KPMG

Estimating the Cost of Capital for PR24

March 2025

Contents

Important notice

This Report has been prepared by KPMG LLP ('KPMG', 'we' or 'our') for South East Water Limited, Thames Water Utilities Limited, Anglian Water Services Limited and Southern Water Services Limited, ('group of companies') on the basis of an engagement contract dated 28 February 2025 between the group of companies and KPMG (the "Engagement Contract"). As stated in our Engagement Contract, the group of companies have agreed that this final written report supersedes all previous oral, draft or interim advice, reports and presentations, and that no reliance will be placed by the group of companies on any such oral, draft or interim advice, reports or presentations other than at their own risk.

The group of companies commissioned this work to assist in their considerations regarding the Water Services Regulation Authority (Ofwat)'s PR24 Final Determination (FD) on the cost of capital. Ofwat published the FD on 19th December 2024.

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 psroceed with any particular course of action.

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Information in this Report is based on financial information platforms, datasets, and publicly available sources. Our analysis is based on data available up to January 2025, with additional market research, including equity analyst reports and credit rating agency publications, considered through February 2025. The analysis in the Report reflects prevailing conditions as of these periods, all of which are accordingly subject to change. We have not undertaken to update the Report for events or circumstances arising after these periods. 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 these sources. KPMG does not accept any responsibility for the underlying data used in this Report.

Where our Report makes reference to ‘KPMG analysis’ this indicates only that we have (where specified) undertaken certain analytical activities on the underlying data to arrive at the information presented. We do not accept responsibility for the underlying data.

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

1. Key messages

1.0.1. The CMA will need to address two critical questions in estimating the cost of capital (WACC) for water companies: (1) how to objectively estimate WACC through analysis of each Capital Asset Pricing Model (CAPM) parameter, and (2) how to integrate evidence from alternative models, benchmarks, and cross-checks which can inform whether the sector is likely to be able to attract and retain investor capital.

1.0.2. The overall risk in the water sector has increased significantly, with downgrades of the regulatory regime by all three rating agencies due to increases in operational, business and regulatory risk at PR24. The reliance on historical data to estimate CAPM-beta does not fully capture these evolving future risks for the sector, presenting a challenge in deriving an estimate that accurately reflects the sector's increasing risk profile.

1.0.3. Estimating the cost of equity (CoE) is inherently complex and uncertain, as the CoE itself is not directly observable, and its parameters are subject to both theoretical debate and statistical uncertainty.

1.0.4. Ofwat's CAPM-based approach to estimating the CoE relies on a single risk factor (the market risk factor), derived from a sample of only two companies within the sector. This limited sample size is likely to introduce material bias and a lack of precision in CoE estimates.

1.0.5. Multi-factor models (MFMs) have been demonstrated to be more robust and accurate than CAPM in estimating the CoE. While CAPM remains the primary model for estimation of returns, MFMs should be incorporated into the estimation process as a cross-check, providing a diversified approach to asset pricing models.

1.0.6. The additional risk premium in CoE over the cost of debt has reduced materially relative to previous price controls. This suggests either that equity in the sector has become less risky compared to debt, or that the allowed CoE is significantly underestimated. Evidence of low realised returns over recent years strongly points to the latter.

1.0.7. The sector needs to attract significant new equity capital across the next five years. Ofwat estimates that £12.7bn of new equity capital needs to be raised. New capital can only be attracted based on objective, positive forward-looking investment appraisal for the investors who are critical to providing this additional capital to the sector. If the allowed rate of return is set too low relative, companies may struggle to deliver on ambitious investment programmes and meet statutory requirements. Conversely, if the rate is set too high, customers will bear additional costs.

1.0.8. This Report estimates the CoE based on the CAPM:

1) Beta is estimated using data from the three listed water companies (Severn Trent, United Utilities and Pennon). The significant step change in forward-looking risk for the sector indicates that betas should be higher than at PR19.

2) The risk-free rate (RFR) is likely to lie above the ILG yield because (1) investors cannot borrow at the ILG yield, and (2) ILGs benefit from the convenience yield. This Report estimates RfR to lie between the risk-free borrowing rate (AAA bonds) and the risk-free saving rate (ILGs adjusted for convenience yield).

3) TMR is estimated based on a historical ex post method, which is widely considered the most reliable, objective, and straightforward approach.

1.0.9. The Report considers a broad range of cross-check evidence to select a point estimate and assess whether the CoE based on the CAPM is likely to attract and retain equity capital:

1) Analysis of debt financeability indicates that the notional company would not be able to achieve the target rating (Baa1/BBB+) at the midpoint of the CAPM range.

2) MFMs with stronger explanatory power than the CAPM, such as the q-factor model, indicate that the CAPM is underestimating water company risk.

3) Cross-checks that infer the CoE from the current pricing of water company debt indicate that the CAPM-derived CoE is materially understated.

1.0.10. A point estimate is selected above the midpoint of the CAPM range to reflect cross-check evidence and to ensure that the CoE is competitive and able to attract and retain the equity capital required to deliver investment across AMP8.

1.0.11. The Cost of Debt (CoD) is estimated to reflect the all-in costs expected to be incurred by the sector on average, current market evidence and financing requirements implied by the FD.

2. Executive summary

2.0.1. Ofwat issued its Final Determination (FD or PR24 FD) for the next price control ('PR24') on 19 December 2024. The FD includes an estimate of the allowed cost of capital (WACC) for the five-year period to 2030. KPMG has been engaged by a group of water companies to estimate the WACC for PR24.

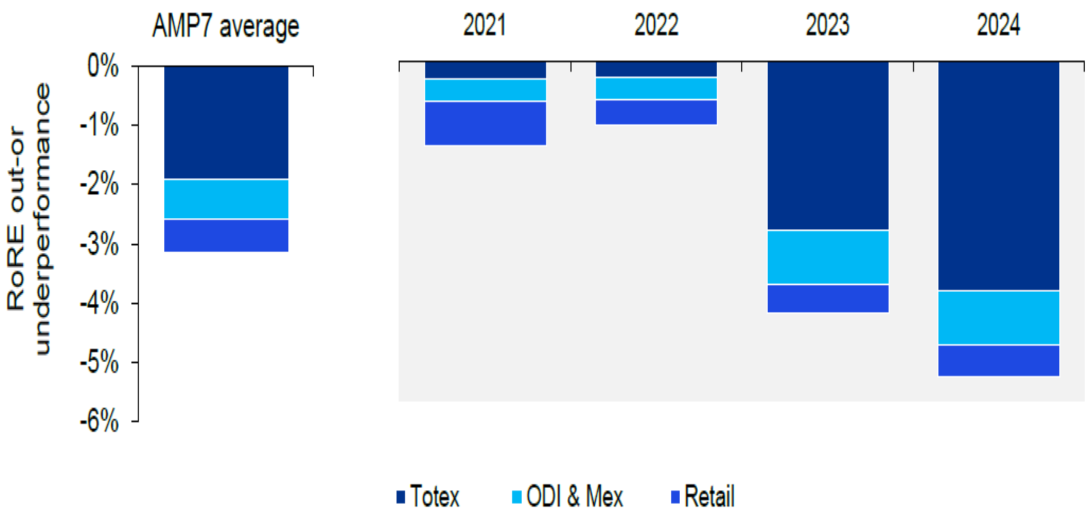
2.0.2. The Report starts by considering the broader context at PR24, focusing on whether there have been changes in (1) risk facing the sector (2) investor perceptions of risk facing the sector (3) factors which could affect availability of equity capital (4) macroeconomic conditions.

2.1. There have been fundamental shifts in the risk landscape for water companies

2.1.1. AMP8 marks a significant shift in the operating, investment, and risk environment for water companies, with capital programmes set to double in scale compared to the last three price controls. As a result, companies face much higher delivery risk.

2.1.2. This increase in capital intensity coincides with substantial spending above allowances and large operational penalties in AMP7, amounting to under-performance equivalent to 3% Return on Regulated Equity (RoRE) across the first four years.

Figure 1: Decomposition of AMP7 sector average operational performance



Source: KPMG analysis

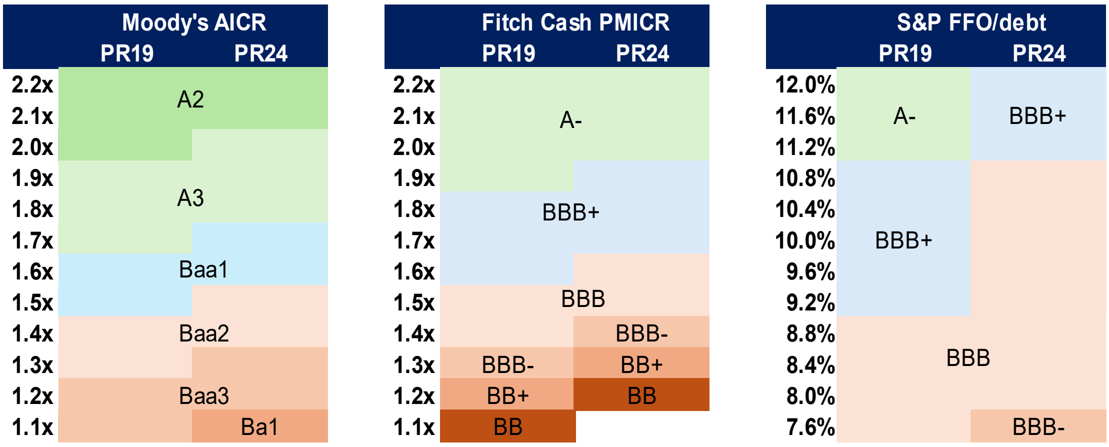
2.1.3. Investor perception of risk has also increased significantly, with downgrades of the regulatory regime and companies by all three rating agencies based on increases in operational, business and regulatory risk.

1) In November 2024, Moody's downgraded its assessment of regulatory stability and predictability from Aa to A. This "A" score places Ofwat two notches below Ofgem and other leading European regulators, aligning it with less-established regimes in Estonia and Portugal.

2) On 18 February, S&P downgraded Ofwat's "regulatory advantage" from strong to strong/adequate, now positioning it alongside regulators in Spain, Slovakia, Hungary, and the Baltic states, whereas it was previously on par with those in France, Italy, Sweden, and the Czech Republic.

2.1.4. Reflecting increased risks, all three agencies have tightened their rating thresholds – by a half notch at Moody's, between a half and full notch at Fitch, and a full notch at S&P. In combination with weaker forecast cash flow and greater downside risk, this has triggered a wave of downgrades across the sector.

Figure 2: Changes to rating thresholds for UK water companies since PR19



Source: KPMG analysis

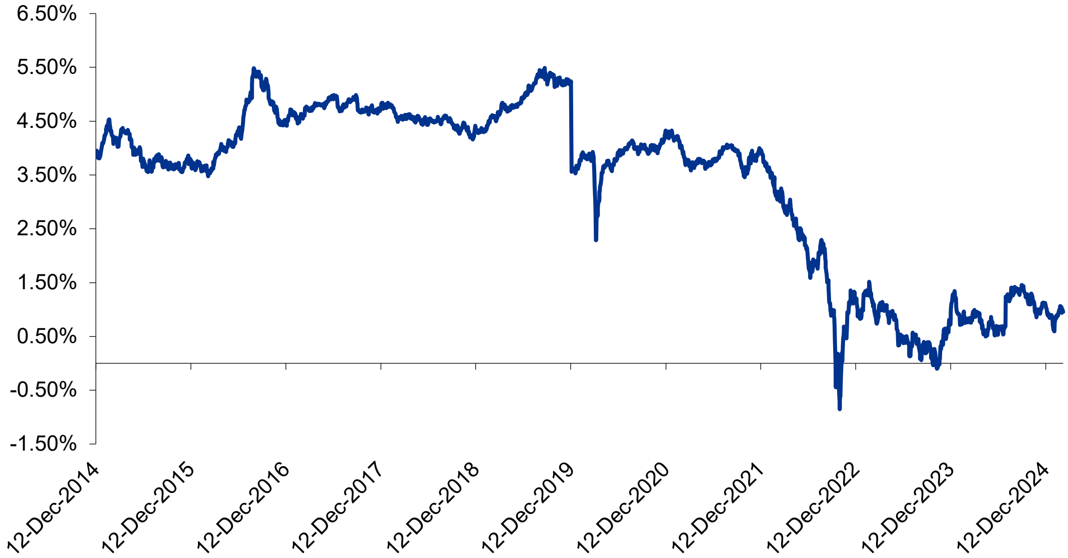
2.2. Unprecedented levels of new equity capital are required to deliver capital programmes in AMP8 and beyond

2.2.1. Ofwat estimates that £12.7bn of new equity capital will need to be raised across AMP8. This is unprecedented, and with high investment expected over the next 25 years, new equity will be needed on an ongoing basis. The scale of the requirement for new equity capital represents a step change, as companies have historically relied on free cash flow to fund most investments.

2.2.2. At the same time, interest rates have increased by 400-500bps since PR19, and direct evidence from the debt markets indicates that the allowed CoE no longer includes the same risk premium over debt as it did previously. The figure below shows the evolution of the differential between the allowed CoE and borrowing costs for water companies[1].

1 Proxied by yields on iBoxx A/BBB 10+ index which have been adjusted to reflect applicable benchmark adjustments applied for each price control period.

Figure 3: Comparison of allowed CoE and CoD across recent price controls



Source: KPMG analysis of LSEG Workspace data and past regulatory determinations.

2.2.3. Given the riskier nature of equity, the expected return on equity needs to be substantively above the expected return on debt for water companies, as otherwise investors are unlikely to be incentivised to commit equity capital to the sector.

2.2.4. In this context, the Report uses CAPM as the primary model for estimating CoE, but cross-checks CAPM-derived estimates against market evidence to ensure that the CoE can attract and retain the equity capital needed to investment across AMP8.

2.3. Risk-free rate (RFR)

2.3.1. In this Report, the risk-free rate for the CAPM is derived from a 1-month trailing average of 20Y RPI index-linked gilt (ILG) yields, with adjustments for two factors: (1) investors cannot borrow at the ILG yield, and (2) ILGs include a convenience yield (CY).

In relation to (1):

2.3.2. The standard CAPM assumes investors can borrow and save at the same risk-free rate, but in practice, the borrowing rate (r_B) exceeds the saving rate (r_S), positioning the risk-free rate for the CAPM between these two rates, as outlined by Brennan (1971).

2.3.3. The CMA viewed its PR19 FD as an application of Brennan (1971), applying the ILG yield for r_S and the AAA corporate bond yield for r_B.

In relation to (2):

2.3.4. ILGs like other government bonds provide additional benefits to investors (such as their superior collateral value) which push their yield below the risk-free rate. The difference is CY.

2.3.5. Under the assumption that investors can borrow and save at the same risk-free rate, CY on ILGs must be added to the ILG yield to determine the risk-free rate.

2.3.6. In the more realistic case where investors' r_B exceeds their r_S, CY(ILG) must be included in the calculation of both rates. r_S remains ILG yield plus CY(ILG) and r_B now becomes ILG yield plus CY(ILG) plus borrowing costs.

2.3.7. A range of 15.5-67bps and a point estimate of 41bps are adopted for the required adjustment to ILG yields. This range represents the minimum required to derive r_S and r_B.

2.3.8. Based on the 1-month trailing average of 20Y yields in January 2025 and an up-to-date RPI-CPIH wedge, the overall range for the risk-free rate is 2.33%-2.85%, with a point estimate of 2.59% in CPIH terms.

2.4. Total market return (TMR)

2.4.1. A TMR estimate of 6.93% is adopted in this Report based on the historical ex post method, using a one-year arithmetic average.

2.4.2. The one-year average is used due to the lack of statistically significant serial correlation and the need to estimate a neutral TMR that reflects both investor and capital budgeter perspectives.

2.4.3. The ex post method is preferred over ex ante estimates because it is reliable, objective, and straightforward. It avoids the volatility and sometimes challenging interpretations of dividend growth and yield, as well as the assumptions needed for decomposing returns into expected and unexpected elements. As a result, this Report adopts the ex post method as the TMR point estimate.

2.5. Beta

2.5.1. This Report estimates an unlevered beta range of 0.32 to 0.36, based on two principles: (1) beta should reflect long-term systematic risks expected by investors; and (2) historical betas may not fully capture forward-looking risk in a dynamic environment.

I. Selection of comparators

2.5.2. A key challenge in estimating beta is that historically there have only been two pure-play listed water companies – Severn Trent (SVT) and United Utilities (UUW) – characterised by strong operational and financing performance. Estimating beta based on only two companies with similar characteristics is likely to introduce material bias and a lack of precision.

2.5.3. Since 2020, Pennon (PNN) has also become a pure-play water company. Incorporating data from PNN is crucial for estimating beta for PR24, given the small sample size of water companies. As a smaller WaSC with operational performance more in line with the industry average than SVT and UUW, PNN improves the representativeness of the comparator set.

2.5.4. PNN's betas indicate that UUW and SVT's betas understate the systematic risk faced by the industry.

II. Treatment of distortive events

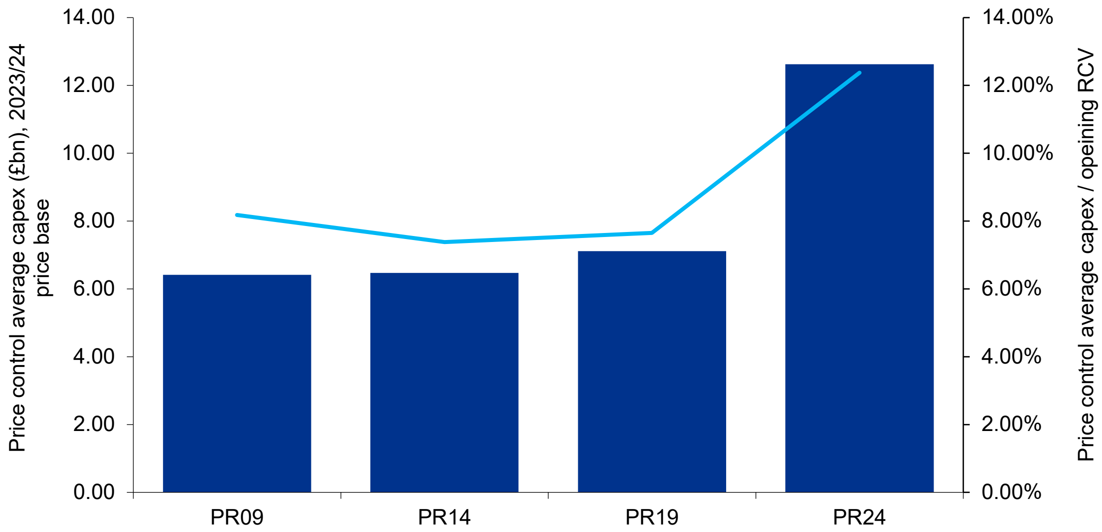
2.5.5. The response to the Covid-19 pandemic – which resulted in mandated shutdowns of large sections of the economy – significantly distorted water sector betas. Not adjusting for these assumes a recurrence of restrictions similar in scale to the Covid-19 pandemic response, which is highly unlikely given the profound economic and societal consequences of those restrictions.

2.5.6. Adjusting for these distortions yields a beta range of 0.29 to 0.36, before considering forward-looking risks.

III. Treatment of forward-looking risk

2.5.7. The upcoming price control marks a significant shift for water companies, with an unprecedented increase in the scale of capital programmes. This introduces higher delivery risks (supply chain, financing, execution) amid increased regulatory scrutiny.

Figure 4: Evolution of capital intensity



Source: KPMG analysis based on data from Ofwat's Capex Intensity Model[2]

2.5.8. Analysis of risk implied by the FD suggests that AMP8 is likely to increase risk further, with higher performance risk driven by more challenging targets and greater cost recovery risk.

2.5.9. This increase in risk is not yet reflected in beta estimates, which tend to lag in capturing the impact on share prices and total returns due to their reliance on historical data.

2.5.10. The projected increases in systematic risk, driven by the substantial step-up in capital intensity, imply that beta estimates based solely on historical data from the water sector may significantly understate future risk, especially if it is affected somewhat by distortions. As a result, this Report narrows the overall range to reflect only the upper half, adopting a beta range of 0.32 to 0.36.

2.5.11. The estimated beta range: (1) mitigates distortions due to the response to Covid, (2) incorporates PNN data, and (3) reflects the likely increase in forward-looking risk.

2.6. Retail margin adjustment (RMA)

2.6.1. Ofwat has applied the RMA 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).

2.6.2. Ofwat has carried out a Return On Capital Employed (ROCE) analysis to inform quantification of the RMA. As part of this calculation, Ofwat has assumed that retail working capital is financed based on the cost of retail-specific credit facilities.

2.6.3. However, the retail business is part of the integrated appointee, with financing managed at the appointee level. Any debt to finance working capital balances in retail would increase gearing above notional levels at the appointee level and introduce internal inconsistency. In consequence, the retail business would be primarily equity-financed and the cost of retail financing would either be the appointee CoE or at a minimum the appointee WACC.

2.6.4. Adjusting Ofwat's ROCE calculation to reflect the appointee WACC or CoE (rather than retail-specific financing costs) reduces the RMA to 1bp to -3bps. As a result, the Report does not apply an RMA.

2 From the response to query Ofwat-FD-ANH-12.

2.7. Cross-checks and selection of a point estimate

2.7.1. Estimating the cost of equity (CoE) is inherently complex and uncertain, as the CoE itself is not directly observable, and its parameters are subject to both theoretical debate and statistical uncertainty. Under-estimating returns can introduce more customer harm than overestimating them.

2.7.2. The Report considers a broad range of cross-check evidence to assess whether the CoE based on the CAPM is likely to attract and retain equity capital and inform selection of a point estimate.

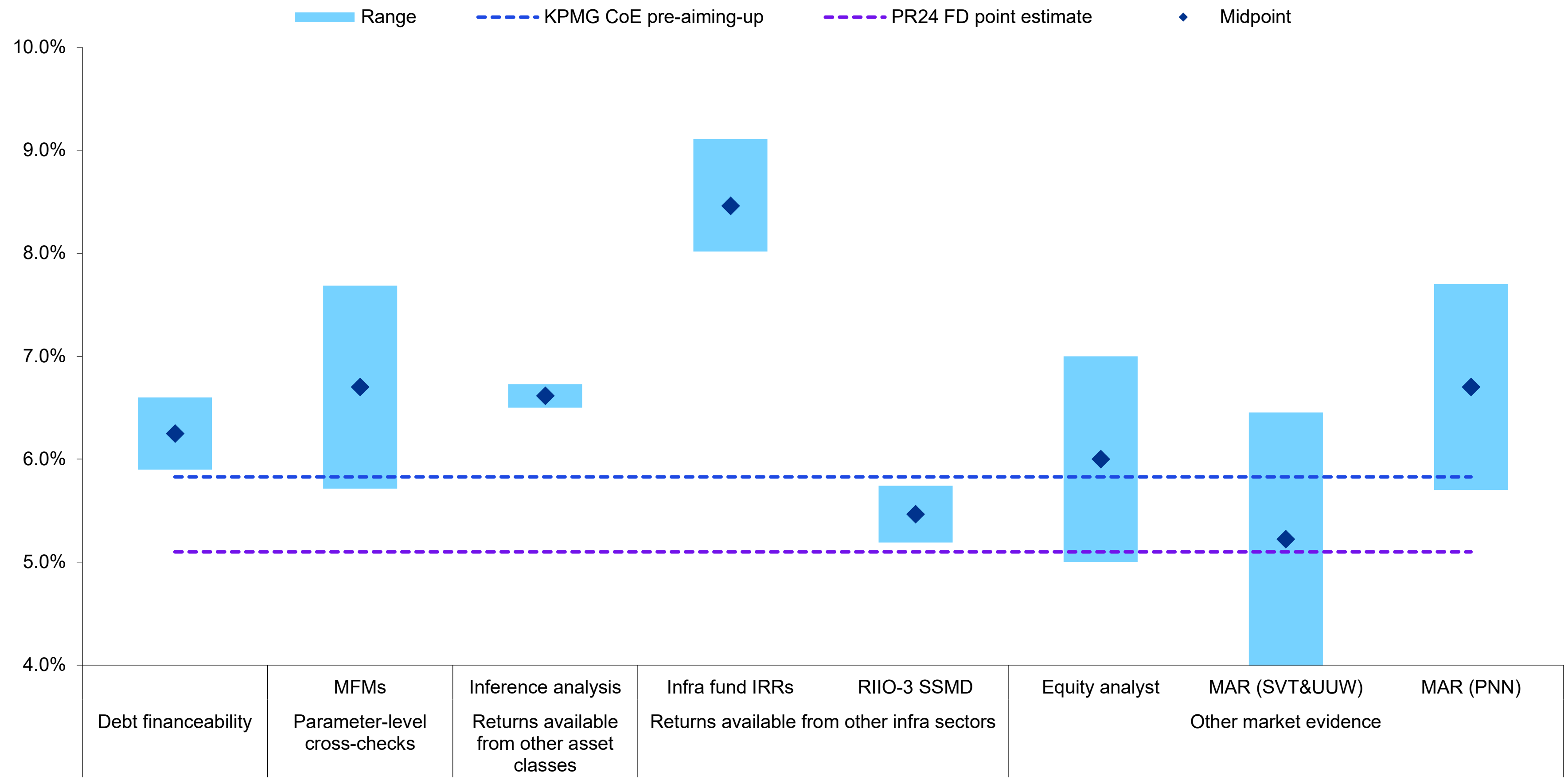
2.7.3. Cross-check evidence considered in this Report supports a CoE above 6.30% (CPIH, 55% gearing). The Report adopts an aiming up adjustment of 50bps primarily to reflect:

1) **Debt financeability:** Analysis of projected credit metrics, based on the latest thresholds from the three major rating agencies, shows that a CoE of at least 6.10% (27bps aiming up) is necessary to achieve the target rating and maintain financial resilience at 55% gearing. Ofwat's own financial modelling assumes that gearing would increase across the price control to 57.5%, which would require a CoE of 6.24% (41bps aiming up) to achieve the target rating across AMP8.

2) **Multi-factor models (MFMs):** The q-factor model, as a key cross-check to the CAPM, provides a more granular view of risk and has demonstrated superior empirical performance in the UK. It meets the high bar for statistical robustness applied in academic literature for asset pricing models. The q-factor model evidence suggests that the CAPM materially under-prices systematic risk for water companies by 43 to 181bps under the same beta scenarios. MFM evidence supports aiming up by at least 50bps.

3) **Inference analysis:** Equity investors assess multiple investment options with varying risk-return profiles. Due to the higher risk of equity, its expected return must be significantly above that of debt to incentivise investment. Inference analysis suggests that the CAPM-derived CoE in this Report (pre-aiming up) is at least 67bps lower than expected based on current debt market pricing and the debt-equity return relationship.

Figure 5: CoE implied by cross-check evidence (real, CPIH)



Source: KPMG analysis

2.7.4. An aiming up adjustment of 50bps is adopted in this Report, in line with the CMA's PR19 provisional determination. This adjustment the minimum required to meet financeability tests, ensure financial resilience, and attract equity capital, in particular given the fundamental shift in the risk landscape for water companies at PR24.

2.7.5. The 50bps aiming up adjustment results in a 6.33% point estimate at 55% gearing, placing it at the 66th percentile of the range when accounting for statistical uncertainty inherent in the CAPM. This estimate aligns with the CAPM evidence and the approach to point estimate selection in past regulatory decisions, such as the CMA's PR19 decision and the New Zealand Commerce Commission (NZCC)'s approach of using the 67th percentile for energy price controls.

Table 1: Comparison of CoE ranges with and without parameter uncertainty

Parameter (CPIH)	KPMG (Jan 2025) 55% gearing Lower bound	KPMG (Jan 2025) 55% gearing Upper bound
CAPM-CoE range i.e. excluding parameter uncertainty	5.60%	6.04%
CoE range including parameter uncertainty	4.94%	6.69%

2.7.6. On a 60% gearing basis, the wholesale CoE point estimate is 6.68% for January 2025 and 6.51% for September 2024.

2.7.7. This Report does not apply an adjustment for asymmetric risk exposure. The point estimate should be adjusted to reflect company-specific expected out- or under-performance and skewness.

2.8. CoE estimate for PR24

2.8.1. The table below sets out the estimated range for the required CoE at PR24. The CoE estimate is presented on a 55% notional gearing basis to enable like-for-like comparison with the FD estimate. This implies a CoE range of 5.60 – 6.04% pre aiming up and 6.10 – 6.54% post aiming up.

Table 2: PR24 CoE range based on parameter-level estimates, 55% gearing

Parameter (CPIH)	KPMG (Jan 2025) 55% gearing Lower bound	KPMG (Jan 2025) 55% gearing Upper bound
Notional gearing	55%	55%
TMR	6.93%	6.93%
RFR	2.33%	2.85%
Unlevered beta	0.32	0.36
Debt beta	0.10	0.10
Observed gearing	51.19%	50.18%
Asset beta	0.37	0.41
Notional equity beta	0.71	0.78
CoE before aiming up, appointee	5.60%	6.04%
Aiming up	0.50%	0.50%
CoE, appointee	6.10%	6.54%
RMA	-	-

Parameter (CPIH)	KPMG (Jan 2025) 55% gearing Lower bound	KPMG (Jan 2025) 55% gearing Upper bound
CoE, wholesale	6.10%	6.54%

Source: KPMG analysis

2.8.2. On a 55% gearing basis, the point estimate for the wholesale CoE is 6.33% (January 2025 cut-off) and 6.12% (September 2024 cut-off), compared to 4.97% in the FD (September 2024 cut-off).

Table 3: Comparison of CoE point estimates, 55% gearing

Parameter (CPIH)	Ofwat FD (Sept 2024) 55% gearing	KPMG (Sept 2024) 55% gearing	KPMG (Jan 2025) 55% gearing
Notional gearing	55%	55%	55%
TMR	6.83%	6.93%	6.93%
RFR	1.52%	1.98%	2.59%
Unlevered beta	0.28	0.34	0.34
Debt beta	0.10	0.10	0.10
Observed gearing	52.27%	49.64%	50.69%
Asset beta	0.34	0.39	0.39
Notional equity beta	0.62	0.73	0.75
CoE before aiming up, appointee	4.83%	5.62%	5.83%
Aiming up	0.27%	0.50%	0.50%
CoE, appointee	5.10%	6.12%	6.33%
RMA	-0.13%	-	-
CoE, wholesale	4.97%	6.12%	6.33%

Source: KPMG analysis

2.9. Cost of debt

2.9.1. The cost of debt (CoD) component of the WACC estimate reflects the return required to compensate debt investors for lending to a notional company.

I. Cost of embedded debt

2.9.2. The FD estimated the cost of embedded debt (CoD_E) at 4.82% in nominal terms, based on projected debt costs for WaSCs and large WoCs over AMP8.

2.9.3. This Report adjusts the FD estimate to 5.00% by:

1) Updating with the latest market data (+1bps);

2) Excluding weight on the actual-notional approach (+6bps);

3) Including swaps (+11bps).

Treatment of 'actual-notional' approach

2.9.4. No weight is attached to the 'actual-notional' approach in this Report:

1) The 'actual-notional' cost adjusts not only for debt mix but also issuance timing, which does not meet its intended purpose.

2) Based on the FD models, the 'all-in' cost and 'actual-notional' cost vary materially for individual companies as well as the sector.

3) The inclusion of the 'actual-notional' approach results in the average company being underfunded for its actual cost.

Treatment of swap costs

2.9.5. This Report sets a high hurdle rate for excluding instruments to avoid variance between allowance and actual costs. Swaps are included in projected costs because:

1) The sector routinely uses swaps as part of an efficient strategy.

2) If Ofwat excludes swaps, it should provide a plausible counterfactual that achieves similar risk management objectives, such as replacing a synthetic index-linked bond with a direct index-linked bond.

II. Cost of new debt

2.9.6. This Report estimates CoD_N in the range of 4.27% – 4.47% (CPIH real terms), with a midpoint of 4.37%.

2.9.7. The estimate uses the 1-month average of yields on the iBoxx A/BBB 10+ index as a starting point and adjusts it based yield at issue (primary evidence) and secondary market data to derive an achievable allowance for the notional company.

2.9.8. Yield at issuance analysis based on November 2022 to January 2025 supports an adjustment of 46bps. Secondary market evidence from January 2025 supports an adjustment of 30 – 50bps.

2.9.9. In consequence, this Report adopts an adjustment of 30bps at the low end based on secondary market data and 50bps at the high end based on yield at issue analysis and the upper end of the secondary market range.

III. Share of new debt

2.9.10. When estimating the share of new debt, it is essential to use relevant refinancing and RCV growth assumptions and apply methodologies consistent with the calculation of CoD_E.

2.9.11. Adjusting the PR24 FD calculation to update incorrect inputs and address internal inconsistencies, as shown in the table below, while retaining the overall methodology, increases the estimate from 24% to 28% for WaSCs and large WoCs.

Table 4: Inputs and assumptions for calculating the share of new debt

Input or assumption	FD position	This Report
Sample of companies	All companies	WaSCs & large WoCs only
Gearing to calculate debt for RCV growth	Notional	Actual based on March 2024 values
RCV growth	5% real	8.1 nominal growth rate used (5.7% real).

Source: KPMG analysis

2.9.12. Adjusting the PR24 FD calculation to update incorrect inputs and address internal inconsistencies, whilst retaining the overall methodology, increases the estimate from 24% to 28%[3] for WasCs & large WoCs.

3 To adjust the gearing assumption informing the quantum of new debt, the gearing values from the 2023-24 Monitoring Financial Resilience are used.

IV. Additional borrowing costs

2.9.13. Additional borrowing costs include the cost of carry, liquidity, issuance costs, and basis risk management costs. This Report adopts the same estimate for issuance costs as the FD.

Basis risk

2.9.14. The accelerated transition to full CPIH indexation implemented at PR24 exposes companies to new risks and costs, including basis risk from the mismatch between RPI-linked debt and CPIH-linked RCV, and the higher cost of less liquid CPIH debt.

2.9.15. This Report estimates the cost of managing this basis risk at 6bps, based on bank pricing evidence. This aligns with Ofgem's RIIO-2 methodology, which provided a 5bps allowance for energy networks. The higher estimate for water companies reflects the greater prevalence of index-linked debt in their portfolios.

Cost of carry and liquidity

2.9.16. Cost of carry reflects the cost of issuing debt ahead of need (for example, pre-financing maturing debt, capital expenditure, working capital requirements).

2.9.17. Revolving Credit Facilities (RCFs) can reduce the need for companies to pre-finance. However, companies typically pre-finance a portion of their liquidity needs even for the portion of their liquidity requirement that can be covered by RCFs. In addition, a portion of the RCF must remain available to cover unforeseen circumstances or financial shocks. Consequently, this Report estimates cost of carry assuming that only 50% of the total committed RCFs can be utilised to reduce pre-financing requirements. A sensitivity where 100% of the RCF is available to reduce pre-financing is also considered.

2.9.18. Ofwat's approach assumes that companies do not pre-finance upcoming debt maturities. In practice, companies pre-finance upcoming debt maturities alongside other drivers of the liquidity requirement such as capex. The Report considers the total liquidity requirement, including for pre-financing upcoming debt maturities, across two components:

1) Portion not covered by RCFs: This portion is assumed to be pre-financed for a minimum of 12 months in accordance with company liquidity policies.

2) Portion covered by RCFs: Companies typically pre-finance this component 6 months in advance as part of company liquidity policies.

2.9.19. The cost of carry is estimated at 17–26bps, with the upper end assuming 50% of the total liquidity requirement is pre-financed for 12 months and the rest for 6 months, supported by RCFs. The lower end assumes 100% of the RCF is available to reduce pre-financing requirements, with the cost of carry reflecting six months of pre-financing for the total liquidity requirement.

2.9.20. Liquidity costs reflect the cost of maintaining the requisite liquidity facilities and are estimated at 4bps.

2.10. Cost of debt estimate for PR24

2.10.1. The overall CoD range is 3.60 – 3.81%.

Table 5: Overall CoD range for PR24

	Lower bound	Upper bound
CoD_E	2.94%	2.94%
CoD_N	4.27%	4.47%
Share of new debt	28.00%	28.00%
CoD_A	0.29%	0.44%
Overall CoD	3.60%	3.81%

Source: KPMG analysis

2.11. WACC

2.11.1. The point estimate for wholesale WACC as of January 2025 is 4.89%. The same methodology would yield an estimate of 4.71% if applied to September 2024 data, c. 70bps higher than the PR24 FD.

Table 6: Comparison of CoE point estimates, 55% gearing

Parameter (CPIH)	Ofwat FD (Sept 2024) 55% gearing	KPMG (Sept 2024) 55% gearing	KPMG (Jan 2025) 55% gearing
Notional gearing	55%	55%	55%
TMR	6.83%	6.93%	6.93%
RFR	1.52%	1.98%	2.59%
Unlevered beta	0.28	0.34	0.34
Debt beta	0.10	0.10	0.10
Observed gearing	52.27%	49.64%	50.69%
Asset beta	0.34	0.39	0.39
Notional equity beta	0.62	0.73	0.75
CoE before aiming up, appointee	4.83%	5.62%	5.83%
Aiming up	0.27%	0.50%	0.50%
CoE, appointee	5.10%	6.12%	6.33%
RMA	-0.13%	-	-
CoE, wholesale	4.97%	6.12%	6.33%
CoD_E	2.77%	2.94%	2.94%
CoD_N	3.74%	3.83%	4.37%
Share of new debt	24.00%	28.00%	28.00%
CoD_A	0.15%	0.37%	0.37%
Overall CoD	3.15%	3.56%	3.71%
WACC, wholesale	3.97%	4.71%	4.89%

Source: KPMG analysis

3. Context and scope

3.0.1. KPMG has been engaged by a group of water companies that referred Ofwat's final determinations to the CMA to estimate the weighted average cost of capital (WACC) for PR24.

3.0.2. The purpose of the regulatory WACC is to provide sufficient financial incentives to attract and retain investment in the sector, ensuring that companies can finance their ongoing operations. For the WACC to serve its intended function, it must accurately capture the risks faced by companies and align with current market conditions.

3.0.3. Investors will assess the investment proposition offered by UK water based on the attractiveness of its risk-return trade-off relative to other available opportunities. This assessment will reflect investors' current perception of the risks associated with investing in the sector. Similarly, it is essential that the WACC reflects prevailing market conditions to ensure the return offered is sufficient to attract investment.

3.0.4. The Report starts by considering the broader context at PR24, focusing on whether there have been changes in (1) risk facing the sector (2) investor perceptions of risk facing the sector (3) factors which could affect availability of equity capital (4) macroeconomic conditions.

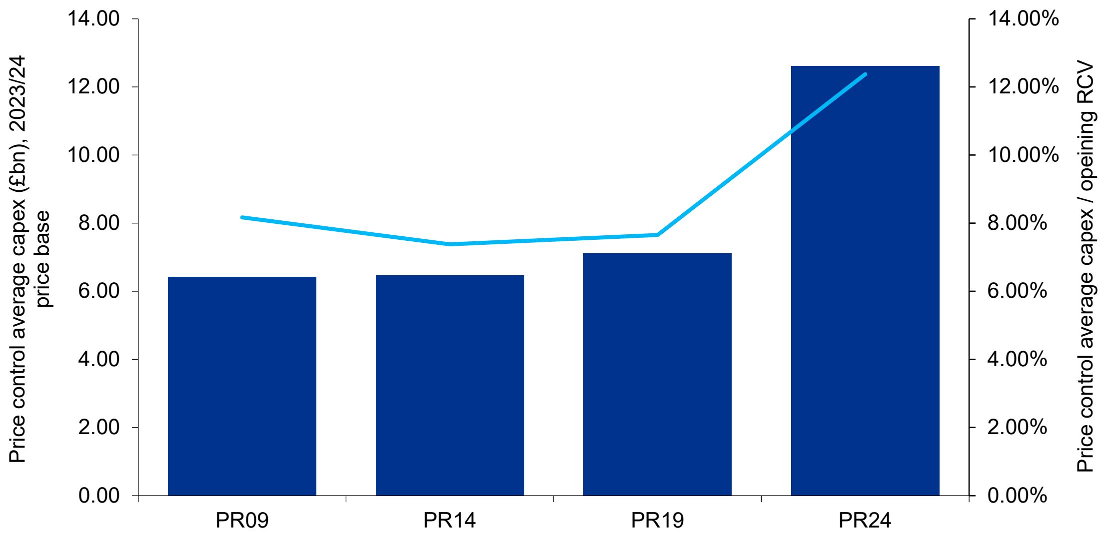
3.1. Context

I. There have been fundamental shifts in the risk landscape for water companies

Higher delivery and performance risk

3.1.1. The upcoming AMP8 represents a material shift in the operating, investment and risk environment for water companies. There is a significant and unprecedented step up in the scale of capital programmes expected for AMP8. This step change introduces significantly greater delivery risk around timely and on-budget delivery of capital programmes that are on average double the size of programmes delivered in any of the last three price controls.

Figure 6: Evolution of capital intensity

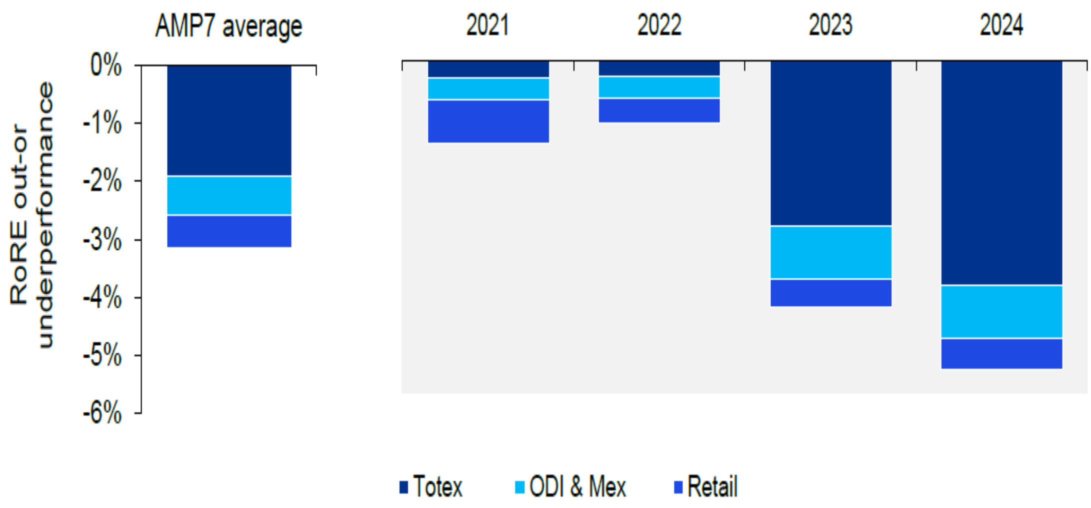


Source: KPMG analysis based on data from Ofwat's Capex Intensity Model[4].

4 From the response to query Ofwat-FD-ANH-12.

3.1.2. This step change in capital intensity comes at the same time of very significant spend above the allowances and large operational penalties applied by the regulator across the sector in AMP7, equivalent to almost 3% RoRE in the first four years.

Figure 7: Decomposition of AMP7 sector average operational performance



Source: KPMG analysis

3.1.3. Analysis of risk exposure implied by Ofwat's FD indicates that AMP8 is likely to increase risk further, with higher performance risk driven by more stretching targets and higher cost recovery risk. Ofwat has introduced a number of new mechanisms to reduce risk, but a number apply only in extreme scenarios. For example, Ofwat has introduced Aggregate Sharing Mechanisms on Totex and ODIs which provide additional risk protections above 2% and 3% RoRE respectively – equivalent in combination to the entire allowed return in real terms. This reflects Ofwat's policy to "improve services to customers as the whole of the real allowed return on equity is at risk in the event of material underperformance"[5]. This underscores that the volatility of returns observed in AMP7 is likely to persist into the next price control period.

Step change in investor perception of risk

3.1.4. Concerns amongst investors and credit rating agencies about the investability of the water sector have been increasing, centred on the sector risk profile.

3.1.5. Ofwat recognised in its FD that "investor sentiment towards the water sector is currently low. This was illustrated by investor engagement at our series of roundtables, and in representations to our draft determinations, for example in the response from the Global Infrastructure Investment Association, who represent the interest of private investors"[6].

3.1.6. Barclays' investor survey in November 2024 rated UK water as the riskiest European utility sector and noted that "Ofwat sees water as a lower-risk asset than other regulated assets. We do not see evidence of this, nor do investors" [7].

3.1.7. The rating agencies have tightened credit metric guidance in view of the deterioration of the sector's business risk profile.

3.1.8. In November 2024, Moody's downgraded its view on the stability and predictability of the regulatory framework in the UK water sector from Aa to A after draft determinations. This

5 Ofwat (2024), PR24 Final Determination, Aligning risk and return, p. 14.
6 Ofwat (2024), PR24 Final Determination, Aligning risk and return – Allowed return appendix, p. 84.
7 Barclays (2024), Breaking the water cycle – no longer, so positive, p. 64.

reflected a "*material and sustained weakening of credit quality for nearly all companies*"[8] as a result of more acute political and regulatory focus, as well as previous decisions to prioritise affordability (as well as shareholder distributions) that contributed to underinvestment in the sector.

3.1.9. An "A" score for stability and predictability places Ofwat two notches below Ofgem and other leading European utility regulators, such as those in Ireland and Norway, and in line with less-established regimes in Estonia and Portugal.

3.1.10. S&P reduced the "regulatory advantage" of UK water companies from strong to strong/adequate on 18 February[9]. S&P previously viewed Ofwat's regulatory framework as comparable to Ofgem and other most highly rated energy regulators in markets like France, Italy, Sweden and the Czech Republic. It now rates Ofwat lower alongside regulators in Spain, Slovakia, Hungary and the Baltic states.

3.1.11. S&P highlighted several aspects of the regulatory framework that it believes have deteriorated:

1) **Regulatory stability** has weakened because of the shift in focus from affordability in PR19 to investment growth in PR24. "The changes in the current and upcoming regulatory periods that would indicate a heightened risk perception for the sector are no longer consistent with our strongest regulatory advantage assessment."

2) **Financial stability** has weakened because the unattractive risk/return balance of PR24 makes it likely that "the amount of equity raised over AMP8 will likely fall short of the regulator's assumptions."

3) **Execution risks** have increased associated with the massive capital investment increase expected at PR24.

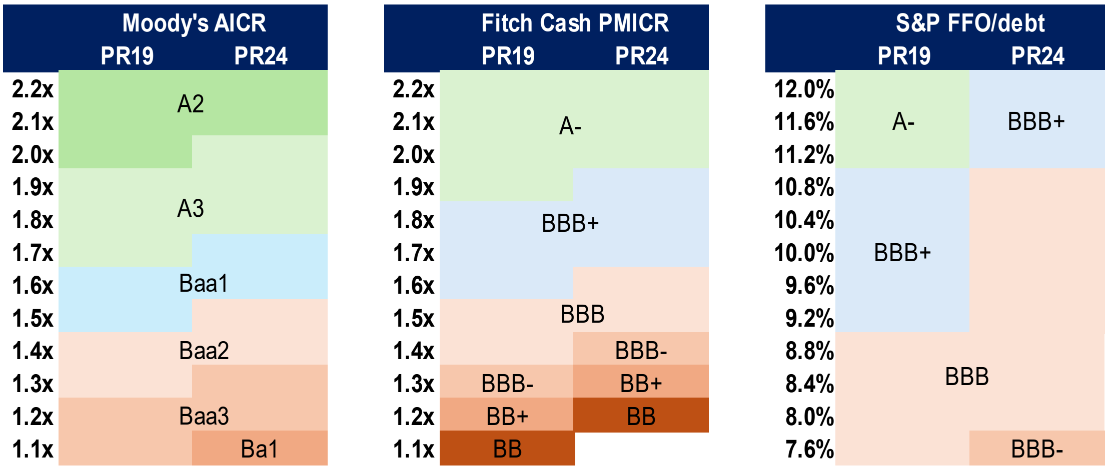
4) **Regulatory independence and insulation** has weakened because of continuous scrutiny and political pressure on Ofwat, and increasing public concern about environmental issues. S&P expects the Cunliffe Commission to increase uncertainty, even if it "would not necessarily result in a worse outcome" for companies.

3.1.12. Reflecting increased risks, all three agencies have tightened their rating thresholds – by a half notch at Moody's, between a half and full notch at Fitch, and a full notch at S&P. In combination with weaker forecast cash flow and greater downside risk, this has triggered a number of downgrades across the sector.

8 Moody's (2024), Regulated Water Utilities – UK Reduced predictability of regulatory environment pressures credit quality, p. 1.

9 S&P (2025), UK. Water Regulatory Framework Support, Low Financial Flexibility In Coming Regulatory Period Drive Rating Actions, p. 2.

Figure 8: Changes to rating thresholds for UK water companies since PR19



Source: KPMG analysis

II. Unprecedented levels of new equity capital are required to deliver capital programmes in AMP8 and beyond

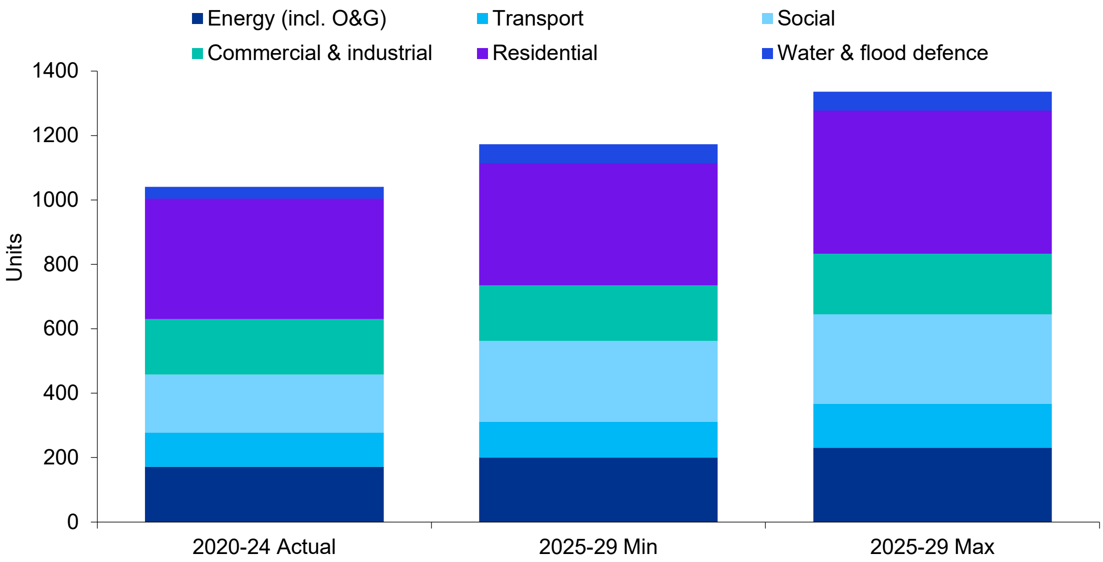
Competition for capital

3.1.13. For the first time since privatisation water companies will need to attract significant amounts of new equity capital to finance critical investments and to be financeable throughout AMP8. The regulatory CoE needs to be sufficient to provide incentives for firms and their investors to meet investment requirements[10]. Attracting new equity will require investment appraisals to yield positive results and for the investment proposition to be sufficiently competitive relative to both other forms of capital investment and other equity investment opportunities. In other words, the cost of capital (and the price control as a whole) must represent an investable proposition.

3.1.14. This is particularly important as many other large UK infrastructure programmes will occur at the same time as AMP8 and will compete for resources the limited supply of construction labour. While the UK water sector enhancement programme is £50bn over 2025-2030, RIIO-3 for gas transmission and distribution and electricity transmission including the Accelerating Strategic Transmission Infrastructure (ASTI) programme is estimated at £99bn over 2026 – 2031 to prepare the country for Net Zero. Other investments needed for net zero including the build out of a hydrogen network and related carbon capture and storage assets, expansion of nuclear energy generation capacity and other renewable energy sources represent an additional investment. Hinkley Point C alone is estimated to cost £40bn. Additionally, the new hospitals programme will spend another £20bn by 2030 to build 40 new hospitals. Demand for construction labour is expected to continue increasing as the UK is set to build out the nation’s infrastructure across a range of sectors.

10 CMA (2021), PR19 Final Determination, para. 9.1236.

Figure 9: Expected increases in the infrastructure investment pipeline across sectors



Source: KPMG analysis

3.1.15. Ofwat assumes £12.7bn[11] new equity will be required in its FD financial modelling, equivalent to 30% of current equity invested in the sector. Equity has not been raised at this scale in the sector to date and it will be critical to ensure that returns are sufficient to attract and retain the equity capital needed to deliver large capital programmes in AMP8 – and that the price control is investable.

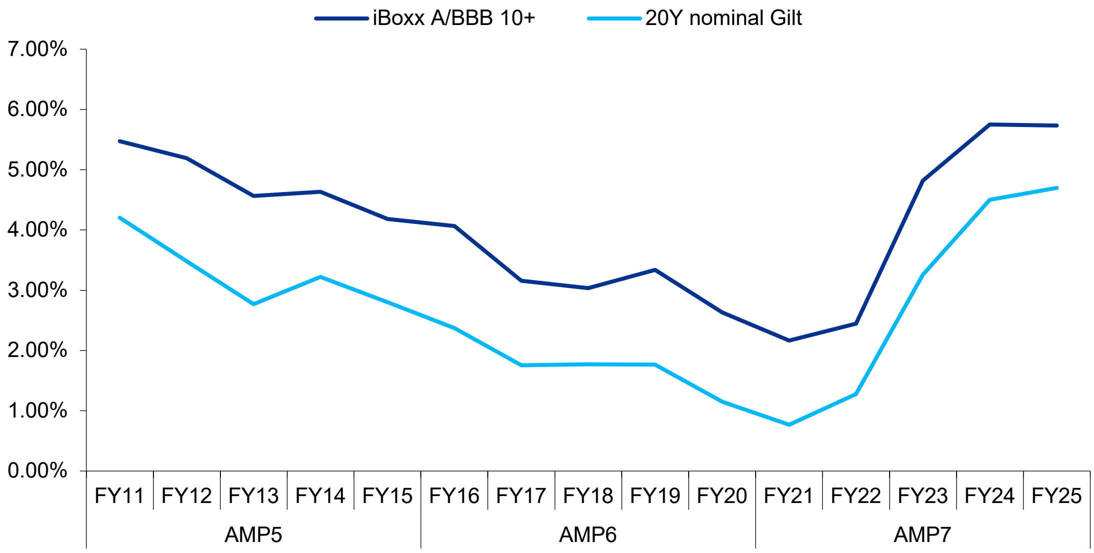
3.1.16. New capital can only be attracted based on objective, positive forward looking investment appraisal. In practice, this means that explicit assessment of the impact of the scale of capital requirements on financeability needs to be carried out. This will need to include systematic cross-checking of allowed returns against market evidence and benchmarks to ensure that allowed returns are sufficient to attract new equity capital to the industry.

Higher for longer market conditions

3.1.17. There has been a significant shift in the macroeconomic landscape since PR19, marked by higher interest rates. The figure below illustrates the step change in interest rates across the last 12 months.

11 Ofwat approves £104bn upgrade to accelerate delivery of cleaner rivers and seas and secure long-term drinking water supplies for customers.

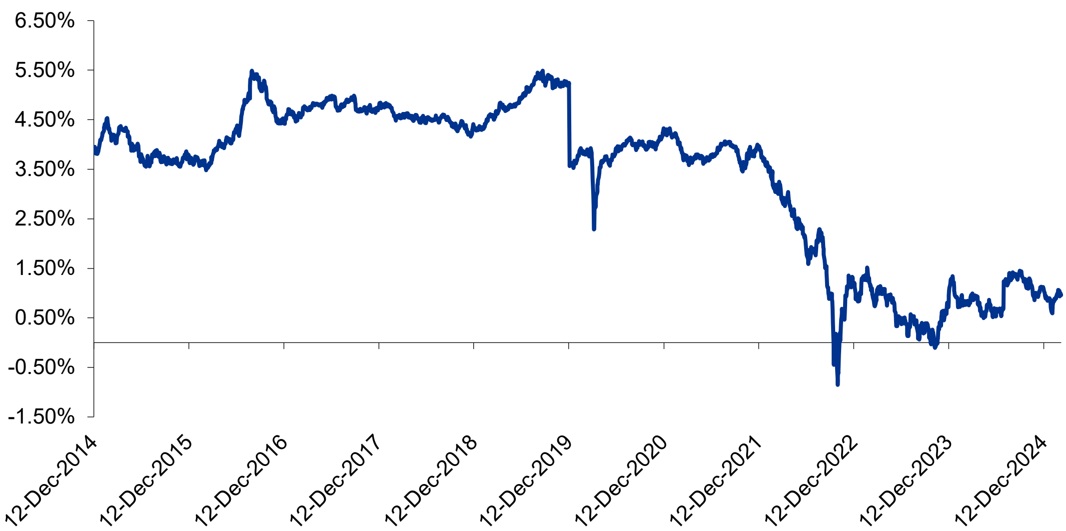
Figure 10: Evolution of iBoxx A/BBB and nominal gilts across recent price controls



Source: KPMG analysis based on LSEG Workspace data

3.1.18. Direct evidence from the debt markets indicates that the allowed CoE no longer includes the same risk premium over debt as it did previously. The figure below shows the evolution of the differential between the allowed CoE and borrowing costs for water companies[12]. The effective maturity of the iBoxx A/BBB index is close to 20 years such that the investment horizons implied in CoE and debt pricing are broadly consistent.

Figure 11: Comparison of allowed CoE and CoD across recent price controls



Source: KPMG analysis based on LSEG Workspace and Bloomberg data

3.1.19. Market commentary has highlighted that the recent convergence between allowed returns on equity and water company debt pricing could limit companies' ability to attract new equity capital:

1) **Barclays:** "[The] Cost of equity allowed by Ofwat looks low vs. debt… we see this spread as too thin" [13].

12 Proxied by yields on iBoxx A/BBB 10+ index which have been adjusted to reflect applicable benchmark adjustments applied for each price control period.

13 Barclays (2024), Breaking the water cycle – no longer so positive, p. 61.

2) **Moody's:** "Based on the proposed parameters, the cost of equity allowance… still indicates a rather low equity premium to attract new funding in a higher interest rate [environment]" [14].

3.1.20. 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, 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.

3.1.21. 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. This is in line with Damodaran who considers that "there should be a relationship across the risk premiums in these asset classes that reflect their fundamental risk differences".

3.1.22. It will be important to cross-check whether the allowed CoE has been set at a level which reflects risk differences between debt and equity capital. This 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.

3.1.23. To attract significant new equity, the CoE must provide returns that adequately compensate for the risks and opportunity cost of capital. 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 and is consistent with market evidence and benchmarks.

3.1.24. In this context, the Report uses CAPM as the primary model for estimating CoE, but cross-checks CAPM-derived estimates against market evidence to ensure that the CoE can attract and retain the equity capital needed to investment across AMP8.

3.2. Scope and structure of the Report

3.2.1. KPMG has been engaged by a group of water companies to develop an estimate of the cost of capital for PR24. This estimate is based on relevant financial literature, regulatory principles, and the latest market data; it considers the implications of the evidence and estimates presented in the PR24 FD.

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

1) **First**, it develops an estimated range for each CoE parameter using methodologies that are well-supported by financial literature, regulatory precedent, and current market evidence. It considers the implications of the evidence and estimates for each parameter provided in the FD (sections 4, 5, 6).

2) **Second**, it considers the appropriate assumptions for notional gearing (section 7) and the retail margin adjustment (section 8).

3) **Third**, it considers the implications of the evidence from cross-checks that can increase the accuracy of the CoE assessment (section 9).

14 Moody's (2024), Ofwat's draft determination increases sector risk, p. 7.

4) **Fourth**, it sets out the framework for the selection of the point estimate of CoE (section 10) and comments on the appropriate risk-reflective point estimate for the allowed return on equity for PR24.
5) **Fifth**, it develops an estimated range for cost of debt, including the cost of embedded debt, cost of new debt, share of new debt and additional borrowing costs (section 11).

3.3. Authors

3.3.1. The sections of this Report on TMR and multifactor models have been written in conjunction with Professor Alan Gregory, a Director in Exefera Limited.

3.3.2. 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.

3.3.3. Professor Gregory was a member of the CC's cost of capital panel from 2009 to 2017 and provided advice to the Competition and Markets Authority (CMA) on cost of capital until 2024. 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'.

3.3.4. The sections of this Report on the risk-free rate and inference analysis have been written in conjunction with Professor Alex Edmans FBA FAcSS.

3.3.5. Professor Edmans is Professor of Finance at London Business School. He is a Fellow of the British Academy, Fellow of the Academy of Social Sciences, a Director of the American Finance Association, and Non-Executive Director of the Investor Forum. From 2017-2022 he was Managing Editor of the Review of Finance, the leading academic finance journal in Europe.

3.3.6. Professor Edmans is a co-author 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 on the link between executive pay and investment.

4. Risk-free rate

4.0.1. The risk-free rate (RfR) 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 estimates the RfR; it is structured as follows:

1) It evaluates Ofwat's starting point for the risk-free rate based on gilt yields.
2) It considers the impact of the convenience yield.
3) It considers the impact of differing risk-free borrowing and saving rates.
4) It considers whether an adjustment to gilt yields is required and different approaches for quantifying the adjustment.
5) It evaluates Ofwat's approach for estimating the RPI-CPIH wedge.
6) It sets out the overall estimate for the risk-free rate.

4.0.2. The table below sets out Ofwat's and this Report's approach to estimating the risk-free rate.

Table 7: Ofwat's and this Report's approach to estimating the risk-free rate

Component	Ofwat	This Report
Risk-free rate proxy	Yields on RPI index-linked gilts (ILGs).	Same as Ofwat.
Tenor	20Y	Same as Ofwat.
Cross-checks	Ofwat considers yields on (1) 10Y and 20Y ILGs; (2) 10Y and 20Y nominal gilts (NGs); (3) 10Y and 20Y SONIA swaps; (4) the CMA PR19 nominal AAA index; and (5) the KPMG RPI AAA sample. It observes that only SONIA swaps and the KPMG RPI AAA sample point to a significantly different estimate than ILGs of the same tenor. SONIA swaps point to a lower estimate. Ofwat does not rely on these as (1) swap rate is less intuitively interpreted than other risk-free rate proxies as an investment return; and (2) large negative swap spreads at 20Y tenor may be due to pension funds buying swaps to increase portfolio duration rather than to increase their weighting of risk-free assets. The KPMG RPI AAA sample points to a higher estimate. Ofwat does not rely on this as it considers the yield data for the sample may not be reliable.	No use of cross-checks. Ofwat does not alter its estimate for cross-checks so the KPMG and Ofwat positions are effectively the same. The KPMG RPI AAA sample is used to inform the adjustment for investors not being able to borrow at the ILG yield (see adjustments row).
Averaging period	1m average of 20Y ILG yields.	Same as Ofwat.
Adjustments	No adjustments have been applied to 20Y ILG yields.	Separate adjustments to reflect that (1) ILGs benefit from the convenience yield; and (2) investors cannot borrow at the ILG yield.
RPI-CPIH wedge	20Y RPI-CPI wedge implied by inflation swaps and official forecasts. This wedge is applied to 20Y ILG yields to convert from an RPI to a CPIH basis.	Same as Ofwat.

Source: KPMG analysis and PR24 FD and DD

4.1. ILG yields as a starting point for the risk-free rate

4.1.1. This section considers the starting point for the RfR as well as Ofwat's and CEPA's points in relation to the starting point.

I. Starting point for the risk-free rate

4.1.2. Ofwat's starting point for the RfR is the 1-month average of 20-year yields on ILGs. This section considers whether this starting point is appropriate.

Risk-free rate proxy

4.1.3. In the CAPM, an investor can invest their wealth in the market portfolio and the risk-free asset. In practice, no asset is entirely risk-free as is assumed in the CAPM. Government bonds are investors' safest alternative to investing in the market portfolio and investors generally perceive these as risk-free. It follows that the real-world equivalent of the CAPM risk-free asset is a government bond.

4.1.4. Given that Ofwat sets a real allowance, it is a more direct approach to estimate RfR to rely on index-linked government bonds rather than on nominal government bonds. This is in line with UKRN guidance[15].

Tenor

4.1.5. The CMA at PR19 decided to use 20Y ILGs: "…we note 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"[16]. This rationale continues to hold for AMP8.

Averaging period

4.1.6. Ofwat has decided against indexation of the risk-free rate as it considered that the benefits of indexation do not clearly outweigh the costs. This increases the importance of setting the ex-ante trailing average for the risk-free rate appropriately.

4.1.7. Ofwat has used a 1-month trailing average to estimate the RfR. Ofwat considered that this length of trailing average balances the benefits of (1) more recent data which may be more reflective of market conditions over AMP8; and (2) averaging over a longer historical period to protect against unusual daily volatility in yields.

4.1.8. The choice of trailing average should reflect prevailing and expected market conditions.

4.1.9. UKRN guidance advocates for a trailing average length up to 12m[17].

4.1.10. Based on a January 2025 cut-off, the 1m trailing average of 20Y ILG yields was 50bps above the 12m trailing average[18]. The 1m trailing average does not reflect any temporary factors, rather it reflects a clear upward trend in gilt yields over the last 12m. It follows that 1m is the appropriate choice of trailing average length based on the latest outturn yields.

4.1.11. The factors driving the upward trend in gilt yields have been well documented. For example, The Economist commented that it relates to the outcome of the election in the US and investors' concerns about the UK's fiscal credibility as well as sticky inflation[19].

15 UKRN (2023), UKRN guidance for regulators on the methodology for setting the cost of capital, p. 15.
16 CMA (2020), PR19 Provisional Findings, para. 9.128.
17 UKRN (2023), UKRN guidance for regulators on the methodology for setting the cost of capital, p. 15.
18 Based on Bank of England spot curves. These can be found here
19 The Economist (2025), Why have Britain's bond yields jumped sharply?.

4.1.12. Forward rates for 20Y ILGs (and NGs) at present suggest that the market expectation is for the spot rates on these bonds to increase over AMP8. Given Ofwat's finding of insufficiently clear benefits from indexation, the 1m trailing average should be retained if this market expectation holds. The 1m trailing average would minimise the loss to investors if the market expectation was to materialise in practice as it excludes lower rates from earlier months.

4.1.13. The CMA should monitor how spot and forward rates on 20Y ILGs evolve and consider what length of trailing average is merited.

II. Ofwat's and CEPA's points

4.1.14. This section considers Ofwat's and CEPA's points in relation to the starting point for the risk-free rate.

20Y ILGs are not truly risk-free

4.1.15. CEPA, Ofwat's advisors, have been commissioned by Ofwat to estimate CoE for PR24 and to comment on KPMG analysis of CoE. CEPA considered that 20Y ILGs are not truly risk-free. They may embed a degree of default and illiquidity risk, which increase their yield above that of a truly risk-free asset[20]. CEPA previously considered term risk to be another source of potential risk premium in 20Y ILGs[21]. There are four problems with CEPA's position.

4.1.16. First, if government bonds are not risk-free, then there is no risk-free rate. Then, the zero-beta return should be used in the CAPM, as shown by Black (1972). The zero-beta return is significantly higher than the return on government bonds based on the evidence in paragraph 4.2.13.

4.1.17. Second, CEPA's does not appear to be internally consistent. CEPA used the return on government bonds as the risk-free rate. This is inconsistent with its claim that they are not risk-free and its recognition that the zero-beta return should be used if there is no risk-free rate[22].

4.1.18. Third, CEPA has not engaged with the discussion of its points in the KPMG August 2024 CoE report. The discussion reaffirmed that government bonds are the appropriate starting point for the risk-free rate which is in line with the CMA's view at PR19. The discussion is outlined in paragraph 12.0.1 for reference.

