Inference analysis as a cross-check on allowed returns at PR24

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Contents

1 Important notice

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

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2 Executive summary

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

The regulatory allowance for CoE will be particularly significant for AMP8 and beyond in the context of the unprecedented step change in the scale of required capital investment, a significant shift in the macroeconomic landscape – marked by rising interest rates, high inflation, and heightened volatility – and expected increases in risk exposure at PR24.

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

The potential customer detriment from the under-estimation of CoE is particularly acute[1] at PR24 given that it will be necessary for the notional firm to attract significant new equity capital to fund the substantial new investment required for AMP8 and beyond. This Report develops a methodology which uses observed debt pricing and the relationship between the costs of equity and debt to infer the CoE which can be applied as a sense-check to a CAPM-derived estimate.

The key principles underpinning this cross-check are as follows:

- Debt and equity are both claims on the same underlying asset and their values are intrinsically related to the value of the asset[2]. All else equal, the expected returns on equity and debt exhibit a positive correlation, as both are sensitive to the underlying factors that affect the firm's asset value.
- Equity inherently faces higher risks in relation to loss of capital and return compared to debt. This is due to, *inter alia*, the subordinated nature of equity claims in case of insolvency[3], more limited control rights in the event of financial difficulty or distress and differences between contractually obligated debt interest payments and more discretionary equity dividends.
- Equity investors often have multiple investment options, each with varying risk and return profiles. When making capital allocation decisions, an investor would carefully consider the risk-return profile of each opportunity. Given the riskier nature of equity, the expected return on equity needs to be substantively above the expected return on debt of the same company, as otherwise an investor is unlikely to be incentivised to invest in equity.

These principles imply that (1) allowed CoE should be assumed to remain sufficiently above the current CoD to promote equity investment in the sector and price in risk differentials for different claims on the same asset and (2) a cross-check on allowed CoE can be designed based on market pricing of debt and the relationship between debt and equity. This is in line with Damodaran who

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1 The welfare loss arising from under-estimation of the CoE is generally greater than that from over-estimation of the cost of capital. If the allowed return is set too high, customers end up paying more in their bills than they would have had the allowance been based on the true cost of capital. On the other hand, if the allowed return is set too low, companies are discouraged from making new investments or adequately maintaining existing ones, resulting in suboptimal levels of investment and a significant loss in consumer welfare. As the demand for most regulated services is driven by the essential nature of the services provided, the welfare loss from under-investment is substantial. Consequently, the detrimental impact on consumers is not symmetric when the allowed return deviates significantly from the true cost of capital. This asymmetry of consequences would likely be more acute for PR24 given the scale of required investment.

2 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.

3 In the event of an insolvency, debt holders have the priority claim over the firm's assets for debt repayment, while equity holders could receive the remaining assets only once all outstanding debt capital has been repaid and if the remaining value of the firm is non-negative.

considers that "*there should be a relationship across the risk premiums in these asset classes that reflect their fundamental risk differences*"[4]. This has also been recognised by the UKRN[5] and the CMA[6].

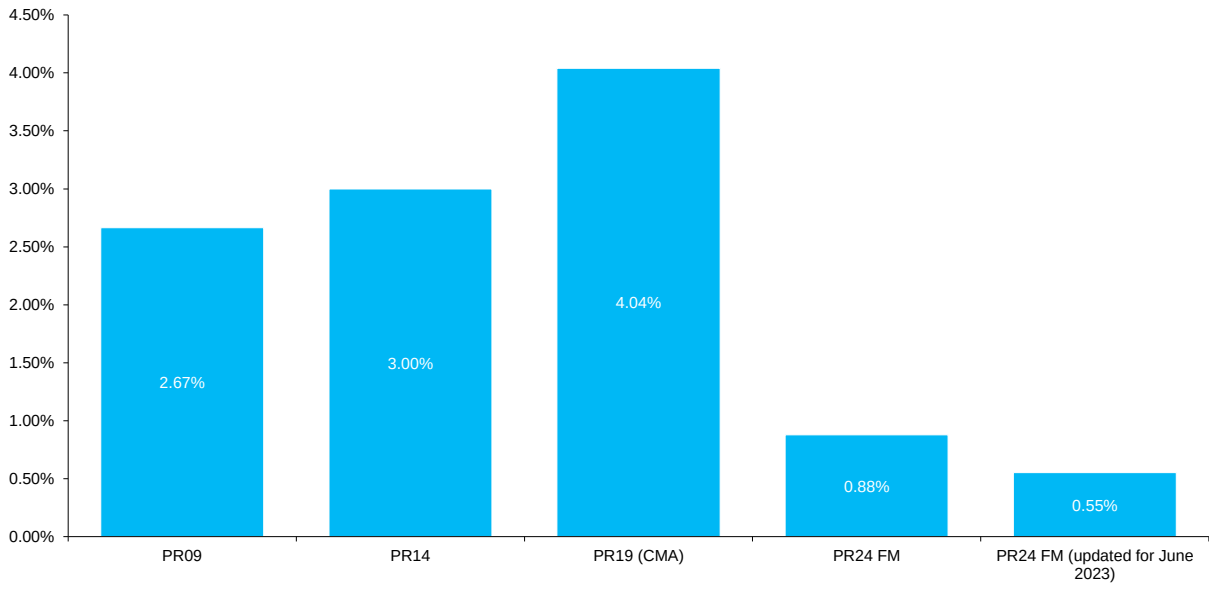
Assuming no changes in the risk exposure faced by equity investors, the differential observed over the most recent price controls would provide a natural point of reference for the PR24 differential given that:

- Past differentials will reflect investor expectations on the pricing of the incremental risk of equity relative to debt.
- Financeability metrics could deteriorate to levels which are not consistent with the target credit rating for the notional firm.

The analysis of the differential between CoE and cost of new debt (CoD_n) based on (1) ex ante allowances from PR24 Final Methodology (FM) and past regulatory determinations and (2) yields on the benchmark indices as a proxy for current borrowing costs indicates that the gap between the pricing of the capital sources has narrowed significantly.

First, as set out in Figure 1, past regulatory determinations were calibrated such that they imply a differential of c.300bps between ex ante allowances for CoE and CoD_n, whereas the FM implies a gap below 100bps. There has subsequently been a significant increase in interest rates – with the CoD_n at its highest level since PR09 – however, this has not translated into higher allowed returns based on the PR24 FM. On a like-for-like basis (55% notional gearing) the FM point estimate of 4.14% CPIH-real does not imply any increases relative to the CoE determined by the CMA based on market data as at December 2020.

Figure 1 The evolution the differential between CoE and CoD_n (on a comparable 55% notional gearing basis)[7]



Note: Ex-ante allowed CoE vs ex-ante allowed CoD. Allowed CoE and CoD are fixed over the price control based on long-term inflation assumptions from the respective regulatory decisions.

Source: Ofwat (2022), PR24 Final Methodology, Appendix 11 – Allowed return on capital, Table 2.1. CMA (2021), PR19 Final Determination, Table 7. Ofwat (2014), Setting price controls for 2015-20 Final price control determination notice: policy chapter A7 – risk and reward, Table A7.10. Ofwat (2009), Future water and sewerage charges 2010-15: final determinations, Table 46, section 5.4.4

[4] Damodaran A., Equity Risk Premiums (ERP): Determinants, Estimation, and Implications – The 2023 Edition

[5] In its cost of capital guidance, UKRN has recognised "*the principle that equity bears more risk than debt and so should normally receive a higher return*".

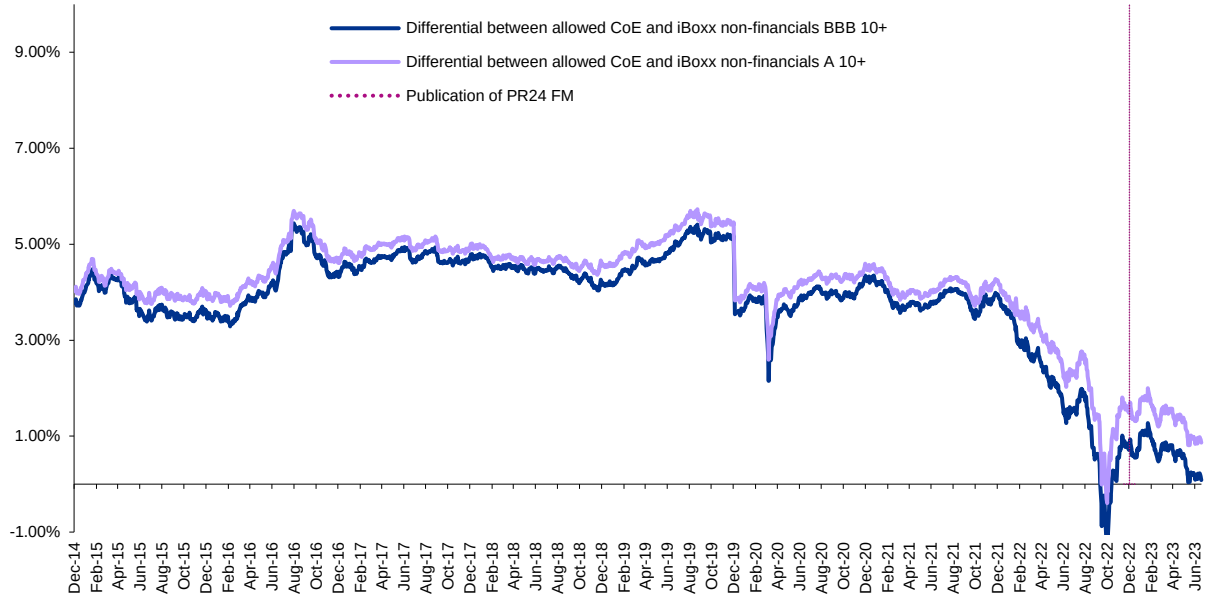
[6] At PR19 the CMA recognised that "*for a regulated business with capped returns, the cost of equity used in the WACC should still be assumed to remain sufficiently above the current cost of debt to promote equity investment in the sector*".

[7] The following inflation assumptions, from the respective determinations, to derive the nominal values: PR24 FM: 2.00%, PR19 (CMA): 2.00%, PR19 (FD): 2.00%, PR14: 2.80%, PR09: 2.50%.

Second, the differential between allowed CoE and yields on the benchmark indices – which remained broadly stable apart from the early Covid19 period (February – March 2020) – experienced a material reduction from 2022. The initial reduction from 2022 onwards was likely driven by a combination of step changes in market rates and limited responsiveness of the regulatory CoE to such changes. The reduction in the differential was also likely exacerbated by the changes in the methodology for CoE estimation stipulated in the PR24 FM.

Since the end of May 2023, the differential between allowed CoE and the yields on the BBB-rated iBoxx has been very close to zero. This does not recognise the additional risks that equity faces due to its subordinated nature and is inconsistent with corporate finance theory.

Figure 2 Evolution of the differential between allowed CoE and yields on the benchmark index (on a comparable 55% gearing basis)



Note: Compares nominal yields on iBoxx indices to allowed CoE converted to nominal using long-term inflation assumptions in respective regulatory decisions. From the publication date of the PR24 FM, the estimate for the allowed CoE for PR24 is based on (1) the FM methodology and (2) an updated data cut-off of June 2023.
Source: KPMG analysis of Ofwat, CMA decisions and Refinitiv Datastream data.

The observed reduction in the differential indicates that the CoE is miscalibrated and may result in the equity investments being deemed less attractive than other available opportunities with better risk-reward profiles. All else equal, a significantly larger differential between observed debt pricing and allowed equity returns would be expected.

To assess the required level of differential for PR24, the Report undertakes an inference analysis based on Merton's (1974) framework[8] and its practical applications[9]. A cross-check based on this framework:

- Is derived from outside the CAPM, in line with Ofwat's preferred specification of cross-checks at PR24.

[8] In Merton's (1974) framework, debt and equity are considered contingent claims over a firm's assets and the values of debt and equity are intrinsically related to the value of the firm's assets.

[9] The Report utilises the methodology and the analytical formula developed in Campello, M., Chen, L., & Zhang, L. (2008). Expected returns, yield spreads, and asset pricing tests. *The Review of Financial Studies*, 21(3), 1297-1338. This analytical formula estimates the expected equity return based on the relationship between equity and debt inferred from Merton's (1974) framework. The inputs into this formula are the elasticity of the equity value with respect to debt value and the expected cost of debt which is the company's weighted-average bond yield adjusted for default risk. Elasticity reflects the percentage change in the value of equity relative to the percentage change in the value of debt, which is equivalent to the ratio of return on equity to the return on debt. If elasticity is high (i.e. a small change in the value of debt leads to a large change in the value of equity), then equity is much riskier than debt and so the equity risk premium will be much larger than the debt risk premium.

- Acknowledges the impact of a firm's risk exposure on both debt and equity returns, whilst (1) recognising that equity inherently carries higher risk than debt and (2) allowing for the fact that the differential between debt and equity will depend on various factors, such as leverage, which may change over time.
- Reflects the prevailing market conditions and risk environment, both in terms of the level of return and the interrelationship between the equity and debt.

As a result, Merton's framework and its practical applications can provide valuable insights into the relationship between required returns on equity and debt for the same firm and inform the estimation of risk-reflective returns for PR24. Importantly, the Report does not propose that this approach can yield a *precise* estimate of the required CoE. This is due to the presence of some noise in the estimation of equity risk premia from debt risk premia, driven by the different nature and risk exposures of each type of capital. Instead, the Report considers that observed debt pricing and the expected differential between debt and equity pricing can represent a useful cross-check on CAPM-derived returns.

To assess the implications of inference analysis evidence for the allowed CoE at PR24, the Report undertakes two comparisons, which consider (1) how the CAPM-derived CoE estimates compare to inferred CoE estimates and (2) how the differentials between CoE and current debt pricing implied by the CAPM-derived CoE compare to those implied by the inferred CoE. This comparison is undertaken for the PR19 re-determination, the PR24 FM (September 2022 and June 2023 cut-offs) as well as for the PR24 CoE range estimated by KPMG[10] (at 55%[11] notional gearing level for comparability).

