robust model with stronger empirical performance<sup>365</sup>.

The models calibrated based on UK data were subjected a two-stage statistical testing to evaluate the empirical performance. The statistical tests deployed – the factor spanning<sup>366</sup> and Gibbons-Ross-Shanken (GRS)<sup>367</sup> tests – are the standard tests applied in the academic literature to assess the statistical robustness of asset pricing models. Both tests allow for the assessment of the performance of different models on a relative basis (i.e. versus each other and the CAPM).

According to these statistical tests the q-factor model performs better than both the CAPM and the FF5F and improves upon the explanatory power of the CAPM based on a more granular and nuanced assessment of risk.

The statistical tests above used to assess the performance and robustness of the q-factor model are consistent with those applied in academic research. As a result, the bar applied to MFM evidence as a potential cross-check is significantly higher than for any other cross-check. All else equal, this suggests that MFM evidence should be considered a *primary* cross-check. This implies in cross-checking the CAPM that weight should be attached to evidence implied by the q-factor model over and above other cross-checks.

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<sup>360</sup> For example, as part of PR04, PR09 in water, Q5 appeal in aviation, TPCR4 in energy.

<sup>361</sup> For example, Fama and French noted in 2004 that *"unfortunately, the empirical record of the model is poor – poor enough to invalidate the way it is used in applications. The CAPM's empirical problems may reflect theoretical failings, the result of many simplifying assumptions. But they may also be caused by difficulties in implementing valid tests of the model"*. Fama, E. and French, K. (2004), *The Capital Asset Pricing Model: Theory and Evidence*.

<sup>362</sup> For example, Fama, E. and French, K. (1993, 1996, 2015), Hou, K. et al (2015), Green, J., Hand, J. R., & Zhang, X. F. (2017), 'The characteristics that provide independent information about average US monthly stock returns'.

<sup>363</sup> Hou, K., Xue, C., and Zhang, L. (2015). 'Digesting anomalies: An investment approach'

<sup>364</sup> Fama, E. and French, K. (2015), 'A Five-Factor Asset Pricing Model'

<sup>365</sup> It was found that (1) The q-factor model outperforms the FF5F on statistical tests based on US data. (2) the value factor in the FF5F is redundant and without the value factor, the FF5F reduces to a 'noisy' variant of the q-factor model and (3) the q-factor model has fewer factors than, and therefore may be preferable to, the FF5F.

<sup>366</sup> Factor spanning regressions are a means to test if an explanatory factor can be explained by a combination of other explanatory factors. Spanning tests are performed by regressing returns of one factor against the returns of all other factors and analysing the intercepts from that regression.

<sup>367</sup> Gibbons, M., Ross, S., and Shanken, J. (1989), 'A test of the efficiency of a given portfolio'



In practice MFM evidence indicates that the point estimate for the allowed CoE for PR24 should be 0.39 – 2.96%<sup>368</sup> higher than the mid-point of the CAPM-derived CoE range.

**Table 34 CoE differentials between estimates derived using the CAPM and q-factor**

Cut-off date	Estimation window	Water portfolio
March 31, 2022	10-year	0.47%
	5-year	0.39%
	2-year	0.52%
February 28, 2020	10-year	1.73%
	5-year	2.20%
	2-year	2.96%

Notes: The estimates presented for each estimation window represent the spot rate  
Source: KPMG analysis

There is material variance between the differentials between returns implied by the CAPM and q-factor models across the two cut-off dates. This is primarily driven by the structural break associated with Covid, which has resulted in a marked ‘flight to safety’ effect. Excluding data from the Covid period the implied differential is 1.73% – 2.96%.

All else equal, the existing MFM evidence suggests that setting the point estimate at or below the mid-point of the CAPM-derived CoE range is likely to materially under-remunerate the systematic risk exposure faced by water companies. In this context, it may be appropriate to select a point estimate towards the upper end of the range to take into account evidence from the q-factor model, which indicates that the CAPM under-prices systematic risk for water companies.

Further refinement of MFM analysis and implications for returns is warranted to reflect the impact of the latest market data, ensure consistency with the beta estimation windows outlined in this Report and explicitly consider the impact of the step up in the scale and complexity of capital programmes in AMP8 and beyond.

## 11.4 Selection of the point estimate for PR24 CoE

This Report adopts an adjustment of 15bps – in line with the CMA’s decision at PR19 – which represents the minimum required to avoid disincentivising high levels of investment projected for AMP8 and beyond in the context of parameter uncertainty.

This analysis undertaken in this Report indicates that there is likely to be material asymmetry, in the form of both expected loss and negative skewness, driven by the proposed design of regulatory mechanisms set out in the PR24 FM. Both corporate finance theory and regulatory precedent (such as CMA decisions for PR19 and SONI appeals, as well as Ofcom’s implementation of the ‘fair bet’ principle) suggest that presence of unmitigated and unremunerated asymmetry is an important criterion for selection of a point estimate for CoE. It is therefore relevant to assess the degree of asymmetry affecting notional companies across the sector and use this evidence to inform the selection of the point estimate.

As the business plan information is not yet publicly available and it is not possible to undertake company-specific notional analysis of asymmetry across the sector, this Report does not include a specific uplift for asymmetry and instead recommends that each company undertake this analysis based on the FM and their business plan. Where companies identify the presence of expected loss or negative skewness, they should apply an adjustment when selecting a point estimate from the CoE range implied by the analysis in this Report.

<sup>368</sup> The variance in returns implied by the two models can be viewed in the context of the extensive academic research which explored empirical shortcomings and contradictions of the CAPM, which has limited power to explain observed returns (which ultimately led to the genesis of MFMs). The q-factor model has been shown to have stronger empirical performance than CAPM based on UK data, and the variances set out in the table above should be considered in this context.

The analysis using the q-factor model indicates it may be appropriate to select a point estimate towards the upper end of the range to address the structural underestimation of systematic risk in the CAPM relative to the q-factor model. Further refinement of MFM analysis is warranted to inform the selection of the point estimate for PR24 CoE.

## 12 CoE estimate for PR24

The table below summarises the estimated range for the required CoE at PR24. This range reflects:

- An estimate of the market-based CoE based on a balanced evaluation of current market data, academic literature, and relevant regulatory precedent; and
- The uplift required to attract and retain equity capital given high levels of investment projected for AMP8 and beyond

**Table 35 KPMG estimates of the PR24 CoE**

Component (CPIH)	KPMG (June 2023 cut-off, 60%)		KPMG (June 2023 cut-off, 55%)	
	Lower bound	Upper bound	Lower bound	Upper bound
Gearing	60%		55%	
RFR	1.93%		1.93%	
TMR	6.39%	6.96%	6.39%	6.96%
Observed gearing	50.79%	49.38%	50.79%	49.38%
Unlevered beta	0.31	0.33	0.31	0.33
Debt beta	0.10	0.10	0.10	0.10
Asset beta	0.36	0.38	0.36	0.38
Equity beta	0.75	0.80	0.68	0.72
CoE before aiming up, appointee	5.28%	5.95%	4.96%	5.56%
Aiming up for estimation uncertainty	0.15%		0.15%	
CoE, appointee	5.43%	6.10%	5.11%	5.71%
RMA	0.00%		0.00%	
CoE, wholesale	5.43%	6.10%	5.11%	5.71%

Source: KPMG analysis and PR24 FM

The CoE range above is presented pre and post aiming up for parameter uncertainty. On a 60% gearing basis – i.e. reflecting the notional gearing assumption adopted in this Report – the CoE range is 5.28 – 5.95% pre aiming up for parameter uncertainty, and 5.43 – 6.10% post aiming up.

The range also does not include an adjustment to address asymmetric risk exposure at this stage as the Report recommends that this adjustment should be applied where required on a company specific basis to reflect analysis of expected loss and negative skewness based on business plan submissions. At this stage the range also does not reflect the evidence from the q-factor analysis that the CAPM materially under-prices the systematic risk exposure for water companies, pending further refinements to the analysis.

The CoE estimate is presented below on a 55% notional gearing basis to enable like-for-like comparison with Ofwat's PR24 FM estimate. This implies a the CoE range of 4.96 – 5.56% pre aiming up for parameter uncertainty and 5.11 – 5.71% post aiming up. This compares to the FM range updated for June 2023 cut-off of 3.88 – 4.87%.

**Table 36 Comparison of the KPMG estimate (55% gearing basis) to the FM and Ofwat's estimate based on June 2023 cut-off**

Component (CPIH)	Ofwat (September 2022 cut-off)		Ofwat (June 2023 cut-off)		KPMG (June 2023 cut-off, 55%)	
	Lower bound	Upper bound	Lower bound	Upper bound	Lower bound	Upper bound
Gearing	55%		55%		55%	
RFR	0.47%		1.48%		1.93%	
TMR	6.00%	6.92%	5.83%	6.95%	6.39%	6.96%
Observed gearing	55.3%	51.4%	53.68%	53.54%	50.79%	49.38%
Unlevered beta	0.26	0.29	0.25	0.28	0.31	0.33
Debt beta	0.15	0.05	0.15	0.05	0.10	0.10
Asset beta	0.34	0.32	0.33	0.31	0.36	0.38
Equity beta	0.58	0.64	0.55	0.62	0.68	0.72
CoE before aiming up, appointee	3.67%	4.60%	3.88%	4.87%	4.96%	5.56%
Aiming up for estimation uncertainty	0.00%		0.00%		0.15%	
CoE, appointee	3.67%	4.60%	3.88%	4.87%	5.11%	5.71%
RMA	0.13% <sup>369</sup>		0.13%		0.00%	
CoE, wholesale	3.54%	4.47%	3.75%	4.74%	5.11%	5.71%

Source: KPMG analysis and PR24 FM

The key drivers of difference between the KPMG CoE estimate (55% gearing basis) and the PR24 FM (updated for June 2023 cut-off) are as follows:

- **Market movements since the PR24 FM:** Movements in market data between June 2023 and the September 2022 cut-off used in the PR24 FM. The impact on CoE is primarily driven by an increase in the RFR, which is partially offset by reductions in beta and TMR based on latest market data and Ofwat's methodologies
- **Risk free rate:** The difference relates to the inclusion of adjustments to reflect the convenience yield in index-linked gilts and that investors' risk-free borrowing rate is higher than their risk-free saving rate. These adjustments are not applied in the PR24 FM
- **Total Market Return:** The difference in the TMR is primarily driven by the adjustments made to the PR24 FM approach to address methodological issues in ex ante TMR estimates set out in the PR24 FM
- **Beta – BAU:** The difference reflects adjustments to reflect BAU systematic risk for the sector. Relative to the PR24 FM, this estimate (1) assigns more limited weight to the temporary distortions due to Covid19 and the war and (2) includes an adjustment to reflect pure play PNN data<sup>370</sup>. The lower bound of the BAU beta estimate (0.29) is based on a single long-term beta estimation window (October 2014 – June 2023) and can be interpreted as the absolute minimum required to price BAU systematic risk given that it attaches some weight to data post 2020 which is affected by temporary distortions
- **Beta – forward-looking risk:** This difference reflects 1) the inclusion of NG as an additional comparator to price the change in forward-looking risk arising from the significant increase in capital intensity for AMP8 and beyond, (2) full exclusion of the impact of Russia-Ukraine war, and (3) reduction in the weight assigned to data affected by the Covid19 such that the resulting estimate assumes a reoccurrence of a similar pandemic once in every 20 years

<sup>369</sup> 0.06% RMA on the WACC corresponds to 0.13% on the CoE.

<sup>370</sup> The adjustment is calculated based on the difference between the betas of equally weighted SVT/UUW/PNN portfolio and that of SVT/UUW for the 2-year estimation window. The adjustment is then applied to the SVT/UUW betas estimated during October 2014 – June 2023.

- **Aiming up:** A difference of 15bps relates to aiming up. The adjustment for aiming up is required to avoid disincentivising levels of investment required for AMP8 and beyond in the context of parameter uncertainty
- **Retail margin adjustment:** The removal of the RMA reflects conceptual and methodological issues for the adjustment in the FM and results in a difference of 13bps

The CoE estimate derived in this Report is consistent with several principles implied by the CMA's determination of the allowed CoE at PR19, supporting consistency with the outcomes of previous price control whilst recognising the new challenges faced by the sector. These principles are important for investor confidence and availability of capital given the long-term financing commitments made by investors in regulated infrastructure. The majority of drivers of difference between the CoE estimate in this Report and the PR24 FM stem from the application of these principles.

**Table 37 Analysis of consistency with CMA PR19 principles for CoE estimation**

CMA PR19 principles	KPMG CoE estimate	PR24 FM CoE estimate
The appropriate risk-free rate for the CAPM lies above the yield on index-linked gilts as gilts and other government bonds benefit from the convenience yield <sup>371</sup> .	✓	×
The appropriate risk-free rate for the CAPM lies between the risk-free saving and borrowing rates in line with Brennan (1971) <sup>372</sup> .	✓	×
TMR is a relatively stable parameter over time <sup>373</sup> .	✓	×
Ex post and ex ante approaches are the most robust basis for deriving the TMR <sup>374</sup> .	✓	✓
Beta estimates should not attach significant weight to very rare events such as Covid19 as this could be distortive <sup>375</sup> . The CMA's approach to deriving the beta range resulted in an estimate that was relatively unaffected by observations from the Covid period.	✓	×
Reductions in notional gearing are not required to alleviate financeability constraints, as the WACC is the primary factor which ensures that an efficient firm can finance its functions <sup>376</sup> .	✓	×
It is important to avoid disincentivising levels of investment required in the context of parameter uncertainty which supports aiming up when selecting a point estimate for CoE <sup>377</sup> .	✓	×
The need for sufficient financial incentives would be particularly acute "if Ofwat required a step change in investment to meet changing resilience requirements in the face of climate change challenges or other stresses on existing infrastructure" <sup>378</sup> .	✓	×
Investors should have a reasonable expectation of earning required returns <sup>379</sup> .	✓	×
The RMA is required to the cost of capital for the appointee is required to avoid double counting compensation for systematic retail risks given that allowed returns are set at the appointee level taking into account risk from all controls (including retail).	×	✓

Source: KPMG analysis, PR24 FM and CMA PR19 FD

<sup>371</sup> CMA (2021), PR19 Final Determination, para. 9.264

<sup>372</sup> Ibid., paras. 9.263-4

<sup>373</sup> Ibid., para. 9.387 and footnote 2473

<sup>374</sup> Ibid., para. 9.393

<sup>375</sup> Ibid., para. 9.493

<sup>376</sup> Ibid., para. 10.72

<sup>377</sup> Ibid., para. 9.1402

<sup>378</sup> Ibid., para. 9.1391

<sup>379</sup> Ibid., para. 9.1339



# 13 Appendix 1: Averaging approaches applied to historical TMR

In this technical appendix, we briefly review the motivations and methodologies behind the various averaging approaches that we have used to estimate the historical ex post TMR parameter

The estimation issue can be summarised as the following. Suppose one wishes to determine an estimate of the expected return on a portfolio of assets over a specified time horizon. It is commonly known that if one assumes that annual returns are approximately identically distributed independent normal random variables, then the expected return over the time horizon (e.g. 15 years) is given by compounding the expected population annual return.

However, the expected population annual return is unknown. Hence, it must be estimated. Simply compounding an arithmetic average of returns biases the estimate of expected returns upwards. Similarly, compounding the geometric average of returns biases estimates downwards. The estimators that attempt to correct for this bias and that we have used in our analysis are summarised in turn below.

Note, however, that the above refers to estimates of expected returns and is hence representative of the investor perspective. It does not estimate the discount rate, which is necessary from the perspective of the capital budgeter. Cooper (1996)<sup>380</sup> shows that estimates of the discount rate can lie above the arithmetic average, not between arithmetic and geometric averages, depending on the assumptions made concerning serial correlation in returns.

## 13.1 Blume (1974) adjusted estimator

A variation on the unbiased estimator proposed by Blume (1974)<sup>381</sup> simply varies the weight between the arithmetic average return (A) and geometric average return (G), according to the time period for which observations are available (T) and the time horizon assumed (H). This estimator is approximately unbiased and is given by:

$$\text{Blume Adjusted Estimator} = A \left( \frac{T - H}{T - 1} \right) + G \left( \frac{H - 1}{T - 1} \right)$$

Thus in the extreme, for a 1-year time horizon, all weight is placed on the arithmetic average, whilst for a time horizon equal to the series length (i.e. 119 years for the DMS data), all weight would be placed on the geometric average.

## 13.2 JKM (2005) unbiased and MSE efficient estimators

Jacquier, Kane and Marcus (2005)<sup>382</sup> present two alternative estimators under slightly different assumptions. The general form for both estimators is given by:

$$\text{JKM Estimator} = e^{(u+0.5\sigma^2k)}$$

Where  $u$  is the mean log return,  $\sigma$  is the standard deviation of returns, and  $k$  is a parameter that varies according to the estimator selected.

The first estimator, known as the 'unbiased' estimator, imposes a value for the weight  $k$  such that the estimator provides an unbiased estimate of the expected return over the specified time horizon. In this case,  $k$  is given by  $k = (1 - H/T)$ .

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<sup>380</sup> Cooper, I. (1996), '[Arithmetic versus geometric mean estimators](#)' (hereafter referred to as 'Cooper (1996)')

<sup>381</sup> Blume, M. (1974), 'Unbiased estimators of long-run expected rates of return'

<sup>382</sup> Jacquier, E., Kane, A., and Marcus, A. (2005), '[Optimal Estimation of the Risk Premium for the Long Run and Asset Allocation: A case of Compounded Estimation Risk](#)'

The second estimator, known as the ‘MSE efficient’ estimator, imposes a value for the weight  $k$  such that the estimator minimises the mean squared error (MSE) in small samples. In this case,  $k$  is given by  $k = (1 - 3H/T)$ .

### 13.3 Cooper (1996) estimator

As with Blume (1974), Cooper simply varies the weight between the arithmetic average return (A) and geometric average return (G), according to the time period for which observations are available (T) and the time horizon assumed (N). However, this weighting is applied to annuity factors to generate a discount factor. The unbiased estimator of the discount factor lies outside the range of  $A^{-N}$  and  $G^{-N}$ . This estimator is approximately unbiased and is given by:

$$\text{Cooper Estimator} = A^{-N} \left( \frac{N + T}{T - 1} \right) + G^{-N} \left( 1 - \frac{N + T}{T - 1} \right)$$

### 13.4 Rolling averages and non-overlapping returns

It should be noted that the estimators above all make some assumptions about the distribution of the returns. This is with the aim of incorporating all available annual observations in the data set. Returns are assumed to be independent and normally distributed in the case of the Blume estimator, and independent and log-normally distributed for both JKM estimators.

An alternative approach is to directly estimate the expected return for the specified time horizon empirically by observing the *actual* returns using the same time horizon. This estimate can be calculated using either non-overlapping or overlapping periods of data, both of which face the trade-off of robustness against sample size.

When using non-overlapping periods, we assume that the full 119-year period consists of a series of independent observations. However, the DMS data set contains only 119 annual observations. Therefore, we have only 11 observations for a 10-year time horizon (and even less for a 20-year), which is a particularly small sample<sup>383</sup>.

The use of overlapping periods (or ‘rolling averages’) results in a data set containing 110 observations for a 10-year time horizon, for example. However, a consequence is that we no longer have independent observations. In this regard, the CC notes that Blume’s simulations suggest that an overlapping mean may be a less efficient estimator than the non-overlapping mean<sup>384</sup>.

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<sup>383</sup> It should be noted that we choose to drop the stub of the earliest annual returns, rather than the most recent, on account of reliability considerations.

<sup>384</sup> Competition Commission (2010), A reference under section 12(3)(a) of the Water Industry Act 1991, [Available at: [https://assets.publishing.service.gov.uk/media/55194c7240f0b614040003d2/558\\_appendices.pdf](https://assets.publishing.service.gov.uk/media/55194c7240f0b614040003d2/558_appendices.pdf)], Appendix N, Annex

# 14 Appendix 2: Analysis of the impact of PR24 regulatory mechanisms

The table below includes more detailed commentary on the impact of each mechanism relative to the arrangements under the current price control, including whether it affects asymmetry, variance or both.

**Table 38 Analysis of the impact of PR24 regulatory mechanisms on risk**

Mechanism	Significance	Asymmetry	Variance	Comments	Category
Notional gearing	Low	No effect	Increase	A reduction in notional gearing masks financeability constraints and can increase the risk that a miscalibration in the price control package will not be detected in the financeability analysis.	1
Share of new debt	Medium	No effect	Increase	The requirement for new debt will differ by company in line with differences in the scale of AMP8 capital programmes.  To the extent that the scale of capital programmes and hence new debt requirements differ, the use of a single assumption for the share of new debt could introduce material variance between company costs and allowances. This could be exacerbated by current elevated interest rates, with a cost of new debt markedly higher than the cost of embedded debt.	2
Outperformance wedge	Low	No effect	Increase	Application of an outperformance wedge implies that the notional firm would not be able to issue 20Y debt at the iBoxx A/BBB benchmark and recover efficient costs.	2
RPI-CPIH mismatch	Low	No effect	Increase	Full transition to CPIH introduces RPI-CPIH basis risk for the notional firm, as there is a mismatch between CPIH linked assets and RPI linked liabilities. This basis risk has not been priced in to returns based on the FM.	2
Additional borrowing costs (cost of carry)	Low	Downward	No effect	The FM provides a 10bps allowance for issuance and liquidity costs. In addition to the unpriced basis risk, this allowance does not remunerate cost of carry <sup>385</sup> .	1

<sup>385</sup> To the extent that floating rate debt is included in the calculation of the sector average debt costs ('all-in' cost approach referred to by Ofwat), it is also appropriate to include a matching adjustment for cost of carry. Inclusion of cost of carry with floating rate debt is consistent with the approach adopted by CMA at PR19 and Ofgem for RII02, where Ofgem provided an allowance of 10bps based on network financing and cash on balance sheet.