4.1.19. Fourth, Ofwat does not appear to agree with CEPA. Ofwat supported CEPA's view in the PR24 DD but no longer mentions CEPA's view in the PR24 FD. Moreover, Ofwat comments in the PR24 FD that "the RPI-linked gilts rate is in principle a risk-free rate…"[23] which is at odds with CEPA's view.

20Y ILGs have been used instead of an average of 10Y and 20Y ILGs

4.1.20. Ofwat considers that instead of using solely 20Y ILGs, it could have weighted 20Y ILGs with 10Y ILGs because its CAPM horizon is 10-20Y.

4.1.21. Ofwat has not engaged with the discussion of why 20Y ILGs are appropriate in the KPMG August 2024 CoE report. The discussion found that:

1) 20Y tenor matches asset lives and the reality of decision-making in the sector.
2) 20Y tenor maintains consistency of tenor across the allowed return.
3) 20Y tenor is the same as that used by regulators in similar sectors such as Ofgem.

20 CEPA (December 2024), PR24 Cost of Equity, p. 29.
21 CEPA (July 2024), PR24 Cost of Equity, p. 50-51.
22 CEPA (December 2024), PR24 Cost of Equity, p. 29-30.
23 Ofwat (2024), PR24 Final Determination, Aligning risk and return – Allowed return appendix, p. 13.

4) CEPA considers that yields on 20Y ILGs are more stable than on 10Y ILGs. Thus, 20Y tenor is preferable to 10Y tenor as investors in utilities target stable returns.

4.1.22. The discussion is outlined in paragraph 12.0.21 for reference.

4.1.23. Ofwat at PR19 DD used the average yield on 10Y and 20Y ILGs as a starting point for the risk-free rate at an investment horizon of 15Y. At PR19 FD, it moved to directly use the yield on 15Y ILGs [24]. The CMA at PR19 ultimately decided to use 20Y rather than 15Y ILGs as adopted by Ofwat. Ofwat does not provide rationale for why it could in principle be correct to deviate from the CMA PR19 FD and revert to its PR19 DD position.

4.2. Convenience yield

4.2.1. This section considers the impact of the convenience yield for estimating the risk-free rate as well as Ofwat's and CEPA's points in relation to the convenience yield.

I. Relevance of the convenience yield

4.2.2. This section explains the relevance of the convenience yield for estimating the risk-free rate.

What is the convenience yield?

4.2.3. The risk-free rate is used as a measure of the time value of money: the required return for receiving a riskless payoff in the future instead of today [25].

4.2.4. Government bonds like ILGs are commonly used for this benchmark because investors perceive them to be risk-free (i.e. zero chance of default). However, government bonds provide additional benefits to investors. These benefits create additional investor demand for government bonds and push their return below that implied by the time value of money alone. The difference is the convenience yield (CY).

4.2.5. The additional benefits that government bonds provide to investors include their superior liquidity (see Krishnamurthy and Vissing-Jørgensen, 2012[26]) and the ease with which they can be traded by agents, posted as collateral, satisfy regulatory capital requirements, or perform other roles similar to that of money (see van Binsbergen et al., 2022[27]).

4.2.6. It is not only government bonds that include CY. For example, physical cash (notes and coins) and cash held in a bank account are both risk-free. However, physical cash earns no return whereas cash held in a bank account earns the deposit rate i.e. physical cash bears CY. This is because physical cash has a superior ability to perform money-like roles as it can be spent immediately. Rational investors are willing to pay for this convenience of using physical cash.

4.2.7. It follows that for ILGs, CY(ILG) must be added to their return to obtain the relevant estimate of the risk-free rate.

Return on the benchmark asset in the CAPM

4.2.8. There are two approaches for estimating the return on the benchmark asset in the CAPM. The first is to estimate the risk-free rate and the second is to estimate the zero-beta return.

4.2.9. An example of a zero-beta asset is a corporate bond (or stock) whose return is uncorrelated with the market. Corporate bonds typically do not have convenience properties (e.g. do not have superior liquidity) and therefore do not benefit from CY. Thus, the zero-beta return does not require an adjustment for CY.

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24 This move was for two reasons: (1) depending on the shape of the yield curve between 10-20Y, the direct yield for 15Y may be different to an average of 10Y and 20Y; and (2) direct yields are generated using a more sophisticated line of best fit.

25 Van Binsbergen, J., Diamond, W., and Grotteria, M. (2022), 'Risk-free interest rates'.

26 Krishnamurthy, A. and Vissing-Jørgensen, A. (2012), 'The Aggregate Demand for Treasury Debt'.

27 Van Binsbergen, J., Diamond, W., and Grotteria, M. (2022), 'Risk-free interest rates'.

4.2.10. It is not possible to identify the risk-free rate either where there is no risk-free asset, or the risk-free asset bears CY which cannot be estimated. In either case, the risk-free rate should be replaced with the return on a zero-beta asset, as shown by Black (1972)[28].

4.2.11. Ofwat's advisor, CEPA, agrees with this: "In principle, the correct model to apply in the absence of an observable risk-free asset is the zero-beta CAPM, under which the risk-free rate is calibrated using the return on a portfolio of risky assets whose covariance with the market portfolio is zero"[29]. Ofwat in the PR24 FM also acknowledged the possibility of using the zero-beta return in the CAPM[30].

4.2.12. The zero-beta asset bears no systematic risk whereas the risk-free asset bears no risk. Hence, the return on the zero-beta will be higher than the risk-free asset as the former bears idiosyncratic risk.

4.2.13. This is supported by relevant finance literature. For example, Di Tella et al. (2023) finds that in the US the real zero-beta return[31] is 7.6% higher than the real 1m Treasury bill return per year on average over 1973-2020[32]. They comment that *"the average level of the zero-beta rate may seem surprising. But it reflects a well-known fact, going back to Black et al. [1972], who pointed out, in the context of CAPM, that the expected return of an equity portfolio with zero covariance to the market was well in excess of Treasury bill yields"*.

4.2.14. This means that both approaches for estimating the return on the benchmark asset in the CAPM imply a rate that is higher than the gilt yield. In the first case, CY must be added to the gilt yield and in the second case, the zero-beta return is necessarily higher than the gilt yield.

II. Evidence for existence of CY

4.2.15. This section considers further evidence for the existence of CY.

4.2.16. Ofwat estimated the risk-free rate rather than the zero-beta return. Its risk-free rate proxy is the 20Y ILG yield. It considered making an adjustment for CY to its proxy to estimate the risk-free rate.

4.2.17. Ofwat in the PR24 FM recognised estimates of CY in government bonds from academic literature[33]. The academic literature on CY is largely focused on the US. Diamond and Van Tassel (DVT, 2025[34]) is the only academic paper that provides UK-specific estimates of CY, which are for short-dated NGs[35].

4.2.18. This means that to apply the estimates of CY in DVT (2025) to Ofwat's risk-free rate proxy, it must be shown that: (1) CY(NG) is a good benchmark for CY(ILG); and (2) CY for shorter-dated safe assets holds for longer-dated safe assets.

4.2.19. In relation to (1), a qualitative analysis of whether the CY factors cited in academic literature apply to ILGs to the same extent as NGs was carried out in the KPMG September 2023 CoE report. This analysis is outlined in paragraph 12.1.1 for reference.

4.2.20. The analysis implies that the vast majority of the CY factors apply similarly to NGs/ILGs but NGs may be more liquid than 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[36].

28 Black, F. (1972), 'Capital Market Equilibrium with Restricted Borrowing'.
29 CEPA (December 2024), PR24 Cost of Equity, p. 30.
30 Ofwat (2022), PR24 Final Methodology, Appendix 11 – Allowed return on capital, p. 13 and 93.
31 The zero-beta return is not tenor-specific because equities are assumed to have a flat term structure. The implication is that the zero-beta return can be used to set the allowed return at both short and long investment horizons.
32 Di Tella, S., Hebert, B., Kurlat, P., and Wang, Q. (2023), 'The Zero-Beta Interest Rate'.
33 Ofwat (2022), PR24 Final Methodology, Appendix 11 – Allowed return on capital, p. 15.
34 Diamond, W. and Van Tassel, P. (2025), 'Risk-Free Rates and Convenience Yields Around The World'.
35 Ofwat referred an earlier version of this paper in the PR24 FM.
36 Ofwat (2022), PR24 Final Methodology, Appendix 11 – Allowed return on capital, p. 12-14.

4.2.21. CEPA agrees that "it is plausible that a convenience yield is reflected in the yield on some ILGs"[37] and CY(ILG) may be of comparable magnitude to CY(ILG)[38]. Whilst the analysis in paragraph 12.1.1 acknowledges that NGs may be more liquid than ILGs, CEPA shows for a sample of NGs/ILGs that ILGs have lower bid-ask spreads than NGs[39].

4.2.22. In relation to (2), the KPMG August 2024 CoE report set out the evidence on this issue. This evidence is outlined in paragraph 12.1.23 for reference.

4.2.23. The evidence suggests it is reasonable to assume that CY holds for longer-dated safe assets. Specifically, (a) the term structure of CY in academic literature is mostly upward sloping; and (b) the collateral value component of CY for longer-dated safe assets is at least the same as that for shorter-dated safe assets.

4.2.24. On balance, the estimates of CY in DVT (2025) are a good starting point for CY in 20Y ILGs. The extent to which any adjustment is required to these is discussed in paragraph 4.4.29.

4.2.25. Ofwat decided it was not possible to estimate CY for 20Y ILGs from DVT (2025) and so did not provide an adjustment for CY. As Ofwat considered it was not possible to estimate CY and therefore identify the risk-free rate, it should have used the zero-beta return in place of the risk-free rate in the CAPM. This is the approach justified by academic literature.

III. Ofwat's and CEPA's points

4.2.26. This section further considers Ofwat's and CEPA's points in relation to CY.

DVT estimate of 2Y CY(NG) has fallen over 2022-2024

4.2.27. DVT estimate CY for NGs with tenors of 3m to 2Y. The first version of the DVT paper was published in 2022 and the most recent version was published in 2025. Ofwat suggests that DVT's estimate of 2Y CY(NG) has fallen between 2022 and 2024 by comparing different versions of the paper. This is incorrect for the following reasons.

4.2.28. First, the KPMG August 2024 CoE report explained that the April 2024 version of the DVT paper showed a 2Y CY(NG) of 29bps which is smaller than the 38bps shown in earlier versions. This was a correction of the estimate using the same data, not an update based on new data. The correction was only to the 2Y CY(NG); CY for shorter tenor NGs did not change between versions. As such, it is incorrect to suggest that 2Y CY(NG) has fallen since 2022. The estimates in the April 2024 and 2025 versions of the paper are the same.

4.2.29. Second, DVT observe that CY(NG) appears to have a positive relationship with interest rates. Given that interest rates in the UK have risen significantly over 2020-2025, it is likely that CY(NG) is higher based on a more recent data cut-off.

DVT estimate of 2Y CY(NG) is lower than 1Y CY(NG), consistent with theory

4.2.30. Ofwat observes that DVT's estimate of 2Y CY(NG) is lower than 1Y CY(NG). It considers that this is consistent with the theory that CY may reduce at longer tenors. This is incorrect for the following reasons.

4.2.31. First, the CY term structure in DVT (2025) is mostly upward sloping. 2Y is an exception but may be an outlier. It is not appropriate to solely highlight one point in the term series when the rest of the time series points to a different conclusion. The most reasonable conclusion to draw from the time series as a whole is that CY does not decline at longer tenors.

4.2.32. Second, Ofwat suggests there is theory that CY declines at longer tenors. Ofwat has not referenced any academic literature that supports this theory. Further, the evidence outlined in paragraph 12.1.30 indicates that it is reasonable to assume that CY holds at longer tenors.

37 CEPA (December 2024), PR24 Cost of Equity, p. 28.
38 CEPA (December 2024), PR24 Cost of Equity, p. 29.
39 CEPA (December 2024), PR24 Cost of Equity, p. 31.

KPMG evidence of haircuts on gilt collateral supports the theory that CY declines with tenor

4.2.33. The KPMG August 2024 CoE report set out the haircuts that are applied to the current market value of gilts and AAA corporate bonds to derive their collateral value. Ofwat considers this evidence supports the theory that CY declines with tenor.

4.2.34. The KPMG August 2024 CoE report explained Ofwat's interpretation of the evidence is based on its misunderstanding of the definition of CY. The evidence is outlined in paragraph 12.1.26.

4.2.35. Ofwat points to the fact that shorter-dated gilts have higher collateral value than longer-dated gilts. This is irrelevant for the term structure of CY as CY for gilts is the difference in yield between gilts and other safe assets, such as AAA corporate bonds, of the *same maturity*. It is necessary to hold constant the maturity as CY is the difference in yield between two assets with the same cashflow profile that differ only in terms of their convenience.

4.2.36. In this context, the evidence shows that the haircuts on gilts are half that for AAA corporate bonds at the same maturity. The difference between the two in absolute terms becomes larger at higher maturities. This means that the collateral value component of CY does not decline at longer tenors.

4.3. Differing risk-free borrowing and saving rates

4.3.1. This section considers the impact of differing risk-free borrowing and saving rates for estimating the risk-free rate as well as Ofwat's and CEPA's points in relation to this.

I. Brennan (1971) and its application in the CMA PR19 FD

4.3.2. This section considers how the risk-free rate in the CAPM should be adjusted where investors' risk-free borrowing and saving rates differ.

4.3.3. The Sharpe-Lintner CAPM assumes that investors can borrow and save at the same risk-free rate. In the real world, the risk-free borrowing rate is higher than the risk-free saving rate. In this case, the appropriate risk-free rate for the CAPM lies between the two rates as shown by Brennan (1971)[40].

4.3.4. The intuition behind Brennan (1971) was explained in the KPMG September 2023 CoE report. It also showed that it is well established that investors in the real world borrow at a higher rate than they save. These explanations are outlined in section 12.2 for reference.

4.3.5. The CMA viewed its PR19 FD to base the risk-free rate on both ILGs and AAA corporate bonds as an application of Brennan (1971): "We consider that our interpretation of the CAPM in a situation of different borrowing and lending rates…is in principle in line with Brennan's (1971) often quoted finding that the market equivalent RFR is a weighted average of the RFR of all individual investors"[41]. In particular, the CMA used ILGs as a proxy for the risk-free saving rate and AAA corporate bonds as a proxy for the risk-free borrowing rate.

4.3.6. Brennan (1971) does not explore CY. Given the CMA's PR19 FD was primarily based on Brennan (1971), its decision cannot directly relate to CY[42]. CY is in effect an additional layer that builds on the CMA's PR19 FD.

II. Interaction between Brennan (1971) and CY

40 Brennan, M. (1971), 'Capital Market Equilibrium with Divergent Borrowing and Lending Rates'.

41 CMA (2021), PR19 Final Determination, para. 9.263.

42 Further, the CMA does not characterise its decision as directly for CY. For example, it comments "what is also clear is that ILGs do not completely meet our [the CMA] requirement of the RFR as applied in the CAPM, that all market participants can borrow at the same rate" in para. 9.104.

4.3.7. The sections above indicate that the appropriate risk-free rate for the CAPM lies above the ILG yield because (1) investors cannot borrow at the ILG yield; and (2) ILGs benefit from CY.

4.3.8. These are two conceptually separate and necessary adjustments. The first applies where the risk-free borrowing rate exceeds the risk-free saving rate. The second applies even where these are the same.

Assume, as a simple benchmark, that investors can borrow and save at the same risk-free rate as in the standard CAPM

4.3.9. The first adjustment does not apply as investors' risk-free borrowing rate is equal to their risk-free saving rate i.e. there is a common risk-free rate.

4.3.10. The second adjustment does apply. The return on government bonds is below the risk-free rate as these bear CY. It follows that CY(ILG) must be added to the ILG yield to obtain the risk-free rate.

Now consider the more realistic case that investors' risk-free borrowing rate exceeds their saving rate

4.3.11. Specifically, investors' saving rate is equal to the common risk-free rate in the previous world but their borrowing rate increases.

4.3.12. The saving rate remains ILG yield plus CY(ILG). The borrowing rate now becomes ILG yield plus CY(ILG) plus borrowing costs. These borrowing costs relate to e.g. the transaction costs and collateral requirements associated with borrowing.

4.3.13. The CMA's estimate of the risk-free borrowing rate is discussed in the section below. The CMA's estimate of the risk-free saving rate is the ILG yield. However, a more complete estimate would be the ILG yield plus CY(ILG) as this explicitly takes into account the presence of CY.

III. AAA corporate bond yields as the risk-free borrowing rate

4.3.14. This section considers the CMA's estimate for the risk-free borrowing rate.

4.3.15. The CMA used AAA corporate bond yields as the risk-free borrowing rate because: "…the risk of loss resulting from default on these bonds is exceptionally low…" [43] 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" [44].

4.3.16. This is supported by Berk and DeMarzo (2014): "…practitioners sometimes use rates from the highest quality corporate bonds in place of Treasury rates in Eq. 12.1 [CAPM]"[45]. Brealey, Myers, Allen, and Edmans (2025) note that: "A common benchmark for r_B, the borrowing rate, is the yield on high-quality (e.g., AAA- or AA-rated) corporate bonds"[46].

4.3.17. The KPMG September 2023 CoE report explained that what matters is the rate at which investors, not corporates, borrow since it is investors who provide capital to corporates. Investors are backed by securities whose prices can significantly fluctuate whereas, corporates are backed by hard assets and thus can achieve lower borrowing costs.

4.3.18. In addition, van Binsbergen et al. (2022) remark that AAA corporate bonds may bear CY since they are safe, liquid, and collateralisable (see paragraph 4.4.37). If a bank lends to an investor, its loan is not safe, liquid, or collateralisable and so investors do not benefit from a

43 CMA (2021), PR19 Final Determination, para. 9.146.
44 CMA (2021), PR19 Final Determination, para. 9.149.
45 Berk, J. and DeMarzo, P. (2014), Corporate Finance, p. 404.
46 Brealey, R., Myers, S., Allen, F. and Edmans, A. (2025), 'Principles of Corporate Finance', Chapter 8

convenience yield when borrowing. It follows that the AAA corporate borrowing rate is a conservative and likely understated estimate of the investor borrowing rate.

4.3.19. The AAA corporate borrowing rate is used as the risk-free borrowing rate even though it is (almost but) not perfectly risk-free as specified by Brennan (1971). This is because the AAA corporate borrowing rate represents the lowest possible rate at which corporates can borrow in the real world, which is a lower bound for the rate at which investors can borrow. In this context, the AAA corporate borrowing rate is the best possible estimate of the risk-free investor borrowing rate for the practical application of Brennan (1971).

4.3.20. The CMA shared this view, noting that it "…consider[s] that the yield on these [AAA] indices provides information on the lowest risk borrowing costs available to nongovernment market participants…" [47].

IV. Ofwat's and CEPA's points

4.3.21. This section considers Ofwat and CEPA's points in relation to Brennan (1971).

Brennan (1971) is not used in other regulatory jurisdictions and rarely in asset pricing

4.3.22. Ofwat indicates that Brennan (1971) is not used in other regulatory jurisdictions and more generally rarely used for asset pricing.

4.3.23. On the first point, Ofwat should not dismiss Brennan (1971) because it is not aware of its use in another regulatory jurisdiction. Brennan (1971) is clearly an improvement on Ofwat's approach due to the empirical reality that borrowing and lending rates differ. A regulator should seek to be a thought leader and implement best practice.

4.3.24. In the UK, Brennan (1971) was first applied by the CMA at PR19. Since PR19, other UK regulators have broadly followed the CMA PR19 FD approach to setting the risk-free rate. This includes CAA H7 FD[48], CAA NR23 FD[49], UREGNI GD23 FD[50] and UREGNI RP7 FD[51].

4.3.25. In Europe, regulators have implicitly adopted Brennan (1971).

4.3.26. The German federal network agency, Bundesnetzagentur, estimates the risk-free rate using an index containing bank, corporate and public sector bonds from domestic issuers. It has adopted this approach in its determinations for energy networks since 2005[52].

4.3.27. The Italian regulatory authority, ARERA, estimates the risk-free rate in the allowed return for gas and electricity sectors using government bond and AAA rated corporate bonds. It has adopted this approach in its latest determination for the gas and electricity sectors[53].

4.3.28. On the second point, Brennan (1971) is theoretically justified, long established and is covered in standard corporate finance textbooks[54] which suggests it is well accepted and best practice for asset pricing.

The Sharpe-Lintner CAPM is simple and has strong backing in regulatory precedent

4.3.29. Ofwat considers that the use of a single risk-free rate as applied in the Sharpe-Lintner CAPM is simple and has long regulatory precedent.

47 CMA (2021), PR19 Final Determination, para. 9.150.
48 CAA (2022), H7 Final Proposals, Section 3: Financial issues and implementation, paras. 9.247-9.248.
49 CAA (2023), NR23 Final Decision, paras. 5.64 and 5.91-5.93.
50 UREGNI (2022), GD23 Final Determination, para. 10.17.
51 UREGNI (2024), RP7 Final Determination, para. 13.57.
52 https://www.bundesnetzagentur.de/DE/Beschlusskammern/BK04/BK4_74_EK_Zins/BK4_Beschl_EK_Zins.ht
53 https://www.arera.it/en/atti-e-provvedimenti/dettaglio/21/614-21
54 Such as Berk and DeMarzo (2014), 'Corporate Finance'; and Brealey, Myers, Allen and Edmans (2025), 'Principles of Corporate Finance'.

4.3.30. On the second point, the CMA at PR19 overturned previous regulatory precedent on the risk-free rate by adopting Brennan (1971). Since PR19, other UK regulators have broadly followed the CMA's PR19 FD approach to setting the risk-free rate as highlighted above.

4.3.31. The CMA at PR19 recognised that prior to the publication of the UKRN CoE Study (2018)[55] there was a consistent precedent of setting the risk-free rate above spot 20Y ILG yields[56]. The purpose of this gap was not explicitly to reflect Brennan (1971). Nevertheless, the CMA considered that the gap *"…may have removed an inadvertent mitigation to problems associated with the standard regulatory approach of sole reliance on the potentially imperfect RFR proxy of government bond yields"*[57].

4.3.32. On the first point, the CMA's application of Brennan (1971) is relatively simple and not a significant departure from the Sharpe-Lintner CAPM. Its application balances the desirability for an accurate estimate of the risk-free rate that reflects the real world with the need to avoid undue complexity.

4.3.33. In this context, the CMA explained the rationale for its application of Brennan (1971) in the PR19 FD: "We [the CMA] acknowledge that we have not tried to undertake the exercise of assessing all investor borrowing and lending rates, or the precise balance of current and potential borrowers and lenders, in our target market. We consider that such an exercise would be impractical within a redetermination process. Rather, we have applied a highly-simplified but, in our opinion, reasonable assumption that we can gain sufficient insight into the market RFR…"[58].

4.3.34. Ofwat previously appeared in the PR24 DD to argue that since it is challenging to apply Brennan (1971) in full form, the right alternative is to do nothing. The CMA's application of Brennan (1971) is clearly an improvement on doing nothing as it recognises the reality of different borrowing and lending rates. It is not challenging to apply since it merely adjusts the yield on ILGs for the AAA-ILG difference as explained in paragraph 4.4.4.

Brennan (1971) is not ambiguously more correct than the Sharpe-Lintner CAPM

4.3.35. CEPA's view is that that Brennan (1971) is not unambiguously more correct than the Sharpe-Lintner CAPM. It acknowledges that its view is not based on an exhaustive review of academic literature.

4.3.36. First, whilst CEPA acknowledges that it has not conducted an exhaustive review of academic literature, it should still review some academic literature in order to form a basis for its arguments. It has not referenced any academic literature to support its view and so it is not clear what its view is based on. It is not possible to evaluate the reasonableness of its view without the relevant references.

4.3.37. Second, academic literature has long recognised that in practice there is not a single risk-free borrowing and saving rate as assumed in the Sharpe-Lintner CAPM. For example, this issue is covered in Brennan (1971) and a review article of the CAPM by Fama and French (2004)[59], as well as standard textbooks. CEPA recognises the same: "…notwithstanding the fact that risk-free borrowing and savings rates do not coincide"[60]. Brennan (1971) provides a model to fix this issue and therefore it is clearly superior to the Sharpe-Lintner CAPM.

55 Wright et al (2018). Estimating the cost of capital for implementation of price controls by UK Regulators, (referred to as UKRN CoE Study in the remainder of this Report)..
56 CMA (2021), PR19 Final Determination, para. 9.99.
57 CMA (2021), PR19 Final Determination, para. 9.107.
58 CMA (2021), PR19 Final Determination, para. 9.263.
59 Fama, E. and French, K. (2004), 'The Capital Asset Pricing Model: Theory and Evidence'.
60 CEPA (December 2024), PR24 Cost of Equity, p. 30.

The Sharpe-Lintner CAPM has a number of assumptions which are invalid in practice

4.3.38. CEPA highlights that the Sharpe-Lintner CAPM has a number of assumptions which are invalid in practice. CEPA then suggests that it is not appropriate to "cherry pick" certain invalid assumptions and make corrections to the Sharpe-Lintner CAPM solely for these.

4.3.39. "Cherry picking" is a significant mischaracterisation of the approach in the KPMG August 2024 CoE report. This approach is to address the assumptions that can be feasibly addressed – regardless of whether doing so leads to an increase or a decrease in the cost of capital – rather than only to make the adjustments that lead to a higher cost of capital.

4.3.40. It is possible to correct for some invalid assumptions of the Sharpe-Lintner CAPM and not others. For example, it is possible to correct for the difference in risk-free saving and borrowing rates but not homogenous expectations. CEPA appears to suggest that as it not possible to correct for all the model's invalid assumptions, none should be corrected. It is reasonable to correct for invalid assumptions where it is possible to do so.

4.3.41. Whilst it is not possible to correct all the invalid assumptions of the Sharpe-Lintner CAPM, moving to Brennan (1971) corrects for the invalid assumption of a single risk-free saving and borrowing rate. As such, Brennan (1971) clearly represents an improvement to the Sharpe-Lintner CAPM because borrowing and lending rates differ.

4.3.42. Selecting Brennan (1971) over the Sharpe-Lintner CAPM is not cherry-picking. Cherry picking describes a situation where there are several equally-justified choices but the choice that gives the best value is selected. A model that allows for the reality of different borrowing and lending rates is clearly more justifiable than one that assumes they are the same.

Brennan (1971) is not in keeping with finance theory

4.3.43. CEPA suggests that Brennan (1971) is not in keeping with finance theory. It comments that "under the typical formulation of this model [i.e. the Black (1972) zero-beta CAPM], only one portfolio can be shown to have zero covariance with the market, which is inconsistent with the Brennan approach under which there are two risk-free portfolios, respectively offering risk-free borrowing and savings rates"[61].

4.3.44. CEPA appears to misunderstand and conflate Black (1972) and Brennan (1971).

4.3.45. First, as a minor point, under the Black (1972) zero-beta CAPM, multiple portfolios have zero covariance with the market. It is the portfolio that has zero covariance with the market *and* has the minimum variance over all such portfolios whose return is used in place of the risk-free rate. On p. 450 he writes "every portfolio with β equal to zero", which highlights how there are many such portfolios, and "portfolio z must be the minimum-variance portfolio".

4.3.46. Second, and more importantly, Black (1972) assumes no shorting costs: thus, borrowing (shorting the zero-beta portfolio) and lending (owning the zero-beta portfolio) are conducted at the same rate. Thus, even if Black (1972) showed that there is only one zero-beta portfolio in a world with no shorting costs, this has no implications for how many zero-beta portfolios there are in a world with shorting costs. Brennan (1971) *should* be inconsistent with Black (1972) as Black assumes away the friction that Brennan introduces.

4.3.47. Specifically, Brennan (1971) does consider shorting costs, or equivalently a difference in borrowing and lending rates. This means that a saver earns the risk-free return and a borrower pays the risk-free return plus shorting costs.

61 CEPA (December 2024), PR24 Cost of Equity, p. 30.

The risk-free saving rate is appropriate for the marginal investor in water

4.3.48. Ofwat considers that provided the marginal investor in water is a net lender, the risk-free borrowing rate is irrelevant. This argument was made by Ofwat and its advisers at the PR19 appeal.

4.3.49. Ofwat has not engaged with the discussion of this argument in the KPMG September 2023 CoE report or the KPMG August 2024 CoE report. CEPA makes only a single comment on the discussion; it comments that the argument made by Ofwat's advisors should not clearly be dismissed as wrong[62].

4.3.50. It is not appropriate for Ofwat to make this argument without engaging with the evidence. CEPA has not provided any evidence to support its view that the argument is not wrong. This is not the right evidential standard to make decisions about the allowed return.

4.3.51. The evidence in the previous CoE reports is outlined below. The intuition behind this is discussed further in section 12.2.

4.3.52. Ofwat relies on the arguments by Wright and Mason (2020)[63]. They correctly state that it is the marginal investor that determines asset prices and the cost of capital, and correctly define the marginal investor as "the investor who is most likely to be trading actively at the margin and therefore has the most influence on price" (paragraph 3.9). However, they incorrectly assume that marginal investors are the same as current investors.

4.3.53. In paragraph 3.10, they write: "The type of the marginal investor is typically assumed to be the same as the type who holds most of the stock. In the case of the four UK water companies in this appeal, the marginal investor appears to be institutional". In the footnote attached to this paragraph, they refer to the then current shareholders of Anglian Water (webpage no longer available), Bristol Water (webpage no longer available), Northumbrian Water and Yorkshire Water.

4.3.54. The conflation of current investors with marginal investors is an important misunderstanding of CAPM, and indeed the economic concept of the term "marginal". The marginal investor is the one whose demand is most elastic to small changes in the price: they will buy more if the price drops slightly and sell some if the price rises slightly. Because their trading behaviour responds to price changes, they act as price-setters and determine market prices in equilibrium. Since buying more may involve borrowing at the borrowing rate, differential borrowing and lending rates are relevant for determining asset prices and thus the cost of capital, even if current water investors do not borrow. Indeed, hedge funds are often considered to be marginal investors, as they arbitrage away small mispricings. Hedge funds borrow – indeed, borrowing is sometimes necessary to buy underpriced stock – and are thus affected by the differential between borrowing and lending rates.

4.3.55. In contrast, current investors in water companies are not "trading actively", so they do not meet Wright and Mason's own (correct) definition of marginal investors. They do not adjust their holdings in response to small price changes (perhaps due to having a preference for utilities), meaning they do not act as price setters. For example, Mason and Wright refer to the shareholders of NWL. CKI have owned a majority stake in NWL since 2011.

4.3.56. A second reason why differential borrowing and lending rate matters, even if water companies' current investors are unlevered, is as follows. In the Brennan (1971) CAPM, investors no longer hold the market portfolio: different investors hold different portfolios depending on whether they are borrowers or lenders, and are thus not fully diversified. In the standard CAPM, risk-tolerant, return-seeking investors are willing to hold water, despite their low expected returns, because they can lever up to achieve their desired high expected returns. However, if borrowing rates exceed lending rates, the increased cost of borrowing

62 CEPA (December 2024), PR24 Cost of Equity, p. 30.

63 Wright and Mason (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, p. 4-10.

deters investors from fully leveraging their portfolios. This reduces their demand for water stocks, lowering their price and increasing their expected return. Intuitively, since borrowers hold fewer utilities stocks in a CAPM world, lenders hold more water stocks. Due to their resulting under-diversification and increased exposure to specific risks, they require higher expected returns as compensation. Thus, investors in water stocks earn higher returns not because they face higher borrowing rates themselves, but because they are undiversified.

4.3.57. The CMA at PR19 ultimately decided that it is was not necessary to define the exact nature of the marginal investor in water[64].

Risk premia should be deducted from the AAA corporate borrowing rate to derive the risk-free borrowing rate

4.3.58. CEPA considers that risk premia should be deducted from the AAA corporate borrowing rate to derive the risk-free borrowing rate. It cites illiquidity, default and complexity risk[65].

4.3.59. CEPA has not engaged with the discussion of this point in the KPMG September 2023 CoE or KPMG August 2024 CoE reports. Ofwat previously supported CEPA's point in the PR24 DD but does not mention it in the PR24 FD. This suggests Ofwat may no longer agree with CEPA.

4.3.60. Premia for illiquidity risk, default risk, and complexity risk should not be deducted because they affect the actual rates faced by investors. They pay such risk premia because borrowing markets are illiquid, investors may default, and their portfolios are complex. Indeed, capital market imperfections are why investors face different borrowing and lending rates to begin with, and are the motivation for the Brennan (1971) extension of the CAPM.

4.3.61. Indeed, Brealey, Myers, Allen, and Edmans (2025) do not recommend removing illiquidity, default, or complexity premia from AAA bond yields. Berk and DeMarzo (2020) note that borrowing rates are percentage points (not basis points) higher than Treasury yields; if illiquidity, default, or complexity premia were subtracted, they would be very similar.

4.3.62. The first proposed deduction is an illiquidity premium. However, illiquidity premia should not be deducted because borrowing markets are less liquid than lending markets. While investors can lend by investing in a wide range in safe assets all around the world, they have more limited sources of borrowing.

4.3.63. The second proposed deduction is a default premium, However, investors bear default premia because they may default. Indeed, default premia may be higher than for high-quality corporates since investors are backed by securities whose prices can significantly fluctuate whereas, corporates are backed by hard assets.

4.3.64. The third proposed deduction is a complexity premium, However, there do not appear to be established asset pricing models that feature complexity risk and this risk seems to have been proposed with limited theoretical or empirical justifications. CEPA does not cite academic papers that suggest that complexity risk should be priced in, nor that AAA bonds bear complexity risk. Moreover, even if a complexity premium exists, it may be that investors bear such complexity risk since lenders to such investors would have to evaluate their portfolios when deciding whether to lend to them.

4.3.65. The AAA corporate borrowing rate represents the lowest possible (and likely understated) cost at which investors in practice can borrow as explained in paragraph 4.3.14. It therefore represents the best estimate for the risk-free borrowing rate. It is not correct to deduct risk, liquidity, or complexity premia from the AAA corporate borrowing rate to derive the risk-free borrowing rate. This is discussed in paragraph 12.2.21.

64 CMA (2021), PR19 Final Determination, paras. 9.159 and 9.265.

65 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". CMA (2021), PR19 Final Determination, para. 9.138.

4.3.66. CEPA may consider it is not possible to identify the risk-free borrowing rate. In this case, CEPA should use the zero-beta return *plus* shorting costs in place of the risk-free borrowing rate in the Brennan (1971) framework. This is shown in Table 8.

4.4. Quantitative analysis of adjustments to ILG yields

4.4.1. This section estimates the adjustment required to the ILG yield to arrive at the appropriate risk-free rate for the CAPM in RPI terms.

I. Bounds for the appropriate risk-free rate in the CAPM

4.4.2. The bounds for the appropriate risk-free rate in the CAPM were set out in the preceding sections. These bounds are summarised in the table below. In the table, r* is the appropriate risk-free rate, r_S is the risk-free saving rate and r_B is the risk-free borrowing rate.

Table 8: 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

Source: KPMG analysis

4.4.3. The table covers two separate cases.

4.4.4. In the first case, r_S can be identified. r* lies between r_S and r_B in line with Brennan (1971). r_S is derived by adding CY(ILG) to the ILG yield. r_B is derived by adding the difference in yield between ILGs and AAA corporate bonds to the ILG yield, to end up with the AAA corporate bond yield. In other words, the lower bound adjustment to the ILG yield is CY(ILG) and the upper bound adjustment is the AAA-ILG difference.

4.4.5. In the second case, r_S cannot be identified. This may be the case if there is no risk-free asset, or the risk-free asset bears CY that cannot be estimated. 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.

4.4.6. This Report considers that the first case rather than the second case applies. To this end, the AAA-ILG difference and CY(ILG) are estimated in the sections below.

II. Adjustment for risk-free borrowing rate (AAA-ILG difference)

4.4.7. The KPMG August 2024 CoE report estimated the AAA-ILG difference directly by comparing the yield on RPI-linked AAA bonds to the yield on maturity-matched ILGs. The analysis in this Report has been improved in four ways.

4.4.8. First, CEPA commented that "it is not clear that the comparison between index-linked bond yields and the spot curve is like-for-like. The spot curve reflects the yield on a zero-coupon bond, while most of the ILBs used by KPMG are plain vanilla fixed-coupon - this difference in cash flow structure may drive yield differences…"[66]. For this reason, the analysis now compares the yield on RPI-linked AAA bonds to duration-matched ILGs.

4.4.9. Duration measures the weighted average time it takes for an investor to receive all the cashflows from a bond. Matching on the basis of duration rather than maturity limits differences in cashflow structure between index-linked bonds and ILGs.

66 CEPA (July 2024), PR24 Cost of Equity, p. 98.

4.4.10. Duration is shorter than the maturity of a bond where the bond has a non-zero coupon or is amortising. ILGs are zero coupon and bullet so their duration and maturity are equal.

4.4.11. This analysis comprises eight bonds; seven issued by the EIB and one used by the IBRD. These bonds meet the following criteria:

1) Bond is linked to RPI
2) Bond has been rated AAA throughout its life
3) Bond is GBP denominated
4) Bond is not an asset-backed security
5) Bloomberg has data for the bond

4.4.12. Bloomberg has duration data for active bonds and the yields for active bonds was generally only available from December 2014. Hence, the earliest window that could be adopted for the analysis was December 2014.

4.4.13. Second, the previous analysis considered the long-run and short-run averages of the AAA-ILG difference. The analysis in this Report focuses more on the 1m average like CEPA[67]. The 1m average reflects the latest data and therefore may provide the most reliable estimator. The 1m average is cross-checked against the long-run average to ensure it does not reflect temporary factors. The 1m average over January 2025 is used in this analysis.

4.4.14. Third, CEPA commented that Bloomberg uses the BVAL algorithm to price the index-linked bonds and the BVAL score[68] has in the past been below 5 for some of the bonds. As a result, the bond data for the analysis may be unreliable. To address this point, this analysis only uses index-linked bonds with a BVAL score of at least 6 on average over January 2025.

4.4.15. Bloomberg considers that "a BVAL score between 6 and 10 reflects that the BVAL price was generated by the Direct Observations model, using recent direct observations on the target bond such as trades, and/or with high corroboration across multiple executable or indicative data" [69]. Thus applying a threshold of 6 ensures the bond data is reliable.

4.4.16. Fourth, the previous analysis used bonds of all maturities to inform the estimate. The highest duration amongst the sample of bonds is 5.2Y as at 31 January 2025. This analysis uses the three bonds in the sample with a duration above 5Y (and a BVAL score of at least 6). Whilst these bonds fall short of the duration of Ofwat's risk-free rate proxy of 20Y, they represent the best available data that exists to inform the AAA-ILG adjustment.

4.4.17. The ISINs for the three index-linked bonds in the analysis are XS0132108704, XS0172367921 and XS0218874989. These were all issued by the EIB.

4.4.18. The analysis in this Report is carried out as follows:

1) Download the daily yield, daily price and daily amount outstanding as well as the daily duration for the three RPI-linked AAA bonds.
2) Calculate the daily AAA-ILG difference for each RPI-linked AAA bond based on its yield less the yield on a duration-matched ILG where data for both is available.
3) Calculate the daily market value for each RPI-linked AAA bond based on its price multiplied by its amount outstanding.

67 CEPA (December 2024), PR24 Cost of Equity, p. 28-29.

68 Bloomberg describe the BVAL score as "a unique numerical rating (on a 1 to 10 scale) that shows the relative strength of the recency, quantity and quality of market data inputs used in calculating the BVAL price for a particular security at a particular snapshot". Bloomberg (2023), BVAL's Pricing Methodologies, p. 3.

69 Bloomberg (2023), BVAL's Pricing Methodologies, p. 3.

4) Calculate the daily market value weighted-average of the AAA-ILG difference across the group of three RPI-linked AAA bonds.

5) Average the daily market value weighted-average over the estimation window.

4.4.19. The 1m average over January 2025 is 67bps. The average BVAL score over the same window for the first bond was 7.4 and other two was 7.1. This means the bonds are firmly above Bloomberg's BVAL score threshold of 6.

4.4.20. The long-run average over 08/12/2014 to 31/01/2025 across the 8 bonds was 137bps. The market-value weighted-average duration of the bonds was 8Y. The BVAL scores for the bonds have been below 5 for periods within this window.

4.4.21. This suggests that the 1m average is low relative to the long-run average but the 1m average is based on significantly more reliable data. On this basis, the 1m average of 67bps is selected as the point estimate.

4.4.22. The AAA corporate borrowing rate is a conservative estimate of r_B, as noted in paragraph 4.3.17. This means that at least 67bps needs to be added to the ILG yield to derive r_B.

III. Adjustment for risk-free saving rate (CY)

4.4.23. CY(ILG) can be estimated based on approaches using DVT (2025) and RPI AAA bonds. These approaches are discussed in turn.

Reworking of Ofwat's analysis based on DVT (2025)

4.4.24. DVT (2025) estimates CY(NG) using the put-call parity relationship on European FTSE100 options. It finds 2Y CY(NG) of 29bps.

4.4.25. In the PR24 FM, Ofwat inferred 2Y CY(ILG) from the 2Y CY(NG) in DVT (2025) by applying the following formula from Liu et al. (2015)[70]:

CY(NG) – CY(ILG) = Gilt BEI – Swap BEI (breakeven inflation)

4.4.26. The KPMG September 2023 CoE report indicated that this formula assumes the entire gap between gilt BEI and swap BEI is due to higher CY for 2Y NGs relative to 2Y ILGs. However, it should reflect that the gap could also be due to the illiquidity of inflation swaps. The modified formula becomes:

CY(NG) – CY(ILG) = Gilt BEI – Swap BEI + inflation swap illiquidity premium

4.4.27. Ofwat appears to agree with this modified formula[71].

4.4.28. In the PR24 FM, Ofwat used an estimation window for CY of 18/06/2007 to 27/07/2020 which broadly aligns with that in DVT. 2Y CY(NG) less 2Y CY(ILG) is 27bps over Ofwat's estimation window based on the modified formula above. This implies a 2Y CY(ILG) of 2bps.

4.4.29. The KPMG September 2023 CoE report considered that 2Y CY(ILG) is likely to lie between the estimate from the modified Ofwat analysis and the 2Y CY(NG) estimate from DVT (2025). This approach reflects a key finding from the Report 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. This finding is outlined in paragraph 12.1.22 for reference.

4.4.30. The result of the approach is a range for 2Y CY(ILG) of 2-29bps. The bounds of 2bps and 29bps are both likely to be higher based on a more recent data cut-off:

70 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'.

71 Ofwat (2024), PR24 Final Determination, Aligning risk and return – Allowed return appendix, p. 18.

1) DVT observe that CY(NG) appears to have a positive relationship with interest rates. Given that interest rates in the UK have risen significantly over 2020-2025, it is likely that CY(NG) is higher based on a more recent data cut-off.

2) 2Y CY(NG) less 2Y CY(ILG) is 27bps over Ofwat's estimation window. Updating the data cut-off to 31/01/2025 implies a slightly smaller value of 23bps. This would result in a higher estimate of CY(ILG), all else equal.

4.4.31. This means that it would not be appropriate to place excessive weight on the lower bound. The midpoint of the range of 15.5bps is selected as the point estimate for 2Y CY(ILG). It is reasonable to assume this 15.5bps holds for longer-dated ILGs based on paragraph 12.1.30.

4.4.32. This means that CY(ILG) of 15.5bps needs to be added to the 20Y ILG yield to derive r_S.

Cross-check based on RPI AAA bonds

4.4.33. CY(ILG) can be estimated by comparing the yield on RPI AAA bonds after adjusting for default risk to the yield on duration-matched ILGs. ILGs are the risk-free asset with CY, and RPI bonds after adjusting for default risk are the risk-free asset without CY.

4.4.34. This approach was adopted by the academic literature on CY prior to the publication of van Binsbergen et al. (2022), which was basis of DVT (2025). For example, Krishnamurthy and Vissing-Jorgensen (2012) compare the yield on AAA corporate bonds controlling for default risk to US Treasuries to estimate CY for US Treasuries. Importantly, the paper only adjusts for default risk, implicitly assuming that the superior liquidity of US Treasuries relative to other safe assets is part of its CY.

4.4.35. 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 (e.g. default and complexity risk) in AAA rated gilts alongside the convenience yield"[72].

4.4.36. The RPI AAA bonds are not asset-backed (senior unsecured) so complexity risk is not relevant. They are not illiquid so illiquidity risk is not relevant as shown in paragraph 4.4.62.

4.4.37. van Binsbergen et al. (2022) comments that the approach above could underestimate CY for US Treasuries. This is because a AAA corporate bond is sufficiently safe, liquid, and collateralisable to be somewhat money-like and therefore may itself bear CY. In this case, the yield on AAA corporate bonds controlling for default risk may be lower than the CY-free risk-free rate.

4.4.38. The estimate of CY(ILG) based on DVT (2025) should serve as the primary approach as this is at present the leading academic study on CY. However, estimates of CY(ILG) based on the approach above can serve as a cross-check as it originates from earlier academic literature on CY and has been endorsed by Ofwat in the PR24 FM.

4.4.39. The default risk embedded in AAA corporate bonds yields is estimated in paragraph 12.3.1. This range is 0-8bps with a point estimate of 4bps at the midpoint of the range. This point estimate recognises that AAA corporate bonds are not risk-free but are very low risk.

4.4.40. This suggests that estimates of CY(ILG) can be obtained by reducing the point estimate of the AAA-ILG difference by 0-8bps. The result is an estimate for CY(ILG) of at least 59bps.

4.4.41. This cross-check exerts upwards pressure on the estimate of CY based on DVT (2025). It supports a CY(ILG) adjustment of at least 15.5bps to the 20Y ILG yield to derive r_S.

72 Ofwat (2022), PR24 Final Methodology, Appendix 11 – Allowed return on capital, p. 15.

IV. Ofwat's and CEPA's points on AAA-ILG difference

4.4.42. This section considers Ofwat's and CEPA's points in relation to AAA-ILG difference.

The bond data may have reliability issues

4.4.43. Ofwat suggests that the data for the bonds in the sample may be unreliable and therefore the analysis should be dismissed entirely.

4.4.44. First, the analysis only uses bonds with a BVAL score above 6 which is Bloomberg's threshold for reliable data. As such, Ofwat's concern should now be resolved.

4.4.45. Second, in principle, it does not appear reasonable to dismiss the analysis entirely on the basis of data limitations. The analysis simply reflects the extent of the best available data.

4.4.46. Third, the CMA and CEPA used AAA bonds as the basis for their analysis. This suggests that CEPA and the CMA, like KPMG, rely on AAA bonds with the understanding that the data available for these bonds is not perfect but reflects the best that exists.

Most of the bonds are issued by the EIB and the EIB is not completely risk-free

4.4.47. CEPA comments that most of the bonds in the sample have been issued by the EIB and supranational organisations like the EIB are not completely risk-free.

4.4.48. The CMA recognised that supranational organisations like the EIB are common issuers of AAA rated bonds in its decision to base r_B on nominal AAA indices[73]. Supranational bonds are backed by multiple sovereign sponsors which means they are effectively sub-sovereign. As a result, they are very low risk and less risky than bonds issued by private institutions.

4.4.49. AAA bonds like those issued by supranational organisations are very but not completely risk-free. They represent the best possible estimate of r_B as explained in paragraph 4.3.19.

4.4.50. The CMA recognised the same, noting that it "…consider[s] that the yield on these [AAA] indices provides information on the lowest risk borrowing costs available to nongovernment market participants…"[74]. Moreover, AAA bonds have become slightly less risky since the CMA formed its view at PR19. This is indicated by the reduction in the default premium for AAA corporate issuers between PR19 and now which is discussed in paragraph 12.3.4.

4.4.51. In any case, the yields on AAA bonds are a conservative estimate of the investor borrowing rate as explained in paragraph 4.3.17. Thus it would be expected that most investors in practice could only borrow above this rate.

4.4.52. Brealey, Myers, Allen, and Edmans (2025) write that: "In practice, even though investors can save at the risk-free rate by buying Treasury bills, most can't borrow at that rate since they aren't risk free. A common benchmark for r_B, the borrowing rate, is the yield on high-quality (e.g., AAA- or AA-rated) corporate bonds. However, the rate at which investors can borrow may be even higher than for companies, because financial assets are often more volatile than corporate assets such as buildings and machines"[75].

4.4.53. Berk and DeMarzo (2020) note 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% to 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"[76]. This suggests that even collateral-rich investors have to borrow at a premium

73 CMA (2021), PR19 Final Determination, paras. 9.111 and 9.150.
74 CMA (2021), PR19 Final Determination, para. 9.150.
75 Brealey, R., Myers, S., Allen, F. and Edmans, A. (2025), 'Principles of Corporate Finance', Chapter 8.
76 Berk, J. and DeMarzo, P. (2020), 'Corporate Finance', p. 440.

over government rates that is above that implied by the AAA corporate borrowing rate (67bps based on paragraph 4.4.22).

V. Ofwat's and CEPA's points on CY

4.4.54. This section considers Ofwat's and CEPA's points in relation to CY.

Negative AAA-NG difference may point to negative CY(NG)

4.4.55. CEPA compares the yield on 20Y NGs to the yield on the CMA's nominal AAA index. It finds that the yield on the CMA's nominal AAA index has been 1bp below 20Y NGs in nominal terms over September 2024. It considers that the finding may point to negative CY(NG).

4.4.56. It is more correct to compare the yield on the CMA's nominal index to duration-matched NGs. CEPA has recognised the same[77].

4.4.57. Over January 2025, the iBoxx AAA 10Y+ index has been 36bps higher and iBoxx AAA 10-15Y+ has been 42bps higher then duration-matched NGs[78].

4.4.58. iBoxx indices start on 01/01/1998 which means the longest averaging window that can be taken for the AAA-NG difference is from this date until 31/01/2025. Over this long-run window, the iBoxx AAA 10Y+ index has been 57bps higher and the iBoxx AAA 10-15Y+ index has been 73bps higher than duration-matched NGs.

4.4.59. This indicates that AAA-NG difference is clearly positive. If this AAA-NG was adjusted for default risk in AAA bonds of up to 8bps, it would indicate a clearly positive CY(NG).

Illiquidity premium in RPI AAA bonds may overstate CY(ILG)

4.4.60. CEPA suggests that the illiquidity premium in the RPI AAA bonds may overstate the estimate of CY(ILG) in the cross-check. In other words, the estimate of CY(ILG) may reflect the illiquidity of RPI AAA bonds rather than solely the superior liquidity of gilts.

4.4.61. CEPA considers that assets with bid-ask spreads above 1% are illiquid[79]. This threshold has strong regulatory precedent. It has been adopted by Ofcom in the UK, BNetzA in Germany, E-Control in Austria and CNMC in Spain[80].

4.4.62. The average bid-ask spreads[81] over January 2025 for the three index-linked bonds in the analysis are 0.41% for the first bond, 0.71% for the second bond and 0.62% for the third bond. Accordingly, the bonds are liquid with reference to the 1% threshold. It follows that the bonds cannot carry an illiquidity premium.

4.4.63. Relatedly, bid-ask spreads can reflect more than just liquidity, such as: (1) inventory risk (the market maker might end up holding too much of the bond); or (2) adverse selection risk / information asymmetry (which can affect bid-ask spreads directly, not only indirectly through affecting liquidity). This could mean the index-linked bonds are more liquid than suggested by their bid-ask spreads.

4.4.64. The primary approach for estimating CY(ILG) based on DVT (2025) implies an estimate of 15.5bps and the cross-check based on RPI AAA bonds implies 59bps. Even if the RPI AAA bonds were assumed to be illiquid, the illiquidity premium would need to reflect 43.5bps of the 59bps for the cross-check to imply an estimate below the primary estimate of 15.5bps. This does not appear to be reasonable.

77 CEPA (July 2024), PR24 Cost of Equity, p. 98.
78 Based on daily duration-matching.
79 CEPA (December 2024), PR24 Cost of Equity, p. 32.
80 Frontier Economics (2020), Criteria to select peers for efficient beta estimation, p. 6.
81 Defined as (ask price less bid price) / ask price, as per CEPA.

CY(ILG) of 2bps could represent measurement noise

4.4.65. Ofwat considers the lower bound estimate of CY(ILG) of 2bps could represent measurement noise and thus the true value could be nil.

4.4.66. The 2bps represents the absolute minimum for the estimate of CY(ILG). The upper bound is 29bps. The point estimate is the midpoint of 15.5bps which is markedly greater than nil. The lower and upper bounds are likely to be higher based on a more recent cut-off date which would result in a higher point estimate. Further, the cross-check for CY(ILG) based on RPI AAA bonds implies a significantly higher estimate than 15.5bps.

CY(ILG) of 15.5bps would be offset by the default and illiquidity premia in ILGs

4.4.67. CEPA suggests that the point estimate of CY(ILG) of 15.5bps would be offset by the default and illiquidity premia in ILGs. CEPA cites an estimate of 26bps for the premia in ILGs.

4.4.68. First, CEPA has not proven any default or illiquidity premia in ILGs. Its analysis shows ILGs are nearly perfectly liquid and therefore cannot carry any illiquidity risk[82]. Investors and the CMA perceive government bonds to be free of default risk as explained in paragraph 12.0.7.

4.4.69. Second, the 26bps that CEPA cites is an estimate for the default and illiquidity premia in AAA bonds, not ILGs[83]. As such, it should not be deducted from estimates of CY.

4.4.70. Third, the 26bps can be deducted from AAA-ILG difference to derive an estimate of CY(ILG). The point estimate of the AAA-ILG difference is 67bps and removing 26bps from implies CY(ILG) of 41bps. This Report considers that there is no illiquidity premia in the RPI AAA bonds and the default premia is up to 8bps based on the most recent data.

VI. Conclusion

4.4.71. This section sets out the range and point estimate for the adjustment required to the ILG yield to arrive at a robust and unbiased estimate of the risk-free rate in RPI terms.

4.4.72. The range adopted for the adjustment required to the ILG yield is 15.5-67bps.15.5bps is the minimum adjustment required to derive r_S and 67bps is the same for r_B.

4.4.73. Brennan (1971) states that r* is a weighted average of r_B and r_S; however the theoretical weights cannot be translated into empirical measures.

4.4.74. The CMA in its application of Brennan (1971) at PR19 decided it was not necessary to assess the precise balance of borrowers and savers[84]. The CMA ultimately determined r* to be the midpoint of its estimates of r_B and r_S[85].

4.4.75. These considerations imply a point estimate of 41bps for the adjustment to the ILG yield, which is slightly below the midpoint of 15.5bps and 67bps. This might still be an underestimate as the estimates adopted for r_B and r_S are themselves potentially biased down.

4.4.76. Ofwat could consider that it is not possible to identify r_S if it considers that either there is no risk-free asset or the risk-free asset bears CY, which cannot be estimated. In either case, Ofwat should have followed the zero-beta return option in Table 8.

4.4.77. The zero-beta return option would imply a significantly higher adjustment to the ILG yield than 41bps based on the evidence presented in paragraph 4.2.13.

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82 CEPA (December 2024), PR24 Cost of Equity, p. 31.
83 CMA (2021), PR19 Final Determination, para. 9.110.
84 CMA (2021), PR19 Final Determination, para. 9.263.
85 CMA (2021), PR19 Final Determination, para. 9.265.

4.5. RPI-CPIH wedge

4.5.1. This section evaluates Ofwat's estimate of the RPI-CPIH wedge.

4.5.2. Ofwat comments that regulators have typically used the OBR's long-run RPI-CPI wedge of 0.9-1% to convert ILG yields into CPIH terms. However, the UKSA RPI reform should mean that there is no RPI-CPIH wedge after 2030. In this context, Ofwat has estimated the RPI-CPIH wedge in PR24 using a different approach to that in previous price reviews[86].

4.5.3. In the PR24 FD, Ofwat estimated an RPI-CPIH wedge of 0.33%.

4.5.4. Ofwat has estimated this RPI-CPIH wedge by placing equal weight on forecasts for the RPI-CPI wedge from inflation swaps and official forecasters. These forecasts are at the 20Y horizon reflecting that Ofwat's starting point for the risk-free rate is 20Y ILGs.

4.5.5. These two approaches are briefly described below:

1) **Inflation swaps** – uses 20Y zero-coupon RPI and CPI swap rates to directly estimate the 20Y wedge priced in financial markets. These swap rates do not include a forward rate adjustment.

2) **Official forecasts** – uses official forecasts of the annual wedge and assumes the annual wedge is zero post-2030 due to the UKSA RPI reform. This is a more fundamentals-based approach.

4.5.6. Ofwat does not place sole weight on swap-implied forecasts because swap rates contain illiquidity and inflation risk premia that may distort the swap-implied wedge as a measure of the true wedge expected by investors. It places equal weight on swap-implied forecasts and official forecasts because it considers the current macroeconomic environment could widen the gap between the inflation expectation priced-in financial markets and in official forecasts[87]. This has been Ofwat's position since the PR24 FM.

4.5.7. Ofwat in the PR24 FD revised its position; it now prefers swap-implied inflation to official forecasts. However, it continues to place equal weight on both approaches for consistency with its methodology in the PR24 FM and DD.

4.5.8. Ofwat assumes CPI can proxy CPIH because it considers the CPI-CPIH wedge is generally small and not persistently negative or positive over time. In the PR24 FM, Ofwat commented that CPIH was 6bps higher than CPI on average over the longest run of data available until September 2022[88].

4.5.9. Ofwat's approach for estimating the RPI-CPIH wedge appears reasonable in principle. Based on a January 2025 cut-off date, the estimate of the RPI-CPIH wedge is 0.32%[89].

4.5.10. The CMA should monitor evidence on the RPI-CPIH wedge and consider whether it is appropriate to assume a CPI-CPIH wedge of zero over the period until the 2030 UKSA RPI reform[90].

4.6. Derivation of the risk-free rate range for PR24

4.6.1. The table below summarises the overall range and point estimate for the risk-free rate.

86 Ofwat (2024), PR24 Draft Determination, Aligning risk and return – Allowed return appendix, p. 109.
87 Ofwat (2022), PR24 Final Methodology, Appendix 11 – Allowed return on capital, p. 22.
88 Ofwat (2022), PR24 Final Methodology, Appendix 11 – Allowed return on capital, p. 22.
89 Based on OBR's October 2024 Economic and fiscal outlook as the official forecast (here).
90 The RPI-CPIH wedge is expected to become zero after 2030 which will make the CPI-CPIH wedge irrelevant from that point. This means the CPI-CPIH wedge is only relevant for 5Y out of the 20Y horizon of Ofwat's RPI-CPIH wedge estimate.

Table 9: Overall range and point estimate for the risk-free rate

Component	Index	Formula	Ofwat	KPMG		
				Lower	Upper	Point
1m average of 20Y ILG yields	RPI	A	1.85%	1.85%	1.85%	1.85%
Adjustments	RPI	B	0%	0.155%	0.67%	0.41%
Risk-free rate	RPI	C = A+B	1.85%	2.01%	2.52%	2.26%
RPI-CPIH wedge	n/a	D	0.32%	0.32%	0.32%	0.32%
Risk-free rate	CPIH	E = (1+C)*(1+D)-1	2.18%	2.33%	2.85%	2.59%

Notes: Based on a cut-off date of 31 January 2025
Source: KPMG analysis and data from LSEG

4.6.2. Ofwat's PR24 FD was based on a cut-off date of 30 September 2024. The table below summarises the overall range and point estimate for the risk-free rate based on this cut-off.

Table 10: Overall range and point estimate for the risk-free rate

Component	Index	Formula	Ofwat	KPMG		
				Lower	Upper	Point
1m average of 20Y ILG yields	RPI	A	1.19%	1.19%	1.19%	1.19%
Adjustments	RPI	B	0%	0.155%	0.74%	0.45%
Risk-free rate	RPI	C = A+B	1.19%	1.35%	1.93%	1.64%
RPI-CPIH wedge	n/a	D	0.33%	0.33%	0.33%	0.33%
Risk-free rate	CPIH	E = (1+C)*(1+D)-1	1.52%	1.68%	2.27%	1.98%

Notes: Based on Ofwat's PR24 FD RPI-CPIH wedge and a cut-off date of 30 September 2024
Source: KPMG analysis and data from LSEG

5. Total Market Return

5.0.1. The total market return (TMR) represents the expected return on a market portfolio that reflects the investment opportunities available to a well-diversified investor. TMR is not directly observable, as it is a forward-looking estimate based on investors' expectations of returns for taking on equity market risk. As a result, it must be estimated.

5.0.2. This section outlines the methodology used in this Report to estimate the TMR and addresses the points raised by Ofwat in the FD. The section is structured as follows:

1) It sets out the methodology for estimating the ex post TMR.
2) It sets out the methodology for estimating the ex ante TMR.
3) It derives an overall TMR range based on both ex post and ex ante estimates.

5.0.3. For each of these components, the table below summarises and contrasts the approach adopted in this Report with the methodology used in the PR24 FD.

Table 11: Ofwat's and this Report's approach to estimating TMR

Component	This Report	PR24 FD
Historical ex post	Simple 1-year arithmetic average	10- and 20-year overlapping averages of returns
Historical ex ante	DMS decompositional approach[91] and implementation of the Fama-French Dividend Growth Model (DGM)[92] using Global Investment Returns Yearbook (DMS) data	
Overall TMR range	Bounded by the midpoint of the ex-ante and ex-post ranges.	Bounded by highest and lowest datapoints from the combined analysis.

Source: KPMG analysis and PR24 FD

5.1. Estimation of TMR using the historical ex post approach

5.1.1. The historical ex post approach estimates the expected market return using returns observed over a long period (120+ years). The returns are calculated annually, and an averaging technique is then applied to derive a single value from the annual returns of multiple periods.

5.1.2. Several averaging techniques can be used to derive the TMR estimate. The process of selecting the appropriate technique involves two steps[93]: (1) assessing whether there is robust evidence of serial correlation[94] in the returns; and (2) considering the perspectives[95] of both investors (providers of capital) and capital budgeters (users of capital, or the company).

91 This approach seeks to infer the TMR by decomposing 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. The latter two elements are considered to be 'non-repeatable', at least in expectation, while the first two elements are taken to inform investors' expectations.

92 Fama and French use a dividend growth model to decompose 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).

93 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.

94 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. Negative serial correlation would indicate that a period of outperformance in returns is likely to be followed by a period of underperformance, and vice versa.

95 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.

5.1.3. If returns are serially uncorrelated, the simple 1-year average provides the best estimate of expected returns for any randomly selected year and serves as the correct measure for long-run forecasts.

5.1.4. Serial correlation in returns is not a necessary condition for using long-run average historical returns to estimate the TMR. Rather, the use of historical returns is grounded in the principle that they provide a reasonable expectation of future performance, based on the assumption that past trends can inform future market behaviour.

5.1.5. Determining the presence or absence of serial correlation is primarily an empirical question. The application of statistical models is a well-established practice in corporate finance and econometrics for evaluating the existence of serial correlation.

5.1.6. Serial correlation is not a default feature of data, but rather a condition that must be established through empirical analysis of the specific dataset. In other words, the assumption is that there is no serial correlation unless proven otherwise. Consistent with this, the absence of serial correlation is treated as the null hypothesis in conventional statistical testing.

5.1.7. There is no statistically significant evidence of serial correlation at 5% significance level in UK real returns used for TMR estimation based on the empirical analysis undertaken in this Report[96].

5.1.8. 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. 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'"[97].

5.1.9. As both perspectives are equally valid, the correct approach in a regulatory setting – as noted by Schaefer (2020)[98] – 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.

5.1.10. To represent a neutral rate, the TMR estimate must be free of any assumptions regarding holding periods, investment horizons, and reinvestment patterns. Only in this way can the TMR remain unbiased, unadjusted, and suitable for use by both investors and capital budgeters, with each applying their own adjustments to suit their respective scenarios. A TMR estimated based on a simple 1-year average provides this neutral rate.

5.1.11. The 1-year simple arithmetic average yields a TMR of 6.93% CPIH-real. This figure aligns with the midpoint of the ex post range from the FD (6.87 – 6.98%).

96 This Report employs both the Cumby-Huizinga test and the Portmanteau test to assess whether there is statistically significant evidence of serial correlation. 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. 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. 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: 1953 and 1954, 1958 and 1959, and 1973 and 1974. The final pair is responsible for apparent negative autocorrelation. Where these pairs are excluded from the testing 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

97 CMA (2021), PR19 Final Determination, para. 9.328.

98 Steven Schaefer (2020), Comments on CMA views on Estimating Expected Returns.

Table 12: Ex post TMR estimate

CPIH-real	Estimate
1-year simple arithmetic average	6.93%

Source: KPMG analysis

I. Ofwat's points

Negative serial correlation supports departure from the 1-year simple arithmetic average

5.1.12. Ofwat has not presented any statistically significant evidence of serial correlation in UK real returns. Instead, it argues that statistical tests have limited utility in detecting serial correlation and that negative serial correlation in historical equity returns is "a widely-recognised finding in academic and practitioner studies alike"[99]. In effect, Ofwat is asserting that the presence of serial correlation should be accepted as a given.

5.1.13. In statistics, the burden of proof lies in demonstrating that serial correlation is present, rather than proving its absence. In a regulatory context, accuracy and objectivity are essential, meaning that any adjustments and assumptions must be well justified and based on empirical evidence. It is unclear why a lower standard of evidence for serial correlation should be applied in a regulatory setting compared to what would be expected in a statistical context.

5.1.14. The quantitative evidence cited by Ofwat does not provide sufficient or robust grounds to conclude that serial correlation is present and should be actively considered in the selection of the averaging technique. Ofwat argues the following:

1) The authors of the DMS dataset acknowledge the presence of serial correlation, finding a coefficient of -0.08 for UK real returns. However, this value is not statistically significant[100] and should not be relied upon to inform the approach for the estimation of ex post TMR.

2) Observed variance ratios of UK equity returns decline over time, indicating that longer holding periods reduce variance, consistent with negative serial correlation. However, as Ofwat acknowledges, this variance falls within the confidence interval of the theoretical variance ratio for a series without serial correlation[101]. The visual observation that UK outturn data is "at the lower end of possible outcomes"[102] does not, on its own, meet the evidential threshold required to justify reducing the TMR on the basis of serial correlation.

5.1.15. This dismissal of statistical significance as a necessary criterion for evidence to be used in regulatory price setting is inconsistent with Ofwat's approach to other CoE evidence, such as its treatment of cross-checks.

5.1.16. Ofwat argues that regulatory precedent from the CMA accepts the presence of negative serial correlation. However, the CMA has noted that there is "limited evidence on serial correlation in UK returns" [103]. The CMA has not categorically concluded that UK returns data is significantly serially correlated, nor has it opined on what constitutes a robust and objective approach to evaluating the presence of serial correlation in the specific dataset in question.

5.1.17. Notably, Ofgem appears to have revised its position on serial correlation, as it is now proposing to estimate the ex post TMR for RIIO-3 based on the 1-year simple arithmetic average, without any adjustments for serial correlation[104].

99 Ofwat (2024), PR24 Final Determination, Aligning risk and return – Allowed return appendix, p. 32.
100 DMS 2024 does not comment on the statistical significance of this value, However, the value can be replicated by applying the Cumby-Huizinga statistical test to the UK return series which allows for the examination of statistical significance.
101 Ofwat (2024), PR24 Final Determination, Aligning risk and return – Allowed return appendix, p. 33.
102 Ofwat (2024), PR24 Final Determination, Aligning risk and return – Allowed return appendix, p. 33.
103 CMA (2021), RIIO-2 Final Determination Volume 2A: Cost of equity, para. 5.258.
104 Ofgem (2024), RIIO-3 Sector Specific Methodology Decision – Finance Annex, para. 3.120, 3.123.

5.1.18. The academic and practitioner evidence cited[105] by Ofwat does not robustly or directly support the presence of negative serial correlation in UK real returns. First, the studies referenced are not specifically focused on UK equity returns. Second, this evidence is more nuanced than captured in the FD. For instance, Damodaran notes that “many estimation services and academics argue for the arithmetic average as the best estimate of the equity risk premium,” while Fama and French highlight that evidence of autocorrelation over longer time horizons is “clouded with statistical issues.” Furthermore, the paper from the CFA Research Foundation employs statistical testing to evaluate serial correlation, which appears inconsistent with Ofwat’s own position.

