KPMG

Relative risk analysis and beta estimation for PR24

Report prepared for Water UK

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Contents

1   Important notice

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2   Executive summary

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

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

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

— Analysis of structural breaks[1] arising from SARS-CoV2/Covid19 (hereafter "Covid19" or "Covid") and the Russia-Ukraine war

— Approaches to de- and re-levering beta

— Estimation of beta

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

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

2.2.2   To explore this, the Report considers:

— The relevant investment horizon for beta estimation, as the cost of capital is time varying over short time horizons. This is because interest rates, the risk-free rate observed from proxy instruments and rolling, and spot betas can change materially when estimated over short or long horizons.[2] The specified time horizon can therefore be an important input into the estimation of WACC.

— The methodology for estimation of returns based on an *unconditional* CAPM used in regulation, which estimates required return on an equity investment over a single

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

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

period or investment horizon[3].

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

Setting beta based on a long-run investment horizon

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

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

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

Setting returns based on an *unconditional* CAPM

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

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

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

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

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

[6] Ibid, p. 3

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

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

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

Interpretation of Covid19 and Russia-Ukraine war structural breaks

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

— *How likely is it that pandemics with similar impact to Covid19 will occur over the (at least) 15Y investment horizon assumed by Ofwat?*

— *Is the impact of the Russia-Ukraine war likely to be temporary or protracted, relative to the investment horizon implied by the PR24 WACC?*

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

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

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[7] Intensity and frequency of extreme novel epidemics | PNAS
[8] CMA PR19 FD, para. 9.493

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

[14] UKRN cost of capital principles

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

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

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

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

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

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

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

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

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

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

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[17] CMA PR19 FD, para. 36
[18] det_pr20141212wholesale.pdf (ofwat.gov.uk)

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

2.4 Approaches to de- and re-levering beta

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

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

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

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[19] Mason and Wright - A report on financial resilience, gearing and price controls - Ofwat
[20] Modigliani, Franco, and Merton H. Miller. "The Cost of Capital, Corporation Finance and the Theory of Investment." *The American Economic Review*, vol. 48, no. 3, 1958, pp. 261–97.
[21] Appendix-11-Allowed-return-on-capital-appendix.pdf (ofwat.gov.uk), page 20

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

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

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

— difficult to apply objectively, including which parameter should be adjusted and by how much. An approach which forces invariance to gearing is trying to arrive at a combination of parameters that is ultimately not known, for example the resulting WACC is no longer a combination of parameters that were ex-ante determined to represent appropriate inputs into the estimation of allowed returns.

— can introduce new distortions (because it is not clear which level of WACC it might be correct to hold constant at different levels of gearing). Variance with gearing could be driven by a methodology for a different parameter which has been set too low. This does not appear to have been considered in the draft methodology at this stage. In this case hard-wiring debt beta – which all else would result in lower returns – could *compound* an existing issue which is already resulting in under-estimation of required returns.

— does not recognise that there might be various other factors affecting the cost of capital that might cause departures from MM

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

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

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

2.4.8   Assuming invariance of cost of capital:

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

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

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

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

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[23] First Economics Risk Free Rate

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

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

2.5   Beta estimates for PR24

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

— The upper bound of the range is based on the equally weighted average of spot estimates of 2- and 5-year betas as at 28 February 2020 **(0.304).** The use of the 28 February cut off is informed by the inference that the CMA placed no or very limited weight on Covid-affected estimates. The use of 2- and 5-year betas reflects the evidence of a structural break around PR14 which implies that as at February 2020 estimation windows longer than 5 years would not be reflective of fundamental business risk going forwards.