Mechanism	Significance	Asymmetry	Variance	Comments	Category
Calibration of ODIs: stretching targets	High	Downward	No effect	PR24 will likely incorporate stretching targets <sup>386</sup> which could require a further step change in performance relative to PR19 levels. Observed performance for AMP7 would suggest that the current targets are already stretching and the resulting impact on returns would be exacerbated should these targets be made more challenging for AMP8.	4
Calibration of ODIs: removal of caps and collars	Medium	Downward	Increase	Ofwat is proposing to remove penalty caps <sup>387</sup> , and deadbands on penalty-only measures <sup>388</sup> . This increases the range of outcomes as they will no longer be constrained by caps and deadbands.	4
Calibration of ODIs: other	Medium	Downward	Increase	Apart from limited exclusions <sup>389</sup> , companies will be exposed to impacts of exogeneous factors (such as severe weather). This is likely to increase the range of outcomes.  Some incentives are downside-only or have downside risk that does not have a commensurate upside <sup>390</sup> .  Ofwat expects to set enhanced incentives (with incentive rates at twice the size of standard rates) <sup>391</sup> for six performance commitments <sup>392</sup> for 'very high' performance. Whilst in principle this aspect of ODI calibration could be upwards asymmetric, in practice achieving the associated rewards could be challenging.	4
C-Mex	Medium	No effect	Increase	PR24 will include stronger financial rewards and penalties related to the residential customer service measure (C-Mex). Ofwat has signalled that the value of the C-MeX incentive is expected to be $\pm 18\%$ <sup>393</sup> of annual allowed residential retail revenue (compared to a range of +6% to -12% in AMP7).	4

<sup>386</sup> Ofwat (2022), PR24 Final Methodology Executive Summary "We will do this by setting stretching but achievable performance targets for the whole sector. And we will encourage companies to go further, with simple and powerful incentives to deliver better performance where it is in the interests of customers, communities, and the environment". "We expect companies to identify stretching but achievable performance commitment levels (PCLs) in their business plans".

<sup>387</sup> Ofwat intends to manage ODI risk primarily at an aggregate level with only targeted use of caps and collars on individual performance commitments (1) that are new or bespoke and therefore more uncertain; (2) where the benefits from high outperformance are uncertain, to protect customers and avoid over-incentivising companies; or (3) that have the potential to be a significant source of skew in the outcomes package.

<sup>388</sup> Ofwat will only set a deadband on the compliance risk index performance commitment.

<sup>389</sup> Ofwat (2022), PR24 Final Methodology, Appendix 7 – Performance commitments, section 2.4.4

<sup>390</sup> For example, the targets for discharge permit compliance, compliance risk index and serious pollution incidents are 100%, 0.00 and Zero incidents by 2025-26 with the zero level maintained throughout the 2025-30 period (all to be delivered from base funding according to table 4.2 in Appendix 9). Based on the 2022 environmental performance report published by the EA, all companies except Northumbrian and United Utilities would incur penalties for serious pollution incidents if this performance were to be repeated in AMP8.

<sup>391</sup> Ofwat (2022), PR24 Final Methodology, Appendix 8 – Outcome delivery incentives, section 3.4

<sup>392</sup> Water supply interruptions, leakage, per capita consumption, internal sewer flooding, external sewer flooding and total pollution incidents

<sup>393</sup> Ofwat (2022), PR24 Final Methodology, Appendix 8 – Outcome delivery incentives, section 4.1

Mechanism	Significance	Asymmetry	Variance	Comments	Category
Performance risk sharing	Low	Upward	Reduce	<p>For PR24 Ofwat will apply an aggregate sharing mechanism once ODI payments exceed <math>\pm 3\%</math> return on regulatory equity<sup>394</sup>.</p> <p>Aggregate sharing is likely to have a moderately upwards-biased impact on returns as the mechanism is more likely to be triggered on the downside than on the upside. The mechanism is also likely to reduce the range of potential outcomes and hence variance.</p>	4
Quality and Ambition Assessment (QAA)	Medium	Downward	Increase	<p>QAA rewards are (1) capped +30 bps on regulatory equity in each year of the 2025-30 price control, (2) protection from reductions in specified components of determinations, (3) protection from reduction in the allowed return and in base allowances – companies would be able to benefit from increases<sup>395</sup>.</p> <p>The level of potential financial penalties has not been specified but will represent the degree of improvement required in each company's plan<sup>396</sup>.</p> <p>Based on this information, it is not possible to assess whether the design of the QAA is symmetric or asymmetric.</p> <p>However, in practice the calibration is likely to be asymmetric. At PR19 no company was able to achieve an 'exceptional' (the highest) categorisation whereas four companies received 'significant scrutiny' (the lowest) categorisation. Most companies received 'slow track' categorisation<sup>397</sup>.</p> <p>This mechanism can also affect the range of potential outcomes.</p>	1
Greater prevalence of PCDs (relative to PR19) <sup>398</sup>	Medium	Downward	No effect	<p>PCDs are by design asymmetric mechanisms with no or limited upside and scope for material downside.</p> <p>Furthermore, this is likely to imply downside-only risk and reduce flexibility to re-allocate outperformance across a portfolio of projects.</p> <p>All else equal, PCDs may have limited impact on the range of potential outcomes due to two offsetting effects: (1) by constraining scope for outperformance they may narrow the range of potential outcomes on the upside, and (2) by increasing the scope for underperformance they may widen the range of outcomes on the downside.</p>	3

<sup>394</sup> Ibid., section 5.1.4

<sup>395</sup> Ofwat (2022), PR24 Final Methodology, Appendix 12 – Quality and ambition assessment, section 3.4.3

<sup>396</sup> Ibid, section 3.4.4

<sup>397</sup> [Initial assessment of plans - Ofwat](#)

<sup>398</sup> "At PR19 we implemented bespoke and scheme delivery type performance commitments for material areas of investment. Our expectation for PR24 is for companies to build on this to ensure delivery in a wider number of areas". Ofwat (2022), PR24 Final Methodology, Appendix 9 – Setting expenditure allowances, section 5.4.4.



Mechanism	Significance	Asymmetry	Variance	Comments	Category
Base costs	Medium	Downward	No effect	In the FM Ofwat noted that it will exercise its regulatory judgement at the draft and final determinations to consider whether to set a more stretching catch-up efficiency benchmark than the upper quartile at PR24, taking into account a range of evidence <sup>399</sup> .  Efficiency targets potentially above upper quartile combined with the assumption that stretching performance can be achieved from base <sup>400</sup> is likely to introduce a more challenging cost package and a downwards skew to potential cost performance.	3
Enhancement costs	Very high	Downward	Increase	Scale of enhancement programmes expected at PR24 is likely to materially increase risk exposure on Totex at PR24. A step up in the scale of capital programmes would increase exposure to a combination of risk factors, <i>inter alia</i> , higher complexity of spend, higher uncertainty in ex ante cost forecasts supply chain risk, input price risk, which would increase volatility of returns.  There is likely an increase in downside asymmetry given that construction projects have typically experienced cost overruns and delays <sup>401</sup> .	3
Cost sharing rates	Low	No impact	No impact	Ofwat is proposing to make cost sharing rates more symmetric relative to its PR19 FD, with rates sitting in the range of 40%:60%, to 50%:50%, with the latter available to companies in the top two categories of QAA <sup>402</sup> . This compares to the CMA's calibration of 45:55% at PR19 <sup>403</sup> .  Ofwat is continuing to consider the application of lower enhancement cost sharing rates to recognise the relatively larger influence of companies' enhancement programmes and to account for the potentially different characteristics of the two types of cost (base and enhancement) <sup>404</sup> .  There are will not be cost sharing for bioresources <sup>405</sup> .	3

<sup>399</sup> Ofwat (2022), PR24 Final Methodology, Appendix 9 – Setting expenditure allowances, section 2.4.4

<sup>400</sup> Ibid. "Companies should deliver stretching improvements from base expenditure to support delivery of established long term targets". "We will forecast the level of performance improvement we expect to be delivered through our efficient base expenditure allowances from the baseline position. This will account for the overall level of stretch expected across all performance commitments from base expenditure". "We will adjust performance commitment levels (PCLs) from the level delivered by base allowances to account for impacts of enhancement expenditure to avoid customers paying twice for the same performance improvements, where necessary".

<sup>401</sup> For example, 37% of the respondents to KPMG's 2023 Global Construction Survey responded that they had missed budget or schedule targets over the previous 12 months. Also see, for example, Institution of Civil Engineers, Reducing the gap between cost estimates and outturns for major infrastructure projects and programmes or Mckinsey, The construction productivity imperative.

<sup>402</sup> Ibid., section 2.1

<sup>403</sup> CMA (2021), PR19 Final Determination, para. 6.107

<sup>404</sup> Ibid., section 2.4.5

<sup>405</sup> Ofwat (2022), PR24 Final Methodology, Appendix 4 – Bioresources control, section 5.3.1

Mechanism	Significance	Asymmetry	Variance	Comments	Category
Equity beta	High	Downward	No effect	The departure from CMA PR19 principles is downwards asymmetric as it unconditionally reduces the return relative to an increasing risk exposure.	1
TMR	Medium	Downward	No effect	The departure from CMA PR19 principles is downwards asymmetric as it unconditionally reduces the return relative to an increasing risk exposure.	1
RFR	Low	Downward	No effect	The departure from CMA PR19 principles is downwards asymmetric as it unconditionally reduces the return relative to an increasing risk exposure.	1

Source: KPMG analysis

# 15 Appendix 3: Analysis of the potential speed of reversion to the 'normal' economic conditions extant prior to the war and Covid19

Russia-Ukraine conflict is still ongoing, 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 with the duration of the war itself and is likely to vary between short-, medium- and long-term windows.

Initially, the war triggered a massive shock to the global economy, especially to energy and food markets, squeezing supply and pushing up prices to unprecedented levels and exacerbating the inflationary pressures building up in the post-pandemic recovery. Despite having limited direct energy imports from Russia, the UK was exposed to the volatility in regional gas prices as a net importer<sup>406</sup> of gas. Russia and Ukraine play a substantial role in the global food production and supply and the increases in global food prices resulting from the conflict were passed through to UK consumer prices. However, the effects of the war on Europe via developments in international energy and food markets have started to moderate. For example:

- EU dependence on Russian gas decreased at a faster pace than expected in 2022. *“At the beginning of 2021, the EU imported 90% of its gas consumption, with Russia providing more than 40% of the EU’s total pipeline gas demand. According to early statistical data, in the EU imports of Russian gas were reduced by 74% in March 2023, compared to March 2021”*<sup>407</sup>
- *“In 2022 natural gas consumption in the EU decreased by almost 20%, which helped the EU to cope with the reduction in gas imports from Russia owing in part to EU sanctions...Efforts to save energy and diversify energy supplies have contributed to the sharp fall in natural gas prices over recent months from their record highs of Autumn 2022”*<sup>408</sup>
- Analysis by Bank of England ('BoE')<sup>409</sup> and European Central Bank<sup>410</sup> signal the expectation that food inflation will moderate over the next months

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. KPMG previously adopted<sup>411</sup> forecast UK CPI inflation as a proxy for the evaluation of the potential speed of reversion to the 'normal' economic conditions extant prior to the war based on the view from 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”*<sup>412</sup>.

BoE further commented that *“one of the main causes of today’s inflation is Russia’s invasion of Ukraine. It led to a big rise in the price of gas and some food basics like wheat”*<sup>413</sup>. In combination the war and global supply bottlenecks (driven predominantly by the imbalance between goods and

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<sup>406</sup> [ONS \(2022\), Trends in UK imports and exports of fuel](#)

<sup>407</sup> [European Commission \(2023\), REPowerEU - one year on](#)

<sup>408</sup> [European Commission \(2023\), One year since Russia’s invasion of Ukraine – the effects on euro area inflation](#)

<sup>409</sup> [Bank of England \(2022\), Monetary Policy Report May 2022](#)

<sup>410</sup> [European Commission \(2023\), One year since Russia’s invasion of Ukraine – the effects on euro area inflation](#)

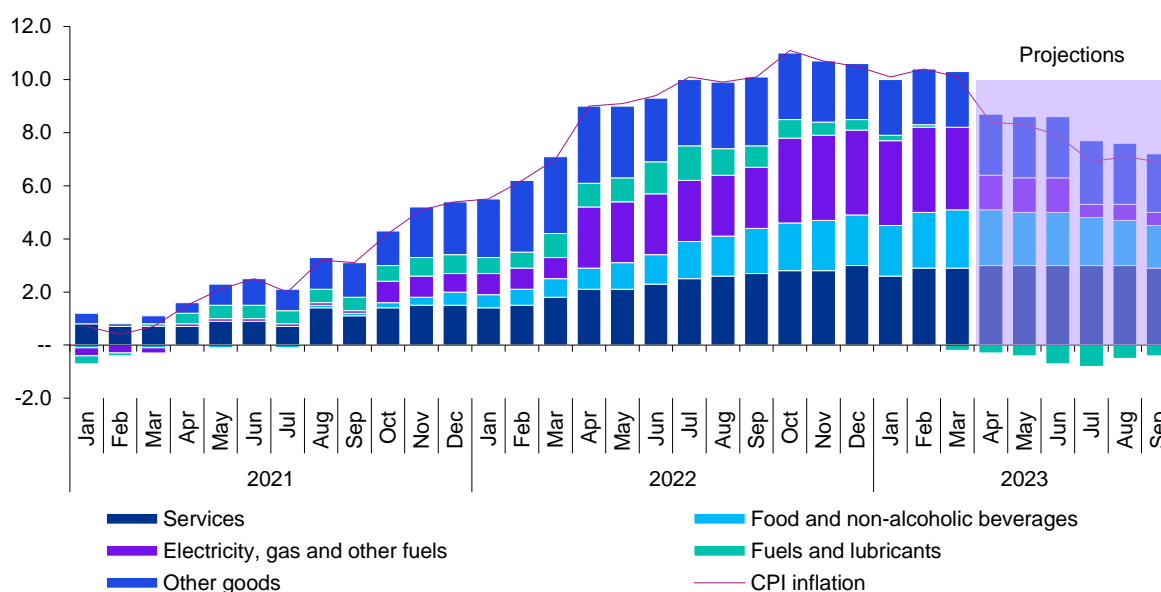
<sup>411</sup> Ibid.

<sup>412</sup> [Bank of England \(2022\), Monetary Policy Report May 2022](#)

<sup>413</sup> [Bank of England \(2022\), Monetary Policy Report May 2022](#)

services demand) associated with the aftermath of the pandemic are largely responsible for inflation overshooting BoE's target. The chart below illustrates the contribution of these factors to inflation.

**Figure 18 Bank of England analysis of contributors to CPI inflation**



Source: [Monetary Policy Report - May 2023 | Bank of England](#)

The implication is that the level of inflation 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 and the relationship between stocks which have some structural protection from inflationary effects (such as water companies through indexation of RCV) and the wider market.

The figure also shows that the contribution of energy prices to inflation has been decreasing – driven by lower natural gas prices – and is expected to revert to the levels observed before the inception of the war. The fall in oil prices relative to one year ago is also reducing the cost of fuel for consumers. In addition to lower energy prices, supply chain pressures have eased materially since the start of the year, supported by faster delivery times and a drop in shipping costs<sup>414</sup>. That should also support the near-term fall in consumer price inflation.

Indicators continue to suggest that food price inflation will decline in coming months, but it is now forecast to do so at a slower pace than expected by BoE at the beginning of this year. As food production is quite energy intensive, the high rates of food inflation reflect in part the indirect and lagged effects of high energy prices<sup>415</sup>.

Core inflation has been relatively slow to decline. As international supply bottlenecks have eased, and shipping costs stabilised around pre-pandemic levels, indicators of goods prices have continued to weaken, signalling a potential reduction in core goods inflation. Services inflation has remained high, driven most materially by spillovers from input costs, but also pay growth and past services inflation according to BoE analysis<sup>416</sup>. There are indications that the labour market has started to loosen, with vacancies down from their peak in 2022, declining job-to-job flows<sup>417</sup> and increasing staff availability according to the KPMG/REC UK report on Jobs<sup>418</sup>. Nominal pay growth has fallen back slightly and more timely indicators of pay growth such as HMRC payroll data and KPMG/REC permanent staff salaries index suggest that the pay growth could weaken further. In combination with the reduction of energy price inflation, the loosening of the labour market and the weakening of pay growth could potentially have a positive impact on services inflation.

<sup>414</sup> [KPMG \(2023\), UK economic update - June 2023](#)

<sup>415</sup> [European Commission \(2023\), One year since Russia's invasion of Ukraine – the effects on euro area inflation](#)

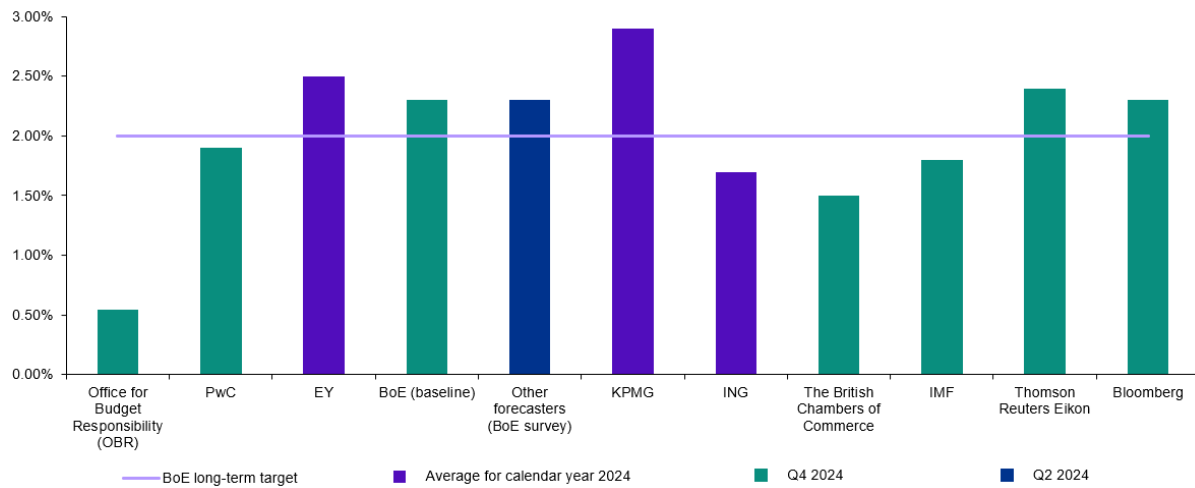
<sup>416</sup> [Bank of England \(2022\), Monetary Policy Report May 2022](#)

<sup>417</sup> Which tend to be high when the labour market is tight.

<sup>418</sup> [Bank of England \(2023\), Monetary Policy Report May 2023](#)

Overall, the combination of the factors set out above drives the expectation that inflation will normalise ahead of the start of the PR24 price control as reflected in the chart below. This implies that the impact of the war could mean revert over the next couple of years and is not likely to be relevant for setting the allowed returns for PR24 over the long-run investment horizon. Attaching material weight to the data affected by the war and responses to the war would be tantamount to assuming that its impact (proxied by macroeconomic effects such as elevated inflation) will persist during the PR24 period and beyond.

**Figure 19 Forecast inflation for 2024 (sorted by timing of the projection, from earliest to most recent projections)**



Source: [Monetary Policy Report - May 2023 | Bank of England](#), [Inflation - Office for Budget Responsibility \(obr.uk\)](#), [UK Economic Outlook, April 2023 \(pwc.co.uk\)](#), [EY ITEM Club Spring Forecast](#), [UK Economic Outlook – June 2023 \(kpmg.com\)](#), [June 2023 ING](#), [Quarterly economic forecast \(britishchambers.org.uk\)](#), [United Kingdom and the IMF](#)



# 16 Appendix 4: Identification of construction comparators for beta

The determination of a robust and relevant sample of construction comparators is undertaken as follows:

- 1 The starting point is the set of UK construction and engineering companies according to Bloomberg Industry Classification Systems
- 2 This list is filtered to exclude companies with less than 5 years of trading history and companies with 5-year average bid-ask spread of more than 2%. This results in a pool of 9 potential comparator companies
- 3 Segmental disclosures and annual report commentary are examined to identify companies that are diversified geographically and in terms of activities. This is required to isolate the specific impact of exposure to construction risks within the UK market which is more relevant to the estimation of UK water sector returns than the systematic risk of, for example, construction firms with significant exposures to other markets. This results in a pool of 5 companies
- 4 The degree of exposure to the UK water sector within wider infrastructure construction activity is assessed largely qualitatively due to the limited availability of quantitative data at this level of granularity in annual reports. All 5 companies have some exposure to the UK water sector

**Table 39 Summary of the selection of construction comparators**

Company	Trading history > 5Y?	Bid-ask spread <2%?	UK construction focused?	Exposure to the UK water sector?
Spirax-Sarco Engineering plc	✓	✓	x <sup>419</sup>	
IHS Holding ltd	x			
Balfour Beatty plc	✓	✓	x <sup>420</sup>	
Helios Towers plc	x			
Morgan Sindall Group plc	✓	✓	✓	✓ <sup>421</sup>
Dar Global plc	x			
Keller Group plc	✓	✓	x <sup>422</sup>	
Renew Holdings plc	✓	✓	✓	✓ <sup>423</sup>

<sup>419</sup> Spirax-Sarco Engineering plc notes in its 2022 annual report that “revenue generated by Group companies based in the USA is £433.0m (2021: £342.4m), in China is £213.2m (2021: £181.6m), in Germany is £134.3m (2021: £118.2m), in the UK is £115.7m (2021: £99.6m) and the rest of the world is £714.4m (2021: £602.7m)” and “non-current assets in the USA were £686.8m (2021: £345.6m), in France were £403.1m (2021: £150.5m), in the UK were £284.1m (2021: £231.2m), in Germany were £165.6m (2021: £154.6m) and in the rest of the world were £191.8m (2021: £177.6m)”. This indicates that the company is quite diversified geographically and UK market represents a relatively small proportion of the overall business.