5.1.19. Statistical testing is essential, as findings are specific to the data source, and academic and practitioner evidence cannot be assumed to apply universally. In the absence of robust evidence of serial correlation in the UK real returns used for TMR estimation, there is no justification for dismissing the null hypothesis of no serial correlation.

5.1.20. Overall, a departure from the 1-year simple arithmetic average on the grounds of serial correlation is neither required nor justified.

Investor perspective is the more relevant perspective

5.1.21. Ofwat argues that the investor perspective is the more relevant one, given its primary objective to secure capital from investors with a horizon similar to the 10-20 years assumed in its CAPM. However, this position overlooks the dual purpose of the regulatory WACC. The regulatory WACC is also used by the notional company in determining present values for capital budgeting decisions and in guiding investment and financial planning within the regulated environment.

5.1.22. Ofwat acknowledges that the debate over which perspective is "correct" remains unresolved. However, by adopting a specific holding period based on the investment horizons of investors, Ofwat implicitly disregards the relevance of the capital budgeter perspective, effectively assuming the regulatory WACC is irrelevant for capital budgeters.

5.1.23. As it cannot be conclusively demonstrated that *only* the investor perspective is relevant, both perspectives should be accommodated by setting a neutral rate.

5.1.24. Overall, a departure from the 1-year simple arithmetic average on the grounds of perspectives is not required or justified.

5.2. Estimation of TMR using the historical ex ante approach

5.2.1. The historical ex ante approach uses long-run historical data to estimate forward-looking expectations, aiming to distinguish genuine investor expectations from the effects of ‘luck’. Two generally accepted methods for estimating the historical ex-ante TMR are: (1) the DMS decompositional approach and (2) the Fama-French DGM. These approaches are applied in this Report, as well as in the PR24 FD and CMA's PR19 FD[106].

5.2.2. The expansion of the DMS dataset in 2024 enables the implementation of both the Decompositional and Fama-French DGM approaches using this reputable and robust data source, allowing for direct estimation of the ex ante TMR in CPIH terms. This availability eliminates the need for alternative sources, such as the Barclays Equity Gilt Study, and ensures internal consistency with the ex post estimates. This data was not available to the CMA during the PR19 Redetermination but has been used in both this Report and the PR24 FD.

105 Namely: A. Damodaran (2023), Equity Risk Premiums (ERP): Determinants, Estimation, and Implications – the 2023 Edition; Fama, E.F. and K.R. French (1988), Permanent and Temporary Components of Stock Prices; D.Blanchett and J. Stempien (2024), Investment horizon, serial correlation, and better (retirement) portfolios, CFA Institute Research Foundation, p. 3.

106 CMA (2021), PR19 Final Determination, paras. 9.349-9.354.

5.2.3. Using this dataset, the ex ante TMR estimates under both methods fall within the range of 6.68% – 6.82%, as outlined in the tables below.

Table 13: Estimation of the ex ante TMR under the DMS Decompositional approach

Component	Value
Geometric mean dividend yield	4.55%
Growth rate of real dividends	0.65%
Geometric-to-arithmetic conversion	1.62%
Ex ante TMR (arithmetic)	**6.82%**

Source: KPMG analysis

Table 14: Estimation of the ex ante TMR under the DMS Decompositional approach

Component	Value
Average dividend yield95F[107]	4.41%
Average dividend growth rate	1.74%
Bias adjustment	0.53%
Ex ante TMR (arithmetic)	**6.68%**

Source: KPMG analysis

5.2.4. This Report and Ofwat's PR24 FD are consistent in not applying serial correlation adjustments to ex ante estimates. This is because the application of such adjustments is inconsistent with the principles outlined in the literature upon which these methodologies are based and may risk introducing distortions in the estimates or invalidating the models used.

5.2.5. Ofwat's approach to estimating ex ante TMR has evolved throughout the PR24 review, with the final position adopted in the FD being generally consistent with this Report. The 6.82% estimate under the DMS Decomposition approach is the one adopted in the FD. The exact estimate selected under the Fama-French approach remains unclear.

5.2.6. In applying the Fama-French model, the interpretation of the DMS data, particularly the definition of trailing dividend yield[108], influences the resulting estimate. The interpretation adopted in this Report – confirmed with one of the authors of the dataset – yields a TMR estimate of 6.68%. An alternative interpretation would result in an estimate of 6.91%.

5.2.7. Ofwat notes that "as the definition of trailing dividend yield used by KPMG corresponds to the definition used by one of the curators of the DMS dataset, we have incorporated the estimates from KPMG's ex-ante range into our determination of TMR"[109]. However, both the 6.68% estimate and the 6.91% estimate based on the alternative approach appear in Table 8 of the Allowed Return appendix, which is not consistent with the statement above. It should be noted, however, that due to the way Ofwat derives the overall TMR range, the 6.91% estimate does not impact on the FD TMR estimate, whereas the 6.68% estimate directly influences it.

107 As detailed in the 2002 paper, the Fama-French DGM uses arithmetic averages for dividend yield and growth rate unlike the DMS Decompositional approach. When projected forward these averages yield an equivalent of an expected geometric return. It is necessary to then apply an adjustment to account for the fact that dividend growth is less volatile than price growth. Fama, E. and French, K. (2002), 'The Equity Premium'.

108 DMS provides indices for total returns and capital gains, necessitating the formulation of an income index. Fama and French calculate a real dividend yield based on the opening value of the price index. Depending on the assumptions underpinning DMS data, additional transformation may be required to ensure the inputs are compatible with the Fama-French calculation. If the dividend stream is assumed to be continually reinvested, DMS inputs can be used in the Fama-French without additional transformation. If the dividend stream is assumed to be reinvested once at the end of the year, it needs to be divided by the opening price index. DMS does not explicitly state the assumed method. Clarification from the authors revealed that pre-1955 data assumes annual reinvestment, while post-1955 data assumes dividends are reinvested when received (although monthly data is not available). However, maintaining the pre-1955 assumption of annual reinvestment would increase the Fama-French estimator by approximately 23bps.

109 Ofwat (2024), PR24 Final Determination, Aligning risk and return – Allowed return appendix, p. 31.

5.3. Derivation of the TMR range for PR24

5.3.1. Table 18 sets out the TMR estimates derived in this Report based on approaches best justified based on a balanced evaluation of the most current market data, pertinent financial literature, and relevant regulatory precedent.

Table 15: Summary of TMR evidence

CPIH	Lower bound	Upper bound
Historical ex post		6.93%
Historical ex ante	6.68%	6.82%

Source: KPMG analysis

5.3.2. The historical ex post method is widely considered the most reliable, objective, and straightforward approach. In comparison, ex ante estimates introduce more subjectivity, particularly in the assumptions made about separating 'luck' from investor expectations and in determining what constitutes repeatable versus non-repeatable factors.

5.3.3. A key challenge with ex ante estimates is their reliance on assumptions regarding dividend growth, which can exhibit significant volatility. The Fama-French DGM approach projects dividend growth forward to infinity using the most recent annual growth rate. The DMS Decompositional method uses the geometric average dividend growth since 1900, however, this number itself can be quite unstable. Specifically, the UK dividend growth estimates in the 2020-2024 DMS yearbooks evolved as follows: 1.03, 0.57, 0.69, 0.66, and 0.75. The corresponding geometric yield estimates were 4.58%, 4.57%, 4.56%, 4.56%, and 4.55%.

5.3.4. When summing these and applying the 1.5% DMS suggested uplift for geometric-to-arithmetic conversion, the resulting variation in the ex ante estimate ranged between a minimum of 6.6% and a maximum of 7.1%. In contrast, the TMR estimate (based on DMS inflation) showed a more stable progression: 7.3%, 7.2%, 7.2%, 7.1%, and 7.1%. A similar result would be expected if the Fama-French analysis were back-cast to these years.

5.3.5. Moreover, the precise interpretation of dividend yields and reinvestment in the historical model presents additional challenges, as early years of the DMS dataset only report returns on an annual basis. However, in more recent years, as data availability has improved, the precise timing of dividends has been better documented and is unambiguously addressed in the datasets.

5.3.6. By contrast, the historical mean return has a clearer interpretation and is more defensible theoretically. If it is assumed that expected returns on the market are approximately normally distributed and follow a stationary process, the arithmetic average return represents the expected one year ahead return for any given year. Additionally, it has the advantage of having a measurable standard deviation, and thus an observable standard error, which can be a useful into the selection of the point estimate.

5.3.7. This suggests that placing greater weight on the ex post method could result in a more robust TMR estimate. In consequence, this Report adopts the ex post estimate only to inform the TMR range. The resulting point estimate of 6.93% is similar to the CMA's PR19 point estimate of 6.81% and the 6.83% estimate from the PR24 FD.

5.3.8. Notably, Ofwat has altered its approach to weighting ex ante and ex post estimates: instead of setting an overall TMR range based on the midpoint of the ex ante and ex post ranges, it now uses the highest and lowest data points from the combined analysis. This is because applying the DMS data to ex ante estimates results in a significantly narrower TMR range than in previous determinations. Depending on the values of the underlying estimates, this approach may lead to an unequal weighting of the ex post and ex ante methods, which could fail to accurately reflect the relative robustness of each approach.

6. Beta

6.0.1. Beta parameter within the CAPM framework reflects an asset's (or a portfolio of assets') exposure to systematic risks relative to the market.

6.0.2. This section outlines the methodology used in this Report to estimate beta. It also addresses the points raised by Ofwat in the FD. The section is organised into the following key 6 steps:

1) It sets out the risk context for estimation of the PR24 beta.
2) It considers the appropriate treatment of distortive events affecting historical betas in the estimation of the forward-looking beta for PR24.
3) It considers which available comparators can most closely capture the underlying systematic risk for the sector on a forward-looking basis.
4) It considers the potential impact of changes in forward-looking risk on beta.
5) It comments on other technical issues including available data frequencies and averaging techniques and their relevance and reliability for the estimation of PR24 beta.
6) It derives an overall beta range for PR24.

6.0.3. For each of these steps, the table below summarises and contrasts the approach adopted in this Report with the methodology used in the PR24 FD.

Table 16: Ofwat's and this Report's approach to estimating beta

Component	KPMG Report	PR24 FD
Treatment of distortive events	Yes – variants based on long-run data	None
Treatment of forward-looking risk	Yes – yes via several different approaches	None
Comparators	SVT, UUW, PNN and NG	SVT and UUW
Data frequency	Daily	
Estimation windows	10-year	5- and 10-year
Averaging windows	Spot	
Debt beta	0.10	

Source: KPMG analysis and PR24 DD

6.1. Risk context for the estimation of PR24 beta

6.1.1. Beta is a forward-looking measure of the systematic risk expected by investors over the assumed long-term investment horizon[110]. Beta estimates derived from historical data may not accurately reflect future risk, particularly in a changing risk environment. Regulators[111] have generally recognised these limitations and tried to adapt their beta estimation methodologies to incorporate forward-looking risk factors.

110 In the PR24 DD, Ofwat noted that its "estimate of beta attempts to proxy for market participants' view of long-run (10-20 year) systematic risk exposure over 2025-30". Ofwat (2024), PR24 Draft Determination, Aligning risk and return – Allowed return appendix, p. 49. See also CMA (2023), H7 Final Determination, paras. 6.69 and 6.87.

111 In the SSMD for RIIO-3, Ofgem noted that "regulators typically use historical beta data as the base of the estimate for beta on a forward-looking basis. This means that estimating beta is easier in a 'steady state' environment than a dynamic environment" and that "to ensure that we are capturing the risk of the sector on a forward-looking basis as accurately as possible, we have considered ways to make our beta assessment more robust". Ofgem (2024), RIIO-3 Sector Specific Methodology Decision – Finance Annex, paras. 3.192 and 3.194.
The CMA during the H7 appeal noted that "it does not follow that betas based on historical data are necessarily the most appropriate guide to the future assessment of risk". CMA (2023), H7 Final Determination, para. 6.87.

6.1.2. This Report starts beta estimation by evaluating whether historical risk is a suitable proxy for future risk. This is particularly critical for AMP8, as the sector is no longer in a steady state. Water companies are operating in a dynamic environment, characterised by increased delivery and performance challenges, heightened public, political, and regulatory scrutiny, and a much more challenging financing environment.

6.1.3. One of the most significant drivers of risk relevant to beta estimation is the increase in capital intensity. The scale of the AMP8 capital programme is unprecedented, presenting substantial deliverability challenges. These challenges are widely recognised by the market.

6.1.4. S&P characterises the increase in capital intensity at AMP8 as significant, highlighting that "an all-time high capital program creates significant execution risks"[112]. It notes that companies will face substantial pressure in AMP8 to secure supply chains, financing, and ensure timely, budget-compliant execution, all while contending with heightened regulatory scrutiny. Similarly Moody's anticipates that the ratio of capex to the existing base will rise in AMP8 compared to AMP7, resulting in a decline in the scores for the size and complexity subfactor[113].

6.1.5. These deliverability challenges stem from several risk factors, including supply chain constraints, labour market uncertainty, input price volatility, and uncertainty in ex-ante cost forecasts. The drivers of increasing capital delivery risk are predominantly systematic, as they are linked to broader, economy-wide factors.

6.1.6. The significant increase in water sector investment, alongside significant concurrent investments in other infrastructure sectors, could strain supplier capacity and undermine supply chain stability, leading to delays, quality issues, and higher prices. These challenges are further exacerbated by ongoing constraints in the supply chain in terms of both availability of both suppliers and materials. These challenges are compounded by the residual impacts of Brexit, Covid-19, and the war in Ukraine. The impact of these events translate into systematic risk as they stem from broad, economy-wide issues that impact the entire market as well as the water sector.

6.1.7. Labour availability is also a material risk factor. The UK construction sector is already facing a shortage of skilled workers, with a significant number of vacancies unfilled. This challenge is expected to worsen due to an ageing workforce, the declining appeal of construction-related professions among younger generations, and uncertainties surrounding future immigration policies. Simultaneously, the rollout of large infrastructure programmes, including AMP8, will further limit the available labour pool. This represents a systematic risk factor because it stems from broader macroeconomic trends, such as demographic shifts, labour market dynamics, and immigration policies, which impact the wider economy, as well as the water sector.

6.1.8. Input price volatility, driven by global supply chain disruptions, inflation, and fluctuations in exchange rates, adds another layer of market-wide risk. These factors represent broader economic pressures that affect the entire economy and multiple sectors, and also significantly affect the water industry. While the regulatory regime provides some protection, it does not insulate companies from the broader macroeconomic factors that drive these costs.

6.1.9. Large and complex programmes can present inherent difficulties in budgeting and planning. Cost forecasts may be influenced by optimism bias[114], leading to estimates that do not fully capture the range of potential expenditure outcomes. Differences between cost estimates and allowances further exacerbate these challenges. While these issues are primarily company-specific, they are compounded by broader systematic risk factors, such as supply chain disruptions, input price volatility, and labour shortages. These broader economic pressures make it more difficult to accurately budget, plan, and execute large-scale projects, increasing the risk of cost overruns and delays.

112 S&P (2025), UK. Water Regulatory Framework Support, Low Financial Flexibility In Coming Regulatory Period Drive Rating Actions, p. 14.
113 Moody's (2024), Regulated Water Utilities – UK Reduced predictability of regulatory environment pressures credit quality, p. 4.
114 Supplementary Green Book guidance Optimism bias.

6.1.10. These factors point to increase systematic risk for the notional company going forwards. This implies that beta estimates calculated from historical listed water company data are unlikely in isolation to price forward-looking risk. Consideration of alternative approaches is required capture and price in forward-looking systematic risks.

6.1.11. In consequence, this Report estimates the PR24 beta in two stages. First, beta is calculated using long-term historical data to ensure the accurate pricing of business-as-usual (BAU) risk. Second, forward-looking evidence is incorporated to refine and adjust the beta for future risk exposures.

6.2. Treatment of distortive events

6.2.1. The estimation of a forward-looking beta, which appropriately captures the systematic risk that investors are expected to over the long term, requires careful consideration of distortive events and their potential impact on estimates of systematic risk over a long-run horizon.

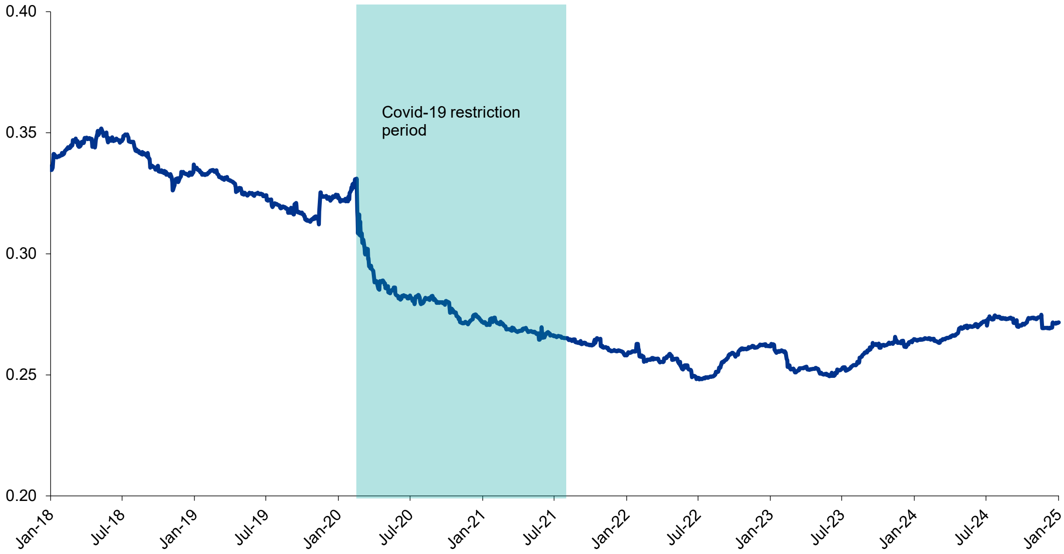
6.2.2. The AMP7 period was characterised by significant macroeconomic and geopolitical volatility. In particular, the Covid-19 pandemic shut down large sections of global and UK economies, fundamentally altering demand, disrupting supply chains, and changing consumer behaviour. Inflationary pressures intensified post-pandemic, compounded by the Russia-Ukraine war, which spiked energy prices and further strained global supply chains. In response, the Bank of England (BoE) raised base rates to levels not seen since the early 2000s. Some of the subsequent policies further destabilised the UK economy, adding to the uncertainty faced by businesses and investors.

6.2.3. Of these factors, the most material affecting the representativeness of historical water company betas for the future is the mandated shutdown of large sections of the economy during the Covid-19 pandemic. The Bank of England characterised this period as "one of the most turbulent periods of its economic, political, and public health history"[115] noting that "the prospect of economic paralysis, due to a global health crisis, pressed the UK Government to take unprecedented measures to protect the economy and millions of jobs"[116].

6.2.4. The material impact of the pandemic onset and the associated response on betas is evident in the figure below. The figure shows an immediate and significant decline in water company betas. Notably, within one year of the pandemic's onset, 5-year betas – which are typically more stable than short-term estimates – fell by 16-17%, a material reduction.

115 The UK economy during Covid-19: insights from the Bank of England's Citizens' Panels.
116 The UK economy during Covid-19: insights from the Bank of England's Citizens' Panels.

Figure 12: Evolution of SVT and UUW 5-year unlevered betas



Source: KPMG analysis using LSEG Workspace data.

6.2.5. To empirically examine the impact of the pandemic response on water betas, a structural break analysis[117] is applied to the 10-year beta estimation window for the SVT/UUW composite. A dummy variable (RP) is used to capture the periods affected by Covid-19 restrictions from 16 March 2020 to 19 July 2021, based on UK Covid-19 lockdown timeline[118]. This dummy variable and its intersection terms are then included in the beta regression to identify the impact of the structural break on beta values[119].

6.2.6. The table below summarises the regression outcomes. The negative and statistically significant coefficient β_3 indicates that the pandemic restrictions led to a significant reduction in the raw equity beta for the pure play water portfolio, of c. 0.17.

Table 17: Stuctural break analysis outputs for testing the impact of pandemic on betas for the water sector

Variable	Coefficients	Standard error	t-statistics	P-value
Intercept (α)	0.000	0.000	0.349	0.727
Base SVT/UUW beta (β_1)	0.657***	0.030	21.720	0.000
Dummy variable – RP (β_2)	0.000	0.001	0.399	0.690
The impact of pandemic on beta (β_3)	-0.171***	0.056	-3.043	0.002

Note: *** represents the coefficient is statistically significant at 99% confidence level since p-value is smaller than 0.01.
Source: KPMG analysis using LSEG Workspace data

6.2.7. The lockdowns and restrictions implemented during the pandemic led to the shutdown of large sections of the economy. This resulted in some sectors experiencing high fixed costs and no revenue, such as airports, hotels, cruise ships, and restaurants. This in turn resulted in an increase in both operating and financial leverage, subsequently increasing betas for

117 Structural break analysis is a statistical tool used to identify points in a time series where there is a significant change in the underlying behaviour of the data. A dummy variable is typically introduced, taking the value of 1 for data points that fall within the structural break period and 0 otherwise. This dummy variable, along with interaction terms – representing the dummy variable multiplied by other explanatory variables – is then included in the original regression. The coefficient of the interaction variable reflects the impact of the structural break on the underlying data.

118 The first restrictions on non-essential activities were introduced on 16 March 2020, and most Covid restrictions were lifted after 19 July 2021, marking the end of the 4-stage roadmap for easing the lockdown. Source: Institute for government analysis, Timeline of UK government coronavirus lockdowns and measures, March 2020 to December 2021.

119 The structural break analysis is run on the following regression over the period from 1 February 2015 to 31 Jan 2025, where the coefficient β_3 represents the impact of pandemic restrictions on the betas for the water sector:
$Water\ stock\ return = \alpha + \beta_1 * FTSE\ return + \beta_2 * RP + \beta_3 * FTSE\ return * RP$

these industries. As value-weighted betas must sum to unity, the betas for sectors less impacted by the restrictions – such as utilities – decreased as a mechanical effect of the rise in betas for the industries most affected by the Covid-related shutdowns. Given the economic and societal consequences of the response to the pandemic, it is highly unlikely that future responses to pandemics would involve such extensive lockdowns or restrictions. Consequently, occurrence of comparable restrictions within the investment horizon for water companies is improbable.

6.2.8. There is no definitive method for mitigating the impact of distortive events on beta estimates. However, not applying adjustments to address this impact leads to a bias in both beta and CoE estimates. An adjustment is therefore necessary to reduce the bias, but the level of adjustment is uncertain.

6.2.9. Given inherent uncertainty in this analysis, this Report explores three different approaches for adjusting beta estimates, each based on different assumptions regarding the extent to which the impact of Covid-19 response should be adjusted for in beta estimates. These approaches are applied to SVT, UUW and PNN (comparator selection is discussed in 6.3).

6.2.10. The first approach does not apply any adjustments to empirical estimates and instead relies on a long-term, stable 10-year estimation window. Longer-term estimates offer a larger sample size, improving precision and reliability by reducing random variations, smoothing short-term fluctuations, and mitigating the impact of temporary market conditions. A 10-year window is broadly representative of the regulatory regime without including less relevant data from the early 2010s.

Table 18: Beta estimates under the first approach

SVT/UUW	PNN
0.29	0.32

Source: KPMG analysis using LSEG Workspace data

6.2.11. The second approach incorporates an explicit adjustment for distortions due to Covid response. It calculates the beta estimates under the assumption that the mandated lockdowns did not occur[120]. This approach assumes that the economic impact of the pandemic was primarily confined to the actual lockdown periods, and therefore only those periods need to be adjusted. The resulting beta is 0.30 and 0.34 for SVT/UUW composite and PNN respectively.

Table 19: Beta estimates under the second approach[121]

SVT/UUW	PNN
0.30	0.34

Source: KPMG analysis using LSEG Workspace data

6.2.12. The third approach adjusts beta estimation for the entire period during which Covid restrictions were implemented. This approach reflects the fact that the disruptions caused by Covid persisted even during less stringent restriction periods. The resulting beta is 0.32 and 0.36 SVT/UUW composite and PNN respectively.

120 Based on the UK Covid-19 lockdown timeline, there are in total 3 official lockdowns implemented during the pandemic. First round started from 23 March 2020 to 23 June 2020, second round lasted for only 4 weeks from 05 November 2020 to 02 December 2020 and the last round occurred between 06 January 2021 and 08 March 2021. Source: Institute for government analysis, Timeline of UK government coronavirus lockdowns and measures, March 2020 to December 2021.

121 The coefficient before the market return variable in the structural break analysis represents the raw equity beta if structural breaks did not occur. This equity beta is then de-levered to an unlevered beta based on the 10-year average gearing excluding the structural break dates, as of 31 January 2025.

Table 20: Beta estimates under the third approach

SVT/UUW	PNN
0.32	0.36

Source: KPMG analysis using LSEG Workspace data

6.2.13. The overall range across the three approaches is 0.29 to 0.36, with the lower bound based on the unadjusted 10-year beta for SVT/UUW, and the upper bound based on the adjusted 10-year beta for PNN, adjusted for the full period of Covid restrictions. The average of the estimated range is 0.32.

6.2.14. Ofwat estimates beta based on an average of unadjusted 5- and 10-year betas. The 5-year beta estimate for SVT/UUW as of January 2025 is 0.27, which is materially lower than the betas from the three variants and significantly below the pre-pandemic beta of 0.33, as estimated by the CMA at PR19[122]. This lower beta reflects the fact that a significant portion of this 5-year period – approximately 26% – is affected by restrictions. As a result, the 5-year estimate is not reflective of long-run risk for the sector or changes in the risk landscape at PR24, and is not used to underpin the beta estimate in this Report.

I. Ofwat's and CEPA's points

The Covid-19 pandemic is an 'uninfluential factor' for the water sector

6.2.15. Ofwat considers that the impact of Covid-19 on the water sector is immaterial, particularly when compared to other sectors such as aviation[123]. In support of this view, Ofwat quoted the CMA's statement in the H7 decision that "the impact of the pandemic on water betas was relatively small compared to airport groups."

6.2.16. Statistical analysis clearly indicates that the impact of the Covid-19 response on water company betas was material. At PR19, the CMA acknowledged the pandemic's significant influence, noting that the inclusion of affected data "materially reduces the spot, 1-year, and 2-year rolling average beta estimates in comparison with the various estimates to February 2020"[124].

16.5-year betas confirm that the PR24 FD estimate aligns with the risks investors expect over a long-run CAPM horizon

6.2.17. Ofwat considered that the 16.5-year beta, which covers the longest possible window without incorporating data from non-pure play periods, results in an average unlevered beta of 0.283[125]. This is aligned with the midpoint of its 5- and 10-year beta ranges, providing Ofwat with confidence that the approach adequately reflects the long-term risks investors might expect over a 10-20 year CAPM horizon.

6.2.18. First, using 16.5 years of data is arbitrary and inherently includes outdated information that is less relevant for pricing forward-looking risks for water companies. Second, there is a trade-off between the representativeness and robustness of beta estimates. A 16.5-year period incorporates data from the beginning of AMP5 which was a fundamentally different regulatory, operational and financing environment for water companies.

6.3. Comparator selection

6.3.1. The selection of appropriate comparators for estimating forward-looking betas in the water sector is a significant challenge. Even if risk were assumed to be stable over time, out of twelve large water and sewage companies[126] only three are publicly listed. This significantly

122 CMA (2021), PR19 Final Determination, Table 9-10.
123 Ofwat (2024), PR24 Final Determination, Aligning risk and return – Allowed return appendix, p. 44.
124 CMA (2021), PR19 Final Determination, para. 9.94.
125 Ofwat (2024), PR24 Final Determination, Aligning risk and return – Allowed return appendix, p. 58.
126 Including both water and sewage companies, and large water-only companies.

limits the pool of direct comparators and could introduce a material bias if the small sample available is not fully representative of the sector. This issue is compounded by the fact that historical betas of water companies may not accurately reflect the increasing risks associated with the substantial rise in investment required in the sector.

6.3.2. In recent price controls, only Severn Trent (SVT) and United Utilities (UUW) have been used for beta estimation by Ofwat. PNN was excluded due to its non-pure-play status, as it previously owned the waste disposal business Viridor, which was sold in 2020 [127]. National Grid (NG) has not been used in the estimation of water company betas, although water company betas are used in the estimation of energy network betas. This likely reflects, in part, the historical perception that water companies were lower risk compared to energy companies.

I. SVT and UUW

6.3.3. SVT and UUW as long-run pure play water companies are key comparators to underpin beta estimation.

6.3.4. At the same time, SVT and UUW have historically outperformed the industry due to several structural advantages, including strong operational performance, beneficial regulatory strategies, and favourable financing arrangements. This outperformance is not representative of the average company in the sector or the notional company, which is assumed to neither outperform nor underperform. Additionally, some of these advantages, such as long-term financing arrangements, are structural and likely to be enduring.

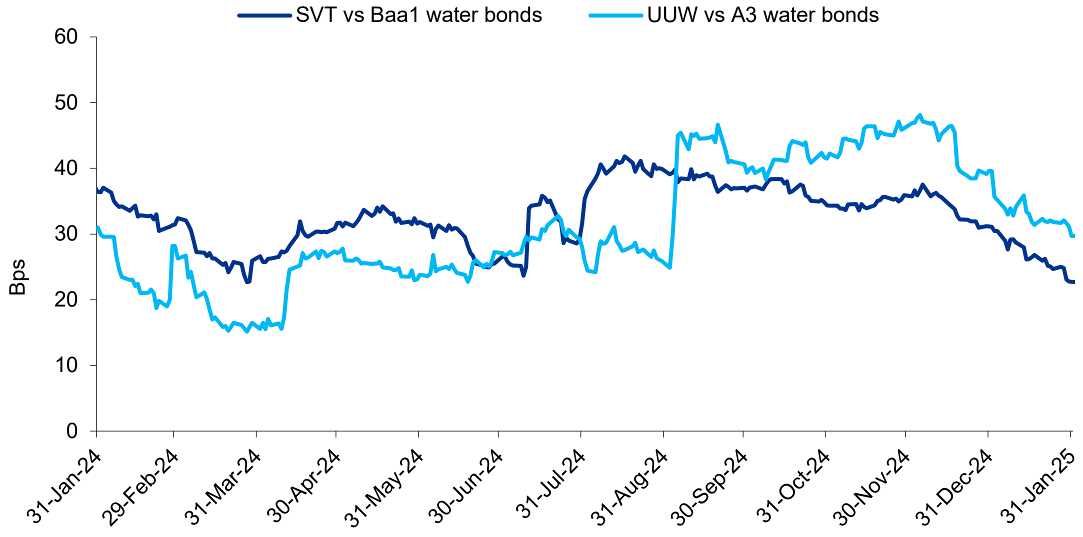
6.3.5. In this context, S&P in its recent sector downgrade has sought to differentiate its methodology for different groups of water companies. S&P's ratings for SVT and UUW incorporate a positive "business strategy modifier", which under its rating criteria is applicable only to companies whose strategy "bolsters the utility's regulatory advantage through favorable commission rulings, beyond what is typical for a utility in that jurisdiction" [128] to reflect their more favourable determinations and different risk profile. For typical companies, however, it will apply more demanding rating thresholds.

6.3.6. The figure below illustrates that other water companies have significantly higher yields on their public debt than SVT and UUW when issuing at the same rating. It will be important in this context that allowed returns are set such that the average firm in the industry can attract and retain equity capital.

127 Pennon's announcement of disposal of the Viridor Business.

128 S&P (2024), Sector-Specific Corporate Methodology, p. 149.

Figure 13: Comparison of SVT/UUW spreads to other water companies



Source: KPMG analysis based on LSEG Workspace data.
Note: Includes bonds issued by NES, WSX, SBB, SVT, UUW, ANH.

6.3.7. Relatedly, Moody's notes that UUW has delivered significant financing outperformance in AMP7, driven by low average cash interest costs and a well-spread debt maturity profile, ensuring continued outperformance on embedded debt in AMP8. It is also considered well-positioned to achieve financing outperformance on new debt[129].

6.3.8. This outperformance results in more stable and predictable returns compared to companies without these advantages.

6.3.9. The Total Return Index (TRI), which captures both price return and dividend yield, reflects the combination of a company's stock price movement and dividends. Because SVT and UUW have a track record of stability and regulatory success, their stock prices are less likely to experience significant volatility compared to companies without such advantages.

6.3.10. Stock price returns are largely driven by investor expectations and sentiment, and since SVT and UUW are perceived as having a predictable and strong regulatory and financial position, investors expect less uncertainty about their future performance. This results in reduced price volatility, which leads to a lower beta relative to the broader market, where companies are more sensitive to broader economic or industry-wide fluctuations.

6.3.11. Beta can be split into two components: correlation and the volatility ratio (the standard deviation of stock returns to market returns). The lower price volatility for SVT and UUW not only reduces their standard deviation of stock returns but also contributes to a lower correlation with the market. Since their performance is driven more by company-specific factors, such as regulatory and financial stability, rather than broader market movements, their stock returns are less likely to move in sync with the broader market. This lower correlation with market movements further contributes to a lower beta, as their price returns are less influenced by the same factors that drive overall market fluctuations.

6.3.12. SVT and UUW's strong performance, particularly in terms of low-cost financing and sector-leading operational performance, allows these companies to maintain stable or growing dividends. Dividend yield is an objective measure based on actual company performance and reflects the stability of cash flows. Since dividends are included in the TRI, any stability in dividends directly impacts the stability of the TRI. A company with consistent or growing dividends will exhibit less fluctuation in TRI because the dividend component of the TRI adds

129 Moody's (February 2025), United Utilities Water Limited / United Utilities PLC, Update following ratings downgrade, p. 8.

a stable, predictable element to the total return, helping to smooth out overall returns and reduce total volatility.

6.3.13. The stability of dividends also signals to investors the company's financial health and future prospects. If a company can maintain or grow its dividends, it generally indicates strong cash flow generation and a sustainable business model, even in challenging market conditions. Investors often interpret consistent or growing dividends as a sign of lower risk.

6.3.14. Both the price return and dividend yield impacts point toward a lower beta for SVT and UUW. The lower price volatility results in a lower standard deviation of stock returns, while the lower correlation with market movements means these companies' stock returns are less likely to track with broader market swings. Additionally, stable dividend yields further reduce the overall volatility of the companies' TRI, contributing to a lower risk profile and, consequently, a lower beta.

6.3.15. Overall, SVT and UUW as pure play water companies are key comparators – however, as outliers in the sector with more stable and predictable performance than the industry average company, it is critical to broaden the comparator set beyond these two companies where possible to capture a risk profile which is more representative of the sector on average and better reflects forward looking risk.

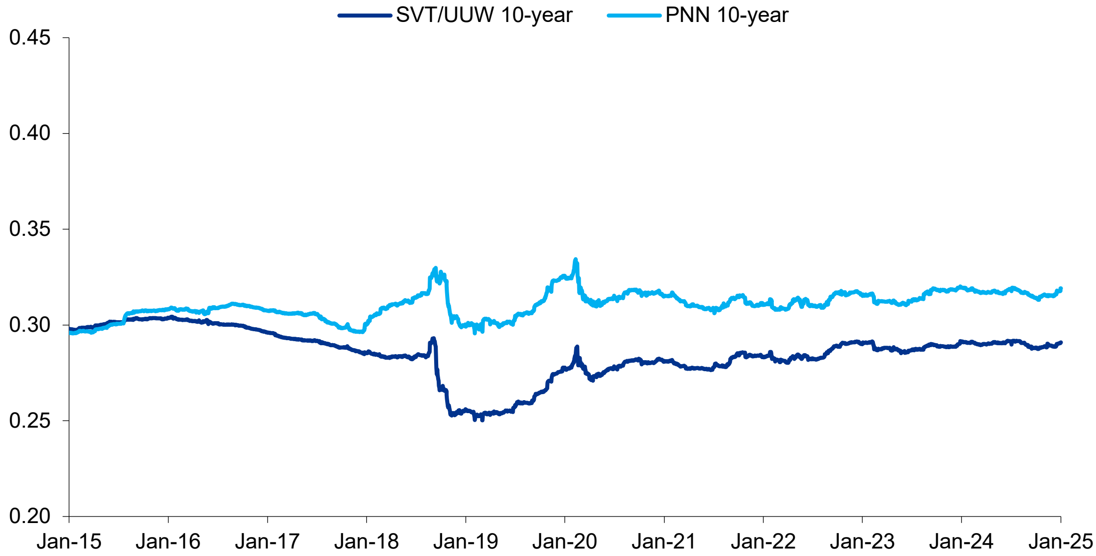
II. PNN

6.3.16. A key challenge in estimating beta is that historically there have only been two pure-play listed water companies characterised by strong operational and financing performance. Estimating beta based on only two companies with similar characteristics is likely to introduce material bias and a lack of precision.

6.3.17. In previous price controls PNN was considered a less suitable comparator for the notional company, based on the assumption that the difference between the unlevered betas of SVT/UUW and PNN reflected a higher overall business risk associated with PNN's combination of water and waste disposal operations. However, following the divestiture of Viridor, PNN's waste disposal business, it is now possible to analyse the impact of the sale and reassess the relative risk profiles of PNN's water and waste disposal businesses, as well as the systematic risk profile of the combined entity.

6.3.18. First, a comparison of the 10-year beta for PNN with the SVT/UUW beta reveals a significant differential. Two key observations emerge: (1) there has been a trend of divergence between these betas since around 2019, and (2) the differential has not notably reduced following the sale of Viridor in 2020, suggesting that the waste disposal business may not have been a material driver of the beta differential.

Figure 14: Evolution of the differential between pure play PNN and SVT/UUW 10-year betas



Source: KPMG analysis using LSEG Workspace data.
Note: The chart only covers the periods after the unwinding of the PNN net cash position. These values are based on observed, unadjusted gearing.

6.3.19. Second, structural break analysis of the impact of the Viridor disposal supports the conclusion that it did not have a statistically significant effect on PNN's beta. Since the transaction was completed during the pandemic, this analysis examines the impact of two distinct events, the pandemic (RP) and the sale of Viridor (PV), on PNN's long-run beta estimate as of 31 January 2025[130].

6.3.20. The table below summarises the outcomes. The coefficient β_3 is statistically significant, indicating that the pandemic led to a significant reduction in PNN beta, similar to SVT and UUW. In contrast, the higher p-value on the coefficient β_5 suggests that the sale of Viridor has no significant impact on PNN's beta[131]. Put differently, the primary factor influencing PNN's beta is not the sale of its non-regulated business, but rather the impact of Covid restrictions, which imposed a similar effect on the other two water companies as shown above (see para. 6.2.6).

6.3.21. PNN can be considered as a relevant comparator pre- and post-disposal of Viridor as (1) the impact of the disposal was not statistically significant (2) the differential between PNN and SVT/UUW has not reduced following the disposal, suggesting that characteristics of the PNN water business are a key driver of the differential to SVT/UUW.

130 This analysis includes two separate dummy variables. One dummy variable 'RP' (for the 'Restricted Period') is for the Covid restriction period from 16 March 2020 to 17 September 2021, as per the same dummy variable identified in para.6.2.5. Another dummy variable, 'PV' for 'Post Viridor,' is introduced, taking the value of 1 for PNN data after the sale of Viridor (08 July 2020) and 0 for data prior to the sale. Since these two dummy variables have overlapping periods, a multicollinearity test is applied and ensures no issues with multicollinearity. This is due to the overlapping period between the two variables being immaterial in comparison to the duration of the 'PV' dummy, which takes the value of 1 from 9 July 2020 to the analysis cut-off of 31 January 2025.

Then this analysis is applied using the following regression, covering the data span from February 1, 2015, to January 31, 2025, Where the coefficients β_3 and β_5 represent the impact of pandemic and Viridor sale on PNN beta respectively:

$$PNN\ return = \alpha + \beta_1 * FTSE\ return + \beta_2 * RP + \beta_3 * FTSE\ return * RP + \beta_4 * PV + \beta_5 * FTSE\ return * PV$$

131 The positive sign of the coefficient β_5 also infers that the sale of Viridor may have an upward impact on the PNN's long-run beta.

Table 21: Stuctural break analysis outputs for testing the impact of pandemic and the sale of Viridor on PNN's beta

Variable	Coefficients	Standard error	T-statistics	P-value
Intercept (α)	0.000	0.000	0.718	0.473
Base PNN beta (β_1)	0.679	0.043	15.721	0.000
Dummy variable - RP (β_2)	0.001	0.001	0.906	0.365
The impact of pandemic on PNN beta (β_3)	**-0.289*** **	**0.069**	**-4.203**	**0.000**
Dummy variable – PV (β_4)	-0.001	0.001	-1.546	0.122
The impact of Viridor sale on PNN beta (β_5)	**0.110**	**0.065**	**1.687**	**0.092**

Note: *** represents the coefficient is statistically significant at 99% confidence level since p-value is smaller than 0.01
Source: KPMG analysis using LSEG Workspace data.

6.3.22. PNN has operational performance which aligns more closely to the industry average than SVT and UUW. In this context, incorporating data from PNN is crucial for estimating beta for PR24, given that there are only two other water company comparators.

6.3.23. As a smaller WaSC with a risk profile that is more aligned with the industry average water company, PNN improves the representativeness of the comparator set.

III. National Grid (NG)

6.3.24. Historical betas in the water sector are unlikely to reflect the forward-looking risks associated with the unprecedented increase in the scale of required investment for PR24. To better capture and price this systematic risk, it is important to consider comparators that reflect these risks, including data from other UK regulated sectors with more significant historical capital programmes.

6.3.25. In principle, sectors such as energy, aviation, and telecoms could serve as useful references for pricing the risks associated with increased investment intensity. However, the regulatory regimes in aviation and telecoms differ significantly from those in the water sector, implying distinct exposures to regulatory risk. This introduces challenges in isolating the impact of investment intensity on beta estimates.

6.3.26. Historically, the regulatory frameworks for energy networks were considered more closely aligned with water networks. For instance, 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"[132].

6.3.27. Ofgem has also characterised "water networks in England and Wales as having very similar characteristics to the GB Energy networks, including a very similar regulatory regime and thematically similar challenges relating to ensuring resilience, managing investment and adapting to climate change"[133].

6.3.28. However, over the past several years, the perception of risk within the water sector has shifted. There is increasing evidence that the water sector is currently viewed as riskier than energy networks by some equity and credit market participants. For example:

132 CMA (2021), RIIO-2 Final Determination Volume 2A: Cost of equity, para. 5.347.
133 Ofgem (2024), RIIO-3 Sector Specific Methodology Decision – Finance Annex, para. 3.197.

1) S&P considers the water sector riskier than electricity transmission networks, owing to a deterioration in public and political perception and weaker financial resilience across the sector[134].

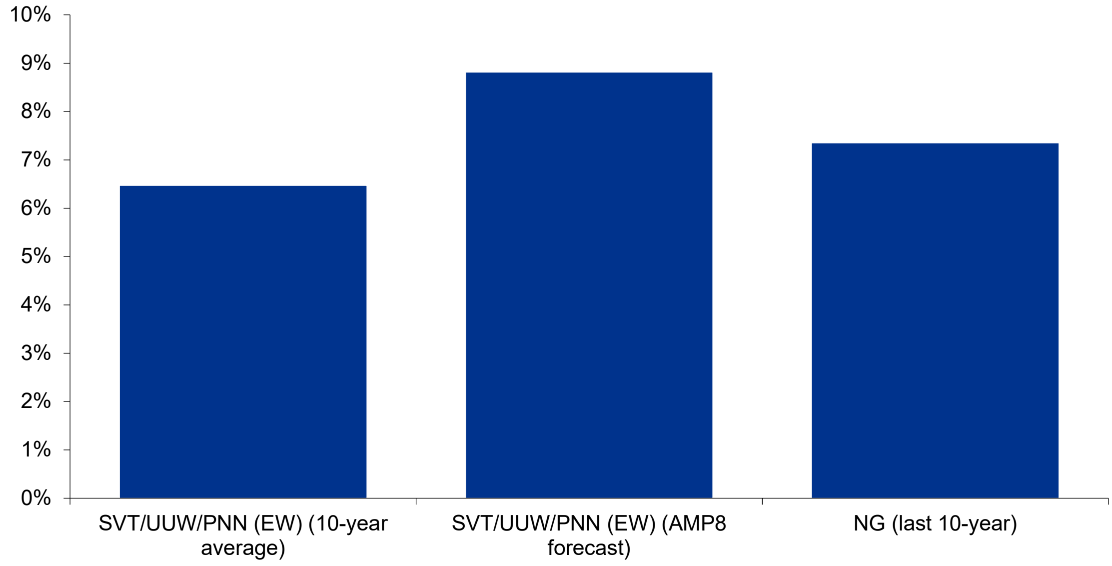
2) Following Moody's downgrade of its assessment of the stability and predictability of the regulatory environment for water from Aa to A, there is a two-notch delta between water and energy[135].

3) After the DD, Barclays noted that "Ofwat sees water as a lower-risk asset than other regulated assets. We do not see evidence of this, nor do investors... for example, we now see an asset beta for water of 0.40 versus 0.37[136] for power"[137]. Barclays continues to use a 0.40 asset beta for the water sector after the FD[138].

6.3.29. The increased risk for the water sector is supported by current market evidence. SVT/UUW betas now exceed beta estimates for NG.

6.3.30. Despite the recent divergence in market perception of risk, NG may still provide useful evidence for pricing forward-looking risk exposure. NG's historical capital intensity aligns more closely with the projected capital intensity for PR24 compared to the historical growth in the water sector, as illustrated in the chart below. However, while NG's beta data offers valuable insights, it may not fully capture the future risk exposure of the water sector due to two factors: (1) NG historically had lower capital intensity than projected for PR24, and (2) there is a growing perception of greater risk in the water sector compared to energy.

Figure 15: Comparison of capital intensity ratio



Source: KPMG analysis using LSEG Workspace data and London Share Price Database (LSPD).
Note: The capital intensity ratio is calculated as capital expenditure divided by opening total assets, excluding opening long-term receivables and current assets.

6.3.31. Ofgem is similarly considering the inclusion of additional comparators, specifically European energy networks, to enhance the pricing of forward-looking risk, despite these networks not being directly comparable to GB energy networks. Ofgem noted that "to ensure that we are capturing the risk of the sector on a forward-looking basis as accurately as possible, we have considered ways to make our beta assessment more robust. As we cannot 'create' pure-play

134 S&P (2025), UK. Water Regulatory Framework Support, Low Financial Flexibility In Coming Regulatory Period Drive Rating Actions, p. 9.

135 The stability and predictability of the regulatory regime for NG is scored at AAA. See, for example, Moody's (April 2024), National Grid Electricity Transmission plc, Update to credit analysis, p. 11.

136 Barclays uses a debt beta of 0.2.

137 Barclays (2024), Breaking the water cycle – no longer, so positive, p. 58.

138 Barclays (December 2024), Increasing certainty should re-rate sector, p. 11.

listed comparators, and manual adjustments to historical data (as suggested by the GDNs) are likely to be extremely subjective, we view the best improvements are likely to focus on including other relevant comparators in our dataset" [139].

6.3.32. Given the above, NG's beta is considered in this Report in the suite of evidence used to inform pricing of forward-looking risk exposure.

IV. Ofwat's and CEPA's points

6.3.33. Ofwat raises concerns regarding the inclusion of additional comparators such as PNN and NG, citing several arguments related to their relevance to the risk profile of the notional water company as set out below.

6.3.34. There is a significant risk that exclusion of a comparator omits relevant evidence which could improve the comparator set and give greater access to data that reveals investors' perceptions of the risks in water companies. While it is acknowledged that no comparator is perfect, SVT/UUW may not be representative of the notional company's risk profile as they are outliers in the water sector in terms of their operational, financing and regulatory performance.

Atypical volatility in PNN's gearing distorts the unlevered beta

6.3.35. Ofwat and CEPA consider that forward-looking expectations of PNN's overall value are influenced by factors that may not align with the risk exposure of a notional entity.

6.3.36. Key factors cited include[140]: (1) the acquisition of highly geared SES (relative to other companies and the notional entity), (2) an equity financing gap, and (3) potential impact of enforcement action on equity value[141].

6.3.37. Ofwat and CEPA question whether the higher unlevered beta estimates derived from PNN's data reflect the underlying business risk in the water sector or are influenced by lower-than-expected enterprise value gearing[142]. They suggest that using historical gearing to estimate PNN could underestimate the necessary de-levering adjustment, as investor expectations of higher gearing are not fully reflected, potentially overstating the unlevered beta.

6.3.38. First, the acquisition of SES has a negligible effect on gearing[143].

6.3.39. Second, the equity financing gap has now closed, and market analysts have adjusted their expectations for PNN's gearing. BNP Paribas[144] notes that the rights issue exceeded previous projections, with net debt/RCV gearing now expected to remain in the 60-65% range during AMP8. RBC[145] highlights that the £490m rights issue removed the balance sheet overhang, with gearing now projected at approximately 60% for the start of AMP8. Similarly, Morgan Stanley considers that the recent rights issue and DPS re-basing resolve balance sheet concerns for PNN[146].

6.3.40. Third, enforcement action for Pennon does not have a statistically significant impact on its beta. The announcement of the action in 2023 does not appear to have had any impact on the differential between PNN and SVT/UUW betas.

139 Ofgem (2024), RIIO-3 Sector Specific Methodology Decision – Finance Annex, para. 3.192.
140 CEPA (December 2024), PR24 Cost of Equity, p. 18.
141 CEPA notes "Barclays noted enforcement action could have led to £500m of equity valuation being wiped off Pennon's valuation, broadly equivalent to 20% of their equity value".
142 Ofwat (2024), PR24 Final Determination, Aligning risk and return – Allowed return appendix, p. 54.
143 As of March 2024, the combined gearing of South West Water and Bristol Water stands at 68.3%, while SES Water's gearing is 79.1%. With a total RCV of £4,837.8m for South West Water and Bristol Water, and £347.4m for SES Water, the weighted gearing of South West Water post-acquisition is 69.0%, which is a marginal increase relative to the 68.3%. See South West Water 2023-24 annual performance report, page 112, SES Water 2023-24 annual performance report, page 33, and Ofwat's Monitoring Financial Resilience report 2023-24 charts and underlying data.
144 BNP Paribas (29 January 2025), Valuation still looks attractive post rights issue, p. 1.
145 RBC Capital Markets (4 February 2025), Pennon Group Plc Upgrade to Outperform, PT 600p/sh, p. 1.
146 Morgan Stanley, Equity Story De-Risked, Onward to Growth, p. 1.

PNN is still not a fully 'pure play' wholesale water network

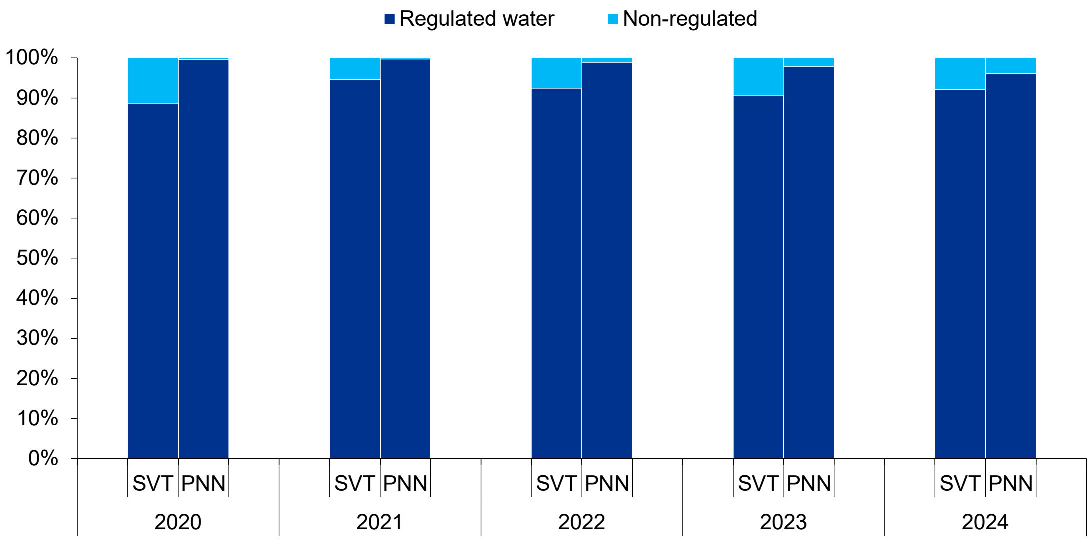
6.3.41. CEPA highlights that over a quarter of Pennon's 2023/24 revenues come from business retail activities subject to competition[147]. This exposure to competition is likely to make these activities riskier than the wholesale water network operations. This could explain the differences between PNN betas and those of other listed water companies.

6.3.42. CEPA notes that not being fully pure-play does not invalidate the evidence base, but rather requires assessing its relevance to the notional company and determining the appropriate weight to place on it.

6.3.43. Focusing on EBIT ((Earnings Before Interest and Taxes), rather than revenue share, provides a clearer and more meaningful assessment of the risk profile of PNN's business, particularly in light of its exposure to highly competitive and low-margin retail activities[148]. While retail activities represent 25% of revenue, they contribute less than 5% to EBIT, as illustrated in the chart below. This stark contrast highlights how relying on revenue share could misrepresent the impact of non-regulated activities. In comparison, the margin on SVT's non-regulated activities is significantly higher than for PNN[149], contributing more to overall profitability. All else equal, this suggests that PNN could be more representative of a pure play water company than SVT.

6.3.44. Investors are generally more concerned with profitability and the underlying returns of a business, which are better captured by EBIT. Revenue alone does not fully reflect risk, as it overlooks margin variations across different business segments. EBIT, as a measure of operational performance, provides a more accurate understanding of cash flow stability and risk, which directly impacts dividends and returns to investors.

Figure 16: Comparison of the share of non-regulated business in EBIT



Source: KPMG analysis using LSEG Workspace data.

6.4. Treatment of forward-looking risk

6.4.1. To ensure a robust and credible assessment, this Report first establishes the beta range based on long-term empirical beta estimates. It then refines the range using forward-looking evidence to identify the most accurate representation of future risk exposure.

147 CEPA (December 2024), PR24 Cost of Equity, pp. 17-18.
148 According to LSEG workspace, the average operating margin over 2020-2024 is below 1.5%.
149 2020-2024 average is 20%+..

6.4.2. The forward-looking analysis draws on several key sources of evidence, including 10-year beta estimates from NG, an examination of the relationship between capital intensity and beta, and the translation of the impact of increasing capital expenditure intensity on the RoRE range into the equity beta.

I. Evidence from long-run NG betas

6.4.3. The 10-year beta for NG is 0.33 under all three variants of mitigating the impact of Covid-19. This is above the midpoint of the BAU beta range of 0.32.

6.4.4. However, NG's beta may not fully capture the future risk exposure of the water sector due to two factors: (1) NG historically had lower capital intensity than projected for PR24, and (2) there is a growing perception of greater risk in the water sector compared to energy.

6.4.5. Analysis of NG's beta suggests that the upper half of the BAU beta range is more relevant for estimating a forward-looking beta for the water sector.

II. Evidence from the relationship between capital intensity and beta based on FTSE 350 excluding financials

6.4.6. This section investigates the relationship between capital intensity and beta based on the analysis of non-financial UK stocks included in the FTSE 350 [150]. Portfolios formed from FTSE 350 constituents, which are well-diversified and hence 'look through' company-specific factors, can isolate the impact of capital intensity on market beta.

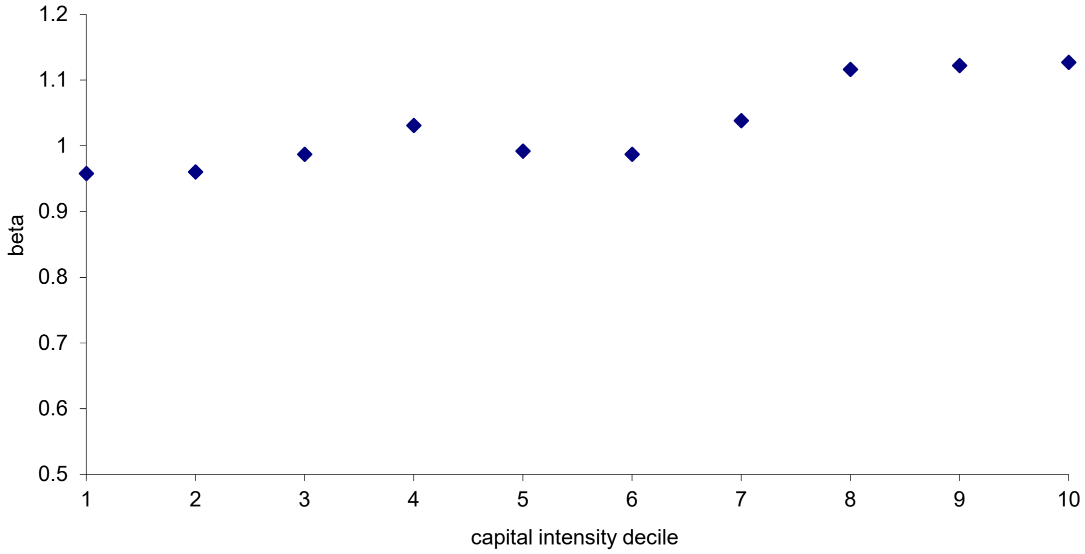
6.4.7. The non-financial companies within the FTSE 350 are classified into ten equally sized groups to form decile portfolios each year, based on their capital intensity ratios [151]. Two types of decile portfolios are constructed: 1) equally weighted (EW), where each constituent is assigned the same weight, and 2) value-weighted (VW), where weights are based on the market capitalisation of each constituent. A 10-year CAPM regression is performed on each capital intensity decile portfolio to estimate the respective portfolio beta. The detailed decomposition of the decile portfolios in terms of ratio and sectors are listed in Appendix 13.0.

6.4.8. There is a clear positive correlation between equity beta and capital intensity ratio is observed in both the EW and VW capital intensity portfolios. The relationship is not perfectly, but clearly observable. This is illustrated in the figures below.

150 Financials firms are excluded from the sample, given that the interpretation and implications of ratios, such as the leverage ratio and book-to-market ratios, are different across financials and non-financials firms. Foreign firms are excluded to be consistent with regulatory approach of focusing on the UK listed stocks.

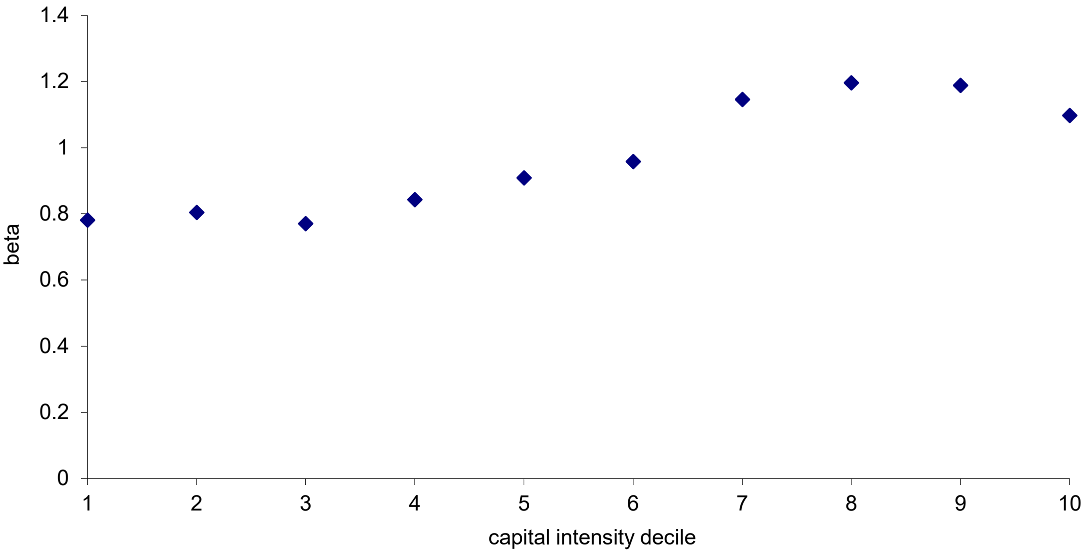
151 The capital intensity ratio for the FTSE 350 non-financial companies is calculated as capital expenditure divided by opening total assets, excluding opening long-term receivables and current assets.

Figure 17: Relationship between capital intensity and equity beta based on FTSE350 market-wide evidence (equally weighted decile portfolios)



Source: KPMG analysis using LSEG Workspace data and LSPD

Figure 18: Relationship between capital intensity and equity beta based on FTSE350 market-wide evidence (value weighted decile portfolios)



Source: KPMG analysis using LSEG Workspace data and LSPD.

6.4.9. To estimate the impact of increased capital intensity on beta for the water sector, a CAPM regression is run on a long-short capital intensity portfolio. The long portfolio reflects the forecasted capital intensity ratio of the water sector proxies[152], while the short portfolio reflects the water portfolios' average capital intensity ratio over the last 10-year. A positive and statistically significant market beta indicates that the systematic risk is expected to increase with the increase in capital intensity of the water portfolio in AMP8.

$$r_{\text{long}-\text{short porfolio}} = \alpha + \beta_m \ (r_m \ - \ r_f)$$

152 The forecasted capital intensity ratio is derived by applying a scaling factor of 1.36, based on the ratio of 10.9% (AMP8 forecasted capex/RCV) to the 15-year average of 8.0%. Water portfolios are constructed by equally weighting the SVT, UUW, and PNN portfolios

6.4.10. The decomposition of the long-short portfolio is shown in Appendix 13.0.

Table 22: Specification of the long-short portfolio analysis

Parameter	Specification
Regression window	December 31st 2014 to December 31st 2024
Water portfolio's historical ratio	Last 10-year average of SVT (6.87%), UU (5.62%) and PNN (6.91%)
Resulting capital intensity decile	6th decile
Water portfolio's forecast ratio	1.36 × historical 10-year average of SVT/UUW/PNN
Resulting capital intensity decile	7th decile
Long-short portfolio	$r_{\text{long-short porfolio}} = r_{\text{7th decile portfolios}} - r_{\text{6th decile portfolios}}$

Source: KPMG analysis using LSEG Workspace data and LSPD

6.4.11. Both EW and VW long-short portfolio have a market beta that is positive and statistically significant (with p-value of 0.00%). The beta estimates have a relatively tight 95% confidence interval, suggesting a high level of precision and certainty on the estimation of beta[153]. The regression outputs suggest an increase in capital intensity ratio for PR24 corresponds to an increase in equity beta of 0.051 and 0.188 for the EW and VW long-short portfolio, respectively, before adjusting for gearing.

Table 23: Equity beta value from the equally weighted (EW) long-short portfolio

Coefficient	Coefficient value	Standard error	p-value	95% confidence interval	
Intercept (α)	-0.000	0.000	54.3%	-0.000	0.000
Equity beta (β_m)	0.051***	0.014	0.00%	0.023	0.078

Note: * is significant at the 10% level, ** at the 5% significance level and *** at the 1% level.
Source: KPMG analysis using LSEG Workspace data and LSPD

Table 24: Equity beta value from the value weighted (VW) long-short portfolio

Coefficient	Coefficient value	Standard error	p-value	95% confidence interval	
Intercept (α)	0.000	0.000	88.8%	-0.000	0.000
Equity beta (β_m)	0.188**	0.020	0.00%	0.148	0.228

Note: * is significant at the 10% level, ** at the 5% significance level and *** at the 1% level.
Source: KPMG analysis using LSEG Workspace data and LSPD

6.4.12. Given that most companies included in the long-short portfolio analysis do not have regulatory risk mitigations, the lower end of the beta based on EW long-short portfolio is adopted in the analysis to avoid inflating the required uplift. The 0.042 increase in unlevered beta terms as per the table below is either applied in full or applied net of a 50% reduction to approximate the impact of regulatory protections. This results in implied forward-looking beta of 0.34 to 0.36.

Table 25: Results of the long-short portfolio analysis, unlevered beta impact

<table>
<tr><th></th><th>Adjustment 1</th><th>Adjustment 2</th></tr>
<tr><td>Equity beta impact</td><td colspan="2">0.051</td></tr>
<tr><td>Average EV gearing level of the 6th and 7th decile portfolio</td><td colspan="2">18%</td></tr>
<tr><td>Unlevered beta impact</td><td>0.042×50%</td><td>0.042</td></tr>
<tr><td>BAU beta (section 6.2.13)</td><td colspan="2">0.32</td></tr>
</table>

153 The 95% confidence interval suggests that 95% of the time the equity beta will fall within the range.

	Adjustment 1	Adjustment 2
Implied forward-looking beta	0.34	0.37

Source: KPMG analysis using LSEG Workspace data and LSPD

III. Evidence from translating the impact of the increasing capex intensity on RoRE range to the equity beta

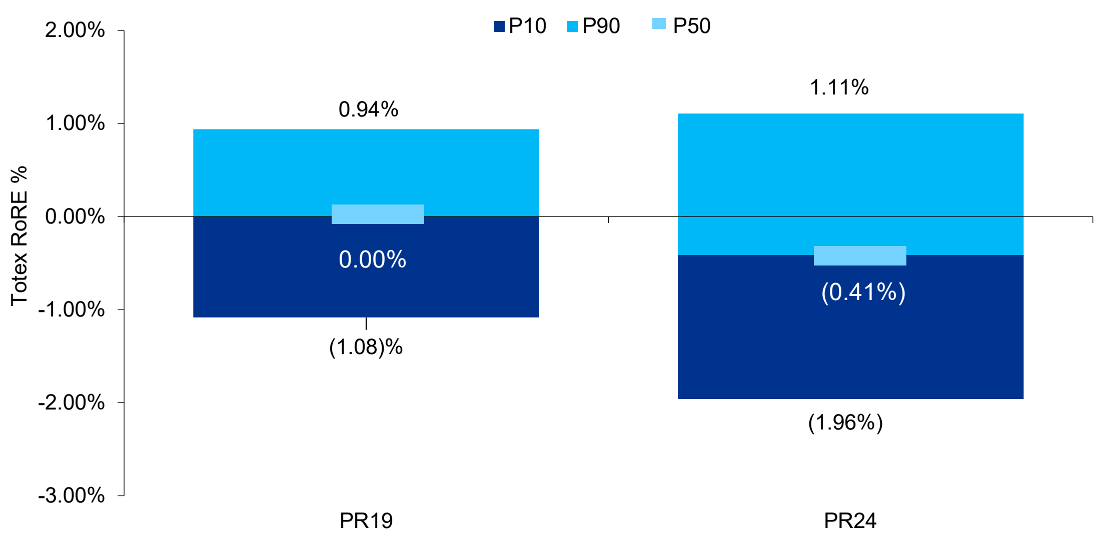
6.4.13. Regulators typically consider risk in RoRE terms and calibrate risk allocation such that the allowed CoE reflects the risks implied by ex-ante RoRE ranges.

6.4.14. The analysis of risk exposure implied by the PR24 FD Totex using KPMG's stochastic risk model (the KPMG model [154]) finds that there is a material increase in Totex risk relative to PR19 even after accounting for risk mitigations.

6.4.15. The analysis of risk is carried out by comparing the variance in the total RoRE range (the average of P10-P50 and P90-P50) based on two Totex range scenarios: (1) the Totex range PR19 FD [155], and (2) a Totex range reflecting forward-looking risk for PR24, with all other risk factors held constant. The change in the Totex RoRE is assumed to be predominantly driven by increased capex intensity.

6.4.16. The resulting variance in the total RoRE range for PR24 Totex is *higher* than the corresponding variance based on PR19 Totex [156]. This is in line with CEPA's consideration of capital intensity, which notes that "larger capex-to-RCV ratios create a greater potential impact on financial returns from cost efficiency incentives, relative to their base return. This can be shown by changes in Return on Regulatory Equity (RoRE)" [157].