— The lower bound of the range assigns some weight to the Covid-affected data such that the resulting beta estimate assumes that a c. 2-year pandemic of a similar scale as Covid occurs once in 15 years **(0.280).** This 15-year horizon is consistent with the tenor of 15Y Gilts referred to by Ofwat in the draft methodology

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

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

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[24] Frontier Economics Setting Notional Gearing

Figure 1 Summary of unlevered beta estimates
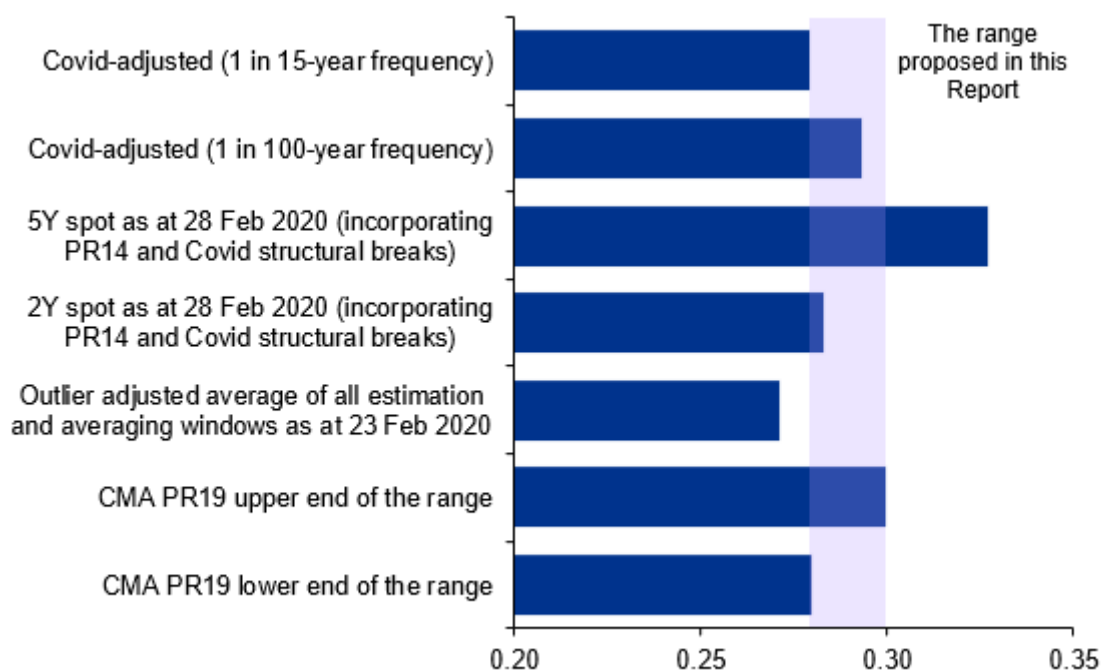
Source: KPMG analysis.

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

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

Table 2 Notional equity beta range for PR24

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

Source: KPMG analysis.

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

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[25] CMA PR19 FD, Table 9-19

3   Context and scope

3.1   Context

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

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

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

— Ofwat relied on a report by Europe Economics in order to inform its beta estimate. Europe Economics estimated composite equity betas for Severn Trent ('SVT') and United Utilities ('UUW') for 1-year, 2-year and 5-year horizons, using daily, weekly, and monthly frequencies.

— Ofwat focused on values of 2-year and 5-year daily betas over time and as of September 2019. It derived a raw equity beta range of 0.58 to 0.66 and a point estimate of 0.63.

— Ofwat used the simple average of 2 year and 5-year daily Enterprise Value gearing, notional gearing of 60% and a debt beta of 0.125 to derive a notional equity beta of 0.71.

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

— *Estimation windows of 2, 5 and 10 years.* The CMA recognised the potential presence of 'noise' in short term estimates and considered that short-term windows should be used along with longer periods and frequencies to provide the most robust data from which to estimate equity betas. By including longer periods in its approach the CMA aligned the implied horizon more closely with the long-term investment horizon used to set the WACC for regulated companies and the approach used to set the total market return and the risk-free rate.

— *Daily, weekly, and monthly frequencies.* The CMA saw merit in considering a wide range of evidence for estimation of beta despite noting that monthly estimates have higher standard errors and could be 'noisier' as a result. The weight placed on

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

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

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

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

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

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

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

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

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

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

day effect[28]'.