<sup>420</sup> According to Balfour Beatty’s 2022 annual report, UK construction revenue comprised 43% (£2,763m/£6,409m) of the total statutory revenue for construction services for 2022 and 44% (£2,593m/£5,920m) for 2021. As a result, the company has a significant exposure to the US market.

<sup>421</sup> For example, p. 50 of the 2022 annual report notes that “in water, tunnelling was completed on the Thames Tideway ‘super sewer’ project to expand London’s sewer network and help prevent pollution in the Thames, while work continued as part of the long-term AMP7 framework with Welsh Water”.

<sup>422</sup> The segmental analysis set out in Keller’s 2022 annual report, shows that it’s revenue and assets are primarily derived from the North American market. The company is also diversified in Europe and Asia-Pacific, Middle East, and Africa.

<sup>423</sup> For example, p. 21 of the 2022 annual report notes that “during the period we continued our work with Dŵr Cymru Welsh

Company	Trading history > 5Y?	Bid-ask spread <2%?	UK construction focused?	Exposure to the UK water sector?
Ricardo plc	✓	✓	x <sup>424</sup>	
Kier Group plc	✓	✓	✓	✓ <sup>425</sup>
Goodwin plc	✓	x		
Severfield plc	✓	x		
Galliford Try Holdings plc	✓	✓	✓	✓ <sup>426</sup>
Costain Group plc	✓	✓	✓	✓ <sup>427</sup>
Thomasloyd Energy Impact Trust	x			
Smart (J) & Co (Contractors)	✓	x		
Tclarke plc	✓	x		
Billington Holdings plc	✓	x		
Van Elle Holdings plc	✓	x		
Hercules Site Services plc	x			
Nexus Infrastructure plc	✓	x		
Northern Bear plc	✓	x		
Vulcan Industries plc	x			
Aukett Swanke Group plc	✓	x		
Fulcrum Utility Services Ltd	✓	x		
<b>25 companies</b>	<b>19 companies</b>	<b>9 companies</b>	<b>5 companies</b>	<b>5 companies</b>

Source: KPMG analysis and data from Bloomberg, Refinitiv Eikon, Refinitiv Datastream and annual reports

Water (“DCWW”) and currently hold a number of contracts with market-leading companies including for the Pressurised Pipelines Framework and the Capital Delivery Alliance Civils and Pipeline Framework. We are delighted that for the first time, we have secured a place on the DCWW Major Civils 8-year Framework, a key strategic target for the Group. Elsewhere, we have been awarded a new framework with Severn Trent and we continue engagements for Bristol Water on mains renovation, Wessex Water on the Phosphate Removal Programme and we are maintaining and renewing existing assets on operational treatment and distribution facilities (AMP7 Minor Civils Framework) with Yorkshire Water... During the period we added Thames Water, Affinity Water, South East Water and Southern Water to our growing list of clients”.

<sup>424</sup> According to the 2022 annual report, UK revenue comprised 35% (£134.5m/£380.2m) of the total revenue for 2022 and 35% (£118.7m/£343.7m) for 2021. The company’s operations are diversified across the UK, Europe, North America, Asia, Australia, and the rest of the world.

<sup>425</sup> For example, the 2022 annual report notes that “our Water business manages and maintains assets for several companies such as Anglian Water and Thames Water” and comments that AMP7 represents an important market opportunity.

<sup>426</sup> For example, the 2022 annual report notes that “our Environment business is one of the largest players in the water sector. We deliver design and build work for 10 out of the 11 major water and sewage companies in the UK, where our national footprint and established client relationships are a key advantage” and “examples of key frameworks include... AMP7 with Northumbrian Water, Yorkshire Water, Southern Water, Thames Water and Severn Trent Water”.

<sup>427</sup> According to the 2022 annual report, revenue from the water sector comprised 17% (£238.2m/£1,421.4m) of the total revenue for 2022 and 18% (£200m/£1,135.2m) for 2021.

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## C. Inference Analysis Cross Check on Allowed Returns





Ofwat  
Centre City Tower  
7 Hill Street  
Birmingham  
B5 4UA

**SES Water**  
London Road  
Redhill, Surrey,  
RH1 1LJ  
Telephone: 01737 772000  
Facsimile: 01737 766807  
Website: [www.seswater.co.uk](http://www.seswater.co.uk)  
Email: [contactus@seswater.co.uk](mailto:contactus@seswater.co.uk)

Dear Ofwat

### **Report on Inference Analysis as a Cross-check on Allowed Returns at PR24**

We attach a copy of the above confidential report dated September 2023 the (“Final Report”) prepared by KPMG LLP (“KPMG”). The Final Report was solely prepared for Wessex Water Services Limited, South East Water Limited, Thames Water Utilities Limited, Anglian Water Services Limited, Southern Water Services Limited, Affinity Water Limited, Sutton & East Surrey Plc and South Staffordshire Water Plc (“the Companies”).

KPMG has agreed that we may disclose the attached Final Report to you, on the basis set out in this letter, to enable you to verify that a report has been commissioned by us and issued by KPMG in connection with the estimation of required cost of equity for the PR24 business plans, and to facilitate the discharge by you of your regulatory functions subject to the remaining paragraphs of this letter to which your attention is drawn. KPMG has also agreed that you may publish the Final Report (in full only) on your website pages.

KPMG’s work was designed to meet our agreed requirements and the engagement activities were determined by our needs at the time. The Final Report should not be regarded as suitable to be used or relied on by any party other than us for any purpose or in any context.

In consenting to the disclosure of the Final Report to you, KPMG does not assume any responsibility to you in respect of its work for us or for the Final Report. To the fullest extent permitted by law, KPMG accepts no liability in respect of any such matters to you. If you rely on the Final Report or any part of any of them, you do so at your own risk.

Yours faithfully

Paul Kerr  
Chief Financial Officer





# Inference analysis as a cross-check on allowed returns at PR24

September 2023



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# 1 Important notice

This Report has been prepared by KPMG LLP ('KPMG', 'we' or 'our') for Wessex Water Services Limited, South East Water Limited, Thames Water Utilities Limited, Anglian Water Services Limited, Southern Water Services Limited, Affinity Water Limited, Sutton & East Surrey Plc and South Staffordshire Water Plc ('group of companies') on the basis of an engagement contract dated 20 June 2023 between the group of companies and KPMG (the "Engagement Contract").

The group of companies commissioned this work to aid in their deliberations concerning the cost of equity (CoE) estimates included by the Water Services Regulation Authority (Ofwat) in the Final Methodology for the upcoming price control (PR24). The agreed scope of work is included in section 3.2 of this Report. The group of companies should note that our findings do not constitute recommendations as to whether or not the group of companies should proceed with any particular course of action.

This Report is for the benefit of the group of companies only. It has not been designed to be of benefit to anyone except the group of companies. In preparing this Report we have not taken into account the interests, needs or circumstances of anyone apart from the group of companies, even though we may have been aware that others might read this Report. We have prepared this Report for the benefit of the group of companies alone.

This Report is not suitable to be relied on by any party wishing to acquire rights against KPMG (other than the group of companies) for any purpose or in any context. Any party other than the group of companies that obtains access to this Report or a copy and chooses to rely on this Report (or any part of it) does so at its own risk. To the fullest extent permitted by law, KPMG does not assume any responsibility or liability in respect of our work or this Report to any party other than the group of companies.

In particular, and without limiting the general statement above, since we have prepared this Report for the benefit of the group of companies 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.

You should be aware that KPMG, including members of the engagement team, delivers other advisory services to individual companies who are within the group of companies.

KPMG has not made any decisions for the group of companies, nor for any individual company within the group of companies, on any aspect of their business plans or responses to the Final Methodology CoE estimates. KPMG has not assumed any responsibility for what the group of companies, or any individual company within the group of companies, decides, or has decided to, include in its response(s).

This engagement is not an assurance engagement conducted in accordance with any generally accepted assurance standards and consequently no assurance opinion is expressed.

This Report should not be copied, referred to or disclosed, in whole or in part, without our prior written consent, except as specifically permitted in the Engagement Contract.



## 2 Executive summary

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 (CoE) for the price control.

The regulatory allowance for CoE will be particularly significant for AMP8 and beyond in the context of the unprecedented step change in the scale of required capital investment, a significant shift in the macroeconomic landscape – marked by rising interest rates, high inflation, and heightened volatility – and expected increases in risk exposure at PR24.

Setting an appropriate, evidence-based, allowance for the CoE is essential to retain and attract equity capital in the sector. An appropriate allowance for the CoE is one that reflects the return that investors can earn on investments of comparable risk (i.e. reflects the opportunity cost of capital) and remunerates investors for probability-weighted losses (or gains). Only where the allowed CoE meets this criterion can the investment be deemed financeable, i.e. be able to attract sufficient equity (and debt) capital on reasonable terms, consistent with what is priced in the allowance.

The potential customer detriment from the under-estimation of CoE is particularly acute<sup>1</sup> at PR24 given that it will be necessary for the notional firm to attract significant new equity capital to fund the substantial new investment required for AMP8 and beyond. This Report develops a methodology which uses observed debt pricing and the relationship between the costs of equity and debt to infer the CoE which can be applied as a sense-check to a CAPM-derived estimate.

The key principles underpinning this cross-check are as follows:

- Debt and equity are both claims on the same underlying asset and their values are intrinsically related to the value of the asset<sup>2</sup>. All else equal, the expected returns on equity and debt exhibit a positive correlation, as both are sensitive to the underlying factors that affect the firm's asset value.
- Equity inherently faces higher risks in relation to loss of capital and return compared to debt. This is due to, *inter alia*, the subordinated nature of equity claims in case of insolvency<sup>3</sup>, more limited control rights in the event of financial difficulty or distress and differences between contractually obligated debt interest payments and more discretionary equity dividends.
- Equity investors often have multiple investment options, each with varying risk and return profiles. When making capital allocation decisions, an investor would carefully consider the risk-return profile of each opportunity. Given the riskier nature of equity, the expected return on equity needs to be substantively above the expected return on debt of the same company, as otherwise an investor is unlikely to be incentivised to invest in equity.

These principles imply that (1) allowed CoE should be assumed to remain sufficiently above the current CoD to promote equity investment in the sector and price in risk differentials for different claims on the same asset and (2) a cross-check on allowed CoE can be designed based on market pricing of debt and the relationship between debt and equity. This is in line with Damodaran who

---

<sup>1</sup> The welfare loss arising from under-estimation of the CoE is generally greater than that from over-estimation of the cost of capital. If the allowed return is set too high, customers end up paying more in their bills than they would have had the allowance been based on the true cost of capital. On the other hand, if the allowed return is set too low, companies are discouraged from making new investments or adequately maintaining existing ones, resulting in suboptimal levels of investment and a significant loss in consumer welfare. As the demand for most regulated services is driven by the essential nature of the services provided, the welfare loss from under-investment is substantial. Consequently, the detrimental impact on consumers is not symmetric when the allowed return deviates significantly from the true cost of capital. This asymmetry of consequences would likely be more acute for PR24 given the scale of required investment.

<sup>2</sup> When the firm's asset value rises, equity holders benefit from larger residual claims, and debt value benefits from the reduction in the firm's leverage and the lower likelihood of default. Conversely, a decline in asset value diminishes the residual claims of equity holders and heightens the risk of default.

<sup>3</sup> In the event of an insolvency, debt holders have the priority claim over the firm's assets for debt repayment, while equity holders could receive the remaining assets only once all outstanding debt capital has been repaid and if the remaining value of the firm is non-negative.

considers that “there should be a relationship across the risk premiums in these asset classes that reflect their fundamental risk differences”<sup>4</sup>. This has also been recognised by the UKRN<sup>5</sup> and the CMA<sup>6</sup>.

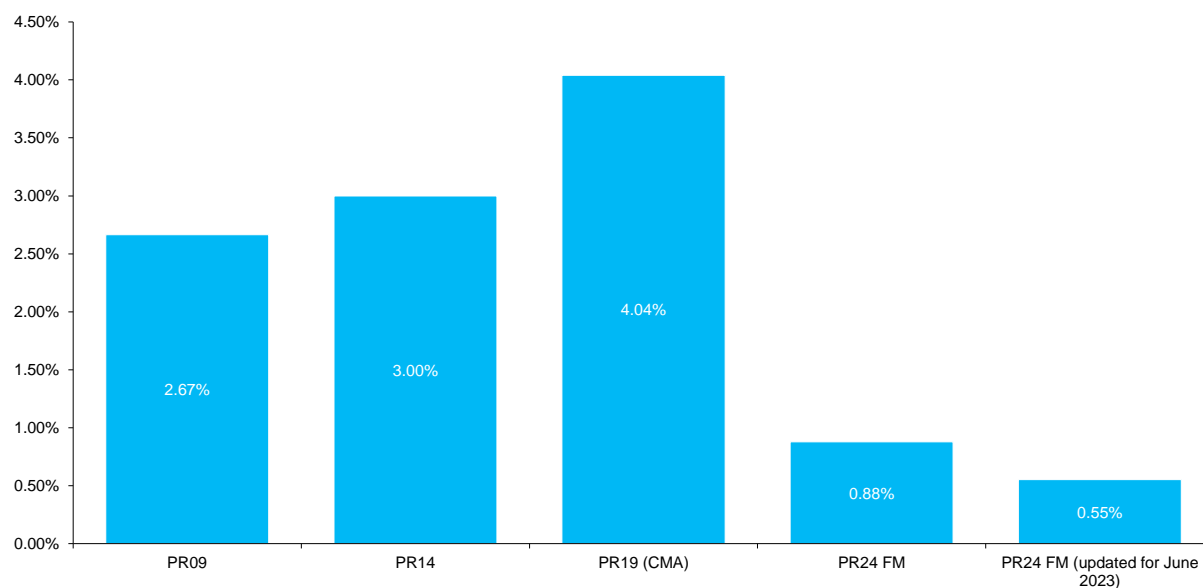
Assuming no changes in the risk exposure faced by equity investors, the differential observed over the most recent price controls would provide a natural point of reference for the PR24 differential given that:

- Past differentials will reflect investor expectations on the pricing of the incremental risk of equity relative to debt.
- Financeability metrics could deteriorate to levels which are not consistent with the target credit rating for the notional firm.

The analysis of the differential between CoE and cost of new debt (CoD<sub>n</sub>) based on (1) ex ante allowances from PR24 Final Methodology (FM) and past regulatory determinations and (2) yields on the benchmark indices as a proxy for current borrowing costs indicates that the gap between the pricing of the capital sources has narrowed significantly.

First, as set out in Figure 1, past regulatory determinations were calibrated such that they imply a differential of c.300bps between ex ante allowances for CoE and CoD<sub>n</sub>, whereas the FM implies a gap below 100bps. There has subsequently been a significant increase in interest rates – with the CoD<sub>n</sub> at its highest level since PR09 – however, this has not translated into higher allowed returns based on the PR24 FM. On a like-for-like basis (55% notional gearing) the FM point estimate of 4.14% CPIH-real does not imply any increases relative to the CoE determined by the CMA based on market data as at December 2020.

**Figure 1 The evolution the differential between CoE and CoD<sub>n</sub> (on a comparable 55% notional gearing basis)<sup>7</sup>**



Note: Ex-ante allowed CoE vs ex-ante allowed CoD. Allowed CoE and CoD are fixed over the price control based on long-term inflation assumptions from the respective regulatory decisions.  
Source: Ofwat (2022), PR24 Final Methodology, Appendix 11 – Allowed return on capital, Table 2.1. CMA (2021), PR19 Final Determination, Table 7. Ofwat (2014), Setting price controls for 2015-20 Final price control determination notice: policy chapter A7 – risk and reward, Table A7.10. Ofwat (2009), Future water and sewerage charges 2010-15: final determinations, Table 46, section 5.4.4

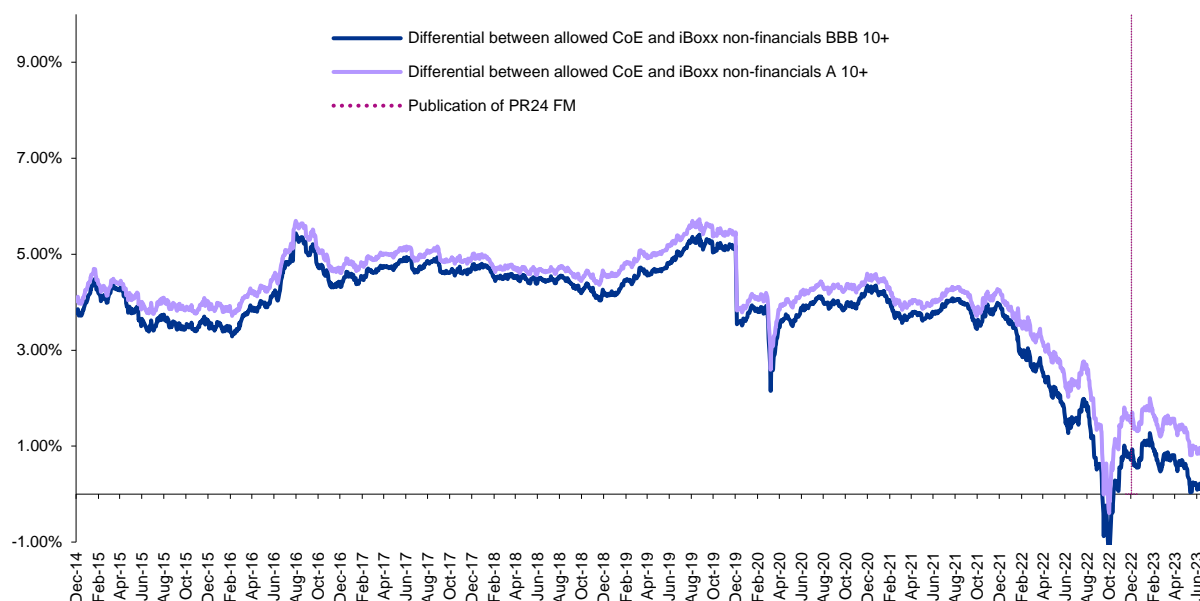
<sup>4</sup> Damodaran A., Equity Risk Premiums (ERP): Determinants, Estimation, and Implications – The 2023 Edition  
<sup>5</sup> In its cost of capital guidance, UKRN has recognised “the principle that equity bears more risk than debt and so should normally receive a higher return”.  
<sup>6</sup> At PR19 the CMA recognised that “for a regulated business with capped returns, the cost of equity used in the WACC should still be assumed to remain sufficiently above the current cost of debt to promote equity investment in the sector”.  
<sup>7</sup> The following inflation assumptions, from the respective determinations, to derive the nominal values: PR24 FM: 2.00%, PR19 (CMA): 2.00%, PR19 (FD): 2.00%, PR14: 2.80%, PR09: 2.50%.



Second, the differential between allowed CoE and yields on the benchmark indices – which remained broadly stable apart from the early Covid19 period (February – March 2020) – experienced a material reduction from 2022. The initial reduction from 2022 onwards was likely driven by a combination of step changes in market rates and limited responsiveness of the regulatory CoE to such changes. The reduction in the differential was also likely exacerbated by the changes in the methodology for CoE estimation stipulated in the PR24 FM.

Since the end of May 2023, the differential between allowed CoE and the yields on the BBB-rated iBoxx has been very close to zero. This does not recognise the additional risks that equity faces due to its subordinated nature and is inconsistent with corporate finance theory.

**Figure 2 Evolution of the differential between allowed CoE and yields on the benchmark index (on a comparable 55% gearing basis)**



Note: Compares nominal yields on iBoxx indices to allowed CoE converted to nominal using long-term inflation assumptions in respective regulatory decisions. From the publication date of the PR24 FM, the estimate for the allowed CoE for PR24 is based on (1) the FM methodology and (2) an updated data cut-off of June 2023.

Source: KPMG analysis of Ofwat, CMA decisions and Refinitiv Datastream data.

The observed reduction in the differential indicates that the CoE is miscalibrated and may result in the equity investments being deemed less attractive than other available opportunities with better risk-reward profiles. All else equal, a significantly larger differential between observed debt pricing and allowed equity returns would be expected.

To assess the required level of differential for PR24, the Report undertakes an inference analysis based on Merton's (1974) framework<sup>8</sup> and its practical applications<sup>9</sup>. A cross-check based on this framework:

- Is derived from outside the CAPM, in line with Ofwat's preferred specification of cross-checks at PR24.

<sup>8</sup> In Merton's (1974) framework, debt and equity are considered contingent claims over a firm's assets and the values of debt and equity are intrinsically related to the value of the firm's assets.

<sup>9</sup> The Report utilises the methodology and the analytical formula developed in Campello, M., Chen, L., & Zhang, L. (2008). Expected returns, yield spreads, and asset pricing tests. *The Review of Financial Studies*, 21(3), 1297-1338. This analytical formula estimates the expected equity return based on the relationship between equity and debt inferred from Merton's (1974) framework. The inputs into this formula are the elasticity of the equity value with respect to debt value and the expected cost of debt which is the company's weighted-average bond yield adjusted for default risk. Elasticity reflects the percentage change in the value of equity relative to the percentage change in the value of debt, which is equivalent to the ratio of return on equity to the return on debt. If elasticity is high (i.e. a small change in the value of debt leads to a large change in the value of equity), then equity is much riskier than debt and so the equity risk premium will be much larger than the debt risk premium.