In each of the charts below, the diamond represents either the CAPM-derived CoE or the CAPM-implied differential and the floating bar represents the range implied by the inference analysis. The data labels represent the difference between the CAPM-derived values and the lower bound of the range from inference analysis.[12]

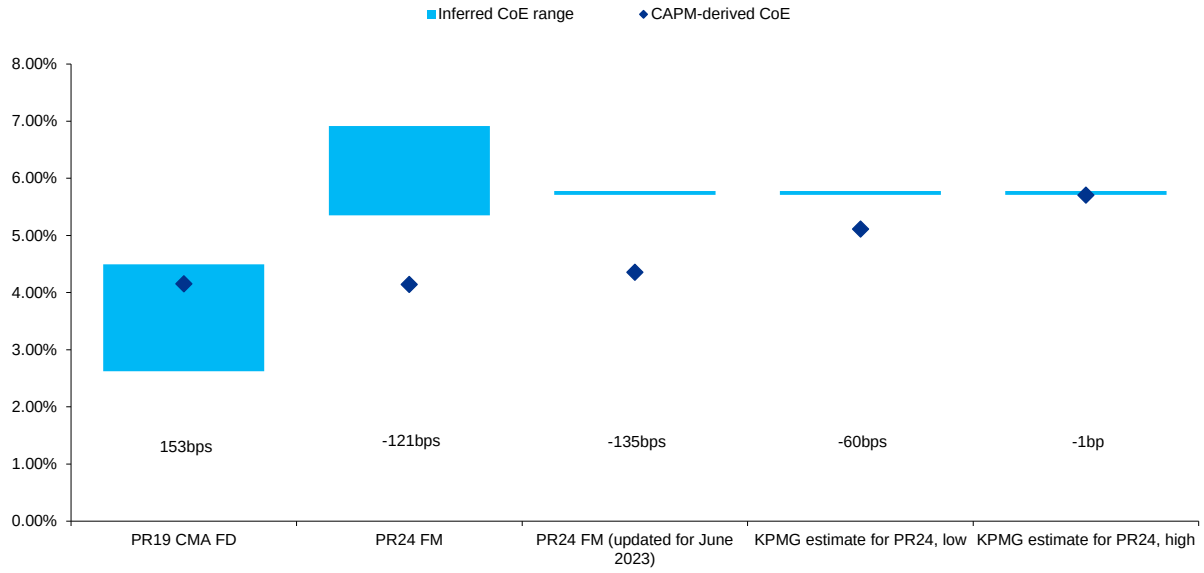
As illustrated on Figure 3 and Figure 4 both the CAPM-derived CoE based on the PR24 FM and the resulting differential with current debt pricing are significantly below the range implied by inference analysis. In contrast, the CMA's PR19 allowed CoE and the resulting differential were within the range implied by inference analysis. All else equal, this suggests that the CAPM-derived CoE based on the PR24 FM is not consistent with current market pricing of debt and the relationship between debt and equity pricing expected based on corporate finance theory and implied by the CMA's PR19 re-determination.

[10] KPMG (2023), Estimating the Cost of Equity for PR24

[11] The CoE range estimated by KPMG is based on a 60% notional gearing assumption in practice.

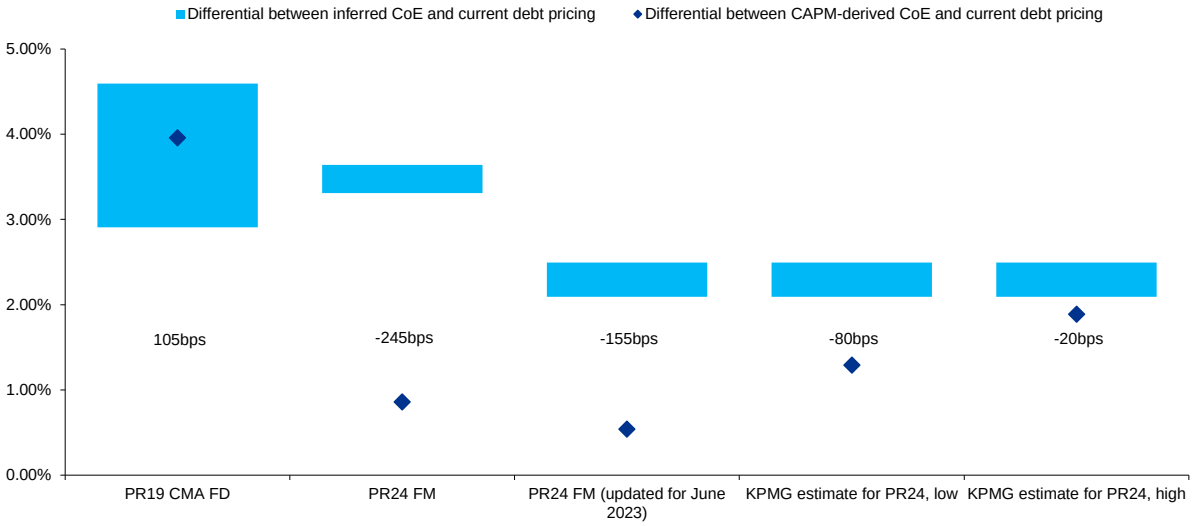
[12] The ranges for inferred CoE and inferred differentials between inferred CoE and current pricing of debt for each cut-off date are formed based on the (1) minimum and maximum CoE and (2) minimum maximum differentials implied by the 1-, 3-, and 6-month averaging windows as at that date. Note that the height of range will not be the same for inferred CoE and differentials. The range for the CoE depends only how different 1-, 3- and 6-month averages of CoE are from each other. The range for the differentials is affected by both CoE and debt pricing. This means that for the two ranges to be consistent, the debt pricing being deducted to calculate differentials would need to be the same based on 1-, 3-, and 6-month averaging windows. This is not the case as debt pricing varies depending on the averaging window.

Figure 3 Comparison between inferred and CAPM-derived CoE[13]



Source: KPMG analysis

Figure 4 Comparison of differentials between CoE and current debt pricing implied by inferred versus CAPM-derived CoE



Source: KPMG analysis

The scale of the disconnect between equity and debt pricing implied by the CAPM-derived CoE based on the PR24 FM may be indicative of a material miscalibration of the allowed CoE. This, in turn, could mean that the cost of capital materially exceeds allowed returns for AMP8, making investment in PR24 less attractive compared to other opportunities with better risk-reward profiles. Investors are

[13] It is noted that the elasticity (and hence the CoE) derived based on the Merton (1974) framework and its practical applications based on market leverage can differ from the current notional gearing assumption of 55% set out in the PR24 FM. Since the beginning of 2022, market leverage has remained below assumed notional gearing in the PR24 FM of 55%, meaning that expected elasticity based on market leverage will yield inferred CoE estimates that somewhat *understate* the required returns at the notional gearing level. The inferred CoE estimates for PR24 in this Report are based on market leverage and can thus be considered to be conservative. In contrast, the inferred CoE for PR19 is likely to be overstated as market leverage exceeded current notional gearing assumptions in AMP6.

likely to be disincentivised to invest in water sector equity where CAPM-derived equity risk premia, which underpin allowed returns, do not align practically with and reflect appropriate differentials to lower-risk debt pricing.

The availability of equity capital required to meet the substantial investment needs in PR24 is contingent on allowed returns that adequately compensate for forward-looking risk exposure and the opportunity cost of capital in current market conditions. Limitations in the available equity capital could result in a significant customer detriment as well as potential increases in gearing to address the shortfall.

As illustrated in the figures above and Table 1 below, the KPMG range implies materially greater consistency with current debt pricing and could better facilitate the achievement of policy objectives for the sector. The comparison suggests that a CAPM-derived CoE estimate from the upper end of the KPMG range may be justified. This is particularly the case given that inferred CoE is based on market (rather than notional) leverage and hence under-estimates required returns inferred from debt pricing.

Table 1 Comparison of CoE and differentials between CoE and current debt pricing for inferred versus CAPM-derived CoE

CPIH-real	Cut-off date	Inferred CoE	CAPM-derived CoE	Differential between inferred CoE and current debt pricing	Differential between CAPM-derived CoE and current debt pricing
PR19 CMA FD	31/12/2020	2.62 – 4.50%	4.15%	2.91 – 4.59%	3.96%
PR24 FM	30/09/2022	5.35 – 6.91%	4.14%	3.31 – 3.64%	0.86%
PR24 FM (updated for June 2023)	30/06/2023		4.36%		0.54%
KPMG estimate for PR24, low	30/06/2023	5.71 – 5.78%	5.11%	2.09 – 2.49%	1.29%
KPMG estimate for PR24, high	30/06/2023		5.71%		1.89%

Source: KPMG analysis
Note: CAPM-derived CoE is always on a 55% notional gearing basis.

The inference analysis evidence implies that a careful re-examination of the methodology and estimates of the PR24 allowed CoE is required to ensure that allowed returns and equity risk premia are sufficient to attract equity capital in current macroeconomic conditions and relative to current levels of observed debt pricing.

3 Context and scope

3.1 Context

Water companies are due to submit their final business plans for the next price control (PR24) which will cover the five-year period to 31 March 2030 on 2 October 2023. The final plans will include the companies' estimates of the required cost of equity (CoE) for the price control. In the Final Methodology (FM) for PR24, Ofwat set out its approach for estimating and cross-checking the baseline allowed return on equity.

The FM sets out a point estimate for the allowed appointee CoE of 4.14% CPIH-real based on a September 2022 cut-off and a 55% notional gearing level. On a like-for-like basis (55% notional gearing assumption) this estimate does not imply an increase in returns relative to the CoE determined by the CMA based on market data as of December 2020.

Key factors relevant to the estimation of allowed returns at PR24

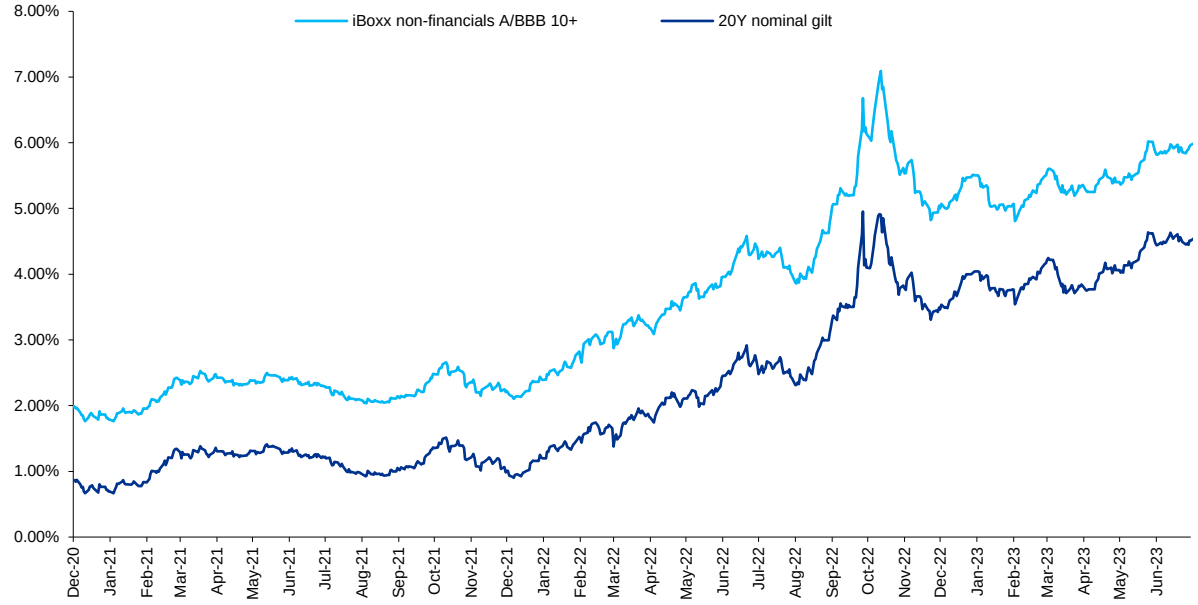
Setting an appropriate, evidence-based, allowance for the CoE is essential to attract and retain equity capital in the sector. An appropriate allowance for the CoE is one that reflects the return that investors can earn on investments of comparable risk (i.e. reflects the opportunity cost of capital)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

The regulatory allowance for CoE will be particularly significant for AMP8 and beyond in the context of the unprecedented step change in the scale of required capital investment. It will be necessary for the notional firm to attract significant new equity capital as well as retain existing equity capital deployed in the sector to fund this investment, which will in turn be contingent on allowed returns that adequately compensate for forward-looking risk exposure and the opportunity cost of capital in current market conditions.

There has been a significant shift in the macroeconomic landscape, marked by rising interest rates, high inflation, and heightened volatility. Forward curves[14] imply that long-term rates (15-20Y) are likely to remain broadly stable at current levels until the end of AMP8. Bank of England projections imply that while the bank rate may decrease by c.100bps between 2023 and 2025[15], it is expected to remain at least 300bps above the 2010-2021 average. The significant increase in rates has not translated into higher allowed returns based on the PR24 FM.

[14] As of June 2023
[15] Bank Of England (May 2023), Monetary Policy Report, Table 1.B

Figure 5 Evolution of interest rates since PR19



Source: Refinitiv Datastream

Companies may need to raise substantial debt and equity capital at relatively elevated interest rates. Regulatory methodologies for estimation of allowed returns that were developed and applied during a low interest rate environment may no longer be appropriate in the new market reality with significantly higher capital costs.

There is inherent uncertainty in estimating CoE and greater potential harm from under-estimation of returns compared to over-estimation[16]. As recognised by the CMA, regulatory CoE needs to be sufficient to provide incentives for firms to meet investment requirements.[17] The CMA considered that the need for sufficient financial incentives would be particularly acute "*if Ofwat required a step change in investment to meet changing resilience requirements in the face of climate change challenges or other stresses on existing infrastructure*"[18].

The role and principles for the use of cross-checks in setting allowed returns

In the context of (1) a step change in interest rates; and (2) a requirement to attract capital to invest in very large capital programmes at AMP8 and beyond, cross-checks will be critical to ensure that the allowed CoE can attract and retain equity capital. Cross checks that are transparent, targeted, objective, incentive compatible, and consistent with regulatory precedent and academic literature[19], can be effective in increasing the reliability and robustness of the CoE estimate derived based on the CAPM.

Recent regulatory determinations have recognised that to develop a robust CoE estimate, CAPM-derived returns should be cross- or sense-checked with reference to alternative market benchmarks. Ofwat, UKRN and the CMA have positioned the role of cross-checks as follows:

- Ofwat in its PR24 DM stated that: *"Our proposed implementation of the CAPM…is reliant on significantly backwards-looking data, particularly on TMR, where we propose to capture over 120*

[16] The welfare loss arising from under-estimation of the CoE is greater than that from over-estimation of the cost of capital. If the allowed return is set too high, customers end up paying more in their bills than they would have had the allowance been based on the true cost of capital. On the other hand, if the allowed return is set too low, companies are discouraged from making new investments or adequately maintaining existing ones, resulting in suboptimal levels of investment and a significant loss in consumer welfare. As the demand for most regulated services is driven by the essential nature of the services provided, the welfare loss from under-investment is substantial. Consequently, the detrimental impact on consumers is not symmetric when the allowed return deviates significantly from the true cost of capital.