Figure 19: PR19 vs. PR24 FD Totex RoRE for WaSCs



Source: PR19 Totex RoRE is based on Ofwat's expected PR19 Totex risk ranges in Ofwat PR19 FD - Aligning risk and return technical appendix, Figure 3.1. PR24 Totex RoRE is based on KPMG's risk analysis post PR24 FD.

154 KPMG risk analysis assesses, based on the available empirical evidence and historical sector performance data, whether the FD parameters and mechanisms allow the notional company to earn base allowed return on a median expected basis. The stochastic risk model is constructed to simulate the notional company's risk exposure in RoRE terms by key risk drivers, accounting for risk mitigations purposed by Ofwat in PR24 FD. In this Report, the RoRE outputs are based on the "Unmitigated" scenario in the club risk model focussed on design risk only, which is the scenario with full estimated risk exposure of the notional company under the FD regulatory regime, but removing the miscalibration risk, i.e. assuming that companies are able to improve their performance to the levels required in AMP8 to meet the FD targets.

155 PR19 Totex risk ranges presented in Ofwat PR19 FD - Aligning risk and return technical appendix, Figure 3.1.

156 See Appendix 2: Beta for detailed results.

157 CEPA (2024). PR24 Cost of Equity, page. 78.

6.4.17. In this context, the potential impact of the increasing capex intensity on the equity beta is assessed through the associated change in RoRE risk exposure arising from the step change in the scale of capital programmes at PR24.

6.4.18. Equity beta can be decomposed into the correlation between a company's returns and the market portfolio, multiplied by the ratio of the company's return volatility to that of the market portfolio.

6.4.19. The increase in RoRE variance indicates higher return volatility for the notional company. The approach to translating higher RoRE variance into betas has been refined in this Report. For this analysis, it is now assumed that the volatility of the market portfolio remains unchanged. As a result, the impact on equity beta depends on the correlation between the company's returns and the broader market, which will be influenced by the underlying drivers of the increase in volatility.

6.4.20. At one extreme, if the increase in volatility is driven entirely by systematic factors, the correlation between the company's returns and the broader market is likely to increase, resulting in a higher beta. At the other extreme, if the increase in volatility is driven entirely by idiosyncratic risk, the correlation with the broader market is likely to decrease.

6.4.21. The increase in PR24 Totex RoRE relative to previous price controls is expected to be at least in part driven by systematic factors as discussed in section 6.1.

6.4.22. Under the benchmark assumption that the increase in volatility arises from a proportionate increase in both systematic and idiosyncratic components, the correlation will remain unchanged. As a result, the increased standard deviation translates into a proportionate increase in beta.

6.4.23. This analysis may underestimate the scale of incremental risk exposure driven by AMP8 capital programmes due to its reliance on historical data from the water sector and the wider infrastructure project database complied by KPMG [158]. Past data is unlikely to reflect the full extent of the delivery challenge that large infrastructure programmes will face going forwards and may understate forward-looking risk. For example, supply chains will be strained by unprecedented competition for resources due to simultaneous large-scale infrastructure investments across various sectors and globally, significantly impacting delivery risk for water companies.

6.4.24. The variance in RoRE range is converted to an implied standard deviation of the company return, which is a traditional measure of the total risk exposure faced by companies, assuming that each risk driver performance is normally distributed [159]. RoRE outputs from the KPMG model and the PR19 RoRE range implies an increase in standard deviation of 1.1x.

6.4.25. Based on the difference in the total risk exposure associated with the increasing capex intensity, the unlevered beta expected to be uplifted by the same scaling factor from the BAU beta to 0.36, as shown in the table below:

Table 26: Results of the translating RoRE variance to equity beta, unlevered beta impact

	Unlevered beta
BAU beta (A)	0.32
Scaling factor on BAU beta (B)	1.10x
Implied forward-looking beta (C = B*A)	0.36

Source: KPMG analysis using KPMG club risk model and Ofwat's expected PR19 Totex risk ranges in Ofwat PR19 FD - Aligning risk and return technical appendix, Figure 3.1.

158 KPMG (2025), PR24 Final Determinations – risk analysis for a notional company

159 See Appendix 2: Beta for technical details.

IV. Ofwat's points

The increase in capital intensity is not material

6.4.26. Ofwat calculates that the average annual capex-to-RCV ratio for the 2025-30 period is 10.9%, compared to an average of 8.0% over the 15-year period to March 2024[160]. Ofwat considers that this change is not material, it is important to note that the forecasted ratio of 10.9% represents a 36.25% increase compared to previous years, indicating a significant change.

6.4.27. Ofwat's calculation is based on annual ratios, i.e. annual capex over the opening RCV for that year. The annual capex-to-RCV ratio measures capital investment relative to the opening RCV for each year. However, as the RCV grows annually, the denominator increases, which dilutes the apparent scale of investment. This approach underestimates the true scale of the AMP8 capital investment programme and delivery risk compared to recent price control periods and does not adequately capture the full delivery risk.

6.4.28. When assessing RCV growth and delivery risks associated with capital investment programmes, a relevant measure is the price control average capex-to-price control opening RCV ratio. The annual capex-to-RCV ratio, used by Ofwat, does not fully capture the delivery risks of large, multi-year investment, particularly regarding the total financial commitment required over the price control period.

6.4.29. In contrast, the price control average capex-to-opening RCV ratio provides a more comprehensive measure by considering total capital investment relative to the opening RCV over the entire price control period. This metric captures the cumulative investment commitment, offering a clearer view of the overall delivery risk and the financial commitment required from both companies and investors throughout the period. Additionally, it accounts for the scale of the activity relative to the size of the business, providing a more accurate picture of the overall delivery risk from the multi-year capital investment programme.

6.4.30. When recalculated as the price control average capex-to-price control opening RCV, the capex intensity for PR09-PR19 ranges from 7% to 8%, while for PR24 it is 12%. This represents an increase of over 50%.

The analysis of the relationship between capital intensity and beta has imperfect read-across to water

6.4.31. Ofwat raises several points regarding the capital intensity analysis[161]:

1) The inclusion of total assets in the capex intensity ratio, which encompasses current assets and long-term receivables that are not considered long-term investments and are not part of the RCV.
2) The use of estimation windows that differ from those used in its own analysis.
3) The assumption that correlations from non-regulated companies are applicable to regulated water companies.

6.4.32. In response to Ofwat's first two points, the measure of capital intensity has been adjusted to exclude current assets and long-term receivables from total assets, and the regression window has been reduced from 30 to 10 years.

6.4.33. In relation to Ofwat's final point, which concerns the applicability of correlations from non-regulated companies, while the predominance of unregulated companies in the sample warrants caution, it does not invalidate the analysis. The results can still inform decision-making, provided they are interpreted and applied carefully.

160 Ofwat (2024), PR24 Final Determination, Aligning risk and return – Allowed return appendix, p. 47.
161 Ofwat (2024), PR24 Final Determination, Aligning risk and return – Allowed return appendix, p. 50.

New regulatory protections mitigate incremental risk

6.4.34. Ofwat considers that the enhanced risk protection provided to companies in PR24, compared to PR19, is likely to *reduce* the systematic risks faced by companies[162].

6.4.35. However, despite the introduction of new risk mitigation mechanisms, the overall risk exposure of water companies in PR24 remains higher than in previous price controls, as evidenced by KPMG's analysis of the notional company's risk exposure. The notional company is specifically exposed to higher risk on Totex relative to PR19, even after accounting for these mitigations.

It is uncommon for regulators to adjust econometric estimates of beta

6.4.36. Ofwat contends that it is rare in UK regulation to adjusted econometric beta estimates in proportion to capex intensity[163].

6.4.37. However, regulators have acknowledged that beta should be estimated with a forward-looking perspective, consistent with the horizon of the CAPM. Regulators have also recognised the inherent limitations in using historical data to price future risk, as past data may not accurately reflect the evolving risk profile. If there is a general consensus that future risks must be priced appropriately, it follows that capital intensity – especially when it has a substantial impact on a company's risk profile – should be incorporated into beta estimates.

6.4.38. Additionally, there are alternative approaches to deriving a risk-reflective beta based on future risk expectations. For instance, Ofgem is considering the inclusion of additional comparators in RIIO-3[164] to better capture forward-looking risk exposures in the energy sector. This Report includes NG as an additional comparator to capture potential impacts of higher capital intensity on forward-looking risk exposure for water companies.

Adjusting for forward-looking risks may result in double-counting the impact of capital intensity, as betas inherently capture some information about future risks

6.4.39. Ofwat considers that adjusting betas before a control period risks double-counting the impact of regulatory changes and may be unnecessary, as share price movements already reflect market expectations of future risks[165].

6.4.40. In principle, it is reasonable to expect the market to incorporate the impact of additional risks into prices once information about the scale of investment and related regulatory policies becomes widely disseminated and understood. However, there is a lag between the impact on share prices and total returns and when betas meaningfully reflect this new information, due to the reliance of beta estimates on historical data.

6.4.41. This is consistent with the CMA's view from the H7 appeal that "while at any point in time a stock's share price is expected to reflect the market's latest expectations of future cash flows and returns, assuming markets are efficient, it does not follow that betas based on historical data are necessarily the most appropriate guide to the future assessment of risk"[166]. In practice, the scale of required investment has become clear only recently and whilst it is likely to be reflected in shorter-term estimates, it does not follow that it would be reflected in the long-term beta estimates used by Ofwat which assign significantly greater weight to periods with significantly lower investment levels.

Any increase in outturn beta during AMP8 will be reflected in the subsequent price controls

6.4.42. Ofwat contends that any higher-than-expected outturn beta will be captured in the PR29 estimation window[167]. In response to concerns that longer windows may dilute the impact,

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162 Ofwat (2024), PR24 Final Determination, Aligning risk and return – Allowed return appendix, p. 47.
163 Ofwat (2024), PR24 Final Determination, Aligning risk and return – Allowed return appendix, p. 47.
164 Ofgem (2024), RIIO-3 Sector Specific Methodology Decision – Finance Annex, para. 3.192.
165 Ofwat (2024), PR24 Final Determination, Aligning risk and return – Allowed return appendix, p. 50.
166 CMA (2023), H7 Final Determination, para. 6.74.
167 Ofwat (2024), PR24 Final Determination, Aligning risk and return – Allowed return appendix, p. 51.

Ofwat argues that these windows could retain risk-affected data across multiple price controls, offsetting any potential dilution.

6.4.43. Investors evaluating the sector for investment will assess its attractiveness based on its current risk and return profile, rather than relying on adjustments that may occur five years later. The investability of the price control should not depend on future corrections for potential under-pricing, particularly if these adjustments span multiple price controls and do not account for the time value of money.

Short term betas do not indicate higher forward-looking risk and are on a declining path

6.4.44. 2-year betas are inherently more volatile and statistically less robust than longer-term estimates, meaning due caution should be exercised when considering this evidence.

6.4.45. At the same time, 2-year betas could capture recent shifts in the company's risk profile, which will not be reflected in longer-term estimates. In this context, the scale of required investment for the water sector has only become apparent more recently.

6.4.46. It is noted that 2-year beta range for the three water companies spans from 0.32 to 0.38. In comparison, the BAU beta range falls between 0.29 and 0.36. All else equal, although subject to higher volatility than longer term estimates which limit the extent to which 2-year betas can improve the prevision of the beta estimate, evidence from 2-year betas suggests that the upper half of the BAU beta range is more relevant for estimating a forward-looking beta for the water sector.

Table 27: Comparison of 2-year betas to the BAU range

	SVT/UUW	PNN
2-year	0.33	0.38
BAU beta range	0.29	0.36

Source: KPMG analysis using LSEG Workspace data

6.5. Other technical issues

I. Data frequency

6.5.1. Typical frequencies used in the estimation of betas include daily, weekly, and monthly. For liquid stocks, which are less prone to asynchronous trading [168], daily betas provide the highest precision due to their lower standard errors and absence of the reference day effect [169]. Accordingly, this Report uses daily betas, as does the PR24 FD, recognising these advantages. Ofgem adopts the same approach in the RIIO-3 SSMD [170].

II. Averaging windows

6.5.2. Beta estimates can be calculated as spot estimates or rolling averages. Spot estimates are derived using only the data within a specific estimation window, with each data point receiving equal weight. Rolling betas are calculated using a moving window of historical data, where each new estimate incorporates the most recent data point and drops the oldest, giving more weight to data points closer to the centre of the window.

168 Asynchronous trading occurs when a stock trades less frequently than the overall market portfolio, resulting in a lag between the assimilation of new information in the stock price and its reflection in the broader market.

169 The reference day effect refers to the phenomenon where the calculation of a stock's beta is influenced by the specific days selected as the reference period for the analysis.

170 Ofgem (2024), RIIO-3 Sector Specific Methodology Decision – Finance Annex, para. 3.177.

6.5.3. While rolling betas can be useful for visualising trends or structural breaks, the overweighting of certain data points can lead to a skewed assessment of beta over the period. Therefore, this Report uses spot betas, as do the PR24 FD and RIIO-3 SSMD[171].

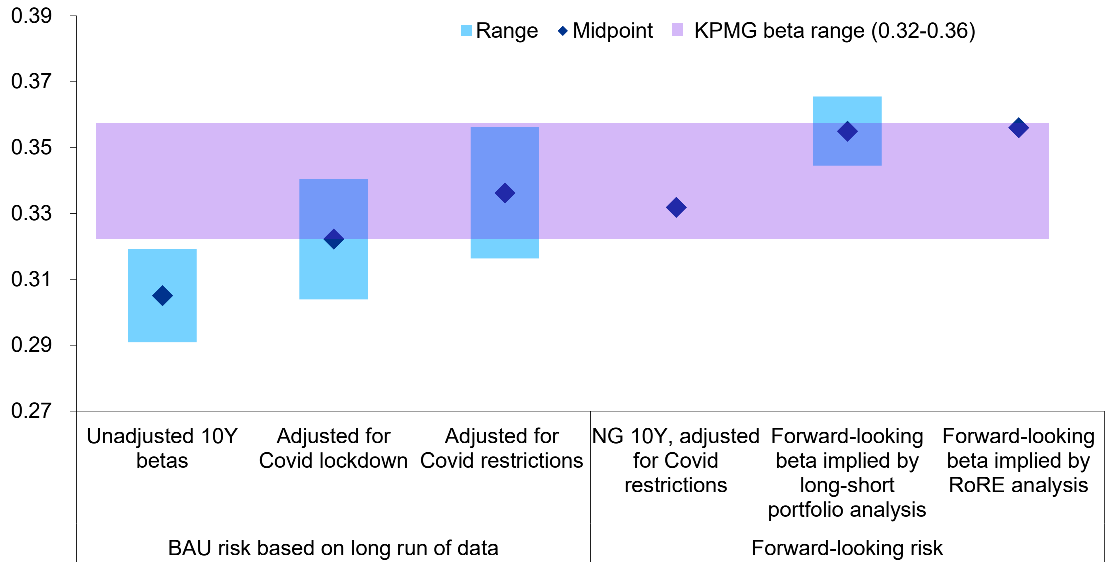
6.6. Derivation of the beta range for PR24

6.6.1. Three alternative approaches are applied to derive the business-as-usual (BAU) beta:

6.6.2. The first variant relies on empirical estimates without adjustments, using a long-term, stable 10-year estimation window. The second variant adjusts beta estimation for the period of mandated lockdowns. The third variant adjusts beta estimation for the entire period during which Covid restrictions were implemented.

6.6.3. The overall range derived from these approaches is 0.29 to 0.36, with a midpoint of 0.32. Forward-looking evidence is incorporated by uplifting the midpoint (0.32) based on RoRE risk evidence and the relationship between capital intensity and beta.

Figure 20: Evidence for PR24 beta estimation



Source: KPMG analysis using LSEG Workspace data.

6.6.4. Both historical and forward-looking evidence suggest that a beta of 0.29 is likely to materially underestimate the risk. The projected increases in systematic risk, driven by the substantial step-up in capital intensity, imply that beta estimates based solely on historical data from the water sector may significantly understate future risk, especially if it is affected somewhat by distortions. As a result, this Report narrows the overall range to reflect only the upper half, adopting a beta range of 0.32 to 0.36, as illustrated by the horizontal lines on the chart.

6.6.5. Notably, the 2-year betas, which are most responsive to new market information, fall within the upper half of this range, with the betas for the three listed water companies ranging from 0.32 to 0.38.

Table 28: Overall beta range for PR24

	Lower bound	Upper bound
Unlevered beta	0.32	0.36
Debt beta	0.10	0.10

171 Ofgem (2024), RIIO-3 Sector Specific Methodology Decision – Finance Annex, para. 3.178.

	Lower bound	Upper bound
Observed gearing	51.19%	50.18%
Asset beta	0.37	0.41
Equity beta, 55% gearing	0.71	0.78

Source: KPMG analysis

7. Notional gearing

7.0.1. 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 net debt to RCV.

7.0.2. 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:

1) It sets out Ofwat's and KPMG's approaches for estimating notional gearing.

2) It comments on and analyses Ofwat's approach for setting notional gearing

3) It sets out the estimate for notional gearing.

7.1. Summary of the approach for estimating notional gearing

7.1.1. The table below sets out Ofwat's and this Report's approach for estimating notional gearing.

Table 29: Ofwat's and this Report's approach for estimating notional gearing

Component	Ofwat	This Report
Notional gearing	Ofwat has reduced notional gearing from 60% applied at PR19 to 55% at PR24.	60% based on the PR19 notional capital structure.

Source: KPMG analysis and PR24 FD

7.2. Commentary on and analysis of Ofwat's approach for setting notional gearing

7.2.1. Ofwat has reduced notional gearing from 60% applied at PR19 to 55% at PR24. The rationale for the assumed reduction in the PR24 FD is set out below.

1) **Efficient financing choices:** Ofwat considers that lower notional gearing supports financial resilience. Ofwat notes that lower gearing would support the notional company's capacity to raise finance efficiently and remain resilient to shocks given the risks to which the notional company is exposed.

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 financing 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.

4) **Impact of inflation:** Ofwat highlights that reductions in gearing levels were achievable for the notional firm across AMP7 given recent high inflation.

7.2.2. The Report comments on each rationale for a reduction in notional gearing at PR24 in turn:

1) **Efficient financing choices:** Assuming a lower notional gearing cannot improve the company's overall financial position with a constant level of business risk at both gearing

levels; rather, it transfers risk exposure from debt to equity. In some cases, the scale of key business risks is driven by the quantum of regulatory equity assumed. ODI exposure increases mechanistically in proportion to the quantum of regulated equity – in consequence, the lower the notional gearing, the higher the business risk.

Where the notional company is not financially resilient to risk exposure, this could be because (1) returns are not sufficient or (2) downside risk exposure for the notional firm is excessive and is not in line with returns.

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 in the first instance to reflect business risks. In this context, Ofwat's estimate of beta assumes that risk will *reduce* at PR24 and is lower than the corresponding beta at PR19.

Changes to the notional capital structure do not represent a substitute for appropriately pricing risks in the required returns in the first place.

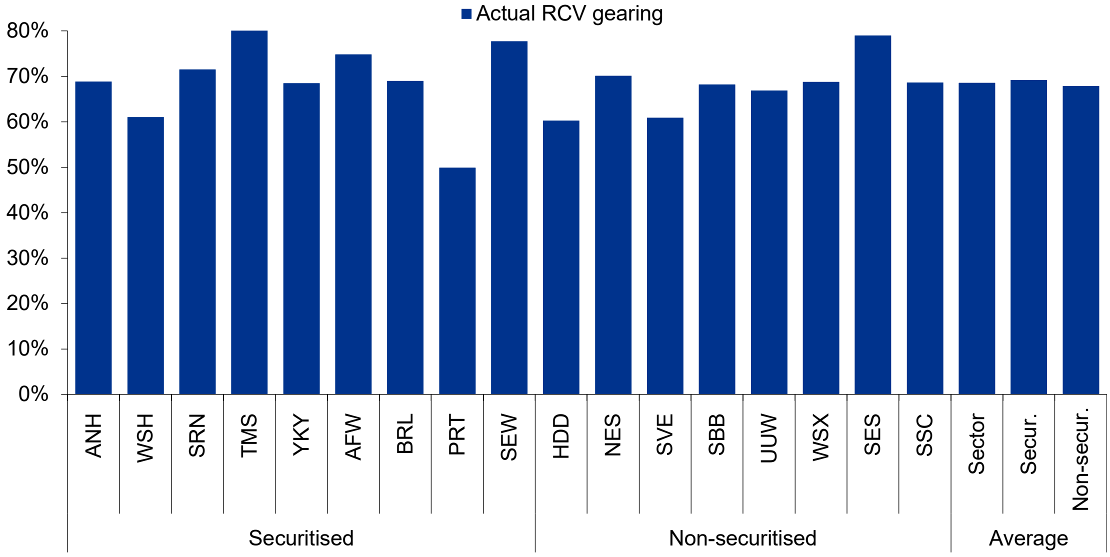
2) **Scale and nature of investment needs:** The scale of investment is likely to result in a material requirement for equity and debt capital. Ofwat estimates that across the sector £12.7bn new equity would be required based on the notional capital structure, equivalent to almost 30% of current equity capital deployed in the sector. The need to attract significant equity capital is unprecedented in the sector. An assumed reduction in notional gearing all else equal exacerbates 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 increases 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 around what represents an optimal capital structure for water companies and introduces an inconsistency of approach compared to other WACC parameters. The figure below illustrates that as at 31 March 2024 that all WaSCs are geared above the proposed 55% notional gearing level and hence assuming a reduction from 60% to 55% is not supported by or consistent with market evidence from the sector. S&P notes that "We anticipate that the amount of raised capital will fall short of Ofwat's assumptions, whose notional company gearing of 55% is expected to remain far from any actual company's gearing which is projected to be significantly above this over AMP8"[172].

   As shown in the figure below, the proposed gearing of 55% sits materially below the average for the sector, including companies which have recently sought to raise equity capital such as Severn Trent. All else equal, this suggests that 55% gearing is below efficient market levels for the water sector.

172 S&P (2025), UK. Water Regulatory Framework Support, Low Financial Flexibility In Coming Regulatory Period Drive Rating Actions, p. 2.

Figure 21: Sector gearing, 2023-24



Source: KPMG analysis of 2023-24 APRs.
Note: BRL gearing is for FY23, as the FY24 figure is not separate from the overall SBB figure

Gearing and interest coverage metrics (such as AICR and PMICR) are largely independent constraints on credit ratings under the Moody's and Fitch rating approaches. At both agencies, 60% net debt/RCV would be consistent with an A3/A- rating, and this would not be enhanced by reducing leverage to 55%. The achievable rating for the notional firm based on the PR24 FD is instead constrained by interest coverage, reflecting the insufficient cash flow provided by the FD.

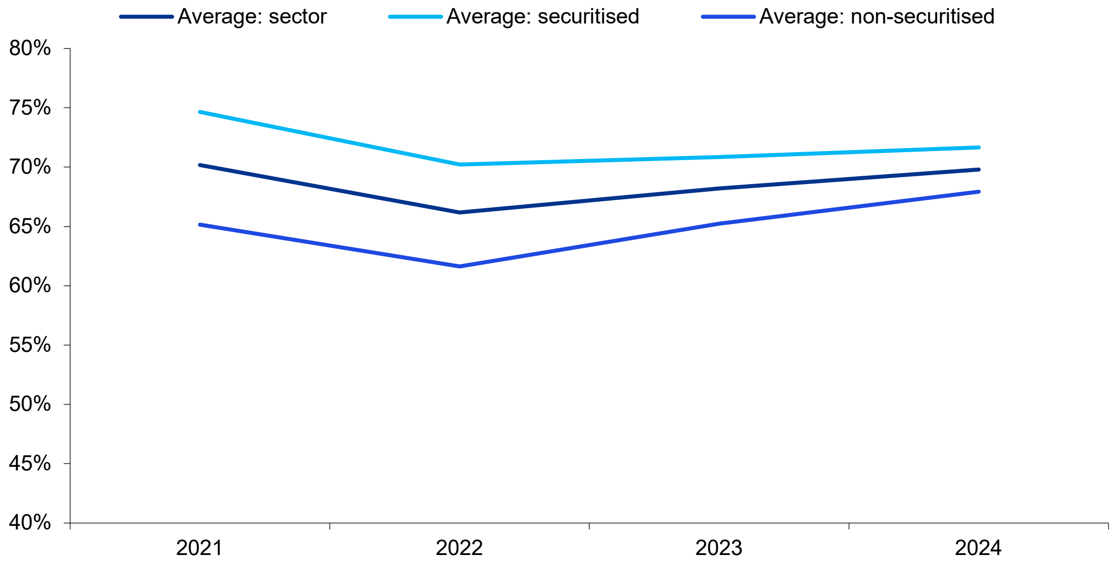
4) **Impact of inflation:** Recent high inflation has reduced observed gearing in the sector and Ofwat considers that this supports an assumed reduction in notional levels of gearing. The figure below illustrates based on data from 2024 that a proportion of the reduction in gearing observed in 2022 has since reversed and that gearing for non-securitised companies most comparable to the notional company is above the level of March 2021.

Higher than forecast inflation did act to reduce observed gearing in the sector, particularly in 2022, though inflation has subsequently stabilised at close to BoE target levels and sector average gearing has increased.

However, consideration of outturn inflation in isolation does not capture all drivers of company gearing levels. There are other factors which exert upwards pressure on gearing across the sector in AMP7, most prominently AMP7 performance. Net RoRE [173], which considers all risk drivers including financing, is significantly below allowed returns on a sectorial basis. All else equal, this exerts upwards pressure on gearing which is reflected in the sector's upwards trend in gearing post-2022.

173 Cumulative for AMP7, to end of year 4.

Figure 22: Sector gearing, 2021 to 2024



Source: KPMG analysis

7.3. Estimate for notional gearing

7.3.1. This Report adopts a 60% gearing assumption in line with the notional capital structure at PR19. This level is consistent with (1) target gearing for non-securitised companies such as Severn Trent and United Utilities, (2) gearing levels across the sector, which have not changed materially across AMP7, and (3) gearing levels required to achieve a Baa1/BBB+ rating based on rating agency methodologies.

8. Retail margin adjustment

8.0.1. Ofwat remunerates financing costs for the household retail price control with a net margin which is applied to retail cost-to-serve, wholesale and DPC revenues and funds retail financing costs. A margin approach is applied to the retail control as the asset-light nature of the retail business means traditional return on capital approaches are less suited to estimation of appropriate returns.

8.0.2. 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).

8.0.3. Ofwat calculates the adjustment as 6bps based on assumptions around retail working capital balances and the cost of financing fixed assets[174] and working capital. The FD calculation is set out in the table below:

Table 30: Ofwat calculation of the RMA in the PR24 FD

Component (2025-30 average)	Calculation	Value
Fixed asset balance for retail controls	**A**	318.0
Cost of financing fixed assets	**B**	6.10%[175]
Required revenue for return on retail fixed assets	**C = (A x B)**	19.4
Debtor balance	**D**	2,078.0
Creditor balance	**E**	99.0
Measured income accrual	**F**	2,062.0
Advance receipts	**G**	1,459.0
Annual working capital requirement	**H = (D + F) - (E + G)**	2,582.0
Working capital financing rate	**I**	4.65%[176]
Required revenue for return on working capital	**J = H x I**	120.1
Total retail-specific capital costs	**K = C + J**	139.5
Retail margin allowed revenue apportioned to households.	**L**	212.0
Required return for retail systematic risk	**M = L - K**	72.5
Average RCV (2020-25)	**N**	121,790.0

Source: PR24 FD

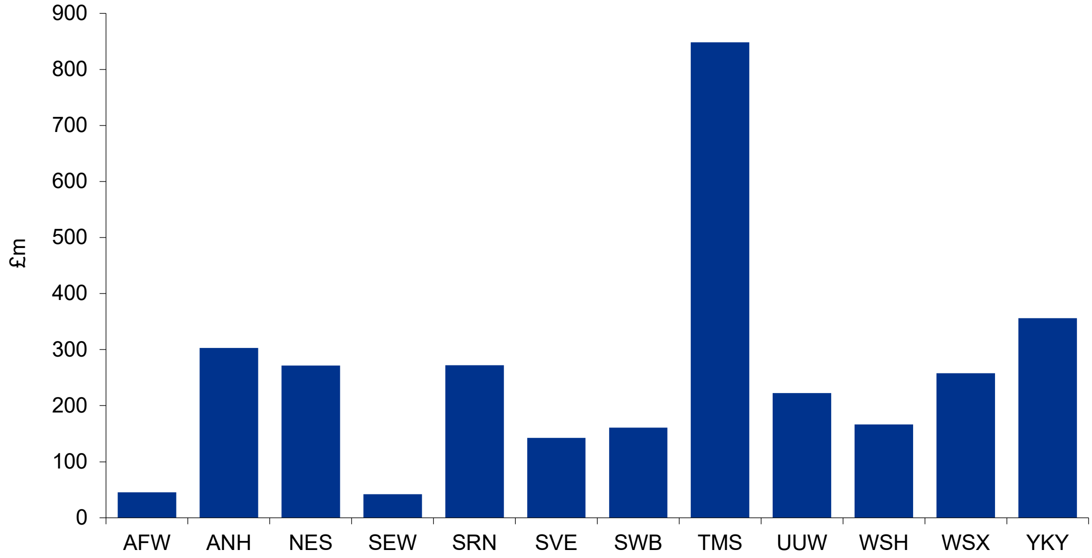
8.0.4. At PR19, the CMA adopted a similar approach based on Return On Capital Employed (ROCE) to calculate the RMA.

8.0.5. The ROCE for retail comprised the same components as Ofwat's calculation: return on fixed assets and return on working capital. However, the CMA set working capital balances to nil, and therefore the required return was not included in its calculation. This was because the evidence available suggested that "that the majority of companies in the sector have a negative or low working capital requirement"[177] and it had not received evidence from appealing companies which indicated the contrary.

174 Ofwat calculates the fixed asset balance using a 'discounted closing balance' approach.
175 PR24 FD appointee WACC in nominal terms.
176 Average working capital financing rate from business plans excluding outliers, characterised by Ofwat as a "short-term financing rate". Ofwat (2024), PR24 Final Determination, Aligning risk and return – Allowed return appendix, p. 124.
177 CMA (2021), PR19 Final Determination, para. 9.1142.

8.0.6. Analysis of the PR24 financial models indicate that companies are expected to have significant positive working capital balances throughout the price control. With these positive balances incorporated into the calculation alongside the relevant financing rates, the CMA's approach yield results which are consistent with this Report.

Figure 23: Working capital balances in PR24 financial models



Source: KPMG analysis of the PR24 financial models
Note: Calculated as (Debtors + Income Accrual) – (Creditors + Advance Receipts). Other than capex creditors, creditor balances are excluded in line with the updated position in the FD. However, the majority of companies remain working capital positive even with the inclusion of creditor balances.

8.0.7. This section considers the key assumptions underpinning Ofwat's ROCE calculation and is structured as follows:

1) It considers the cost of financing for the RMA calculation

2) It considers the conceptual basis for the application of the RMA calculation to the appointee WACC

8.1. The cost of financing for the RMA calculation

8.1.1. The assumption underpinning the RMA is that the retail business operates as part of an integrated appointee. For example:

1) In the PR24 FD, Ofwat removed wholesale creditor balances from the RMA calculation "on the grounds that it may be an intercompany balance and thus not a true cost to companies" [178], recognising the integrated nature of the retail business with the rest of the company

2) At PR19, the CMA noted that "In the real-world scenario where the financing of the appointee is still fully integrated, we are not persuaded that there is a benefit for customers for paying a higher profit to reflect the higher financing costs associated with a notional separation which has been put in place for other purposes"[179].

8.1.2. The integrated nature of the retail business aligns with the operating model of water companies. Retail is treated as a business unit similar to water or wastewater, with shared governance and functions. Companies do not have separate treasury functions or raise

178 Ofwat (2024), PR24 Final Determination, Aligning risk and return – Allowed return appendix, p. 124.
179 CMA (2021), PR19 Final Determination, para. 9.1140.

financing specifically for the retail division; instead, retail financing is managed as part of the overall financial position of the company.

8.1.3. In practice, the retail business is financed on an integrated basis primarily through long-term funding, sourced and managed at the appointee level, rather than being separately financed for the retail division.

8.1.4. Moreover, any debt required to finance fixed assets or negative working capital balances in retail would increase gearing above notional levels for the appointee level and introduce internal inconsistency. In consequence, analysis of the retail business on an integrated basis indicates that it would be primarily equity-financed. In this context, the cost of retail financing would either be the appointee cost of equity or at a minimum the appointee WACC.

8.1.5. Using the point estimate of the KPMG appointee CoE and WACC estimates based on a January 2025 market data cut off, with no other changes to Ofwat's calculation, the RMA is calculated as -3bps (variant 1) or 0.8bps (variant 2), all else equal[180].

Table 31: Ofwat calculation of the RMA

Component (2025-30 average)	Calculation	PR24 FD	KPMG variant 1	KPMG variant 2
Financing assumption for retail fixed assets and working capital		Short-term retail facilities	Appointee CoE	Appointee WACC
Fixed asset balance for retail controls	**A**	318.0	318	318
Cost of financing fixed assets	**B**	6.10%	8.45%	6.97%
Required revenue for return on retail fixed assets	**C = (A x B)**	19.4	26.9	22.2
Debtor balance	**D**	2,078.0	2,078.0	2,078.0
Creditor balance	**E**	99.0	99.0	99.0
Measured Income Accrual	**F**	2,062.0	2,062.0	2,062.0
Advance receipts	**G**	1,459.0	1,459.0	1,459.0
Annual working capital requirement	**H = (D + F) - (E + G)**	2,582.0	2,582.0	2,582.0
Working capital financing rate	**I**	4.65%	8.45%	6.97%
Required revenue for return on working capital	**J = H x I**	120.1	218.3	179.9
Total retail-specific capital costs	**K = C + J**	139.5	245.2	202.0
Retail margin allowed revenue apportioned to households.	**L**	212.0	212.0	212.0
Required return for retail systematic risk	**M = L - K**	72.5	(33.2)	10
Average RCV (2020-25)	**N**	121,790.0	121,790.0	121,790.0
RMA		0.06%	(0.03%)	0.01%

Source: KPMG analysis

8.1.6. Ofwat's approach appears to stem from an assessment of how a retailer might be financed on a standalone, rather than on an integrated basis.

1) Ofwat assumes that the working capital requirements for a standalone retail business would be funded via short-term facilities. However, facilities such as overdrafts or RCFs

180 Substituting Ofwat's WACC (6.10%) for the cost of capital calculated in this Report results in an RMA of 3bps.

are generally considered liquidity backstops at the integrated appointee level, intended for occasional and temporary use, rather than for long-term financing[181].

2) If the retail business were standalone, it would incur a significantly higher cost of financing than assumed in the calculations above. A standalone retail business would have leverage of above 10.0x[182], which maps to a sub-investment 'Ca' factor score on the relevant scorecard[183].

8.2. Conceptual issues

8.2.1. At 1bp to -3bps, this Report considers that application of an RMA represents spurious accuracy in line with the CMA at PR19, which noted that: '*…estimating opaque metrics such as relative exposure to systematic risk to this level of accuracy risks any sensible range of estimates being larger than the central estimate (thus making zero a realistic possibility)*[184].

8.2.2. The application of the RMA is heavily reliant on certain key assumptions. It assumes that (1) the systematic risk of retail activities is higher than that of wholesale activities, and (2) the risks associated with retail activities are fully reflected in the allowed retail margin. If the first assumption did not hold, the wholesale WACC would be equal to or higher than the appointee WACC. If the second assumption did not hold, the margin would be understated, thereby reducing the potential for double-counting.

8.2.3. The FD does not include evidence to support these assumptions. The retail margin is estimated using an imprecise approach based on the ratio of allowed household retail revenues at PR24 relative to PR19, rather than based on analysis of retail risks and benchmarking the remuneration required for these risks. It is unclear whether the 1.5% margin adequately compensates for retail risks.

8.2.4. Furthermore, the calculation above does not consider all relevant inputs. For example, AMP8 is projected to see increased volumes of capital delivery through off-balance sheet methods, such as DPC and SIPR. While these methods impact the margins included in the calculation, they are not reflected in the fixed asset balances, leading to internal inconsistency in the approach.

181 Further, other aspects of Ofwat's cost of capital calculations such as the cost of carry rely on undrawn liquidity facilities. This assumption is inconsistent with the expectation that the retail business utilities short term financing frequently.

182 Calculated as Debt / EBITDA for WaSCs and large WoCs. Underlying data is sourced from the FinStat Retail tabs of the PR24 FD financials models. Debt is calculated as (Debtors + Income Accrual) – (Capex Creditors + Advance Receipts).

183 Moody's (2021), Business and Consumer Services Methodology. This methodology is selected as it is employed by Moody's for private water retailers, p. 4.

184 CMA (2021), PR19 Final Determination, para. 9.1139

9. Cross-checks

9.0.1. The role of the regulatory CoE is to ensure that sufficient incentives are in place to attract and retain equity investment in the sector. To fulfil its purpose, the regulatory CoE must be evidence-based, balanced, risk-reflective, and competitive.

9.0.2. The CAPM is used as the primary methodology to estimate the cost of equity. However, there are many reasons for why the CAPM may lead to an inaccurate estimate.

9.0.3. The forward-looking market risk premium could be incorrectly estimated. This could be due to many reasons:

1) An inaccurate proxy for the market portfolio is used. In theory, the market portfolio should contain all risky assets – public equities, private equity, bonds, real estate, commodities, art – around the world. However, the return to such a portfolio is unobservable. Thus, the UK equity market is typically used as a proxy. This proxy only considers public equity (not other asset classes) and it only considers UK assets (not global assets). Both inaccuracies could be problematic given that investors in UK water companies typically invest in other asset classes and other countries. Moreover, even this proxy is internally inconsistent. For example, the proxy relies on UBS Global Returns Yearbook which, up to 1954, contained the largest 100 companies, similar to the FTSE 100. Now it is based on the London Share Price Database and contains all companies listed on the London Stock Exchange, similar to the FTSE All-Share.

2) It is not clear over what period the historic market risk premium should be calculated. A longer history is less affected by outliers, but may include earlier years that are less applicable to today. More importantly, regardless of the window used, only the historic market risk premium can be calculated. The CAPM requires the forward-looking market risk premium, and the historic premium will be an inaccurate estimate, particularly in changing market conditions.

3) The risk-free rate (which is subtracted to obtain the market risk premium) is incorrectly estimated, as described below.

9.0.4. The risk-free rate could be incorrectly estimated. This could be due to many reasons:

1) The wrong starting point for the risk-free rate is used. In the CAPM theory, there is a single, global risk-free rate. In practice, there is not: there is not a single sovereign entity that issues debt, but different entities such as the UK and US governments. In practice, UK gilt yields are used as a proxy for the risk-free rate, but the yields on US Treasuries or German bunds may be more relevant for some investors.

2) Under the CAPM, all investors can both borrow and lend at the risk-free rate. This is not possible in practice: investors borrow at higher rates than the government. Thus, the government bond yield is not an accurate estimate of the investor borrowing rate.

3) The government bond yield may be lower than the true risk-free rate due to a convenience yield: additional desirable characteristics of government bonds that mean that investors are willing to earn less than the risk-free rate when holding it.

4) Government bonds are not risk-free. Then, there is no risk-free asset in the economy, and the standard CAPM cannot be used. Instead, regulators should be using the zero-beta CAPM of Black (1972) with the return on a zero-beta asset in place of the risk-free rate.

9.0.5. The beta could be incorrectly estimated. This could be due to many reasons:

1) An incorrect proxy for the market portfolio is used

2) It is not clear over what period the historic beta should be calculated.

3) More importantly, the historic beta may be an inaccurate estimate of the forward-looking beta.

9.0.6. The CAPM may not hold. This could be due to many reasons:

1) Investors demand compensation for other sources of systematic risk than exposure to the market portfolio. For example, the q-factor model also features size risk, profitability risk, and investment risk.

2) Investors are not fully diversified and thus require compensation for idiosyncratic risk

3) Investors are not fully diversified and thus do not compare a water stock to the market portfolio when deciding whether to invest in it. They may be constrained to investing in certain industries or have a preference for investing in certain industries.

4) Investors care about more than the mean and variance of returns. For example, they may be concerned with negative skewness, i.e. the probability of left-tail events.

9.0.7. Identifying the inputs that CAPM requires, and the challenges with estimating them, is useful for two reasons.

9.0.8. First, cross-checks should not be dependent on exactly the same inputs as CAPM. Otherwise, an invalid input that affects the CAPM will also affect the cross-check. A cross-check which is based, in part, on different inputs will be less affected by misestimation of a given CAPM input (or set of inputs). It is a useful way to verify that the CAPM cost of equity estimate is not too high or too low due to particular incorrect inputs.

9.0.9. Second, cross-checks should not be subject to more stringent evidential hurdles than the CAPM. All estimation models are imperfect, and so it is invalid to reject a cross-check for being imperfect when the CAPM is also imperfect. For a cross-check to be useful, it needs to provide additional information that is not in the CAPM. This does not require it to provide perfect information. Indeed, the evidential hurdle for a cross-check should arguably be lower than for CAPM, because it is used as a secondary methodology for estimating the cost of capital, not the primary methodology.

9.0.10. Both of the above reasons are consistent with the core principles of Bayesian information aggregation. Consider an existing signal (A) of an unknown true state (S), such as the cost of equity. For a second signal (B) to be informative, i.e. A and B to provide a more precise estimate of S than A alone, B needs to be less than perfectly correlated with A (the first point above), and informative about S but not perfectly informative (the second point above). Indeed, even if B is less precise than A, B still provides valuable information.

9.0.11. In this context, cross-checks play a crucial role in supporting investability by validating CAPM estimates, addressing the inherent limitations of the model, and providing a market-based perspective on what constitutes an appropriate and investable CoE under current market conditions for the investors the sector aims to attract and retain.

9.0.12. Throughout PR24, Ofwat has applied MAR as a cross-check to its CoE estimate. However, in the FD, Ofwat also considered additional cross-checks, including those based on the RIIO-3 SSMD, namely CoE estimates from analyst reports, and investor survey evidence (both its own and Oxera's)[185].

9.0.13. Ofwat has considered and rejected other cross-checks proposed during the price review process, including MFMs and debt-equity cross-checks. Notably, Ofwat has not outlined a structured and consistent approach for evaluating cross-checks. In their evaluation of MFM evidence, for example, Robertson & Wright draw on the principles of implementability[186] and defensibility[187] that they applied in the formation of recommendations in the UKRN CoE

185 Ofwat (2024), PR24 Final Determination, Aligning risk and return – Allowed return appendix, p. 80.

186 An approach is considered implementable if it does not entail excessive cost or complexity to carry out.

187 An approach is considered defensible if it is robust to reasonable criticism.

Study (2018) [188] to introduce specific criteria that alternative asset pricing models such as MFMs must meet to be considered capable of providing reliable CoE estimates.

9.0.14. These criteria include: (1) stronger explanatory power than the CAPM, (2) replicable data construction yielding consistent estimates, (3) stable, statistically significant factor loadings, betas, and risk premia. These criteria imply a high bar, requiring stronger performance across several dimensions than the CAPM, the primary methodology for return estimation. Consequently, they may be more appropriate for evaluating asset pricing models intended to replace the CAPM as the primary model and are unlikely to be proportionate in the evaluation of cross-checks.

9.0.15. In contrast, the cross-checks used by Ofwat are not subject to any formal evaluation. Applying different criteria and standards to different cross-checks risks omitting relevant evidence in the process of cross-checking returns. To ensure a comprehensive and impartial assessment, consistent criteria should be applied to all cross-checks.

9.0.16. A broad range of cross-checks has been considered in this Report. These cross-checks are not intended to replace the CAPM as the primary method for estimating returns, but rather to ensure that the CAPM outputs align with other potential indicators and yield an investable CoE. The criteria for determining the weight assigned to each cross-check should reflect their role as supplementary tools, as well as their relative robustness in comparison to other cross-checks. Given that each cross-check has its own limitations, it is crucial to evaluate them in a balanced and consistent manner.

9.0.17. The table below sets out the categories of cross-checks considered in this Report and the associated rationale. The table is structured to reflect the weight attached to each cross-check, with more weight attached for example to minimum returns implied by debt financeability and less weight attached to MAR and equity analyst reports.

Table 32: Categories of cross-checks

Category	Rationale
Debt financeability	Debt financeability analysis serves as a check to ensure that the CoE – which underpins allowed revenues for the notional company and in turn implies forecast credit metrics based on the notional capital structure – is consistent with the target credit rating assumed for the notional company.
Parameter-level cross-checks: multi-factor models (MFMs)	MFMs offer superior explanatory power compared to the CAPM by providing a more comprehensive and accurate pricing of risk. These models help refine the estimate of the CoE by incorporating additional factors that may influence asset returns.
Returns available from other asset classes: inference analysis	As equity is inherently riskier than debt, the expected return on equity should exceed the return on debt to incentivise investment into equity. Inference analysis is an asset pricing model which allows for the estimation of CoE from the observed CoD given these dynamics.
Returns available from other infrastructure sectors: RIIO-3 SSMD, infrastructure fund implied IRR	In the context of increasing competition for infrastructure investment capital, investors are likely to make risk-adjusted comparisons of opportunities within core infrastructure sectors when making investment decisions.
Other market evidence: Market-asset-ratios (MAR), equity analyst reports	These cross-checks offer insights into investor sentiment and market expectations for the sector.

Source: KPMG analysis

188 UKRN CoE Study, p. 5.

9.1. Debt financeability

9.1.1. The achieved return on equity is a key driver of debt and equity financeability. For a notionally-financed company that is assumed to achieve its totex allowances and performance commitments, CoE is the primary driver of operating cash flow, and the relationship between the CoE and CoD is the primary driver of interest coverage. An insufficient allowed equity return will therefore limit a notional company's ability to service debt in downside scenarios, even if it is assumed that maturing obligations can be refinanced.

9.1.2. The ratio of Funds From Operations to net debt (FFO/debt) and interest cover (including Moody's AICR and Fitch's Cash and Nominal PMICRs) are key ratios considered by credit rating agencies because they are predictive of regulated companies' ability to repay obligations as they become due. In turn, credit ratings influence equity financeability because they determine whether companies will be able to pay dividends and remain in compliance with their licence conditions.

9.1.3. It is therefore appropriate to consider, as cross-check, whether Ofwat's cost of equity allowance supports financeability by reference to the credit ratio thresholds applied by the rating agencies. This is consistent with the CMA's decision in PR19, where it said that "we consider financeability to provide a relevant cross-check on the choice of the cost of equity. The use of credit ratios at least provides a check on whether the cost of equity appears to be of a level which is broadly consistent with the high-quality credit ratings required by Ofwat and implied in the cost of debt" [189].

9.1.4. Ofwat's financeability assessment at final determinations targeted a credit rating of BBB+/Baa1 on the basis that this "provides a reasonable level of headroom within the investment grade category that is sufficient for companies to cope with most cost shocks"[190]. This threshold is appropriate because companies are required to maintain at least two investment grade ratings (i.e. BBB-/Baa3 or above) and holding any rating below BBB/Baa2 with stable outlook will trigger a cash lock-up under Condition P of their licences.

9.1.5. The PR24 process and Ofwat's final determination have reduced rating agency assessments of the "stability and predictability of the regulatory framework" (Moody's)[191], Ofwat's "regulatory advantage" (S&P)[192] and the sector's business risk (Fitch)[193]. As a consequence, all three agencies have tightened their rating thresholds – by approximately a half notch at Moody's, between a half and full notch at Fitch, and a full notch at S&P.

9.1.6. Based on a review of recent credit rating actions, thresholds below are likely applicable to a typical company, before considering the impact of covenanted financing structures or of holding company leverage.

189 CMA (2021), PR19 Final Determination, para. 9.1399.
190 Ofwat (2024), PR24 Final Determination, Aligning risk and return appendix, p. 58.
191 Moody's (2024), Regulated Water Utilities – UK Reduced predictability of regulatory environment pressures credit quality, p. 2.
192 S&P (2025), UK Water Regulatory Framework Support, Low financial Flexibility In Coming Regulatory Period Drive Rating Actions.
193 For example, Fitch (2025), Fitch Downgrades Dwr Cymru's Senior Secured Class A and Class B Debt to 'A-'; Outlook Stable.

Table 33: Credit rating thresholds applicable to typical companies

Moody's			S&P		Fitch			
	Net debt/ RCV (maximum)	AICR (minimum)		FFO/ debt (minimum)		Net debt/RCV (maximum)	Cash PMICR (minimum)	Nominal PMICR (minimum)
A3	60%	1.8x	**A-**	14%	**A-**	60%	2.0x	2.1x
Baa1	68%	1.6x	**BBB+**	11%	**BBB+**	65%	1.7x	1.9x
Baa2	75%	1.4x	**BBB**	8%	**BBB**	70%	1.5x	1.8x
Baa3*	80%	1.2x	**BBB-**	6%	**BBB-**	75%	1.4x	1.7x
					BB+	80%	1.3x	1.6x

Source: KPMG analysis of rating agency reports.
Note: The thresholds for Baa3 are an estimate based on SRN and SEW as Moody's has not published sector-wide guidance for Baa3.

9.1.7. For a notional company performing in line with its operational targets and cost allowances, AICR can be represented as

$$AICR = \frac{g \times CoD + (1 - g) \times CoE}{g \times (CoD + (1 - ILD) \times i)}$$

9.1.8. Where g is net debt/RCV, CoD is real cost of debt, CoE is real cost of equity, ILD is the share of CPI-linked debt and i is breakeven inflation.

9.1.9. Similarly, FFO/net debt (where FFO is calculated after total interest expense, consistent with S&P methodology) can be represented as [194]:

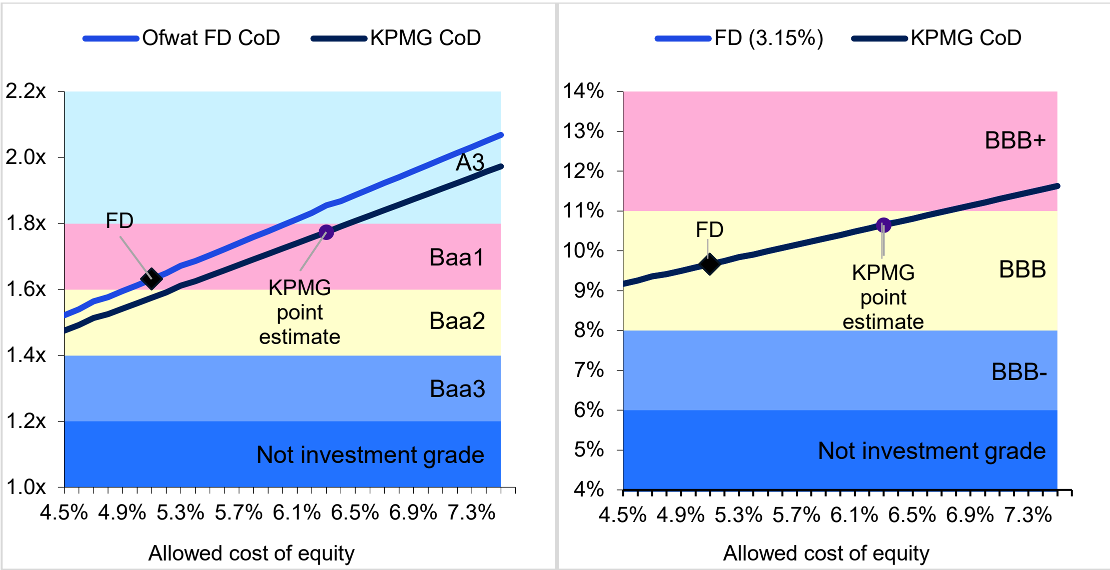
$$FFO/net\ debt = \frac{(1 - g) \times CoE + d - (\pi \times g)}{g}$$

Where d is the average RCV run-off rate and π is inflation.

9.1.10. The relationship (in steady state) between allowed CoE and these ratios is shown below for a notionally-financed company with borrowing costs in line with the allowed CoD, 33% CPI-linked debt and neutral operating performance. This shows that the FD allowed cost of equity, 5.10%, would have supported a cash PMICR of approximately 1.65x, below the 1.7x required for Ofwat's targeted BBB+ rating from Fitch. From S&P, Ofwat's FD allowance would support FFO/debt of just 9.7% for a notionally-financed company, significantly below the 11% consistent with Ofwat's BBB+ target. The FD AICR of 1.65x is close to Moody's minimum threshold for the Baa1 rating.

194 FFO/net debt, as defined by S&P, is calculated after subtracting total interest expense including accretion on inflation-linked debt. Because the cost of debt allowance and real cost of debt net to zero for the notional company, it is necessary only to subtract the sum of (a) breakeven inflation implicit in fixed-rate debt and (b) actual inflation on index-linked debt. For simplicity we have assumed these rates are equal.

Figure 24: Moody's AICR (left) and S&P FFO/debt (right) by allowed cost of equity



9.1.11. However, it is not sufficient for Ofwat's allowed return to support the minimum cash flow consistent with the targeted rating in an ideal scenario, because water companies operate in a dynamic environment and are vulnerable to, inter alia, variation in weather and macroeconomic factors. RORE underperformance of just 0.15% would result in metrics below the Baa1 threshold from Moody's.

9.1.12. In its PR19 decisions, the CMA said "we recognise that the actual credit ratings will be influenced heavily by the ability of the water companies to achieve the cost and outcomes targets set for AMP7. It is therefore important to consider whether the assumptions made about costs and outcomes are likely to be achievable in practice, and whether the balance of risk for the companies is consistent with those credit ratings" [195]. Accordingly, CMA "modelled downside scenarios to assess financial resilience to a reasonable downside in operational performance" [196]. In its PR24 financeability assessment, Ofwat has failed to follow this approach.

9.1.13. Moreover, Ofwat's approach to setting the cost of equity at final determinations would not be sustainable over time. If market conditions are assumed to remain constant, such that the cost of equity remains at 5.10% while companies' cost of debt converges to KPMG's 4.73% cost of new debt estimate (plus 0.37% additional borrowing costs), Moody's AICR would fall below 1.5x.

9.1.14. In PR19, CMA noted that "some of the public statements from the agencies are supportive of the view that the ratios should be considered together as part of a broader assessment, rather than seeing each as a constraint, with the rating being linked to the lowest possible level" [197]. As a result, CMA considered that "caution is required in a financeability assessment to avoid placing undue emphasis on the value of a particular ratio." [198] For reasons set out in Appendix 3: Debt financeability, it is not prudent to assume that Moody's or S&P will disregard any metrics below published thresholds during AMP8.

9.1.15. As a cross-check, the CoE that would be consistent with key credit metrics for Ofwat's targeted BBB+/Baa1 rating category has therefore been calculated. The CoE that would provide 2% headroom to the cash lock-up threshold (BBB/Baa2) has also been considered. These outcomes are regarded as consistent with both debt and equity financeability because

195 CMA (2021), PR19 Final Determination, para. 10.73.
196 CMA (2021), PR19 Final Determination, para. 10.73.
197 CMA (2021), PR19 Final Determination, para. 10.95.
198 CMA (2021), PR19 Final Determination, para. 10.94.

a notionally-financed company would be allowed to avoid cash lockup in reasonable downside scenarios.

Table 34: CoE to achieve BBB+/Baa1 thresholds at 55% gearing

	Ofwat FD (3.15% cost of debt)	KPMG midpoint (3.71% cost of debt)	Long-run (4.73% cost of debt)
S&P	6.7%	6.7%	6.7%
Moody's	4.9%	5.3%	6.1%
Fitch	5.5%	6.0%	6.8%
Median	**5.5%**	**6.0%**	**6.7%**

Source: KPMG analysis

Table 35: CoE to achieve BBB/Baa2 thresholds with 200bps RORE headroom at 55% gearing

	Ofwat FD (3.15% cost of debt)	KPMG midpoint (3.71% cost of debt)	Long-run (4.73% cost of debt)
S&P	5.1%	5.1%	5.1%
Moody's	5.8%	6.1%	6.6%
Fitch	6.4%	6.7%	7.3%
Median	**5.8%**	**6.1%**	**6.6%**

Source: KPMG analysis

9.1.16. The median credit rating is considered to be most relevant for financeability, since companies are required to maintain two investment grade ratings; a company with three ratings would therefore remain in compliance with its licence even if one rating fell below investment grade. However, this can be regarded as a conservative assumption because (a) nine companies have two or fewer ratings and (b) a cash lock-up is triggered if any rating falls to BBB/Baa2 with negative outlook or below.

9.1.17. Taken together, the financeability cross-checks support a CoE of 6.0-6.7% for AMP8 and on a long-run basis on the basis of 55% gearing. This range reflects the CoE required to achieve (1) a Baa1/BBB+ rating across each of the three rating agency methodologies and (2) BBB/Baa2 thresholds with 200bps RORE headroom at 55% gearing. The CoE range reflects the rating agencies' diminished confidence in Ofwat's regulatory framework, which increases the required CoE to achieve BBB+/Baa1 thresholds by 50-180bps compared to thresholds applicable at PR19.

9.1.18. Given uncertainty over the assumed equity contribution at the start of AMP8, the notional company should also be financeable at 60% gearing. This would require a CoE of 6.7%-6.9% (at 55% gearing) to achieve Baa1/BBB+ ratings with 200bps RORE headroom based on both the Moody's and Fitch rating methodologies.

9.2. Parameter-level cross-checks: MFMs[199]

9.2.1. CAPM is the traditional asset pricing model used by UK regulators as the primary method for setting the allowed CoE in price controls, due to its simplicity, straightforward interpretation, and ease of use. However, its limitation lies in relying on a single risk factor – the market risk factor – which fails to capture all relevant factors for pricing returns in practice. Given the risk that CAPM may over- or understate returns, MFMs, with their superior explanatory power,

199 Please refer to Appendix 4: MFMs for the description of the methodology, assumptions and results of regressions and statistical tests.

can serve as a robust cross-check and enhance the accuracy of CAPM-derived estimates through more precise risk pricing.

9.2.2. Since the early 1980s, academic research has explored factors beyond the market risk factor to explain asset returns, leading to the development of MFMs. These models recognise that return anomalies[200] cannot be fully explained by the market risk factor alone, as investors seek compensation for additional sources of risk.

9.2.3. By relaxing the CAPM's assumptions of market efficiency and a frictionless market, MFMs recognise the multiple dimensions that investors use to assess risks and predict returns. As a result, MFMs offer a more realistic view of how investors evaluate risks and returns. Today, MFMs are widely used in both corporate finance and academic research to explain observed returns. A recent Journal of Finance study found that MFM use has grown significantly over the past 20 years, with 69% of large corporate users employing at least one MFM to measure CoE[201].

9.2.4. With the ongoing development of MFMs in academic literature, the Hou, Xue, and Zhang (2015)[202] q-factor model and the Fama and French (2015)[203] 5-Factor model (FF5F) have emerged as two leading models. Unlike other MFMs that combine factors based purely on empirical performance, these models are grounded in robust theoretical principles – with the q-factor model derived from Tobin's q theory[204] and the FF5F based on the dividend discount model[205] in valuation theory. Both models have demonstrated strong performance in explaining returns in the US market and are widely recognised in academia and the investment industry.

9.2.5. Tharyan, Gregory, and Chen (2025)[206] have calibrated these models for the UK market and investigated their performance using statistical tests from the asset pricing literature. Consistent with US findings, the tests for the UK suggest that both models outperform the CAPM, offering additional explanatory power beyond the market factor. Furthermore, the q-factor model subsumes the FF5F, but not vice versa. Consequently, the study concludes that the q-factor model is the preferred MFM for use in the UK. As a result, this Report uses the q-factor as a cross-check for the CAPM-derived CoE.

9.2.6. Ofwat has not accepted MFMs in the suite of cross-checks for PR24 supported by the findings from the reviews Professors Mason, Robertson and Wright (MRW)[207]. MRW proposed three criteria that the model must meet to be considered a valid cross-check for CoE (see 9.0.14 above). However, these criteria diverge significantly from the standard tests typically employed in the literature to assess model performance. For example, the stability requirements for factor beta and risk premia are excessively stringent, to the point where even the CAPM would not meet them.

9.2.7. In examining the performance of MFMs, MRW based some of their conclusions on the preliminary results submitted to Ofwat in 2022[208] instead of the updated evidence provided in PR24 DD response based on Tharyan et al. (2024), although the updated MFM datasets, including the statistical tests and the link to the SSRN paper, were provided to Ofwat in response to its data query following the PR24 DD[209]. Despite updated MFM datasets, statistical tests, and a link to the SSRN paper being provided to Ofwat in response to its data

200 Anomalies refer to the situations when the performance of assets are in contrary to the notion of efficient markets, where all available information is fully incorporated into the asset and investors cannot outperform the market without allocating more weight to the market portfolio.

201 Graham, J. (2022). Presidential Address: Corporate Finance and Reality, *The Journal of Finance*.

202 Hou, K., Xue, C., & Zhang, L. (2015). Digesting anomalies: An investment approach. *The Review of Financial Studies*, 28(3), 650-705.

203 Fama, E. F., & French, K. R. (2015). A five-factor asset pricing model. *Journal of financial economics*, 116(1), 1-22.

204 Tobin, J. (1969). A general equilibrium approach to monetary theory. *Journal of money, credit and banking*, 1(1), 15-29; Cochrane, J. H. (1991). Production‐based asset pricing and the link between stock returns and economic fluctuations. *The journal of finance*, 46(1), 209-237.

205 Gordon, M. J., & Shapiro, E. (1956). Capital equipment analysis: the required rate of profit. *Management science*, 3(1), 102-110.

206 Tharyan, R., Gregory, A., & Chen, B. (2025). An investigation of multi-factor asset pricing models in the UK. *Available at SSRN*.

207 Mason, Robertson and Wright (December 2024) Responses to KPMG's August 2024 report on the cost of equity.

208 KPMG (2022) Exploring Multi-factor Models as a cross-check on allowed returns at PR24.

209 MRW note: "while we have not re-run the model on their updated data, on the original data we find the following point estimates for the alphas…."

query[210], MRW's analysis did not mention this updated evidence. Detailed responses to the key conditions set by Ofwat and its advisors for the adoption of MFMs as a cross-check are set out in section 15.1 and section 15.3 of the Report.

9.2.8. Ofwat also expressed concerns regarding the substantial resources required to implement the model. However, Tharyan et al. (2024) have made MFM factor data freely available on Northumbria University's website, which will be updated regularly each year. This data is provided in a consistent format comparable to the Kenneth French Data Library[211] and the global-q factor website. With the availability of this data, Ofwat could run the q-factor[212] regression on the water portfolio in the same manner as the CAPM regression.

9.2.9. Overall, the evaluation of MFMs in the FD does not present sufficient or robust grounds for excluding MFMs from the suite of cross-checks in the PR24 FD, particularly given the outdated nature of some analysis and the technical shortcomings identified.

9.2.10. The q-factor CoE is calculated based on scenarios used for the lower and upper bound of the beta range before attenuation, using the same TMR and RfR methodologies applied in this Report. This ensures a direct and consistent comparison between the CAPM and q-factor models. The detailed methodologies and assumptions underpinning the CoE estimation are set out in section 15.0.

9.2.11. Table 36 below outlines the differentials between the q-factor and CAPM CoE, which are calculated based on the same scenarios to enable the like-for-like comparison between CAPM and q-factor model. Using the lower and upper bound of the beta scenarios before attenuation, the CoE differentials between q-factor and CAPM range between 43 to 181bps.

Table 36: Differentials between q-factor and CAPM CoE as of December 31st 2024 cut off

Comparator	Adjustment	Regression window	CAPM CoE[213]	q-factor CoE[214]	CoE differential
SVT/UUW	No adjustment (Approach 1)	10-year	5.28%	5.71%	0.43%
PNN	Adj. for the entire period of Covid restriction (Approach 3)	10-year	5.88%	7.69%	1.81%

Source: KPMG analysis
Note: SVT/UUW betas are calculated on an equally weighted basis.

9.2.12. The differential between the q-factor and CAPM reflects the water portfolio's exposure to factors not captured by the CAPM. These exposures can be positive, neutral, or negative. In this instance, the positive CoE differential suggests that investors perceive the water companies' exposure to these additional factors as positive, necessitating higher returns to compensate for the associated risks.

9.3. Returns available from other asset classes: inference analysis[215]

9.3.1. A number of the cross-checks depend on the CAPM and are thus subject to the same estimation errors as the CAPM. For example, one potential cross-check is the cost of equity explicitly featured in equity analyst valuation models. However, since equity analysts often use the CAPM to estimate the cost of equity, this will be affected by the same estimation errors. A second is the MAR (Market Asset Ratio), which backs out the cost of equity from

210 It appears as though MRW have not examined the updated datasets, as reflected in their statement: "while we have not re-run the model on their updated data, on the original data we find the following point estimates for the alphas…."
211 Kenneth R. French - Data Library
212 Global-q factor
213 The CAPM CoE based on 60% gearing is equal to 5.58% and 6.26% for SVT/UUW (Variant 1) and PNN (Variant 3), respectively.
214 The q-factor CoE based on 60% gearing is equal to 6.07% and 8.29% for SVT/UUW (Variant 1) and PNN (Variant 3), respectively.
215 Please refer to Appendix 5: Inference analysis for the description of the methodology, assumptions and results of regressions and statistical tests.

observed market prices. However, if investors use the CAPM to estimate the cost of equity and determine what price to pay for a stock, this will be affected by the same estimation errors.

9.3.2. Inference analysis is an alternative way to estimate the cost of equity that does not rely on the CAPM framework. The analysis is derived based on Merton's (1974)[216] contingent claim framework and its empirical application by Campello, Chen and Zhang (2008)[217]. In Merton's framework, debt and equity are considered contingent claims over a 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.

9.3.3. The analysis does not require an estimate of the market risk premium, and is thus not affected by issues such as:

1) Choosing a proxy for the market portfolio (e.g. FTSE 100, FTSE All-Share, MSCI World)

2) The chosen proxy being an imperfect representation of the market portfolio

3) Choosing a window to estimate the historic market premium

4) The historic market premium being an inaccurate estimate of the forward-looking market premium.

9.3.4. In addition, inference analysis starts from a different premise. The CAPM is based on the idea that investors hold a portfolio of both the risk-free rate and the market. Thus, when deciding whether to hold a utilities stock, they will compare it to the market. Specifically, they will estimate the expected return and beta of the utilities stock. They will construct a portfolio of the risk-free rate and the market that gives the same beta as the utilities stock. If the expected return on that portfolio is higher than the utilities stock, then investors will sell the utilities stock, pushing its price down until the expected return is the same. If the expected return on that portfolio is lower than the utilities stock, then investors will buy the utilities stock, pushing its price up until the expected return is the same. As a result, the expected return on the utilities stock is pinned down by its beta, the risk-free rate, and the expected return on the market – as given by the CAPM equation.

9.3.5. Crucially, the expected return on the market is very difficult to estimate (it requires (i) specifying the market portfolio, (ii) specifying the historic estimation window, and (iii) assuming that historic premia are an accurate estimate of forward-looking beta or estimating an appropriate adjustment).

9.3.6. In contrast, inference analysis is based on the idea that investors will compare a utilities stock only not to the market, but also to the utility's bonds: both are ways of gaining exposure to the same underlying asset. Thus, what matters is the expected return on the stock compared not to the market but to the yield on debt for utilities.

9.3.7. Compared to the market return, the yield on the debt can be directly observed. In particular, the yield is automatically forward-looking, in contrast to estimates of historic market risk premia. What is observed is the promised yield, and so a default risk premium needs to be subtracted to obtain the expected yield. However, there is a clear way to calculate the adjustment, while there is no clear way to know what market proxy to use, what historic estimation window to use, and how to adjust historic risk premia to estimate forward-looking risk premia.

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216 Merton, R. C. (1974). On the pricing of corporate debt: The risk structure of interest rates. *The Journal of Finance*, 29(2), 449-470.

217 Campello, M., Chen, L., & Zhang, L. (2008). Expected returns, yield spreads, and asset pricing tests. The Review of Financial Studies, 21(3), 1297-1338.