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

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

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

3.2   Scope of work

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

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

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

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

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

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

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[28] Beta estimates can differ materially depending on the day of the week or month chosen
[29] A structural break is an observable change over time in the parameters of regression models, which can lead to forecasting errors and unreliability of the model.

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

3.3   Structure of the Report

3.3.1   The Report is structured as follows:

— Section 4 sets out the evolution of the regulatory landscape and implications for risk;

— Section 5 establishes a framework for the relative risk assessment and undertakes the assessment based on qualitative evidence;

— Section 6 considers methodological issues for estimation of beta at PR24;

— Section 7 undertakes an assessment of the de- and re-levering proposals set out by Ofwat in its draft methodology; and

— Section 8 considers the implications of the analyses set out in the Report for the beta estimate for PR24.

4 Evolution of the risk landscape for PR24

4.1 Introduction

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

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

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

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

— The first relates to the technical planning and investment challenges that face the sector due to its role in responding to population growth and the country's Net Zero ambition.

— The second relates to the major changes in environmental obligations.

— The third relates to the evolving regulatory environment for the sector. This conveys its own risk characteristics and will have implications for regulatory regime design and regulatory processes.

— The fourth relates to the introduction of competition as a driver of increasing risk.

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

4.2 Industry drivers of change

I. Demand

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

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[30] UKRN cost of capital principles
[31] Ibid.

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

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

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

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

II.   **Transition to Net Zero**

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

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

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

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

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

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

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

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

4.3   Environmental drivers of change

I.   Storm overflows

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

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

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

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

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

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

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

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

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

II.   **Wastewater environmental targets**

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

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

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

be spent on phosphorus removal to meet this target, to remove phosphorus from the load produced by 80% of the 56.5 million population of England.

III. Abstraction reduction and improved drought resilience

4.3.9 The Environment Agency has an increasing ambition to protect the environment by restricting some water abstractions,[41] which means that companies have to seek new sources of water. Although not a big issue for every company, for those affected, the investment required to replace sources is considerable, may require collaboration with neighbouring companies and requires concerted stakeholder engagement, particularly where water recycling, desalination or large reservoir construction is being considered. The scale of the required investment may be further increased by the need to improve resilience to a once-in-500-year drought.[42] The urgency of meeting increased drought resilience has been brought sharply into focus with many parts of England and Wales under drought conditions and increasing temporary use bans in place during recent months. Investment to mitigate such risks has been shown to be needed more immediately than anticipated, and companies will be expected to put forward deliverable investment plans as part of their PR24 business plans.

4.3.10 Large and regional water resources solutions are likely to be candidates for Direct Procurement for Customers (DPC), which can reduce risk to companies by transferring risks of large-scale investment into a contract with a third-party infrastructure provider. However, all companies with such schemes will need to manage complex procurement processes that may be beyond their current capabilities, and incumbent water companies may be exposed – pending contracts with third parties – to residual risks in relation to assets which are not captured within regulated assets.

4.3.11 DPC involves complex interactions for the procuring water companies, with contractual arrangements required for what would otherwise be normal operational management of a set of assets delivering the services companies provide to their customers. Such contracts are particularly challenging since the water companies cannot pass all their statutory duties onto the third-party infrastructure provider.[43] In addition rating agencies such as Moody's[44] have highlighted that DPC could have potential implications for financeability as it DPC will increase leverage and hence financial risk. DPC may therefore increase risk for companies from managing the interactions and remaining

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[41] Environment Agency, March 2020, Water Resources National Framework, Appendix 4: Longer term environmental water needs.

[42] Environment Agency, March 2020, Meeting our Future Water Needs: a National Framework for Water Resources, p.10.

[43] See Ofwat, PR19 methodology, Appendix 9: Direct procurement for customers, p.14, that says "For the avoidance of doubt, we have written into the principles that appointees remain ultimately responsible for ensuring their statutory and licence responsibilities are fulfilled."