- Acknowledges the impact of a firm's risk exposure on both debt and equity returns, whilst (1) recognising that equity inherently carries higher risk than debt and (2) allowing for the fact that the differential between debt and equity will depend on various factors, such as leverage, which may change over time.
- Reflects the prevailing market conditions and risk environment, both in terms of the level of return and the interrelationship between the equity and debt.

As a result, Merton's framework and its practical applications can provide valuable insights into the relationship between required returns on equity and debt for the same firm and inform the estimation of risk-reflective returns for PR24. Importantly, the Report does not propose that this approach can yield a *precise* estimate of the required CoE. This is due to the presence of some noise in the estimation of equity risk premia from debt risk premia, driven by the different nature and risk exposures of each type of capital. Instead, the Report considers that observed debt pricing and the expected differential between debt and equity pricing can represent a useful cross-check on CAPM-derived returns.

To assess the implications of inference analysis evidence for the allowed CoE at PR24, the Report undertakes two comparisons, which consider (1) how the CAPM-derived CoE estimates compare to inferred CoE estimates and (2) how the differentials between CoE and current debt pricing implied by the CAPM-derived CoE compare to those implied by the inferred CoE. This comparison is undertaken for the PR19 re-determination, the PR24 FM (September 2022 and June 2023 cut-offs) as well as for the PR24 CoE range estimated by KPMG<sup>10</sup> (at 55%<sup>11</sup> notional gearing level for comparability).

In each of the charts below, the diamond represents either the CAPM-derived CoE or the CAPM-implied differential and the floating bar represents the range implied by the inference analysis. The data labels represent the difference between the CAPM-derived values and the lower bound of the range from inference analysis.<sup>12</sup>

As illustrated on Figure 3 and Figure 4 both the CAPM-derived CoE based on the PR24 FM and the resulting differential with current debt pricing are significantly below the range implied by inference analysis. In contrast, the CMA's PR19 allowed CoE and the resulting differential were within the range implied by inference analysis. All else equal, this suggests that the CAPM-derived CoE based on the PR24 FM is not consistent with current market pricing of debt and the relationship between debt and equity pricing expected based on corporate finance theory and implied by the CMA's PR19 re-determination.

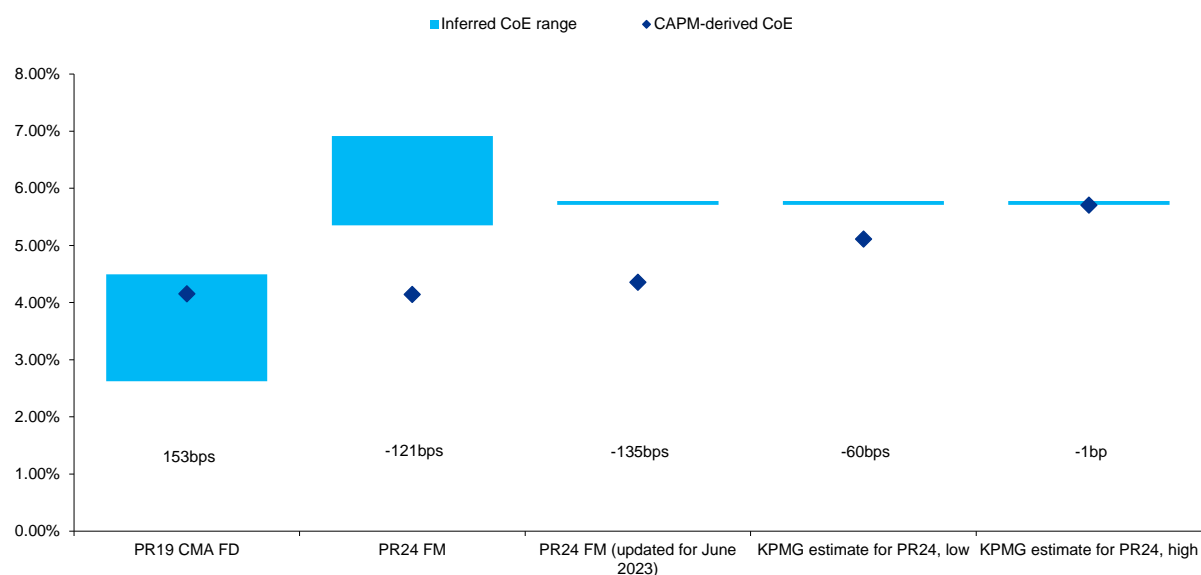
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<sup>10</sup> KPMG (2023), Estimating the Cost of Equity for PR24

<sup>11</sup> The CoE range estimated by KPMG is based on a 60% notional gearing assumption in practice.

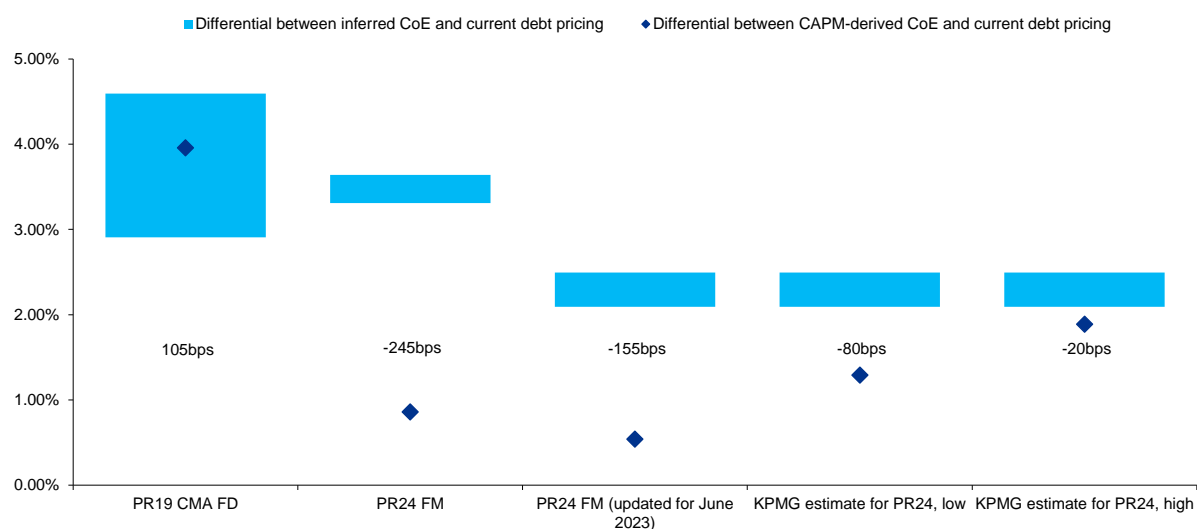
<sup>12</sup> The ranges for inferred CoE and inferred differentials between inferred CoE and current pricing of debt for each cut-off date are formed based on the (1) minimum and maximum CoE and (2) minimum maximum differentials implied by the 1-, 3-, and 6-month averaging windows as at that date. Note that the height of range will not be the same for inferred CoE and differentials. The range for the CoE depends only how different 1-, 3- and 6-month averages of CoE are from each other. The range for the differentials is affected by both CoE and debt pricing. This means that for the two ranges to be consistent, the debt pricing being deducted to calculate differentials would need to be the same based on 1-, 3-, and 6-month averaging windows. This is not the case as debt pricing varies depending on the averaging window.

**Figure 3 Comparison between inferred and CAPM-derived CoE<sup>13</sup>**



Source: KPMG analysis

**Figure 4 Comparison of differentials between CoE and current debt pricing implied by inferred versus CAPM-derived CoE**



Source: KPMG analysis

The scale of the disconnect between equity and debt pricing implied by the CAPM-derived CoE based on the PR24 FM may be indicative of a material miscalibration of the allowed CoE. This, in turn, could mean that the cost of capital materially exceeds allowed returns for AMP8, making investment in PR24 less attractive compared to other opportunities with better risk-reward profiles. Investors are

<sup>13</sup> It is noted that the elasticity (and hence the CoE) derived based on the Merton (1974) framework and its practical applications based on market leverage can differ from the current notional gearing assumption of 55% set out in the PR24 FM. Since the beginning of 2022, market leverage has remained below assumed notional gearing in the PR24 FM of 55%, meaning that expected elasticity based on market leverage will yield inferred CoE estimates that somewhat *understate* the required returns at the notional gearing level. The inferred CoE estimates for PR24 in this Report are based on market leverage and can thus be considered to be conservative. In contrast, the inferred CoE for PR19 is likely to be overstated as market leverage exceeded current notional gearing assumptions in AMP6.

likely to be disincentivised to invest in water sector equity where CAPM-derived equity risk premia, which underpin allowed returns, do not align practically with and reflect appropriate differentials to lower-risk debt pricing.

The availability of equity capital required to meet the substantial investment needs in PR24 is contingent on allowed returns that adequately compensate for forward-looking risk exposure and the opportunity cost of capital in current market conditions. Limitations in the available equity capital could result in a significant customer detriment as well as potential increases in gearing to address the shortfall.

As illustrated in the figures above and Table 1 below, the KPMG range implies materially greater consistency with current debt pricing and could better facilitate the achievement of policy objectives for the sector. The comparison suggests that a CAPM-derived CoE estimate from the upper end of the KPMG range may be justified. This is particularly the case given that inferred CoE is based on market (rather than notional) leverage and hence under-estimates required returns inferred from debt pricing.

**Table 1 Comparison of CoE and differentials between CoE and current debt pricing for inferred versus CAPM-derived CoE**

CPIH-real	Cut-off date	Inferred CoE	CAPM-derived CoE	Differential between inferred CoE and current debt pricing	Differential between CAPM-derived CoE and current debt pricing
PR19 CMA FD	31/12/2020	2.62 – 4.50%	4.15%	2.91 – 4.59%	3.96%
PR24 FM	30/09/2022	5.35 – 6.91%	4.14%	3.31 – 3.64%	0.86%
PR24 FM (updated for June 2023)	30/06/2023		4.36%		0.54%
KPMG estimate for PR24, low	30/06/2023	5.71 – 5.78%	5.11%	2.09 – 2.49%	1.29%
KPMG estimate for PR24, high	30/06/2023		5.71%		1.89%

Source: KPMG analysis  
 Note: CAPM-derived CoE is always on a 55% notional gearing basis.

The inference analysis evidence implies that a careful re-examination of the methodology and estimates of the PR24 allowed CoE is required to ensure that allowed returns and equity risk premia are sufficient to attract equity capital in current macroeconomic conditions and relative to current levels of observed debt pricing.

# 3 Context and scope

## 3.1 Context

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 (CoE) for the price control. In the Final Methodology (FM) for PR24, Ofwat set out its approach for estimating and cross-checking the baseline allowed return on equity.

The FM sets out a point estimate for the allowed appointee CoE of 4.14% CPIH-real based on a September 2022 cut-off and a 55% notional gearing level. On a like-for-like basis (55% notional gearing assumption) this estimate does not imply an increase in returns relative to the CoE determined by the CMA based on market data as of December 2020.

### Key factors relevant to the estimation of allowed returns at PR24

Setting an appropriate, evidence-based, allowance for the CoE is essential to attract and retain equity capital in the sector. An appropriate allowance for the CoE is one that reflects the return that investors can earn on investments of comparable risk (i.e. reflects the opportunity cost of capital) and remunerates investors for probability-weighted losses (or gains). Only where the CoE meets this criterion can the investment be deemed financeable, i.e. be able to attract sufficient equity (and debt) capital on reasonable terms, consistent with what is priced in the allowance.

The regulatory allowance for CoE will be particularly significant for AMP8 and beyond in the context of the unprecedented step change in the scale of required capital investment. It will be necessary for the notional firm to attract significant new equity capital as well as retain existing equity capital deployed in the sector to fund this investment, which will in turn be contingent on allowed returns that adequately compensate for forward-looking risk exposure and the opportunity cost of capital in current market conditions.

There has been a significant shift in the macroeconomic landscape, marked by rising interest rates, high inflation, and heightened volatility. Forward curves<sup>14</sup> imply that long-term rates (15-20Y) are likely to remain broadly stable at current levels until the end of AMP8. Bank of England projections imply that while the bank rate may decrease by c.100bps between 2023 and 2025<sup>15</sup>, it is expected to remain at least 300bps above the 2010-2021 average. The significant increase in rates has not translated into higher allowed returns based on the PR24 FM.

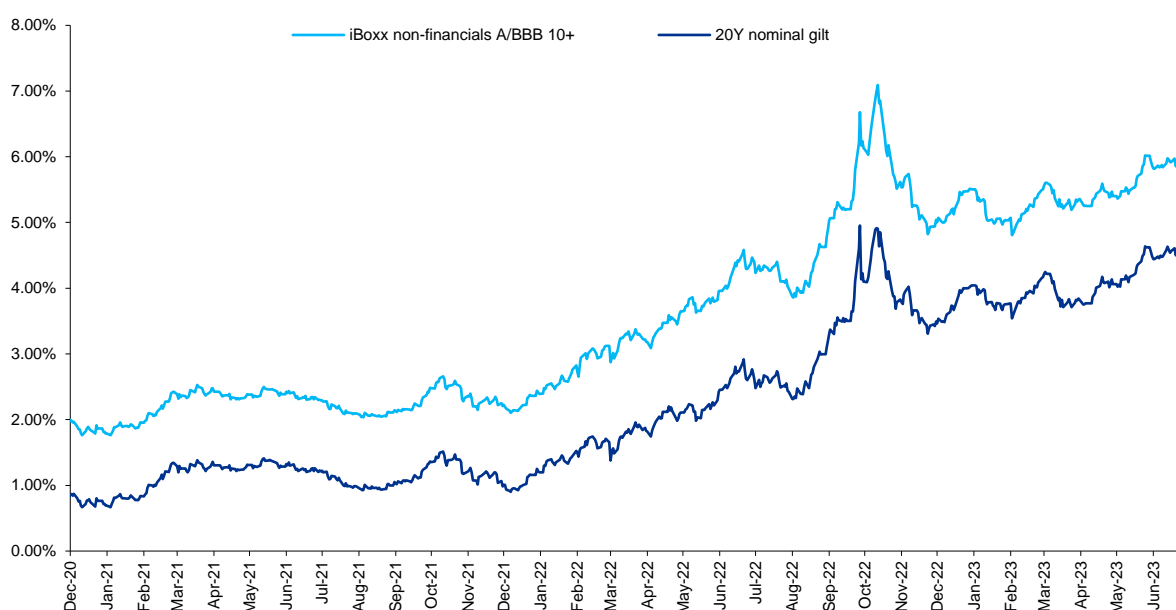
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<sup>14</sup> As of June 2023

<sup>15</sup> Bank Of England (May 2023), Monetary Policy Report, Table 1.B



**Figure 5 Evolution of interest rates since PR19**



Source: Refinitiv Datastream

Companies may need to raise substantial debt and equity capital at relatively elevated interest rates. Regulatory methodologies for estimation of allowed returns that were developed and applied during a low interest rate environment may no longer be appropriate in the new market reality with significantly higher capital costs.

There is inherent uncertainty in estimating CoE and greater potential harm from under-estimation of returns compared to over-estimation<sup>16</sup>. As recognised by the CMA, regulatory CoE needs to be sufficient to provide incentives for firms to meet investment requirements.<sup>17</sup> The CMA considered that the need for sufficient financial incentives would be particularly acute “if Ofwat required a step change in investment to meet changing resilience requirements in the face of climate change challenges or other stresses on existing infrastructure”<sup>18</sup>.

### The role and principles for the use of cross-checks in setting allowed returns

In the context of (1) a step change in interest rates; and (2) a requirement to attract capital to invest in very large capital programmes at AMP8 and beyond, cross-checks will be critical to ensure that the allowed CoE can attract and retain equity capital. Cross checks that are transparent, targeted, objective, incentive compatible, and consistent with regulatory precedent and academic literature<sup>19</sup>, can be effective in increasing the reliability and robustness of the CoE estimate derived based on the CAPM.

Recent regulatory determinations have recognised that to develop a robust CoE estimate, CAPM-derived returns should be cross- or sense-checked with reference to alternative market benchmarks. Ofwat, UKRN and the CMA have positioned the role of cross-checks as follows:

- Ofwat in its PR24 DM stated that: “Our proposed implementation of the CAPM...is reliant on significantly backwards-looking data, particularly on TMR, where we propose to capture over 120

<sup>16</sup> The welfare loss arising from under-estimation of the CoE is greater than that from over-estimation of the cost of capital. If the allowed return is set too high, customers end up paying more in their bills than they would have had the allowance been based on the true cost of capital. On the other hand, if the allowed return is set too low, companies are discouraged from making new investments or adequately maintaining existing ones, resulting in suboptimal levels of investment and a significant loss in consumer welfare. As the demand for most regulated services is driven by the essential nature of the services provided, the welfare loss from under-investment is substantial. Consequently, the detrimental impact on consumers is not symmetric when the allowed return deviates significantly from the true cost of capital.

<sup>17</sup> CMA (2021), PR19 Final Determination, para. 9.1236

<sup>18</sup> Ibid., para. 9.1391

<sup>19</sup> KPMG (2022), Use of Market-to-asset ratios (MARs) as a cross-check in the context of regulatory price controls

years of historical evidence. One implication of this approach may be an allowed return which is slow to adapt to changing market conditions. Because our objective is to set an allowed return aligned with investors' expectations over 2025-30, it is therefore important to cross-check our CAPM-derived estimates against estimates from alternative approaches underpinned by more recent and forward-looking data<sup>20</sup>.

- Ofwat also noted that: “For our point estimate we propose that we would ordinarily use the midpoint of this CAPM-derived plausible range. We consider there should be a high evidential bar for moving away from this central estimate, limited to evidence from our market cross-checks. We expect that any adjustment would be modest and would in any case lie within the endpoints of our CAPM-derived cost of equity stated range”<sup>21</sup>.
- UKRN in its guidance for regulators on the methodology for setting the cost of capital noted that: “Since the CAPM is just one model of expected returns, market benchmarks...provide a sense-check on the CAPM point estimate when such market data are available” and “as available cross-checks themselves may be uncertain and reliant on assumptions, there should be a high evidential bar to deviating from the mid-point of the [CAPM] cost of equity range”<sup>22</sup>.
- As part of the RIIO GD&T2 appeals the CMA considered that the role of cross-checks is to assess whether the CAPM-implied returns appear materially miscalibrated relative to market-based evidence<sup>23</sup>. In this context, the CMA commented that: “the ultimate requirement should be to ensure that the overall cost of equity allowance is sufficient to attract investors and allow companies to finance their activities” and “market-based cross-checks can help with this process”<sup>24</sup>.
- The CMA in its PR19 re-determination noted that cross-checks of the point estimate for CoE – in particular, financeability – are valuable given that CAPM could be used to derive a wide range of potential estimates for the CoE<sup>25</sup>. Further, the CMA considered that “arguments for picking a point estimate higher than the midpoint include...to take into account a cross-check on market data and financeability ratios”<sup>26</sup>.

In the PR24 FM, Ofwat indicates that it will rely on Market-to-Asset Ratio (MARs) analysis as a cross-check the CoE. Given the widely recognised shortcomings and limitations of the MAR cross-check, placing full weight on this evidence is unlikely to provide valuable additional insight to the CAPM and hence will not robustly cross-check whether allowed returns will attract and retain equity capital<sup>27</sup>.

As a result, for PR24, the consideration of more robust alternative cross-checks is important to refine the CAPM-derived CoE range and/or inform the selection of the point estimate for the CoE.

### Relationship between debt and equity pricing as a potential cross-check

The following principles have informed the exploration of the relationship between debt and equity pricing for more detailed consideration in this Report:

- In its guidance for setting the cost of capital (WACC), the UK Regulators' Network (UKRN) highlights that returns should be “risk reflective”<sup>28</sup> such that “the reward will reflect the allocation of risk in the regulatory framework and sectors”<sup>29</sup>. The allowance for the cost of capital set by regulators should be commensurate with the risks faced by debt and equity investors.

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<sup>20</sup> Ofwat (2022), PR24 Draft Methodology, Appendix 11 – Allowed return on capital, p. 24

<sup>21</sup> Ibid., p. 25

<sup>22</sup> UKRN (2023), Guidance for regulators on the methodology for setting the cost of capital

<sup>23</sup> CMA (2021), RIIO2 Final Determination, Volume 2A: Joined Grounds: Cost of equity, para. 5.718

<sup>24</sup> Ibid., para. 5.723

<sup>25</sup> CMA (2021), PR19 Final Determination, para. 9.1378

<sup>26</sup> Ibid., para. 9.1240

<sup>27</sup> KPMG (2022), Use of Market-to-asset ratios (MARs) as a cross-check in the context of regulatory price controls. The analysis highlighted the following limitations of the MAR cross-check. Firstly, it is challenging to solely attribute MAR to differences in assumed investor return and allowed return due to numerous unknown factors, making it less targeted. Secondly, academic research suggests that MAR cannot be used to assess CoE without controlling for all influencing factors, which is often not feasible. Additionally, using MARs to adjust CoE could lead to unintended consequences which may not be in customer interest. Lastly, transaction MARs face transparency and objectivity issues, as they rely on non-public information and can be biased towards winning bidders' aims, assumptions, and strategic advantages.

<sup>28</sup> [UKRN cost of capital principles](#)

<sup>29</sup> Ibid.

- In its guidance, UKRN has similarly recognised “*the principle that equity bears more risk than debt and so should normally receive a higher return*”<sup>30</sup>.
- At PR19 the CMA recognised that “*for a regulated business with capped returns, the cost of equity used in the WACC should still be assumed to remain sufficiently above the current cost of debt to promote equity investment in the sector*”<sup>31</sup>.