9.3.8. The expected return on debt is only one input into inference analysis. Another input is the elasticity of the return on equity to the return on debt. The intuition is that equity is riskier than debt and so requires a higher return even though it is based on the same underlying asset.

9.3.9. It is true that estimating this elasticity requires assumptions, but these assumptions are analogous to the assumptions needed for the CAPM.

9.3.10. The current elasticity is estimated by regressing historic elasticities on a set of control variables: risk-free rate, leverage, and volatility. While these control variables come from the Merton (1974) model, other control variables could be added as well, so the user needs to make a decision on what controls to include.

1) Similarly, the CAPM estimates beta by regressing historic returns on the market factor. While this factor comes from the Sharpe-Lintner model, other factors could be added as well (as in the q-factor model), so the user needs to make a decision on what factors to include.

9.3.11. The current elasticity is estimated by regressing historic elasticities on control variables to estimate coefficients. This requires choosing an estimation window and assuming that historic coefficients are a good guide to today's coefficients.

1) Similarly, the CAPM requires the choice of an estimation window for calculating beta and assuming that the historic beta is a good guide to the forward-looking beta.

9.3.12. Note that CAPM involves two sets of assumptions linking historic estimates to future predictions: the historic risk premium is a good guide to the forward-looking risk premium, and the historic beta is a good guide to the forward-looking beta. In contrast, inference analysis involves one assumption: that historic coefficients are a good guide to the current coefficients. The historic coefficients are applied to the current volatility, leverage, and risk-free rate, which are all observed rather than having to be estimated.

9.3.13. In addition, inference analysis also requires estimation of the risk-free rate, as it is an input into the model. However, it is affected by misestimation in the opposite direction to the CAPM. The inference analysis equation is as follows:

$$E[r_E] = r_f + \frac{\partial E/E}{\partial D/D}\,(E[r_D] - r_f)$$

9.3.14. and CAPM is given by:

$$E[r_E] = r_f + \beta_E\,(E[r_M] - r_f)$$

9.3.15. Since $\frac{\partial E/E}{\partial D/D} > 1$, the estimated cost of equity from inference analysis is decreasing in the risk-free rate. Since β_E is lower than one for water companies, the estimated cost of equity from the CAPM is increasing in the risk-free rate. This increases its value as a cross-check. For example, if the risk-free rate were overestimated, leading to the CAPM-implied cost of equity being high, this would be offset by the inference analysis-implied cost of equity being low.

9.3.16. The detailed methodologies and assumptions are specified in section 16.1. Based on the current debt pricing and the relationship between debt and equity, the inferred CoE range is 6.50% to 6.73%.

9.3.17. The scale of the disconnect between equity and debt pricing implied by the inference analysis and the CAPM-derived CoE based on the PR24 FD 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 water less attractive compared to water debt. Water companies may have difficulty raising equity and thus choose to raise debt instead, increasing their leverage and potentially their financial fragility.

9.4. Returns available from other infrastructure sectors

I. RIIO3-SSMD

9.4.1. For a potential infrastructure investor in UK water, the UK regulated energy sector offers a clear alternative investment opportunity. Consistent with this, market commentators, including rating agencies and equity analysts, often benchmark the risk-return trade-off between water and energy. For example, S&P recently noted that the risk-return trade-off is less favourable for UK water companies compared to their counterparts in the UK regulated energy sector[218].

9.4.2. In the RIIO-3 SSMD, Ofgem provisionally included European energy networks to enhance the pricing of forward-looking risk and support investability. It noted that it may not select the midpoint of the resulting wider beta range (relative to the RIIO-2 range) and indicated that including European comparators would likely raise its beta estimate to the upper half of the 0.30 – 0.40 asset beta range, exceeding the beta used in RIIO-2[219].

9.4.3. Assuming all other CAPM parameters are at their midpoints, combining the attenuated beta range of 0.35 – 0.40 with the RFR updated to January 2025 and 55% gearing yields a CoE range of 5.19 – 5.74%[220].

9.4.4. As discussed in section 6.3, the risk exposure of the water sector going forward may exceed that of the energy sector. In this case, this benchmark may underestimate the risk-reflective and competitive returns required for the water sector.

II. Infrastructure fund implied IRR

9.4.5. To assess what a competitive rate of return might look like for UK water in comparison to other core infrastructure investments, a set of infrastructure funds investing in private finance initiatives and private utility assets serves as a useful proxy.

9.4.6. This Report replicates Ofgem's approach used in RIIO-2[221], including the selection of funds[222] to derive implied IRR values for infrastructure funds[223]. Ofgem inferred an IRR for each fund by adjusting the discount rates for the premium-to-net asset value (NAV) of each fund, reflecting the outperformance of the underlying assets.

9.4.7. The resulting range of implied IRRs is wide, likely reflecting the varying investment mandates and risk appetites of these funds. To mitigate the impact of extreme values, outliers are identified and excluded using the interquartile range (IQR) rule[224].

9.4.8. The implied IRR has increased significantly compared to the PR19 level. The share prices of these funds have declined since 2023, causing them to trade at a discount. Simultaneously, discount rates have increased, and together, these factors have led to a higher implied IRR.

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218 S&P (2025), UK. Water Regulatory Framework Support, Low Financial Flexibility In Coming Regulatory Period Drive Rating Actions, p. 9..

219 Ofgem (2024), RIIO-3 Sector Specific Methodology Decision – Finance Annex, para. 3.305.

220 The CoE range based on 60% gearing is 5.57% to 6.19%.

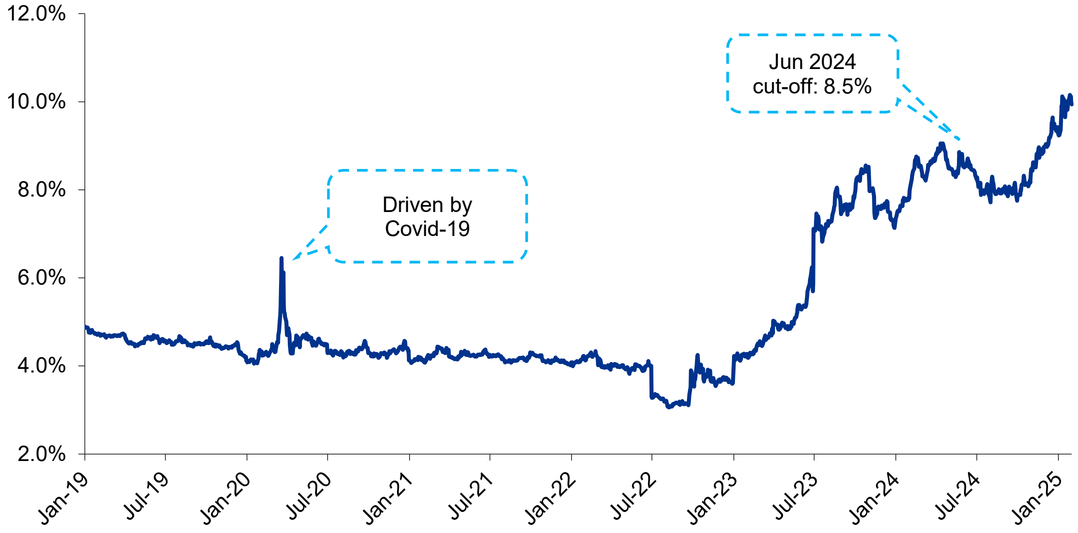
221 Ofgem (2020), RIIO-2 Draft Determinations – Finance Annex, p. 62.

222 The sample has evolved over time due to funds closing, being renamed, or data no longer being available. Of the 13 funds used by Ofgem, 3 have been excluded from this analysis: JLIF, JLP, and UKW. JLIF and JLP were delisted in September 2018 and 2021, respectively. Greencoat UK Wind (UKW) is excluded due to a change in the company's reporting of the discount rate in 2022, which made the previous data irreconcilable.

223 Implied IRR is calculated as $\frac{Fund\ discount\ rate}{Fund\ share\ price / Fund\ NAV\ per\ share}$

224 The interquartile range is the difference between the 75th percentile (or third quartile) and the 25th (or first quartile) percentile in a dataset. It measures the spread of the middle 50% of values. An observation is considered an outlier where it is either 1.5 times the interquartile range greater than the third quartile or 1.5 times the IQR less than the first quartile.

Figure 25: Infrastructure fund implied IRRs, simple average (CPIH181F225)



Source: KPMG analysis using infrastructure fund annual reports, Bloomberg and LSEG Workspace data

9.4.9. The discount rates used in this calculation are sourced from periodic reports issued by the funds and are not updated continuously. Most of these funds last reported their discount rates in June. Since market rates have continued to increase since then, assuming the June discount rate remains unchanged for calculating implied IRRs for January 2025 could distort the results. Therefore, this analysis adopts a cut-off date of June.

9.4.10. The IQR-adjusted 1-month average range as of June is 8.0 – 9.1%, with a median of 8.5% in CPIH real terms. Applying the delta between implied IRRs from 2024 and 2019 to the PR19 CoE would result in a higher estimate.

9.4.11. It is important to recognise the limitations of this cross-check when using it to inform the CoE estimate for PR24. These limitations include its relative imprecision and the lack of direct comparability to the water sector, unless adjustments are made for factors such as geographical focus and asset mix. Therefore, it is not necessary for the CAPM values to align one-for-one with this cross-check. Instead, it serves more as an indicator of the equity return needed to remain competitive and attract investment in regulated utilities.

9.5. Other market evidence

I. MAR

9.5.1. MAR compares a company's market value to its regulatory asset value. A MAR above one indicates the market values the company higher than its regulatory value, while a MAR below one suggests the opposite.

9.5.2. MAR is a commonly used cross-check by regulators, including Ofwat at PR24, but has well-known limitations. These include its sensitivity to assumptions and the influence of multiple factors, making it impossible to isolate the CoE's contribution with sufficient certainty. Despite these challenges, MAR can still provide some insight into investor sentiment towards the sector.

9.5.3. Ofwat's approach involves using stylised assumptions about RCV growth and RoRE outperformance, projected into perpetuity with a given regulatory CoE, to estimate a plausible CoE that accounts for the residual MAR premium. This is done after adjusting for factors such as non-regulated business and applying the assumed regulatory return on equity.

225 Derived using a long-term inflation assumption of 2%.

9.5.4. As of January 2025[226], the MAR of SVT and UUW are 1.13 and 1.07, respectively, while the MAR of PNN is 0.98. Using the updated MAR values and the PR24 FD allowed CoE of 5.1%, the following MAR-implied CoE values are derived.

Table 37: MAR-inferred CoE (real, CPIH)[227]

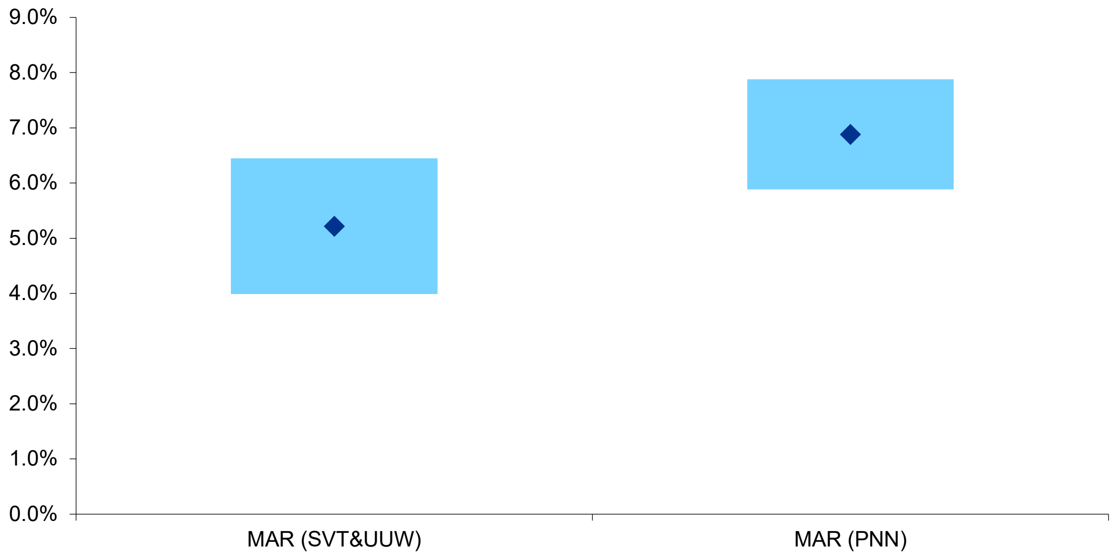
	SVT	UUW	PNN
Low scenario	4.0%	4.5%	5.7%
High scenario	6.0%	6.5%	7.7%

Source: KPMG analysis based on Ofwat's MAR inference analysis tool.

9.5.5. Ofwat calculates the MAR-inferred CoE by equally weighting the three water companies. This approach likely underestimates the sector's CoE, given the historical and expected outperformance[228] and lower risk profile of SVT and UUW. The MAR-inferred CoE range for these two companies, extending to January 2025, is 4.0% to 6.5%.

9.5.6. In contrast, PNN may provide a more realistic reflection of sector performance, although it also expects outperformance during AMP8[229], which may not be representative of the notional company. Its MAR-inferred CoE range is 5.7% to 7.7%, highlighting that Ofwat's FD CoE of 5.1% falls short of investor expectations for water companies with performance closer to the industry average profile.

Figure 26: MAR-inferred CoE range (real, CPIH)



Source: KPMG analysis based on Ofwat's MAR inference analysis tool

9.5.7. The MAR cross-check reflects market perceptions of risk and return, which are influenced by the regulatory framework, including allowed returns set by regulators. When a regulator's determinations are publicly available or shape market expectations, circularity can arise – where market return expectations are partially driven by the regulator's own assessments. This

226 The net debt, RCV and non-regulated activities used for the calculation of MAR are updated based on the latest Morgan Stanley report published on January 14, 2025 as per Ofwat's methodology.

227 The MAR range based on 60% gearing is 3.9% to 5.9% for SVT, 4.4% to 6.4% for UUW, and 5.8% to 7.8% for PNN.

228 Equity analysts expect RoRE outperformance from SVT and UUW in AMP8. For example, Barclays notes that "In terms of RORE, we view SVT as the best positioned in the sector, estimating a +1.8% ODI RORE and a 0.9% financing RORE, which brings us to a potential 8.1% real achieved RORE (10.1% nominal)". Barclays (December 2024), SVT FD Response: All set for AMP8, p. 1. Jefferies assumes for UUW "0.75% RoRE outperformance over base allowed returns, driven by 0.5% of financing outperformance and 0.25% of ODI outperformance across AMP8". Jefferies (January 2025), Finding its Flow; Reiterate Buy on PNN, Hold on UU/SVT, p. 10.

229 For example, JP Morgan notes that, for PNN, "Our estimates include 34% nominal RCV growth over AMP8, and 100bps RoRE outperformance at the notional company level, assuming 55% gearing, driven of financing outperformance". JP Morgan (January 2025), UK Water Surfing the earnings upgrade wave - we remain positive, p. 14.

undermines the MAR's effectiveness as an independent cross-check. Given these limitations, as well as those discussed above, the MAR cross-check is only considered to be indicative.

II. Equity analyst estimates

9.5.8. Equity analyst reports may be tailored to specific investors or house views, rather than representing the average or marginal investor in the sector. Furthermore, circularity can arise if analysts estimate how they expect the regulator to set allowed CoE, rather than developing independent assessments. More fundamentally, many analysts do not provide sufficient detail to consistently and comparably assess the post-tax required CoE for the notional geared water company.

9.5.9. Barclays[230] provides its own estimates of the notional company WACC, noting that the FD WACC still lies below its estimate of required returns of 6.1% real RoRE and 4.42% real WACC.

9.5.10. JP Morgan[231] notes that "core infrastructure in general should provide a real equity return of 5-7%, with Ofwat's final CoE allowance just scraping into this range (vs. being below this range in the DDs). Returns are only 'adequate' in our view considering absolute levels are still modest, with better returns available from other infrastructure sectors. We think the returns now available in PR24 should meet investor hurdle rates for higher quality UK water companies, but the adequacy of Ofwat's returns for weaker water companies (e.g. THAMES, SWSFIN) is less certain".

9.5.11. The values cited by Barclays and JP Morgan can be compared to the PR24 FD and used for indicative benchmarking purposes, implying an overall range of 5-7% CPIH. Other analyst reports published after the FD lack sufficient detail to infer required CoE for the notional company.

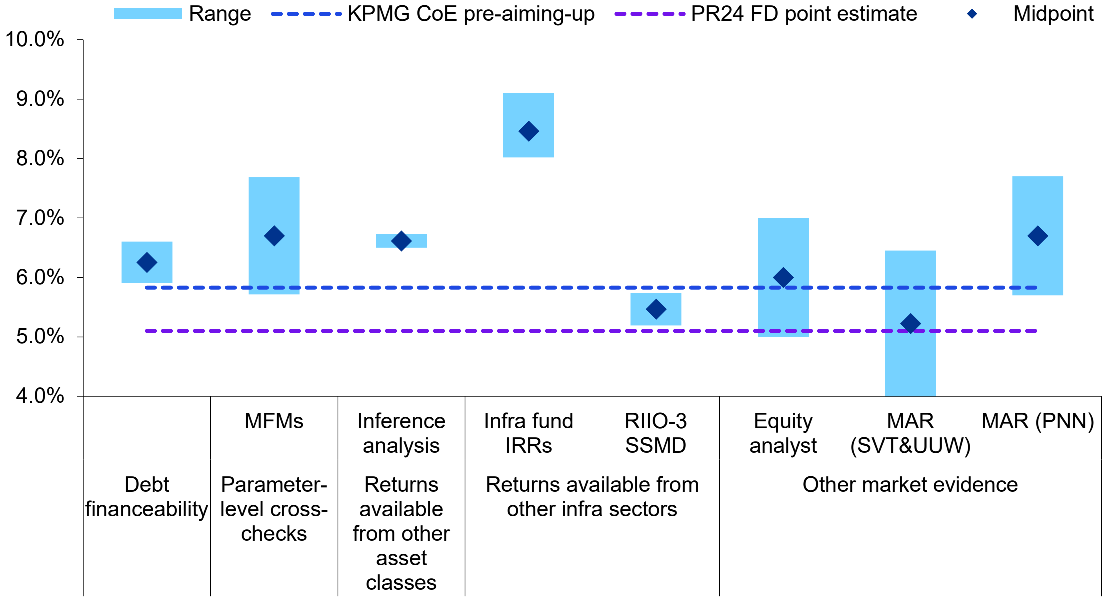
9.6. Implications of cross-check evidence for estimation of PR24 CoE

9.6.1. The figure below presents the CoE values implied by all the cross-checks considered in this section, alongside the PR24 FD point estimate and the midpoint of the CoE range derived in this Report before aiming up.

230 Barclays (December 2024), Increasing certainty should re-rate sector, p. 11.

231 JP Morgan (December 2024), A rising tide lifts all ships, pp. 3-4.

Figure 27: CoE implied by cross-check evidence (real, CPIH)



Source: KPMG analysis

9.6.2. The PR24 FD lies outside the range of nearly all cross-check evidence, except for the MAR range from SVT/UUW, which represents a very small subset of the available data. The PR24 FD remains below the RIIO-3 SSMD, highlighting that the risk-return trade-off in the water sector may not be competitive. The PR24 FD CoE is significantly lower than the range required for the notional company to achieve the target rating.

9.6.3. On balance, the cross-check evidence supports a CoE estimate above 6.30%. Of these cross-checks, the debt financeability cross-check indicates minimum returns required to achieve the target credit rating across AMP8. Ofwat's own financial modelling assumes that gearing would increase across the price control to 57.5%, which would require a cost of at least equity of 6.24% (41bps aiming up) to achieve the target rating across AMP8. MFMs and inference analysis support CoE at this level or higher.

10. CoE range and estimate for PR24

10.0.1. The preceding sections of this Report considered the estimation of each of the CoE parameters. The resulting CoE range is set out in the table below on a 55% and 60% notional gearing basis.

10.0.2. This section focuses on the selection of the point estimate for allowed return on equity from a range constructed based on parameter-level estimates. It explores the potential application of an adjustment to the CoE to account for parameter uncertainty, investability and evidence from cross-checks, including alternative pricing models.

Table 38: PR24 CoE range based on parameter-level estimates, 55% gearing

Parameter (CPIH)	KPMG (Sept 2024) 55% gearing Lower bound	KPMG (Sept 2024) 55% gearing Upper bound	KPMG (Jan 2025) 55% gearing Lower bound	KPMG (Jan 2025) 55% gearing Upper bound
Notional gearing	55%	55%	55%	55%
TMR	6.93%	6.93%	6.93%	6.93%
RFR	1.68%	2.27%	2.33%	2.85%
Unlevered beta	0.32	0.35	0.32	0.36
Debt beta	0.10	0.10	0.10	0.10
Observed gearing	50.35%	48.94%	51.19%	50.18%
Asset beta	0.37	0.40	0.37	0.41
Notional equity beta	0.70	0.77	0.71	0.78
CoE, appointee	5.37%	5.84%	5.60%	6.04%
RMA	-	-	-	-
CoE, wholesale	5.37%	5.84%	5.60%	6.04%

Source: KPMG analysis

Table 39: PR24 CoE range based on parameter-level estimates, 60% gearing

Parameter (CPIH)	KPMG (Sept 2024) 60% gearing Lower bound	KPMG (Sept 2024) 60% gearing Upper bound	KPMG (Jan 2025) 60% gearing Lower bound	KPMG (Jan 2025) 60% gearing Upper bound
Notional gearing	60%	60%	60%	60%
TMR	6.93%	6.93%	6.93%	6.93%
RFR	1.68%	2.27%	2.33%	2.85%
Unlevered beta	0.32	0.35	0.32	0.36
Debt beta	0.10	0.10	0.10	0.10
Observed gearing	50.35%	48.94%	51.19%	50.18%
Asset beta	0.37	0.40	0.37	0.41
Notional equity beta	0.78	0.85	0.79	0.87
CoE, appointee	5.76%	6.23%	5.95%	6.39%
RMA	-	-	-	-
CoE, wholesale	5.76%	6.23%	5.95%	6.39%

Source: KPMG analysis

10.1. Selecting a point estimate

10.1.1. The core principle underpinning aiming up is to mitigate the greater welfare loss arising from underestimation 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.

10.1.2. 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.

10.1.3. This principle 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"[232].

10.1.4. The CAPM-CoE is not directly measurable, and its parameters are subject to both theoretical debate and statistical uncertainty. In the context of this uncertainty aiming up when selecting the point estimate for CoE supports investor confidence, encourages investment, and ultimately protects consumer welfare in regulated sectors.

10.1.5. The CMA in its PR19 redetermination set the point estimate for CoE 25bps above the midpoint of the CoE range to address investment incentives, comprised of c15bps[233] for parameter uncertainty and 10bps for asymmetric risk on ODIs.

10.1.6. The CMA considered that the need to promote investment should be a consideration in selecting 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"[234].

10.1.7. The CMA's PR19 decision indicates that its concerns around incentives for investment and customer welfare would be particularly acute in case of a step change in investment. In referencing the need for sufficient financial incentives to ensure that appropriate capital projects were identified and designed at a desirable level, the CMA noted 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"[235].

10.1.8. The risks of underinvestment identified by the CMA in PR19 are likely to be even more pronounced at PR24. With a step change in required investment, coupled with the need for equity injections to maintain the financeability of the notional structure, it is vital that the sector attracts the necessary capital. Failing to secure this investment could result in significant detriment to consumer welfare, exacerbating the risks of underfunding essential infrastructure.

232 UKRN CoE Study, p. 72.

233 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 midpoint 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.

234 CMA (2021), PR19 Final Determination, para. 9.1394.

235 CMA (2021), PR19 Final Determination, para. 9.1391.

10.1.9. This Report adopts a two-step approach for selecting the point estimate for the CoE. First, it evaluates the implications of the statistical uncertainty inherent in the CAPM for the overall CoE range. Second, it considers the implications of cross-checks to determine an investable CoE within that range.

I. Accounting for statistical uncertainty in parameters

10.1.10. Uncertainty exists not only around the choice of methodology for each parameter in the CAPM but also in the statistical uncertainty associated with the true parameter values. Each parameter estimate aims to approximate the unobservable true values, which are inherently subject to statistical uncertainty. Even with the most robust methodology in CAPM estimation, this uncertainty persists, as illustrated below:

1) The beta estimate is derived from the Ordinary Least Square (OLS) mean in the CAPM regression, which is an unbiased and consistent estimator[236] of the true beta parameter. However, this estimate is subject to statistical uncertainty, as reflected in the standard error[237] and confidence interval reported in the regression. For example, the CAPM regression on PNN, controlling for the full restriction period (Variant 3), produces an OLS mean of 0.715 with a 95% confidence interval ranging from 0.642 to 0.788. This interval represents the range within which the true beta parameter is likely to fall with 95% confidence. While the OLS mean of 0.715 is used as the beta estimate for the regulatory CoE calculation, the statistical uncertainty inherent in this estimate should not be disregarded.

2) The TMR and RfR estimates are based on the sample mean over a specified period. The sample mean is an unbiased and consistent estimate of the true population mean. However, the estimate may vary if a different period is used, leading to statistical uncertainty around the true value of TMR and RfR.

10.1.11. The statistical uncertainty inherent in CAPM parameter estimates is an inherent feature of the estimation process, persisting each time the parameters are re-estimated. As a result, the uncertainty affecting the estimation process cannot be addressed through future estimations, as each new estimation will carry its own uncertainty.

10.1.12. A CoE range incorporating the statistical uncertainty inherent in the CAPM parameters is derived by first estimating the uncertainty in these parameters and then combining the estimated beta[238], TMR[239], and RFR[240] values through the CAPM formula. The resulting CoE distribution is broadly symmetrical and resembles a normal distribution, with a median of 5.81%. The interquartile range (25th to 75th percentile[241]) of the CoE spans from 4.94% to 6.69%, with the median aligning closely with the CAPM point estimate of 5.8% based on the January 2025 cut-off at 55% gearing[242].

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236 An unbiased estimator means that, on average, the estimated value will equal to the true value of the parameter. A consistent estimator means that as the sample size, increases, the estimated value gets closer to the true value of the parameter.

237 The standard error of a regression coefficient is a measure of the uncertainty in the estimated value of the coefficient. It tells us how much the coefficient is likely to vary from its true value if we were to repeat the regression analysis many times with different samples of data.

238 The statistical uncertainty around beta is estimated using the following steps: 1) Obtain the OLS mean and standard error of the raw equity beta for both the unattenuated low and high beta scenarios through CAPM regressions. 2) Calculate the mean and standard error of the raw equity beta for the attenuated low beta scenario. The mean of the attenuated low beta scenario is the average OLS mean between the low and high beta scenario. The standard error is calculated as the square root of $(0.5 \times SE\ of\ low\ beta\ scenario)^2 + (0.5 \times SE\ of\ low\ beta\ scenario)^2 + 2 \times 0.5 \times 0.5 \times low\ beta\ SE \times high\ beta\ SE\ \times corrlation\ between\ low\ and\ high\ scenario$. 3) Simulate the beta range assuming a normal distribution around the OLS mean and standard error 50,000 times, with equal likelihood assigned to both the attenuated low and high beta scenarios. 4) Convert the raw equity beta to the notional equity beta based on a 55% notional gearing and a 0.1 debt beta.

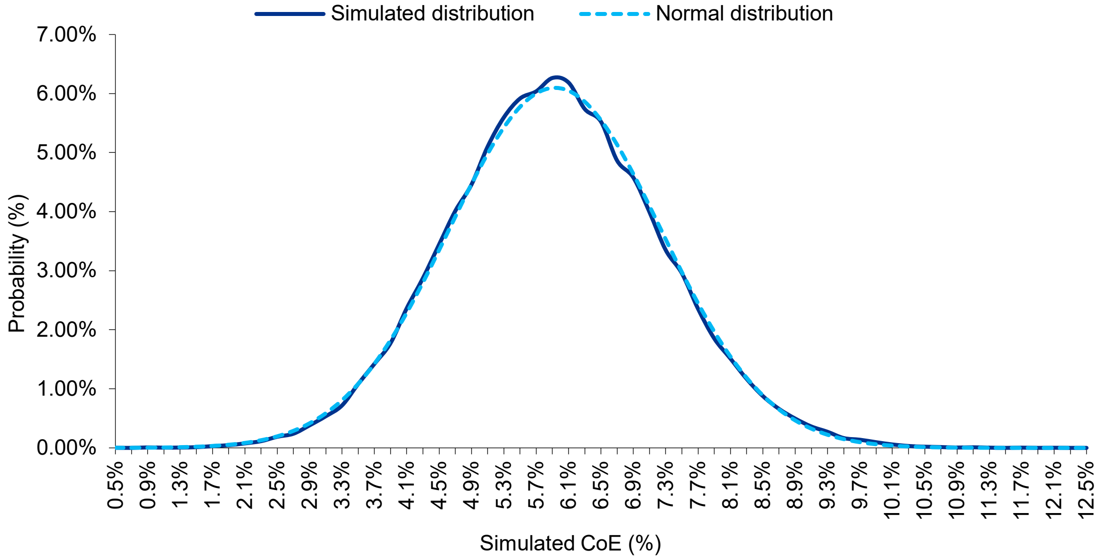
239 The statistical uncertainty around TMR is estimated using the following steps: 1) Calculate the standard error of the TMR estimate. The standard error of 1.72% is calculated as the standard deviation of the real equity return series from 1900 to 2023 divided by the square root of 124, in which 124 represents the number of years from 1900 to 2023. 2) Simulate the TMR range by assuming a normal distribution with the TMR point estimate (6.93%) and standard error (1.72%) over 50,000 iterations.

240 RFR is calculated as the observed 1-month average of ILG yields, with fixed adjustments for CY and differing risk-free borrowing and saving rates. Since the RFR is calculated from observed data and fixed adjustments without applying any statistical distribution, it is assumed that there is no standard error associated with it.

241 The use of the 25th and 75th percentiles (interquartile range) provide a robust measure of the CoE distribution's spread, as it focuses on the middle 50% of values, excluding extreme outliers that may skew the interpretation. This range effectively captures the central tendency and uncertainty of the CoE.

242 For simulated CoE based on 60% gearing, the interquartile range is 5.19% to 7.13%, with the median closely aligned with the CAPM point estimate of 6.18%.

Figure 28: The simulated distribution of CoE accounting for parameter uncertainty



Source: KPMG analysis

10.1.13. The interquartile range from the simulated distribution – which takes into account estimation uncertainty – denotes a wider range of potential outcomes than implied by the CAPM low and high estimates in the tables above. This wider range of potential outcomes which takes into account estimation uncertainty in the CAPM is considered in the selection of the point estimate CoE for PR24.

II. Implications of cross check evidence for the point estimate

10.1.14. Cross-checks support investability by validating CAPM estimates, addressing the model's limitations, and providing a market-based perspective on a suitable and investable CoE under current market conditions. This helps ensure the sector attracts and retains the right investors.

10.1.15. Cross-check evidence indicates that CAPM-derived returns may not be competitive compared to those available in other regulated sectors and asset classes.

10.1.16. The Report adopts an aiming up adjustment of 50bps primarily to reflect:

1) **Debt financeability:** with all three major rating agencies having tightened their rating thresholds, analysis of projected credit metrics for the notional company based on the latest thresholds indicates that a CoE of at least 6.10% (27bps aiming up) is required to achieve the target rating and underpin the financial resilience of the notional firm at 55% gearing. A CoE of at least 6.66% – equivalent to 83bps aiming up – would be required to achieve the target rating at 60% gearing. Ofwat's own financial modelling assumes that gearing would increase across the price control to 57.5%, which would require a CoE of 6.24% (41bps aiming up) to achieve the target rating across AMP8.

2) **MFM:** MFM evidence – and in particular the CoE derived using the q-factor model – is considered a key cross-check to the CAPM-derived CoE. This is because, *inter alia*, the q-factor model provides a more granular view of risk than the CAPM, improves upon the empirical performance of the CAPM based on UK data and has met the high bar for statistical robustness applied in academic literature for the evaluation of asset pricing models. The q-factor model evidence suggests that the CAPM materially under-prices systematic risk for water companies by 43 to 181bps[243], under the same beta scenarios. MFM evidence supports aiming up of at least 50bps.

243 The 43bps to 181bps is calculated by the q-factor CoE minus the CAPM CoE under the same beta scenarios.

3) **Inference analysis:** 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. Inference analysis suggests that the CAPM-derived CoE in this Report (pre-aiming up) is at least 67bps lower than would be expected relative to the current market pricing of debt in the sector and the relationship between debt and equity pricing.

10.1.17. An aiming up adjustment of 50bps is adopted in this Report, in line with the level of aiming up adopted in the CMA's provisional determination at PR19[244]. This adjustment is considered the minimum necessary to meet financeability requirements, ensure financial resilience within the gearing tolerance assumed for the notional company's financial modelling, and attract equity capital, particularly in light of the fundamental shifts in the risk landscape for water companies.

10.1.18. However, an aiming up adjustment of 50bps would result in a point estimate lower than the levels implied by the thresholds required to achieve the target rating at 60% gearing, inference analysis, infrastructure fund IRRs, the Pennon MAR, and the ranges for equity analysts and the MAR.

10.1.19. Aiming up by 50bps from the midpoint of the CAPM-implied range results in a point estimate of 6.33% on a 55% gearing basis, placing it at the 66th percentile of the range when accounting for statistical parameter uncertainty. In consequence, the point estimate is consistent with the CAPM evidence developed in this report, and is aligned to previous regulatory decisions which have explicitly set point estimates above the midpoint to mitigate against the risk of under-investment. For example, as highlighted in the CMA PR19 decision, The New Zealand Commerce Commission (NZCC)[245] follows a policy of setting regulatory price controls in energy based on the 67th percentile of its WACC range.

Table 40: Comparison of CoE ranges with and without parameter uncertainty

Parameter (CPIH)	KPMG (Jan 2025) 55% gearing Lower bound	KPMG (Jan 2025) 55% gearing Upper bound
CAPM-CoE range i.e. excluding parameter uncertainty	5.60%	6.04%
CoE range including parameter uncertainty	4.94%	6.69%

Source: KPMG analysis

10.1.20. 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[246] may be deemed less attractive than other available opportunities with better risk-reward profiles.

10.1.21. The distribution of expected returns is a relevant and important criterion for selection of a point estimate for CoE. Analysis of the FD 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. In consequence, this Report recommends that each

244 The use of the 25th and 75th percentiles (interquartile range) provide a robust measure of the CoE distribution's spread, as it focuses on the middle 50% of values, excluding extreme outliers that may skew the interpretation. This range effectively captures the central tendency and uncertainty of the CoE.

245 Commerce Commission New Zealand (2014), Amendment to the WACC percentile for price-quality regulation for electricity lines services and gas pipeline services, paragraphs X17-X20.

246 Skewness measures the shape of a distribution. A negatively skewed distribution has a longer left tail, meaning extreme negative returns are more likely. Conversely, a positively skewed distribution has a longer right tail, indicating that extreme positive returns are more likely.

company undertake this analysis based on the FD and any additional risk mitigants included in Statements of Case. 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.

10.2. CoE range and point estimate for PR24

10.2.1. On a 55% gearing basis – i.e. reflecting the notional gearing assumption adopted in the FD – the point estimate for the wholesale CoE is 6.33% based on a January 2025 cut-off and 6.12% based on a September 2024 cut-off. This compares to 4.97% estimated in the FD based on a September 2024 cut-off.

Table 41: Comparison of CoE point estimates, 55% gearing

Parameter (CPIH)	Ofwat FD (Sept 2024) 55% gearing	KPMG (Sept 2024) 55% gearing	KPMG (Jan 2025) 55% gearing
Notional gearing	55%	55%	55%
TMR	6.83%	6.93%	6.93%
RFR	1.52%	1.98%	2.59%
Unlevered beta	0.28	0.34	0.34
Debt beta	0.10	0.10	0.10
Observed gearing	52.27%	49.64%	50.69%
Asset beta	0.34	0.39	0.39
Notional equity beta	0.62	0.73	0.75
CoE before aiming up, appointee	4.83%	5.62%	5.83%
Aiming up	0.27%	0.50%	0.50%
CoE, appointee	5.10%	6.12%	6.33%
RMA	-0.13%	-	-
CoE, wholesale	4.97%	6.12%	6.33%

Source: KPMG analysis

10.2.2. On a 60% gearing basis the point estimate for the wholesale CoE is 6.68% based on a January 2025 cut-off and 6.51% based on a September 2024 cut-off.

Table 42: Comparison of KPMG CoE point estimates

Parameter (CPIH)	KPMG (Sept 2024) 55% gearing	KPMG (Sept 2024) 60% gearing	KPMG (Jan 2024) 55% gearing[247]	KPMG (Jan 2024) 60% gearing[248]
Notional gearing	55%	60%	55%	60%
TMR	6.93%	6.93%	6.93%	6.93%
RFR	1.98%	1.98%	2.59%	2.59%
Unlevered beta	0.34	0.34	0.34	0.34
Debt beta	0.10	0.10	0.10	0.10
Observed gearing	49.64%	49.64%	50.69%	50.69%
Asset beta	0.39	0.39	0.39	0.39
Notional equity beta	0.73	0.81	0.75	0.83
CoE before aiming up, appointee	5.62%	6.01%	5.83%	6.18%
Aiming up	0.50%	0.50%	0.50%	0.50%
CoE, appointee	6.12%	6.51%	6.33%	6.68%
RMA	-	-	-	-
CoE, wholesale	6.12%	6.51%	6.33%	6.68%

Source: KPMG analysis

247 With the 50bps aiming up included at both ends of the range, the CoE range increases to 6.10% – 6.54%, up from 5.60% – 6.04%
248 With the 50bps aiming up included at both ends of the range, the CoE range increases to 6.45% – 6.89%, up from 5.95% – 6.39%

11. Cost of debt

11.0.1. The cost of debt (CoD) component of the WACC estimate reflects the return required to compensate debt investors for lending to a notional company.

11.0.2. The CoD comprises the cost of embedded debt (CoD_E), which reflects the interest rate on existing debt carried over from previous periods; the cost of new debt (CoD_N), which is the interest rate on debt raised during the current control period; the share of new debt, determined by the level of refinancing and RCV growth in the period; and additional borrowing costs (CoD_A), which include non-interest expenses associated with borrowing.

11.0.3. This section outlines the methodology used in this Report to estimate the CoD and addresses the challenges raised by Ofwat. It is organised into the following key components:

1) The methodology for estimating CoD_E.
2) The methodology for estimating CoD_N.
3) The methodology for estimating the share of new debt.
4) The methodology for estimating CoD_A.
5) The derivation of an overall CoD estimate.

11.0.4. For each of these components, the table below summarises and contrasts the approach adopted in this Report with the methodology used in the PR24 FD.

Table 43: Ofwat's and this Report's approach to estimating CoD

Component	PR24 FD	This Report
CoD_E	Median of the forecast cost of embedded debt 50% weight on 'all-in' cost and 50% on 'actual-notional' cost, excluding swaps, based on a September 2024 cut off	Adopts the PR24 FD as a starting point, but (1) updates the market data cut-off to January 2025 (2) attaches no weight to actual-notional costs (3) includes swap costs in all-in costs
CoD_N	iBoxx A/BBB non-financials + 30bps adjustment to reflect water company secondary yields	iBoxx A/BBB non-financials + 40bps adjustment to reflect water company secondary yields for Baa1-rated company (low end) and Baa2-rated company (high end)
Share of new debt	Calculated based on expected refinancing needs and expected notional RCV growth for the sector.	Applies the same overall methodology but with refinements to assumptions and inputs.
CoD_A	An allowance for issuance costs, liquidity and cost of carry based on a modelling of future pre-financing and liquidity requirements per the DD.	Adopts the same assumption regarding issuance costs. Integrates updated assumptions on future financing and liquidity requirements, along with alternative assumptions regarding the use of Revolving Credit Facilities (RCFs) and the pre-financing period. Additionally, an allowance for basis risk is incorporated to account for potential variations in market conditions.

Source: KPMG analysis and PR24 FD

11.1. Cost of embedded debt

11.1.1. The FD estimated the cost of embedded debt (CoD_E) at 4.82% in nominal terms, based on projected debt costs for WaSCs and large WoCs over AMP8.

11.1.2. A central estimate of 4.99% (nominal) for CoD_E is adopted in this Report based on:

1) **Sample of companies:** Based on WaSCs and large WoCs. This approach excludes small WoCs and the central estimate is not sensitive to whether large WoCs are included or excluded.

2) **Averaging approach:** This method avoids assigning disproportionate weight to outliers. Given the wide variation in company CoD_E, outliers could potentially distort estimates of expected costs for the notional firm.

3) The all-in cost represents the primary approach for estimation of the CoD_E in this Report, on the basis that this approach would allow the average company in the sector to recover its costs. Assigning direct weight to approaches which 'notionalise' costs such as the actual-notional costs could mean that the notional company – as proxied by a company incurring the average costs for the sector – may not be able to recover its efficient costs.

4) This Report adopts a high hurdle rate for exclusion of instruments, as this could introduce variance between the allowance and costs being incurred by the average company in the sector.

11.1.3. A comparison of key differences in methodology for CoD_E across the PR24 FD and this Report is set out in the table below.

Table 44: Ofwat's and this Report's approach to estimating CoD_E

Component	PR24 FD	This Report
Sample of companies	WaSCs and large WoCs	WaSCs and large WoCs
Averaging approach	Median	Median
Benchmark for assessing debt costs	50% weight on 'all-in' cost and 50% on 'actual-notional' cost	100% weight on 'all in'
Exclusions	All swaps (other than cross-currency), junior debt, liquidity facilities / overdraft / RCF, intercompany debt, debenture stock, preference shares	Junior debt, liquidity facilities / overdraft / RCF, intercompany debt not on a pari-passu basis, debenture stock, preference shares
Market data cut off	September 2024	January 2025

Source: KPMG analysis and PR24 FD

11.1.4. The analysis in this Report adopts the FD position of 4.82% as a starting point and makes the following adjustments to derive a cost of embedded debt of 5.00%:

1) Updates to reflect latest market data i.e. a January 2025 cut off (+1bps)

2) No weight attached to the actual-notional approach (+6bps)

3) Inclusion of swaps based on the difference between Ofwat and KPMG modelling at DDs (+11bps)

11.1.5. The sections below (1) set out the rationale for these adjustments (2) comments on the Ofwat FD position.

I. Key in-principle issues implied by Ofwat's balance sheet approach

11.1.6. This section outlines the key in-principle issues implied by Ofwat's balance sheet approach in the FD.

11.1.7. First, Ofwat has characterised its balance sheet approach as "…based on debt instruments relevant for the notional company that are observed on company balance sheets for the larger companies"[249].

11.1.8. This departs from the CMA's position at PR19. The CMA also used a balance sheet approach but included the cost of all debt instruments. The CMA explained that it "…included all debt costs, including those 'non-pure' costs previously disputed in Ofwat's balance sheet approach, negating much (but not all) of the disagreement on the correct measurement of actual debt costs"[250].

11.1.9. Second, (a) Ofwat has specified the notional company for its balance sheet approach ex-post; and (b) this notional company does not resemble any one company or the average company in the sector[251].

11.1.10. On (a), Ofwat did not signal ex-ante what the notional company would or would not issue.

11.1.11. On (b), no one company meets every criteria of the notional company and accordingly, neither would the average company in the sector.

11.1.12. Even larger companies that are close to notionally geared (WSH, SVH and UUW) have raised debt instruments which Ofwat considers the notional company would not have issued. For example, all three companies actively use swaps and WSH has made use of wrappers in the past.

11.1.13. In consequence, Ofwat's notional company does not represent an achievable benchmark.

11.1.14. Third, Ofwat's balance sheet approach 'double notionalises' the sector's actual cost:

11.1.15. The first round of notionalisation is in the calculation of the 'all-in' cost. Ofwat sanitises company balance sheets for categories of instrument that it considers would not have been issued by the notional company. It follows that despite being labelled the 'all-in' cost, it is a notional cost.

11.1.16. The second round of notionalisation is in the calculation of the 'actual-notional' cost. Ofwat superimposes the notional debt mix on the already notional 'all-in' cost.

11.1.17. Ofwat applies equal weight to both of these notional costs to form its balance sheet estimate.

11.1.18. The result of Ofwat's 'double notionalisation' is that its balance sheet estimate does not reflect the reality of the sector's actual cost[252]. In practice, this means that Ofwat's balance sheet estimate underfunds the sector's actual cost.

11.1.19. This contravenes the principle underpinning the balance sheet approach, like other sector average approaches, that the sector's actual cost is the proxy for the efficient cost.

11.1.20. Fourth, Ofwat's exclusions to company balance sheets are one-sided in that it does not reflect what the plausible counterfactual would have been if the company had not issued the 'excluded' debt.

11.1.21. For example, Ofwat excludes wrapping fees but retains the very low coupons of wrapped debt which typically had an AAA rating at inception. This counterfactual assumes that the

249 Ofwat (2024), PR24 Draft Determination, Aligning risk and return, p. 18.

250 CMA (2021), PR19 Final Determination, para. 9.552.

251 See Appendix 6: Cost of embedded debt sets out UUW's treasury policy on interest rate risk over 2008-2024.

252 Ofwat critiques the March 2024 CoD report for its focus on the sector's actual costs, noting that: "KPMG's focus appears to be on understanding the cost of debt taking account of actual financing choices of the companies". See Ofwat (2024), PR24 Draft Determination, Ofwat comments on cost of debt report submitted by Water UK, p. 8.

actual (or notional) company could have raised AAA rated debt without a wrapper. This is not a plausible counterfactual.

II. Treatment of the 'actual-notional' cost under the balance sheet approach

11.1.22. Ofwat assigns equal weight to the 'all-in' cost and 'actual-notional' cost to form its balance sheet estimate. This section considers the usefulness of placing weight on the 'actual-notional' cost.

11.1.23. Ofwat's FD model estimates an 'all-in' cost of 4.89% and an 'actual-notional' cost of 4.76% in nominal terms. The average of these costs results in a balance sheet estimate of 4.82%.

11.1.24. Ofwat considers "…the 'Actual notional' cost to be an important element of our [Ofwat's] benchmark efficient cost of embedded debt. Rather than aiming to identify errors, we include it because it aligns with our long-standing principle that companies are responsible for their own financing choices"[253].

11.1.25. Companies cannot change their past decisions (embedded debt), only their future decisions (new debt) which implies there is a limited efficiency incentive of including the 'actual-notional' cost. Instead, its inclusion could mean that companies are underfunded for their actual cost.

The 'actual-notional' cost does not adjust solely for debt mix

11.1.26. The 'actual-notional' cost does not in practice solely adjust a company's portfolio for the notional debt mix. It also adjusts the weighted-average timing of issuance of a company's portfolio.

11.1.27. For example, assume a company's portfolio comprises two equally sized bonds. One index linked which was issued when rates were high and one fixed rate which was issued when rates were low. The 'actual-notional' cost assumes that 67% of the portfolio was raised when rates were low whereas in reality this was 50%[254]. In this example, the 'actual-notional' cost would understate the actual cost.

11.1.28. Instead, the 'actual-notional' cost should be calculated such that the cost of the additional 17% fixed rate debt is based on the same timing of issuance as the index linked bond.

11.1.29. The implication is that Ofwat's 'actual-notional' cost is over simplified and does not fulfil the purpose for which it was designed. The more robust version of the 'actual-notional' cost above would correct the distortion related to timing of issuance but is likely to be challenging to implement in practice.

The 'actual-notional' cost can give a misleading view of the actual cost

11.1.30. Ofwat's 'actual-notional' cost (and the more robust version above) is synthetically constructed and can give a misleading view of the sector's actual cost.

11.1.31. First, whilst Ofwat's FD model implies that the 'all-in' cost and 'actual-notional' cost are different at the sector-level, they also vary materially at the company-level.

11.1.32. At the company-level, the differences can be very material. For example, in the case of SSC, its 'all-in' cost is 97bps higher than its 'actual-notional' cost based on Ofwat's FD model.

11.1.33. This suggests that the 'actual-notional' cost should not be used as an input into the balance sheet estimate. Its inclusion could result in the average company being underfunded for its actual cost. This undermines the principle underpinning the sector average approach.

11.1.34. As such, this Report attaches no weight to the 'actual-notional' cost in deriving the cost of embedded debt, which increases the cost of embedded debt by 6bps relative to the FD.

253 Ofwat (2024), PR24 Draft Determination, Ofwat comments on cost of debt report submitted by Water UK, p. 8.
254 The notional debt mix comprises 67% fixed rate debt and 33% index linked debt.

III. Treatment of swaps in the 'all-in' cost under the balance sheet approach

11.1.35. This section considers Ofwat's position on swaps.

Swaps

11.1.36. Ofwat has retained its position of excluding all swaps in its balance sheet approach except cross currency swaps. This section considers whether this position is appropriate.

Use of swaps

11.1.37. Ofwat considers that its decision to exclude swaps would not disincentivise companies to adopt efficient financing strategies. However, the majority of the sector, including companies with near notional gearing, routinely uses swaps. This suggests that the sector considers swaps to form part of an efficient financing strategy. In consequence, Ofwat's exclusion of swaps could be interpreted as disincentivising efficient financing strategy.

11.1.38. In addition, it appears to depart from the principle that underpins the sector average approach that what the sector has done on average represents the proxy for efficiency.

11.1.39. This section explores why companies have used swaps as part of their financing strategies and whether this use of swaps is efficient.

Interest rate swaps

11.1.40. Interest rate swaps have been used to match Ofwat's cost of debt for the notional company.

11.1.41. UUW has signalled that it has used interest rate swaps in this way since 2008[255]. As a recent example, its policy on interest swaps for AMP7 has been outlined below.

11.1.42. For context, Ofwat's new debt allowance for AMP7 was based on a share of new debt of 20% and a cost of new debt indexed to the iBoxx A/BBB index i.e. a floating rate.

11.1.43. UUW's policy for AMP7 has been to raise long-term fixed rate debt and convert this into floating using interest rate swaps at inception for the life of the debt. It uses a second layer of interest rate swaps to revert the synthetic floating rate debt back to fixed on a 10Y reducing balance basis. At the start of AMP7, a proportion of the debt book remained floating, reflecting the 20% share of new debt, until it is fixed via the 10Y reducing balance mechanism. UUW's rationale for this is to approximate Ofwat's new debt allowance and thus the new debt issuance of the notional company.

11.1.44. UUW's policy suggests that the only way for actual companies to mimic the notional company's debt issuance in practice is through the use of interest rate swaps. This appears reasonable since no company can issue benchmark debt on a daily basis as implied by the new debt allowance.

11.1.45. NGN has adopted a similar strategy to match Ofgem's cost of debt for the notional company in RIIO-2. NGN states in its annual report that: "In practice, most floating rate debt, in addition to debt issued at fixed rate and swapped back to floating rate for life, has its rate re-fixed with interest rate swaps on a staggered basis in order to align the rate re-fixing profile on this debt with the regulatory cost of debt allowance, which is calculated with reference to a trailing average of certain corporate bond yields"[256].

11.1.46. Ofwat's primary reason for excluding swaps is that it does not consider the notional company would have issued these instruments. However, companies have used interest rate swaps to proxy the notional company's debt issuance profile which is not directly achievable. It does not appear reasonable to exclude interest rate swaps from company balance sheets in this context.

255 See Appendix 6: Cost of embedded debt sets out UUW's treasury policy on interest rate risk over 2008-2024.
256 NGN (2023), Annual report 2023, p. 5.

Inflation swaps

11.1.47. Inflation swaps have been used to efficiently create synthetic index linked debt.

11.1.48. First, the market for index linked debt has limited liquidity and has been completely illiquid at various points in the past, such as during the global financial crisis. During these periods of limited liquidity or illiquidity, the only means for companies to maintain their proportion of index linked debt was to raise this synthetically through index linked swaps. This has been recognised by Ofwat and others:

1) **Moody's:** "…as the availability of index-linked bonds at attractive rates subsided with the dawn of the 2008-09 global financial crisis, issuers sought other means to achieve the benefits that index-linked debt can provide. In many cases, they have turned to synthetic index-linked debt, effectively being a conventional fixed-rate bond swapped to index linked"[257].

2) **CMA:** "They [companies] may also be required to…increase the use of derivatives in the face of a lack of suitable index-linked debt available at desired maturities"[258].

3) **CMA:** "Such [index linked] debt may not always be available from the markets in the quantities or calibrations required – leading companies to synthetically create them using derivatives"[259].

4) **CEPA for Ofwat/CAA:** "…the lack of liquidity in the index-linked, bond market makes execution easier in the nominal bond market"[260].

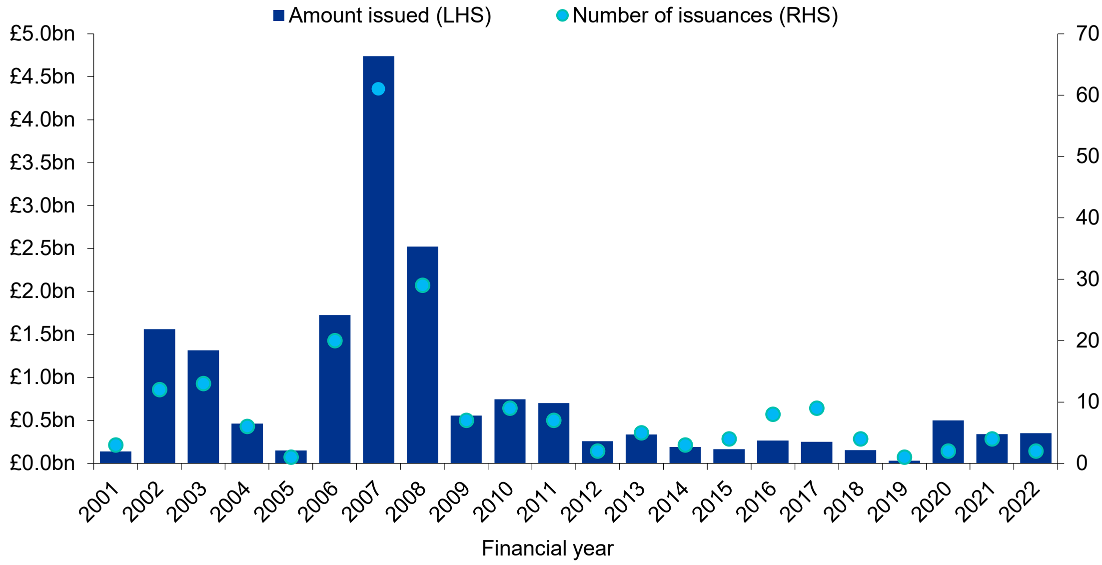
5) **Ofwat/Ofgem:** "In the past there may have been limited appetite for direct issuance of corporate index-linked debt due to a limited number of investors and constraints on their portfolios"[261].

6) **Ofwat:** "Although there has been some issuance of index-linked debt since our draft determinations, evidence of market appetite for the issuance of new index-linked debt remains limited… It is possible that the debt markets could recover such that companies will be able to issue index linked debt either directly or through swap arrangements"[262].

11.1.49. The chart below illustrates that index linked bond issuance by water and energy sectors peaked in 2007 and subsequently reduced to very low levels after the financial crisis.

257 Moody's (2012), UK Regulated Utilities - Why Index-Linked Swaps May Not Provide the Same Cash Flow Benefit as Index-Linked Bonds, p. 3.
258 CMA (2021), Water Redeterminations 2020, Cost of Debt – Working Paper, para. 122.
259 CMA (2021), RIIO-2 Final Determination, Volume 3: Individual grounds, para. 14.219.
260 CEPA (2016), Ofwat and CAA – Alternative approaches to setting the cost of debt for PR19 and H7, p. 197.
261 Ofwat and Ofgem (2006), Financing Networks: A Discussion Paper, para. 148.
262 Ofwat (2009), Future water and sewerage charges 2010-15: Final determinations, p. 139-140.

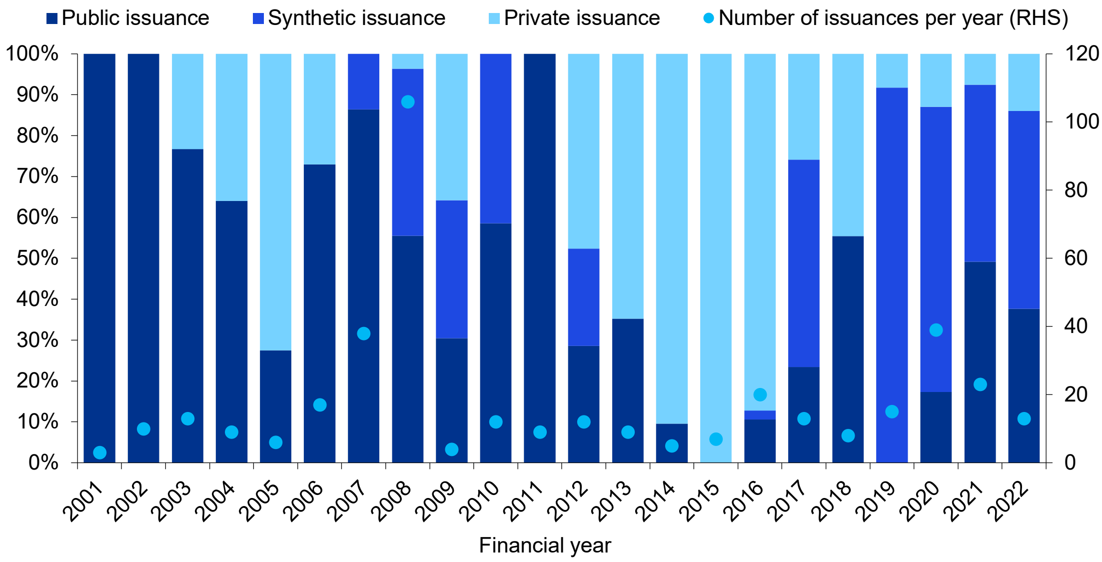
Figure 29: Index linked public bonds issuances by water and energy sectors over 2001-2022



Source: KPMG analysis and data from Bloomberg, Refinitiv, Ofwat FM balance sheet model and DNO annual reports

11.1.50. At the same time, the proportion of index linked debt issued synthetically in the water sector increased significantly during and after the financial crisis as shown in the chart below. Further, the uptick in synthetic index linked debt observed after 2017 in the chart is likely driven by (1) Brexit which removed the option to access direct index linked debt from the EIB; and (2) the move from RPI to CPIH indexation in the context of nascent markets for direct issuance in CPI and CPIH.

Figure 30: Proportion of direct and synthetic index linked debt in 2022 APR water portfolios



Source: KPMG analysis and data from Ofwat FM balance sheet model

11.1.51. Relatedly, on a forward looking basis, companies may need to access the index linked swap market to match the notional company's proportion of index linked debt at AMP8. There may not be sufficient liquidity in the direct index linked debt market to accommodate the sector's requirement for index linked debt, implied by the scale of RCV growth and notional proportion of index linked debt.

11.1.52. Second, raising synthetic index linked debt has been cheaper than equivalent direct issuance at different times in the past.

11.1.53. Companies are incentivised to minimise costs and therefore it would be expected that where they have entered into synthetic positions, this represents the lowest cost option. Indeed, CEPA for Ofwat/CAA recognised that companies use swaps to secure the optimal outcome:

1) "There is no evidence of derivatives being used for speculative purposes, but rather as a way to compensate for shifts in demand in the underlying capital markets, which have meant that companies have not been able to secure their optimal debt position from direct issuance alone"[263].

2) "Corporate Treasurers thus triangulate between maturity needs, relative investor demand at a maturity for IL debt vs nominal and their outstanding swap positions and hence swap market access, in order to decide what debt to issue in a particular moment in time"[264].

11.1.54. Notwithstanding the incentives for companies, there are good reasons for why companies may achieve cheaper pricing via synthetic positions.

11.1.55. It is widely recognised by banks that there is greater demand from institutional investors in the inflation swap market compared to the inflation linked corporate debt market[265].

11.1.56. One major bank explained that similar investors (pension funds and insurance companies) trade in both markets. These investors break up their investment activities into separate mandates (e.g. equities, corporate debt, government debt) and run overarching liability hedges centrally (e.g. inflation risk, rate risk). Most investors prefer not to mix corporate credit risk (managed in their corporate debt portfolio) with liability hedging (typically managed centrally). In consequence, demand for inflation linked corporate debt tends to be limited compared to that for inflation swaps.

11.1.57. Further, CEPA for Ofwat/CAA explored why some companies prefer index linked swaps to direct issuance. It considered that "one explanation is that the spread on index-linked debt is typically larger than a comparable spread on nominal debt. Others include the difference in implied inflation breakeven rates between the swap and index-linked bond market"[266]. This also seems to suggest that it may have been cheaper to raise synthetic index linked debt.

11.1.58. Third, Ofwat has implemented a full transition to CPIH at AMP8 but the market for direct CPI/CPIH debt is still developing. In this context, companies have tapped the basis swap market to proactively manage the mismatch between their embedded RPI debt and CPIH assets at AMP8.

11.1.59. For example, UUW has transacted both RPI-to-CPI and RPI-to-CPIH basis swaps: "…we have made good progress in transitioning the mix of our index-linked debt away from RPI-linked…to CPI or CPIH-linked…including last summer executing the first ever CPIH-linked swap"[267].

11.1.60. UUW and SVE have both transacted such swaps according to their 2024 APRs[268].

11.1.61. In conclusion, inflation swaps have been used efficiently by companies and are likely to have led to lower costs than the counterfactual of direct index linked debt issuance.

263 CEPA (2016), Ofwat and CAA – Alternative approaches to setting the cost of debt for PR19 and H7, p. 199.
264 CEPA (2016), Ofwat and CAA – Alternative approaches to setting the cost of debt for PR19 and H7, p. 197.
265 Based on KPMG's bank survey covered in the August 2024 Cost of New Debt and Additional Borrowing Costs report.
266 CEPA (2016), Ofwat and CAA – Alternative approaches to setting the cost of debt for PR19 and H7, p. 197.
267 UUW (2021), Full year results investor presentation 2021, p. 18.
268 Based on the instrument names in Table 4B, it is possible to pair RPI receive legs to CPI pay legs.

Currency swaps

11.1.62. Ofwat has included cross-currency swaps in its balance sheet approach. It follows that the notional company is expected to make use of cross-currency swaps.

11.1.63. This appropriately recognises that companies have sought to widen their investor pool and thus lower costs by accessing foreign debt markets. Currency swaps are a core component of these transactions as they fix foreign interest payments in sterling which ensures consistency with sterling revenues.

11.1.64. Interest rate and inflation swaps like cross-currency swaps are an indivisible component of financing strategies. However, Ofwat has not explained why the notional company would only be expected to hedge currency risk, not interest rate or inflation risk through swaps.

Risky use of swaps

11.1.65. Ofwat considers that some companies may have used swaps for risky purposes which may not be reflective of the behaviour of the notional company.

11.1.66. These risky purposes have been highlighted in its 'Financial resilience in the water sector: a discussion paper'. The paper indicates that swaps have been used to profile cashflows, for example, reduce short-term effective interest costs at the expense of highly likely future cash outflows.

11.1.67. Ofwat accepts that "swaps have been used by [only] a small number of companies with already weak levels of financial resilience to alter the profile of cash interest payments"[269]. The March 2024 CoD report explained that the data collection process for the KPMG Tool reaffirmed it is rare for swaps to be used in this way and where they are, the cash profiling component had been removed[270].

11.1.68. In any event, it is not appropriate to conflate a small number of risky swaps with all other swaps.

11.1.69. The paper also indicates that the use of swaps in general may introduce additional risk for companies. For example, counterparties may require swap contracts to include (a) accretion paydowns; and (b) break clauses to limit their credit exposure.

11.1.70. On (a), accretion paydowns on inflation swaps are not dissimilar to repayments on amortising index linked debt. A significant proportion of the index linked debt in the sector has been raised in the form of amortising loans from the EIB.

11.1.71. In the swap case, the company is required to pay down the entire balance of accretion that has accumulated since the last paydown date. In the loan case, the company is required to repay a proportion of the initial size as well the accretion that has accumulated on that proportion since issuance. In both cases, this 'amortising' profile results in lower coupon rates for companies compared to a bullet profile as the 'amortising' profile is less risky for counterparties.

11.1.72. Further, the EIB has required considerably more frequent cash outflows to be made than swap counterparties. The EIB amortising index linked debt in the sector requires repayments to be made every 6m compared to the 5Y accretion paydowns that Ofwat cites for inflation swaps.

11.1.73. This implies the first point is not a material differentiator between swaps and other debt.

11.1.74. On (b), the data collection process for the KPMG Tool indicated that there were not many swaps with mandatory break clauses in the sector.

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269 Ofwat (2021), Financial resilience in the water sector: a discussion paper, p. 16.

270 KPMG (2024), Estimating the Cost of Embedded Debt and Share of New Debt for PR24, p. 37. A tool was developed (KPMG Tool) to estimate the CoD_E and share of new debt for this report.

Ofwat's policy on swaps in previous price reviews

11.1.75. Ofwat asserts it has always excluded swaps in setting the cost of embedded debt in previous price reviews and that this maintains a consistent approach which improves the predictability of the regime.

11.1.76. Ofwat's approach to the cost of embedded debt over PR04-PR19 is set out in the table below.

Table 45: Ofwat's approach to the cost of embedded debt over PR04-PR19

Price review	Ofwat's approach to the cost of embedded debt
PR04	Risk free rate plus a debt premium based on (1) current and historical spreads on traded water company debt; and (2) current and historical spreads on A and BBB rated bonds
PR09	Actual cost based on direct observations from companies' existing debt portfolios
PR14	10Y fixed average of iBoxx A/BBB index less an outperformance wedge (based on yield at issue for water company bonds vs yield on the index at the time)
PR19	Primarily using benchmark index approach: 15Y fixed average of iBoxx A/BBB index less an outperformance wedge (based on yield at issue for 10Y+ fixed rate water company bonds vs yield on the index at the time) Cross-checked using balance sheet approach: median cost of embedded debt across WaSCs and large WoCs, excluding swaps and non-standard debt instruments (such as junior debt)

Source: KPMG analysis and data from Ofwat PR04, PR09, PR14 and PR19 FDs

11.1.77. Ofwat's approach has varied over time and the balance sheet approach was first used at PR19 (albeit as a cross-check). In previous price reviews, company balance sheets were not the focus and therefore swaps were not explicitly considered.

11.1.78. PR19 was the first time Ofwat gave a clear signal that swaps would be excluded from the assessment of embedded debt. However, Ofwat's exclusion of swaps at PR19 was ultimately overturned by the CMA FD which companies might have expected to be the starting point for PR24.

11.1.79. Even if companies overlooked the CMA FD, Ofwat's signal in PR19 has not given companies sufficient time to change their use of swaps. By PR19, companies had already raised a significant volume of swaps which typically have long tenors and cannot be restructured without significant cost.

11.1.80. Ofwat has determined ex-post that swaps would not be issued by the notional company. This is not appropriate and could, counter to Ofwat's view, undermine the predictability of the regime.

11.1.81. It is difficult to reconcile Ofwat's decision to exclude swaps with its long history of recognising the importance of swaps. Ofwat has consistently recognised swaps as a valid means of hedging inflation risk in previous price reviews and more recently for hedging interest rate and currency risk:

1) **Ofwat/Ofgem at PR09:** "The same effect can be produced through adopting financial swaps that convert the company's liability to pay from nominal interest to real interest (with the inflation added to the principal sum borrowed) or by manufacturing synthetic index-linked debt instruments with the help of financial intermediaries"[271].

271 Ofwat and Ofgem (2006), Financing Networks: A Discussion Paper, para. 146.

2) **Ofwat at PR09:** "…companies will be able to issue index-linked debt either directly or through swap arrangements…If these companies are able to issue more index-linked debt, consumers will not be disadvantaged"[272].

3) **Ofwat at PR14:** "In setting price limits for the future, we could consider a greater proportion of index-linked debt. This may reflect an expectation that greater amounts of index-linked debt might be raised in the future. Or it may reflect the ability of the companies to swap floating or fixed rate liabilities to mimic index-linked liabilities using swaps"[273].