[44] Moody's (2022), United Utilities Water Limited/United Utilities PLC, Regular update reflecting reported performance YTD 2021/22 "*Depending on the gearing profile of the project SPV, this approach may result in a modest loss of financial flexibility for UUW and the UU group with respect to Moody's ratio guidance*".

responsible for services to customers. Overall, it is hard to conclude on the net impact of DPC on risk exposure which may vary for different projects.

IV.   Farming Rules for Water and the EA's sludge strategy

4.3.12   The Environment Agency has been reviewing the application of its Farming Rules for Water to the activity of spreading bioresources products to agricultural land. Although it has relaxed its guidance from its original intention, there remains a real risk that concerns over nutrients washing off into waterways from bioresources recycling could make such recycling activities more difficult and expensive, due to restrictions in periods when recycling is permitted.[45] Current guidance is to be reviewed no later than September 2025, which means there is a risk material changes could occur very early in the AMP8 period. With no cost sharing proposed for the bioresources price control, companies are more exposed to such risk than if it impacted wastewater network plus activities.

4.3.13   The Environment Agency is also producing a Sludge Strategy which is reviewing the Sludge (use in agriculture) Regulations with a view of updating them and aligning with its approach to regulating other organic waste management activities through Environmental Permitting Regulations.[46] Such a change may introduce additional charges but will level the playing field between water and waste management activities, which may make co-digestion of bioresources and other organic waste easier since the two materials will be within the same environmental regulatory framework.

4.4   Business drivers of change

I.   Bad debt

4.4.1   The Covid19 pandemic had a number of impacts on the water sector, including a reduction in non-household consumption and an increase in household consumption due lockdowns and working from home[47]. This, combined with macro-economic challenges, has led to a number of challenges for water companies regarding debt collection.

4.4.2   Inflation is also expected to reach 13%,[48] which would be the highest level since the water sector was privatised and may represent an affordability challenge unlike anything the industry has experienced to date.

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[45] Environment Agency, June 2022, Applying the farming rules for water.
[46] Environment Agency, July 2020, 'Environment Agency strategy for safe and sustainable sludge use'
[47] Hybrid working has to a large extent replaced office-based working that was the norm before the pandemic and has continued after all restrictions were lifted.
[48] Bank of England (2022) 'Monetary Policy Report: August 2022'

4.4.3   While inflation is forecast to return to normal levels around the start of the next control period (which we expand on in section 6.4), all forecasts contain a degree of uncertainty. In addition, it is not clear whether a prolonged period of high customer default will result in sustained behaviours of non-payment.

4.5   Regulatory drivers of change

4.5.1   The regulatory framework is one of the biggest determinants of risk and value for water companies. Ofwat's draft methodology for the 2025-30 period contains several significant changes from the previous control period including:

Change in cost sharing rates

4.5.2   At PR19, Ofwat set cost sharing rates in the range of 32%:75%[49] (companies gain from 32% of any outperformance, sharing the rest with customers, while companies bear 75% of any underperformance, sharing the rest with customers) to 50%:50%. For PR24, Ofwat is proposing to make cost sharing rates more symmetric, with rates sitting in the range of 40%:60%, to 50%:50%. This is more closely aligned to the rates applied by the CMA at PR19[50].

Reforms to outcome delivery incentives

4.5.3   Ofwat is proposing major changes to companies' outcome packages. This includes:

— setting fewer financial performance measures (this may have an effect of reducing the current 'portfolio' effect that companies experience by having a large pool of measures);

— introducing new performance measures (for example, serious pollution incidents and business demand);

— changing how incentive rates are calculated (by moving to an approach that primarily uses marginal benefits);

— removing incentive deadbands, caps and collars;

— removing exclusions for events outside of companies' control (for example exclusions for extreme weather); and

— introducing a new aggregate out / under performance sharing mechanism when ODI performance passes outside of predetermined thresholds (specified in terms of return on regulated equity).