[17] CMA (2021), PR19 Final Determination, para. 9.1236

[18] Ibid., para. 9.1391

[19] KPMG (2022), Use of Market-to-asset ratios (MARs) as a cross-check in the context of regulatory price controls

years of historical evidence. One implication of this approach may be an allowed return which is slow to adapt to changing market conditions. Because our objective is to set an allowed return aligned with investors' expectations over 2025-30, it is therefore important to cross-check our CAPM-derived estimates against estimates from alternative approaches underpinned by more recent and forward-looking data"[20].

- Ofwat also noted that: *"For our point estimate we propose that we would ordinarily use the midpoint of this CAPM-derived plausible range. We consider there should be a high evidential bar for moving away from this central estimate, limited to evidence from our market cross-checks. We expect that any adjustment would be modest and would in any case lie within the endpoints of our CAPM-derived cost of equity stated range"*[21].
- UKRN in its guidance for regulators on the methodology for setting the cost of capital noted that: "*Since the CAPM is just one model of expected returns, market benchmarks…provide a sense-check on the CAPM point estimate when such market data are available"* and *"as available cross-checks themselves may be uncertain and reliant on assumptions, there should be a high evidential bar to deviating from the mid-point of the* [CAPM] *cost of equity range"*[22].
- As part of the RIIO GD&T2 appeals the CMA considered that the role of cross-checks is to assess whether the CAPM-implied returns appear materially miscalibrated relative to market-based evidence[23]. In this context, the CMA commented that: *"the ultimate requirement should be to ensure that the overall cost of equity allowance is sufficient to attract investors and allow companies to finance their activities"* and *"market-based cross-checks can help with this process"*[24].
- The CMA in its PR19 re-determination noted that cross-checks of the point estimate for CoE – in particular, financeability – are valuable given that CAPM could be used to derive a wide range of potential estimates for the CoE[25]. Further, the CMA considered that *"arguments for picking a point estimate higher than the midpoint include…to take into account a cross-check on market data and financeability ratios"*[26].

In the PR24 FM, Ofwat indicates that it will rely on Market-to-Asset Ratio (MARs) analysis as a cross-check the CoE. Given the widely recognised shortcomings and limitations of the MAR cross-check, placing full weight on this evidence is unlikely to provide valuable additional insight to the CAPM and hence will not robustly cross-check whether allowed returns will attract and retain equity capital[27].

As a result, for PR24, the consideration of more robust alternative cross-checks is important to refine the CAPM-derived CoE range and/or inform the selection of the point estimate for the CoE.

Relationship between debt and equity pricing as a potential cross-check

The following principles have informed the exploration of the relationship between debt and equity pricing for more detailed consideration in this Report:

- In its guidance for setting the cost of capital (WACC), the UK Regulators' Network (UKRN) highlights that returns should be "*risk reflective*"[28] such that "*the reward will reflect the allocation of risk in the regulatory framework and sectors*"[29]. The allowance for the cost of capital set by regulators should be commensurate with the risks faced by debt and equity investors.

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[20] Ofwat (2022), PR24 Draft Methodology, Appendix 11 – Allowed return on capital, p. 24
[21] Ibid., p. 25
[22] UKRN (2023), Guidance for regulators on the methodology for setting the cost of capital
[23] CMA (2021), RIIO2 Final Determination, Volume 2A: Joined Grounds: Cost of equity, para. 5.718
[24] Ibid., para. 5.723
[25] CMA (2021), PR19 Final Determination, para. 9.1378
[26] Ibid., para. 9.1240
[27] KPMG (2022), Use of Market-to-asset ratios (MARs) as a cross-check in the context of regulatory price controls. The analysis highlighted the following limitations of the MAR cross-check. Firstly, it is challenging to solely attribute MAR to differences in assumed investor return and allowed return due to numerous unknown factors, making it less targeted. Secondly, academic research suggests that MAR cannot be used to assess CoE without controlling for all influencing factors, which is often not feasible. Additionally, using MARs to adjust CoE could lead to unintended consequences which may not be in customer interest. Lastly, transaction MARs face transparency and objectivity issues, as they rely on non-public information and can be biased towards winning bidders' aims, assumptions, and strategic advantages.
[28] UKRN cost of capital principles
[29] Ibid.

- In its guidance, UKRN has similarly recognised "*the principle that equity bears more risk than debt and so should normally receive a higher return*"[30].
- At PR19 the CMA recognised that "*for a regulated business with capped returns, the cost of equity used in the WACC should still be assumed to remain sufficiently above the current cost of debt to promote equity investment in the sector*"[31].

These regulatory principles suggest that a cross-check based on the relationship between current pricing of new debt in the sector and equity pricing in allowed returns would also be relevant. This is because (1) debt and equity are both claims on the same underlying asset, and there should be a relationship between them and (2) the CoE cannot be observed whereas cost of debt can be observed. This is in line with Damodaran (2023) which considers that "*there should be a relationship across the risk premiums in these asset classes that reflect their fundamental risk differences*"[32]*.* As a result, observed debt pricing and the relationship between the CoE and the cost of debt could be used to infer the CoE which can be applied as a sense-check to the CAPM-derived estimate.

It is a core principle of corporate finance that equity is inherently riskier than debt. Both security classes represent contingent claims over a firm's assets. In the event of an insolvency, debt holders have the priority claim over the firm's assets for debt repayment, while equity holders could receive the remaining assets only once all outstanding debt capital has been repaid and if the remaining value of the firm is non-negative. This suggests that equity holders face higher risks in relation to loss of capital and return.

Similarly, as the payment terms of debt are fixed, debt is known as fixed income. If the company fails to make the required interest or principal payments, it is in default and debt holders can take control of the business. By contrast any dividends can only be paid to equity holders once fixed payments have been made to debtholders. As a result, debtholders are senior and equity holders are junior – they can only be paid *after* all debtholders are paid.

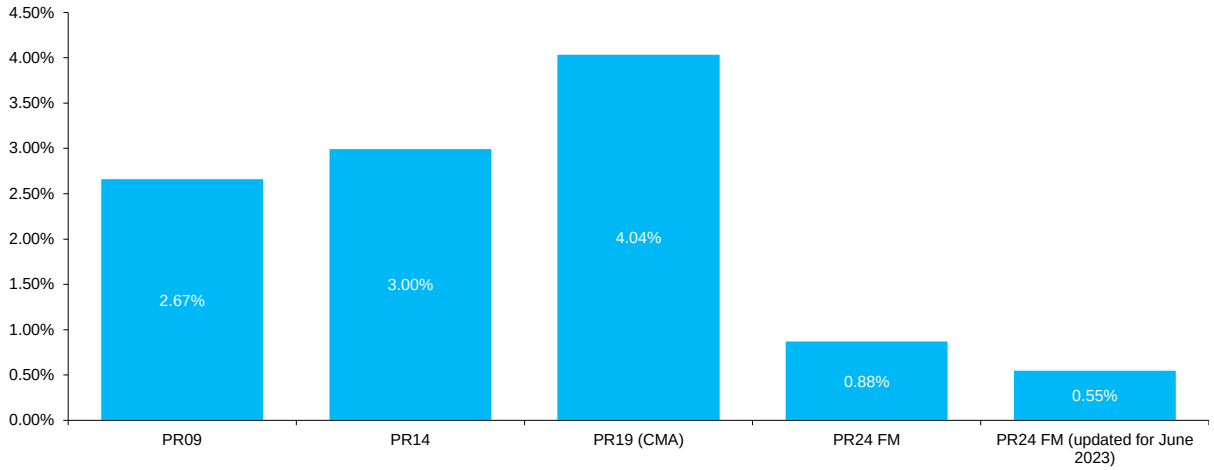
Given the inherently riskier nature of equity, the expected return on equity needs to be substantively above the expected return on debt of the same company. If the allowed WACC does not consistently reflect the subordinated nature of equity relative to debt, equity investors may seek alternative investments that appropriately reflect these factors, such as projects with similar risks or lower-risk assets like debt that provide equivalent or higher returns.

Analysis of the differences between CoE and cost of new debt (CoD_n) implied by the PR24 FM indicates that the gap between the pricing of these sources of capital has narrowed significantly relative to previous regulatory determinations. Equity investors often have multiple investment options, each with varying risk and return profiles. When making capital allocation decisions, investors would carefully consider the risk-return profile of each opportunity. In the context of the choice between investing in a single firm's debt or equity, absent an appropriate differential between the returns available from these investments, an investor is unlikely to be incentivised to invest in equity given its higher risk exposure.

There has recently been a significant increase in interest rates, with the CoD_n at its highest level since PR09. Conversely, there has not been a corresponding increase in CoE. As set out in Figure 6, based on Ofwat's calibration of allowed CoE in PR24 FM, the differential between CoE and CoD_n has reduced significantly by c.300bps from CMA PR19. The differential reduces by a further 33bps when allowed CoE and CoD_n are updated for the June 2023 cut-off.

[30] UKRN (2023), Guidance for regulators on the methodology for setting the cost of capital, Appendix A: Guidance Consultation Issues and Taskforce Response
[31] CMA (2021), PR19 Final Determination, para. 9.1386
[32] Damodaran A., Equity Risk Premiums (ERP): Determinants, Estimation, and Implications – The 2023 Edition

Figure 6 The evolution the differential between CoE and CoD_n (on a comparable 55% notional gearing basis)[33]



Note: Ex-ante allowed CoE vs ex-ante allowed CoD. Allowed CoE and CoD are fixed over the price control based on long-term inflation assumptions from the respective regulatory decisions.

Source: Ofwat (2022), PR24 Final Methodology, Appendix 11 – Allowed return on capital, Table 2.1. CMA (2021), PR19 Final Determination, Table 7. Ofwat (2014), Setting price controls for 2015-20 Final price control determination notice: policy chapter A7 – risk and reward, Table A7.10. Ofwat (2009), Future water and sewerage charges 2010-15: final determinations, Table 46, section 5.4.4.

The significantly reduced headroom between allowed CoE and CoD_n is not consistent with corporate finance principles and may be indicative of a miscalibration of the PR24 FM CoE which warrants further investigation.

3.2 Scope and structure of the Report

This Report develops a cross-check for the regulatory CoE based on the market pricing of debt and relationship between debt and equity based on following steps:

- First, it considers the evolution of observed differentials between allowed CoE and market pricing of debt and its implications for the calibration of PR24 CoE (section 4).
- Second, it establishes the conceptual framework for inferring CoE from CoD based on established corporate finance theories and sets out the approach and methodology for empirical analysis (section 5 and 6).
- Third, it comments on the implications of the empirical analysis for the calibration of the PR24 CoE (section 7).

3.3 Authors

This Report has been written in conjunction with Professor Alex Edmans, who is a sub-contractor of KPMG LLP.

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

[33] The following inflation assumptions, from the respective determinations, to derive the nominal values: PR24 FM: 2.00%, PR19 (CMA): 2.00%, PR19 (FD): 2.00%, PR14: 2.80%, PR09: 2.50%.

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

4 Analysis of observed differentials between allowed CoE and market pricing of debt

This section explores the pricing dynamics between allowed CoE and yields on the benchmark index during PR14, PR19 and following the publication of the PR24 FM. It comments on the evolution on the differential between allowed CoE and prevailing market pricing of debt and its implications for investability and financeability during PR24. The PR24 CoE reflected in the analysis in the section has been updated to reflect a June 2023 cut-off in terms of data with no changes to methodology[34].

Corporate finance theory implies that equity bears more risk that debt and hence that allowed CoE should be assumed to remain sufficiently above the current CoD to promote equity investment in the sector and price in risk differentials for different claims on the same asset. This has been recognised by the UKRN and the CMA (section 3.1).

Assuming no changes in the risk exposure faced by equity investors, the differential observed over the most recent price controls provides a natural point of reference for the PR24 differential given that:

- Past differentials will reflect investor expectations on the pricing of the incremental risk of equity relative to debt.
- Financeability metrics could deteriorate to levels which are not consistent with the target credit rating for the notional firm.

The observed differential from previous price controls would not reflect any changes in forward-looking risk exposure – to the extent that equity risk is increasing and is not accompanied by an equivalent increase in the risk borne by debt, the differential between the pricing of CoE and current CoD would be expected to widen.

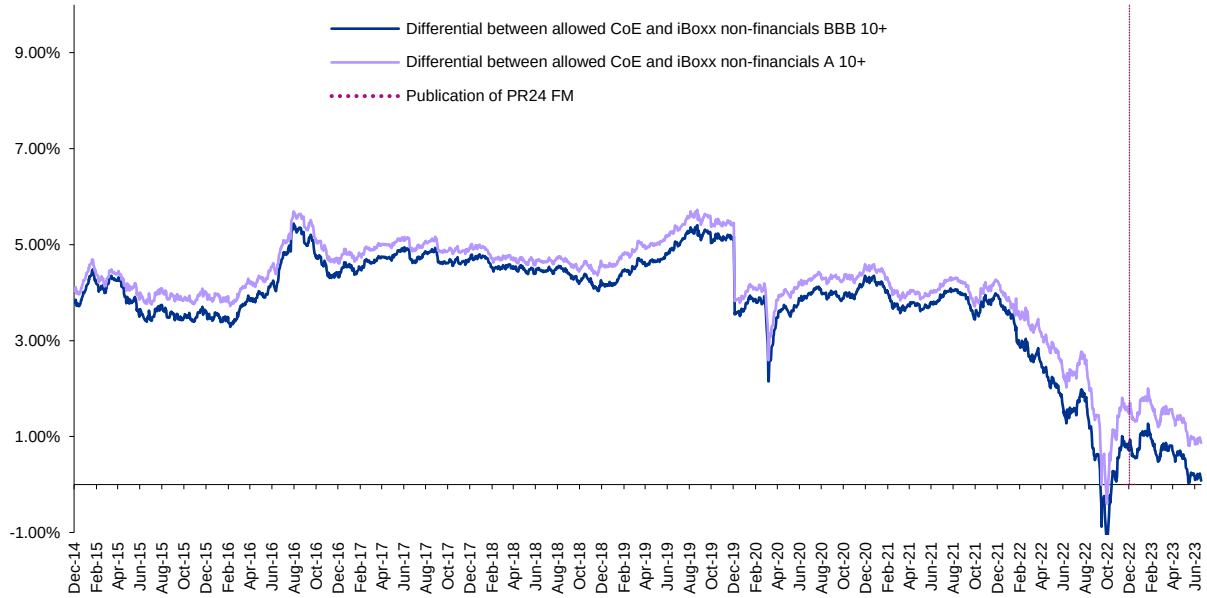
The figure below shows the evolution of the differential between allowed CoE and yields on the benchmark indices as a proxy for current borrowing costs. The effective maturity of the A/BBB non-financials index is close to 20 years such that the investment horizons implied in CoE and debt pricing are broadly consistent.