These regulatory principles suggest that a cross-check based on the relationship between current pricing of new debt in the sector and equity pricing in allowed returns would also be relevant. This is because (1) debt and equity are both claims on the same underlying asset, and there should be a relationship between them and (2) the CoE cannot be observed whereas cost of debt can be observed. This is in line with Damodaran (2023) which considers that “*there should be a relationship across the risk premiums in these asset classes that reflect their fundamental risk differences*”<sup>32</sup>. As a result, observed debt pricing and the relationship between the CoE and the cost of debt could be used to infer the CoE which can be applied as a sense-check to the CAPM-derived estimate.

It is a core principle of corporate finance that equity is inherently riskier than debt. Both security classes represent contingent claims over a firm’s assets. In the event of an insolvency, debt holders have the priority claim over the firm’s assets for debt repayment, while equity holders could receive the remaining assets only once all outstanding debt capital has been repaid and if the remaining value of the firm is non-negative. This suggests that equity holders face higher risks in relation to loss of capital and return.

Similarly, as the payment terms of debt are fixed, debt is known as fixed income. If the company fails to make the required interest or principal payments, it is in default and debt holders can take control of the business. By contrast any dividends can only be paid to equity holders once fixed payments have been made to debtholders. As a result, debtholders are senior and equity holders are junior – they can only be paid *after* all debtholders are paid.

Given the inherently riskier nature of equity, the expected return on equity needs to be substantively above the expected return on debt of the same company. If the allowed WACC does not consistently reflect the subordinated nature of equity relative to debt, equity investors may seek alternative investments that appropriately reflect these factors, such as projects with similar risks or lower-risk assets like debt that provide equivalent or higher returns.

Analysis of the differences between CoE and cost of new debt (CoD<sub>n</sub>) implied by the PR24 FM indicates that the gap between the pricing of these sources of capital has narrowed significantly relative to previous regulatory determinations. Equity investors often have multiple investment options, each with varying risk and return profiles. When making capital allocation decisions, investors would carefully consider the risk-return profile of each opportunity. In the context of the choice between investing in a single firm’s debt or equity, absent an appropriate differential between the returns available from these investments, an investor is unlikely to be incentivised to invest in equity given its higher risk exposure.

There has recently been a significant increase in interest rates, with the CoD<sub>n</sub> at its highest level since PR09. Conversely, there has not been a corresponding increase in CoE. As set out in Figure 6, based on Ofwat’s calibration of allowed CoE in PR24 FM, the differential between CoE and CoD<sub>n</sub> has reduced significantly by c.300bps from CMA PR19. The differential reduces by a further 33bps when allowed CoE and CoD<sub>n</sub> are updated for the June 2023 cut-off.

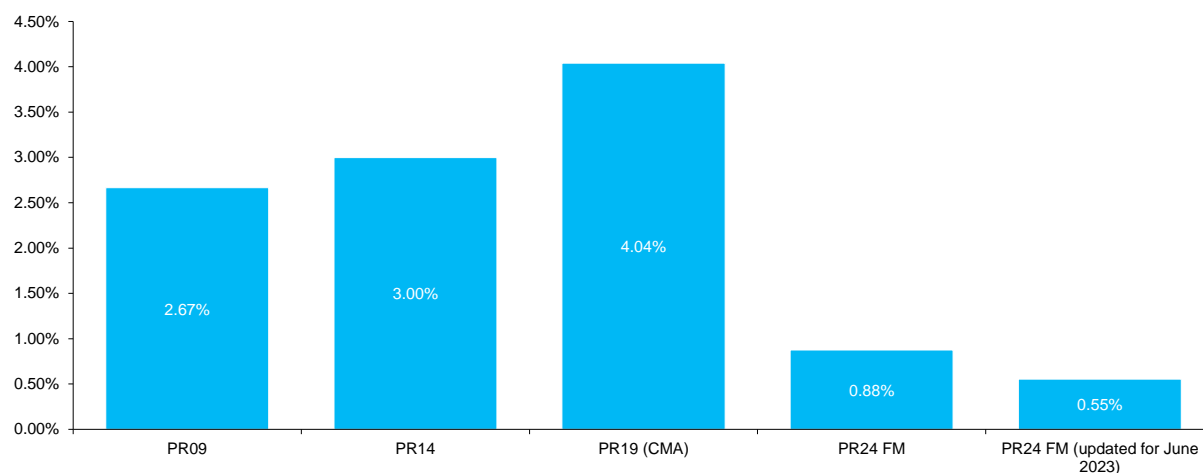
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<sup>30</sup> UKRN (2023), Guidance for regulators on the methodology for setting the cost of capital, Appendix A: Guidance Consultation Issues and Taskforce Response

<sup>31</sup> CMA (2021), PR19 Final Determination, para. 9.1386

<sup>32</sup> Damodaran A., Equity Risk Premiums (ERP): Determinants, Estimation, and Implications – The 2023 Edition

**Figure 6 The evolution the differential between CoE and CoD<sub>n</sub> (on a comparable 55% notional gearing basis)<sup>33</sup>**



Note: Ex-ante allowed CoE vs ex-ante allowed CoD. Allowed CoE and CoD are fixed over the price control based on long-term inflation assumptions from the respective regulatory decisions.  
 Source: Ofwat (2022), PR24 Final Methodology, Appendix 11 – Allowed return on capital, Table 2.1. CMA (2021), PR19 Final Determination, Table 7. Ofwat (2014), Setting price controls for 2015-20 Final price control determination notice: policy chapter A7 – risk and reward, Table A7.10. Ofwat (2009), Future water and sewerage charges 2010-15: final determinations, Table 46, section 5.4.4.

The significantly reduced headroom between allowed CoE and CoD<sub>n</sub> is not consistent with corporate finance principles and may be indicative of a miscalibration of the PR24 FM CoE which warrants further investigation.

## 3.2 Scope and structure of the Report

This Report develops a cross-check for the regulatory CoE based on the market pricing of debt and relationship between debt and equity based on following steps:

- First, it considers the evolution of observed differentials between allowed CoE and market pricing of debt and its implications for the calibration of PR24 CoE (section 4).
- Second, it establishes the conceptual framework for inferring CoE from CoD based on established corporate finance theories and sets out the approach and methodology for empirical analysis (section 5 and 6).
- Third, it comments on the implications of the empirical analysis for the calibration of the PR24 CoE (section 7).

## 3.3 Authors

This Report has been written in conjunction with Professor Alex Edmans, who is a sub-contractor of KPMG LLP.

Professor Edmans is Professor of Finance at London Business School. Professor Edmans' research interests are in corporate finance and behavioural finance. He is a Director of the American Finance Association and a Fellow of the Financial Management Association. From 2017-2022 he was Managing Editor of the Review of Finance, the leading academic finance journal in Europe. Professor Edmans has spoken at the World Economic Forum in Davos, testified in the UK Parliament, presented to the World Bank Board of Directors as part of the Distinguished Speaker Series, and given the TED talk What to Trust in a Post-Truth World and the TEDx talks The Pie-Growing Mindset and The Social Responsibility of Business. Alex was named Professor of the Year by Poets & Quants in 2021 and has won 25 teaching awards at Wharton and LBS.

<sup>33</sup> The following inflation assumptions, from the respective determinations, to derive the nominal values: PR24 FM: 2.00%, PR19 (CMA): 2.00%, PR19 (FD): 2.00%, PR14: 2.80%, PR09: 2.50%.

Professor Edmans' book, *Grow the Pie: How Great Companies Deliver Both Purpose and Profit*, was featured in the Financial Times Best Business Books of 2020 and won the Financial Times award for Excellence in Sustainable Finance Education. He is a co-author of the 14th edition of *Principles of Corporate Finance* (with Brealey, Myers, and Allen). The UK government appointed him to conduct one study on the alleged misuse of share buybacks and a second one the link between executive pay and investment.



# 4 Analysis of observed differentials between allowed CoE and market pricing of debt

This section explores the pricing dynamics between allowed CoE and yields on the benchmark index during PR14, PR19 and following the publication of the PR24 FM. It comments on the evolution on the differential between allowed CoE and prevailing market pricing of debt and its implications for investability and financeability during PR24. The PR24 CoE reflected in the analysis in the section has been updated to reflect a June 2023 cut-off in terms of data with no changes to methodology<sup>34</sup>.

Corporate finance theory implies that equity bears more risk than debt and hence that allowed CoE should be assumed to remain sufficiently above the current CoD to promote equity investment in the sector and price in risk differentials for different claims on the same asset. This has been recognised by the UKRN and the CMA (section 3.1).

Assuming no changes in the risk exposure faced by equity investors, the differential observed over the most recent price controls provides a natural point of reference for the PR24 differential given that:

- Past differentials will reflect investor expectations on the pricing of the incremental risk of equity relative to debt.
- Financeability metrics could deteriorate to levels which are not consistent with the target credit rating for the notional firm.

The observed differential from previous price controls would not reflect any changes in forward-looking risk exposure – to the extent that equity risk is increasing and is not accompanied by an equivalent increase in the risk borne by debt, the differential between the pricing of CoE and current CoD would be expected to widen.

The figure below shows the evolution of the differential between allowed CoE and yields on the benchmark indices as a proxy for current borrowing costs. The effective maturity of the A/BBB non-financials index is close to 20 years such that the investment horizons implied in CoE and debt pricing are broadly consistent.

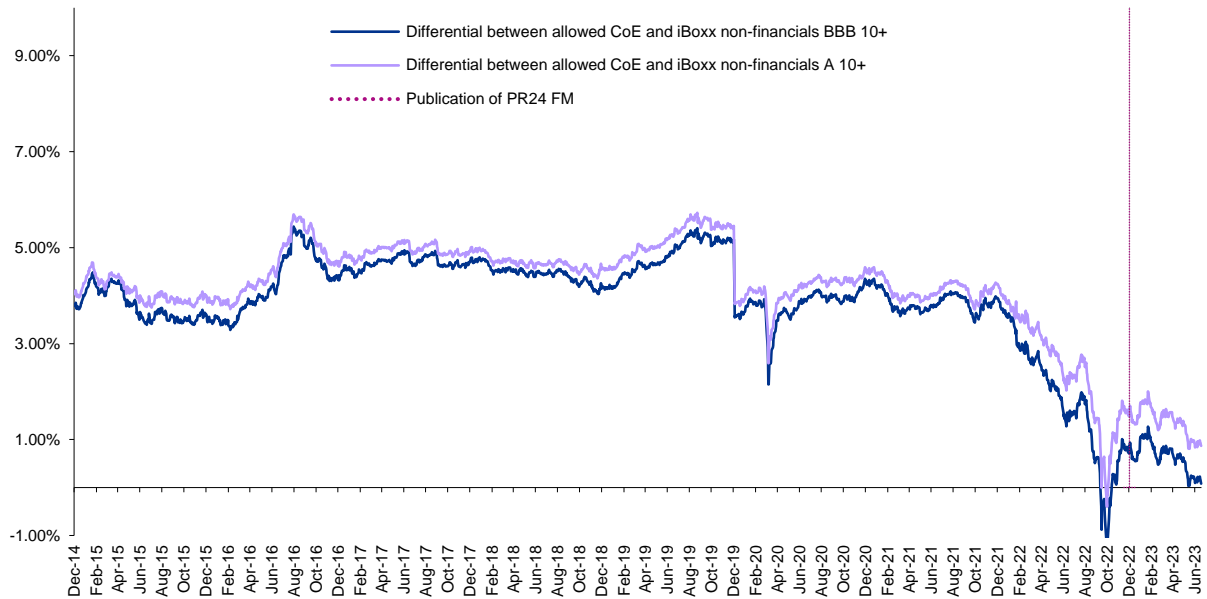
Apart from the early Covid19 period (February – March 2020) the differential has remained broadly stable until 2022 where it experienced a material reduction. The initial reduction from 2022 onwards was likely driven by a combination of step changes in market rates and limited responsiveness of the regulatory CoE to such changes. It was likely exacerbated by the changes in the methodology for CoE estimation stipulated in the PR24 FM.

Since the end of May 2023, the differential between allowed CoE and the yields on the BBB-rated has been very close to zero (Figure 7) which effectively assumes that equity has the same risk exposure as BBB-rated debt. This is not consistent with corporate finance theory.

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<sup>34</sup> This results in an increase of 22bps in the appointee CoE.

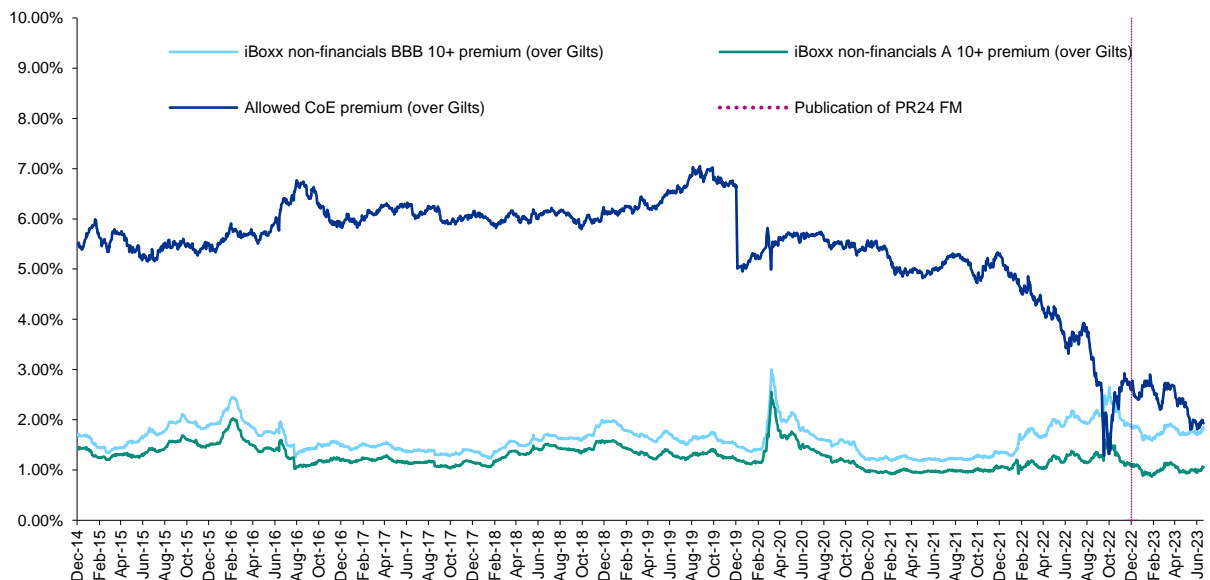
**Figure 7 Evolution of the differential between allowed CoE and yields on the benchmark index (on a comparable 55% gearing basis)**



Note: Compares nominal yields on iBoxx indices to allowed CoE converted to nominal using long-term inflation assumptions in respective regulatory decisions. From the publication date of the PR24 FM, the estimate for the allowed CoE for PR24 is based on (1) the FM methodology and (2) an updated data cut-off of June 2023.  
 Source: KPMG analysis of Ofwat, CMA decisions and Refinitiv Datastream data.

Figure 8 illustrates that the implied premium (over Gilts) for CoE has decreased materially from the beginning of 2022 whereas debt premia have remained relatively stable. This suggests that the observed reduction in the differential between allowed CoE and yields on the benchmark index is driven by the allowed CoE.

**Figure 8 Evolution of CoE (on a comparable 55% gearing basis) and benchmark index premia (over Gilts)**

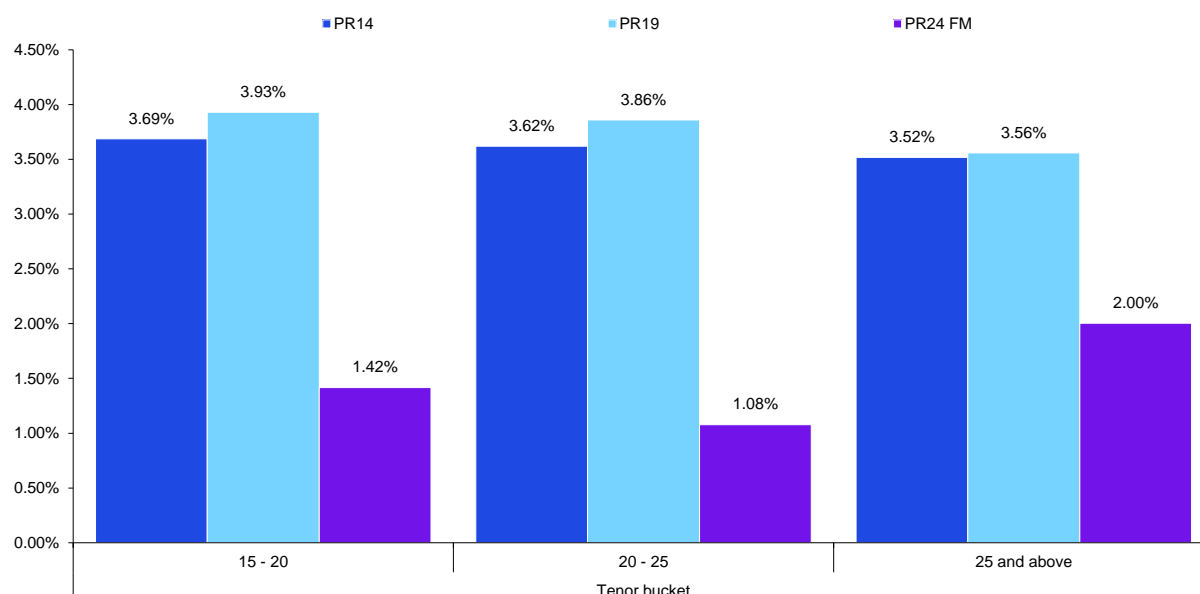


Note: Compares nominal yields on iBoxx indices to allowed CoE converted to nominal using long-term inflation assumptions in respective regulatory decisions. Premium calculated relative to the 20Y nominal gilt yield. From the publication date of the PR24 FM, the estimate for the allowed CoE for PR24 is based on (1) the FM methodology and (2) an updated data cut-off of June 2023.  
 Source: KPMG analysis of Ofwat, CMA decisions and Refinitiv Datastream data.

A similar comparative analysis can be undertaken for outturn yields on water company debt which may more closely reflect the borrowing costs faced by the companies relative to the notional benchmark index and is more likely to be considered by investors when assessing the relative attractiveness of different investment opportunities.

Figure 9 compares the allowed CoE and traded yields during the 6-month window preceding the publication of the regulator’s decision to reflect the market conditions and information that would have been available at the time of decision-making. The figure illustrates that there has been a significant decrease in the differential between allowed CoE and yields on traded water company debt based on PR24 relative to previous price controls.

**Figure 9 Differential between allowed CoE (on a comparable 55% gearing basis) and yields on traded water company debt 6 months prior to decision publication**



Note: Compares nominal yields on water company fixed rate debt to allowed CoE converted to nominal using long-term inflation assumptions in respective regulatory decisions. Premium calculated relative to the 20Y nominal gilt yield. From the publication date of the PR24 FM, the estimate for the allowed CoE for PR24 is based on (1) the FM methodology and (2) an updated data cut-off of June 2023. A long-list of water company fixed rate GBP-denominated bonds was sourced from Bloomberg and was narrowed down further based on the availability of credit rating and traded yield information and to exclude bonds with special features such as calls. The resulting instruments were categorised according to prevailing credit rating (A/BBB and sub-investment grade categories) and remaining maturity (15-20 years, 20-25 years, and above 25 years) for comparability. Debt with shorter remaining maturity was excluded for consistency with the long investment horizon implied in the allowed CoE<sup>35</sup>.

Source: KPMG analysis of Ofwat, CMA decisions, Bloomberg and Refinitiv Datastream data.

Whilst the analysis in this section focuses on differentials between allowed CoE and debt costs at the investment grade credit rating level, one would also expect to observe a positive but smaller gap between allowed CoE and (1) junior debt issued by OpCos and (2) debt issued by MidCos<sup>36</sup>. Whilst the latter can be viewed as more equity-like than debt found within the regulatory ringfence, it nonetheless holds a superior position in the hierarchy of financing sources when it comes to asset claims during bankruptcy and control rights in the event of financial difficulty or distress at the MidCo

<sup>35</sup> The table below sets out the numbers of instruments being considered under each investment rating and time to maturity bucket. All sampled instruments fall into the A/BBB rating category as sub-investment grade debt is more short-term.

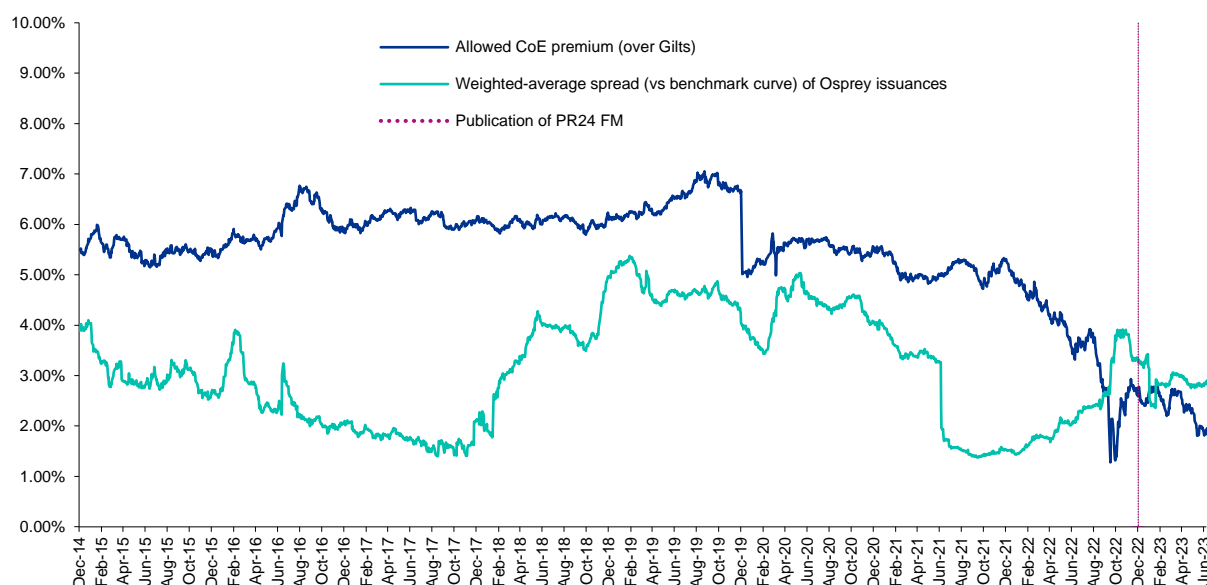
Rating bucket	A/BBB		
	15 - 20	20 - 25	25 and above
PR14	8	4	8
PR19	5	6	5
PR24 FM	10	1	4

<sup>36</sup> Kemble debt has been excluded from the analysis due to traded yields being affected by company-specific factors which are not necessarily relevant for the estimation of CoE for the sector.

level. As a result, even though MidCo debt sits outside the regulatory ring fence, it can still provide valuable insights on the extent to which allowed CoE reflects the greater exposure of equity relative to debt given that from a lender perspective the risk exposure of this debt is linked to the same regulatory assets and cash flows as OpCo equity.