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[49] PR19-final-determinations-Securing-cost-efficiency-technical-appendix.pdf (ofwat.gov.uk), p.140
[50] CMA PR19 FD, para. 6.107

4.5.4   The above changes have the effect of fundamentally changing the overall risk profile of companies' incentive packages. Further clarity on this overall level of change will be gained when the performance commitment levels are set.

Removal of aspects of developer services from the price control

4.5.5   Ofwat is proposing to remove certain developer services from the price review. This will affect the volatility of the revenue recovered by companies that contributes towards the overall revenue controls. This in turn, may affect how companies perform in relation to the revenue forecasting incentives (RFIs).

Change of bioresources controls

4.5.6   Ofwat is proposing to move from a standard regulatory building block approach that incorporates an efficiency challenge of companies' expenditure, to benchmarking revenues, which includes a different approach for post 2020 RCV. This is a new approach for asset-heavy services. Ofwat has not yet consulted on its modelling framework and so the full implications of this regulatory change are not yet known. The changes are aligned to a market-based approach for bioresources services which is described below.

Removal of bilateral entry adjustment mechanism

4.5.7   In the 2020-25 period, the framework included an adjustment mechanism to adjust downwards water resources' revenue to reflect bilateral market entry. This mechanism will not apply in the 2025-30 period. While there has been no bilateral market entry to date, this change to the framework may impact within-period revenue risk going forward.

Full transition to CPIH

4.5.8   Prior to 2020, companies' RCVs and revenues were linked to RPI. During the 2020-25 period, revenues have been linked to CPIH, while the RCV has been linked to a blend of RPI and CPIH (50% of the opening balance linked to RPI, with the remaining balance and additions linked to CPIH). Going forwards, Ofwat has proposed that everything should be linked to CPIH. The strength of correlation between RPI and CPIH has varied over time. Companies and investors have raised concerns that CPIH-linked assets risks creating a mismatch with the RPI-linked debt that many companies hold. Ofwat is not proposing at this stage to provide for costs associated with hedging RPI-CPIH basis risk.

4.6   Competition drivers of change

4.6.1   The government is continuing to promote markets in the sector, in particular in bioresources services and in the provision of large infrastructure projects. The provision of infrastructure through direct procurement for customers is discussed above.

4.6.2 At PR24, Ofwat's approach to setting allowed revenues for bioresources services introduces more market-type risks, such as volume risk, but also presents opportunities to optimise efficiency across company borders, expand into other companies' areas by selling bioresources services through non-regulated business, or potentially gain benefits from co-digestion of bioresources with other organic waste materials.

4.7   Key conclusions

4.7.1   Table 3 below sets out the drivers of change discussed in this section along with an assessment of their potential impact on the sector risk is provided.

Table 3 Overview of the impact of PR24 changes on risk exposure

Change driver	Parties affected by driver	Change in risk since PR19	Commentary
Demand	All UK water sector	No change	Forecasting of population growth is relatively straightforward and companies are used to planning for growth
Transition to net zero	All UK water sector	Increasing	Ways of reducing process emission are not well-established, making Net Zero planning uncertain.
Storm overflows	English wastewater companies	Increasing	Large and under-developed investment programmes are difficult to cost out accurately.
Wastewater environmental targets	English wastewater companies	Increasing	Increasing pace of investment in treatment processes is needed to meet ambitious goals.
Abstraction reduction and drought resilience	English water companies	Increasing	Gives rise to large, complex DPC programmes requiring coordination between companies.
Farming rules for water and EA sludge strategy.	English wastewater companies	Increasing	Increasing uncertainty over the previously stable route for using bioresources products.
Bad debt	All UK water sector	Increasing	Cost of living crisis means bad debt increasing and more intransigent.
Change in cost sharing rates	English & Welsh (E&W) water sector	Decreasing	Companies more able to share any cost overruns with customers.
Reforms to outcome delivery incentives	E&W water sector	Increasing	Removal of exclusions, caps and collars risks higher downside in extreme weather events
Removal of aspects of developer services from price control	E&W water sector	Decreasing	Reduced volatility of revenue collected and considered through forecasting incentives
Change of bioresources controls	E&W wastewater companies	Increasing	New approach means revenue at risk which was not present before