Apart from the early Covid19 period (February – March 2020) the differential has remained broadly stable until 2022 where it experienced a material reduction. The initial reduction from 2022 onwards was likely driven by a combination of step changes in market rates and limited responsiveness of the regulatory CoE to such changes. It was likely exacerbated by the changes in the methodology for CoE estimation stipulated in the PR24 FM.

Since the end of May 2023, the differential between allowed CoE and the yields on the BBB-rated has been very close to zero (Figure 7) which effectively assumes that equity has the same risk exposure as BBB-rated debt. This is not consistent with corporate finance theory.

[34] This results in an increase of 22bps in the appointee CoE.

Figure 7 Evolution of the differential between allowed CoE and yields on the benchmark index (on a comparable 55% gearing basis)

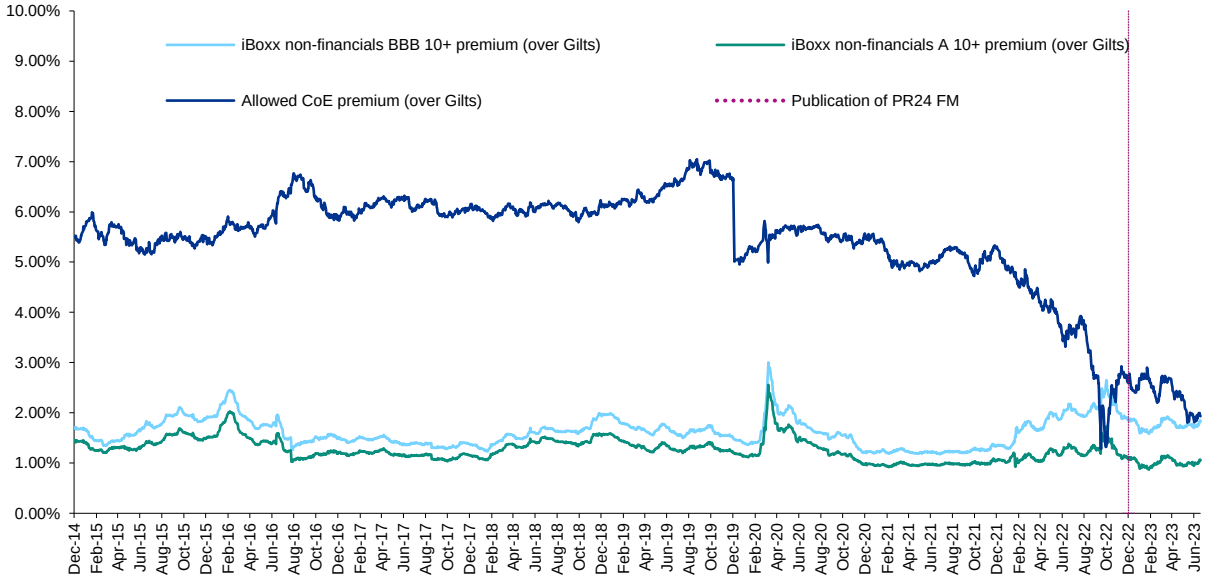


Note: Compares nominal yields on iBoxx indices to allowed CoE converted to nominal using long-term inflation assumptions in respective regulatory decisions. From the publication date of the PR24 FM, the estimate for the allowed CoE for PR24 is based on (1) the FM methodology and (2) an updated data cut-off of June 2023.

Source: KPMG analysis of Ofwat, CMA decisions and Refinitiv Datastream data.

Figure 8 illustrates that the implied premium (over Gilts) for CoE has decreased materially from the beginning of 2022 whereas debt premia have remained relatively stable. This suggests that the observed reduction in the differential between allowed CoE and yields on the benchmark index is driven by the allowed CoE.

Figure 8 Evolution of CoE (on a comparable 55% gearing basis) and benchmark index premia (over Gilts)



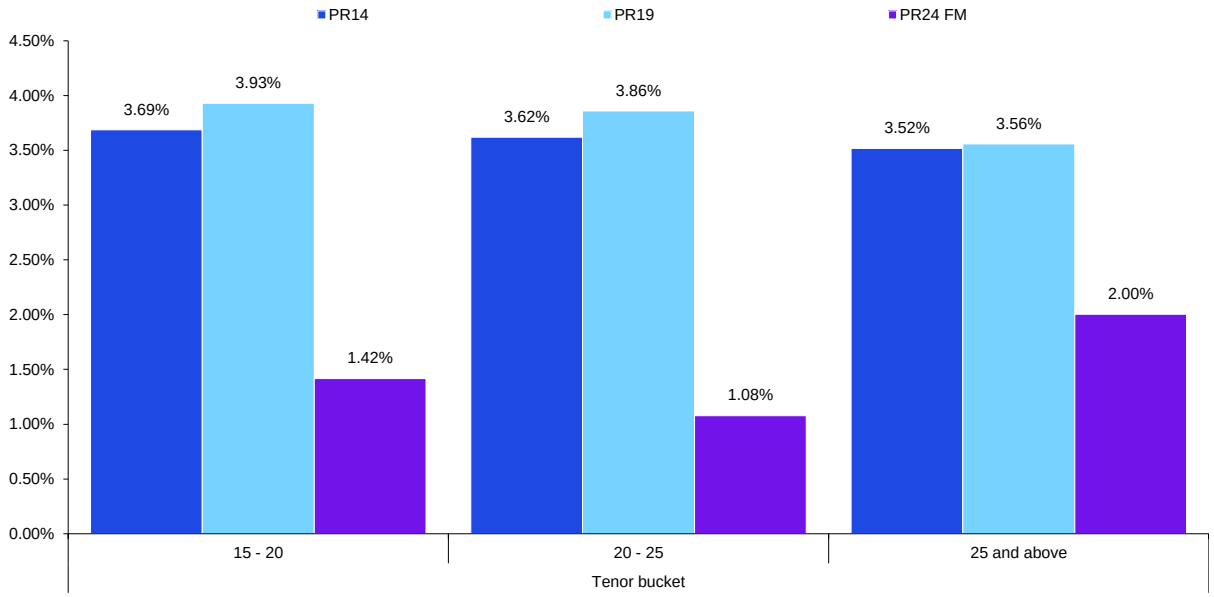
Note: Compares nominal yields on iBoxx indices to allowed CoE converted to nominal using long-term inflation assumptions in respective regulatory decisions. Premium calculated relative to the 20Y nominal gilt yield. From the publication date of the PR24 FM, the estimate for the allowed CoE for PR24 is based on (1) the FM methodology and (2) an updated data cut-off of June 2023.

Source: KPMG analysis of Ofwat, CMA decisions and Refinitiv Datastream data.

A similar comparative analysis can be undertaken for outturn yields on water company debt which may more closely reflect the borrowing costs faced by the companies relative to the notional benchmark index and is more likely to be considered by investors when assessing the relative attractiveness of different investment opportunities.

Figure 9 compares the allowed CoE and traded yields during the 6-month window preceding the publication of the regulator's decision to reflect the market conditions and information that would have been available at the time of decision-making. The figure illustrates that there has been a significant decrease in the differential between allowed CoE and yields on traded water company debt based on PR24 relative to previous price controls.

Figure 9 Differential between allowed CoE (on a comparable 55% gearing basis) and yields on traded water company debt 6 months prior to decision publication



Note: Compares nominal yields on water company fixed rate debt to allowed CoE converted to nominal using long-term inflation assumptions in respective regulatory decisions. Premium calculated relative to the 20Y nominal gilt yield. From the publication date of the PR24 FM, the estimate for the allowed CoE for PR24 is based on (1) the FM methodology and (2) an updated data cut-off of June 2023.
A long-list of water company fixed rate GBP-denominated bonds was sourced from Bloomberg and was narrowed down further based on the availability of credit rating and traded yield information and to exclude bonds with special features such as calls. The resulting instruments were categorised according to prevailing credit rating (A/BBB and sub-investment grade categories) and remaining maturity (15-20 years, 20-25 years, and above 25 years) for comparability. Debt with shorter remaining maturity was excluded for consistency with the long investment horizon implied in the allowed CoE[35].

Source: KPMG analysis of Ofwat, CMA decisions, Bloomberg and Refinitiv Datastream data.

Whilst the analysis in this section focuses on differentials between allowed CoE and debt costs at the investment grade credit rating level, one would also expect to observe a positive but smaller gap between allowed CoE and (1) junior debt issued by OpCos and (2) debt issued by MidCos[36]. Whilst the latter can be viewed as more equity-like than debt found within the regulatory ringfence, it nonetheless holds a superior position in the hierarchy of financing sources when it comes to asset claims during bankruptcy and control rights in the event of financial difficulty or distress at the MidCo

[35] The table below sets out the numbers of instruments being considered under each investment rating and time to maturity bucket. All sampled instruments fall into the A/BBB rating category as sub-investment grade debt is more short-term.

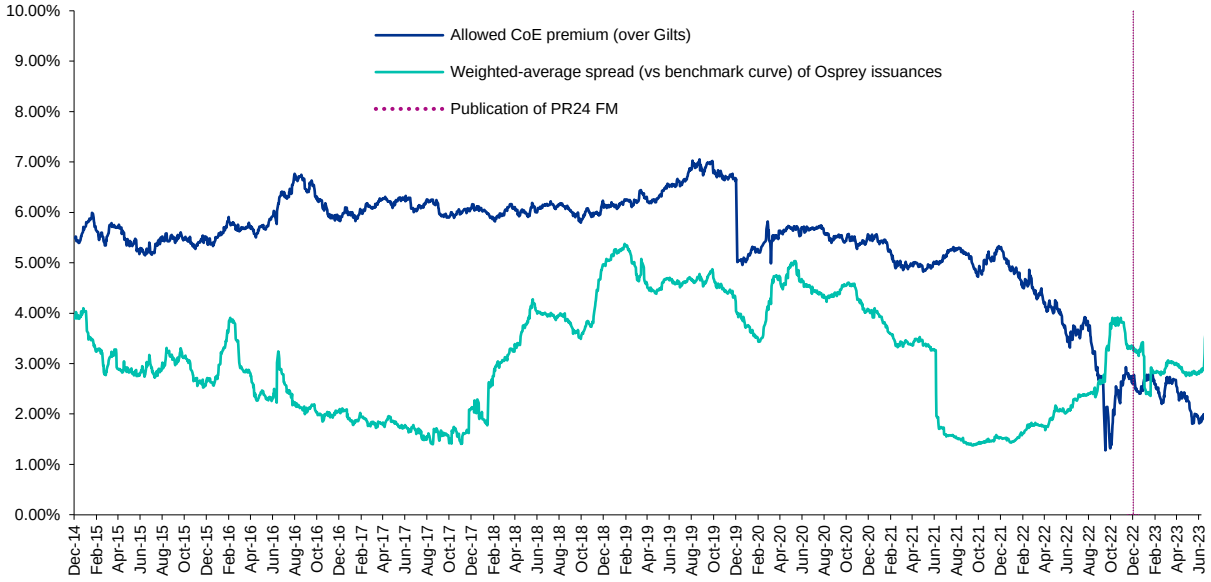
Rating bucket	A/BBB		
Maturity bucket	**15 - 20**	**20 - 25**	**25 and above**
PR14	8	4	8
PR19	5	6	5
PR24 FM	10	1	4

[36] Kemble debt has been excluded from the analysis due to traded yields being affected by company-specific factors which are not necessarily relevant for the estimation of CoE for the sector.

level. As a result, even though MidCo debt sits outside the regulatory ring fence, it can still provide valuable insights on the extent to which allowed CoE reflects the greater exposure of equity relative to debt given that from a lender perspective the risk exposure of this debt is linked to the same regulatory assets and cash flows as OpCo equity.

The figure below sets out the evolution of the differential between the allowed CoE and yields on MidCo debt. For comparability in terms of tenor, the figure is based on spreads / premia relative to gilts. Historically there has been a positive differential between MidCo spreads and allowed CoE which is consistent with the subordinated nature of equity claims relative to MidCo debt. Since 2022, this differential has become negative and so is inconsistent with corporate finance theory and indicative of the miscalibration of CoE.

Figure 10 Differential between allowed CoE (on a comparable 55% gearing basis) and yields on traded MidCo debt



Note: Compares nominal yields on MidCo debt to allowed CoE converted to nominal using long-term inflation assumptions in respective regulatory decisions. MidCo debt has shorter tenor than the investment horizon implied in the CoE and therefore the comparison is on the basis of spreads/premia. CoE premium calculated relative to the 20Y nominal gilt yield. Weighted-average spread on MidCo debt is based on spreads against the benchmark curve (of the closest maturity), weighted based on prevailing market value of the instrument. Excludes the impact of the significant spike in Kemble spreads at the end of June 2023. From the publication date of the PR24 FM, the estimate for the allowed CoE for PR24 is based on (1) the FM methodology and (2) an updated data cut-off of June 2023.

Source: KPMG analysis of Ofwat, CMA decisions and Refinitiv Datastream data.

In principle a reduction in the observed pricing differentials between CoE and current CoD may be appropriate in case of a material reduction in risk borne by equity that is not accompanied by an equivalent reduction in the risk borne by debt. This is unlikely to be the case for PR24 as:

- There is a significant and unprecedented step change in the scale of capital programmes expected for AMP8 and beyond. The scale of required investment reflects a series of environmental obligations, including on the use of storm overflows, transition to Net Zero, environmental targets, abstraction reduction and resilience. All else equal, a step change in the scale of investment would be expected to exacerbate the exposure to existing risks and/or create exposure to new risks.
- There are material changes to the specification of regulatory mechanisms set out in the FM. Notable examples include ODIs – with changes to rates and removal of caps/collars – and the expected increased prevalence of price control deliverables (PCDs) which are, by design, asymmetric[37].

[37] PCDs imply only downside without upside.

- Exposure to regulatory and performance risk in relation to Totex and ODIs affects returns to equity but not to debt. As a result, exposure to equity is expected to increase as more value is put at risk through Totex and ODI regulatory incentives, with limited corresponding impact on debt.

The observed reduction indicates that the CoE is likely miscalibrated and may result in equity investment in PR24 the being deemed less attractive than other available opportunities with better risk-reward profiles. In the most recent period the returns available for equity investment in the UK water sector have been broadly commensurate with those available from BBB-rated debt which does not recognise the additional risks that equity faces due to its subordinated nature of equity and so is inconsistent with corporate finance theory. In this context, it is important to consider the appropriate level of differential for PR24.

Precedent from previous price controls explored in this section suggests that on an ex-ante basis the appropriate differential would be c. 300bps. The subsequent sections of this Report undertake more detailed analysis of the appropriate differential based on debt pricing and the relationship between equity and debt outlined in corporate finance theory.