The figure below sets out the evolution of the differential between the allowed CoE and yields on MidCo debt. For comparability in terms of tenor, the figure is based on spreads / premia relative to gilts. Historically there has been a positive differential between MidCo spreads and allowed CoE which is consistent with the subordinated nature of equity claims relative to MidCo debt. Since 2022, this differential has become negative and so is inconsistent with corporate finance theory and indicative of the miscalibration of CoE.

**Figure 10 Differential between allowed CoE (on a comparable 55% gearing basis) and yields on traded MidCo debt**



Note: Compares nominal yields on MidCo debt to allowed CoE converted to nominal using long-term inflation assumptions in respective regulatory decisions. MidCo debt has shorter tenor than the investment horizon implied in the CoE and therefore the comparison is on the basis of spreads/premia. CoE premium calculated relative to the 20Y nominal gilt yield. Weighted-average spread on MidCo debt is based on spreads against the benchmark curve (of the closest maturity), weighted based on prevailing market value of the instrument. Excludes the impact of the significant spike in Kemble spreads at the end of June 2023. From the publication date of the PR24 FM, the estimate for the allowed CoE for PR24 is based on (1) the FM methodology and (2) an updated data cut-off of June 2023.

Source: KPMG analysis of Ofwat, CMA decisions and Refinitiv Datastream data.

In principle a reduction in the observed pricing differentials between CoE and current CoD may be appropriate in case of a material reduction in risk borne by equity that is not accompanied by an equivalent reduction in the risk borne by debt. This is unlikely to be the case for PR24 as:

- There is a significant and unprecedented step change in the scale of capital programmes expected for AMP8 and beyond. The scale of required investment reflects a series of environmental obligations, including on the use of storm overflows, transition to Net Zero, environmental targets, abstraction reduction and resilience. All else equal, a step change in the scale of investment would be expected to exacerbate the exposure to existing risks and/or create exposure to new risks.
- There are material changes to the specification of regulatory mechanisms set out in the FM. Notable examples include ODIs – with changes to rates and removal of caps/collars – and the expected increased prevalence of price control deliverables (PCDs) which are, by design, asymmetric<sup>37</sup>.

<sup>37</sup> PCDs imply only downside without upside.

- Exposure to regulatory and performance risk in relation to Totex and ODIs affects returns to equity but not to debt. As a result, exposure to equity is expected to increase as more value is put at risk through Totex and ODI regulatory incentives, with limited corresponding impact on debt.

The observed reduction indicates that the CoE is likely miscalibrated and may result in equity investment in PR24 being deemed less attractive than other available opportunities with better risk-reward profiles. In the most recent period the returns available for equity investment in the UK water sector have been broadly commensurate with those available from BBB-rated debt which does not recognise the additional risks that equity faces due to its subordinated nature of equity and so is inconsistent with corporate finance theory. In this context, it is important to consider the appropriate level of differential for PR24.

Precedent from previous price controls explored in this section suggests that on an ex-ante basis the appropriate differential would be c. 300bps. The subsequent sections of this Report undertake more detailed analysis of the appropriate differential based on debt pricing and the relationship between equity and debt outlined in corporate finance theory.



# 5 Framework for inferring CoE based on the relationship between debt and equity pricing

This section sets out an overall framework for inferring the CoE based on debt pricing and specification of the key drivers of the relationship between debt and equity pricing as outlined in corporate finance theory. The purpose of this analysis is to inform the assessment of the appropriate differential in current market conditions.

Merton's (1974)<sup>38</sup> contingent claim framework – developed as part of his work on option and derivative pricing – and its modern applications represent a potential basis for estimation of CoE based on the interrelationship between equity and debt pricing.

In Merton's framework, debt and equity are considered contingent claims over a firm's assets<sup>39</sup>. This framework views equity as a European call option, exercised when firm assets exceed debt value, granting shareholders the right to acquire assets. When assets fall below debt value (signifying default), shareholders forgo this option, leaving assets for debtholders. Debt is akin to risk-free debt and shorting a European put option on assets. If assets surpass debt value, equity holders repay the debt, granting debtholders the debt's value instead of firm assets.

The values of debt and equity are intrinsically related to the value of the firm's assets. When the firm's asset value rises, equity holders benefit from larger residual claims, and debt value benefits from the reduction in the firm's leverage and the lower likelihood of default. Conversely, a decline in asset value diminishes the residual claims of equity holders and heightens the risk of default. Consequently, all else equal, the expected returns on equity and debt exhibit a positive correlation, as both are sensitive to the underlying factors that affect the firm's asset value.

Campello, Chen and Zhang (2008)<sup>40</sup> have developed an analytical formula (see Equation (1) below) to estimate the expected equity return based on the relationship between equity and debt inferred from Merton's framework. Their research is published in the top-ranking *Review of Financial Studies*.

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<sup>38</sup> Merton, R. C. (1974). On the pricing of corporate debt: The risk structure of interest rates. *The Journal of Finance*, 29(2), 449-470.

<sup>39</sup> The framework views equity as a European call option, while debt is considered as a European put option.

- Equity holders are effectively holding a European call option on the firm's assets, which means that they have the right, but not the obligation, to obtain the firm's assets by paying off the debt. Their net payoff is the residual value of the firm, the difference between the asset value and the debt value. They will thus exercise the option when the residual value is positive, i.e., when the firm's asset value exceeds the value of debt.
  - When the value of a firm's assets is lower than the value of debt (i.e., the company is in default), then the payoff from exercising the option is negative – shareholders would lose money by paying off the debt to obtain assets of lower value. They will thus allow the option to expire worthless, leaving debtholders with all of the firm's assets.
  - When the value of a firm's assets is higher than the value of debt, shareholders can exercise their call option to buy the assets, retaining the residual claim on the firm's assets.
- Debt holders are effectively holding risk-free debt and shorting a European put option on the firm's assets. The risk-free debt reflects the money they have lent and expect to be repaid. Unlike the buyer of an option which has the right, but not the obligation to exercise his option, the option seller, in this case the debtholder, gets what the option holder chooses to leave them with. When the value of the firm's assets is lower than the value of debt (i.e., the company is in default), equity holders choose not to exercise their option to buy the firm's assets; instead, they leave the firm's assets to the debtholders and do not repay the debt.
  - When the value of the firm's assets exceeds the value of debt, equity holders choose to repay the debt. Thus, debtholders receive the value of the debt rather than the firm's assets.

<sup>40</sup> Campello, M., Chen, L., & Zhang, L. (2008). Expected returns, yield spreads, and asset pricing tests. *The Review of Financial Studies*, 21(3), 1297-1338.

The inputs into this formula are the elasticity of the equity value with respect to debt value ( $\frac{\partial E/E}{\partial D/D}$ ) and the expected cost of debt which is the company's weighted-average bond yield adjusted for default risk.<sup>41</sup>

$$\text{Equation (1)} \quad E[r_E] - r_f = \frac{\partial E/E}{\partial D/D} (E[r_D] - r_f)$$

Elasticity ( $\frac{\partial E/E}{\partial D/D}$ ) reflects the percentage change in the value of equity relative to the percentage change in the value of debt, which is equivalent to the ratio of return on equity to the return on debt. If elasticity is high (i.e. a small change in the value of debt leads to a large change in the value of equity), then equity is much riskier than debt and so the equity risk premium  $E[r_E] - r_f$  will be much larger than the debt risk premium  $E[r_D] - r_f$ .

This Report uses Equation (1) to infer CoE based on the elasticity of debt to equity and debt pricing. Academic literature suggests two ways of decomposing elasticity into key drivers. One approach is based on Schaefer and Strebulaev (2008)<sup>42</sup> and the Black-Scholes-Merton option pricing model<sup>43</sup> and the other on Friewald, Wagner and Zechner (2013)<sup>44</sup>.

These approaches are described in Appendix 1. They suggest that risk-free rate, asset volatility, debt volatility, equity volatility, market leverage and time to maturity of the firm's debt<sup>45</sup> represent the key drivers for elasticity. The analysis undertaken in this Report follows the methodology put forward by Campello et al., in which the key drivers considered are the risk-free rate, market leverage, and equity volatility<sup>46</sup>. These drivers underpin empirical estimation of CoE based on CoD pricing in the next section.

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<sup>41</sup> Campello et al. (2008) explain why bond yield data could be used to represent investors' expected return on debt. Bond yields are computed in the spirit of forward-looking internal return, capturing factors such as probability of default and yield spreads that incorporate the expected risk premiums associated with default risks. Controlling for default risks, bonds with higher systematic risk should have higher yield spreads.

<sup>42</sup> Schaefer, S. M., & Strebulaev, I. A. (2008). Structural models of credit risk are useful: Evidence from hedge ratios on corporate bonds. *Journal of Financial Economics*, 90(1), 1-19.

<sup>43</sup> Black-Scholes-Merton model is an option pricing model that determine the fair value of a stock option based on the price of the underlying asset, the strike price of the option, risk-free rate, time to maturity of an option, and the volatility of an asset.

<sup>44</sup> Friewald, N., Wagner, C., & Zechner, J. (2014). The cross-section of credit risk premia and equity returns. *The Journal of Finance*, 69(6), 2419-2469.

<sup>45</sup> This Reports estimates the inferred CoE for a 20Y investment horizon based on yields on the benchmark index with similar maturity. As the horizons of CoE and CoD are aligned, time to maturity is not included as an independent variable in the regression.

<sup>46</sup> The methodology used by Campello et al. focuses on equity volatility which is measured as the standard deviation of daily stock returns. As asset volatility is not considered directly in the empirical analysis in subsequent sections, this Report does not comment on its relationship with elasticity.

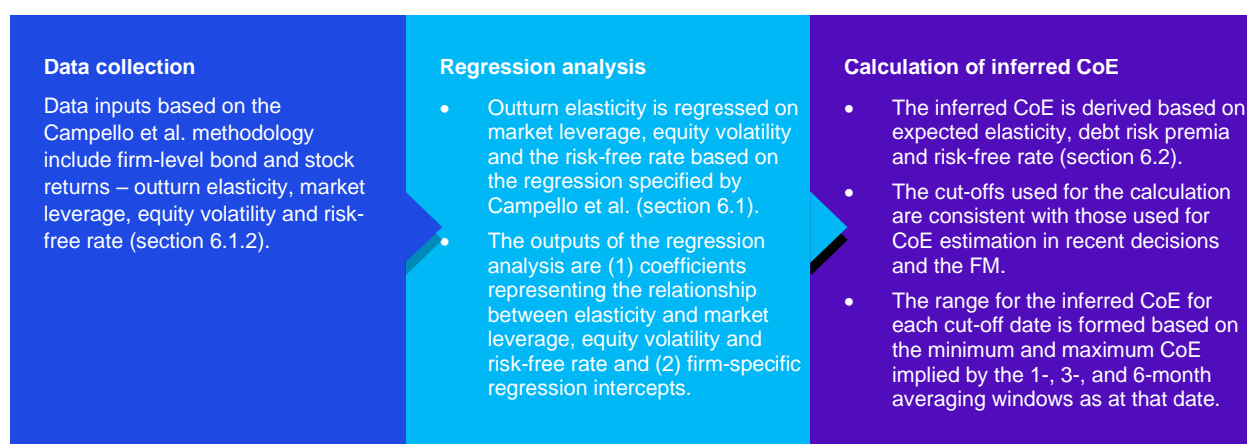
# 6 Methodology for inference analysis to estimate CoE based on debt pricing

This section sets out the approach and data used for the estimation of inferred CoE using the analytical formula developed by Campello, Chen and Zhang (2008) (Equation (1)).

The calculation of inferred CoE based on this formula requires an estimate of the expected elasticity for listed water companies as well as estimates of debt risk premia and risk-free rate.

The section first comments on the methodology for estimating the expected elasticity, including the specification of the regression, data collection, and the calculation of the expected elasticity based on regression outputs. It then comments on how the expected elasticity is combined with debt risk premia and risk-free rate to generate a range for the inferred CoE.

**Figure 11 Overview of the methodology for the estimation of inferred CoE**



## 6.1 Outline of the methodology for the estimation of expected s

The elasticity used for estimating the expected CoE is the expected elasticity, which reflects the expected relationship between equity and debt returns based on the drivers suggested by Merton's framework, including market leverage, equity volatility and risk-free rate. The relationships between elasticity and its drivers are established through a regression analysis conducted over an extended timeframe. This approach ensures that the derived elasticity reflects the underlying fundamental relationships, free from distortions caused by transient factors.

These relationships (represented by regression coefficients) in conjunction with the values of drivers based on most up-to-date market data are used to calculate current expected elasticity (expected elasticity).

### 6.1.1 Regression framework specification based on outturn elasticity

To derive expected elasticity, Campello et al. (2008) regress outturn elasticity ( $\frac{\partial E/E}{\partial D/D}$ ) on historical market leverage, equity volatility and the risk-free rate based on monthly frequency bond and stock data<sup>47</sup>.

$$\text{Equation (2)} \quad \frac{\partial E/E}{\partial D/D}_{it} = \alpha + \beta_{lev} \text{Leverage}_{it} + \beta_{vol} \text{Volatility}_{it} + \beta_{rf} r_{f_t} + \varepsilon_{it}$$

where

- $\frac{\partial E/E}{\partial D/D}_{it}$  is the outturn elasticity, measured as the change in the market value of equity divided by the change in the market value of debt. The market value of debt is calculated by scaling the book value of debt using the weighted average bond market price
- $\alpha$  is the intercept term
- $\text{Leverage}_{it}$  is the market leverage, measured by the ratio of market value of debt to market value of equity
- $\text{Volatility}_{it}$  is the equity volatility, measured by the standard deviation of daily stock returns, based on a rolling window of 180 days
- $r_{f_t}$  is the 30-day Treasury bill rate
- $\varepsilon_{it}$  is the error term, representing the difference between the actual elasticity based on market data and the expected elasticity based on the regression
- $i$  and  $t$  refer to each firm  $i$  at each time  $t$ . The data used in the regression has both a cross-sectional component (different firms at a given time  $t$ ) and a time-series component (each firm  $i$  over different time  $t$ ). As the regression contains multiple firms over time, it is a panel regression<sup>48</sup>

### 6.1.2 Approach to data collection

The Report relies on the period from October 2014 to June 2023 informed by the following considerations.

First, January 2013 to June 2023 is the longest window for which it is possible to draw a robust sample size based on bond returns available from Bloomberg<sup>49 50</sup>.

Second, the analysis undertaken by KPMG and Gregory et al (2020)<sup>51</sup> found a structural break<sup>52</sup> in water sector betas around the PR14 period<sup>53</sup> (c. October 2014), signalling a change in systematic risk

<sup>47</sup> Campello et al. conduct the regression based on 1205 nonfinancial firms listed in the U.S. from January 1973 to March 1998.

<sup>48</sup> Panel regression is a type of regression that contains data with both cross-sectional and time-series dimensions. Panel data sets consist of observations on multiple firm over time.

<sup>49</sup> Campello et al. use data collected from Lehman Brothers Fixed Income Database, which provides bond-specific data in the US from January 1973 to December 1997. This source is not available in the UK.

<sup>50</sup> Relative to the later years, the number of companies with bond data available before 2013 decreases significantly to be less than 50 companies. This could be because Bloomberg does not have the bond data for stocks listed in the earlier years which subsequently de-listed and could result in the results being affected by survivorship bias should these periods be included in the analysis.

Survivorship bias results from the use of a dataset that consists of survivors over a period, not the full set of companies that were listed. As the characteristics of survivors are likely to differ systematically from those who have delisted, the results will be biased. Therefore, the report uses the period from 2010 onwards to reduce the likelihood of survivorship bias.

<sup>51</sup> Gregory, A., Harris, R., and Tharyan, R. (2020). A response to the CMA's Provisional Findings on Water and the Estimation of Beta

<sup>52</sup> In econometrics and statistics, 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. In the case of beta measurement, the most obvious structural break would come from a distinct and meaningful change to the gearing at companies being measured.

<sup>53</sup> Gregory, A., Harris, R., and Tharyan, R. (2021), The Evolution of Beta Through the Covid Crisis, Gregory, A., Harris, R., and Tharyan, R. (2020). A response to the CMA's Provisional Findings on Water and the Estimation of Beta, Gregory, A., Harris, R., and Tharyan, R. (2020). A Report on the Estimation of Beta for Regulatory Charge Control Purposes.

exposure relative to past periods due to the changes in the nature of the regulatory regime. Ofwat has previously recognised the existence of this break “**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”<sup>54</sup>.

This change in the risk borne by equity does not appear to have been accompanied by an equivalent change in the risk borne by debt<sup>55</sup>. All else equal, this suggests that the risk relationship between debt and equity may have changed post-PR14 and that data from 2014 onwards is most relevant for inferring a forward-looking CoE.

The collection of data for the analysis is undertaken in three steps:

- Step 1: Obtain the list of all stocks listed in the London Stock Exchange for each year
- Step 2: Apply the filtration criteria to exclude non-financial companies and Alternative Investment Market (AIM) listed companies
- Step 3: Download firm-level bond and stock data required for the regression

### Step 1

The London Share Price Database (LSPD)<sup>56</sup> is used to obtain a list of all the stocks listed on the London Stock Exchange from 2013 to 2023. LSPD provides a comprehensive list of stocks from 1955 to date, including companies that have since de-listed and / or gone bankrupt. De-listed stocks are included in the dataset to avoid survivorship bias.

### Step 2

The list of stocks obtained from LSPD is filtered as outlined in the table below.

**Table 2 Filtration criteria and rationale**

Criterion	Treatment	Rationale
Financial firms <sup>57</sup>	Exclude	The implications of high leverage are different across financial and non-financial firms (consistent with Campello et al.). Whilst high leverage is common for financial firms and not indicative of financial distress, in non-financial firms, high leverage may indicate financial distress or difficulty.
AIM listed firms <sup>58</sup>	Exclude	AIM-listed firms are excluded to capture the tradable and investable universe for institutional investors. AIM-listings include many small and illiquid stocks. AIM stocks have not historically been viewed as investible by many fund managers due to their high failure rates and poorer standards of reporting. Therefore, the UK studies focus on the Main Market of the London Stock Exchange and exclude AIMs.

Stocks that are not excluded based on the filtration criteria above are then taken forward to the next step for data collection.

### Step 3

The dependent and independent variables used in the regression include firm-level bond and stock returns, outturn elasticity, market leverage, equity volatility and risk-free rate. The methodology for deriving these variables is broadly consistent with Campello et al. with targeted exceptions as set out below.

<sup>54</sup> Ofwat (2022), PR24 Final Methodology, Appendix 11 – Allowed return on capital, p. 15

<sup>55</sup> Interpolated 20Y credit spreads on SVT/UUW fixed rate debt have remained relatively stable since 2010 and have closely tracked the spreads on A/BBB indices. Periodic spikes in observed volatility in the SVT/UUW spreads correlate closely with the developments in the wider UK market such as Brexit, Covid19, 'Trussonomics', so appear more market- rather than sector-driven.

<sup>56</sup> [London Share Price Database | Finance | London Business School](#)

<sup>57</sup> Sector information as of each year is obtained using Bloomberg and DataStream based on Global Industry Classification Standard (GICS) definition of sectors.

<sup>58</sup> The classification of AIM-listed stocks is obtained from LSPD.



- Leverage is measured on the same basis as in Campello et al., i.e. as the ratio of market value of debt to market value of equity, where market value of debt is obtained by scaling the book value of debt by the weighted-average bond market price.
- Stock volatility is measured in the same manner as in Campello et al. i.e. based on the 180-day daily stock return volatility. The daily stock return is calculated as the daily percentage change in the Total Return Index (TRI).
- Risk-free rate is measured based on the yields on the 20-year nominal gilt whereas Campello et al. use the 30-day treasury bill rate. As shown in equation (4) in Appendix 1, risk-free rate is used to calculate the delta ( $\Delta$ ) of the call option, which in this case is the value of equity. Consequently, a long-term measure of risk-free rate is used to reflect the long-term horizon of equity investors.
- Outturn elasticity ( $\frac{\partial E/E}{\partial D/D}$ ) is calculated based on the ratio of month-on-month total return on equity to total return on debt, whereas Campello et al. use the ratio of month-on-month changes in the market value of equity to market value of debt.