4) **CEPA for Ofwat/CAA at PR19:** "The primary use of derivatives has been to convert fixed rate sterling debt into Index linked debt"[274].

5) **CEPA for Ofwat/CAA at PR19:** "Issuance of a nominal bond combined with an inflation swap will provide the same cash outcome at the end of the term as issuance of an inflation linked bond of the same term"[275].

6) **Ofwat at PR24:** "Swaps can form part of a considered approach to treasury risk management, for example, where linked to underlying instruments and used to hedge interest rate, inflation or exchange rate risks"[276].

11.1.82. Companies may have interpreted these statements as support for using swaps. As such, Ofwat's exclusion of swaps at PR24 could be seen as extracting the realised benefits of swaps ex-post.

11.1.83. Separately, Ofwat comments that other regulators have consistently excluded swaps from their assessment of sector costs. Ofgem in GD&T2 and ED2 focused on sector costs excluding swaps to calibrate the length of its trailing average, but uses sector costs including swaps as a broad cross-check[277]. Ofgem notes in both price reviews that its chosen trailing average length not only covers but has headroom against this cross-check in a number of scenarios including the base case[278].

Counterfactual

11.1.84. Ofwat's exclusion of swaps from company balance sheets implies a retrospective change to treasury policies. This is because it assumes that in the counterfactual where companies had not entered into swaps, they would have issued the same conventional debt without change.

11.1.85. In practice, it is likely that companies would have adapted their approach to conventional debt issuance to still achieve their risk management objectives in the counterfactual. However, it is not possible to know with certainty exactly what companies would have done in the counterfactual.

11.1.86. Plausible counterfactuals for common uses of swaps in the sector are set out in the table below. Ofwat's counterfactuals for the same are also presented.

272 Ofwat (2009), Future water and sewerage charges 2010-15: Final determinations, p. 140.
273 Ofwat (2011), Financeability and financing the asset base – a discussion paper, paras. 65-66.
274 CEPA (2016), Ofwat and CAA – Alternative approaches to setting the cost of debt for PR19 and H7, p. 199.
275 CEPA (2016), Ofwat and CAA – Alternative approaches to setting the cost of debt for PR19 and H7, p. 189.
276 Ofwat (2021), Financial resilience in the water sector: a discussion paper, p. 15.
277 Ofgem (2022), RIIO-ED2 Final Determination – Finance Annex, para. 2.69.
278 Ofgem (2022), RIIO-ED2 Final Determination – Finance Annex, para. 2.100; Ofgem (2021), RIIO-2 Final Determinations – Finance Annex (REVISED), para. 2.40.

Table 46: Factual and counterfactual scenarios for swaps

Swap type	Factual with swaps	Plausible counterfactual without swaps	Ofwat counterfactual without swaps
Interest rate	Benchmark floating rate bond with 10Y reducing balance floating-to-fixed swap	Sub-benchmark fixed rate bond issuance every year for 10Y	Benchmark floating rate bond
Inflation	Fixed rate bond with fixed-to-index linked swap	Index linked bond	Fixed rate bond
Currency	Foreign currency bond with sterling swap	Sterling bond	Sterling bond[1]

Notes: (1) This sterling bond is at the same cost as the factual scenario (foreign currency bond with sterling swap) as Ofwat includes currency swaps
Source: KPMG analysis

11.1.87. Ofwat's counterfactual for companies is likely to misstate the actual cost they could have achieved at the time assuming the same risk management objectives. Instead, a plausible counterfactual for companies should be reflected.

11.1.88. This counterfactual is likely to be challenging to price and in any case be more costly than the factual. If the counterfactual was less costly, companies would likely have executed this instead of the factual given they have been incentivised to meet their risk management objectives at minimum cost.

11.1.89. This suggests it may be more straightforward to include swaps.

11.1.90. Ofwat's reconciliation suggests that the 'all-in' cost would increase in nominal terms by 10bps if interest rate and inflation swaps are included.

11.2. Cost of new debt

11.2.1. New debt is the debt expected to be issued during the upcoming price control period to finance RCV growth and refinance existing debt as it matures.

11.2.2. From an economic perspective, financing costs are normal costs for a firm and are fully priced in an efficient market equilibrium. If prices do not reflect and allow the recovery of financing costs, the economic activity is not viable as investors would not be able to earn their required return.

11.2.3. When financing infrastructure, investors are generally unwilling and unable to bear material market risk from any significant deviations between revenues and costs of financing over time. This is due to (1) the asset-heavy nature of the industry, which implies significant capital employed, (2) long-term asset lives and hence investment horizons, and (3) limited flexibility when investing in fixed assets.

11.2.4. In this context, the CoD_N allowance should be a fair and achievable estimate of the cost of debt likely to be incurred by a notionally geared, efficient company. Ofwat's objective for PR24 is to set "an allowance on the basis that allows the efficient company with a notional capital structure to recover reasonable costs over time"[279].

11.2.5. The allowance is estimated using the notional approach, allowing companies to make their own financing choices whilst retaining incentives to issue debt efficiently. The allowance for CoD_N is based on a corporate bond index which should, in principle, provide an objective, transparent and independent benchmark for efficient issuance that companies can target ex ante. The benchmark index selection and any adjustments to the benchmark index should represent a fair estimate of efficient borrowing costs for the sector, ensuring the allowance is reasonable and achievable.

11.2.6. The assessment of whether the index is good proxy for the notional company's cost of debt should consider if water companies, on average, can issue debt at the rates implied by the

279 Ofwat (2024), PR24 Final Determination, Aligning risk and return – Allowed return appendix, p. 129.

benchmark index when issuing debt at the target credit rating assumed for the notional company (Baa1/BBB+) and at a comparable tenor.

11.2.7. Comparing water company bond yields to a like-for-like index in terms of both tenor[280] and rating[281] ensures that the benchmark index for the CoD_N is achievable in practice and does not expose customers to risks related to companies' financing decisions. This is consistent with the approach adopted by the CMA which cited the finding of no like-for-like outperformance for water company debt relative to the benchmark index[282] as the basis for its decision to remove the outperformance wedge adjustment from CoD_N at PR19.

11.2.8. Two sources of evidence are available to inform the estimation of a reasonable and achievable CoD_N allowance. The first is yield at issuance data, which compares the yield of new water bonds with iBoxx yields on the same day, assessing whether water companies can issue new bonds at the benchmark-implied yield. The second is spread differentials between traded water bonds and the iBoxx index in the secondary market.

11.2.9. Yield at issuance data offers a distinct advantage over secondary market evidence by directly reflecting the cost of new debt a company would face when raising capital. It is determined by prevailing market conditions and investor demand, making it the most accurate proxy for future borrowing costs. In contrast, secondary market data, based on previously issued bonds, is influenced by factors such as liquidity and investor behaviour, which may not accurately represent the pricing for new debt.

11.2.10. As a result, yield at issuance is preferred as primary evidence where it is available, with secondary market data used to supplement primary evidence where required.

I. Yield at issuance analysis

11.2.11. The analysis focuses on bonds with tenor at issue of 10yrs+, which aligns with iBoxx 10+ inclusion criteria and Ofwat's approaches in the DD and FD.

11.2.12. The proposed methodology is broadly consistent with the one adopted in the analysis developed by KPMG during the PR19 appeal, with some differences outlined below:

1) Callable bonds are included as they are also included in iBoxx indices[283].
2) The threshold for the identification of outliers is set to +/- 1.5% to avoid distortions and maintain representativeness.
3) Debt held above the operating company level and unrated bonds are excluded, as they may not be representative of debt issuance within the regulatory ringfence.

11.2.13. The analysis of the suitability and achievability of the cost of debt benchmark based on yield at issuance relies on past issuance data. The relevance of historical data to AMP8 depends on how accurately past factors reflect the expected future conditions. This assessment is influenced by sector-specific elements, such as perceptions of sector risk and creditworthiness, as well as broader economic conditions. It is crucial that the issuances considered are relevant and indicative of future borrowing costs. For instance, if the lookback period is too long, the bonds may reflect outdated assessments of credit risk, reducing their relevance to future borrowing conditions.

11.2.14. Issuances prior to AMP7 are inherently less relevant for this analysis as issuance data which pre-dates AMP7 may not reflect current spreads of water company debt. In consequence, analysis of yield at issue focusses on AMP7 issuance data.

280 To enable assessment on a tenor-controlled basis, hypothetical iBoxx curves are constructed. These curves provide the yield that would prevail on hypothetical iBoxx indices, equivalent to the actual indices, had the actual iBoxx maintained a specific weighted average tenor.

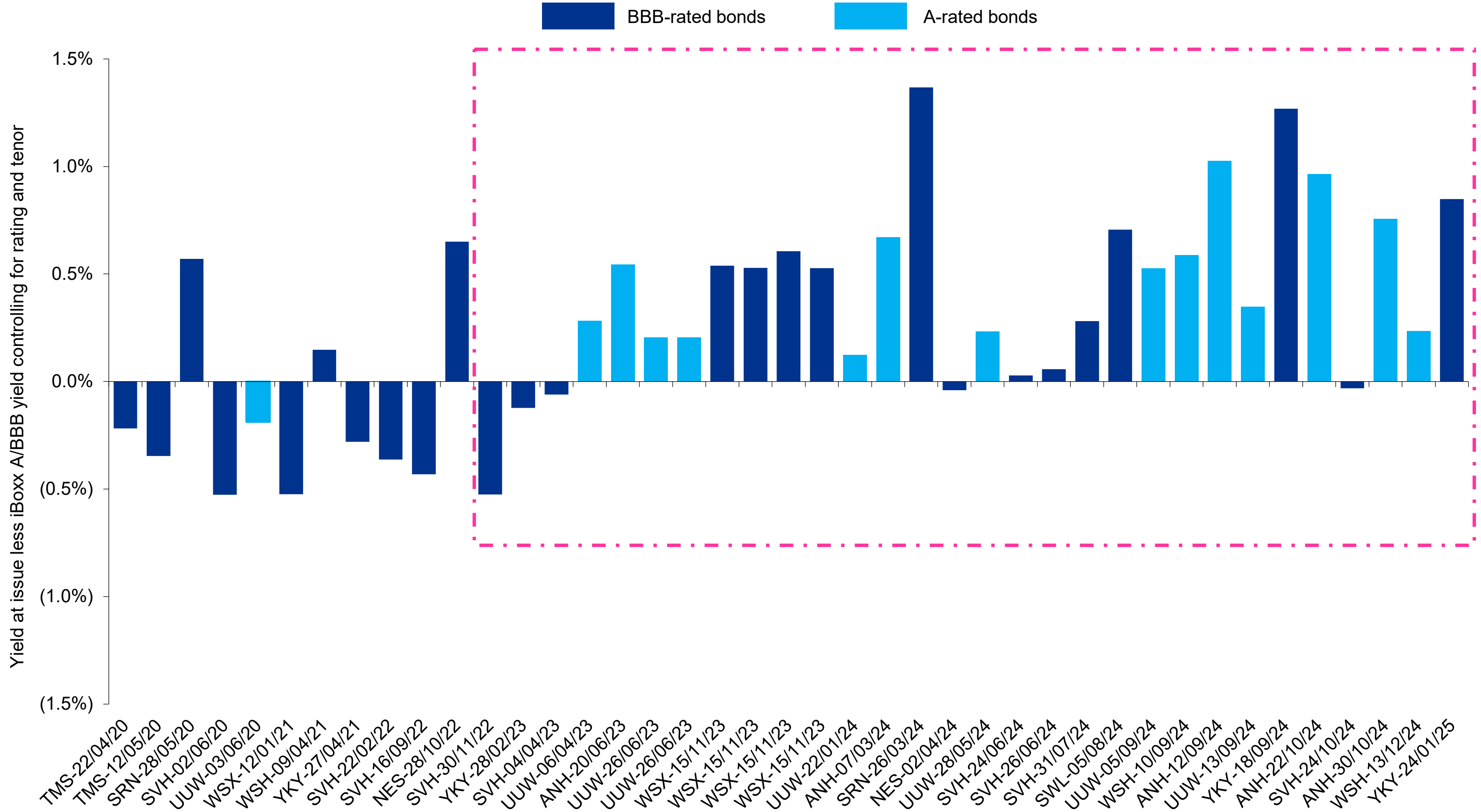
281 The analysis controls for rating based on Moody's rating for simplicity and to reflect the fact that a Moody's rating available for more water company bonds than for the other ratings agencies

282 CMA (2021), PR19 Final Determination, para. 9.823.

283 Markit (2024), iBoxx GBP Benchmark Index Guide, p. 5.

11.2.15. Within AMP7, earlier issuances do not appear to be representative of future borrowing costs due to market distortions arising from large sections of the economy being shut down during Covid at the start of the price control, during which water and utility companies generally priced more favourably. However, this trend reversed in 2022, as illustrated in the chart below. Water companies were able to issue bonds in line with the iBoxx benchmark until November 2022. Since then, nearly all new bonds have been issued at a cost above the benchmark, indicating that the iBoxx benchmark is likely to become increasingly unachievable for water companies.

Figure 31: Trend of yield at issue spreads to rating- and tenor-matched iBoxx for AMP7 issuances (tenor 10+ years)



Source: KPMG analysis based on LSEG Workspace and Capital IQ data.

11.2.16. The average yield difference for Baa1/BBB+ water company bonds on a like-for-like basis from 1 November 2022 to 31 January 2025 is 46bps. The same November 2022 starting point was adopted in the DD for the analysis of CoD_N[284].

11.2.17. A limitation of this analysis is the scarcity of new issuance since the publication of the PR24 FD, and hence yield at issue data may not be reflective of current spreads for water company debt. In consequence, more recent secondary market data is also considered to inform quantification of the adjustment to the benchmark index.

II. Spread differentials between traded water bonds and iBoxx in the secondary market

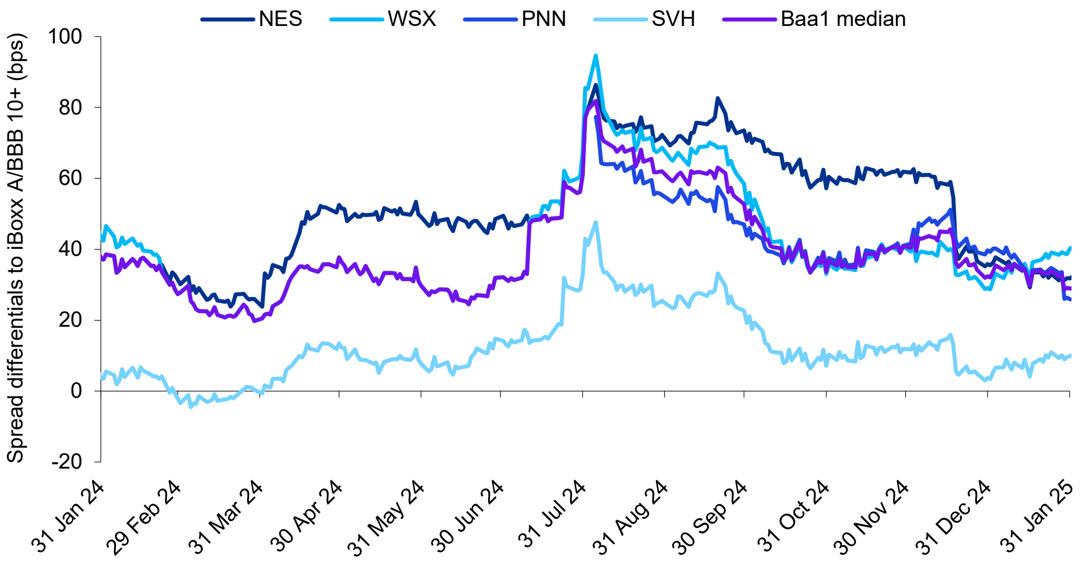
11.2.18. The rationale for supplementing primary market evidence based on yield at issuance with secondary market data is to assess whether primary evidence reflects current spreads of water company debt in the absence of recent water company issuance.

11.2.19. In consequence, the secondary market analysis examines the data from across the last 12 months only to determine whether primary market evidence is likely to reflect current water company spreads. In line with the approach to primary market evidence above, data from previous AMPs and the earlier years in AMP7 is not considered relevant for assessment of current water company spreads.

11.2.20. The secondary market analysis focuses on the spread differentials between water company bonds in the iBoxx BBB 10+ index (as of the 31 January 2025 cut-off), aggregated by issuer[285], and the iBoxx A/BBB 10+ index.

11.2.21. The chart below illustrates that spread differentials for Baa1/BBB+ bonds[286] across the last 12 months were particularly elevated during and immediately after the DD period. Since December, differentials have reduced and stabilised at levels observed at the beginning of the year.

Figure 32: Evolution of spread differentials between Baa1-rated bonds (Moody's) and iBoxx



Source: KPMG analysis using LSEG Workspace data.

284 Ofwat (2024), PR24 Draft Determination, Aligning risk and return – Allowed return appendix, p. 77.

285 Spreads relative to the government benchmark curve (referred to as the 'G-spread') are calculated using LSEG Workspace. The spread differential is determined by subtracting the G-spread of the iBoxx A/BBB 10+ index from the G-spread of water bonds. The G-spreads are aggregated per company as an average.

286 The bonds considered are NES 2042, SVT 2042, SVT 2040, WSX 2036, SVT 2036, NES 2037, SVT 2038, and SBB 2041, all of which are part of the iBoxx BBB 10+ index as of 31 January 2025 and hold a Baa1 rating from Moody's. Compared with Ofwat's analysis in the FD, two bonds have been excluded due to their tenors falling below 10 years, resulting in their removal from the iBoxx BBB 10+ index.

11.2.22. In the FD, Ofwat applied an upward adjustment of 30bps to the CoD_N based on secondary market evidence. Specifically, Ofwat calculated an average spread of 24bps between the yields of water bonds and the iBoxx A/BBB 10+ index over a six-month period as of September 2024. The analysis in this Report refines the Ofwat FD approach in two areas.

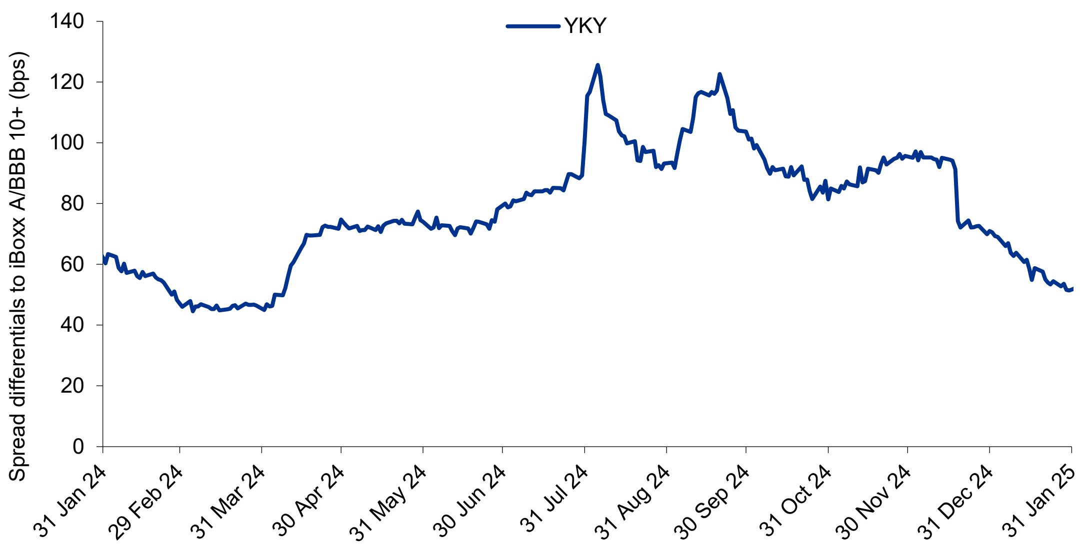
11.2.23. First, Ofwat's analysis derived the spread by comparing traded yields on bonds to those on the iBoxx index, without controlling for tenor. The analysis in this Report addresses this limitation by focussing on G-spreads, which inherently control for tenor differences. Second, given volatility in water company spreads across the last 12 months, this Report focusses on a shorter period than the 6 months considered in the FD. Analysis of current water company spreads is based on January 2025 only, which only includes data since publication of the FD. On this basis, the 1-month average of the median spread differential for January 2025 is approximately 33bps. This is lower than the 46bps yield difference based on primary market data.

11.2.24. As discussed in the debt financeability section above, it is unlikely that the notional water company will achieve and maintain the target rating set out in the FD across all three rating agencies based on the CoE estimate in this Report, given the revised views from rating agencies on regulatory and business risks in the sector. Consequently, a CoD_N based on Baa1/BBB+ issuance may not be achieved. As a result, it is important to consider the spread differentials on Baa2/BBB-rated water bonds in the iBoxx BBB 10+ index, as this could inform the adjustment required to reflect the borrowing costs that the notional company can achieve.

11.2.25. YKY bonds, rated Baa2 by Moody's but BBB+ by Fitch and S&P, represent a hybrid credit quality between Baa1/BBB+ and Baa2/BBB. As such, YKY's spreads are representative of a company that falls between Baa1/BBB+ and Baa2/BBB ratings, which may be the most relevant for the notional company at PR24.

11.2.26. As of January 2025, the 1-month average YKY spread is approximately 26bps higher than the Baa1/BBB+ median level.

Figure 33: Evolution of spread differentials between Baa2-rated bonds (Moody's) and iBoxx



Source: KPMG analysis using LSEG Workspace data.

11.2.27. Overall, secondary market evidence suggests an upward adjustment range of 30-50bps. The lower bound of 30bps is based on the spread differential for Baa1/BBB+ bonds as of January 2025, while the upper bound of 50bps reflects the possibility that the notional company may not be able to achieve a Baa1/BBB+ rating with all three rating agencies.

III. Overall estimate for CoD_N

11.2.28. Yield at issuance analysis based on November 2022 to January 2025 supports an adjustment of 46bps. Secondary market evidence supports an adjustment of 30 – 50bps, with the upper end of the range broadly in line with the primary evidence based on yield at issuance.

11.2.29. In consequence, this Report adopts an adjustment of 30bps at the low end based on secondary market data and 50bps at the high end based on yield at issue analysis and the upper end of the secondary market range.

11.2.30. This Report derives a CoD_N estimate in a range of 4.27% – 4.47% in CPIH real terms, with a midpoint of 4.37%.

Table 47: Cost of new debt estimate

	Lower bound	Upper bound
1-month average of iBoxx A/BBB 10+ index as of January 2025	6.05%	6.05%
Upward adjustment	0.30%	0.50%
CoD_N, nominal	6.35%	6.55%
CoD_N, CPIH-real (applying Ofwat's 2% assumption)	4.27%	4.47%

Source: KPMG analysis

11.3. Share of new debt

11.3.1. The share of new debt reflects the level of refinancing and RCV growth during the period. It determines the relative weight given to CoD_N and CoD_E in the calculation of the overall allowance. If there is a material discrepancy between CoD_N and CoD_E, an inaccurate weighting could result in significant over- or under-funding of efficient costs.

11.3.2. Additionally, the notional firm is exposed to different risks on new and embedded debt. The assumed share of new debt influences the proportion of the notional company's debt that is subject to ex post true-up at the end of the AMP period for differences between the estimated and actual yields on the benchmark index.

11.3.3. To determine the share of new debt, it is essential to use the correct inputs, based on relevant refinancing and RCV growth assumptions. Additionally, the calculation must be internally consistent, ensuring that the share of new debt aligns with the methods and inputs used across the other CoD elements. The table below outlines the necessary inputs and assumptions for calculating the share of new debt and evaluates whether the FD calculation is based on correct inputs and is internally consistent.

Table 48: Inputs and assumptions for calculating the share of new debt

Input or assumption	FD position	Evaluation
Sample of companies	All companies	Not consistent with the approach applied to CoD_E which is based on WaSCs & large WoCs only
Gearing to calculate debt for RCV growth	Notional	Not consistent with the approach applied to CoD_E where debt balances reflect actual gearing. Assuming new debt based on notional gearing introduces internal inconsistency between the quantum of new and embedded debt
Treatment of accretion	All accretion is included within new debt and is	Accretion should be split between embedded debt and new debt. Introducing this split reduces the new debt requirement

Input or assumption	FD position	Evaluation
	increasing the new debt requirement	
Inflation treatment	The calculation includes accretion but also incorporates real RCV growth	The calculation should be consistently carried out either on a real basis or on a nominal basis. For the CoD, it is more intuitive for the calculation to be performed on a nominal basis. This means that nominal growth assumptions should be used to ensure internal consistency.
RCV growth	5% real	The PR24 FD implies a 5.7% real growth (geometric) or 8.1% nominal growth[287]. According to a query response from Ofwat the 5% assumption reflected RCV growth based on the data received from companies in advance of DD[288] and hence is outdated.
Opening RCV	£105.8bn after the midnight adjustment at 31 March 2025	This value was included in the DD, where Ofwat indicated that it was derived from the data in the business plans[289]. It is broadly consistent with the value from the FD[290].

Source: KPMG analysis

11.3.4. Adjusting the PR24 FD calculation to update incorrect inputs and address internal inconsistencies, whilst retaining the overall methodology, increases the estimate from 24% to 28%[291] for WaSCs & large WoCs.

11.4. Additional costs of borrowing

11.4.1. Additional borrowing costs include the cost of carry, liquidity, issuance costs, and basis risk management costs. This Report adopts the same estimate for issuance costs as the FD.

I. Cost of carry and liquidity

11.4.2. To ensure adequate liquidity to meet operational requirements, companies must have sufficient cash available ahead of need. In the context of AMP8, water companies are expected to operate in a net cash outflow position, with significant capex commitments requiring liquidity levels higher than in previous price control periods.

11.4.3. Cost of carry reflects the cost of issuing debt ahead of need (for example, pre-financing maturing debt, capital expenditure, working capital requirements). This cost is calculated as the spread between CoD_N and the deposit rate earned on the cash proceeds from the debt issuance over the duration of the pre-financing period.

11.4.4. Liquidity cost reflects the cost of maintaining the requisite liquidity facilities.

Length of the pre-financing period

11.4.5. Liquidity requirements derived from credit rating agencies, accounting standards, and company policies serve as a useful proxy, consistently supporting a liquidity runway of 12 to 15 months.

287 Sourced from Key Dataset 2 Costs, Past Delivery and Risk and Return data.

288 Based on query OFW-FD-SEW-009.

289 Ofwat (2024), PR24 Draft Determination, Aligning risk and return – Allowed return appendix, p. 79.

290 Based on a comparison of the values of item "C_PR24FM_RR12_006TOT_PR24" on the <F_Inputs> tabs between FD Key Dataset 2 Costs, Past Delivery and Risk and Return data and DD Key Dataset 2: Costs, Past Delivery and Risk and Return data.

291 To adjust the gearing assumption informing the quantum of new debt, the gearing values from the 2023-24 Monitoring Financial Resilience are used.

11.4.6. S&P requires corporate issuers to achieve “adequate” or “strong” liquidity assessment for BBB- rating and above[292].

11.4.7. For regulated utilities, S&P defines adequate liquidity as a ratio of sources to uses of at least 1.1x over the next 12 months[293], which equates to 13.2 months. Sources in this assessment include both expected capital spending and debt maturities[294].

11.4.8. Moody's requires that companies maintain a sustained forward-looking liquidity runway of at least 12 months to be considered as operating with a financial policy consistent with investment-grade credit quality. In assessing liquidity, Moody’s compares a company’s estimated cash sources (such as cash flow from operations, cash reserves, and available credit facilities) with its cash uses (including capital expenditures, debt maturities, and dividend payments). This assessment is typically conducted on a quarterly basis for at least the next 12 months, assuming no market access during that period[295].

11.4.9. Under FRS 102, The Financial Reporting Standard applicable in the UK and Republic of Ireland, management is required to assess whether the company is a going concern and prepare the accounts accordingly[296]. The assessment is “at least, but is not limited to, 12 months from the date when the financial statements are authorised for issue”. The assessment must take into consideration whether the company will, considering all available information, continue to operate into the foreseeable future.

11.4.10. The 12-month period specified in FRS 102 effectively results in a review window extending at least 15 months from the balance sheet date. This is due to the fact that audited financial statements are typically issued 3 to 5 months after the financial year-end.

11.4.11. The annual reports of WASCs and large WoCs indicate liquidity policies ranging from 3 to 24 months, which, excluding outliers, translates to 12 to 15 months.

Table 49: Water company liquidity policies

Water co	Liquidity policy (months)	Liquidity policy description
AFW	12+	“Our treasury policy requires us to maintain a minimum level of liquidity capable of covering at least 12 months of forecast cash flow requirements”.
ANH	12	“The Group maintains sufficient liquidity to cover 12 months' working capital requirements, and the non-regulated businesses are run on a cash-positive basis”.
NES	Not stated	Not stated
SEW	Not stated	Not stated
SRN	At least 12	“We ensure that sufficient liquidity (cash and committed bank facilities) is in place to fund the business for at least the next 12 months (including loan and inflation-linked swap accretion maturities)”.
SVE	At least 15	“The Group maintains liquidity headroom of at least 15 months in line with the Board approved Liquidity Policy”.
TMS	At least 15	“The Group’s key objectives in managing capital are… To provide liquidity sufficient to fund ongoing obligations for a minimum of a 15-month forward period on an ongoing basis without reliance on the £550 million liquidity facilities”.
UUW	15 – 24, with flexibility to exceed 24	“The group’s policy of maintaining a robust liquidity position, with liquidity to cover expected cash outflows

292 S&P (2014, 2023), Methodology And Assumptions: Liquidity Descriptors For Global Corporate Issuers, p. 15.

293 S&P (2014, 2023), Methodology And Assumptions: Liquidity Descriptors For Global Corporate Issuers, p. 20 and S&P (2025), UK. Water Regulatory Framework Support, Low Financial Flexibility In Coming Regulatory Period Drive Rating Actions, p. 14.

294 S&P (2014, 2023), Methodology And Assumptions: Liquidity Descriptors For Global Corporate Issuers, p. 15.

295 Moody’s (2024), Regulated Water Utilities – UK Reduced predictability of regulatory environment pressures credit quality, p. 4.

296 FRC (2024), FRS 102, The Financial Reporting Standard applicable in the UK and Republic of Ireland, p. 75.

Water co	Liquidity policy (months)	Liquidity policy description
		for the next 15–24 months, and flexibility to exceed the upper end of the liquidity range in periods of greater uncertainty”.
WSH	12	“Under the Common Terms Agreement which governs obligations to bondholders and other financial creditors, the GCA group is required to have cash available to fund operations for 12 months”.
WSX	Not stated	Not stated
YKY	More than 15	“We have extended our liquidity policy to target available cash and committed facilities in excess of 15 months requirements”.

Source: AFW p. 88, ANH p.218, NES p. 63, SEW p. 238, SRN p. 111, SVE p. 99, TMS p. 140, UUW p. 18, WSH p. 32, WSX p. 39, YKY p. 101.

The scale of liquidity requirement

11.4.12. The PR24 FD tool calculates liquidity requirements based on several key financial inputs, including capex, cash flow, interest, tax, and debt balance, expressed as a percentage of the total debt balance. The main drivers of liquidity requirements are the maturities of existing debt and the anticipated capex.

11.4.13. However, the final version of the FD tool uses assumptions based on DD values, which have not been updated to reflect FD values. This results in an understatement of liquidity requirements by approximately 2%. When the tool is updated to reflect the financial models in the FD, the total liquidity requirement becomes approximately 14% of total debt, based on median values derived from WaSCs and large WoCs.

11.4.14. The FD calculations separate liquidity needs for capex and refinancing, creating a distinction between these two categories of liquidity requirement. Ofwat’s approach assumes that companies do not pre-finance upcoming debt maturities.

11.4.15. In practice, companies do not distinguish between pre-financing activities relating to refinancing upcoming debt maturities and other drivers of the liquidity requirement such as capex; they pre-finance to meet total liquidity requirements, including refinancing maturing debt. This is in line with the approach adopted by credit rating agencies, in their evaluation of liquidity, which do not differentiate between drivers of liquidity. In consequence, this Report considers the total liquidity requirement which companies need to manage at AMP8 and does not delineate between different drivers of this requirement.

11.4.16. Revolving Credit Facilities (RCFs) are an important component of managing forward liquidity. By providing access to committed credit lines, RCFs can reduce the need for companies to pre-finance liquidity requirements. However, it is important to note that not all of the RCF capacity can be used to offset pre-financing needs. A portion of the RCF must remain available to cover unforeseen circumstances or financial shocks. Consequently, it is assumed that only 50% of the total committed RCFs can be utilised to reduce pre-financing requirements. A sensitivity where 100% of the RCF is available to reduce pre-financing is also considered. This represents a lower bound as it is not likely that RCFs would be 100% available to reduce pre-financing.

11.4.17. The portion of liquidity needs that is covered by RCFs does not need to be pre-financed for the same period as liquidity not covered by RCFs, as companies can draw on these facilities when required. However, it is standard practice for companies to pre-finance the portion of liquidity needs that is covered by RCFs. Companies typically pre-finance a portion of their liquidity needs (typically for 6 months) even for the portion covered by RCFs, to ensure financial stability and mitigate the risk of unexpected cash flow issues.

11.4.18. As a result, the total liquidity requirement can be decomposed into two main components:

3) Portion not covered by RCFs: This portion is assumed to be pre-financed for a minimum of 12 months in accordance with company liquidity policies above.

4) Portion covered by RCFs: Companies typically set pre-finance this component 6 months in advance as part of company liquidity policies.

Cost of holding cash

11.4.19. The cost of holding cash has been calculated based on a 1-month average difference between CoD_N and the forward rate on the overnight SONIA. The rationale for using the forward rate is that there is an inherent mismatch in tenor and rate expectations between the long-term iBoxx rate, which reflects the expected future trajectory of rates, and the overnight SONIA, which, by definition, is a one-day rate and does not account for the trajectory of rates over AMP8. As a result, to avoid distortions in the spread, a forward rate adjustment is necessary to capture the expected movements in the OIS rate during AMP8.

Table 50: Calculation of cost of holding cash

Input	Value
CoD_N	6.45%
OIS (spot)	4.48%
OIS forward (12 months)	4.13%
OIS forward (24 months)	4.05%
OIS forward (36 months)	3.96%
OIS forward (48 months)	3.92%
Average OIS forward	4.08%
Cost of holding cash	2.38%

Source: KPMG analysis

11.4.20. This approach differs from that adopted by Ofwat, which uses a spread based on 2020–2022 data, does not apply a forward rate adjustment, and does not incorporate the 30bps adjustment to the CoD_N applied in the PR24 FD. In contrast, the calculation above incorporates a 40bps spread in line with the CoD_N estimate in this Report.

Liquidity cost calculation

11.4.21. Liquidity costs are determined by the total liquidity requirement and the commitment fee associated with securing the assumed level of the facility.

Cost of carry and liquidity cost estimates

11.4.22. Based on the updated total liquidity requirement of 14% of total debt, the cost of holding cash, and the assumption that 50% of the total liquidity requirement will be pre-financed for at least twelve months (consistent with credit rating agency and going concern requirements), while the other 50% will be pre-financed for six months based on company liquidity policies, the estimated cost of carry is 26bps, and the liquidity cost is 4bps. This scenario forms the high end of the range adopted in the Report.

11.4.23. Under a sensitivity where 100% of the RCF is available to reduce pre-financing requirements, the cost of carry allowance would reflect 6 months of pre-financing for the entire liquidity requirement. On this basis the estimated cost of carry is 17bps, and the liquidity cost is 4bps. It is important to note that this scenario does not provide liquidity buffer for managing unforeseen circumstances or shocks, which may not align with prudent treasury management practices which the notional company would be expected to follow. This scenario forms the low end of the range adopted in the Report.

Table 51: Cost of carry and liquidity cost estimates

	Cost of carry	Liquidity
Assuming 50% of the RCF is available for pre-financing	17bps	4bps
Assuming 100% of the RCF is available for pre-financing	26bps	4bps

Source: KPMG analysis

11.4.24. This analysis and the associated estimates are based on the assumption that companies can secure RCFs of the necessary size to cover total liquidity requirements. If, in practice, this assumption proves incorrect – for instance, due to a re-evaluation of the sector's credit risk, the notional company's financial position or reduced bank appetite – the cost of carry would likely increase.

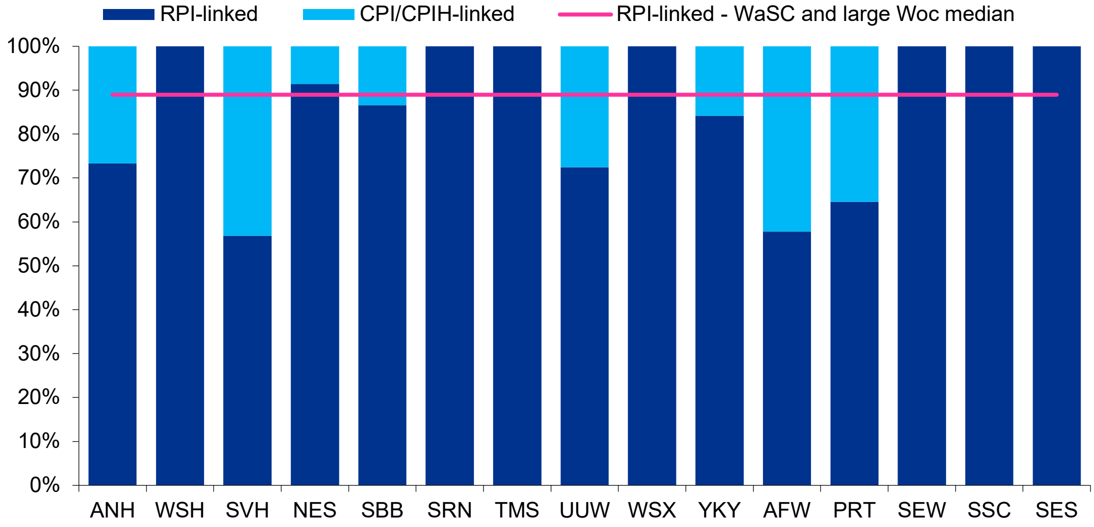
II. Basis risk

11.4.25. In the water sector, RCV and revenues are indexed to outturn inflation, meaning that both the RCV and the revenue that water companies can earn vary with outturn inflation. Issuing index-linked debt (ILD) allows companies to match their liabilities (debt repayments) with the inflation-adjusted revenue they receive. Unlike fixed-rate debt, whose repayments do not vary depending on outturn inflation, ILD has both principal and interest payments indexed to inflation. Issuing ILD reduces the risk that inflation will increase company costs (through higher interest payments on non-inflation-linked debt) without a corresponding increase in revenue. Consistent with this, the water sector has typically maintained just over 50% of its total debt in ILD form. Prior to AMP7, the RCV was indexed to RPI, and companies issued RPI-linked debt to match their RPI-linked asset base.

11.4.26. AMP8 will see the water sector transition to full CPIH indexation, replacing the 50% RPI and 50% CPIH indexation applied at the beginning of AMP7. This decision to accelerate the transition to CPIH by 2030 (RPI Reform) is beyond the control of companies and could not have been predicted when company debt structures and hedging strategies were established over the last 20-30 years. This introduces additional risk and cost for companies.

11.4.27. Embedded ILD in the sector is almost entirely RPI-linked. This is illustrated in the chart below, which shows the composition of ILD for each company. The accelerated transition to CPIH indexation introduces a mismatch between RPI-linked liabilities and CPIH-linked assets, creating basis risk exposure on embedded debt.

Figure 34: Composition of index-linked debt



Source: KPMG's analysis based on the data from Monitoring Financial Resilience 2024 report

11.4.28. Companies will also need to issue CPIH-linked debt in AMP8 to match the RCV. CPIH-linked debt is less liquid and incurs incremental costs on new debt. Given the substantial capital programs projected for AMP8, the sector is expected to raise significant new debt. The market's ability to absorb this increased supply is uncertain, which could further drive up the costs of new debt.

11.4.29. The additional costs and risks associated with basis risk management are not priced in the PR24 FD.

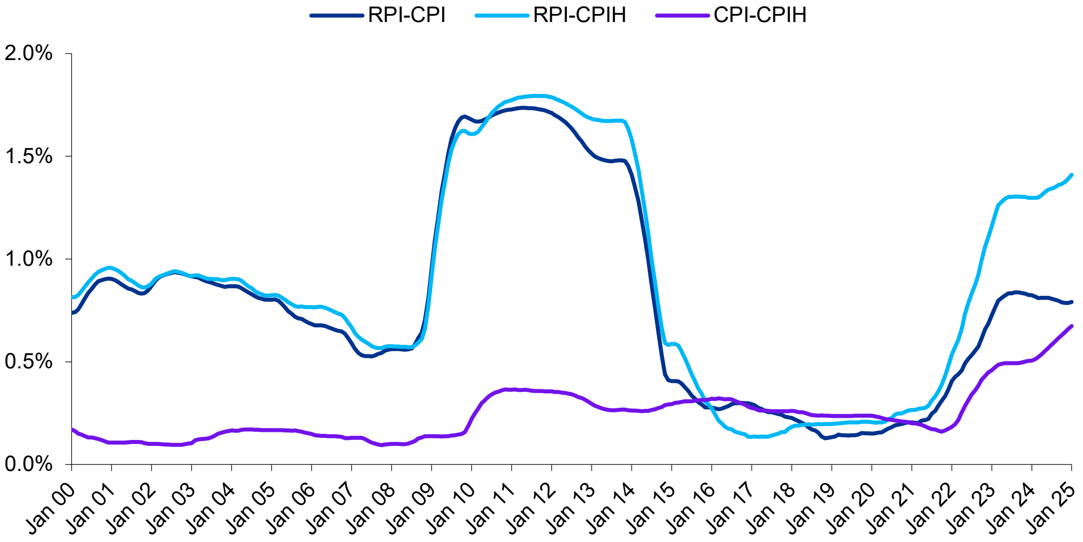
11.4.30. Ofwat considers that it is not necessary to price the additional costs and risks associated with basis risk management as it has been over-generous in its estimate of the RPI-CPIH wedge which is used to estimate the cost of RPI-linked debt in CPIH terms.

11.4.31. Latest forecasts indicate that a significant wedge is expected to persist leading up to the 2030 RPI Reform. For instance, HMT's comparison of independent forecasts from November 2024 suggests a wedge of 1.2% for 2028[297], while CPI and RPI-linked swap data for January 2025 indicates an average wedge of around 100bps for the next five years through 2030[298]. This suggests that a 90bps FD wedge is not overly generous.

11.4.32. Furthermore, historical data indicates considerable variability around the central estimate for each of these wedges. The chart below shows the wedges fluctuates over time, and the volatility increased substantially after 2021, indicating heightened basis risk. This means that regardless of the central estimate of the RPI-CPIH adopted for PR24 there is a substantial risk of the actual outturn wedge across AMP8 deviating from this.

297 HMT (November 2024), Forecasts for the UK economy: a comparison of independent forecasts, Table M3.
298 KPMG's analysis on 5-year zero-coupon RPI and CPI inflation swap data from Bloomberg.

Figure 35: Rolling five-year average standard deviation of inflation wedges



Source: KPMG's analysis based on the data from ONS

11.4.33. The cost of new debt allowance assumes that the nominal cost of RPI-linked debt is the same as CPIH-linked debt. This does not consider the higher costs associated with issuing CPIH-linked debt compared to RPI-linked debt, due to the illiquidity premium in the CPIH debt market.

11.4.34. Water companies have the option to either bear or hedge basis risk. They can hedge the risk by entering into a basis swap to overlay on the existing RPI-linked debt or by issuing CPIH-linked debt. If companies choose to bear the risk, the additional risk must be priced. If they choose to hedge the risk, the additional costs must be compensated. If they continue to bear the risk, the additional risk exposure should be priced.

11.4.35. Absent an additional allowance, companies will be exposed to additional risks and costs which are not priced in due to the specification of regulatory policy on accelerated transition to CPIH. The transition should be implemented in a manner that is NPV-neutral and does not penalise or disadvantage companies due to exogenous factors beyond their control, in line with Ofwat's stated intent for the transition[299]. This Report presents quantitative evidence on the risks and costs associated with these two options.

Bearing basis risk – translating the impact of the basis risk on RoRE variance to CoD

11.4.36. The effect of the basis risk exposure on the CoD is estimated by first translating the associated RoRE impact into beta terms. This beta value is then translated into the WACC and expressed as an equivalent change in the CoD. The RoRE impact is estimated using the KPMG risk model[300], considering the financing RoRE range both with and without the basis risk exposure, while holding all other risk factors constant.

11.4.37. The resulting variance in the total RoRE range (the average of P10-P50 and P90-P50) is higher for a company with exposure to basis risk. In the PR24 FD Ofwat contends that the

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299 For example, Ofwat noted that: "We will commit to ensuring that the impact of this is neutral to both company (nominal) revenues and customer bills in net present value terms... We see this commitment as being a critical part of our package and understand its importance. We therefore welcome views as to how we can best support the credibility of this commitment". "We also stated that the choice of indexation method should not impact on the total (nominal) level of returns earned by investors". Ofwat (2015), Water 2020: Regulatory framework for wholesale markets and the 2019 price review, pp. 123 and 111.

300 KPMG risk analysis assesses, based on the available empirical evidence and historical sector performance data, whether the FD parameters and mechanisms allow the notional company to earn base allowed return on a median expected basis. The stochastic risk model is constructed to simulate the notional company's risk exposure in RoRE terms by key risk drivers, accounting for risk mitigations purposed by Ofwat in PR24 FD. In this Report, the RoRE outputs are based on the "Unmitigated" scenario in the club risk model focussed on design risk only, which is the scenario with full estimated risk exposure of the notional company under the FD regulatory regime, but removing the miscalibration risk, i.e. assuming that companies are able to improve their performance to the levels required in AMP8 to meet the FD targets.

analysis of historical CPIH and RPI-CPIH wedge outturns does not indicate losses for companies in RoRE terms[301]. However, Ofwat's analysis does not isolate the impact of the wedge, meaning it does not directly measure the effect of basis risk.

11.4.38. The increase in RoRE variance due to basis risk exposure is converted to an implied standard deviation of the notional company's return. Based on RoRE outputs from the KPMG risk model and assuming normally distributed returns, the standard deviation for a notional company with basis risk at PR24 is 0.61%, versus 0.57% without it, indicating a 1.08x increase in total risk exposure[302].

11.4.39. The scaled-up standard deviation is translated into an equity beta uplift, assuming the company's correlation with the overall market as well as the volatility of market returns remains constant. Under the benchmark assumption that the increase in volatility arises from a proportionate increase in both systematic and idiosyncratic components, the correlation will remain unchanged. As inflation is a macroeconomic risk factor beyond companies' control, this increased variance likely has a significant systematic component. As a result, the increased standard deviation translates into a proportionate increase in beta.

11.4.40. As a result, the notional equity beta should be uplifted by the same scaling factor of 1.08x, leading to an increase of 25bps in the CoE (based on the point estimate of ERP of 4.34% based on KPMG analysis[303]) and an implied rise of 11bps in the WACC. This translates to approximately 20bps on the CoD.

Hedging basis risk – pricing evidence from bank questionnaires

11.4.41. To inform the estimation of hedging costs, a questionnaire was distributed to seven leading banks that are key participants in the debt and swap market for the water sector. The questionnaire is designed to gather: (1) quantitative data on swap charges and the illiquidity premium associated with CPIH direct issuance; and (2) insights on market capacity to absorb the anticipated increase in supply from companies during AMP8.

11.4.42. For existing RPI-linked debt, the questionnaire responses suggest that the optimal hedging strategy involves trading in basis swaps. However, since the CPIH swap market is still under-developed, basis swaps are almost exclusively available in the RPI-CPI market, meaning that companies are left exposed to the risk associated with the CPI-CPIH wedge. Bank quotes for RPI-CPI basis swaps for a 5-year tenor average around 7bps, with a maximum of 12bps. A 5-year swap is deemed appropriate as there may not be a need to hedge this risk after the RPI Reform.

11.4.43. For new issuances, water companies can mitigate basis risks in two ways: (1) by directly issuing CPIH or CPI bonds, with the latter potentially exposing them to the CPI-CPIH wedge; or (2) by issuing nominal bonds and entering into an inflation swap (fixed-to-CPI/CPIH). The questionnaire responses indicate that although liquidity in the CPI bond market has improved over time, the market's capacity to absorb direct CPI issuance remains insufficient to accommodate all expected ILD issuances in the water sector during AMP8. Furthermore, the CPIH bond market is even less liquid, with some banks estimating an illiquidity premium of 9 – 13bps on CPIH bond issuance. In contrast, the responses suggest that there is a greater capacity in the CPI swap market[304]. As a result, the most effective way to issue new ILD that more closely aligns with the price control's indexation measure may be to raise nominal

301 Ofwat (2024), PR24 Final Determination, Aligning risk and return appendix, p. 33.

302 Base on the same technical analysis specified in Appendix 2: Beta.

303 As per section 10.2.

304 The explanation provided by one of the banks for this dynamic is as follows: Similar investors, such as pension funds and insurance companies, are active in both the index-linked bond and swap markets. These investors typically separate their investment activities into distinct mandates, such as equities, corporate debt, and government debt, while managing overarching liability hedges – like inflation and interest rate risk –at a central level. This separation means that liability hedging is handled independently from the management of corporate credit risk. Therefore, these institutional investors may opt for inflation swaps, which allow them to hedge inflation risk directly without introducing additional corporate credit risk. This results in greater demand for swaps as they effectively address the specific liability risks without overlapping with their corporate debt portfolios.

bonds and enter into CPI inflation swaps. Bank quotes for inflation swap charges are in the range of 58 – 62bps.

Basis risk estimates based on pricing evidence from bank questionnaires

11.4.44. The cost of basis risk management is estimated at 6bps (shown in tables below) across embedded and new debt based on pricing evidence from banks.

1) For embedded debt, the range of 2-3bps reflects the cost of hedging basis risk, cross-checked against by quantifying the additional volatility arising from basis risk, which translates into a 20bps adjustment on CoD. This significantly exceeds the cost of hedging through swaps. This cross-check, along with the potential market response to a significantly increased supply of ILD during AMP8, supports adopting 3bps as the estimate for pricing basis risk management on embedded debt.

2) For new debt, the range of 1-6bps reflects the cost of issuing new CPI(H)-linked debt. 3bps is proposed as the point estimate.

Table 52: Pricing of basis risk on embedded debt

	Basis of pricing	Estimate
Lower bound	The lower bound reflects the median cost of hedging the risk, based on information gathered from banks regarding basis swap charges.	7bps
Upper bound	The upper bound represents the maximum cost of hedging the risk based on bank surveys. This is corroborated by the quantification of the additional volatility arising from basis risk, which translates into a 20bps adjustment on CoD.	12bps
Overall range		7-12bps
Share of embedded debt		72%
ILD proportion		33%
Pricing of basis risk on embedded debt		2-3bps

Source: KPMG analysis
Note: Based on a 28% share of new debt estimated in this Report.

Table 53: Pricing of basis risk on new debt

	Basis of pricing	Estimate
Lower bound	The lower bound reflects the additional costs from issuing more illiquid CPIH-linked debt to maintain asset-liability matching.	9-13bps
Upper bound	The pricing is based on CPI inflation swap charge information gathered from banks. Survey responses indicate that the demand for inflation-linked bonds is limited relative to swaps and that there is virtually no market for CPIH swaps, suggesting that swapping nominal debt into CPI may be the most effective way of issuing CPI-linked debt.	58-62bps
Overall range		11-60bps
Share of new debt		28%
ILD proportion		33%
Pricing of basis risk on embedded debt		1-6bps

Source: KPMG analysis
Note: Based on a 28% share of new debt estimated in this Report.

11.4.45. The pricing of basis risk is based on the proportion of ILD assumed for the notional company. However, in practice, the actual average ILD proportion differs significantly from the 33% notional assumption. As a result, 6bps represents a *de minimis* estimate.

11.4.46. This approach broadly aligns with Ofgem's RIIO-2 methodology, which introduced full CPIH indexation based on swap charges for RPI-CPI swaps and provided a 5bps allowance to energy networks. The higher estimate for water companies reflects the greater proportion of index-linked debt (ILD) and associated basis risk in the water sector.

11.4.47. Analysis of pricing the higher risk (rather than the cost of hedging the higher risk) indicates an adjustment to CoD equivalent to 20bps. This corroborates that providing for hedging costs of 6bps is likely to represent a *de minimis* estimate.

Ofwat's points

11.4.48. Ofwat analyses the impact of its inflation assumptions (2% CPIH inflation and a 90bps RPI-CPIH wedge) on regulated equity (inflation RoRE), taking into account the variance between its projected inflation assumptions and the actual inflation outcomes. Based on the historical dataset from 1997, Ofwat calculates the P10 and P90 outcomes for the five-year period. With the absolute value of P90 surpasses the P10, Ofwat concludes that water companies are more likely to out- than under-perform its inflation assumptions.

11.4.49. Based on above, Ofwat contends that providing an additional allowance for basis risk is unnecessary, and that companies' claimed costs for hedging this risk are considered as a risk management choice in question.

11.4.50. Latest forecasts indicate that a significant wedge is expected to persist leading up to the 2030 RPI Reform. For instance, HMT's comparison of independent forecasts from November 2024 suggests a wedge of 1.2% for 2028[305], while CPI and RPI-linked swap data for January 2025 indicates an average wedge of around 100bps for the next five years through 2030[306]. This suggests that a 90bps FD wedge is not overly generous. In consequence, Ofwat's inflation assumptions do not obviate the need to provide for basis risk management costs.

305 HMT (November 2024), Forecasts for the UK economy: a comparison of independent forecasts, Table M3.
306 KPMG's analysis on 5-year zero-coupon RPI and CPI inflation swap data from Bloomberg.

11.5. CoD range and estimate for PR24

11.5.1. The overall CoD range is 3.60 – 3.81%.

Table 54: Overall CoD range for PR24

	Lower bound	Upper bound
CoD_E	2.94%	2.94%
CoD_N	4.27%	4.47%
Share of new debt	28.00%	28.00%
CoD_A	0.29%	0.44%
Overall CoD	3.60%	3.81%

Source: KPMG analysis

12. Appendix 1: Risk-free rate

12.0. ILG yields as a starting point for the risk-free rate

I. 20Y ILGs are not truly risk-free

12.0.1. This section considers whether there may be a risk premium in government bonds.

12.0.2. The extent that there is any small risk premium present in government bonds, this does not alter the investor choice of using government bonds like the CAPM risk-free asset. Accordingly, CEPA's points on a risk premium in government bonds are not relevant for the real world application of the CAPM as long as government bonds are the safest alternative to investing in the market portfolio. Notwithstanding this, CEPA's points are discussed below.

Default risk

12.0.3. CEPA suggests that UK government bonds are not completely immune to default risk because (1) the UK government does not have unlimited power to print money to cover GBP liabilities; (2) the UK government was downgraded in 2016 and 2017 to AA/Aa2 credit rating; and (3) 5Y UK credit default swaps imply a low default probability.

12.0.4. In theory, the UK government *does* have unlimited power to print money and there has not been a situation in the past which has called into question its power to do so. As such, it is expected that the UK government can always print money to honour its GBP liabilities and thus avoid default.

12.0.5. It may be possible that there is a small risk of default under extreme conditions, but this is not reflective of normal or plausible market conditions. Indeed, CEPA recognises that *"it is true that the UK government has effective recourse in the event of nearly any default…"*[307]. It appears appropriate to focus on plausible rather than non-plausible scenarios with remote likelihoods of occurring.

12.0.6. Importantly, the CMA at PR19 appeared to share the same view. The CMA acknowledged the UK government's credit rating downgrades, but still concluded that "it appears clear to us [the CMA] that ILGs closely match part of our key requirement of the RFR, that the bonds are risk free"[308].

12.0.7. This would imply that CEPA's point on default risk is not material and reaffirm that UK government bonds are an appropriate starting point for the risk-free rate.

Illiquidity risk

12.0.8. CEPA suggests there are plausible arguments for why government bonds may carry illiquidity risk.

12.0.9. First, Ofwat in the PR24 FM recognised estimates of the convenience yield (CY) for government bonds[309]. CY is driven by the additional benefits of government bonds beyond their risk/return trade-off i.e. beyond the properties of the CAPM risk-free asset. The superior liquidity of government bonds is a driver of their CY.

12.0.10. The presence of CY for government bonds means that they are more liquid than other safe assets. Put differently, they may be too liquid compared to the CAPM risk-free asset. Ofwat has implicitly agreed with this by recognising estimates of CY for government bonds.

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307 CEPA (July 2024), PR24 Cost of Equity, p. 50.

308 CMA (2021), PR19 Final Determination, para. 9.103.

309 Ofwat (2022), PR24 Final Methodology, Appendix 11 – Allowed return on capital, p. 93.

12.0.11. Second, CEPA has not provided any specific arguments or evidence on illiquidity risk which means it is not possible to evaluate the reasonableness of its point.

12.0.12. In any case, government bonds are widely considered to be the most liquid asset in the market. CEPA appears to agree with this, noting that "gilts are likely to have higher liquidity than a comparable corporate bond"[310]. Thus government bonds cannot be illiquid since all other assets are relatively less liquid. The implication is that government bonds cannot carry illiquidity risk.

12.0.13. Third, CEPA shows for a sample of NGs and ILGs that these have bid-ask spreads of 0.05% and 0.03% respectively[311]. This indicates that government bonds have near perfect liquidity. CEPA recognises the same: "…tight bid-ask spreads correspond to highly liquid markets (such as those for gilts)"[312]. This strongly reaffirms that government bonds cannot carry illiquidity risk.

Term risk

12.0.14. CEPA suggests that longer-dated government bonds feature term risk. It cites two potential drivers for the term risk: (1) there is higher sensitivity to interest rate risk at longer tenors i.e. the market value of longer-dated bonds is more sensitive to changes in interest rates; and (2) this is compensation for investors who are locking up their funds for a longer horizon.

12.0.15. First, the CAPM assumes that investors hold the risk-free asset until its maturity. In this case, the risk-free asset is proxied by government bonds.

12.0.16. Government bonds provide a risk-free return over their maturity i.e. these are only risk-free when held to maturity, not when used for short-run trading. In consequence, term risk is only relevant for an investor if they sell the government bonds before maturity. This is not the case in the CAPM.

12.0.17. For example, interest rate risk is irrelevant for the investor as they would not be seeking to sell the government bond for its market value at any point in time. The investor has knowingly bought the (zero-coupon) bond purely for the risk-free cashflow they receive at maturity of the bond.

12.0.18. Second, the allowed return has been calibrated using long-dated government bonds as investors in the sector have long holding periods. This calibration assumes that investors invest in long-dated government bonds that match the duration of their long holding period.

12.0.19. CEPA's point around term risk implies that it would be appropriate to calibrate the return for investors with long holding periods using short-dated government bonds. This calibration, in contrast, assumes that investors continually reinvest in short-dated government bonds over their long holding period.

12.0.20. The latter is not convenient or efficient for investors. As a result, it is not relevant to compare the yield on longer- and shorter-dated government bonds.

II. 20Y ILGs have been used instead of an average of 10Y and 20Y ILGs

12.0.21. This section considers whether the use of 20Y ILGs is supported by evidence.

12.0.22. The sole use of 20Y ILGs is supported by:

1) Ofwat in the PR24 FD has used a run-off (depreciation) rate of 4.15% on average for the sector[313]. This corresponds to an average remaining asset life of 24Y for AMP8. 20Y ILGs would broadly match the duration of cashflows implied by this average remaining asset life. Indeed, they can be seen as conservative as their maturity is only 20Y rather than 24Y.

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310 CEPA (July 2024), PR24 Cost of Equity, p. 51.
311 CEPA (December 2024), PR24 Cost of Equity, p. 31.
312 CEPA (December 2024), PR24 Cost of Equity, p. 31.
313 Ofwat (2024), PR24 Final Determination, Aligning risk and return appendix, p. 56.

2) Ofwat requires companies to plan their capex over the next 25Y through its new Long Term Delivery Strategy framework for AMP8 [314]. This suggests that 20Y ILGs should be used to broadly match the reality of decision-making that Ofwat requires for the sector.

3) The risk-free rate and the cost of new debt in the allowed return both provide forward-looking expectations of rates. Ofwat has used the iBoxx non-financial A/BBB 10+ index as the benchmark index for the cost of new debt. This index has a tenor close to 20Y [315]. The risk-free rate should therefore be based on 20Y ILGs to maintain consistency across the allowed return.

4) Ofgem in the RIIO-3 SSMD bases its estimate of the risk-free rate on 20Y ILGs. It comments that this is in line with RIIO-2 and consistent with UKRN guidance that the maturity of the risk-free rate proxy matches the investment horizon for the sector [316].

5) CEPA considers the yields on 20Y ILGs are more stable than on 10Y ILGs [317]. Thus sole use of 20Y ILGs is preferable because investors in utilities target stable returns over a long time horizon.

12.0.23. Notwithstanding that conceptually it appears appropriate to rely only on 20Y ILGs, there is one point on CEPA's empirical analysis that should be highlighted:

1) The difference in yield between 20Y ILGs and 15Y ILGs is smaller than that between 20Y ILGs and the average of 10Y and 20Y ILGs. The use of 15Y ILGs represents Ofwat's PR19 FD position. Further, the differences are significantly smaller over a long-term window e.g. 20Y.

12.1. Convenience yield

I. Difference between CY(NG) and CY(ILG)

12.1.1. This section analyses whether the CY factors cited in academic literature apply to ILGs to the same extent as NGs. The 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)

12.1.2. 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.

12.1.3. 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.

12.1.4. 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. 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)

12.1.5. 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.

12.1.6. 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.

314 Ofwat (2022), PR24 and beyond: Final guidance on long-term delivery strategies, p. 13.

315 The tenor of the iBoxx non-financials A/BBB 10+ index has been 19.8Y on average over the >27Y period from 01/01/1998 (date on which iBoxx begins) to 31/01/2025.

316 Ofgem (2024), RIIO-3 Sector Specific Methodology Decision – Finance Annex, paras. 3.37-3.38.

317 CEPA (July 2024), PR24 Cost of Equity, p. 49.

12.1.7. Sectors with inflation-linked liabilities, such as pensions, may have special demand for ILGs over NGs given their inflation protection[318]. 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)

12.1.8. 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.

12.1.9. 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[319]). Banks require collateral to mitigate the credit risk generated by undertaking these transactions.

12.1.10. The collateral value of an asset is derived by applying a haircut to its current market value to account for valuation uncertainty[320]. 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[321]. There are also conditions under which their haircut is zero[322].

12.1.11. 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)[323] states that this 'repo specialness' contributes to a convenience yield that "…distinguishes the Treasury rate from the riskless rate".

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

12.1.12. 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.

12.1.13. 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[324].

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318 IPE (2014), Liability-Driven Investment: Banks and the linkers market.

319 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.

320 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.

321 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 ≤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.

322 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.

323 Feldhütter, P. and Lando, D. (2008), 'Decomposing swap spreads'.

324 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

12.1.14. 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. NG/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[325].

12.1.15. 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[326] NG/ILGs is nil whereas it is 15% of the current market value for unencumbered AAA corporate bonds[327].

12.1.16. 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[328], this increases to >12% for a residual duration of >20Y[329].

5. Safety

12.1.17. 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.

12.1.18. 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.

12.1.19. 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.

12.1.20. 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

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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.

325 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

326 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.

327 https://www.prarulebook.co.uk/rulebook/Content/Part/392857/20-07-2023

328 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.

329 The Standard Formula capital charges for spread risk 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 $stress_i$ 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.

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".

12.1.21. 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"[330].

12.1.22. In conclusion, the vast majority of factors apply similarly to NGs/ILGs but NGs may be more liquid.

II. Term structure of CY

12.1.23. DVT estimate CY for NGs with tenors of 3m to 2Y. This section analyses whether estimates of CY for shorter-dated safe assets can be extrapolated to longer-dated safe assets.

Empirical analysis of CY term structure

12.1.24. The CY term structure in DVT (2025) is mostly upward sloping (2Y is the exception but may be an outlier) and there is not enough of a time series to conclude that CY declines at longer tenors. As such, it appears reasonable to assume that the 2Y CY could hold at longer tenors, all else equal.

Qualitative analysis of CY term structure

12.1.25. The usefulness of government bonds as collateral is driver of their CY. The most robust way to assess whether there is a difference in CY between shorter- and longer-dated safe assets due to collateral value is to review the applicable legislation.

12.1.26. The haircuts for gilts and AAA corporate bonds required by the applicable legislation are set out in the table below[331].

330 CMA (2021), PR19 Final Determination, para. 9.103.

331 Article 224 illustrates the haircuts that have to be applied to the current market value of assets to derive their collateral value. Gilts 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. Gilts and AAA corporate bonds are both of credit quality step 1 based on the EBA mapping table. Articles can be found here and the EBA mapping table can be found here.

Table 55: Haircuts for gilts and AAA corporate bonds

Remaining maturity	Gilts			AAA corporate bonds		
	20-day liquidation period	10-day liquidation period	5-day liquidation period	20-day liquidation period	10-day liquidation period	5-day liquidation period
≤1Y	0.707%	0.5%	0.354%	1.414%	1%	0.707%
>1 and ≤5Y	2.828%	2%	1.414%	5.657%	4%	2.828%
>5Y	5.657%	4%	2.828%	11.314%	8%	5.657%

Source: KPMG analysis and data from Articles 197 and 224 and EBA mapping table

12.1.27. Reading the table vertically indicates that the haircuts on (1) gilts with tenors of 1-5Y are 4x that of gilts with tenors of ≤1Y; and (2) gilts with tenors of >5Y are 2x that of gilts with tenors of 1-5Y. This is irrespective of the liquidation period of the transaction for which the gilt is used as collateral[332].

12.1.28. However, the difference in collateral value between shorter- and longer-dated gilts is not relevant for the term structure of CY as Ofwat suggests. This is because CY for gilts is the difference in yield between gilts and other safe assets, such as AAA corporate bonds, *of the same maturity*. It is necessary to hold constant the maturity as CY is the difference in yield between two assets with the same cash flow profile that differ only in terms of their convenience. As such, the table should only be read horizontally, not vertically, to evaluate the term structure of CY.

12.1.29. Reading the table horizontally indicates that the haircuts on gilts are half that for AAA corporate bonds at the same maturity (and liquidation period). The difference between the two in absolute terms becomes larger at higher maturities (and liquidation periods). This means that the collateral value component of CY does not decline at longer tenors.

12.1.30. On balance, it appears reasonable to assume that CY holds for longer-dated safe assets.

12.2. Differing risk-free borrowing and saving rates

I. Same borrowing and saving rates

12.2.1. This section considers the case where investors can borrow and save at the same risk-free rate as assumed in the Sharpe-Lintner CAPM.

12.2.2. In the Sharpe-Lintner 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.

12.2.3. 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.

12.2.4. 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[333].

12.2.5. 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

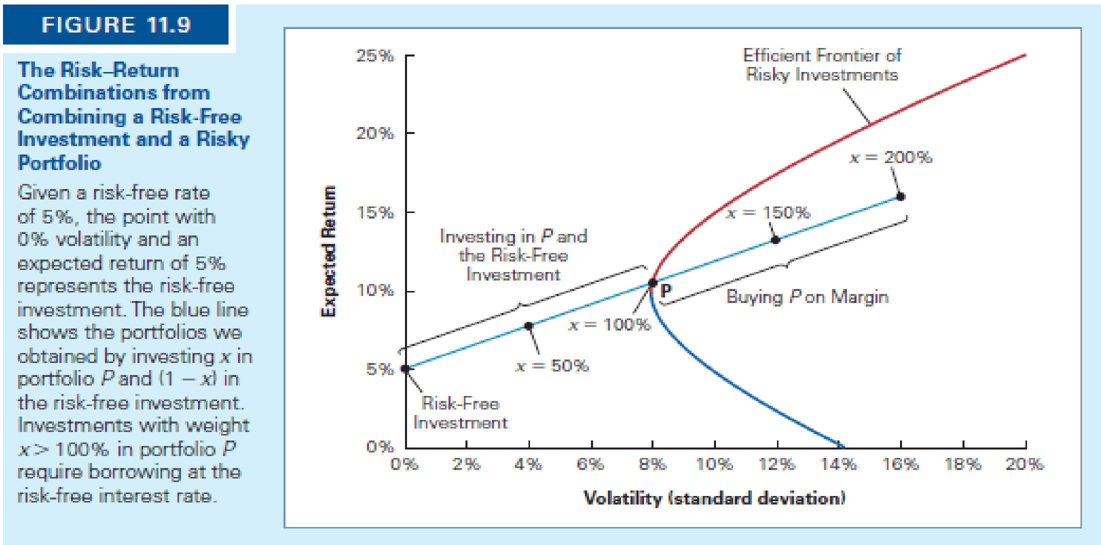
332 The liquidation periods that apply for different types of transactions are explained in Article 224(2).