5 Framework for inferring CoE based on the relationship between debt and equity pricing

This section sets out an overall framework for inferring the CoE based on debt pricing and specification of the key drivers of the relationship between debt and equity pricing as outlined in corporate finance theory. The purpose of this analysis is to inform the assessment of the appropriate differential in current market conditions.

Merton's (1974)[38] contingent claim framework – developed as part of his work on option and derivative pricing – and its modern applications represent a potential basis for estimation of CoE based on the interrelationship between equity and debt pricing.

In Merton's framework, debt and equity are considered contingent claims over a firm's assets[39]. This framework views equity as a European call option, exercised when firm assets exceed debt value, granting shareholders the right to acquire assets. When assets fall below debt value (signifying default), shareholders forgo this option, leaving assets for debtholders. Debt is akin to risk-free debt and shorting a European put option on assets. If assets surpass debt value, equity holders repay the debt, granting debtholders the debt's value instead of firm assets.

The values of debt and equity are intrinsically related to the value of the firm's assets. When the firm's asset value rises, equity holders benefit from larger residual claims, and debt value benefits from the reduction in the firm's leverage and the lower likelihood of default. Conversely, a decline in asset value diminishes the residual claims of equity holders and heightens the risk of default. Consequently, all else equal, the expected returns on equity and debt exhibit a positive correlation, as both are sensitive to the underlying factors that affect the firm's asset value.

Campello, Chen and Zhang (2008)[40] have developed an analytical formula (see Equation (1) below) to estimate the expected equity return based on the relationship between equity and debt inferred from Merton's framework. Their research is published in the top-ranking Review of Financial Studies.

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[38] Merton, R. C. (1974). On the pricing of corporate debt: The risk structure of interest rates. *The Journal of Finance*, 29(2), 449-470.

[39] The framework views equity as a European call option, while debt is considered as a European put option.

- Equity holders are effectively holding a European call option on the firm's assets, which means that they have the right, but not the obligation, to obtain the firm's assets by paying off the debt. Their net payoff is the residual value of the firm, the difference between the asset value and the debt value. They will thus exercise the option when the residual value if positive, i.e., when the firm's asset value exceeds the value of debt.
    - When the value of a firm's assets is lower than the value of debt (i.e., the company is in default), then the payoff from exercising the option is negative – shareholders would lose money by paying off the debt to obtain assets of lower value. They will thus allow the option to expire worthless, leaving debtholders with all of the firm's assets.
    - When the value of a firm's assets is higher than the value of debt, shareholders can exercise their call option to buy the assets, retaining the residual claim on the firm's assets.
- Debt holders are effectively holding risk-free debt and shorting a European put option on the firm's assets. the risk-free debt reflects the money they have lent and expect to be repaid Unlike the buyer of an option which has the right, but not the obligation to exercise his option, the option seller, in this case the debtholder, gets what the option holder chooses to leave them with. When the value of the firm's assets is lower than the value of debt (i.e., the company is in default), equity holders choose not to exercise their option to buy the firm's assets; instead, they leave the firm's assets to the debtholders and do not repay the debt.
    - When the value of the firm's assets exceeds the value of debt, equity holders choose to repay the debt. Thus, debtholders receive the value of the debt rather than the firm's assets.

[40] Campello, M., Chen, L., & Zhang, L. (2008). Expected returns, yield spreads, and asset pricing tests. *The Review of Financial Studies*, *21*(3), 1297-1338.

The inputs into this formula are the elasticity of the equity value with respect to debt value ($\frac{\partial E/E}{\partial D/D}$) and the expected cost of debt which is the company's weighted-average bond yield adjusted for default risk.[41]

Equation (1)

$$E[r_E] - r_f = \frac{\partial E/E}{\partial D/D} (E[r_D] - r_f)$$

Elasticity ($\frac{\partial E/E}{\partial D/D}$) reflects the percentage change in the value of equity relative to the percentage change in the value of debt, which is equivalent to the ratio of return on equity to the return on debt. If elasticity is high (i.e. a small change in the value of debt leads to a large change in the value of equity), then equity is much riskier than debt and so the equity risk premium $E[r_E] - r_f$ will be much larger than the debt risk premium $E[r_D] - r_f$.

This Report uses Equation (1) to infer CoE based on the elasticity of debt to equity and debt pricing. Academic literature suggests two ways of decomposing elasticity into key drivers. One approach is based on Schaefer and Strebulaev (2008)[42] and the Black-Scholes-Merton option pricing model[43] and the other on Friewald, Wagner and Zechner (2013)[44].

These approaches are described in Appendix 1. They suggest that risk-free rate, asset volatility, debt volatility, equity volatility, market leverage and time to maturity of the firm's debt[45] represent the key drivers for elasticity. The analysis undertaken in this Report follows the methodology put forward by Campello et al., in which the key drivers considered are the risk-free rate, market leverage, and equity volatility[46]. These drivers underpin empirical estimation of CoE based on CoD pricing in the next section.

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[41] Campello et al. (2008) explain why bond yield data could be used to represent investors' expected return on debt. Bond yields are computed in the spirit of forward-looking internal return, capturing factors such as probability of default and yield spreads that incorporate the expected risk premiums associated with default risks. Controlling for default risks, bonds with higher systematic risk should have higher yield spreads.

[42] Schaefer, S. M., & Strebulaev, I. A. (2008). Structural models of credit risk are useful: Evidence from hedge ratios on corporate bonds. *Journal of Financial Economics*, *90*(1), 1-19.

[43] Black-Scholes-Merton model is an option pricing model that determine the fair value of a stock option based on the price of the underlying asset, the strike price of the option, risk-free rate, time to maturity of an option, and the volatility of an asset.

[44] Friewald, N., Wagner, C., & Zechner, J. (2014). The cross-section of credit risk premia and equity returns. *The Journal of Finance*, *69*(6), 2419-2469.

[45] This Reports estimates the inferred CoE for a 20Y investment horizon based on yields on the benchmark index with similar maturity. As the horizons of CoE and CoD are aligned, time to maturity is not included as an independent variable in the regression.

[46] The methodology used by Campello et al. focuses on equity volatility which is measured as the standard deviation of daily stock returns. As asset volatility is not considered directly in the empirical analysis in subsequent sections, this Report does not comment on its relationship with elasticity.

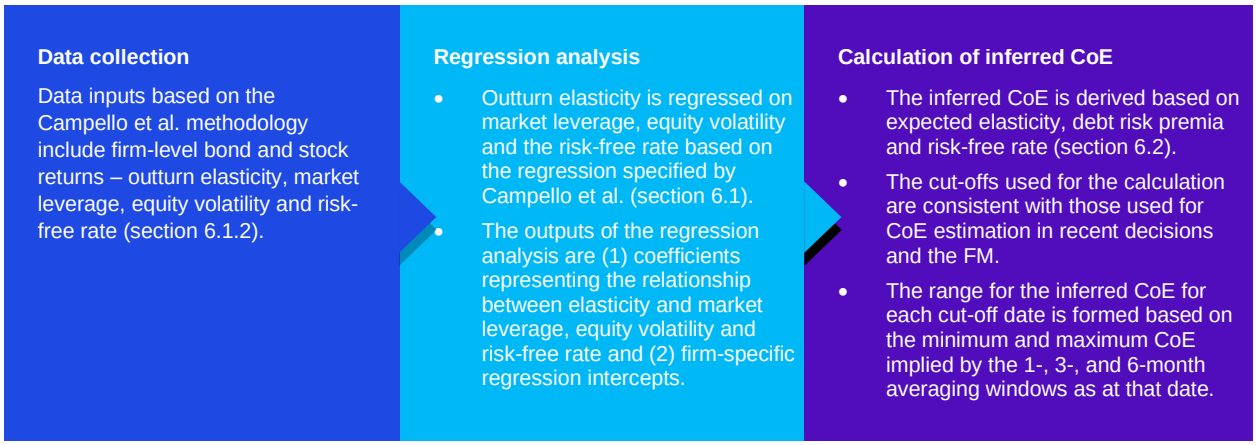
6 Methodology for inference analysis to estimate CoE based on debt pricing

This section sets out the approach and data used for the estimation of inferred CoE using the analytical formula developed by Campello, Chen and Zhang (2008) (Equation (1)).

The calculation of inferred CoE based on this formula requires an estimate of the expected elasticity for listed water companies as well as estimates of debt risk premia and risk-free rate.

The section first comments on the methodology for estimating the expected elasticity, including the specification of the regression, data collection, and the calculation of the expected elasticity based on regression outputs. It then comments on how the expected elasticity is combined with debt risk premia and risk-free rate to generate a range for the inferred CoE.

Figure 11 Overview of the methodology for the estimation of inferred CoE



6.1 Outline of the methodology for the estimation of expected s

The elasticity used for estimating the expected CoE is the expected elasticity, which reflects the expected relationship between equity and debt returns based on the drivers suggested by Merton's framework, including market leverage, equity volatility and risk-free rate. The relationships between elasticity and its drivers are established through a regression analysis conducted over an extended timeframe. This approach ensures that the derived elasticity reflects the underlying fundamental relationships, free from distortions caused by transient factors.

These relationships (represented by regression coefficients) in conjunction with the values of drivers based on most up-to-date market data are used to calculate current expected elasticity (expected elasticity).

6.1.1 Regression framework specification based on outturn elasticity

To derive expected elasticity, Campello et al. (2008) regress outturn elasticity ($\frac{\partial E/E}{\partial D/D}$) on historical market leverage, equity volatility and the risk-free rate based on monthly frequency bond and stock data[47].

Equation (2)

$$\frac{\partial E/E}{\partial D/D}_{it} = \alpha + \beta_{lev}\ Leverage_{it} + \beta_{vol}\ Volatility_{it} + \beta_{rf}\ r_{f_t} + \varepsilon_{it}$$

where

- $\frac{\partial E/E}{\partial D/D}_{it}$ is the outturn elasticity, measured as the change in the market value of equity divided by the change in the market value of debt. The market value of debt is calculated by scaling the book value of debt using the weighted average bond market price
- α is the intercept term
- $Leverage_{it}$ is the market leverage, measured by the ratio of market value of debt to market value of equity
- $Volatility_{it}$ is the equity volatility, measured by the standard deviation of daily stock returns, based on a rolling window of 180 days
- r_{f_t} is the 30-day Treasury bill rate
- ε_{it} is the error term, representing the difference between the actual elasticity based on market data and the expected elasticity based on the regression
- i and t refer to each firm i at each time t. The data used in the regression has both a cross-sectional component (different firms at a given time t) and a time-series component (each firm i over different time t). As the regression contains multiple firms over time, it is a panel regression[48]

6.1.2 Approach to data collection

The Report relies on the period from October 2014 to June 2023 informed by the following considerations.

First, January 2013 to June 2023 is the longest window for which it is possible to draw a robust sample size based on bond returns available from Bloomberg[49] [50].

Second, the analysis undertaken by KPMG and Gregory et al (2020)[51] found a structural break[52] in water sector betas around the PR14 period[53] (c. October 2014), signalling a change in systematic risk

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47 Campello et al. conduct the regression based on 1205 nonfinancial firms listed in the U.S. from January 1973 to March 1998.

48 Panel regression is a type of regression that contains data with both cross-sectional and time-series dimensions. Panel data sets consist of observations on multiple firm over time.

49 Campello et al. use data collected from Lehman Brothers Fixed Income Database, which provides bond-specific data in the US from January 1973 to December 1997. This source is not available in the UK.

50 Relative to the later years, the number of companies with bond data available before 2013 decreases significantly to be less than 50 companies. This could be because Bloomberg does not have the bond data for stocks listed in the earlier years which subsequently de-listed and could result in the results being affected by survivorship bias should these periods be included in the analysis.
Survivorship bias results from the use of a dataset that consists of survivors over a period, not the full set of companies that were listed. As the characteristics of survivors are likely to differ systematically from those who have delisted, the results will be biased. Therefore, the report uses the period from 2010 onwards to reduce the likelihood of survivorship bias.

51 Gregory, A., Harris, R., and Tharyan, R. (2020). A response to the CMA's Provisional Findings on Water and the Estimation of Beta

52 In econometrics and statistics, a structural break is an observable change over time in the parameters of regression models, which can lead to forecasting errors and unreliability of the model. In the case of beta measurement, the most obvious structural break would come from a distinct and meaningful change to the gearing at companies being measured.

53 Gregory, A., Harris, R., and Tharyan, R. (2021), The Evolution of Beta Through the Covid Crisis, Gregory, A., Harris, R., and Tharyan, R. (2020). A response to the CMA's Provisional Findings on Water and the Estimation of Beta, Gregory, A., Harris, R., and Tharyan, R. (2020). A Report on the Estimation of Beta for Regulatory Charge Control Purposes.

exposure relative to past periods due to the changes in the nature of the regulatory regime. Ofwat has previously recognised the existence of this break "***regulatory reforms can change a sector's systematic risk.*** *For example, before 2015, our determinations were set as controls on tariffs, but since PR14 we have set total revenue controls for wholesale activities, with an accompanying reduction in revenue risk"*[54].

This change in the risk borne by equity does not appear to have been accompanied by an equivalent change in the risk borne by debt[55]. All else equal, this suggests that the risk relationship between debt and equity may have changed post-PR14 and that data from 2014 onwards is most relevant for inferring a froward-looking CoE.

The collection of data for the analysis is undertaken in three steps:

- Step 1: Obtain the list of all stocks listed in the London Stock Exchange for each year
- Step 2: Apply the filtration criteria to exclude non-financial companies and Alternative Investment Market (AIM) listed companies
- Step 3: Download firm-level bond and stock data required for the regression

Step 1

The London Share Price Database (LSPD)[56] is used to obtain a list of all the stocks listed on the London Stock Exchange from 2013 to 2023. LSPD provides a comprehensive list of stocks from 1955 to date, including companies that have since de-listed and / or gone bankrupt. De-listed stocks are included in the dataset to avoid survivorship bias.

Step 2

The list of stocks obtained from LSPD is filtered as outlined in the table below.

Table 2 Filtration criteria and rationale

Criterion	Treatment	Rationale
Financial firms[57]	Exclude	The implications of high leverage are different across financial and non-financial firms (consistent with Campello et al.). Whilst high leverage is common for financial firms and not indicative of financial distress, in non-financial firms, high leverage may indicate financial distress or difficulty.
AIM listed firms[58]	Exclude	AIM-listed firms are excluded to capture the tradable and investable universe for institutional investors. AIM-listings include many small and illiquid stocks. AIM stocks have not historically been viewed as investible by many fund managers due to their high failure rates and poorer standards of reporting. Therefore, the UK studies focus on the Main Market of the London Stock Exchange and exclude AIMs.