Merton (1974) – upon which Campello et al’s analysis is based – uses a simplified model that assumes that there are no coupon payments on bonds, no cash dividends, no share repurchase or new equity or debt issuance<sup>59</sup>. Under these simplified assumptions, the changes in the market value of debt and equity could be used to capture investors’ returns, as the only driver of returns would be the movement of market price.

These simplified assumptions do not hold in practice meaning that changes in market values of debt and equity are a poor proxy for total returns received by equity and debt investors. In contrast, total returns capture returns arising from capital gains and the coupons and dividends received by investors. As a result, the total return is used to measure elasticity as follows:

- The total return on equity ( $\partial E/E$ ) is measured as the month-on-month % change in TRI of equity. TRI reflects both the market price movement and dividend distributions, assuming the dividend distributions will be re-invested.
- The total return on debt ( $\partial D/D$ ) is measured as the month-on-month weighted average total return on bonds<sup>60</sup> which includes 1) price movement, 2) accrued interest, 3) coupon actually paid out during the month, and 4) interest on interest (i.e. the interest that is earned by re-investing the coupon).

The table below summarises the data sources used for independent and dependent variables.

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<sup>59</sup> See page 452 to 453 of Merton, R. C. (1974). On the pricing of corporate debt: The risk structure of interest rates. *The Journal of finance*, 29(2), 449-470.

<sup>60</sup> i.e. the weighted average total return of all the fixed-rate bonds issued by each company. For comparability (across sampled companies) and simplicity the analysis focuses on fixed-rate bonds.

**Table 3 Sources of data for independent and dependent variables**

Variable	Underlying data	Data source
Outturn elasticity; Equity volatility	Total Return Index (TRI) on equity	Refinitiv Datastream
Outturn elasticity	Weighted average total return of fixed-rate bonds <sup>61</sup>	Bloomberg
Leverage	<ul style="list-style-type: none"> <li>Weighted average fixed-rate bond price<sup>62</sup></li> <li>Book value of total debt</li> <li>Market value of equity</li> </ul>	Bloomberg
Risk-free rate	20-year nominal gilt rates	Refinitiv Datastream

### 6.1.3 Refinement and specification of the panel regression model

Campello et al. use a pooled Ordinary Least Square (OLS) regression (see Equation (2)), which assumes that the average elasticity is the same across different firms. Under this assumption, the intercept term ( $\alpha$ ) of the regression is a constant term and does not vary across firms.

However, it is reasonable to expect that the average elasticity could vary across firms, due to influence of differentiated factors such as sectors, business risks, management styles etc. This suggests that a firm fixed effect regression – which incorporates a firm-specific intercept ( $\alpha_i$ ) instead of the constant intercept ( $\alpha$ ) – would be appropriate. Indeed, firm fixed effects are used in the vast majority of corporate finance analysis and research.

$$\text{Equation (3)} \quad \frac{\partial E/E}{\partial D/D_{it}} = \alpha_i + \beta_{lev} \text{Leverage}_{it} + \beta_{vol} \text{Volatility}_{it} + \beta_{rf} r_{ft} + \varepsilon_{it}$$

To test whether individual-specific intercept is needed, the Breusch-Pagan Lagrange multiplier test is conducted. The null hypothesis is that ( $\alpha_i$ ) does not differ significantly across firms, in which case the pooled OLS would be the appropriate specification. The results of the test shows that the p-value is equal to 0.0%, which unambiguously rejects the null hypothesis. As a result, there are significant differences across firms, and so the firm fixed effect regression is used.

### 6.1.4 Calculation of elasticity for listed water companies

For comparability with recent regulatory CoE estimates, Severn Trent (SVT) and United Utilities (UUW) are used as proxies for the water sector. The expected elasticity is calculated as the sum of:

- The regression coefficients ( $\beta_{lev}$ ,  $\beta_{vol}$  and  $\beta_{rf}$ ) multiplied by the historical time series of SVT/UUW market leverage and equity volatility and risk-free rate (the 20Y nominal gilt rate used in the regression).
- The intercept values ( $\alpha_{SVT,i}$  and  $\alpha_{UUW,i}$ ).

$$\frac{\partial E/E}{\partial D/D_{SVT,t}} = \alpha_{SVT,i} + \beta_{lev} \text{Leverage}_{SVT,t} + \beta_{vol} \text{Volatility}_{SVT,t} + \beta_{rf} r_{ft}$$

$$\frac{\partial E/E}{\partial D/D_{UUW,t}} = \alpha_{UUW,i} + \beta_{lev} \text{Leverage}_{UUW,t} + \beta_{vol} \text{Volatility}_{UUW,t} + \beta_{rf} r_{ft}$$

It is noted that the elasticity derived from the regression based on market leverage can differ from the current notional gearing assumption of 55% set out in the PR24 FM.

The figure below sets out the evolution of market leverage<sup>63</sup> (SVT/UUW average) relative to the PR24 notional gearing assumption. Since the beginning of 2022, market leverage has remained below assumed notional gearing in the PR24 FM of 55%, meaning that expected elasticity based on market

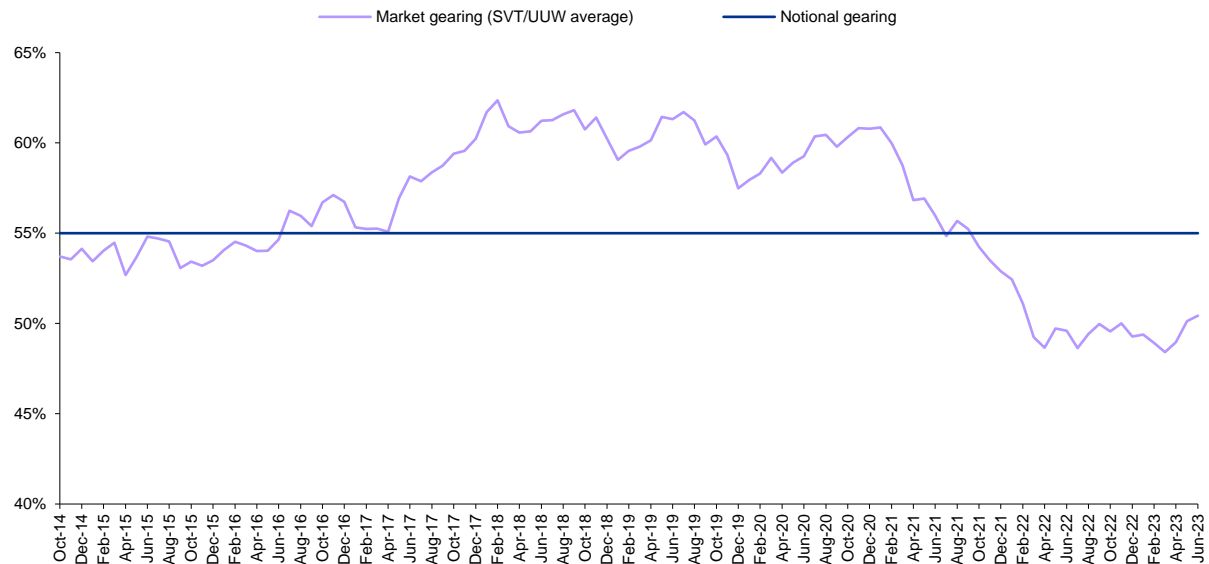
<sup>61</sup> Weighted by amount outstanding of all fixed rate bonds issued by a firm.

<sup>62</sup> Weighted by amount outstanding of all fixed rate bonds issued by a firm.

<sup>63</sup> Market leverage is calculated as the ratio of market value of debt to the market value of equity. Consistent with Campello et al., the market value of debt is derived by scaling the book value of debt by the weighted average fixed rate bond price. For example, if the book value of debt is equal to 60, and the weighted average fixed rate bond price is 120, then market value of debt is equal to 60 x (120/100) = 72. The market value of equity is market capitalisation of the firm.

leverage will yield inferred CoE estimates that somewhat *understate* the required returns at the notional gearing level for PR24. The inferred CoE estimates for PR24 in this Report are based on market leverage and can thus be considered to be conservative.

**Figure 12 Evolution of market leverage (SVT/UUW average) relative to the PR24 notional gearing assumption**



Source: KPMG analysis

Importantly, the Report does not suggest that the market leverage used for the inference analysis is the right market benchmark to inform the notional gearing assumption for the water sector. As is widely acknowledged – including by rating agencies<sup>64</sup> – RCV represents the invested capital on which the water utility will earn a return over time, so the relevant measure of leverage is Net Debt to RCV. In this context, it is appropriate to consider the book value of Net Debt for consistency with the regulatory commitment to allow for the recovery of efficient costs<sup>65</sup>. Separately, in practice, there are significant challenges associated with obtaining up-to-date market values given the prevalence of private debt on companies’ books.

## 6.2 Approach and methodology for estimation of the inferred CoE

The inferred CoE is derived based on expected elasticity, debt risk premia and risk-free rate. The table below provides the specification of methodology and assumptions underpinning this calculation along with associated rationale.

<sup>64</sup> Moody’s (June 2018), Rating Methodology, Regulated Water Utilities

<sup>65</sup> Regulated assets are financed with historic debt as a result of which substantive portions of embedded debt is carried through on balance sheets. Given that the regulatory contract is intended to allow ‘recovery of efficient costs’ – including those of efficiently incurred historic debt – the CoD allowance is based on historic yields at issuance. The allowance assumes that the yield at issuance is the cost that is payable by a regulated firm that holds debt to maturity and for consistency with this assumption considers the book value of debt. Reflecting current market prices in gearing and current yields in the cost of debt allowance, will not only reflect the change in the market price of debt given the reduction in tenor of the debt as it approaches maturity, but will also mark down (or up) costs based on the observed prevailing level of interest rates. This would effectively penalise companies for efficiently incurred debt costs, with the benefit of hindsight. In general, it is a long-established UK regulatory policy to allow the efficient cost of embedded debt, and not to penalise an otherwise efficient company for market movements which are outside of its control.

**Table 4 Methodology and assumptions underpinning the estimation of inferred CoE**

Approach	Rationale	
Cut-off date	30 June 2023, 30 September 2022 and 31 December 2020 used.	Consistent with the cut-offs used for CoE estimation in recent decisions and the FM. June 2023 cut-off included to assess the impact of latest market data.
Averaging window	1-, 3-, 6-month averages used.	Consistent with averaging windows typically considered for estimation of risk-free rate and cost of debt.
Debt risk premium	Market pricing of debt is derived based on outturn yields on benchmark indices (A/BBB), adjusted for default risk by subtracting an expected default loss rate.  The expected default loss rate of 0.15% is calculated based on a 0.24% annualised default rate (the average of highlighted values in Table 5 below) and a 37.7% <sup>66</sup> recovery rate for senior unsecured bonds sourced from Moody's 2023 default study.	Consistent with the regulatory approach for setting the allowance for new debt.  Campello et al. apply a similar default loss rate adjustment based on Moody's data in their analysis.
Treatment of inflation	Inferred CoE is derived in CPIH-deflated terms in three steps:  First, an equity risk premium is calculated by multiplying expected elasticity by a debt risk premium derived from a comparison of default-adjusted nominal yields on the benchmark index and the yields on the 20Y nominal gilt.  Then an inferred CoE is calculated as the sum of the yields on the 20Y nominal gilt and the equity risk premium.  Lastly, the nominal inferred CoE is converted into a CPIH-deflated value based on the 20Y CPI swap rate <sup>67</sup> .	Consistent with the approach for estimating the regulatory CoE which does not reflect compensation for the inflation risk premium (given that it is estimated using index-linked gilts and a real total market return). The deflation using the CPI-swap rate strips out both market-based inflation expectation and the inflation risk premium from nominal inferred CoE. The resulting inferred CoE is thus consistent with the regulatory methodology.

Source: KPMG analysis

**Table 5 Cumulative and annualised default rates for A/BBB corporate issuers**

Rating category	Time period	Time horizon	Cumulative default rate	Annualised default rate	Source
A3	1983 - 2022	10Y	2.00%	0.20%	[1]
		20Y	5.30%	0.27%	[1]
Baa1	1983 - 2022	10Y	2.20%	0.22%	[1]
		20Y	6.00%	0.30%	[1]
A/BBB	1983 - 2022	10Y	2.10%	0.21%	[1]
		20Y	5.65%	0.28%	[1]
A3	1998 - 2022	10Y	2.20%	0.22%	[2]
Baa1	1998 - 2022	10Y	2.20%	0.22%	[2]
A/BBB	1998 - 2022	10Y	2.20%	0.22%	[2]

Notes: (1) Cumulative default rates are issuer-weighted; (2) Annualised default rate = cumulative default rate / time horizon  
 Source: KPMG analysis of Moody's 2023 Annual default study: Corporate default rate will rise in 2023 and peak in early 2024.  
 [1]: Moody's 2023 Annual default study Exhibit 41; and [2] Moody's 2023 Annual default study Exhibit 42

<sup>66</sup> Moody's (2023), Annual default study: Corporate default rate will rise in 2023 and peak in early 2024, Exhibit 7

<sup>67</sup> Sourced from Bloomberg.

The range for the inferred CoE for each cut-off date is formed based on the minimum and maximum CoE implied by the 1-, 3-, and 6-month averaging windows as at that date.

Differentials between the inferred CoE and debt pricing for comparison with the PR24 FM (September and June 2023 cut-offs) are calculated as follows:

- The inferred CoE is converted into CPIH-real terms using CPI swaps. This is consistent with the regulatory approach that strips out both market-based inflation expectation and the inflation risk premium from the estimation of CoE (by using index-linked gilts as a benchmark).
- iBoxx yields are converted to CPIH-real values using long-term inflation of 2% consistent with the approach used in the PR24 FM.
- The real iBoxx yields are deducted from the real inferred CoE for each averaging window at each cut-off date.



# 7 Inference analysis results and implications for CAPM-implied returns at PR24

This section sets out the results of the inference analysis and comments on its implications for the allowed CoE at PR24.

## The role of the inference analysis cross-check in the estimation of the PR24 CoE

A cross-check based on Merton's (1974) framework and its practical applications aligns with the principles described in section 3.1.

- Unlike traditional asset pricing models, Merton's framework is not dependent on a specific model for asset valuation, meaning that the resulting cross-check would be derived from outside the CAPM framework, in line with Ofwat's preferred specification of cross-checks at PR24.
- Merton's framework acknowledges the impact of a firm's risk exposure on both debt and equity returns, whilst recognising that equity inherently carries higher risk than debt. Consequently, it can be utilised to derive a cross-check for the CoE, incorporating the risk differentials between equity and debt capital. The framework further allows for the fact that the differential between debt and equity will depend on various factors, such as leverage, which may vary over time.
- This cross-check would also reflect the prevailing market conditions and the risk environment, both in terms of the level of return and the interrelationship between the equity and debt.

This is in line with Damodaran who considers that “*there should be a relationship across the risk premiums in these asset classes [corporate bonds, stocks, and real estate] that reflect their fundamental risk differences... there is enough of a relationship here that we would suggest using this approach as a secondary one to test to see whether the equity risk premiums that we are using in practice make sense, given how risky assets are being priced in other markets*”<sup>68</sup>.

As a result, this section explores a cross-check based on Merton's framework to sense-check CAPM-derived CoE for water companies based on current debt pricing.

In this context, it is important to note that the Report does not propose that an approach based on Merton's framework and its practical applications can yield a precise estimate of the required CoE. As recognised by Damodaran, there may be some noise in the estimation of equity risk premia from debt risk premia, driven by the different nature and risk exposures of each type of capital.

Estimation of CoE is inherently a complex task, necessitating the consideration of multiple available estimation techniques, data sources, and additional factors such as policy objectives. This is particularly the case where there has been a step change in macroeconomic conditions and firms need to attract equity capital to support unprecedented levels of investment in AMP8 and beyond.

In this context, this Report considers that the Merton framework and its practical applications can provide valuable insights into the relationship between required returns on equity and debt for the same firm. The remainder of this section comments on the results and implications of the inference analysis for PR24 CoE.

## Expected elasticity estimates for listed water companies

The starting point for the derivation of inferred CoE is the estimation of expected elasticity based on regression analysis described in section 6.1.

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<sup>68</sup> Damodaran A., Edition Equity Risk Premiums (ERP): Determinants, Estimation, and Implications – The 2023 Edition

The firm fixed effect regression, excluding outliers<sup>69</sup>, results in the following coefficients for  $\alpha$  and  $\beta$ .

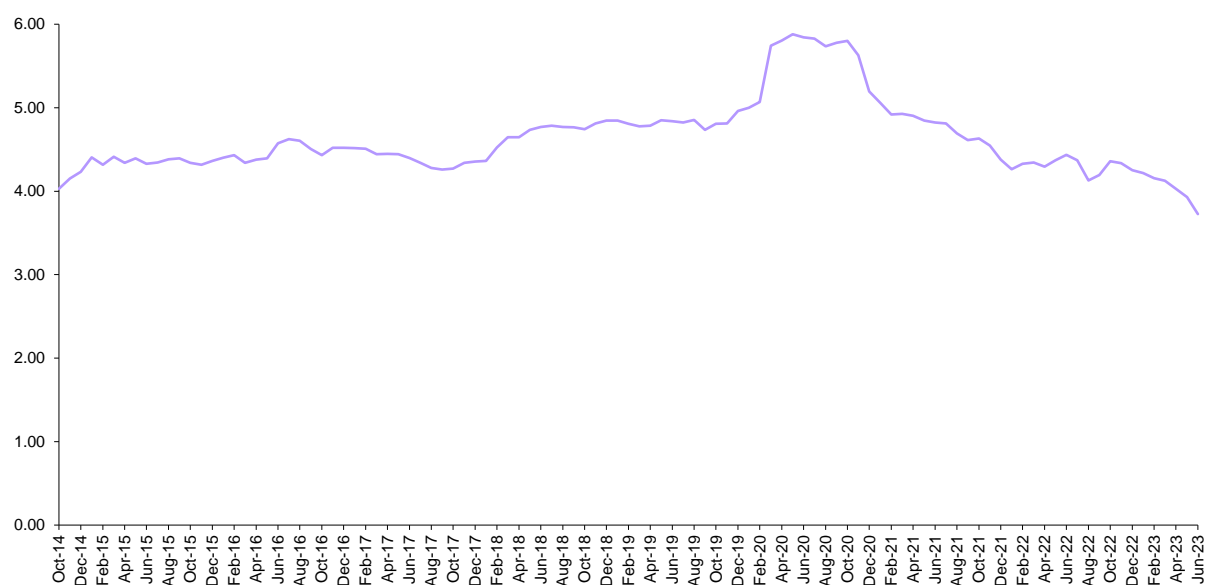
$$\frac{\partial E/E}{\partial D/D_{it}} = \alpha_i + 0.096 \text{ Leverage}_{it} + 91.391 \text{ Volatility}_{it} - 0.299 r_{f_t} + \varepsilon_{it}$$

$\alpha_i$  is equal to 4.25 and 3.45 for SVT and UUW, respectively.

Market leverage and stock volatility are positively correlated with elasticity, while the risk-free rate is negatively correlated. All three independent variables are jointly statistically significant at a 1% significance level, which suggests that they jointly explain the outturn elasticity. Additionally, stock volatility is statistically significant at a 10% level.

As illustrated in Figure 13, apart from a temporary spike during the height of the Covid19 pandemic in 2020, elasticity remained broadly stable until 2022 where it experienced a modest decrease. All else equal, the level and trend of expected elasticity suggest that there should continue to be a significant differential between debt and equity pricing at PR24, albeit with a modest reduction relative to observed differentials implied by regulatory determinations and debt pricing at PR19.

**Figure 13 Expected elasticity for SVT/UUW (average)**



Source: KPMG analysis

### A comparative analysis of inferred and CAPM-derived CoE estimates

To assess the impact and implications of the inference analysis for the allowed CoE at PR24, the Report undertakes two comparisons, which consider (1) how the CAPM-derived CoE estimates compare to inferred CoE estimates and (2) how the differentials between CoE and current debt pricing implied by the CAPM-derived CoE compare to those implied by the inferred CoE. In each of the charts below, the diamond represents either the CAPM-derived CoE or the CAPM-implied differential and the floating bar represents the range implied by the inference analysis. The data labels

<sup>69</sup> This is done by winsorisation, a data cleaning technique commonly adopted in statistics to mitigate the impact of extreme values (outliers) on the coefficient estimates of the regression, which reduces estimation bias and provides more accurate regression outputs. In this Report outliers are 'capped' meaning that they are replaced with the nearest non-outlying values within a specified range. A 5% winsorisation is applied to elasticity ( $\frac{\partial E/E}{\partial D/D_{it}}$ ), which means that all observations greater than the 97.5th percentile are set to be equal to the 97.5th percentile, and all observations lower than 2.5th percentile are set to be equal to 2.5th percentile.

represent the difference between the CAPM-derived values and the lower bound of the range from inference analysis<sup>70</sup>.

As set out in Figure 14, the CAPM-derived CoE based on the methodology from the PR24 FM is c.120 – 140bps below the lower bound of the inferred CoE range, using September 2022 and June 2023 cut-offs, respectively. In contrast, the CMA's PR19 allowed CoE was within the range implied by inference analysis (albeit the inferred CoE for PR19 is likely to be overstated as market leverage exceeded current notional gearing assumptions in AMP6). All else equal, this suggests that the CAPM-derived CoE based on the PR24 FM is not consistent with current market pricing of debt and the relationship between debt and equity pricing expected based on corporate finance theory and implied by the CMA's PR19 re-determination.