333 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.

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.

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

Figure 36: The risk–return combinations from combining a risk-free investment and a risky portfolio

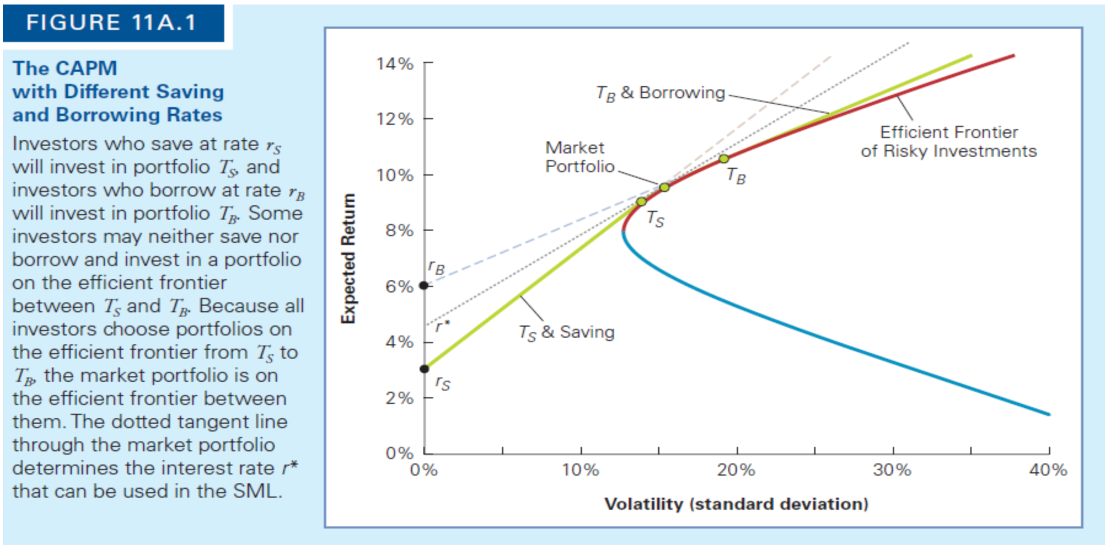


Source: Berk and DeMarzo (2014)

II. Different borrowing and saving rates

12.2.7. The Sharpe-Lintner CAPM assumes that investors can borrow and save at the same risk-free rate. This section considers the case where the risk-free borrowing rate (r_B) is now higher than the risk-free saving rate (r_S)[334]. This is formally analysed in Brennan (1971)[335]; the following figure from Berk and DeMarzo (2014) illustrates its findings:

Figure 37: The CAPM with different saving and borrowing rates



Source: Berk and DeMarzo (2014)

334 Note r_S is equal to the common 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.

335 Brennan, M. (1971), ‘Capital Market Equilibrium with Divergent Borrowing and Lending Rates’.

12.2.8. 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 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:

12.2.9. "…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.

12.2.10. 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".

12.2.11. 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:

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

12.2.12. 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 until it becomes:

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

12.2.13. 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 $r_S + \beta \times (r_M - r_S)$.

12.2.14. In sum, where $r_B > r_S$, utilities are less attractive to investors and so investors require a higher return to hold utilities. This is reflected by the risk-free rate in the CAPM formula increasing from r_S to r^*.

12.2.15. The CMA's interpretation of the figure from Berk and DeMarzo above at PR19 is consistent with the finding in 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"[336].

III. Borrowing and saving rates in the real world

12.2.16. 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.

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

1) **Brealey, Myers, Allen, and Edmans (2025):** "In practice, even though investors can save at the risk-free rate by buying Treasury bills, most can't borrow at that rate since

336 CMA (2021), PR19 Final Determination, para. 9.94.

they aren't risk free. A common benchmark for r_B, the borrowing rate, is the yield on high-quality (e.g., AAA- or AA-rated) corporate bonds. However, the rate at which investors can borrow may be even higher than for companies, because financial assets are often more volatile than corporate assets such as buildings and machines" [337].

2) **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"[338].

3) **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"[339]. The CMA asserted repeatedly throughout the FD that the ILG rate was below the rate at which most investors could in practice borrow.

12.2.18. Ofwat's advisors 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"[340]. This logic is flawed for two reasons.

12.2.19. 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'"[341].

12.2.20. 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.

IV. Risk premia should be deducted from the AAA corporate borrowing rate to derive the risk-free borrowing rate

12.2.21. This section considers whether it is correct to deduct risk premia from the AAA corporate borrowing rate to derive the risk-free borrowing rate.

12.2.22. The three proposed deductions are for illiquidity risk, default risk, and complexity risk. However, these risks should not be deducted because they affect the actual rates faced by investors. They pay such risk premia because borrowing markets are illiquid, investors may default, and their portfolios are complex. Indeed, capital market imperfections are why investors face different borrowing and lending rates to begin with, and are the motivation for the Brennan (1971) extension of the CAPM.

337 Brealey, R., Myers, S., Allen, F. and Edmans, A. (2025), 'Principles of Corporate Finance', Chapter 8.
338 Berk, J. and DeMarzo, P. (2014), Corporate Finance, p. 404.
339 CMA (2021), PR19 Final Determination, para 9.159.
340 CMA (2021), PR19 Final Determination, paras. 9.73-4.
341 CMA (2021), PR19 Final Determination, para. 9.105.

12.2.23. The first proposed deduction is an illiquidity premium. However, illiquidity premia should not be deducted because borrowing markets are less liquid than lending markets. While investors can lend by investing in a wide range in safe assets all around the world, they have more limited sources of borrowing.

12.2.24. The second proposed deduction is a default premium, However, investors bear default premia because they may default. Indeed, default premia may be higher than for high-quality corporates since investors are backed by securities whose prices can significantly fluctuate whereas, corporates are backed by hard assets.

12.2.25. The third proposed deduction is a complexity premium, However, there do not appear to be established asset pricing models that feature complexity risk; this risk seems to have been proposed with limited theoretical or empirical justifications. Moreover, even if a complexity premium exists, it may be that investors bear such complexity risk since lenders to such investors would have to evaluate their portfolios when deciding whether to lend to them.

12.3. Quantitative analysis of adjustments to ILG yields

I. Default risk in AAA corporate bonds

12.3.1. 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.

12.3.2. 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[342]. 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.

Table 56: 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)[343]	1985-2020	Global	10Y	0.03%	0.00%
		Europe	10Y	0.04%	0.00%
Moody's (Feb 2024)[344]	1920-2023	Global	10Y	0.66%	0.07%
			20Y	1.26%	0.06%
	1970-2023	Global	10Y	0.34%	0.03%
			20Y	0.69%	0.03%
	1983-2023	Global	10Y	0.12%	0.01%
			20Y	0.12%	0.01%
	1998-2023	Global	10Y	0.02%	0.00%
			20Y	Data not published	
Fitch (Mar 2024)[345]	1990-2023	Global	10Y	1.32%	0.13%
		EMEA	10Y	-	-
S&P (Mar 2024)[346]	1981-2023	Global	10Y	0.68%	0.07%
			15Y	0.86%	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

342 This approach estimates the default premium for corporate bonds but not for structured finance bonds.
343 Moody's (2021), Default and recovery rates of European corporate issuers, 1985-2020, Exhibit 15.
344 Moody's (2024), Annual default study: Corporate default rate to moderate in 2024 but remain near its long-term average, Exhibits 38-42.
345 Fitch (2024), 2023 Transition and Default Studies, Tab "Global CF Default Rates".
346 S&P (2024), Default, Transition, and Recovery: 2023 Annual Global Corporate Default And Rating Transition Study, Tables 24-25.

12.3.3. The default studies indicate that AAA rated corporate issuers have very low default rates, ranging between 0% and 0.13% on an annualised basis.

12.3.4. 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[347]. 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 0.86% 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 57: Recovery and loss rates for senior unsecured bonds

Default study	Time period	Region	Recovery rate	Loss rate
Moody's (Apr 2021)[348]	1985-2020	Global	37.62%	62.38%
		Europe	36.75%	63.25%
Moody's (Feb 2024)[349]	1983-2023	Global	37.60%	62.40%

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

12.3.5. The default studies indicate that the loss rate for senior unsecured bonds ranges between 62.38% and 63.25%. Berk and DeMarzo (2014) notes that the average loss rate for unsecured debt is about 60% which is in line with the range from the default studies[350].

12.3.6. The overall range for default premium is therefore 0bps to 8bps[351]. A point estimate of 4bps has been selected which is at the midpoint of the range. This point estimate recognises that AAA corporate bonds are not risk-free but are very low risk.

347 CMA (2021), PR19 Final Determination, para. 9.147.
348 Moody's (2021), Default and recovery rates of European corporate issuers, 1985-2020, Exhibit 16.
349 Moody's (2024), Annual default study: Corporate default rate to moderate in 2024 but remain near its long-term average, Exhibit 7.
350 Berk, J. and DeMarzo, P. (2014), Corporate Finance, p. 412.
351 Lower bound = 0% annualised default rate * 62.38% loss rate; upper bound = 0.13% annualised default rate * 63.25% loss rate.

13. Appendix 2: Beta

13.0. Decomposition of capital intensity decile portfolios

I. Capital intensity decile portfolio breakpoints

13.0.1. The capital intensity ratio is calculated as capex to opening total asset excluding current assets and long-term receivables. The non-financials companies in FTSE350 are ranked each year based on their ratios to form the decile portfolios of the year.

13.0.2. The analysis covers the 10-year window with a cut-off date December 31st, 2024. On average, there are 166 non-financials companies with ratios available each year. Below are the 10-year average breakpoints (1st to 9th decile) on capital intensity deciles.

Table 58: Capital intensity ratio decile breakpoints (10-year average)

Decile	Capital intensity ratio for each decile
1st	1.14%
2nd	2.18%
3rd	3.04%
4th	4.11%
5th	5.45%
6th	6.77%
7th	8.44%
8th	10.67%
9th	15.74%

Source: KPMG analysis using LSEG Workspace data and LSPD

II. Long-short portfolio used for capital intensity analysis

13.0.3. The 6th and 7th decile are used to form the long-short portfolio to estimate the impact of changes in capital intensity ratio on water portfolio's beta. The two deciles incorporate over 30 stocks per year. The constituents of the portfolio come from different industries, which help to diversify away company- and industry-specific risks.

Table 59: Sector breakdown in proportion (%) for the long-short portfolio

Sector	6th decile	7th decile
Basic Materials	8.12	12.33
Consumer Discretion	19.4	19.74
Consumer Staples	10.83	8.64
Energy	3.01	8.03
Health Care	3.32	7.05
Industrials	33.21	26.87
Technology	2.68	1.54
Telecommunications	5.75	3.69
Utilities	13.69	12.13

Source: KPMG analysis using LSEG Workspace data and LSPD

13.1. Methodology for translating the RoRE variance into standard deviation of the company return

13.1.1. This appendix describes a three-step approach for translating the RoRE variance, arising from increasing capital intensity, into changes in total risk exposure. This is expressed as the standard deviation of total return, a traditional measure of risk.

13.1.2. To assess the impact of increasing capex intensity on the RoRE range, the PR24 FD RoRE range from the KPMG risk model[352] is considered (1) based on a Totex range reflecting risk in previous price controls in line with the PR19 FD[353] (2) based on a Totex range reflecting forward-risk for PR24, holding all other risk factors constant. The change in the Totex RoRE is assumed to be predominantly driven by increased capex intensity.

I. Step 1 – Simulate RoRE performance in terms of P10/P50/P90 for each risk driver using the KPMG risk model

13.1.3. The tables below set out the RoRE outputs from the KPMG risk model for PR24, 'as is' and with the PR24 Totex RoRE being replaced by PR19 FD level, holding all other risk factors constant. P10 and P90 represent the downside and upside of the expected performance for each factor. The only difference between the tables is the Totex RoRE range (in terms of average variance P90-P50/P10-P50 at 1.53% vs. 1.01%).

II. Step 2 – Calculate the risk exposure for each risk factor

13.1.4. The standard deviation for each risk factor is derived by averaging the P10-P50 and P90-P50 ranges and dividing by the critical value based on a normal distribution.[354].

13.1.5. This approach aligns with the CAPM assumption that returns are normally distributed, meaning they are symmetrically clustered around the mean. While there may be asymmetric downside risks in the expected performance of each risk factor under the PR24 DD regulatory framework, such risks are beyond the scope of this specific analysis.

III. Step 3 – Aggregate the individual risk exposure to the whole company

13.1.6. The standard deviation of each risk factor is aggregated to determine the total risk exposure for the notional company using the following formula:

$$\sigma_P^2 = \sum_{i=1}^{n} \omega_i^2 \, \sigma_i^2$$

$$\sigma_P = \sqrt{\sigma_P^2}$$

13.1.7. Where:

1) σ_P is the total risk exposure measured as standard deviation
2) σ_i is the risk exposure of each driver, e.g. Totex risk
3) ω_i is the relative weight of each risk driver.[355]

352 KPMG risk analysis assesses, based on the available empirical evidence and historical sector performance data, whether the FD parameters and mechanisms allow the notional company to earn base allowed return on a median expected basis. The stochastic risk model is constructed to simulate the notional company's risk exposure in RoRE terms by key risk drivers, accounting for risk mitigations purposed by Ofwat in PR24 FD. In this Report, the RoRE outputs are based on the "Unmitigated" scenario in the club risk model focussed on design risk only, which is the scenario with full estimated risk exposure of the notional company under the FD regulatory regime, but removing the miscalibration risk, i.e. assuming that companies are able to improve their performance to the levels required in AMP8 to meet the FD targets.

353 PR19 Totex risk ranges presented in Ofwat PR19 FD - Aligning risk and return technical appendix, Figure 3.1.

354 This methodology assumes that performance is normally distributed, and thus that (1) P50, mean, and median values for each risk driver are equivalent and (2) the range of P90-P50 and P10-P50 should conceptually be the same and equal to 1.285 standard deviation (SD), where 1.28 is the critical value for the 10% confidence level in a normal distribution. Where the P90-P50 and P10-P50 ranges from the simulation differ, standard deviation is assumed to be the average of P90-P50 and P10-P50.

355 The relative weight of each risk driver is derived as the proportion of its P90-P50/P10-P50 average variance to total RoRE variance. The same weights are applied to PR19 as derived from the KPMG risk model for PR24.

13.1.8. The tables set out the total risk exposure for a notional water company, measured as the weighted average of the standard deviations for each risk driver, based on PR24 and PR19 Totex RoRE ranges. Keeping all risks constant except for Totex risk, the total risk exposure of a notional company with higher capital intensity in PR24 is 0.61%, compared to 0.55% with the lower capital intensity from PR19, which implies an increase in total risk by a scaling factor of 1.10x[356].

Table 60: Simulated RoRE outcome and total risk exposure for a water company in PR24 vs. PR19

PR24 DD	Implied P10	Implied P50	Implied P90	Average of Variance	Standard Deviation of risk drivers (σ_i)	*Relative weight* (ω_i)	Implied risk variance ($\sigma_i^2 \omega_i^2$)	Implied total risk (σ_P)
Totex	-1.96%	-0.41%	1.11%	1.53%	1.20%	28.36%	0.00115%	
Retail	-1.01%	0.00%	0.98%	1.00%	0.78%	18.40%	0.00020%	
ODIs + MeXes	-1.42%	-0.30%	0.69%	1.05%	0.82%	19.49%	0.00026%	
Financing	-1.82%	0.00%	1.75%	1.78%	1.39%	32.99%	0.00211%	
Revenue & other	-0.05%	0.00%	0.00%	0.03%	0.02%	0.46%	0.00000%	
DPC	-0.03%	0.00%	0.00%	0.02%	0.01%	0.30%	0.00000%	
Total	**-6.30%**	**-0.71%**	**4.52%**	**5.41%**	**4.22%**	**100.00%**	**0.00372%**	**0.61%**

Source: KPMG analysis using the KPMG risk model, extracted February 20, 2025.

PR24 DD with PR19 Totex	Implied P10	Implied P50	Implied P90	Average of Variance	Standard Deviation of risk drivers (σ_i)	*Relative weight* (ω_i)	Implied risk variance ($\sigma_i^2 \omega_i^2$)	Implied total risk (σ_P)
Totex	-1.08%	0.00%	0.94%	1.01%	0.79%	*28.36%*	0.00050%	
Retail	-1.01%	0.00%	0.98%	1.00%	0.78%	18.40%	0.00020%	
ODIs + MeXes	-1.42%	-0.30%	0.69%	1.05%	0.82%	19.49%	0.00026%	
Financing	-1.82%	0.00%	1.75%	1.78%	1.39%	32.99%	0.00211%	
Revenue & other	-0.05%	0.00%	0.02%	0.03%	0.02%	0.46%	0.00000%	
DPC	-0.03%	0.00%	0.00%	0.02%	0.01%	0.30%	0.00000%	
Total	**-5.42%**	**-0.30%**	**4.35%**	**4.89%**	**3.81%**	**100.00%**	**0.00307%**	**0.55%**

Source: KPMG analysis using the KPMG risk model, extracted February 20, 2025.

356 Scaling factor 1.10 = 0.61%/0.55%.

14. Appendix 3: Debt financeability

14.0.1. In PR19, CMA noted that "some of the public statements from the agencies are supportive of the view that the ratios should be considered together as part of a broader assessment, rather than seeing each as a constraint, with the rating being linked to the lowest possible level"[357]. As a result, CMA considered that "caution is required in a financeability assessment to avoid placing undue emphasis on the value of a particular ratio"[358].

14.0.2. However, there is reason to regard the S&P FFO/debt rating thresholds as a hard constraint on its rating in AMP8. This is because S&P's corporate rating criteria sets out a structured approach to arriving at an "anchor" rating based on a company's business risk profile, financial risk profile and a volatility table linked to regulatory risk, and S&P's analysts have limited discretion to rate above this anchor.

14.0.3. As a result of its more negative view of Ofwat's regulatory framework, S&P now applies its "medial" volatility table, which sets out higher thresholds for any rating than the "low" volatility table used previously. The table below sets out our estimate of S&P's criteria scores and the anchor rating at a hypothetical 8% FFO/debt.

Table 61: Derivation of S&P anchor rating

	AMP7	AMP8
Preliminary regulatory advantage	Strong	Strong/adequate
Business strategy modifier	Neutral	Neutral
Regulatory advantage	Strong	Strong/adequate
Scale, scope and diversity	Strong	Strong
Operating efficiency	Strong	Strong
Preliminary competitive position	**Excellent**	**Strong**
Profitability	Satisfactory	Satisfactory
Competitive position	**Strong**	**Strong**
Country risk assessment	Low	Low
Industry risk assessment	Very low	Very low
CICRA	**1**	**1**
Business Risk Profile	**Excellent**	**Excellent**
Volatility table	Low	Medial
Example FFO/debt	8%	8%
Financial Risk Profile	**Aggressive**	**Highly leveraged**
Anchor	**bbb**	**bbb-/bb+**

Source: KPMG analysis

357 CMA (2021), PR19 Final Determination, para. 10.95.
358 CMA (2021), PR19 Final Determination, para. 10.94.

14.0.4. S&P's rating committees have discretion to set the Standalone Credit Profile (which would determine the rating for a notionally-financed company) one notch above or below the anchor. In this hypothetical example, that means S&P could have chosen to rate the company between BBB- and BBB+ based on its criteria in AMP7, and between BB and BBB based on its revised scoring in AMP8.

14.0.5. At PR19, CMA was correct to note that S&P had considerable discretion to rate companies higher than would be indicated by their published thresholds. For example, although its analysts chose to set the minimum FFO/debt for BBB+ at 9%, S&P's criteria would have allowed a company with this ratio to be rated between BBB+ and A, as set out in the table below.

14.0.6. However, in AMP8 the situation has been reversed: across most of the plausible range of FFO/debt, S&P's published thresholds are based on the highest rating permitted by their criteria. For example, S&P has chosen to set the minimum FFO/debt for BBB at 8%, which is the top end of the BB to BBB range permitted by its criteria.

Table 62: Comparison of S&P anchor rating and company-specific thresholds

AMP7				AMP8		
FFO/ debt	Anchor	Range of discretion	Company-specific thresholds	Anchor	Range of discretion	Company-specific thresholds
14%	a+/a	A- to AA-	A-	a-	BBB+ to A	A-
13%	a+/a	A- to AA-	A-	a-	BBB+ to A	BBB+
12%	a-	BBB+ to A	A-	bbb	BBB- to BBB+	BBB+
11%	a-	BBB+ to A	A-	bbb	BBB- to BBB+	BBB+
10%	a-	BBB+ to A	BBB+	bbb	BBB- to BBB+	BBB
9%	a-	BBB+ to A	BBB+	bbb	BBB- to BBB+	BBB
8%	bbb	BBB- to BBB+	BBB	bbb-/bb+	BB to BBB	BBB
7%	bbb	BBB- to BBB+	BBB	bbb-/bb+	BB to BBB	BBB-
6%	bbb	BBB- to BBB+	BBB	bbb-/bb+	BB to BBB	BBB-
5%	bbb-/bb+	BB+ to BBB	BBB-	bbb-/bb+	BB to BBB	BB+

Note: Red shading indicates company-specific thresholds set at the lowest possible level under S&P's corporate rating criteria.
Green shading indicates company-specific thresholds set at the highest possible level.

14.0.7. For this reason, it is unlikely that S&P could exercise discretion to leave ratings unchanged if FFO/debt fell below published thresholds in AMP8.

14.0.8. Similarly, Moody's downgraded United Utilities to Baa1 from A3 on 29 January 2025 because of net debt/RCV above the A3 threshold, even though it expected that "UU will maintain an average adjusted interest coverage ratio (AICR) of 2.1x over the AMP, well above minimum guidance for the new rating levels of 1.6x." There is no indication in this or other recent actions that Moody's is "trading off" strength on one metric against weakness in another.

15. Appendix 4: MFMs

15.0. Methodology and assumptions underpinning CoE estimation based on the q-factor model

15.0.1. This section sets out the methodology and data used for the estimation of q-factor CoE.

I. Approach to q-factor regression

15.0.2. The regression employed for the q-factor model is specified below:

$R_{it} - R_{ft} = \alpha + \beta_{market}(R_{Mt} - R_{ft}) + \beta_{size}size_t + \beta_{inv}inv_t + \beta_{ROE}RoE_t + e_{it}$, where

1) α is the regression intercept term; and
2) R_{it} is the security or portfolio return; and
3) R_{ft} is the risk-free rate; and
4) $R_{Mt} - R_{ft}$, $size_t$, inv_t and RoE_t are the market risk premium, size, investment and RoE factor return data from the q-factor model; and
5) e_{it} is regression error term, representing the difference between the expected excess returns from the model and actual access returns.

15.0.3. The table below summarises the data sources used for the regression. The data sources used for the regression is consistent with the sources used to construct the q-factor model by Tharyan et al. (2024).

Table 63: Data sources for the q-factor regression

Variables	Data source
Security/portfolio returns (R_{it})	LSPD
Market return (R_{Mt})	The *rm* variable in Risk Factors for the UK *dailyfactors.zip* file
Risk-free rate (R_{ft}),	The *rf* variable in Risk Factors for the UK *dailyfactors.zip* file
Size factor ($size_t$),	The *size* variable in Risk Factors for the UK *dailyfactors.zip* file
Investment factor (inv_t)	The *inv* variable in Risk Factors for the UK *dailyfactors.zip* file
RoE factor (RoE_t)	The *roe* variable in Risk Factors for the UK *dailyfactors.zip* file

Source: KPMG analysis.

15.0.4. The comparators used in q-factor regression are the same as the ones used for deriving the low and high range of the BAU beta under CAPM, namely (1) equally weighted SVT and UUW, unadjusted for restrictions; and (2) PNN adjusted for the full period of Covid restrictions.

15.0.5. The table below provides the specification of methodology underpinning the regression.

Table 64: Methodology underpinning the q-factor model regression

	Assumptions	Rationale
Estimation window	10-year	Consistent with the regression window used for the BAU beta before attenuation.
Data frequency	Daily	Consistent with the methodology in estimating CAPM beta.
Averaging window	Spot	Consistent with the methodology in estimating CAPM beta. No rolling average window is used.
Cut-off date	December 31st 2024	The latest cut-off date with available q-factor data. The q-factor return data are updated when the updated LSPD return data becomes available. LSPD data are updated quarterly each year.

Source: KPMG analysis.

II. Regression results of the water portfolios based on the q-factor model

15.0.6. The table below presents regression results of the q-factor model for SVT/UUW (EW).

Table 65: Regression results of 10-year SVT /UUW (EW)

	Coefficient	Standard error	t-statistics	p-value
Intercept (α)	0.000	0.000	0.51	0.609
Market risk premium	0.609***	0.0251	24.26	0.000
Size	-0.283***	0.036	-7.89	0.000
Investment	0.029	0.049	0.60	0.548
RoE	0.338***	0.042	7.97	0.000

Source: KPMG analysis using LSPD and Risk Factors for the UK data.
Note: * is significant at the 10% level, ** at the 5% significance level and *** at the 1% level.

15.0.7. The p-value of the F-statistics is 0.00%, suggesting that the factors jointly explain the returns of the water portfolio.

15.0.8. The regression results suggest that the water portfolio (SVT/UUW) has positive and statistically significant exposure to the market and RoE factors, offset somewhat by the negative and statistically significant exposure on the size factor. Critically, the positive loading on the RoE factor does not stem from the historical profit levels of the regulated utilities. A positive loading on the RoE factor means a company is exposed to the additional risk (relative to the CAPM) which is best proxied by the RoE premium. This could indicate for example that a certain level of profitability is expected for investors to commit capital into a stock given its risk exposure.

15.0.9. The table below presents regression results of the q-factor model for PNN, controlling for the Covid restriction periods. RES is the Covid restriction dummy variable covering the period between March 16th 2020 and July 19th 2021. RES multiplied by the factors, for example, RES*market risk premium, are the interaction variables between the restriction dummy variable and the factors, which captures the impact of the full period of Covid restrictions on the factor loadings.

Table 66: Regression results of 10-year PNN, controlling for the impact of Covid restriction

	Coefficient	Standard error	t-statistics	p-value
Intercept (α)	-0.000	0.000	-0.62	0.535
Market risk premium	0.759***	0.037	20.61	0.000
Size	0.134**	0.053	2.53	0.011
Investment	0.088	0.065	1.35	0.176
RoE	0.351***	0.058	6.02	0.000
RES	0.001	0.001	1.07	0.287
RES*Market risk premium	-0.327***	0.068	-4.82	0.000
RES*size	-0.754***	0.095	-7.95	0.000
RES*investment	-0.155	0.156	-1.00	0.320
RES*RoE	-0.053	0.129	-0.41	0.680

Source: KPMG analysis using LSPD and Risk Factors for the UK data
Note: * is significant at the 10% level, ** at the 5% significance level and *** at the 1% level.

15.0.10. The p-value of the F-statistics is 0.00%, suggesting that the factors jointly explain the returns of PNN.

15.0.11. Compared to SVT/UUW portfolio, PNN has a positive exposure to the size factor, which suggests that its exposure to the size factor is similar to a small-size portfolio. The company's exposure to the market risk premium and RoE factors are also positive and statistically significant. In addition, the interaction variable on market risk premium suggests that the impact of Covid restriction on the market beta of PNN is negative and statistically significant. The restriction also has a negative and statistically significant effect on the company's exposure to the size factor.

15.0.12. Overall, the results suggests that the additional factors in the q-factor model are helpful in explaining the returns of the water companies, both individually and jointly. The market beta in the CAPM is also significant, as expected.

III. Calculation of q-factor CoE

15.0.13. Table 67 outlines the assumptions underpinning the calculation of cost of equity using q-factor model.

15.0.14. The excess return of a stock is calculated using the product of the factor premia and factor loadings. As the actual gearing for comparators differs from notional gearing, the Harris-Pringle formula is used to de- and re-lever factor loadings. The excess returns thus derived are then added to the RfR point estimated used in this Report to arrive at a CoE estimate.

Table 67: Assumptions underpinning the calculation of cost of equity using q-factor model

	Assumptions	Rationale
Factor loadings	Derived based on the regression models specified in Table 65 and Table 66	See above
Factor premia	The market risk premium uses the same point estimate of TMR (6.93%) in this Report. The risk-free rate is based on the same methodology used to derive the point estimate of this report as of December 2024 cut off (2.40%)	Consistent assumptions on TMR and RfR as CAPM to ensure a direct and consistent comparison between the CAPM and q-factor models.
	The premia for the additional factors are the long-term average annualised factor premia from FY1980/81 to FY2023/24 converted to CPIH real term.[359] The factors are downloaded from Risk Factor website[360].	Consistent with the approach used for TMR to use a long-term window. FY1980/81 is the furthest window to go back for these factor premia.
Inflation rate used to deflate the additional factor premia	CPIH back-cast series[361] used to deflate nominal factor premia (1980 – 2024)	Consistent with the series used for the estimation of TMR
Observed gearing	Average net debt to RCV of the water portfolio	Consistent with the gearing calculation used in CAPM
Notional gearing	55%	Consistent with the notional gearing used in CAPM

Source: KPMG analysis

359 The long-term annualised factor premia (CPIH, real) of size, investment and RoE are 1.45%, 5.58% and 1.87%.

360 Download the dataset from the annualfactors.zip file in the factor data section of Risk Factors for the UK.

361 From 1980 to 88: ONS (2022) Consumer price inflation, historical estimates and recent trends, UK: 1950 to 2022, Figure 1; From 1989 onwards: CPIH INDEX 00: ALL ITEMS 2015=100 - Office for National Statistics.

15.1. Tharyan et al. (2025), An investigation of multi-factor asset pricing models in the UK

An investigation of multi-factor asset pricing models in the UK

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Abstract

There has been little recent research into asset pricing models in the UK. This is perhaps surprising given the importance of asset pricing models in the regulated utility sector. Further, there is, at the time of writing, no up-to-date UK equivalent to Ken French's US data library or the q-factors available on Global-q.org. The purpose of this paper is to test the CAPM, Fama-French 5 factor (FF5F), and Hou et al. (2015) q-factor models in a UK setting, and further to provide freely downloadable data for all these models. Our principal finding is that whilst both these multi-factor models subsume the CAPM, the q-factor model performs better in spanning tests than the FF5F.

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We are extremely grateful to Mike Staunton of London Business School for providing us with data allowing us track changing SEDOL and Datastream codes with the LSPD Share Price Database. We are also grateful to KPMG for their assistance in data gathering, and for agreeing to support the ongoing updating of the factor data. The usual caveats apply, and we take sole responsibility for any errors or omissions in this paper.

Data

Factor data and test portfolios are available at: https://www.northumbria.ac.uk/about-us/academic-departments/newcastle-business-school/nbs-research/responsible-business/risk-factors-for-the-uk

An investigation of multi-factor asset pricing models in the UK

Introduction

To date, tests of UK asset pricing have yielded somewhat unpromising results. Gregory, Tharyan and Christidis (2013) find that both the Fama and French 3 and 4 factor models are not robust in the UK, though suggest that extending these basic models by including the factor decompositions suggested by Fama and French (2011) and Cremers et al. (2013) lead to a modest improvement in performance. Since then, Nichol and Dowling (2014) test a version of the Fama and French (2014) five factor model (hereafter FF5F) finding it to be a modest improvement over the three-factor model, a result which they describe as "the least bad" model for the UK. Foye (2018) conducts some Fama-MacBeth tests of both the three factor and the FF5F model in the UK over the period October 1989 to September 2016 but do not conduct spanning tests. However, to date there appears to have been no attempt to test the Hou et al. (2015) q-factor model in the UK and compare the performance of the Capital Asset Pricing Model (CAPM), the FF5F, and the q-factor model. We include the CAPM because of its central importance in UK regulated industries.[3] We do not test the Hou et al. (2018) q5 model because the construction of the model requires quarterly earnings which are unobservable for the UK.

We find some support for both models, and clearly either is more robust than the CAPM. However, in spanning tests the q-factor model out-performs the FF5F model, a result similar to that found for the US in Hou et al. (2021). Following Gregory et al. (2013), we also test alternative versions of both models using the Cremers et al. (2013) proposal of value-weighting the underlying portfolios whilst constructing the factors. Perhaps surprisingly given earlier results, we find that the simple averaging method of constructing factors out-performs the value constructing methods in our spanning tests. However, we do not explore the different approaches to factor portfolio construction explored in Michou, Mouselli and Stark (2014), who show that inferences on SMB and HML factors can vary depending on the method chosen.

[3] For a detailed discussion and explanation, see Gregory et al. (2018)

Our basic conclusion is that both the q-factor model and FF5F models show advantages over the CAPM. Given this result, we provide factors for both models on the Northumbria website[4] and also provide information on test portfolios. We hope this data will be of value to academic researchers and also to practitioners.

The models explained

We start with an intuitive explanation of these models and how they came into existence. The earlier 3 and 4 factor versions of the Fama-French (1995,1996) models amount to little more than the conjecture that in rational markets, if book-to-market or momentum appear to be "priced" then they must be proxies for unobservable risk factors.

In both the development of the q-factor model and the FF5F, as the literature evolved attention has paid to the valuation function of the firm, although it must be said that with little or no acknowledgement to the accounting literature, summarised and formalised in Peasnell (1982), following the basic framework was set out in Edwards and Bell (1961).

Both models start with a basic dividend discount model:

$$\boldsymbol{M_0} = \sum_{t=1}^{\infty} \frac{\boldsymbol{D_t}}{(\mathbf{1}+\boldsymbol{r})^{\boldsymbol{t}}}$$

This basic and fundamental model says that any firm is worth the present value of its "dividend" stream (defined as being any cash flow between the firm and its shareholders, including buybacks and new equity issues) in perpetuity, where r is the required rate of return. Now suppose two firms have identical valuations but different expected dividend streams. Say Firm A has expected dividends 10% higher than Firm B, but has the same valuation. How can this be explained if markets are rational? Quite simply, firm B must be more risky, i.e. r must be higher, and since in rational markets only systematic risk will be priced, Firm A has higher systematic risk.

[4] https://www.northumbria.ac.uk/about-us/academic-departments/newcastle-business-school/nbs-research/responsible-business/risk-factors-for-the-uk

We can take this further, following Peasnell (1982). Dividends are earnings minus reinvestment, so provided earnings are "clean surplus", the dividend discount model is equivalent to:

$$\boldsymbol{M_0} = \sum_{t=1}^{\infty} \frac{(\boldsymbol{Y_t} - \boldsymbol{dB_t})}{(\boldsymbol{1} + \boldsymbol{r})^{\boldsymbol{t}}}$$

Where Y_t denotes earnings in year and dB_t is the change in book value at time t, i.e. $B_t - B_{t-1}$

Extending the logic above, suppose Firm A has higher profits (earnings) than Firm B, but both have the same investment, so that Firm A's higher dividends stem directly from the fact it earns higher profits than firm B. It must again be the case that the higher profitability of Firm A is being discounted by markets, because its characteristic feature is that it carries more systematic risk.

The important feature here is that it is *not* the profitability that is the source of the risk. Rather, it is the fact that there is some unobservable feature of Firm A which is causing markets to demand a higher rate of return from investing in it. In essence, this is the same dilemma associated with the presence of a positive return to the HML factor in the Fama-French 3-factor model. We assume that HML is correlated with some unobservable risk factor, but we do not know exactly what that risk factor might be.

Now suppose we have a third firm, Firm C. Firm C has identical dividends to Firm A (i.e. the dividends are 10% higher than Firm B) but an identical valuation to Firms A and B. However, earnings are identical to those of Firm B, but this time the higher dividends flow from the fact that investment, dB_t, is lower than that of Firm B, and so even though it needs to plough back less of its earnings, there is something about Firm C that is fundamentally more risky than Firm B, and so investors demand a higher rate of return/cost of capital, r. Again, it is not the *investment* that is risky – it is the fact that somehow Firm C has an unobservable risk factor that causes markets to discount the benefits of that lower investment.

The above provide all the intuition necessary to derive the q model. The FF 5 factor model adds a further dimension, which is the market to book ratio. Dividing the above expression through by B0, the book value at time 0, yields:

$$\frac{M_0}{B_0} = \sum_{t=1}^{\infty} \frac{(Y_t - dB_t)/(1+r)^t}{B_0}$$

The logic is similar to the above. Firm B would have a higher market to book ratio than either A or C, so flipping the ratio (i.e. book to market) implies that low book to market stocks have lower risk than high book to market stocks.[5]

One might argue that the market to book ratio is redundant given the above arguments on profit and investment. Indeed, that is precisely what Hou et al. argue. Furthermore, as we shall show later, our empirical analysis finds the book to market factor(as measured by the HML factor based on sorts on book-to-market and size) is irrelevant.

Finally, both q and FF5F models ask the question whether these factors are priced in *addition* to the CAPM. In essence they are both extended CAPMs, so another way of thinking about this is to imagine that in the above examples A, B and C have identical CAPM betas. If their required rates of return, *r*, are different but their CAPM betas are identical there must be some systematic risk component that the CAPM is missing.

In detail, the models we investigate are as follows:

First, the simple CAPM:

$$R_i = R_{ft} + \beta_i(R_{mt} - R_{ft}) + \varepsilon_{it} \qquad (1)$$

The second model is the FF5F model, which is:

$$R_i = R_{ft} + \beta_i(R_{mt} - R_{ft}) + s_i SMB_t + h_i HML_t + c_i CMA + r_i RMW_t + \varepsilon_{it} \qquad (2)$$

Where, R_i is the return on an asset/portfolio *i*, the first term in parentheses is the usual CAPM market risk premium, where *Rm* is the return of a broad market index and R_f is the risk free rate of return, and *SMB*, *HML*, *CMA* and *RMW* are respectively size (small minus big),"value" (high minus low book-to-market), investment (conservative minus aggressive investment) and profitability (high minus low operating profit) factors formed from six portfolios formed from inter-acting three size and two book-to-market (BTM), investment and profitability portfolios.

[5] The reason for inverting the ratio is that book: Market is continuous through zero whereas market: book is not. Book values can be negative but market values are at worst zero.

The third model we investigate is the four-factor q-factor model of Hou et al (2014):

$$R_i = R_{ft} + \beta_i(R_{mt} - R_{ft}) + s_i SIZE + j_i INV_t + r_i ROE_t + \varepsilon_{it} \quad (3)$$

Where *SIZE* is a size factor (small minus large), *INV* is an investment factor (low minus high) and *ROE* is a profitability factor (high minus low).

Following Hou et al. (2015) we construct the q-factors from a triple 2-by-3-by-3 sort on size, investment and return on equity. Note that this sorting methodology differs from that of Fama and French, who use 2 x 3 sorts.[6]

In both the q-model and the FF5F model, the portfolio construction method is to equally weight the underlying (value-weighted) portfolios. One potential problem with this, identified by Cremers et al. (2013), is that the effect is to give a "disproportionate" weight to smaller stocks. We therefore investigate the alternative of forming the factors by value weighting the underlying (value-weighted) portfolios rather than using equal weighting. This gives us four basic models to test: the q-model, the FF5F model and the value weighted versions of these models, which we denote V-q and V-FF5F.

Method and Data

Specifically, our methodology differs from that of Gregory et al. (2013) in that our portfolio formation date has changed to follow the US approach. In Gregory et al. 2013, because of the commonality of March year ends in the UK, end September year *t* market data was matched with March year *t* accounting data. However, there appears to be a distinct trend towards December year end accounting in the UK, and so we now follow the approach standard in the US literature.[7] In that literature, median NYSE market equity is used to partition NYSE, Amex and NASDAQ stocks into large and small groupings. Given there is no UK equivalent, we follow the approach used in Gregory et al. (2013) and use the largest 350 firms as a proxy for the NYSE equivalent. Ideally, we would use FTSE membership but there are two problems with this. First, the FTSE

[6] On Global-q.org, Hou at al. claim that "In particular, sorting on investment and Roe jointly helps orthogonalize the two factors."

[7] Agarwal and Tafler (2008) note that 22% of UK firms had a March year end with 37% having a December year end. In 2010, the final year of the Gregory et al. (2013) sample, the proportions are 19% March and 48% December. By 2023 these proportions are 17% March and 50% December. The next most common months were June and September each with 7%.

350 did not exist at the start of our sample period. Second, the LSPD does not record individual membership on a year-by-year basis, and so we construct a "Pseudo FT350" by ranking all stocks by market capitalisation at the end of June each year. We then use the median Pseudo350 market value of equity to split our entire sample two groups, small and big. Independently, at the end of June of year t, we break all stocks into book to market, investment and profitability groups using the Pseudo350 breakpoints for the low 30%, middle 40%, and high 30% of the ranked values of each of these variables for the financial year ending in calendar year $t - 1$.

The difference between the FF5F and q-factor models is firstly the way that size is interacted with the break-point portfolios. Second, although investment is identical, the profitability factor differs. Fama and French base their *RMW* factor on operating profit divided by opening book value, whereas Hou et al. use net income before extraordinary items divided by opening book value. Note that Hou et al. use quarterly data in forming their portfolios. Unfortunately, neither quarterly nor even semi-annual data is available on a consistent basis for the UK back to 1980, so here we use only annual financial data throughout.

The detailed factor construction methods are described in Figure 1:
Figure 1 about here

Our data comes from several sources. First, all stock returns and market capitalisation data are from the LSPD. Accounting data come from a variety of sources. Our initial data source is Datastream, but we find Datastream has many missing values. We supplement this with data from an archived ESRC dataset[8] used in the construction of the Gregory et al. (2013) dataset, and data from Bloomberg. We used data from the LBS to assist with cross-matching codes and SEDOL numbers.[9] Note that to form the Pseudo 350 index we do not need any accounting data, so that is formed annually on the basis of the entire LSPD universe in year t. We then exclude all financials

[8] Unfortunately, this appears to be no longer available
[9] For which we are grateful to Mike Staunton – please see acknowledgements.

(including banks and investment trusts) and real estate companies[10], plus we exclude AIM stocks.

Our first formation year is 1980. A consequence of adding the archived data is that sample size is much higher in the early years. Prior to around 2005, the sample size averages just over 1,000 firms per annum. After that sample size starts to tail off and from 2009 onwards varies between about 335 and 400 firms.[11] We end in June 2024, giving a full 44 years of data.

Having formed the factors from this sample, the summary statistics are described in Table 1.

Table 1: Summary Statistics about here

These findings differ radically from those of Nichol and Downing (2014), although their analysis only covers a short period of 2002-2013. They find that profitability factors alone are significant, whereas in the above only the factors measuring investment are significantly different from zero at conventional levels, together with the CAPM market risk premium. However, the significance of both the CMA and INV factors is striking. They carry monthly premia of 0.43% and 0.45% respectively, but with a much lower standard error than the market risk premium, RMRF (mean monthly return 0.52% and standard error 0.19%). However, the SMB and SIZE factors are insignificantly different from zero, as is the HML factor. Value weighting does not alter the significance levels, although a curiosity is that the value-weighted ROE, VROE, actually becomes negative (although insignificant).

Table 2a and 2b: Correlation between equally weighted factors and value weighted factors about here

Turning to the correlations between factors, in Table 2a, for equally weighted factors all correlations are significant at the five percent level except for that between HML and SMB at 0.0114 and between SIZE and: RMRF at 0.0836; HML at 0.0726 and CMA

[10] For the usual reasons that financial ratios (particularly book to market) do not have a common interpretation between such stocks and industrial and commercial companies.
[11] Clearly this is disappointing despite our efforts to cross-match multiple data sets.

at -0.0672. While in Table 2b, for the value-weighted factors, only SIZE and HML is not significant at 0.0597. Reassuringly, the correlations for size, profitability and investment related factors between the two models are high at 0.9587, 0.8875 and 0.7286 respectively for the equally-weighted factors and higher for the value-weighted factors at 0.999, 0.996 and 0.867 respectively.

Results

We undertake several tests of these models. First, we employ spanning tests. Second, we conduct the standard GRS test from Gibbons et al. 1989. Third, we form test portfolios and test whether the models adequately explain the cross-section of portfolio returns using a GRS test.

The GRS test is widely used in empirical asset pricing when the factors are traded returns as they in the CAPM, FF5F and q-model. They are useful, as in our case, to test whether one asset pricing model dominates another asset pricing model (spanning tests) as shown in Fama & French (2015), Hou et al. (2015) and, Hou et al. (2021).

The GRS statistic tests whether the time-series intercepts (pricing errors) are all zero when excess returns on the test assets (e.g. characteristics sorted portfolios, or risk factors of an asset pricing model) are regressed against the risk factors of any particular asset pricing model. With N number of test assets, the test is whether the N intercepts are jointly indistinguishable from zero. In testing a single factor model (e.g CAPM) the GRS test proceeds by running OLS time series regressions of the form

$$Re_{i,t} = \alpha_i + \beta_i' f_t + \varepsilon_{i,t} \quad t = 1, 2, \ldots T \text{ for each } i \tag{4}$$

for each test asset portfolio i. $Re_{i,t}$ is the excess return on the test portfolio i, f_t the risk factor at time t . Under the assumption of iid normal residuals, a Wald test of the null of pricing errors being jointly equal to zero can performed. The statistic is

$$\hat{\alpha}' \, [\text{var}\ \hat{\alpha}]^{-1} \, \hat{\alpha} \tag{5}$$

In the case of a one factor model, the specific form of the statistic is

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$$T\left[1+\left(\frac{E_T(f)}{\hat{\sigma}(f)}\right)^2\right]^{-1} \hat{\alpha}' \, \hat{\Sigma}^{-1} \, \hat{\alpha} \sim \chi_N{}^2 \tag{6}$$

Where $E_T(f)$ denotes the sample mean of the factor, $\hat{\sigma}(f)$ denotes the sample variance and $\hat{\alpha}$ is a vector of estimated intercepts. $\hat{\Sigma}$ is the residual covariance matrix and T is the number of time periods. The finite sample test statistic developed by GRS is then

$$\frac{T-N-1}{N}\left[1+\left(\frac{E_T(f)}{\hat{\sigma}(f)}\right)^2\right]^{-1} \hat{\alpha}' \, \hat{\Sigma}^{-1} \, \hat{\alpha} \sim F_{N,T-N-1} \tag{7}$$

With K factors, the GRS statistic generalises to

$$\frac{T-N-K}{N}\left[1+E(f)'\hat{\Omega}^{-1}E(f)\right]^{-1} \hat{\alpha}' \, \hat{\Sigma}^{-1} \, \hat{\alpha} \sim F_{N,T-N-K} \tag{8}$$

Finally, following Hou et al. (2021) we test the alphas on a "hedge" portfolio formed by the difference in returns between top decile of our test portfolio and the bottom decile. Here, we are testing for whether the alpha on the long-short portfolio is significantly different from zero or not.

In all our tests above, we base our conclusions assuming a significance level of 5%, unless otherwise mentioned.

Spanning Tests

We start with a simple explanation of why spanning tests are relevant. Suppose we have a simple model (the CAPM, say) and an enhanced multi-factor model. The question that spanning tests address is whether the simple model can fully explain (or "price") the factors in the more complex model. This is tested by examining whether the alphas from regression of the multi factors on the market risk premium (the return on the market minus the risk free rate, RMRF) are jointly zero.

The spanning tests we employ follow those in Hou et al. (2019, pp 9-15), but given the UK regulatory interest in the CAPM we also test whether the CAPM can explain the factor premia on the FF5F and q-factor models. Additionally, we conduct the standard GRS tests that alphas from the explanatory regressions are jointly zero.

Table 3: Explaining the FF5F factors -about here

In Panel A, turning first to the explanatory power of the CAPM, whilst we cannot reject the hypothesis that the CAPM can explain the SMB, HML and RMW factor premia, it is clear that it totally fails to capture the FF5F investment premium, CMA. We also note from Table 1 that this premium is large and highly significant in the UK.

When it comes to pricing the FF5F factors using the q-model, the q-model subsumes the HML (alpha = -0.001, t-statistic = -0.290), and RMW (alpha = -0.001, t-statistic = -1.76), factors, but cannot fully price the CMA factor (alpha = 0.001, t-statistic = 2.15). The alpha is far smaller than under the CAPM (0.001 vs 0.005), and explanatory power far greater (0.858 vs 0.023), but the significant alpha shows that the factor is not fully explained by the q-factor model.

Perhaps not surprisingly, the q-factor size factor has a highly significant role in explaining the SMB factor. As we shall see below, the reverse is also true. Both models are able to price each other's size factors. This has important implications for the GRS tests of the hypothesis that pricing errors are jointly zero and so we also test the hypothesis that pricing errors on the remaining factors are jointly zero.

In Panel B, we show the GRS tests of whether the FF5F alphas, as explained by the CAPM, are jointly zero. With a GRS test statistic of 6.309 we can reject the hypothesis that alphas are jointly zero, meaning that the FF5F factors add explanatory power to the CAPM. Whilst the FF5F model subsumes the CAPM, it cannot explain the pricing of all the q-factor model factors (p=0.10). Finally, following Hou et al. (2019), we test whether the pricing of the HML, CMA and RMW factors are jointly zero (p=0.056). This shows that the FF5F factors are jointly explained by the q-model.

We now investigate whether the FF5F model can explain the q-factor model premia.

Table 4: Explaining the q-model factors – about here

In Panel A, in the case of the q-model, the CAPM fails to explain the prices of both the investment factor, INV(alpha = 0.005, t-statistic = 4.82), and the profitability factor, ROE (alpha = 0.002, t-statistic = 1.98). As in the case of the FF5F model, the CAPM is completely subsumed by the multifactor q-model. Although the FF5F model can explain the INV factor (alpha = 0.001, t-statistic = 1.440), it cannot explain the ROE factor (alpha = 0.002, t-statistic = 3.21).

In Panel B, when we turn to the GRS test, we see that the q-factor model is not subsumed by the FF5F model (GRS=3.448, p=0.017). Finally, leaving aside the SIZE factor, the FF5F model cannot jointly price the INV and ROE factors (GRS 5.171, p =0.006).

In conclusion, based upon the spanning tests of the basic q-factor and FF5F models, both models are superior to the CAPM. While the q-factor model can price the FF5F factors, but the reverse is not true.

Our next group of tests examine whether a value-based version of the respective models can out-perform the equally weighted version. We initially run each model against itself, i.e. value-weighted vs equally-weighted, and *vice versa*.

Table 5: Explaining the FF5F Equally weighted and Value-weighted Factors – about here

In Panel A1 of the table, we show what happens when we explain the value-based versions of the factors by their equally weighted counterparts. VSMB is not fully priced (alpha > 0, t-statistic=2.06), but the other value-based factors appear to be fully priced by the equally weighted factors. In panel B, at the 5% level, we cannot reject the null hypothesis that all alphas are jointly zero (GRS = 2.370, p = 0.052).

Panel A2. of the table shows what happens when we reverse the test and examine whether the value weighted factors can price the equally weighted factors. It seems the value-weighted factors cannot explain the CMA factor (alpha = 0.001, t-statistic = 2.45). .In Panel B, we can reject the hypothesis that the alphas are jointly zero (GRS = 4.243, p = 0.002) so the value weighted version of the FF5F does not add anything to the equally-weighted version.

The conclusion, possibly surprisingly given earlier UK research, is that the basic (equally weighted) version of the FF5F model is superior to the value weighted version. Given this conclusion, for reasons of space we do not report the full regressions for whether the V-FF5F can be explained by the V-q model, but simply report in Panel B, the GRS test for whether we can reject the hypothesis that the V-FF5F model alphas are jointly zero when explained by the V-q model (GRS = 1.669, p = 0.156). Thus, at the 5% level we cannot reject the hypothesis, whilst noting that the result is not as strong as we observe for the equally weighted versions of the model.

Table 6: Explaining the q-Model Equally-Weighted and Value-Weighted Factors – about here

We now run the same tests in relation to the value-weighted and equally weighted versions of the q-model. Panel A1 of Table 6 shows clearly that the equally-weighted version has no problem in pricing any of the value-weighted factors. There are no significant alphas in the regression and in Panel B, the GRS test shows we cannot reject the hypothesis that the alphas are jointly zero. However, the value-weighted factors cannot price the equally weighted factors. It seems clear, therefore, that the equally weighted version of the model is the preferred version. Finally, for completeness In Panel B, we report the test of whether the V-q model factor alphas are jointly zero when priced by the V-FF5F model and (GRS = 3.196, p=0.023) shows we can reject the hypothesis.

Having shown that the basic i.e. equally weighted, versions of both models are preferred, we now proceed to further test these models.

GRS Tests

Following Gregory, Tharyan and Christidis (2013) we conduct GRS tests on value-weighted decile portfolios formed on the following bases:

The investment ratio ((ta1-ta2)/ta2), which is the same measurement of investment ratio as employed by the q-factor and FF5F models; the standard deviation of annual returns calculated over the previous 12 months; market capitalisation; book-to-market and momentum.

The second and fifth of these are chosen because they are completely neutral in terms of model construction (Llewellen et al., 2010), and the former features as a UK test portfolio in Gregory et al. (2013), whereas the first, third feature in the construction of both the q-factor and FF5F models, whilst the fifth features in the construction of the FF5F model but not the q-factor model.

As in Gregory et al. (2013) we base our tests on larger firms only, that is firms that are members of our "Pseudo 350" universe. To save space, we do not report the individual regressions in detail, but simple report the p-values from the GRS tests.

Table 7: Results of GRS tests on test portfolios formed by deciles – about here

It is not untypical for models to struggle with pricing test portfolios other than book-to-market sorted portfolios, and this is largely what we observe here. All the models perform well in explaining the book-to-market sorted portfolios. However, reassuringly, in our tests, the q-factor and FF5F models perform well in pricing the standard deviation sorted portfolios. The CAPM however fails at the 5% level.

Performance on Momentum sorted portfolios is problematic and all the models fail this test at 5% level. We do not report full results using value-weighted factors given the discussion above, but in general results are qualitatively similar.

Interestingly, *all* the models struggle with value-weighted size portfolios. In all cases the problem is caused by an inability to price the extreme portfolios, i.e. the smallest and largest portfolios.

Finally, the CAPM cannot price portfolios sorted on investment ratios.

Alpha tests

We include tests of the alphas on hedge portfolios formed from the above test portfolios, as this is an approach that seems to be favoured in the UKRN (UK Regulators Network) response, and it also features in the anomalies tests conducted in Hou et al. (2021). In each case the test is conducted on a hedge (long-short) portfolio of top decile minus bottom decile.

Table 8: Alpha tests on hedge portfolios – about here

Table 8 confirms that the CAPM is unable to price the hedge portfolio formed on the basis of the investment ratio. Interestingly, the smallest alpha results from the FF5F model although the alphas are not significant at the 5% level in the case of either the q-model or the FF5F model.

The alphas are not significant for any model in the case of the Standard Deviation portfolios, but we note that the alphas are far lower in the case of the factor model, and the adjusted R-squared is much higher. On momentum, whilst at first glance the CAPM does surprisingly well in pricing the hedge portfolio, the F-statistic shows the regression is simply insignificant.

Finally, despite failing the GRS tests, all three models seem able to price the large minus small hedge portfolio. Again, though, the alphas are smaller with the factor models, and the adjusted r-squared much higher (although this is hardly surprising given they include a size factor.

Conclusion

Testing the models over a 44 year period (1980-2024) suggests that either the FF5F model or the q-factor model has better explanatory power when pricing the cross-section of larger UK stock returns than does the CAPM. However, when subjected to spanning tests, the q-factor model can explain the FF5F factors, but the reverse is not true, leading us to prefer the q-factor model. An additional reason for this preference is that the HML factor appears to be redundant in the FF5F model, both from a theoretical point of view, in so far as it is unnecessary in the pricing equation, and from an empirical point of view. Thus, the q-factor model may be viewed as a more parsimonious and effective model. However, the insignificance point is true of the size premia in both models, and again we note that there is nothing in the pricing expression that requires a size premium to be present. By contrast, this pricing expression requires both investment and profitability to be present in some form.

Nonetheless, despite these arguments we make factors and portfolios available for both models, with the aim of encouraging future research into UK asset pricing in general.

It may be the case that models can be improved upon by either decomposing factors, or conditioning factors as discussed in Cremers et al. (2013), but we have shown that value-weighting factors results in weaker models than equally weighting factors. Alternatively, it may be that conditional models may perform better. For example, Fletcher (2010) finds that a conditional version of the FF model is the best performing model in his range of tests, although it performs poorly in out of sample tests. Finally, it is possible that the choice of factor construction methods influence the results. In this regard, we note that Michou et al. (2014) have shown alternative methods for constructing SMB and HML factors can affect inferences. We leave these considerations for future research, but hope that by providing a comprehensive set of factor data and test portfolio data we can facilitate such research in general.

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Table 1: Summary Statistics

Factor	Mean	Std Error	Significance
RMRF	0.52%	0.19%	***
SMB	0.11%	0.14%	
HML	0.20%	0.15%	
CMA	0.43%	0.10%	***
RMW	-0.16%	0.10%	
SIZE	0.11%	0.12%	
INV	0.45%	0.10%	***
ROE	0.15%	0.10%	
VSMB	0.16%	0.14%	
VHML	0.26%	0.17%	
VCMA	0.46%	0.13%	***
VRMW	-0.24%	0.14%	
VSIZE	0.15%	0.14%	
VINV	0.47%	0.13%	***
VROE	-0.13%	0.14%	

The Table shows means and standard errors for the following variables on a monthly basis: RMRF is the return on the FT All Share Index minus the Treasury Bill Rate. SMB, HML, CMA and RMW are the Fama French 5 factors, respectively: Small Minus Big, High book to market Minus Low book to market; Conservative investment Minus Aggressive investment, and Robust profitability Minus Weak profitability. All Fama French factors (except SMB) are formed by two-way sorts on size (large, small) and the variable of interest, giving 6 underlying value-weighted portfolios for each variable. SIZE, INV and ROE are the q-factor variables, respectively; small minus large, low investment minus high investment, and high return on equity minus low return on equity. In the q-factor model all portfolios are inter-acted and sorted on size, giving 3 x 3 x 3 x2 underlying value-weighted portfolios. In the basic models, these underlying portfolios are equally weighted in forming the factors. VSMB, VHML, VCMA, VRMW, VSIZE, VINV and VROE show the factor means and standard errors when the portfolios are value weighted rather than equally weighted. N=528 monthly observations.*** denotes significance at 5% level.

Table 2a: Correlations between equally weighted factor variables

Variable	RMRF	SMB	HML	CMA	RMW	SIZE	INV	ROE
RMRF	1							
SMB	0.1201	1						
HML	0.1262	0.0114	1					
CMA	-0.1587	-0.1006	0.4426	1				
RMW	-0.0948	-0.1648	-0.5363	-0.4263	1			
SIZE	0.0836	0.9587	0.0726	-0.0672	-0.1596	1		
INV	-0.1623	-0.1908	0.3688	0.8875	-0.2461	-0.1402	1	
ROE	-0.1736	-0.1863	-0.4538	-0.1655	0.7286	-0.1546	0.1054	1

Table 2b: Correlations between value weighted factor variables

Variable	VRMRF	VSMB	VHML	VCMA	VRMW	VSIZE	VINV	VROE
RMRF	1							
VSMB	0.1239	1						
VHML	0.132	0.0602	1					
VCMA	-0.1578	-0.1467	0.2916	1				
VRMW	-0.1108	-0.2879	-0.5381	-0.3872	1			
VSIZE	0.124	0.9996	0.0597	-0.1481	-0.2886	1		
VINV	-0.1512	-0.1348	0.2843	0.9971	-0.3787	-0.136	1	
VROE	-0.1357	-0.2636	-0.5752	-0.3332	0.8671	-0.2625	-0.3263	1

Table 3: Explaining the FF5F factors

Panel A

Factor	Alpha	RMRF	SIZE	INV	ROE	Adj R^2
SMB	0.001	0.086				0.013
	(0.520)	(2.780)				
	0.000	0.020	1.028	-0.067	-0.040	0.924
	(0.740)	(2.240)	(76.850)	(-4.110)	(-2.440)	
HML	0.002	0.101				0.014
	(1.000)	(2.920)				
	0.000	0.090	0.064	0.652	-0.707	0.392
	(-0.290)	(3.200)	(1.510)	(12.770)	(-13.550)	
CMA	0.005	-0.085				0.023
	(4.710)	(-3.690)				
	0.001	-0.032	0.019	0.886	-0.266	0.858
	(2.150)	(-3.540)	(1.420)	(54.160)	(-15.900)	
RMW	-0.001	-0.050				0.007
	(-1.310)	(-2.180)				
	-0.001	-0.007	-0.073	-0.331	0.742	0.642
	(-1.760)	(-0.460)	(-3.400)	(-12.730)	(27.920)	

Panel B

Test	FF5F	FF5F	HML,CMA, RMW
by	CAPM	q	q
GRS	6.309	1.953	2.534
p	0.000	0.100	0.056

The Table shows regressions of the Fama-French factors on the q-model factors together with a GRS test of the hypothesis that all alphas are jointly zero. Variables are: RMRF, the return on the FT All Share Index minus the Treasury Bill Rate. SMB, HML, CMA and RMW are the Fama-French factors respectively: Small Minus Big, High book to market Minus Low book to market; Conservative investment Minus Aggressive investment, and; Robust profitability Minus Weak profitability. SIZE, INV and ROE are the q-factor variables, respectively; small minus large, low investment minus high investment, and high return on equity minus low return on equity. t-stats in parentheses. GRS is the GRS test statistic and p is the GRS test p-value. N=528 monthly observations

Table 4: Explaining the q-model factors

Panel A

Factor	Alpha	RMRF	SMB	HML	CMA	RMW	Adj R^2
SIZE	0.001	0.055					0.005
	(0.640)	(1.920)					
	0.000	-0.026	0.891	0.074	0.005	0.057	0.925
	(0.320)	(-3.140)	(78.570)	(5.990)	(0.310)	(3.090)	
INV	0.005	-0.089					0.025
	(4.820)	(-3.770)					
	0.001	0.002	-0.054	0.030	0.955	0.168	0.814
	(1.440)	(0.200)	(-3.650)	(1.900)	(41.060)	(6.890)	
ROE	0.002	-0.093					0.028
	(1.980)	(-4.040)					
	0.002	-0.027	-0.030	-0.098	0.196	0.728	0.572
	(3.210)	(-1.710)	(-1.350)	(-4.090)	(5.670)	(20.110)	

Panel B

Test	q	q	INV, ROE
by	CAPM	FF5F	FF5F
GRS	9.307	3.448	5.171
p	0.000	0.017	0.006

The Table shows regressions of the q-model factors on the Fama-French model factors together with a GRS test of the hypothesis that all alphas are jointly zero. Variables are: RMRF, the return on the FT All Share Index minus the Treasury Bill Rate. SMB, HML, CMA and RMW are the Fama-French factors respectively: Small Minus Big, High book to market Minus Low book to market; Conservative investment Minus Aggressive investment, and; Robust profitability Minus Weak profitability. SIZE, INV and ROE are the q-factor variables, respectively; small minus large, low investment minus high investment, and high return on equity minus low return on equity. t-stats in parentheses. GRS is the GRS test statistic and p is the GRS test p-value. N=528 monthly observations

Table 5: Explaining the FF5F Equally weighted and Value-weighted Factors

Panel A1

Factor	Alpha	RMRF	SMB	HML	CMA	RMW	Adj R^2
VSMB	0.000	0.000	1.023	0.010	0.009	-0.063	0.994
	(2.06)	(0.15)	(272.63)	(2.44)	(1.59)	(-10.32)	
VHML	0.001	-0.007	-0.009	1.002	-0.184	-0.197	0.828
	(1.46)	(-0.41)	(-0.36)	(39.38)	(-4.99)	(-5.10)	
VCMA	0.000	-0.001	-0.105	-0.104	1.173	-0.160	0.825
	(-0.52)	(-0.04)	(-5.64)	(-5.16)	(40.37)	(-5.28)	
VRMW	-0.001	-0.009	-0.083	0.026	0.041	1.253	0.838
	(-0.96)	(-0.66)	(-4.54)	(1.30)	(1.45)	(41.89)	

Panel A2

Factor	Alpha	RMRF	VSMB	VHML	VCMA	VRMW	Adj R2
SMB	0.000	-0.001	0.973	0.000	-0.012	0.046	0.993
	(-1.83)	(-0.38)	(253.59)	(0.12)	(-2.88)	(9.56)	
HML	-0.001	0.024	0.038	0.812	0.135	0.106	0.827
	(-0.95)	(1.62)	(1.78)	(41.74)	(5.63)	(3.91)	
CMA	0.001	-0.017	0.064	0.074	0.687	0.074	0.821
	(2.45)	(-1.66)	(4.44)	(5.61)	(42.30)	(4.07)	
RMW	0.000	-0.002	0.018	-0.039	-0.049	0.632	0.837
	(0.65)	(-0.24)	(1.29)	(-3.14)	(-3.15)	(36.39)	

Panel B

Test	V-FF5F	FF5F	V-FF5F
by	FF5F	V-FF5F	V-q
GRS	2.370	4.243	1.669
p	0.052	0.002	0.156

The first panel of the Table shows the results from regressing the equally weighted Fama French factors on their value weighted equivalents. The second panel shows the results of regressing the value-weighted factors on their equally weighted equivalents. RMRF is the return on the FT All Share Index minus the Treasury Bill Rate. SMB, HML, CMA and RMW are the Fama French 5 factors, respectively: Small Minus Big, High book to market Minus Low book to market; Conservative investment Minus Aggressive investment, and; Robust profitability Minus Weak profitability. VSMB, VHML, VCMA, VRMW, VSIZE, VINV and VROE are the factors when the portfolios are value weighted rather than equally weighted. t-stats in parentheses. GRS is the GRS test statistic and p is the GRS test p-value. N=528 monthly observations

Table 6: Explaining the q-model Equally Weighted and Value-Weighted Factors

Panel A1

Factor	Alpha	RMRF	SIZE	INV	ROE	Adj R2
VSIZE	0.000	0.023	1.059	-0.031	-0.086	0.915
	(1.14)	(2.38)	(72.09)	(-1.75)	(-4.75)	
VINV	0.001	-0.046	-0.069	0.982	-0.333	0.641
	(1.34)	(-2.44)	(-2.45)	(28.76)	(-9.54)	
VROE	-0.001	-0.020	-0.108	-0.307	1.088	0.676
	(-1.63)	(-1.05)	(-3.84)	(-8.97)	(31.17)	

Panel A2

Factor	Alpha	RMRF	VSIZE	VINV	VROE	Adj R2
SIZE	0.000	-0.018	0.864	0.011	0.059	0.913
	(-0.21)	(-2.01)	(70.95)	(0.79)	(4.51)	
INV	0.002	-0.012	-0.016	0.623	0.093	0.594
	(2.63)	(-0.78)	(-0.75)	(25.81)	(3.95)	
ROE	0.002	-0.025	0.017	0.086	0.603	0.636
	(3.17)	(-1.75)	(0.82)	(3.83)	(27.65)	

Panel B

Test	V-q	q	V-q
by	q	V-q	V-FF5F
GRS	1.519	4.361	2.712
p	0.209	0.005	0.044

The Panel A1 of the Table shows the results from regressing the equally weighted q- factors on their value weighted equivalents. The Panel A2. shows the results of regressing the value-weighted factors on their equally weighted equivalents. RMRF is the return on the FT All Share Index minus the Treasury Bill Rate. SIZE, INV and ROE are the q-factor variables, respectively; small minus large, low investment minus high investment, and high return on equity minus low return on equity. VSMB, VHML, VCMA, VRMW, VSIZE, VINV and VROE are the factors when the portfolios are value weighted rather than equally weighted. t-stats in parentheses. GRS is the GRS test statistic and p is the GRS test p-value. N=528 monthly observations

Table 7: Results of GRS tests on test portfolios formed by deciles

Test portfolio	Element	CAPM	q-factor	FF5F
Investment ratio	p-value	0.01	0.31	0.35
	Significant alphas	3	2	1
	Result	Fail	Pass	Pass
Standard Deviation	p-value	0.10	0.23	0.17
	Significant alphas	2	1	1
	Result	Pass	Pass	Pass
Size	p-value	0.03	0.03	0.01
	Significant alphas	1	2	2
	Result	Fail	Fail	Fail
Book-to-market	p-value	0.21	0.28	0.13
	Significant alphas	0	0	0
	Result	Pass	Pass	Pass
Momentum	p-value	0.09	0.04	0.05
	Significant alphas	2	2	1
	Result	Fail	Fail*	Fail

The Table shows the results from regressing decile test portfolios formed on the following bases: investment ratio (increase in total assets divided by opening assets); standard deviation; size (market capitalisation), book-to-market and momentum. For each test portfolio group we report the GRS test p-value of the null hypothesis that all alphas are jointly zero, together with the number of significant alphas.