Change driver	Parties affected by driver	Change in risk since PR19	Commentary
Removal of bilateral entry adjustment mechanism	E&W water sector	Decreasing	Reduced in-period revenue risk.
Full transition to CPIH	E&W water sector	Increasing	Increases potential shortfall in the allowance for RPI-linked debt.
Competition drivers of change - DPC	E&W water sector	Unclear	Higher DPC threshold and DPC by default both change risks but overall position unclear.
Competition drivers of change -bioresources	E&W wastewater companies	Unclear	Bioresources market offers both risks and opportunities.

Source: KPMG analysis

4.7.2   There are material changes to the landscape in which the water companies operate. The changes are driven by factors both external to and within the PR24 methodological approach and are seen across diverse factors, including the challenges of responding to population growth and the country's Net Zero ambition, changes in environmental obligations, regulatory changes and increasing competition.

4.7.3   Many of these factors have the potential to change and increase the risks that companies in the sector face. Table 3 above illustrates the indicative position that the changes facing the sector appear to be increasing risk in the run up to PR24 and that this would need to be reflected in beta, assuming that the increasing risks have a systematic component.

4.7.4   Apart from regulatory changes proposed by Ofwat, the external changes that have the greatest potential to increase risk and asymmetry for PR24 are driven by uncertainty in the detail of large investment programmes which increase deliverability risk. Such investment programmes include those to meet Net Zero targets and those to meet wastewater targets in both storm overflow discharge frequency and phosphate load reductions.

5 Assessment of relative risk for PR24 – qualitative evidence

5.1 Introduction

5.1.1 This section considers in qualitative terms the evolution of the systematic risk exposure faced by water companies and the implications for beta estimation for PR24. In order to address this question, this section first sets out a framework for pricing risk, covering systematic risk and asymmetric risk; then it undertakes a detailed relative risk assessment; and concludes on the implications of the relative risk assessment for PR24 beta estimation.

5.2 Framework for pricing systematic risk and relative risk assessment

5.2.1 The CAPM model is the most common asset pricing model used in the UK and internationally for the purpose of setting regulatory allowed return. Under this framework, the asset is priced according to the risk it contributes to a well-diversified market portfolio, assumed to be held by the investor pricing the asset. Under the CAPM, only systematic, or market-correlated risk is priced, as this risk is unavoidable through diversification. By contrast, sector-, company- or project-specific risks are assumed to be diversifiable, and not requiring remuneration, as they can be mitigated through appropriate diversification.

5.2.2 Beta measures the exposure to systematic risk of the firm or sector in question. Systematic risk is risk that impacts a diversified market as a whole. If the shares of a firm are frequently traded, beta can be observed relative to a suitably representative market index as follows:

$$\beta = (\text{Cov}(R_a, R_m))/(\text{Var}(R_m))$$

Where β is observed Beta, R_a and R_m denote Asset return and Market return respectively

5.2.3 Where the firm/(s) are listed, price movements in the shares of the firm itself can be used to measure the asset return. However, where the firm/(s) are not listed, betas cannot be directly observed, but they may be estimated with reference to traded shares of firms with comparable systematic risk exposure.

5.2.4 The primary means of capturing equity risk for an unlisted firm, when applying the CAPM, is therefore identifying appropriate comparators to estimate beta, which are the listed pure-play water companies.

5.2.5 The framework used in this report for the relative risk assessment considers the underlying sources of business and regulatory risks of the sectors which jointly determine overall cashflow risk, and then considers whether these risk factors should be priced into equity returns based on standard corporate finance principles.