Stocks that are not excluded based on the filtration criteria above are then taken forward to the next step for data collection.

Step 3

The dependent and independent variables used in the regression include firm-level bond and stock returns, outturn elasticity, market leverage, equity volatility and risk-free rate. The methodology for deriving these variables is broadly consistent with Campello et al. with targeted exceptions as set out below.

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

55 Interpolated 20Y credit spreads on SVT/UUW fixed rate debt have remained relatively stable since 2010 and have closely tracked the spreads on A/BBB indices. Periodic spikes in observed volatility in the SVT/UUW spreads correlate closely with the developments in the wider UK market such as Brexit, Covid19, 'Trussonomics', so appear more market- rather than sector-driven.

56 London Share Price Database | Finance | London Business School

57 Sector information as of each year is obtained using Bloomberg and DataStream based on Global Industry Classification Standard (GICS) definition of sectors.

58 The classification of AIM-listed stocks is obtained from LSPD.

- Leverage is measured on the same basis as in Campello et al., i.e. as the ratio of market value of debt to market value of equity, where market value of debt is obtained by scaling the book value of debt by the weighted-average bond market price.
- Stock volatility is measured in the same manner as in Campello et al. i.e. based on the 180-day daily stock return volatility. The daily stock return is calculated as the daily percentage change in the Total Return Index (TRI).
- Risk-free rate is measured based on the yields on the 20-year nominal gilt whereas Campello et al. use the 30-day treasury bill rate. As shown in equation (4) in Appendix 1, risk-free rate is used to calculate the delta (Δ) of the call option, which in this case is the value of equity. Consequently, a long-term measure of risk-free rate is used to reflect the long-term horizon of equity investors.
- Outturn elasticity ($(\frac{\partial E/E}{\partial D/D}$) is calculated based on the ratio of month-on-month total return on equity to total return on debt, whereas Campello et al. use the ratio of month-on-month changes in the market value of equity to market value of debt.

Merton (1974) – upon which Campello et al's analysis is based – uses a simplified model that assumes that there are no coupon payments on bonds, no cash dividends, no share repurchase or new equity or debt issuance[59]. Under these simplified assumptions, the changes in the market value of debt and equity could be used to capture investors' returns, as the only driver of returns would be the movement of market price.

These simplified assumptions do not hold in practice meaning that changes in market values of debt and equity are a poor proxy for total returns received by equity and debt investors. In contrast, total returns capture returns arising from capital gains and the coupons and dividends received by investors. As a result, the total return is used to measure elasticity as follows:

- The total return on equity ($\partial E/E$) is measured as the month-on-month % change in TRI of equity. TRI reflects both the market price movement and dividend distributions, assuming the dividend distributions will be re-invested.
- The total return on debt ($\partial D/D$) is measured as the month-on-month weighted average total return on bonds[60] which includes 1) price movement, 2) accrued interest, 3) coupon actually paid out during the month, and 4) interest on interest (i.e. the interest that is earned by re-investing the coupon).

The table below summarises the data sources used for independent and dependent variables.

[59] See page 452 to 453 of Merton, R. C. (1974). On the pricing of corporate debt: The risk structure of interest rates. *The Journal of finance*, *29*(2), 449-470.

[60] i.e. the weighted average total return of all the fixed-rate bonds issued by each company. For comparability (across sampled companies) and simplicity the analysis focuses on fixed-rate bonds.

Table 3 Sources of data for independent and dependent variables

Variable	Underlying data	Data source
Outturn elasticity; Equity volatility	Total Return Index (TRI) on equity	Refinitiv Datastream
Outturn elasticity	Weighted average total return of fixed-rate bonds[61]	Bloomberg
Leverage	• Weighted average fixed-rate bond price[62] • Book value of total debt • Market value of equity	Bloomberg
Risk-free rate	20-year nominal gilt rates	Refinitiv Datastream

6.1.3 Refinement and specification of the panel regression model

Campello et al. use a pooled Ordinary Least Square (OLS) regression (see Equation (2)), which assumes that the average elasticity is the same across different firms. Under this assumption, the intercept term (α) of the regression is a constant term and does not vary across firms.

However, it is reasonable to expect that the average elasticity could vary across firms, due to influence of differentiated factors such as sectors, business risks, management styles etc. This suggests that a firm fixed effect regression – which incorporates a firm-specific intercept (α_i) instead of the constant intercept (α) – would be appropriate. Indeed, firm fixed effects are used in the vast majority of corporate finance analysis and research.

Equation (3) $$\frac{\partial E/E}{\partial D/D}_{it} = \alpha_i + \beta_{lev}\, Leverage_{it} + \beta_{vol}\, Volatility_{it} + \beta_{rf}\, r_{f_t} + \varepsilon_{it}$$

To test whether individual-specific intercept is needed, the Breusch-Pagan Lagrange multiplier test is conducted. The null hypothesis is that (α_i) does not differ significantly across firms, in which case the pooled OLS would be the appropriate specification. The results of the test shows that the p-value is equal to 0.0%, which unambiguously rejects the null hypothesis. As a result, there are significant differences across firms, and so the firm fixed effect regression is used.

6.1.4 Calculation of elasticity for listed water companies

For comparability with recent regulatory CoE estimates, Severn Trent (SVT) and United Utilities (UUW) are used as proxies for the water sector. The expected elasticity is calculated as the sum of:

- The regression coefficients (β_{lev}, β_{vol} and β_{rf}) multiplied by the historical time series of SVT/UUW market leverage and equity volatility and risk-free rate (the 20Y nominal gilt rate used in the regression).
- The intercept values ($\alpha_{SVT,i}$ and $\alpha_{UUW,i}$).

$$\frac{\partial E/E}{\partial D/D}_{SVT,t} = \alpha_{SVT,i} + \beta_{lev}\, Leverage_{SVT,t} + \beta_{vol}\, Volatility_{SVT,t} + \beta_{rf}\, r_{f_t}$$

$$\frac{\partial E/E}{\partial D/D}_{UUW,t} = \alpha_{UUW,i} + \beta_{lev}\, Leverage_{UUW,t} + \beta_{vol}\, Volatility_{UUW,t} + \beta_{rf}\, r_{f_t}$$

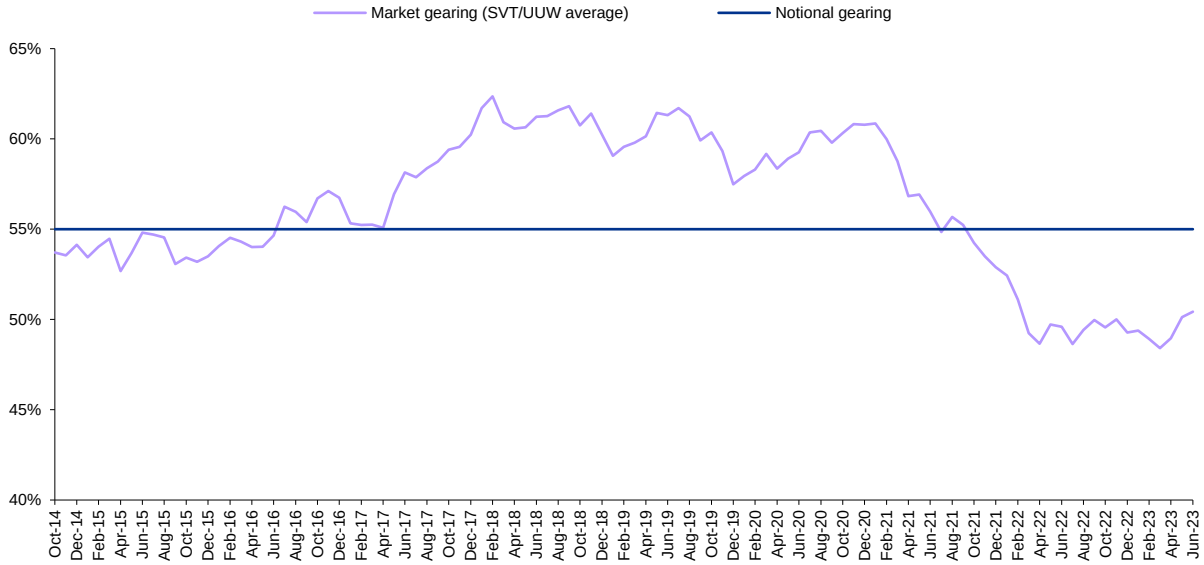
It is noted that the elasticity derived from the regression based on market leverage can differ from the current notional gearing assumption of 55% set out in the PR24 FM.

The figure below sets out the evolution of market leverage[63] (SVT/UUW average) relative to the PR24 notional gearing assumption. Since the beginning of 2022, market leverage has remained below assumed notional gearing in the PR24 FM of 55%, meaning that expected elasticity based on market

[61] Weighted by amount outstanding of all fixed rate bonds issued by a firm.
[62] Weighted by amount outstanding of all fixed rate bonds issued by a firm.
[63] Market leverage is calculated as the ratio of market value of debt to the market value of equity. Consistent with Campello et al., the market value of debt is derived by scaling the book value of debt by the weighted average fixed rate bond price. For example, if the book value of debt is equal to 60, and the weighted average fixed rate bond price is 120, then market value of debt is equal to 60 x (120/100) = 72. The market value of equity is market capitalisation of the firm.

leverage will yield inferred CoE estimates that somewhat *understate* the required returns at the notional gearing level for PR24. The inferred CoE estimates for PR24 in this Report are based on market leverage and can thus be considered to be conservative.

Figure 12 Evolution of market leverage (SVT/UUW average) relative to the PR24 notional gearing assumption



Source: KPMG analysis

Importantly, the Report does not suggest that the market leverage used for the inference analysis is the right market benchmark to inform the notional gearing assumption for the water sector. As is widely acknowledged – including by rating agencies[64] – RCV represents the invested capital on which the water utility will earn a return over time, so the relevant measure of leverage is Net Debt to RCV. In this context, it is appropriate to consider the book value of Net Debt for consistency with the regulatory commitment to allow for the recovery of efficient costs[65]. Separately, in practice, there are significant challenges associated with obtaining up-to-date market values given the prevalence of private debt on companies' books.

6.2 Approach and methodology for estimation of the inferred CoE

The inferred CoE is derived based on expected elasticity, debt risk premia and risk-free rate. The table below provides the specification of methodology and assumptions underpinning this calculation along with associated rationale.

[64] Moody's (June 2018), Rating Methodology, Regulated Water Utilities

[65] Regulated assets are financed with historic debt as a result of which substantive portions of embedded debt is carried through on balance sheets. Given that the regulatory contract is intended to allow 'recovery of efficient costs' – including those of efficiently incurred historic debt – the CoD allowance is based on historic yields at issuance. The allowance assumes that the yield at issuance is the cost that is payable by a regulated firm that holds debt to maturity and for consistency with this assumption considers the book value of debt. Reflecting current market prices in gearing and current yields in the cost of debt allowance, will not only reflect the change in the market price of debt given the reduction in tenor of the debt as it approaches maturity, but will also mark down (or up) costs based on the observed prevailing level of interest rates. This would effectively penalise companies for efficiently incurred debt costs, with the benefit of hindsight. In general, it is a long-established UK regulatory policy to allow the efficient cost of embedded debt, and not to penalise an otherwise efficient company for market movements which are outside of its control.

Table 4 Methodology and assumptions underpinning the estimation of inferred CoE

	Approach	Rationale
Cut-off date	30 June 2023, 30 September 2022 and 31 December 2020 used.	Consistent with the cut-offs used for CoE estimation in recent decisions and the FM. June 2023 cut-off included to assess the impact of latest market data.
Averaging window	1-, 3-, 6-month averages used.	Consistent with averaging windows typically considered for estimation of risk-free rate and cost of debt.
Debt risk premium	Market pricing of debt is derived based on outturn yields on benchmark indices (A/BBB), adjusted for default risk by subtracting an expected default loss rate. The expected default loss rate of 0.15% is calculated based on a 0.24% annualised default rate (the average of highlighted values in Table 5 below) and a 37.7%[66] recovery rate for senior unsecured bonds sourced from Moody's 2023 default study.	Consistent with the regulatory approach for setting the allowance for new debt. Campello et al. apply a similar default loss rate adjustment based on Moody's data in their analysis.
Treatment of inflation	Inferred CoE is derived in CPIH-deflated terms in three steps: First, an equity risk premium is calculated by multiplying expected elasticity by a debt risk premium derived from a comparison of default-adjusted nominal yields on the benchmark index and the yields on the 20Y nominal gilt. Then an inferred CoE is calculated as the sum of the yields on the 20Y nominal gilt and the equity risk premium. Lastly, the nominal inferred CoE is converted into a CPIH-deflated value based on the 20Y CPI swap rate[67].	Consistent with the approach for estimating the regulatory CoE which does not reflect compensation for the inflation risk premium (given that it is estimated using index-linked gilts and a real total market return). The deflation using the CPI-swap rate strips out both market-based inflation expectation and the inflation risk premium from nominal inferred CoE. The resulting inferred CoE is thus consistent with the regulatory methodology.

Source: KPMG analysis

Table 5 Cumulative and annualised default rates for A/BBB corporate issuers

Rating category	Time period	Time horizon	Cumulative default rate	Annualised default rate	Source
A3	1983 - 2022	10Y	2.00%	0.20%	[1]
		20Y	5.30%	0.27%	[1]
Baa1	1983 - 2022	10Y	2.20%	0.22%	[1]
		20Y	6.00%	0.30%	[1]
A/BBB	1983 - 2022	10Y	2.10%	0.21%	[1]
		20Y	5.65%	0.28%	[1]
A3	1998 - 2022	10Y	2.20%	0.22%	[2]
Baa1	1998 - 2022	10Y	2.20%	0.22%	[2]
A/BBB	1998 - 2022	10Y	2.20%	0.22%	[2]

Notes: (1) Cumulative default rates are issuer-weighted; (2) Annualised default rate = cumulative default rate / time horizon
Source: KPMG analysis of Moody's 2023 Annual default study: Corporate default rate will rise in 2023 and peak in early 2024.
[1]: Moody's 2023 Annual default study Exhibit 41; and [2] Moody's 2023 Annual default study Exhibit 42

[66] Moody's (2023), Annual default study: Corporate default rate will rise in 2023 and peak in early 2024, Exhibit 7
[67] Sourced from Bloomberg.

The range for the inferred CoE for each cut-off date is formed based on the minimum and maximum CoE implied by the 1-, 3-, and 6-month averaging windows as at that date.