**Figure 14 Comparison between inferred and CAPM-derived CoE**

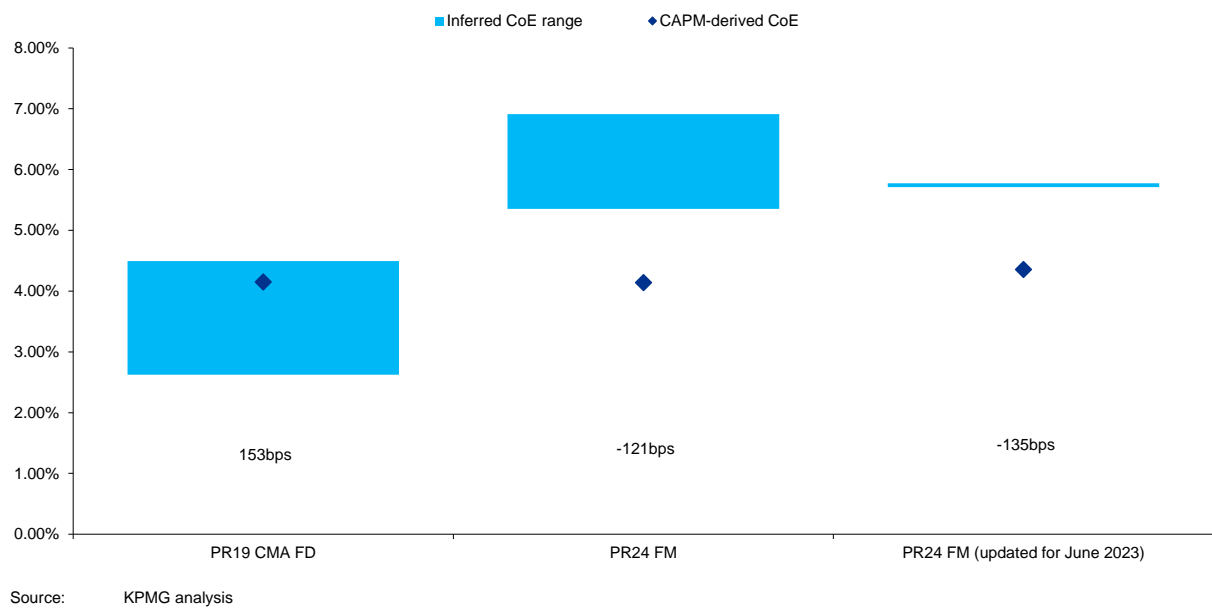
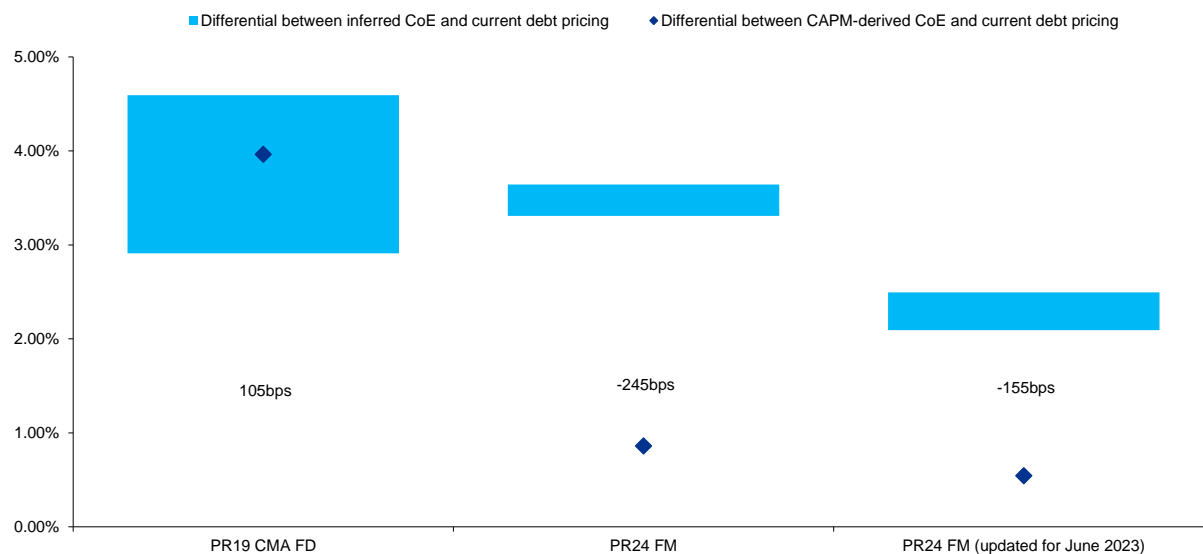


Figure 15 below further illustrates that the differential between CoE and current debt pricing implied by the CAPM-derived CoE is significantly below that implied by the inferred CoE. The differential for PR24 is also substantively below the differential implied by past regulatory precedent (section 3).

<sup>70</sup> The ranges for inferred CoE and inferred differentials between inferred CoE and current pricing of debt for each cut-off date are formed based on the (1) minimum and maximum CoE and (2) minimum maximum differentials implied by the 1-, 3-, and 6-month averaging windows as at that date. Note that the height of range will not be the same for inferred CoE and differentials. The range for the CoE depends only how different 1-, 3- and 6-month averages of CoE are from each other. The range for the differentials is affected by both CoE and debt pricing. This means that for the two ranges to be consistent, the debt pricing being deducted to calculate differentials would need to be the same based on 1-, 3-, and 6-month averaging windows. This is not the case as debt pricing varies depending on the averaging window.

**Figure 15 Comparison of differentials between CoE and current debt pricing implied by inferred versus CAPM-derived CoE**



Source: KPMG analysis

Notably, the gaps illustrated in Figure 14 and Figure 15 are conservative estimates given that the inferred CoE for PR24 is derived based on market leverage that is below notional gearing<sup>7172</sup>.

**Table 6 Comparison of CoE and differentials between CoE and current debt pricing for inferred versus CAPM-derived CoE<sup>73</sup>**

CPIH-real	Cut-off date	Inferred CoE	CAPM-derived CoE	Differential between inferred CoE and current debt pricing	Differential between CAPM-derived CoE and current debt pricing
PR19 CMA FD	31/12/2020	2.62 – 4.50%	4.15%	2.91 – 4.59%	3.96%
PR24 FM	30/09/2022	5.35 – 6.91%	4.14%	3.31 – 3.64%	0.86%
PR24 FM (updated for June 2023)	30/06/2023	5.71 – 5.78%	4.36%	2.09 – 2.49%	0.54%

Source: KPMG analysis

Note: CAPM-derived CoE is always on a 55% notional gearing basis.

<sup>71</sup> It is difficult to translate elasticity from market to notional leverage. The Report explores one approach for deriving a notional inferred CoE. Equation (2) calculates the elasticity of debt to equity as  $\frac{\partial D/D}{\partial E/E} = (\frac{1}{\Delta} - 1)(\frac{1}{L} - 1)$  and implies that the elasticity of equity to debt is the inverse,  $\frac{\partial E/E}{\partial D/D} = \frac{1}{(\frac{1}{\Delta} - 1)(\frac{1}{L} - 1)}$ . This gives  $\frac{\partial E/E}{\partial D/D_{market}} = \frac{1}{(\frac{1}{\Delta} - 1)(\frac{1}{L_{market}} - 1)}$  and  $\frac{\partial E/E}{\partial D/D_{notional}} = \frac{1}{(\frac{1}{\Delta} - 1)(\frac{1}{L_{notional}} - 1)}$ .

Therefore, assuming  $\Delta$  is the same across market leverage and notional gearing, the elasticity based on notional gearing is derived as follows:  $\frac{\partial E/E}{\partial D/D_{notional}} = \frac{\partial E/E}{\partial D/D_{market}} \times \frac{(\frac{1}{L_{market}} - 1)}{(\frac{1}{L_{notional}} - 1)}$ . Notably, this is a simplified approach which assumes that  $\Delta$  is the same for notional gearing and market leverage.

This translation changes the inferred CoE as at June 2023 from 5.71-5.78% to 6.67-6.97% and the differential from 2.09-2.49% to 3.01-3.75%. All else equal, this corroborates that inference of CoE for PR24 based on notional gearing at 55% would be higher than inferred CoE based on market leverage

<sup>72</sup> The Report has examined the impact of sensitising the timeframe used in the regression analysis on the magnitude of the gap between CAPM-derived and inferred CoE estimates. Extending the window to cover the period from January 2010 to June 2023 significantly increases the gap relative to the values in Table 6. Overall, the results derived from the timeframe spanning October 2014 to June 2023 presented in this Report are conservative relative to those based on longer timeframes.

<sup>73</sup> A more detailed version of this table is included in Appendix 2 which shows how inferred CoE and differentials vary based on averaging windows.

## Implications for the estimation of PR24 allowed CoE

Water companies are expected to face heightened risks in AMP8 and beyond, driven by the significant expansion and greater complexity of capital programmes, and corresponding increases in delivery risk, as well as a more stretching incentives regime. Exposure to regulatory and performance risk in relation to Totex and ODIs affects returns to equity but not to debt. As a result, exposure to equity is expected to increase as more value is put at risk through Totex and ODI regulatory incentives, with limited corresponding impact on debt. Consequently, all else equal the differential between observed debt and equity pricing based on regulatory CAPM would be expected to *increase* at PR24. This expected dynamic is not reflected in the evolution of debt and allowed equity pricing since PR19.

The scale of the disconnect between equity and debt pricing implied by the CAPM-derived CoE based on the PR24 FM may be indicative of a material miscalibration of the allowed CoE. This, in turn, could mean that the cost of capital materially exceeds allowed returns for AMP8, making investment in PR24 less attractive compared to other opportunities with better risk-reward profiles. Investors are likely to be disincentivised to invest in water sector equity where CAPM-derived equity risk premia, which underpin allowed returns, do not align practically with and reflect appropriate differentials to lower-risk debt pricing.

The potential customer detriment arising from the under-estimation of CoE is particularly acute for PR24 given that it will be necessary for the notional firm to attract significant new equity capital to fund the substantial new investment required for AMP8 and beyond, which will in turn be contingent on allowed returns that adequately compensate for forward-looking risk exposure and the opportunity cost of capital in current market conditions.

A scenario where the notional firm is unable to raise required equity capital could result in an increase in gearing due to the use of debt to address the shortfall in capital. An increase in gearing as a result of the notional firm not being able to attract and retain equity capital is not consistent with recent regulatory focus on financial resilience in the sector.

The Report also considers whether the PR24 CoE range estimated by KPMG<sup>74</sup> (at 55%<sup>75</sup> notional gearing level for comparability) implies consistency with current debt pricing and corporate finance theory.

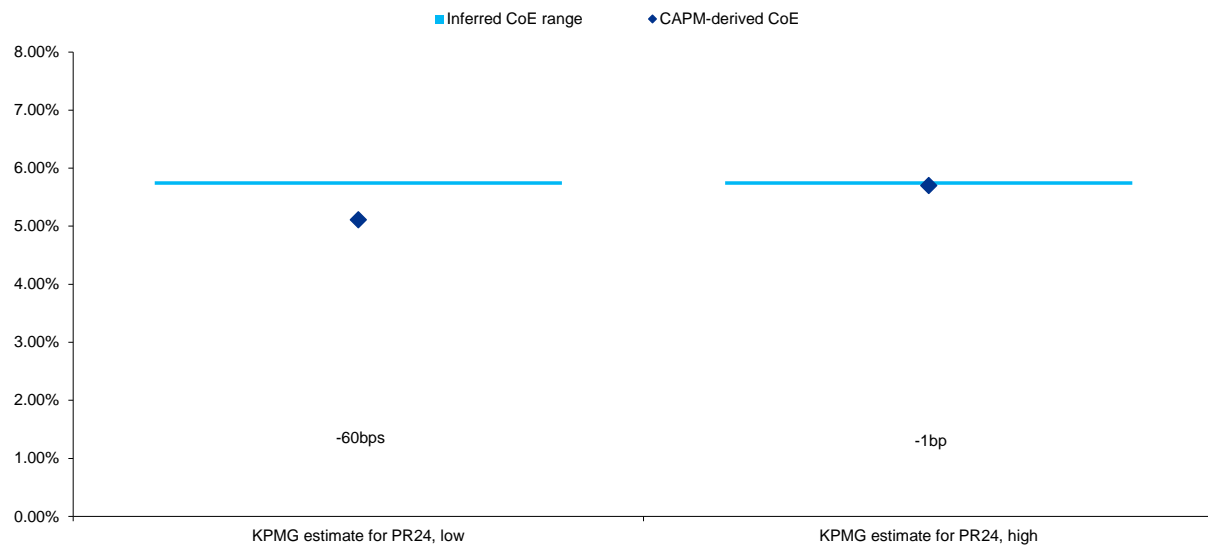
As illustrated in the figures below, the KPMG range implies materially greater consistency with current debt pricing and could better facilitate the achievement of policy objectives for the sector. The comparison suggests that a CAPM-derived CoE estimate from the upper end of the KPMG range may be justified. This is particularly the case given that inferred CoE in this Report is based on market (rather than notional) leverage and hence under-estimates required returns inferred from debt pricing.

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<sup>74</sup> KPMG (2023), Estimating the Cost of Equity for PR24

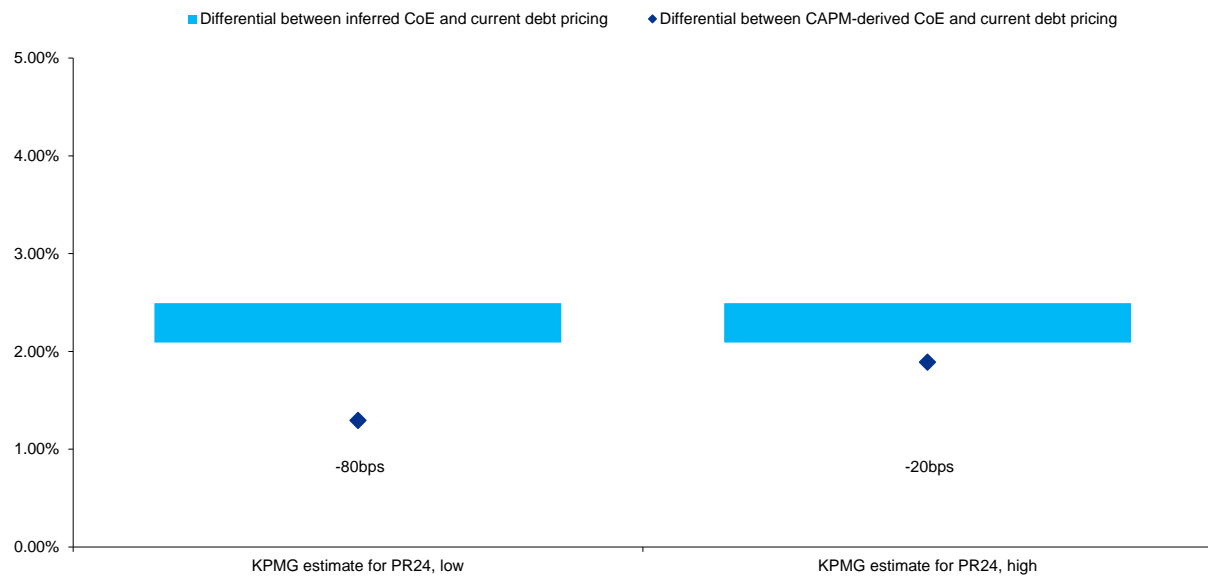
<sup>75</sup> The CoE range estimated by KPMG is based on a 60% notional gearing assumption in practice.

**Figure 16 Comparison between inferred and CAPM-derived KPMG CoE estimate**



Source: KPMG analysis

**Figure 17 Comparison of differentials between CoE and current debt pricing implied by inferred versus CAPM-derived KPMG CoE estimate**



Source: KPMG analysis

Overall, the magnitude of the differential between the inferred CoE and CAPM-implied CoE based on the PR24 FM implies a substantial reduction in the equity risk premium. This effect is likely driven by the under-estimation of CAPM parameters based on methodologies specified in the PR24 FM and the



assumption that the Total Market Return is fixed within the regulatory CAPM<sup>76</sup>, which limits the responsiveness of the regulatory CoE to the significant recent uptick in risk-free rate.

There is no theoretical rationale for investors to willingly accept a lower risk premium compared to other risky assets in the face of a significant increase in interest rates. Accepting a lower risk premium would not align with how investors typically make capital allocation decisions, which depend on all available options. When risk-free rate increases, gilts become relatively more attractive than equities for their level of risk. Since the yields on corporate debt are based on gilts, they also rise and become relatively more attractive than equities for their level of risk, unless the expected return on equities also rises.

An alternative approach could involve assuming a fixed equity risk premium, such that when risk-free rate increases, the CoE increases in lock step; or estimating CoE by attaching weight to both fixed TMR and fixed equity risk premium approaches.

The inference analysis in this Report implies that a careful re-examination of the methodology for CAPM-implied CoE will be required at PR24 to ensure that allowed returns and equity risk premia are sufficient to attract equity capital in current macroeconomic conditions and relative to current levels of observed debt pricing.

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<sup>76</sup> Regulators estimate the equity risk premium within the CAPM as the difference between total market return and the risk-free rate, instead of estimating the risk premium directly. Where TMR is assumed to be stable over time in the context of increasing interest rates the equity risk premium will reduce and constrain the degree to which increased rates translate into the CoE estimate.

# 8 Appendix 1: Decomposing elasticity into underlying drivers

Academic literature suggests two ways of decomposing elasticity into key drivers.

## Approach 1: Decomposing elasticity into delta ( $\Delta$ ) and market leverage ( $L$ )

This approach is based on Schaefer and Strebulaev (2008)<sup>77</sup> and the Black-Scholes-Merton option pricing model<sup>78</sup>.

Schaefer and Strebulaev (2008)<sup>79</sup> derive the elasticity of debt to equity – which is the inverse of elasticity of equity to debt shown in Equation (1) – as follows:

$$\text{Equation (4)} \quad \frac{\partial D/D}{\partial E/E} = \left(\frac{\partial E/E}{\partial D/D}\right)^{-1} = \left(\frac{1}{\Delta} - 1\right)\left(\frac{1}{L} - 1\right)$$

Where:

- $\Delta$  is the change in the equity value with respect to the change in the value of the asset<sup>80</sup>.
- $L$  is the market leverage, calculated as the ratio of market value of debt to the market value of firm.

Further, the Black-Scholes-Merton model implies that the call option delta ( $\Delta$ ) is equal to:

$$\text{Equation (5)} \quad \Delta = N(d_1), \text{ where } d_1 = \frac{\ln(A/D) + (r + \sigma_A^2/2)T}{\sigma_A \sqrt{T}}$$

Where:

- $r$  is the risk-free rate,
- $A$  is the value of the firm's asset,
- $D$  is the value of the firm's debt,
- $T$  is the time to maturity of firms' debt, and
- $\sigma_A$  is the volatility of the return on firm's assets.

As a result, Equation (4) and (5) imply that the underlying drivers of elasticity include the market leverage ( $L$ ), risk-free rate ( $r$ ), asset volatility ( $\sigma_A$ ) and time to maturity of the firm's debt ( $T$ ).

## Approach 2: Decomposing elasticity into the volatility of equity ( $\sigma_E$ ) and debt ( $\sigma_D$ )

Friewald, Wagner and Zechner (2013)<sup>81</sup> derive the following equation, where elasticity is equal to the ratio of the volatility of equity to the volatility of debt.

$$\text{Equation (6)} \quad \frac{\partial E/E}{\partial D/D} = \frac{\sigma_E}{\sigma_D}$$

Therefore, Equation (6) implies that the underlying drivers of elasticity include asset and equity volatility.

<sup>77</sup> Schaefer, S. M., & Strebulaev, I. A. (2008). Structural models of credit risk are useful: Evidence from hedge ratios on corporate bonds. *Journal of Financial Economics*, 90(1), 1-19.

<sup>78</sup> Black-Scholes-Merton model is an option pricing model that determine the fair value of a stock option based on the price of the underlying asset, the strike price of the option, risk-free rate, time to maturity of an option, and the volatility of an asset.

<sup>79</sup> Schaefer, S. M., & Strebulaev, I. A. (2008). Structural models of credit risk are useful: Evidence from hedge ratios on corporate bonds. *Journal of Financial Economics*, 90(1), 1-19.

<sup>80</sup>  $\Delta$  is the delta of the European call option on the firm's asset and given Merton's (1974) framework views equity as a European call option,  $\Delta$  is the change in the equity value in response to the change in the asset value.

<sup>81</sup> Friewald, N., Wagner, C., & Zechner, J. (2014). The cross-section of credit risk premia and equity returns. *The Journal of Finance*, 69(6), 2419-2469.

# 9 Appendix 2: Estimates of inferred CoE and differentials across averaging windows

The table below sets out a comparison of CoE and differentials between CoE and current debt pricing for inferred versus CAPM-derived CoE implied by recent regulatory precedent for each averaging window and at each cut-off date.

**Table 7 Comparison of CoE and differentials between CoE and current debt pricing for inferred versus CAPM-derived CoE implied by recent regulatory precedent**

CPIH-real	Cut-off date	Averaging window	Inferred CoE	CAPM-derived CoE	Differential between inferred CoE and current debt pricing	Differential between CAPM-derived CoE and current debt pricing
PR19 CMA FD	31/12/2020	1-month	2.62%	4.15%	2.91%	3.96%
		3-month	3.80%	4.15%	3.94%	3.96%
		6-month	4.50%	4.15%	4.59%	3.96%
PR24 FM	30/09/2022	1-month	6.91%	4.14%	3.64%	0.86%
		3-month	6.00%	4.14%	3.54%	0.86%
		6-month	5.35%	4.14%	3.31%	0.86%
PR24 FM (updated for June 2023)	30/06/2023	1-month	5.76%	4.36%	2.09%	0.54%
		3-month	5.78%	4.36%	2.36%	0.54%
		6-month	5.71%	4.36%	2.49%	0.54%

Source: KPMG analysis  
 Note: CAPM-derived CoE is always on a 55% notional gearing basis.

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