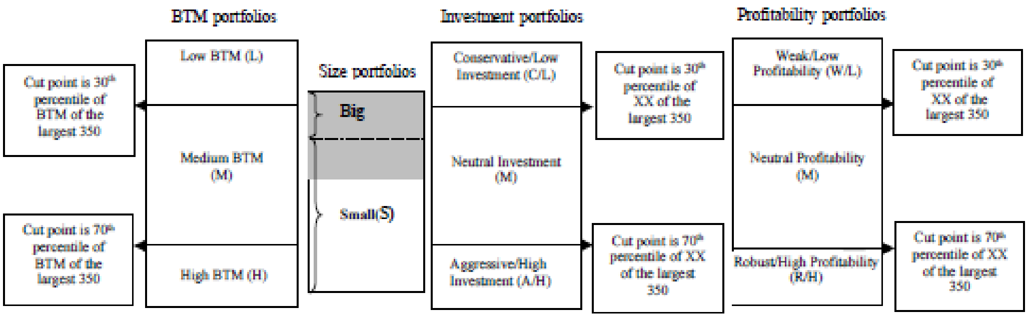
**All test results are qualitatively similar when conducted on the basis of value weighted factors, except for this result which passes at the 10% level*

Table 8: Alpha tests on hedge portfolios

Test portfolio	Element	CAPM	q-factor	FF5F
Investment ratio	alpha	-0.76%	-0.37%	-0.20%
		(-3.31)	(-1.79)	(-1.01)
	Adj R^2	0.019	0.229	0.320
Standard Deviation	alpha	-0.40%	0.08%	-0.09%
		(-1.22)	(0.28)	(-0.32)
	Adj R^2	0.139	0.357	0.356
Size	alpha	-0.23%	-0.16%	-0.12%
		(-1.19)	(-1.35)	(-1.14)
	Adj R^2	0.028	0.625	0.700
Book-to-market	alpha	0.37%	0.15%	0.15%
		(1.45)	(0.93)	(0.69)
	Adj R^2	0.009	0.602	0.300
Momentum	alpha	0.11%	0.52%	0.47%
		(0.34)	(1.65)	(1.60)
	Adj R^2	0.003	0.144	0.273

The Table shows the results from a hedge portfolio of lowest decile minus highest decile test portfolios formed on the following bases: investment ratio (increase in total assets divided by opening assets); standard deviation; size (market capitalisation); book-to-market and momentum. For each group we report the alpha, t-statistic (in parentheses) and adjusted r-squared.

Figure 1. Construction of FF5F: SMB, HML, CMA, RMW and Q-Model: SIZE, IA, ROE risk factors



Represents the largest 350 firms (pseudo-350) by 30th June market capitalisation
-------- Represents the median of the largest 350 (pseudo 350) firms by 30th June market capitalisation
Year ends are in December. All portfolios are formed annually at the end of the following June.
BTM is the book-to-market ratio. Size is the market capitalisation.
Investment: Total Assets growth for both the FF5F model and the Q-Model
Profitability : Net income before extraordinary Items for Q-Model or Operating Profits for FF5F model.

Construction of the factors:
FF5F: Independent (double) sorts on Size and BTM or Size and Investment or Size and Profitability
SMB**$_{btm}$*= (SL + SM + SH)/3 – (BL + BM + BH)/3 ; ***HML= (SH + BH)/2 – (SL + BL)/2 ;
SMB**$_{cma}$* = (SC+SA- BC-BA)/2 ; ***CMA = (SC + BC)/2 – (SA + BA)/2 ; ***RMW*** = (SW + BW)/2 – (SR + BR)/2 ;
SMB**$_{rmw}$* = (SW + SR)/2 – (BW + BR)/2 ; ***SMB = (SMB$_{btm}$ + SMB$_{cma}$ + SMB$_{rmw}$)/3

Q-Model: Independent (triple) sorts on Size, Investment and Profitability
SIZE = (SLL + SLN +SLH+SNL+SNN+SNH+SHL+SHN+SHH)- (BLL + BLN +BLH+BNL+BNN+BNH+BHL+BHN+BHH)/9
IA = (SLL + SLN +SLH+ BLL + BLN +BLH) – (SHL+SHN+SHH + BHL+BHN+BHH)/6
ROE = (SLH + SNH +SHH+ BLH + BNH +BHH) – (SLL + SNL +SHL+ BLL + BNL +BHL) /6

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Appendix 1 – List of variables and data sources.

Variables	Used in	Source	Code/Mnemonic/Formula
Book Value of Equity (bv)	q-model, FF5F	DS/BB/ESRC	DS: WC03501(equity), WC03496 (ESOP) ESRC: 305 BB: EQTY_BEF_MINORITY_INT_DETAILED
Market Capitalisation (mcap)	q-model, FF5F	LSPMA	A4
Total Asset (ta)	q-model, FF5F	DS/BB/ESRC	DS: WC02999 ESRC: 392 BB: BS_TOT_ASSET
NI before extra items	q-Model	DS/BB/ESRC	DS: WC01551 ESRC: 625, 1085, 210 BB: NET_INCOME_BEF_MI
Investment-to-Asset	q-model, FF5F	Computed	(ta1-ta2)/ta2
Operating Profits (op)	FF5F	DS/BB/ESRC	DS: WC01250 (operating income), WC01251 (interest expense), WC01266 (interest income) ESRC: 713 (operating margin), 104 (sales), 993 (operating income), 153 (interest expense), 143 (interest income) BB: IS_OPER_INC, IS_INT_EXPENSE, IS_INT_INC
Profitability_1	FF5F	Computed	op1/bv2
Profitability_2	q-model	Computed	NI before extraordinary items1/bv2
Stock Returns	q-model, FF5F	LSPMRTS	LOGRET, for G1< 9990000
Market Returns (rm)	q-model, FF5F	LSPMRTS	LOGRET, for G1=9990041
Risk-free rate (rf) – 90 day UK Treasury Bill	q-model, FF5F	LSPMRTS	LOGRET, for G1= 9990003
Equity risk premium (rmrf)	q-model, FF5F	Computed	rm - rf

Note: DS – LSEG Workspace (formerly Datastream), BB- Bloomberg, LSPMRTS-is from London Business School Stock Price Database (LSPD), G1 is the unique company identifier in LSPD.ESRC – ESRC dataset.

15.2. Responses to Mason, Robertson and Wright

Responses to Mason, Robertson and Wright

Rajesh Tharyan[1] Alan Gregory[2] and Biying Chen[3]

Alongside the Final Determination (FD) for the PR24 price control, Ofwat published, on December 19th 2024, a review[4] by Professors Mason, Robertson and Wright (MRW) of the multi-factor model analysis (MFM) submitted in response to the PR24 Draft Determination (DD).

In this note, we analyse and comment on the key points raised by MRW in relation to the MFM evidence.

The first point to note is that the updated research on MFMs, which formed the basis of the DD analysis, is now an academic paper available on SSRN[5] which is being submitted for peer review. The factor and test portfolio data used in the paper are freely available on the Northumbria University website[6]. Ofwat was made aware of the publication of the academic paper and the availability of the data by KPMG as part of responses to the regulator's queries on the analysis.

To facilitate this analysis, we, the authors, have updated and expanded the dataset previously available on the University of Exeter Xfi website. That original project was supported by the ESRC, with a grant application endorsed by the former Dean of the Business School, Robin Mason[7]. Further, this project had a letter of support from the CMA stating how useful such a dataset would be to them and other researchers. The publication of the updated MFM analysis and the associated data are, in part, a response to the ongoing demand for factor data from postgraduate students and academics[8].

The information available on Northumbria University's website is consistent with that published by Kenneth French and by Hou et al and will be updated at least annually, and more frequently as and when updates to the daily returns LSPD files permit, which means that the argument regarding implementability – specifically that "*data construction requires large amounts of data not currently available by [sic] regulators*"– is not accurate.

Unfortunately, much of the critique in MRW seems to relate to the preliminary test results submitted to Ofwat during the PR24 process before the publication of the DD. MRW fail to engage with the updated dataset and test results based on the academic version of the research. KPMG's August 2024 report explained that the dataset and the analysis had been updated and that an academic paper was available. The updated MFM datasets, including the statistical tests and the link to the SSRN paper, were provided to Ofwat in response to its data query following the DD. Therefore, both Ofwat and MRW had access to the necessary data to

[1] Associate Professor of Economics and Finance, Northumbria University.
[2] Emeritus Professor of Finance, University of Exeter.
[3] KPMG.
[4] Mason, Robertson and Wright (December 2024) *Responses to KPMG's August 2024 report on the cost of equity.*
[5] Tharyan, R., Gregory, A. and Chen, B. (2025) *An investigation of multi-factor asset pricing models in the UK*.
[6] Risk Factors for the UK.
[7] The MRW report appears to indicate a departure from Professor Mason's earlier position, as he had previously advocated for the dissemination of factor and test portfolio data.
[8] Since the original data was made available on the University of Exeter Xfi website, Professors Gregory and Tharyan have received frequent emails from postgraduate students and academics asking for more up to date data.

replicate the factor construction and statistical tests, and to conduct an updated assessment of MFMs. Despite this, MRW opted not to examine the updated datasets and statistical test results, as reflected in their statement: "*while we have not re-run the model on their updated data, on the original data we find the following point estimates for the alphas....*". Similarly, Ofwat in its FD has not considered the latest evidence on the Gibbons-Ross-Shanken (GRS) test, as implied by its comment in the FD that "*both the q-factor and CAPM models failed the GRS test*".

As is always the case with papers intended for submission and review to academic journals, we continue to refine and improve the paper and the latest version is attached to this response. Taken as a whole, this means the point that implementation of MFMs would require "*nontrivial new resources*" does not apply.

The second point we would make is that the tests proposed by MRW for an asset pricing model (in section 2 of the report) to be valid bear little resemblance to the standard tests proposed in the literature.

In essence, any asset pricing model should explain the cross-section of observed returns. The standard tests of these involve either left-hand side (LHS) tests, which examine the unexplained average returns (intercept terms) in test portfolios, or right-hand side (RHS) tests, which use spanning regressions (Fama and French, 2017). These test whether an individual factor adds to a model's explanatory power by testing whether the intercept from the spanning regression is statistically different from zero. A GRS test can be conducted to see whether multiple factors add to the base model's explanation of expected returns. For example, we can examine whether a multi-factor model adds to the explanatory power of the CAPM.

As Fama and French (2017) point out, these tests are useful for examining "nested" models of the type we investigate. The models (CAPM, q and FF5F) are "nested" as they are essentially variants of the dividend discount model (DDM), expressed in accounting variable form. This relationship between accounting variables (investment and profitability) and the DDM is rigorously examined in Peasnell (1982). The important point is that these factors *belong* in the model theoretically and are not selected at random from a "factor zoo" as claimed.

MRW, however, do not seem to engage with the standard statistical testing approach. Instead, they propose three alternative criteria, namely:

a) Any additional estimated multifactor betas must be stable and significantly different from zero;

b) The additional estimated factor risk premia in MFMs must also be stable and significantly different from zero.

c) Any additional data construction should be replicable and produce consistent estimates.

To our knowledge, no other academic paper has established these criteria as the standard for testing an asset pricing model.

Regarding criterion (a), it seems that the criterion would implicitly reject the CAPM due to the variability of the CAPM beta.[9] It seems unlikely to us that *any* asset pricing model could satisfy such a stringent hurdle.

Additionally, MRW use the consistency in the factor beta signs as a criterion to assess the stability of factor betas and consider changes in sign to be evidence of “data mining”.

We note that the factor portfolios are all *hedge* portfolios, and so by construction the expected coefficient of return (i.e. the “factor beta”) is mean zero, given that on average the returns across stocks must have a value weighted return equal to the return on the market. This, in turn, implies that firms could have either positive or negative loadings on the additional factors, and individual stock loadings can fluctuate in sign over time. Conversely, the market beta has an expected coefficient of unity which reflects the beta of the market portfolio. For any risky asset that exhibits positive correlation with the market, it is unlikely for its beta to turn negative.

We consider that the consistency in factor beta signs is not an appropriate criterion for assessing the stability of additional factors, as the CAPM market beta is unlikely to turn negative, while it is more likely for the additional factors to change sign over time.

For criterion (b), we question why this test only applies to factors additional to the CAPM. We agree that for the *price* of a factor to be relevant in an allowed rate of return model, the factor should have a non-zero mean. However, if we demand the additional property of *stability*, then fairly clearly the basic CAPM fails the test, as the market risk premium itself shows considerable variability.[10]

For criterion (c), we agree but to save researchers the trouble of reinventing the wheel every time they wish to conduct a research project, we provide both the factor data and the test portfolio data on the Northumbria University’s website. This aligns with the original objective of the ESRC-funded project, supported by Exeter University Business School.

Our substantial point here is that MRW have chosen to apply their own criteria while disregarding the spanning tests preferred in the academic literature for testing these types of models.

Our third point relates to testing using the RHS approach, the GRS test. As Fama and French (2017) point out, the problem with such models is that results are highly dependent on the test portfolios chosen. The potential candidate list for test portfolios is large, and there is room for debate regarding their formation. For instance, should test portfolios be constructed using equal weighting or value weighting? Should they be divided into deciles, quintiles or some other partition?

MRW note that the original GRS test, as presented in KPMG’s November 2022 report[11], were based on bivariate sorted quintile portfolios of size and book-to-market ratio (BTM), whereas the updated GRS test in the academic paper use decile portfolios and include additional test

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[9] See, for example the evidence submitted to the PR19 CMA appeal by Gregory, Harris and Tharyan that established structural breaks in water company betas and also highly significant variation in betas during Covid restrictions.

[10] Specifically, the UK long run real market risk premium over bonds is 5.2% with a standard error of 1.6%. (Dimson, Marsh and Staunton 2024 Table 79). Figure 153 then shows considerable time variation in these premia. This can hardly be said to be a “stable” risk premium.

[11] KPMG (November 2022) Exploring Multi-factor Models as a cross-check on allowed returns at PR24.

portfolios for investment, standard deviation and momentum. MRW further assert that "*In doing so, KPMG do not consider what the overall size and/or power characteristics of this multiple sequential testing procedure might be on overall significance levels. It is not valid to change the nature of a statistical test just because you don't like the first outcome.*" We strongly disagree with the statement from MRW, which misrepresents the updated tests.

To begin with, we refined the GRS test with the goal of adapting the analysis to meet the standard of an academic paper suitable for submission to a journal. The test portfolios in the updated version are based on well-established anomalies identified in the literature. To make the GRS test more neutral, the updated version not only includes the BTM, size and investment portfolios – factors commonly used in the construction of MFMs – but also portfolios that are completely neutral in terms of model construction (momentum and standard deviation)[12]. The inclusion of neutral portfolios is consistent with Llewellyn and Shanken (2010) and allows a fairer comparison of the model performance between the CAPM and MFMs.

Further, the move from quintile to decile portfolios gives a finer cut of the data. As such, this represents a more rigorous test for both the CAPM and the MFMs.

Regarding the results of the GRS test, although both the CAPM and MFMs produce similar test results for the size, BTM and momentum portfolios, it is noteworthy that the CAPM fails on the investment test portfolios and only marginally passes on the standard deviation portfolios at a p-value of 10%, whereas both MFMs pass the test. Although one could argue that investment test portfolios may inherently favour MFMs, the fact that the CAPM fails to price these portfolios highlights a limitation of the model, especially considering the scale of investment required from UK utilities in the future.

Fundamentally, we consider MRW fail to acknowledge the crucial point that the principal tests for nested models are the factor spanning tests, which demonstrate that the CAPM is subsumed by both the q-factor model and the FF5F model and that the q-factor model subsumes the FF5F model. The portfolio-based (left hand side) GRS test is only considered a second-order test (Fama and French (2015), Hou et al (2015), Hou et al (2021)). As such, claiming that the results do not conclusively favour the q-factor model because the CAPM gives similar GRS test results under certain test portfolios is inconsistent with academic literature.

Our fourth point is that, while the CAPM has been the foundational asset pricing model, its limitation in explaining long-run returns have been widely acknowledged by academia. For example, an event study around long-run returns would not be acceptable for publication if it solely relies upon the CAPM. Indeed, this was the very reason why the Exeter University dataset was so well-used in academic research. Our academic paper proves that *both* the FF5F and q-factor models, in both equally-weighted and value-weighted forms, subsume the CAPM. This means that both models have a better ability to explain returns compared with the CAPM. The reason the q-factor model is the preferred MFM is that, according to the spanning tests, whilst the FF5F model subsumes the CAPM, the q-factor model in turn subsumes the FF5F model. Given that the additional factors in the q-factor model subsume the CAPM, the corollary is that *excluding* these factors will result in a biased estimate of the “true” CAPM beta. Given the widespread understanding of this standard feature of the least square estimators, we were

[12] The reason why profitability is not included as test portfolios is that it is defined differently in the q-factor model and the FF5F model, and therefore, could potentially bias the results in favour of one model over the other.

surprised that MRW did not address this point in their analysis. We have included Appendix 1 to illustrate how omitted variable bias could contribute to biases in CAPM beta estimation.

The fifth point is that as academic authors, we follow the convention in the literature and test the models using monthly (not daily) data. We make daily factor data available solely out of utility to researchers who wish to use daily data for whatever purposes they may have. In all cases our returns data are from the LSPD which academics would regard as being the most reliable dataset available for the UK. Fundamentally these LSPD data form the basis of the Global Investment Returns Yearbook used by regulators.

We have confirmed with Mike Staunton[13] and reviewed the LSPD Reference Manual[14] to verify the precise calculation of returns. We are assured that irrespective of the period, returns are calculated (in log form on the LSPD monthly series, but simple return form in the daily series) as:

$$((P_t + D_t)/P_{t-1})-1$$

regardless of the accumulation period. This naturally implies a small wedge between daily and monthly returns because in the daily series the dividend is added on the *day* the share goes ex-dividend, whereas in the monthly series the dividend is effectively held in "cash" until the month end. We do not see this as a serious problem as all our statistical tests and factor premia are based on monthly data.

Furthermore, MRW assert that there are sizable differences between the aggregated daily returns and the monthly returns. In the FD Allowed Return Appendix, Annex 4, Ofwat provides an illustration showing that the percentage differences, excluding multiple outliers, have in a few cases exceed 350% for two selected companies (IDs 7024 and 7054). We have obtained the underlying data and calculations supporting Annex 4, and have identified the following issues with the calculations:

1) Ofwat compares compounded daily returns from LSPD (in simple form) with monthly returns from LSPD (in log form). This results in persistent return differences throughout the period.
2) Ofwat calculates return differences in percentage terms [(monthly returns less compounded daily returns)/compounded daily returns], which amplifies the differences compared to calculating them in simple terms (monthly returns - compounded daily returns). For example, for company 7054 as of November 1988, the compounded daily return (in simple form) is -0.00558 while the monthly return (in log form) is -0.0184. The absolute difference between the two is 0.0128 while the percentage difference, as presented by Ofwat, is 229.90%, which is significantly larger.

The sixth point is that MRW posit that, while they have not re-run the updated dataset used for the academic paper, on the original dataset they find that the unexplained component of the returns (alpha) of the water portfolio (SVT/UUW) is indistinguishable between CAPM and q-factor, and therefore, the improvement in goodness-of-fit from the q-factor model is marginal.

As academic authors, we do not offer any opinion on how a model prices individual stocks, as to do so would be to base inference on a sample of two water companies, or three if Pennon is

[13] Who has given us a good deal of help in cross-matching LSPD data with Datastream and Bloomberg, a fact we acknowledge in the paper.
[14] London Share Price Database Reference Manual (June 2024).

included. However, across the board, the q-factor model explains the cross-section of UK stock returns better than the CAPM. As such, we think that regulators and market participants should at least consider what the cost of capital might be if the model was applied.

We concur with MRW's assertion that the observed factor premia need to be statistically significantly different from zero, and that it may be questionable to reward a factor where the price of that factor is effectively zero. On this basis one might reasonably conclude that the "price" of Size and RoE is not statistically significant. However, this is obviously not the case for the Investment factor, which carries a substantial positive and significant risk premium. Note, though, that because of the interactions among factors in the regressions, simply removing the factors that are effectively priced at zero would introduce the omitted variables bias in the regressions. This bias, as discussed in the appendix, can distort the regression results.

However, we strongly disagree with MRW's observation that "*in contrast, the estimated CAPM beta in the 10-year estimation window favoured by KPMG is remarkably stable, so any changes in the implied estimate of the cost of equity are driven almost entirely by changes in assumed market risk premium, and hence in turn by the risk-free rate*." This is manifestly not the case, and as we showed (with Richard Harris) in evidence submitted to the PR19 CMA appeal, there is clear evidence of a structural break in the data in September 2014 (coinciding with PR14) and clear evidence of a structural break in the data around lockdown restrictions due to Covid.

This is such an important feature of the data that we provide a full analysis in the appendix (see Appendix 2). This clearly shows that betas cannot possibly be regarded as stable because lockdown and restriction periods have a highly significant and substantial effect on calculated betas.

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Appendix 1 – Omitted variable bias

Omitting variables which are known to price the cross section of returns from a regression constructed to predict expected returns will result in a biased estimator for the included variable (in this case the CAPM beta). The degree of this bias will depend on the regression coefficients of all the excluded variables on the included variable. This is a standard result in econometrics. It is an irrelevance whether the coefficients themselves are significant in the case of an individual stock or industry, as what matters is the covariance between the market return and the (omitted in the case of the CAPM) factor return. Formally, if the true model of returns is a two-factor model given by:

$$y = \beta_1 x_1 + \beta_2 x_2 + u$$

If the second variable is omitted and instead a single factor model (e.g. a CAPM) is used, this leads to a mis-specified model:

$$y = \beta_1 x_1 + u$$

The resultant estimate of β_1 is:

$$\hat{\beta}_1 = \frac{cov(x_1, y)}{var(x_1)}$$

Substituting the expression for the true model of y into this we get:

$$\hat{\beta}_1 = \beta_1 + \beta_2 \frac{cov(x_1, x_2)}{var(x_1)} + \frac{cov(x_1, u)}{var(x_1)}$$

Since the expectation of the third term on the RHS is zero, this reduces to:

$$E(\hat{\beta}_1) = \beta_1 + b_{21}\beta_2$$

Where b_{12} is the regression coefficient from a regression of x_2 on x_1:

$$x_2 = b_{21} x_1 + u$$

Thus, if the first factor in our model is a CAPM beta, this single factor "beta" is a biased estimator of the true beta, and the bias is given by the coefficient of the excluded variable multiplied by the regression coefficient of the excluded variable on the included variable. This is the case whatever the sign of the additional factor coefficients or whatever the mean value of the additional factor may be. This result is generalisable to either the case of the q model or the FF5F model, as suppose we have a model with n factors and only the first (say CAPM) factor is included, the CAPM estimated beta will be a biased estimator of the true beta and the bias is given by:

$$(\hat{\beta}_1) = \beta_1 + \sum_{i=2}^{n} b_{i1}\beta_i$$

An important point here is that even if some, or all, omitted factors have relatively small effects on the expected return, their cumulative impact on the bias could be substantial depending on their covariance with the market excess return factor (x_1).

Appendix 2: The Stability of Water Company betas since 2014.

MRW, in their rejection of the utility of MFMs, state "In contrast, the estimated CAPM beta in the 10-year estimation window favoured by KPMG is remarkably stable, so any changes in the implied estimate of the cost of equity are driven almost entirely by changes in assumed market risk premium, and hence in turn by the risk-free rate."

This is simply not accurate. In the first place, Gregory, Harris and Tharyan, in 3 submissions to the CMA's PR19 Appeal provided evidence on the impact of a structural break in the data around September 2014 (around PR14) and evidence that Covid restrictions imposed a highly significant downward bias on beta.

We note that in its FD, Ofwat appear to have accepted the MRW "stability" argument and made no allowance for the substantial impact of Covid on the estimated beta.

This consequence is that in ignoring lockdown effects, Ofwat would appear to have substantially under-estimated the long run beta of water companies. Additionally, the MRW claim of stability is false on two grounds. First, they ignore the 2014 break in the data shown in the reports referred to above. Second, in effect they (and Ofwat) assume that lockdowns will be a regular occurrence on a 10-year cyclical basis. Even if there were to be a further pandemic, we find it hard to believe that a lockdown response would be mandated, given the substantial damage inflicted on the economy.

In the analysis below, we use a precise timeline on lockdowns and restrictions, obtained from the Institute of Government Analysis. We then code every day according to whether a lockdown (LD) restriction was in place (LD1, LD2 and LD3) or an alternative "Tier 3" or "Tier 4" was in place (restriction periods plus lockdowns). We code these using a dummy variable = 1 if a period is subject to a full lockdown or a restriction including lockdowns. As we wish to examine the impact of restrictions/lockdowns on beta, we then multiply the dummy by the *rmrf* variable (i.e. the excess return on the market.

We start our analysis on 1st October 2014 and finish on 30th September 2024, a full 10 years of daily data. Our data are daily value weighted excess returns (i.e. return minus the risk free return) on a portfolio of UU and SVT stocks. All data are from the LSPD.

Our first regression is essentially the 10 year spot calculation made by Ofwat:

reg xsVW rmrf if date2>d(30Sep2014)

```
      Source |       SS           df       MS      Number of obs   =     2,526
-------------+----------------------------------   F(1, 2524)      =    583.22
       Model |  .085703764         1  .085703764   Prob > F        =    0.0000
    Residual |  .370901545     2,524  .00014695   R-squared       =    0.1877
-------------+----------------------------------   Adj R-squared   =    0.1874
       Total |  .456605309     2,525  .000180834   Root MSE        =    .01212
```

```
------------------------------------------------------------------------------
      xsVW | Coefficient  Std. err.      t    P>|t|     [95% conf. interval]
-------------+----------------------------------------------------------------
       rmrf |   .6052633   .0250628    24.15   0.000     .5561176    .6544089
      _cons |   .0002096   .0002413     0.87   0.385    -.0002635    .0006827
------------------------------------------------------------------------------
```

This suggests a daily 10-year beta of 0.605, slightly higher than Ofwat's allowed number, but close.

We then undertake two further regressions, the first defining the "abnormal" Covid period using the "restriction" definition described above, and the second using a "pure" lockdown definition. The results are as follows:

reg xsVW rmrf restrict restrictRmrf if date2>d(30Sep2014)

```
      Source |       SS           df       MS      Number of obs   =     2,526
-------------+----------------------------------   F(3, 2522)      =    199.70
       Model |  .087646588         3  .029215529   Prob > F        =    0.0000
    Residual |  .36895872      2,522  .000146296   R-squared       =    0.1920
-------------+----------------------------------   Adj R-squared   =    0.1910
       Total |  .456605309     2,525  .000180834   Root MSE        =     .0121

------------------------------------------------------------------------------
        xsVW | Coefficient  Std. err.      t    P>|t|     [95% conf. interval]
-------------+----------------------------------------------------------------
         rmrf |   .6532572   .0283537    23.04   0.000     .5976582    .7088562
     restrict |  -.0005745   .0009687    -0.59   0.553    -.0024741    .0013251
 restrictRmrf |  -.2127366   .0603968    -3.52   0.000     -.331169   -.0943041
        _cons |   .0002643   .0002492     1.06   0.289    -.0002242    .0007529
------------------------------------------------------------------------------
```

What this regression shows is that restriction periods are associated with a highly significant downward bias in beta of 0.213. The base estimate of 0.653 tells us that in a period free of social and lockdown restrictions, the beta of water companies would be substantially higher than the estimate of 0.605.

If we use "pure" lockdown periods the result is similar but a little stronger:

```
. reg xsVW rmrf ld LDRmrf if date2>d(30Sep2014)

      Source |       SS           df       MS      Number of obs   =     2,526
-------------+----------------------------------   F(3, 2522)      =    200.90
       Model |  .088071014         3  .029357005   Prob > F        =    0.0000
    Residual |  .368534295     2,522  .000146128   R-squared       =    0.1929
-------------+----------------------------------   Adj R-squared   =    0.1919
       Total |  .456605309     2,525  .000180834   Root MSE        =    .01209

------------------------------------------------------------------------------
        xsVW | Coefficient  Std. err.      t    P>|t|     [95% conf. interval]
-------------+----------------------------------------------------------------
        rmrf |   .6561804   .0280421    23.40   0.000     .6011925    .7111682
          ld |  -.0004091   .0010623    -0.39   0.700    -.0024923     .001674
      LDRmrf |  -.2449786   .0621521    -3.94   0.000     -.366853   -.1231042
       _cons |   .0002509   .0002474     1.01   0.311    -.0002343    .0007361
```

The net result is that in ignoring the effects of Covid, Ofwat have substantially under-estimated the true long run expected beta of water companies. The “true” long run beta is under-estimated by 0.05 to 0.06 in round numbers.

15.3. Summary of response to the key conditions set by Ofwat and its advisors on using q-factor model as a cross-check

15.3.1. The table below is a summary of response to Ofwat's commentary on the key conditions to meet the defensibility and implementability of MFMs, stated in Table 17 of the FD allowed return appendix.

Conditions set by Ofwat	Ofwat's commentary	Key response
Estimated betas must be stable and significantly different from zero	The CAPM market beta of the water companies is statistically significant and "strikingly stable" since the early 2000s, while the additional factors in MFM have changed sign over shorter regression windows which suggests that the standard errors are unreliable.	Both the market beta and the addition factor betas in the q-factor model are volatile when using shorter term regression windows, such as 2-year and 5-year window, while being relatively stable over the 10-year window. Therefore, the q-factor regression conducted in this Report adopts the 10-year regression only. In terms of statistical significance of q-factor beta, three out of four factors are statistically significant. All four factors are jointly statistically significant. Further, the consistency in coefficient sign is not an appropriate criterion as CAPM market beta has an expected coefficient mean of 1 (i.e. the beta of the market) while the additional factor portfolios are all hedge portfolio[362] with an expected coefficient mean of zero, and therefore, it's more likely for any portfolio to have changes in beta signs for the additional factor as it is closer to zero.
Estimated factor risk premia must be stable and significantly different from zero	The market risk premium has data availability of over 100 years while the UK factor excess returns are only measured since early 1980s and are only marginally statistically significant.	Early 1980s is the furthest period to go back to with comprehensive daily and monthly return and accounting data for the construction of MFM. It is a high threshold to require any factor return data to have at least 100-year data availability as the market return data. Although non-zero and positive mean should be used to assess factor premia, the stability criteria is not possible to be satisfied by CAPM market premium factor, given the volatility of market returns and RfR observed in the market.

362 Hedge portfolio is a type of portfolio constructed based on long-short portfolio. For example, the size portfolio is constructed by long small-size portfolio and short large-size portfolio.

Conditions set by Ofwat	Ofwat's commentary	Key response
Any additional data construction should be replicable, and produce consistent estimates	Data construction for the q-factor model requires large amounts of data not currently available by regulators. Ofwat considers inconsistency exists in the q-factor dataset as the aggregated daily returns it calculates is not equal to the monthly data.	The factor data for the q-factor model are freely available on Risk Factors for the UK. With the availability of this data, Ofwat could run the q-factor regression on the water portfolio in the same manner as the CAPM regression. The daily and monthly stock returns all come from the LSPD. Ofwat incorrectly compared the compounded daily returns from LSPD (in simple form) with LSPD monthly returns (in log firm), leading to persistent differences throughout the period. In addition, the direct comparison between compounded daily returns and the monthly returns could result in difference as the dividend is considered on the day the share goes ex-dividend in daily return data while it is considered at the month end in the monthly return data.
Implementability	The implementation of q-factor requires nontrivial new resources and the parameter instability in MFM betas could lead to frequent changes in cost of capital estimates.	The process of deriving beta and cost of equity using MFM is similar to the derivation of CAPM (see section 15.0). The instability of the beta and cost of equity mentioned by MRW is mostly due to the incorporation of short-term regression windows. This Report uses 10-year regression only which yields more stable results
Defensibility	The list of candidate factors in the "Factor Zoo" runs into hundreds with susceptibility of "data mining".	Unlike some other MFMs which purely focus on the empirical performance of the model, the two models examined by Tharyan et al. (2024) are established through robust theoretical principles and justifications, with q-factor model derived based on Tobin's q theory and FF5F derived from the dividend discount model in valuation theory.

Source: KPMG analysis

16. Appendix 5: Inference analysis

16.0. Comparison between the CAPM and inference analysis

16.0.1. Inference analysis is an asset pricing model used in this Report to cross-check CAPM-derived returns. The table below sets out a comparison between the CAPM and inference analysis in terms of estimation approaches and underlying intuition underpinning each model.

Table 68: Comparison between CAPM and inference analysis

	CAPM	Inference analysis (based CCZ approach)
Intuitive interpretation	Investors require higher returns for holding stocks that exhibit greater sensitivity to market movements, with the magnitude of this premium contingent upon the asset's systematic risk	Investors require higher returns for assuming the higher risk associated with holding equity – the lowest priority claim against a firm's assets and returns – compared to debt which has a higher priority. This premium is contingent upon the firm's security structure, equity volatility, and the underlying macroeconomic conditions
Formula for estimating returns	$E[r_E] = r_f + \beta_M (E[r_M] - r_f)$	$E[r_E] = r_f + \frac{\partial E/E}{\partial D/D} (E[r_D] - r_f)$ Where: $(\frac{\partial E/E}{\partial D/D})$ represents the elasticity of equity to debt and reflects the % change in the value of equity relative to the % change in the value of debt. It measures the sensitivity of equity return to debt return
Reference for pricing required equity returns	Relative to the risk and return of the wider market	Relative to the risk and return of a specific company's debt or a debt benchmark
Estimation of a company's equity risk premium	A product of market beta and market risk premium	A product of elasticity and debt risk premium
Risk factor	Market beta (β), a systematic risk factor, measures the sensitivity of a company's equity return to the changes in the overall market return. Higher sensitivity indicates higher compensation required by the investors	Elasticity $(\frac{\partial E/E}{\partial D/D})$, a relative risk factor, measures the sensitivity of a company's equity return to its debt return. Higher sensitivity implies higher compensation required by equity investors compared to the debt investors of the same company
Determinant of the risk factor	Market beta (β) is determined by: 1) the covariance between a stock's return and the market return, which can be positive, negative or zero; 2) the volatility of the stock's return relative to the market return	Elasticity $(\frac{\partial E/E}{\partial D/D})$ is determined by several factors such as risk-free rate, asset volatility, and market leverage
Regression model	Regress a stock's realised equity return on realised market return	Regress realised elasticity on risk-free rate, volatility, and market leverage which are the determinants of

	CAPM	Inference analysis (based CCZ approach)
		elasticity predicted by Merton (1974) model. Realised elasticity = $\alpha + \beta_{lev}$ leverage + β_{vol} volatility + β_{rf} risk-free rate
Regression output	Market beta (β_M)	Coefficients for realised risk-free rate, volatility, and market leverage ($\beta_{lev}, \beta_{vol}, \beta_{rf}$) To derive expected elasticity, betas from the regression are multiplied by the outturn leverage, volatility, and risk-free rate, plus α Expected elasticity = $\alpha + \beta_{lev}$ company's outturn leverage + β_{vol} company's outturn volatility + β_{rf} risk free rate

Source: KPMG analysis

16.0.2. There are clear parallels between CAPM and inference analysis, both of which adopt market-based approaches to CoE estimation by estimating a factor that reflects risks of a specific company. The key difference is that CAPM estimates required returns based on the sensitivity of a company's equity returns to market returns, whilst inference analysis considers the sensitivity of a company's equity returns to debt returns of the same company.

16.0.3. Inference analysis is thus a cross-check based on similar economic principles to the CAPM: comparing the return on water company equity to an outside opportunity. However, it applies these economic principles to a different benchmark (companies' debt rather than the market portfolio) and so depends on different inputs – exactly as desired for a cross-check.

16.1. Methodology and assumptions underpinning the estimation

16.1.1. 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).

16.1.2. The calculation of inferred CoE based on this formula requires an estimate of the expected elasticity for the water portfolio as well as estimates of debt risk premia and risk-free rate.

16.1.3. The section first outlines 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 sets out how the expected elasticity is combined with debt risk premia and risk-free rate to generate a range for the inferred CoE.

Table 69: Overview of the methodology for the estimation of inferred CoE

Data collection	Regression analysis	Calculation of inferred CoE
Data inputs based on the Campello et al. methodology include firm-level bond and stock returns – outturn elasticity, market leverage, equity volatility and risk-free rate.	• Regress outturn elasticity on market leverage, equity volatility and the risk-free rate based on the regression specified by Campello et al. • The expected elasticity is then calculated by the predicted elasticity from the regression model.	• The inferred CoE is derived based on expected elasticity, debt risk premia and risk-free rate. • The cut-offs used for the calculation are consistent with those used for CoE estimation in recent decisions or capture the latest market data. • 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-, 6- and 12-month averaging windows as at that date.

Source: KPMG analysis

I. Approach for data collection

16.1.4. The Report relies on the period from October 2013 to January 2025 informed by the following considerations.

16.1.5. First, the earliest start date to draw a robust sample size based on bond returns available from Bloomberg is October 2013[363]

16.1.6. Second, no structural break is identified in the regression model on elasticity at the 5% significance level[364], which indicates that the entire period between October 2013 to January 2025 should be considered.

Step 1: Obtain the list of all stocks listed in the London Stock Exchange for each year

16.1.7. LSPD[365] is used to obtain a list of all the stocks listed on the London Stock Exchange from 2013 to 2024.

Step 2: Apply the filtration criteria

16.1.8. Filtration criteria are applied to exclude financial companies and Alternative Investment Market (AIM) listed companies. Stocks that are not excluded based on the filtration criteria below are then taken forward to the next step for data collection.

363 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.

364 Based on Supremum Wald test, the null hypothesis of no structural break cannot be rejected at 5% significance level. Therefore, no structural break is identified.

365 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.

Table 70: Filtration criteria and rationale

Criterion	Treatment	Rationale
Financial firms	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.
Alternative Investment Market (AIM) listed firms	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.

Source: KPMG analysis

Step 3: Download firm-level bond and stock data required for the regression

16.1.9. 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.

1) 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.

2) 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).

3) 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. A long-term measure of risk-free rate is used to reflect the long-term horizon of equity investors.

4) 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. 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 fixed-rate bonds[366] 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).

16.1.10. The table below summarises the data sources used for independent and dependent variables.

366 i.e. the weighted average total return of all the fixed-rate bonds issued by each company.

Table 71: Sources of data for independent and dependent variables

Variable	Underlying data	Data source
Outturn elasticity; Equity volatility	Total Return Index (TRI) on equity	LSEG Workspace
Outturn elasticity	Weighted average total return of fixed-rate bond[367]	Bloomberg
Leverage	• Weighted average fixed-rate bond price[368] • Book value of total debt • Market value of equity	Bloomberg
Risk-free rate	20-year nominal gilt rates	LSEG Workspace

Source: KPMG analysis.

II. Approach for regression analysis

16.1.11. CCZ use a pooled Ordinary Least Square (OLS) regression, which assumes that the average elasticity is the same across firms. If the assumption of uniform average elasticity across firms does not hold, alternative models, such as the fixed effect model, should be used. The fixed effect model incorporates firm-specific, time-invariant effects, relaxing the assumption of uniform elasticity and accounting for individual heterogeneity[369] across firms that affects elasticity.

16.1.12. The pooled OLS regression can be expressed as follows, where the intercept term α is fixed across firms.

$$\frac{\partial E/E}{\partial D/D}_{it} = \alpha + \beta_L Leverage_{it} + \beta_V\ Volatility_{it} + \beta_r\ r_{f_t} + \varepsilon_{it}$$

16.1.13. The fixed effect model can be expressed as follows, where the term u_i represents the firm-specific, time-invariant effects.

$$\frac{\partial E/E}{\partial D/D}_{it} = \alpha + u_i + \beta_L\ Leverage_{it} + \beta_V\ Volatility_{it} + \beta_r\ r_{f_t} + \varepsilon_{it}$$

16.1.14. This alternative expression may be more intuitive, as the firm-specific, time-invariant effect is represented by a firm-specific intercept α_i, rather than a constant intercept term (α) as in the pooled OLS regression.

16.1.15. It is standard practice for econometricians to base the selection of the panel regression model on statistical testing[370]. While CCZ do not mention any such tests and directly use pooled OLS regression for estimating elasticity, this Report performs statistical tests to select the appropriate panel regression models. The tests are implemented based on the practical guide by Park (2011)[371]. In particular, the F-test and Breusch-Pagan Lagrange Multiplier (LM) test are conducted to inform the selection of the appropriate model. The null hypotheses for these tests are as follows:

1) F-test: the firm-specific fixed effects (u_i) are jointly zero.

2) Breusch-Pagan Lagrange Multiplier (LM) test: random effects are insignificant.

367 Weighted by amount outstanding of all fixed rate bonds issued by a firm
368 Weighted by amount outstanding of all fixed rate bonds issued by a firm
369 Individual heterogeneity, in statistical terms, refers to differences among individuals or firms that are not completely random.
370 See, for example, sections 10.4 and 10.5, Wooldridge, J. M. (2010). *Econometric analysis of cross section and panel data*. MIT press.
371 Park, H. M. (2011). Practical guides to panel data modelling: a step-by-step analysis using Stata. Public Management and Policy Analysis Program, Graduate School of International Relations, International University of Japan, 12, 1-52.

16.1.16. The table below summarises the suggested approach based on the guide depending on the conclusion of the F-test and the LM test:

Table 72: Guidance on the selection of the model for panel data[372]

F-test (for fixed effect)	Breusch-Pagan LM test (for random effect)	Suggested approach
H_0 is not rejected (no fixed effect)	H_0 is not rejected (no random effect)	Pooled OLS
H_0 is rejected (fixed effect)	H_0 is not rejected (no random effect)	Fixed effect model
H_0 is not rejected (no fixed effect)	H_0 is rejected (random effect)	Random effect model
H_0 is rejected (fixed effect)	H_0 is rejected (random effect)	Conduct Hausman test to decide between fixed effect and random effect models

Source: Page 50, Park (2011).

16.1.17. First, applying the F-test on the fixed effect regression on elasticity yields a p-value of 0.00%, which indicates that the null hypothesis of no firm-specific fixed effects should be rejected at the 1% significance level. This suggests the presence of fixed effects. Second, applying the Breusch-Pagan LM test yields a p-value of 100%, which means the null hypothesis of no random effects cannot be rejected. Based on these results and the guidance provided in the table above, the fixed effect model is deemed the appropriate choice for the regression on elasticity.

16.1.18. The results of this empirical testing align with economic intuition. It is reasonable to expect that the average elasticity would vary across firms due to factors such as sector, business segment, and geography. These characteristics are firm-specific and time-invariant, which corresponds to the firm-specific intercept term (α_i) in the fixed effect model. Indeed, firm fixed effects are used in the vast majority of corporate finance analysis and research.

16.1.19. The regression results are shown below. A regression between October 2013 and January 2025 are run to get a long-term stable relationship between elasticity and the independent variables. The p-value of 1% for the F-statistics, which suggests that the independent variables are able to jointly explain the variation of elasticity and are jointly significant at a 5% significance level. The use of F-statistics is appropriate in this context as it assesses the overall statistical significance of the regression model based on the collective impact of all independent variables.

Table 73: Regression results

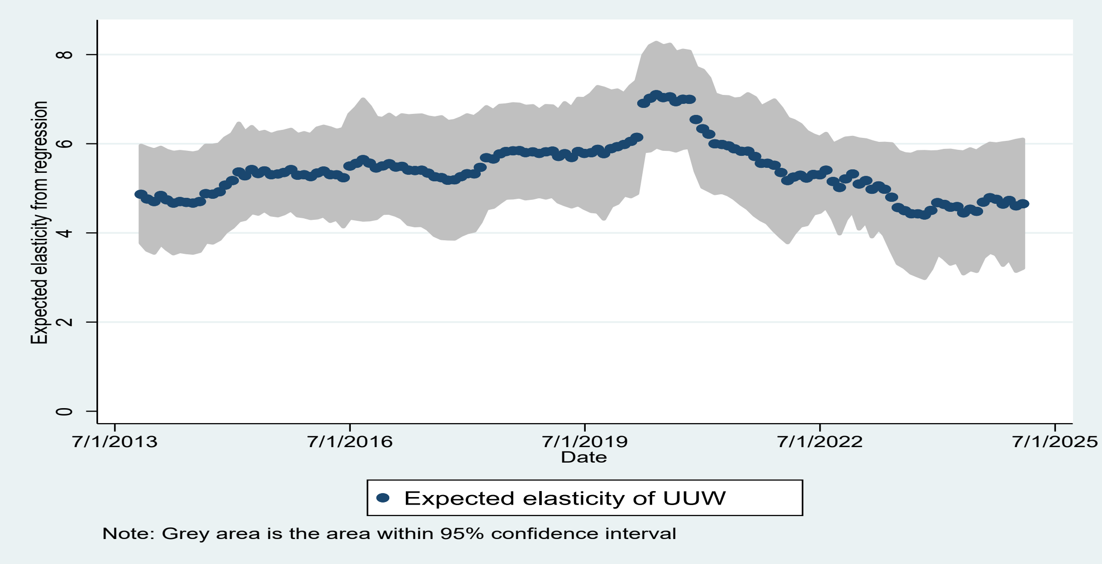
	Coefficient	Standard error	t-stat	p-value
Intercept (α)	2.65**	1.20	2.21	0.03
Leverage	0.15	0.25	0.59	0.55
Volatility	100.09**	41.76	2.40	0.02
Risk-free rate	-0.34	0.26	-1.32	0.19

Source: KPMG analysis.
Note: * is significant at the 10% level, ** at the 5% significance level and *** at the 1% level.

372 Based on the table in p. 50, Park (2011), Practical Guides To Panel Data Modelling: A Step by Step Analysis Using Stata.

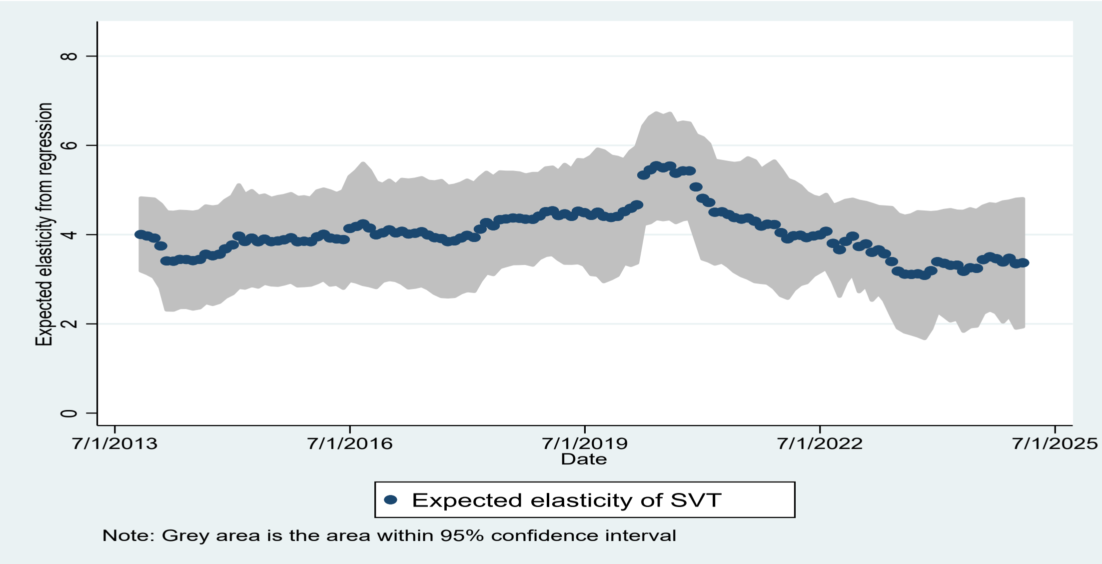
16.1.20. Confidence intervals provide a range within which the true value of a population parameter is likely to fall. They quantify the uncertainty around an estimate, with wider intervals indicating greater uncertainty. The confidence interval of the expected elasticity based on the fixed effect model shows that the 95% confidence interval does not encompass negative elasticity values, which suggests that the elasticity is positive and statistically significant.

Figure 38: Expected elasticity estimated from the regression and 95% confidence interval – UUW



Source: KPMG analysis, output generated using Stata.

Figure 39: Expected elasticity estimated from the regression and 95% confidence interval – SVT



Source: KPMG analysis, output generated using Stata.

III. Calculation of inferred CoE

16.1.21. The scenario specification of cross-checks is in generally aligns with beta. However, due to insufficient PNN bond data – only one fixed-rate bond has return data prior to August 2024 – it is not possible to calculate a robust measure of elasticity for this company. As a result, the inference analysis is based on SVT/UUW (EW) portfolio. The expected elasticity ($\frac{\partial E/E}{\partial D/D}$) of

SVT and UUW are calculated by multiplying the regression coefficients shown in Table with the outturn leverage and volatility of SVT and UUW, and the 20-year risk-free rate, added by the fixed-effect intercept of SVT and UUW.

16.1.22. The table below provides the specification of methodology and assumptions underpinning the calculation of inferred CoE, along with associated rationale.

Table 74: Methodology and assumptions underpinning the estimation of inferred CoE

	Approach	Rationale
Cut-off date	31 January 2025	Market data cut-off used in the FD extended to reflect the impact of latest market data.
Averaging window	1-, 3-, 6-, 12-month averages used	Consistent with averaging windows typically considered for estimation of risk-free rate and cost of debt.
Inferred CoE	$E[r_E] = r_f + \frac{\partial E/E}{\partial D/D}\left(E[r_D] - r_f\right)$	Consistent with the formula used by Campello et al.
Debt risk premium $(E[r_D] - r_f)$	Market pricing of debt is derived based on outturn yields on the benchmark index, adjusted for default risk by subtracting an expected default loss rate. It is assumed that the effective rating of iBoxx Utilities £ 10+ is A/BBB + 40bps The expected default loss rate of 0.15% is calculated based on a 0.24%[373] annualised default rate and a 37.6%[374] recovery rate for senior unsecured bonds sourced from Moody's 2024 default study. Debt risk premium is derived by subtracting the yields on the 20Y nominal gilt from default-adjusted nominal yields on the benchmark index. This subtraction isolates the additional return required for credit risk relative to the nominal gilt.	Adjustment to the benchmark index is 10bps higher than the FD (iBoxx A/BBB+40bps) to reflect debt financeability analysis which indicates that the notional company is unlikely to achieve Baa1/BBB+ based on the latest rating agency methodologies. CCZ apply a similar default loss rate adjustment based on Moody's data in their analysis.
Treatment of inflation[375]	Inferred CoE is derived in CPIH-deflated terms in three steps: First, an equity risk premium is calculated by multiplying expected elasticity by the debt risk premium. Then an inferred CoE is calculated as the sum of the yields on the 1-month average 20Y nominal gilt and the equity risk premium. Lastly, the nominal inferred CoE is converted into a CPIH-deflated value based on the 1-month average 20Y CPI swap rate[376].	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 TMR). 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.

373 Moody's (2024), Annual default study: Corporate default rate to moderate in 2024 but remain near its long-term average, Exhibit 41 and 42.

374 Moody's (2024), Annual default study: Corporate default rate to moderate in 2024 but remain near its long-term average, Exhibit 7.

375 Consistent with the regulatory CoE, the inferred CoE estimates are derived in real terms, and are assumed to be unaffected by inflation and inflation risk premia. First, although the inputs in the elasticity regression are nominal, both the numerator and denominator of the elasticity ratio (i.e., the dependent variable) incorporate inflation which is likely to limit the extent to which inflation affects elasticity and means that elasticity can be used to underpin estimation of CoE in real terms. Second, the debt risk premium is calculated by subtracting the yield on a 20-year nominal gilt from the yield on a similarly long-term corporate benchmark. This approach isolates the impact of credit risk differences, adjusted for default, without including inflation risk premia, as inflation expectations are similar for bonds of the same maturity. Third, while the company-specific ERP is combined with a nominal risk-free rate to derive the CoE in nominal terms, the resulting nominal CoE is deflated using inflation swaps. This deflation removes any inflation risk premia introduced by the nominal risk-free rate.

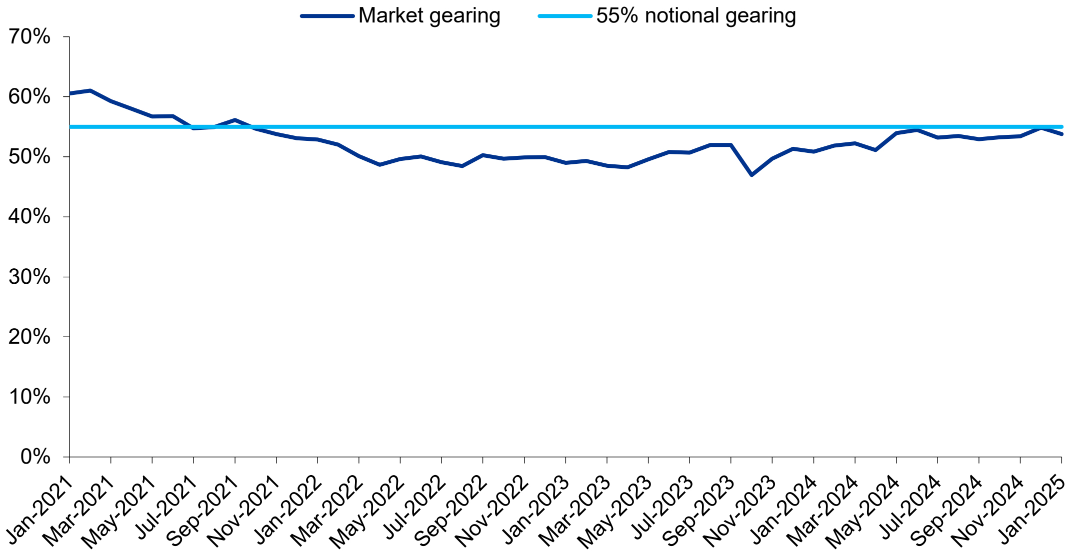
376 Sourced from Bloomberg.

IV. The impact of re-levering on expected elasticity and inferred CoE

16.1.23. Elasticity is derived from regression analysis based on market leverage which may differ from the 55% notional gearing assumption used in the PR24 FD.

16.1.24. As illustrated in the figure below, market leverage for SVT/UUW has been below the assumed notional gearing level since late 2021. The longest averaging window used in the calculation of inferred CoE is 12 months, with expected elasticity estimates extending back from February 2024. During this period, the average market leverage for SVT/UUW was 53.21%, ranging from 51.1% to 54.8%.

Figure 40: Evolution of market leverage (SVT/UUW average) relative to the PR24 notional gearing



Source: KPMG analysis

16.1.25. Given that the market leverage is below notional gearing, de- and re-levering would increase elasticity and CoE estimates. As the Report does not perform this conversion, inferred CoE estimates are likely to somewhat understate the required returns at the notional gearing level for PR24 and can thus be considered conservative.

16.2. Response to Mason, Robertson & Wright

16.2.1. This section provides responses on the technical points raised by Ofwat and Mason, Robertson & Wright (RMW) regarding inference analysis.

I. Stability of the cost of equity

16.2.2. One concern raised about inference analysis is that the estimated cost of equity is less stable than when using the CAPM. MRW argue that “In a regulatory setting taking a multi-year view of investment and the cost of capital, estimates that vary wildly make the setting of the allowed cost of capital too sensitive to the timing of the regulatory decision.”

16.2.3. This concern conflates two points. We agree that a regulatory setting should take a multi-year view of investment and the cost of capital, in that the estimated forward-looking cost of capital should be applicable over the next 20 years, rather than just the next year. However, this does not mean that the estimate itself should not change over time. The yield on a 20-year bond is a multi-year expected return, yet it changes whenever economic news is released.

16.2.4. Indeed, the estimated cost of capital needs to change over time to take into account the most up-to-date market conditions, to ensure that investment in utilities stock remains attractive compared to investors' outside options, such as investing in utilities bonds or other companies. Under inference analysis, the cost of equity will change whenever the cost of debt changes. This is a strength of inference analysis, not a flaw, as it ensures that equity remains an attractive investment. Under CAPM, and in particular the assumption of a fixed total market return used by Ofwat despite being contradicted by textbooks[377], the estimated cost of equity will be stable. This stability is a flaw, not a strength. If market conditions change and the expected return on the market rises, but the expected return on utilities is constant, then utilities become unattractive to invest in. If stability is achieved simply by assuming that a parameter is constant when it is ever-changing in reality, then this is a problem with the model, and is best addressed with a cross-check that does not make the same assumption.

16.2.5. By analogy, the current exchange rate is a more accurate predictor of future exchange rates (e.g. to guide the decisions of a global firm) than the average exchange rate over the past five years. The latter is more stable as it is not affected by recent changes in the exchange rate, but recent changes in the exchange rate should be taken into account.

II. Stability of the elasticity

16.2.6. Similarly, elasticities should change over time because firm characteristics, financial risk, and market conditions evolve. Inference analysis accounts for this by incorporating real-time firm volatility, leverage, and the risk-free rate. The Merton model indeed predicts that the elasticity should change whenever these parameters change, and so the variation in the estimated elasticity shows that the empirical estimation is working as it should.

16.2.7. MRW write that "we were testing the claim that the elasticities (ratios of return on equity to the return on debt) are "broadly stable" (p. 30 of the original KPMG report[378]). Clearly stability is both important and desirable for KPMG's approach—a fact that they implicitly, at least, recognize in claiming broad stability". It is incorrect that we believe that stability is important and desirable. "Broadly stable" was simply a description of the data without imposing any value judgement as to whether stability is important or desirable. Indeed, the full extract was "elasticity remained broadly stable until 2022 where it experienced a modest decrease", which recognises that estimated elasticity may change over time, and is also a description without a value judgement.

16.2.8. The stability of the equity beta in the CAPM stems from an oversimplification in the approach. The equity beta depends on leverage, as shown by Modigliani and Miller (1958). Ofwat's preferred approach of regressing historical stock returns on market returns provides a historical estimate of the equity beta, which in turn depends on historic leverage. This historic beta may not reflect the firm's current risk profile: its business risk (asset beta) or financial risk (leverage). A more correct approach would be to estimate the historic asset beta and then lever this using the firm's current leverage to estimate the current equity beta. Even if the asset beta is stable over time, this approach will lead to the equity beta fluctuating significantly over time since market leverage changes each time the stock price changes. It is true that Ofwat's current approach leads to a stable equity beta, but this is because it ignores the fact that changes in leverage change the cost of equity – in fact, it ignores leverage completely. In contrast, the elasticity is variable because inference analysis correctly takes current leverage into account.

16.2.9. In sum, the CAPM-implied cost of equity is $E[r_E] = r_f + \beta_M\,(E[r_M] - r_f)$. It is stable because the estimate of β_M does not take current leverage into account, and because the estimate of $E[r_M]$ is based entirely on historic data. In contrast, the cost of equity implied by inference

377 For example, Brealey, Myers, Allen, and Edmans (2025) list the following as one of their Principles of Corporate Finance: "The Stable Risk Premium Principle

378 KPMG (2023) Inference analysis as a cross-check on allowed returns at PR24

analysis is $E[r_E] = r_f + \frac{\partial E/E}{\partial D/D}\left(E[r_D] - r_f\right)$. It is variable because the estimate of elasticity takes into account current leverage (in addition to the current risk-free rate and volatility), and the estimate of $E[r_D]$ takes the current debt yield into account. Thus, it is incorrect to dismiss inference analysis based on less stable estimates, as this variability arises from taking current firm and market conditions into account. It addresses the very factors that CAPM omits, making it suitable for a cross-check.

III. Comparison of the differences between elasticity and beta estimates for SVT and UUW

16.2.10. MRW note that the differences in expected elasticity between SVT and UUW are higher than the differences in the equity beta between the two companies.

16.2.11. The differences in elasticity between two comparable companies has no bearing on the differences in their equity betas.

16.2.12. Elasticity measures the sensitivity of a company's equity returns to changes its debt returns, reflecting how variations in debt impact equity. Beta measures the sensitivity of a company's equity returns to fluctuations in overall market returns, capturing how a company's stock reacts to market-wide movements. As elasticity and beta are measuring different types of risk[379] their values and differences between companies are not directly comparable. As a result, variations in elasticity between companies will not necessarily align with differences in beta.

379 The CAPM (and hence the CAPM-beta) prices required equity returns relative to the risk and return of the wider market. Inference analysis (and hence elasticity) prices required returns relative to the risk and return of a specific company's debt or a debt benchmark.

17. Appendix 6: Cost of embedded debt

Table 75: UUW's treasury policy on interest rate risk over 2008-2024

Period	UUW's treasury policy on interest rate risk
2008-2011	"The group's policy is to structure debt in a way that best matches the cashflows generated by its underlying assets… Where long-term debt is raised in a fixed rate form, the group will swap to floating rate, at inception over the life of the liability, through the use of interest rate swaps… The group's revenues are determined based upon the real cost of capital fixed by the regulator for each five-year regulatory pricing period. The group fixes a material proportion of the floating cost of debt for the duration of the five-year regulatory pricing period, using a second layer of interest rate swaps to match the group's revenue stream"
2012-2013	"The group's policy is to structure debt in a way that best matches its underlying assets and cash flows… Where conventional long-term debt is raised in a fixed-rate form, to manage exposure to long-term interest rates, the debt is generally swapped at inception to create a floating rate liability for the term of the liability through the use of interest rate swaps… To manage the exposure to medium-term interest rates, the group has fixed interest costs for a substantial proportion of the group's net debt for the duration of the current five-year regulatory pricing period. During the year, the group revised its interest risk management strategy to now extend the fixing of interest rates out to a 10-year maturity on a reducing balance basis, seeking to lock in a 10-year rolling average interest rate on the group's nominal liabilities"
2014-2017	"The group's policy is to structure debt in a way that best matches its underlying assets and cash flows… Where conventional long-term debt is raised in a fixed-rate form, to manage exposure to long-term interest rates, the debt is generally swapped at inception to create a floating rate liability for the term of the liability through the use of interest rate swaps… To manage the exposure to medium-term interest rates, the group fixes underlying interest rates on nominal debt out to ten years in advance on a reducing balance basis. This is supplemented by managing residual exposure to interest rates within the relevant regulatory price control period by fixing substantively all residual floating underlying interest rates on projected nominal debt across the immediately forthcoming regulatory period at around the time of the price control determination"
2018-2024	"In the next regulatory period, Ofwat intends to continue using materially the same methodology in setting a fixed real cost of debt in relation to embedded debt (currently assumed to be 70 per cent of net debt), but will introduce a debt indexation mechanism in relation to new debt (currently assumed to be 30 per cent of net debt). The group has therefore reviewed its interest rate hedging policy, retaining most elements of the existing policy as Ofwat's embedded debt methodology is materially unchanged… Where conventional long-term debt is raised in a fixed-rate form, to manage exposure to long-term interest rates, the debt is generally swapped at inception to create a floating rate liability for the term of the liability through the use of interest rate swaps… To manage the exposure to medium-term interest rates, the group fixes underlying interest rates on nominal debt out to 10 years in advance on a reducing balance basis, mirroring Ofwat's expected split of 70 per cent embedded and 30 per cent new debt. However, the group will no longer substantively fix the residual floating underlying interest rates on projected nominal net debt at the start of each regulatory period, leaving this element floating until it is fixed via the above 10-year reducing balance basis, which should more closely mirror Ofwat's new debt indexation mechanism"

Notes: (1) Extracts are from the annual report in the first year of the period; (2) UUW has referred to the share of new debt for AMP7 as 20% since its 2020 annual report
Source: KPMG analysis and data from UUW annual reports

Table 76: Comparison of the notional company vs actual companies across the sector

Criteria		Notional	WaSC										Large WoC		Small WoC		
			ANH	NES	UUW	SRN	SVH[1]	SWL	TMS	WSH	WSX	YKY	AFW	SEW	PRT	SES	SSC
Credit rating	Fitch	Baa1/BBB+	A- (Stable)	BBB+ (Stable)	BBB+ (Stable)	BBB (Negative)	BBB+ (Stable)	n/a	n/a	A (Stable)	BBB+ (Stable)	n/a	BBB+ (Stable)	n/a	n/a	n/a	n/a
	Moody's		A3 (Stable)	Baa1 (Stable)	A3 (Stable)	Baa3 (Stable)	Baa1 (Stable)		Baa1 (Stable)	A3 (Stable)	Baa1 (Stable)	Baa2 (Stable)	Baa1 (Stable)	Baa2 (Stable)	Baa2 (Stable)	Baa2 (Stable)	Baa2 (Stable)
	S&P		A- (Negative)	n/a	BBB+ (Stable)	BBB (Stable)	BBB+ (Stable)		BBB (Negative)[2]	A- (Negative)	n/a	A- (Negative)	BBB+ (Negative)	BBB (Negative)	n/a	n/a	BBB+ (Negative)
Gearing		**60.0%**	**68.9%**	**70.2%**	**67.0%**	**71.6%**	**61.0%**	**68.3%**	**81.3%**	**61.1%**	**68.8%**	**68.6%**	**74.9%**	**77.8%**	**50.0%**	**79.1%**	**68.7%**
Debt mix	Fixed rate	67.0%	28.4%	55.1%	31.0%	26.4%	68.3%	66.5%	35.9%	10.6%	55.2%	35.7%	13.4%	29.3%	8.4%	12.5%	20.2%
	Index linked	33.0%	60.5%	36.6%	44.8%	73.3%	28.0%	13.6%	54.6%	84.0%	30.8%	56.9%	86.6%	54.7%	90.5%	67.5%	72.4%
	Floating rate	0.0%	11.2%	8.3%	24.2%	0.2%	3.7%	20.0%	9.4%	5.4%	14.1%	7.4%	0.0%	16.0%	1.1%	20.0%	7.4%
Swaps[3]		No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	No	No	No	No
Junior debt[3]		No	No	Yes	No	Yes	No	No	Yes	Yes	No	Yes	Yes	No	Yes	Yes	No
Intercompany debt[3]		No	No	Yes	Yes	Yes	Yes	Yes	Yes	No	No	No	Yes	No	Yes	Yes	No
Wrapping fees[3]		No	Yes	No	No	Yes	No	No	No	Yes	No	No	No	No	No	Yes	Yes

Notes: (1) Credit ratings shown for SVH are those for SVE. HDD has only a rating from Fitch of BBB+ (Stable) and this aligns with that for SVE; (2) CreditWatch Negative; (3) Based on the KPMG dataset for 2023 debt data
Source: KPMG analysis and data from 2024 APRs

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