Differentials between the inferred CoE and debt pricing for comparison with the PR24 FM (September and June 2023 cut-offs) are calculated as follows:

- The inferred CoE is converted into CPIH-real terms using CPI swaps. This is consistent with the regulatory approach that strips out both market-based inflation expectation and the inflation risk premium from the estimation of CoE (by using index-linked gilts as a benchmark).
- iBoxx yields are converted to CPIH-real values using long-term inflation of 2% consistent with the approach used in the PR24 FM.
- The real iBoxx yields are deducted from the real inferred CoE for each averaging window at each cut-off date.

7 Inference analysis results and implications for CAPM-implied returns at PR24

This section sets out the results of the inference analysis and comments on its implications for the allowed CoE at PR24.

The role of the inference analysis cross-check in the estimation of the PR24 CoE

A cross-check based on Merton's (1974) framework and its practical applications aligns with the principles described in section 3.1.

- Unlike traditional asset pricing models, Merton's framework is not dependent on a specific model for asset valuation, meaning that the resulting cross-check would be derived from outside the CAPM framework, in line with Ofwat's preferred specification of cross-checks at PR24.
- Merton's framework acknowledges the impact of a firm's risk exposure on both debt and equity returns, whilst recognising that equity inherently carries higher risk than debt. Consequently, it can be utilised to derive a cross-check for the CoE, incorporating the risk differentials between equity and debt capital. The framework further allows for the fact that the differential between debt and equity will depend on various factors, such as leverage, which may vary over time.
- This cross-check would also reflect the prevailing market conditions and the risk environment, both in terms of the level of return and the interrelationship between the equity and debt.

This is in line with Damodaran who considers that "*there should be a relationship across the risk premiums in these asset classes* [corporate bonds, stocks, and real estate] *that reflect their fundamental risk differences… there is enough of a relationship here that we would suggest using this approach as a secondary one to test to see whether the equity risk premiums that we are using in practice make sense, given how risky assets are being priced in other markets*"[68].

As a result, this section explores a cross-check based on Merton's framework to sense-check CAPM-derived CoE for water companies based on current debt pricing.

In this context, it is important to note that the Report does not propose that an approach based on Merton's framework and its practical applications can yield a precise estimate of the required CoE. As recognised by Damodaran, there may be some noise in the estimation of equity risk premia from debt risk premia, driven by the different nature and risk exposures of each type of capital.

Estimation of CoE is inherently a complex task, necessitating the consideration of multiple available estimation techniques, data sources, and additional factors such as policy objectives. This is particularly the case where there has been a step change in macroeconomic conditions and firms need to attract equity capital to support unprecedented levels of investment in AMP8 and beyond.

In this context, this Report considers that the Merton framework and its practical applications can provide valuable insights into the relationship between required returns on equity and debt for the same firm. The remainder of this section comments on the results and implications of the inference analysis for PR24 CoE.

Expected elasticity estimates for listed water companies

The starting point for the derivation of inferred CoE is the estimation of expected elasticity based on regression analysis described in section 6.1.

[68] Damodaran A., Edition Equity Risk Premiums (ERP): Determinants, Estimation, and Implications – The 2023 Edition

The firm fixed effect regression, excluding outliers[69], results in the following coefficients for α and β.

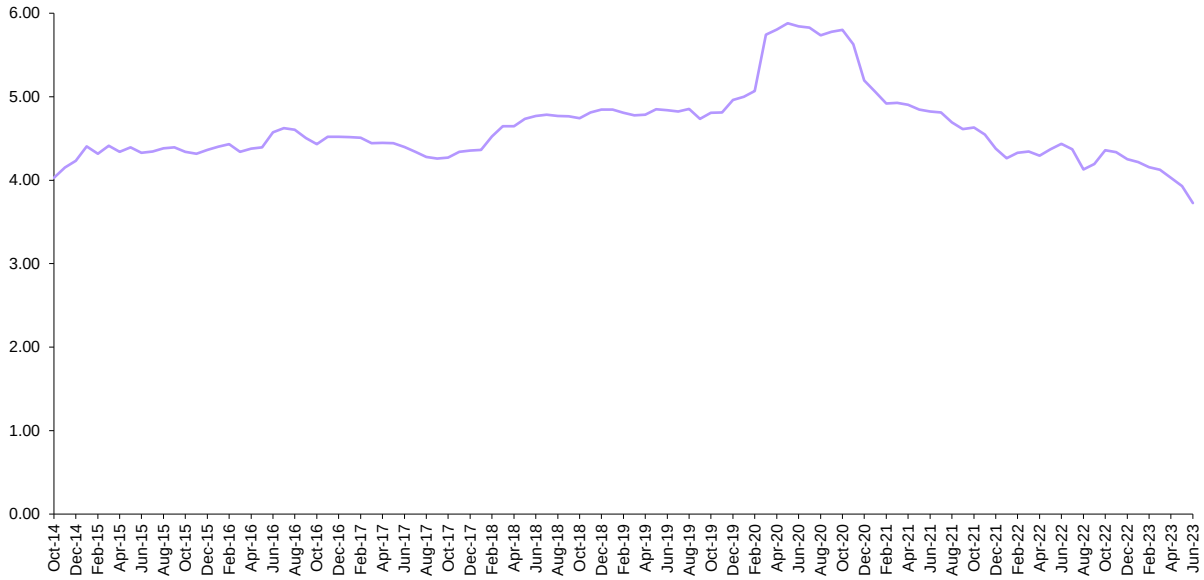
$$\frac{\partial E/E}{\partial D/D_{it}} = \alpha_i + 0.096\ Leverage_{it} + 91.391\ Volatility_{it} - 0.299\ r_{f_t} + \varepsilon_{it}$$

α_i is equal to 4.25 and 3.45 for SVT and UUW, respectively.

Market leverage and stock volatility are positively correlated with elasticity, while the risk-free rate is negatively correlated. All three independent variables are jointly statistically significant at a 1% significance level, which suggests that they jointly explain the outturn elasticity. Additionally, stock volatility is statistically significant at a 10% level.

As illustrated in in Figure 13, apart from a temporary spike during the height of the Covid19 pandemic in 2020, elasticity remained broadly stable until 2022 where it experienced a modest decrease. All else equal, the level and trend of expected elasticity suggest that there should continue to be a significant differential between debt and equity pricing at PR24, albeit with a modest reduction relative to observed differentials implied by regulatory determinations and debt pricing at PR19.

Figure 13 Expected elasticity for SVT/UUW (average)



Source: KPMG analysis

A comparative analysis of inferred and CAPM-derived CoE estimates

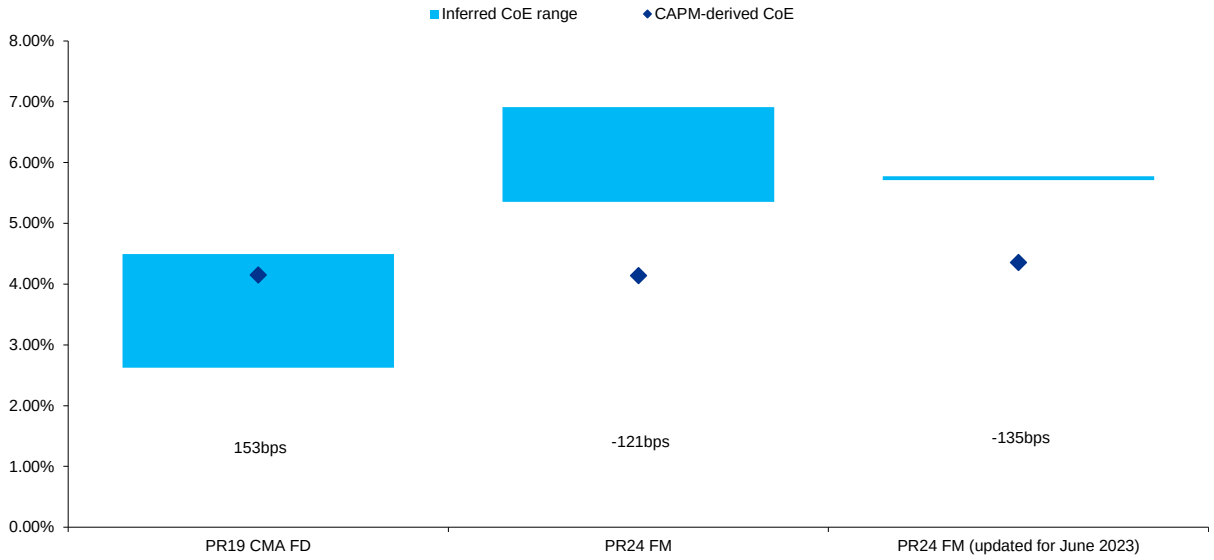
To assess the impact and implications of the inference analysis for the allowed CoE at PR24, the Report undertakes two comparisons, which consider (1) how the CAPM-derived CoE estimates compare to inferred CoE estimates and (2) how the differentials between CoE and current debt pricing implied by the CAPM-derived CoE compare to those implied by the inferred CoE. In each of the charts below, the diamond represents either the CAPM-derived CoE or the CAPM-implied differential and the floating bar represents the range implied by the inference analysis. The data labels

[69] This is done by winsorisation, a data cleaning technique commonly adopted in statistics to mitigate the impact of extreme values (outliers) on the coefficient estimates of the regression, which reduces estimation bias and provides more accurate regression outputs. In this Report outliers are 'capped' meaning that they are replaced with the nearest non-outlying values within a specified range. A 5% winsorisation is applied to elasticity ($\frac{\partial E/E}{\partial D/D_{it}}$), which means that all observations greater than the 97.5th percentile are set to be equal to the 97.5th percentile, and all observations lower than 2.5th percentile are set to be equal to 2.5th percentile.

represent the difference between the CAPM-derived values and the lower bound of the range from inference analysis[70].

As set out in Figure 14, the CAPM-derived CoE based on the methodology from the PR24 FM is c.120 – 140bps below the lower bound of the inferred CoE range, using September 2022 and June 2023 cut-offs, respectively. In contrast, the CMA's PR19 allowed CoE was within the range implied by inference analysis (albeit the inferred CoE for PR19 is likely to be overstated as market leverage exceeded current notional gearing assumptions in AMP6). All else equal, this suggests that the CAPM-derived CoE based on the PR24 FM is not consistent with current market pricing of debt and the relationship between debt and equity pricing expected based on corporate finance theory and implied by the CMA's PR19 re-determination.

Figure 14 Comparison between inferred and CAPM-derived CoE

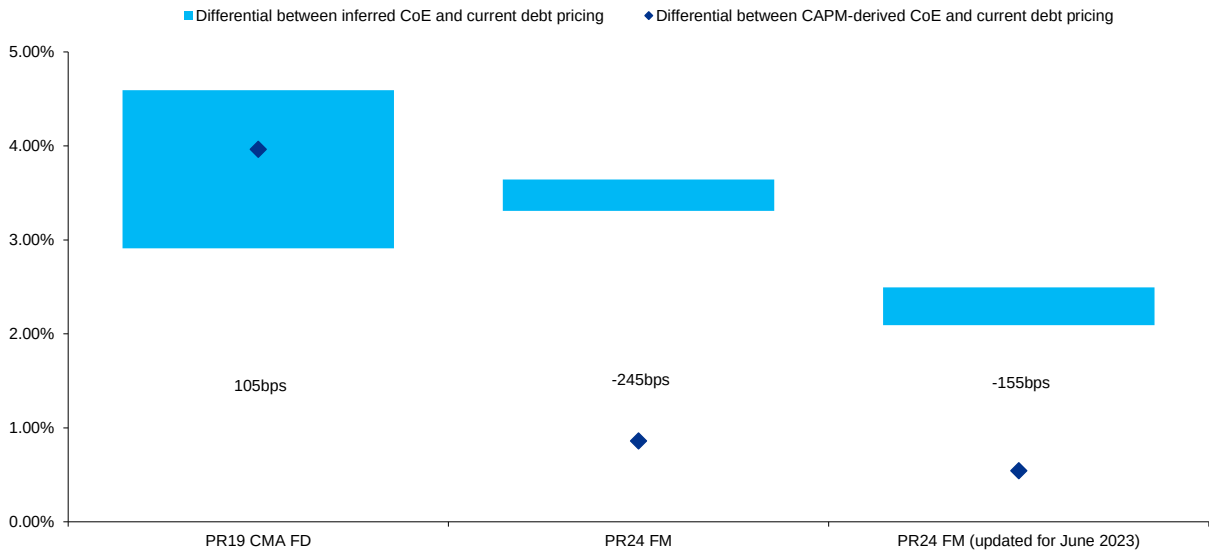


Source: KPMG analysis

Figure 15 below further illustrates that the differential between CoE and current debt pricing implied by the CAPM-derived CoE is significantly below that implied by the inferred CoE. The differential for PR24 is also substantively below the differential implied by past regulatory precedent (section 3).

[70] The ranges for inferred CoE and inferred differentials between inferred CoE and current pricing of debt for each cut-off date are formed based on the (1) minimum and maximum CoE and (2) minimum maximum differentials implied by the 1-, 3-, and 6-month averaging windows as at that date. Note that the height of range will not be the same for inferred CoE and differentials. The range for the CoE depends only how different 1-, 3- and 6-month averages of CoE are from each other. The range for the differentials is affected by both CoE and debt pricing. This means that for the two ranges to be consistent, the debt pricing being deducted to calculate differentials would need to be the same based on 1-, 3-, and 6-month averaging windows. This is not the case as debt pricing varies depending on the averaging window.

Figure 15 Comparison of differentials between CoE and current debt pricing implied by inferred versus CAPM-derived CoE



Source: KPMG analysis

Notably, the gaps illustrated in Figure 14 and Figure 15 are conservative estimates given that the inferred CoE for PR24 is derived based on market leverage that is below notional gearing[71][72].

Table 6 Comparison of CoE and differentials between CoE and current debt pricing for inferred versus CAPM-derived CoE[73]

CPIH-real	Cut-off date	Inferred CoE	CAPM-derived CoE	Differential between inferred CoE and current debt pricing	Differential between CAPM-derived CoE and current debt pricing
PR19 CMA FD	31/12/2020	2.62 – 4.50%	4.15%	2.91 – 4.59%	3.96%
PR24 FM	30/09/2022	5.35 – 6.91%	4.14%	3.31 – 3.64%	0.86%
PR24 FM (updated for June 2023)	30/06/2023	5.71 – 5.78%	4.36%	2.09 – 2.49%	0.54%

Source: KPMG analysis
Note: CAPM-derived CoE is always on a 55% notional gearing basis.

[71] It is difficult to translate elasticity from market to notional leverage. The Report explores one approach for deriving a notional inferred CoE. Equation (2) calculates the elasticity of debt to equity as $\frac{\partial D/D}{\partial E/E} = (\frac{1}{\Delta} - 1)(\frac{1}{L} - 1)$ and implies that the elasticity of equity to debt is the inverse, $\frac{\partial E/E}{\partial D/D} = \frac{1}{(\frac{1}{\Delta}-1)(\frac{1}{L}-1)}$. This gives $\frac{\partial E/E}{\partial D/D_{market}} = \frac{1}{(\frac{1}{\Delta}-1)(\frac{1}{L_{market}}-1)}$ and $\frac{\partial E/E}{\partial D/D_{notional}} = \frac{1}{(\frac{1}{\Delta}-1)(\frac{1}{L_{notional}}-1)}$. Therefore, assuming Δ is the same across market leverage and notional gearing, the elasticity based on notional gearing is derived as follows: $\frac{\partial E/E}{\partial D/D_{notional}} = \frac{\partial E/E}{\partial D/D_{market}} \times \frac{(\frac{1}{L_{market}}-1)}{(\frac{1}{L_{notional}}-1)}$. Notably, this is a simplified approach which assumes that Δ is the same for notional gearing and market leverage.
This translation changes the inferred CoE as at June 2023 from 5.71-5.78% to 6.67-6.97% and the differential from 2.09-2.49% to 3.01-3.75%. All else equal, this corroborates that inference of CoE for PR24 based on notional gearing at 55% would be higher than inferred CoE based on market leverage

[72] The Report has examined the impact of sensitising the timeframe used in the regression analysis on the magnitude of the gap between CAPM-derived and inferred CoE estimates. Extending the window to cover the period from January 2010 to June 2023 significantly increases the gap relative to the values in Table 6. Overall, the results derived from the timeframe spanning October 2014 to June 2023 presented in this Report are conservative relative to those based on longer timeframes.

[73] A more detailed version of this table is included in Appendix 2 which shows how inferred CoE and differentials vary based on averaging windows.

Implications for the estimation of PR24 allowed CoE

Water companies are expected to face heightened risks in AMP8 and beyond, driven by the significant expansion and greater complexity of capital programmes, and corresponding increases in delivery risk, as well as a more stretching incentives regime. Exposure to regulatory and performance risk in relation to Totex and ODIs affects returns to equity but not to debt. As a result, exposure to equity is expected to increase as more value is put at risk through Totex and ODI regulatory incentives, with limited corresponding impact on debt. Consequently, all else equal the differential between observed debt and equity pricing based on regulatory CAPM would be expected to *increase* at PR24. This expected dynamic is not reflected in the evolution of debt and allowed equity pricing since PR19.

The scale of the disconnect between equity and debt pricing implied by the CAPM-derived CoE based on the PR24 FM may be indicative of a material miscalibration of the allowed CoE. This, in turn, could mean that the cost of capital materially exceeds allowed returns for AMP8, making investment in PR24 less attractive compared to other opportunities with better risk-reward profiles. Investors are likely to be disincentivised to invest in water sector equity where CAPM-derived equity risk premia, which underpin allowed returns, do not align practically with and reflect appropriate differentials to lower-risk debt pricing.

The potential customer detriment arising from the under-estimation of CoE is particularly acute for PR24 given that it will be necessary for the notional firm to attract significant new equity capital to fund the substantial new investment required for AMP8 and beyond, which will in turn be contingent on allowed returns that adequately compensate for forward-looking risk exposure and the opportunity cost of capital in current market conditions.

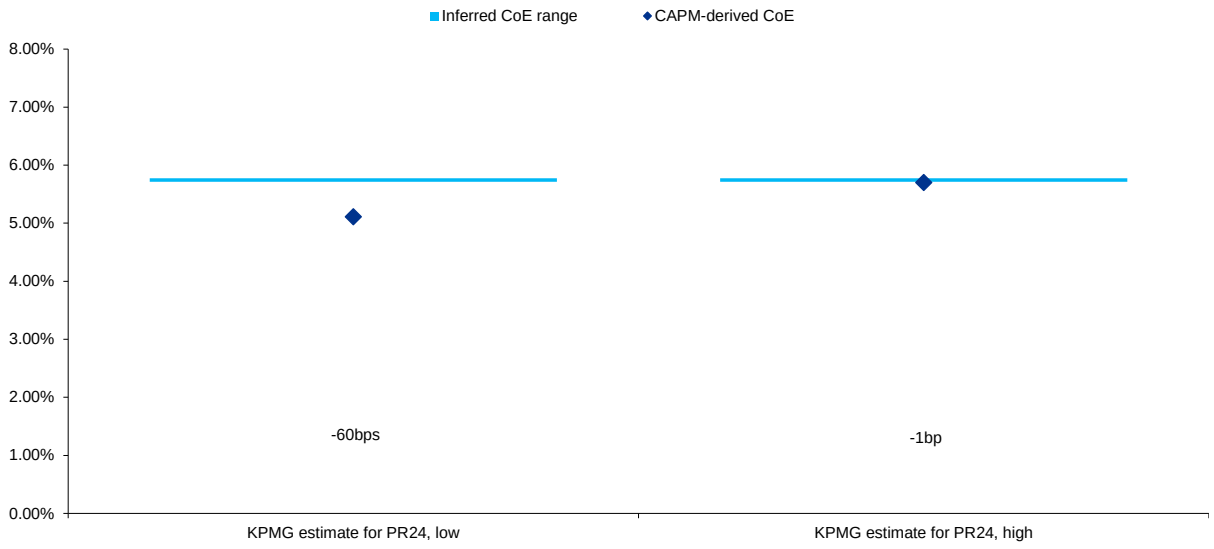
A scenario where the notional firm is unable to raise required equity capital could result in an increase in gearing due to the use of debt to address the shortfall in capital. An increase in gearing as a result of the notional firm not being able to attract and retain equity capital is not consistent with recent regulatory focus on financial resilience in the sector.

The Report also considers whether the PR24 CoE range estimated by KPMG[74] (at 55%[75] notional gearing level for comparability) implies consistency with current debt pricing and corporate finance theory.

As illustrated in the figures below, the KPMG range implies materially greater consistency with current debt pricing and could better facilitate the achievement of policy objectives for the sector. The comparison suggests that a CAPM-derived CoE estimate from the upper end of the KPMG range may be justified. This is particularly the case given that inferred CoE in this Report is based on market (rather than notional) leverage and hence under-estimates required returns inferred from debt pricing.

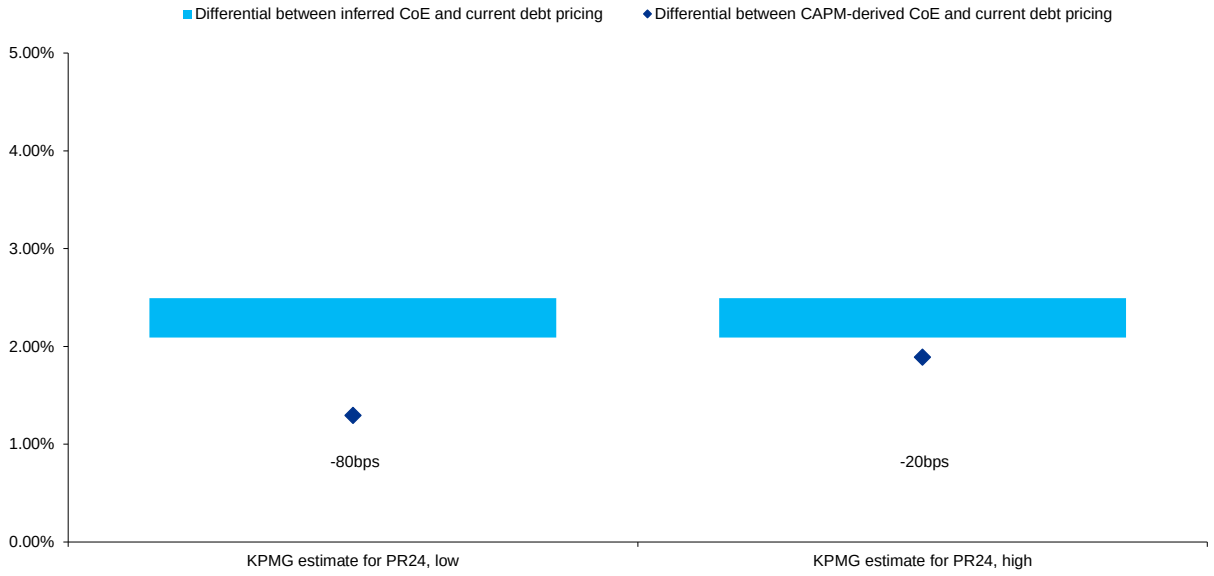
[74] KPMG (2023), Estimating the Cost of Equity for PR24
[75] The CoE range estimated by KPMG is based on a 60% notional gearing assumption in practice.

Figure 16 Comparison between inferred and CAPM-derived KPMG CoE estimate



Source: KPMG analysis

Figure 17 Comparison of differentials between CoE and current debt pricing implied by inferred versus CAPM-derived KPMG CoE estimate



Source: KPMG analysis

Overall, the magnitude of the differential between the inferred CoE and CAPM-implied CoE based on the PR24 FM implies a substantial reduction in the equity risk premium. This effect is likely driven by the under-estimation of CAPM parameters based on methodologies specified in the PR24 FM and the

assumption that the Total Market Return is fixed within the regulatory CAPM[76], which limits the responsiveness of the regulatory CoE to the significant recent uptick in risk-free rate.

There is no theoretical rationale for investors to willingly accept a lower risk premium compared to other risky assets in the face of a significant increase in interest rates. Accepting a lower risk premium would not align with how investors typically make capital allocation decisions, which depend on all available options. When risk-free rate increases, gilts become relatively more attractive than equities for their level of risk. Since the yields on corporate debt are based on gilts, they also rise and become relatively more attractive than equities for their level of risk, unless the expected return on equities also rises.

An alternative approach could involve assuming a fixed equity risk premium, such that when risk-free rate increases, the CoE increases in lock step; or estimating CoE by attaching weight to both fixed TMR and fixed equity risk premium approaches.

The inference analysis in this Report implies that a careful re-examination of the methodology for CAPM-implied CoE will be required at PR24 to ensure that allowed returns and equity risk premia are sufficient to attract equity capital in current macroeconomic conditions and relative to current levels of observed debt pricing.

[76] Regulators estimate the equity risk premium within the CAPM as the difference between total market return and the risk-free rate, instead of estimating the risk premium directly. Where TMR is assumed to be stable over time in the context of increasing interest rates the equity risk premium will reduce and constrain the degree to which increased rates translate into the CoE estimate.

8 Appendix 1: Decomposing elasticity into underlying drivers

Academic literature suggests two ways of decomposing elasticity into key drivers.

Approach 1: Decomposing elasticity into delta (Δ) and market leverage (L)

This approach is based on Schaefer and Strebulaev (2008)[77] and the Black-Scholes-Merton option pricing model[78].

Schaefer and Strebulaev (2008)[79] derive the elasticity of debt to equity – which is the inverse of elasticity of equity to debt shown in Equation (1) – as follows:

Equation (4)

$$\frac{\partial D/D}{\partial E/E} = \left(\frac{\partial E/E}{\partial D/D}\right)^{-1} = \left(\frac{1}{\Delta} - 1\right)\left(\frac{1}{L} - 1\right)$$

Where:

- Δ is the change in the equity value with respect to the change in the value of the asset[80].
- L is the market leverage, calculated as the ratio of market value of debt to the market value of firm.

Further, the Black-Scholes-Merton model implies that the call option delta (Δ) is equal to:

Equation (5)

$$\Delta = N(d_1), \text{ where } d_1 = \frac{\ln(A/D) + \left(r + {\sigma_A}^2/2\right)T}{\sigma_A \sqrt{T}}$$

Where:

- r is the risk-free rate,
- A is the value of the firm's asset,
- D is the value of the firm's debt,
- T is the time to maturity of firms' debt, and
- σ_A is the volatility of the return on firm's assets.

As a result, Equation (4) and (5) imply that the underlying drivers of elasticity include the market leverage (L), risk-free rate (r), asset volatility (σ_A) and time to maturity of the firm's debt (T).

Approach 2: Decomposing elasticity into the volatility of equity (σ_E) and debt (σ_D)

Friewald, Wagner and Zechner (2013)[81] derive the following equation, where elasticity is equal to the ratio of the volatility of equity to the volatility of debt.

Equation (6)

$$\frac{\partial E/E}{\partial D/D} = \frac{\sigma_E}{\sigma_D}$$

Therefore, Equation (6) implies that the underlying drivers of elasticity include asset and equity volatility.

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[77] Schaefer, S. M., & Strebulaev, I. A. (2008). Structural models of credit risk are useful: Evidence from hedge ratios on corporate bonds. *Journal of Financial Economics*, *90*(1), 1-19.

[78] Black-Scholes-Merton model is an option pricing model that determine the fair value of a stock option based on the price of the underlying asset, the strike price of the option, risk-free rate, time to maturity of an option, and the volatility of an asset.

[79] Schaefer, S. M., & Strebulaev, I. A. (2008). Structural models of credit risk are useful: Evidence from hedge ratios on corporate bonds. *Journal of Financial Economics*, *90*(1), 1-19.

[80] Δ is the delta of the European call option on the firm's asset and given Merton's (1974) framework views equity as a European call option, Δ is the change in the equity value in response to the change in the asset value.

[81] Friewald, N., Wagner, C., & Zechner, J. (2014). The cross-section of credit risk premia and equity returns. *The Journal of Finance*, *69*(6), 2419-2469.

9 Appendix 2: Estimates of inferred CoE and differentials across averaging windows

The table below sets out a comparison of CoE and differentials between CoE and current debt pricing for inferred versus CAPM-derived CoE implied by recent regulatory precedent for each averaging window and at each cut-off date.

Table 7 Comparison of CoE and differentials between CoE and current debt pricing for inferred versus CAPM-derived CoE implied by recent regulatory precedent

CPIH-real	Cut-off date	Averaging window	Inferred CoE	CAPM-derived CoE	Differential between inferred CoE and current debt pricing	Differential between CAPM-derived CoE and current debt pricing
PR19 CMA FD	31/12/2020	1-month	2.62%	4.15%	2.91%	3.96%
		3-month	3.80%	4.15%	3.94%	3.96%
		6-month	4.50%	4.15%	4.59%	3.96%
PR24 FM	30/09/2022	1-month	6.91%	4.14%	3.64%	0.86%
		3-month	6.00%	4.14%	3.54%	0.86%
		6-month	5.35%	4.14%	3.31%	0.86%
PR24 FM (updated for June 2023)	30/06/2023	1-month	5.76%	4.36%	2.09%	0.54%
		3-month	5.78%	4.36%	2.36%	0.54%
		6-month	5.71%	4.36%	2.49%	0.54%

Source: KPMG analysis
Note: CAPM-derived CoE is always on a 55% notional gearing basis.

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