5.2.6   All regulated businesses considered in this assessment face underlying business and regulatory risks which impact the volatility of returns to varying degrees. Regulation in general, including the specific regulatory mechanisms proposed for PR24 in particular, interact with the underlying business risks and either exacerbate or mitigate their impact on the volatility of equity returns.

5.2.7   The Report considers the following types of inherent risks for the water companies:

— **Demand risk**, covering within price control volume risk (i.e., short-term demand risk) and long-term demand risk including possible asset stranding risk;

— **Cost risk**, covering the underlying volatility in Totex risk, regulatory discretion risk and input price risk;

— **Performance risk**, associated with outcomes, outputs and licence requirements;

— **Financing risk**, i.e., risk associated with uncertain market interest rates;

— **Performance risk sharing**, which captures risk to the overall returns (in addition to the inherent risks set out above) from the application of regulatory finance mechanisms;

— **Regulatory risk**, including political and wider societal influences on regulatory judgments.

5.2.8   The Report then considers whether each of the identified risks can be classified into one (or more) of the following two categories which affect expected returns, based on standard corporate finance principles and theory:

— **Systematic risks**, priced through observed betas;

— **Asymmetric risks**, requiring adjustments to the cost of equity to compensate investors for downside risks that have an expected loss, which can be incorporated via an explicit uplift to the allowed return.

Systematic risk

5.2.9   The CAPM prices the systematic component of equity risk on the assumption that investors hold a diversified portfolio and do not therefore need compensation for idiosyncratic (or specific) risk. CAPM considers that the correlation of returns with equity markets is a sufficient proxy for exposure to systematic risk, which means that to the extent that companies are exposed to other systematic risks, CAPM will understate the required return.

Asymmetric risk

5.2.10   The typical implicit assumption in the regulatory model is that investors have a mean expectation of earning the CAPM derived cost of equity.

5.2.11   Under certain circumstances, however, a business might be exposed to downside risk that does not have a commensurate upside i.e., there is asymmetric risk. If the assumed cashflows are not appropriately adjusted for such downside events, the un-adjusted cost of equity will not be adequate and will have to be appropriately uplifted to reflect expected losses on a mean probability-weighted expected basis[51].

5.3   Systematic risk exposure at PR24 relative to previous price reviews

5.3.1   This section sets out detailed analysis of the risk exposure faced by water companies at PR24 resulting from the interaction of a range of inherent risks, including as appropriate those explored in previous sections, with relevant regulatory mechanisms, as well as detailed benchmarking against PR14 and PR19. The detailed benchmarking identifies key differentiating factors, from a systematic risk perspective, which are relevant to determining the appropriate beta for PR24.

5.3.2   The analysis set out in this section considers holistically the risk exposure faced by water companies and provisionally classifies each individual risk exposure as either systematic or asymmetric. The analysis recognises that some exposures may be asymmetric and not relevant for the setting of the beta for PR24. However, whether the risk is systematic or asymmetric is contingent on how regulatory mechanisms interact with inherent risks which will become clearer once the price control calibration is further progressed.

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

The table below sets out the risks facing water companies, the nature of the risk (i.e., systematic or asymmetric), an assessment of how that risk is likely to be exacerbated or mitigated by regulation and how the exposure to that risk is likely to differ between PR24 and PR14 and the CMA's re-determination for four disputing companies at PR19 (which represents the most recent determination on beta in the sector). Although the risks identified here will need to be kept under review as the detail of the PR24 package becomes clearer, the qualitative assessment set out below clearly indicates that the sector will be higher risk at PR24 relative to previous price controls. Red denotes higher risk exposure at PR24 than in previous price controls.

Table 4 Risk comparisons between PR24 draft methodology and approaches used in previous price reviews

Risk category	Risk	Description	Impact of regulation	Classification	PR24 vs PR19 CMA	PR24 vs PR14
Demand risk	Volume risk	The risk associated with deviations between actual and forecast revenues within the regulatory period, either due to differences in volume forecasts and actuals or timing and resulting volatility of cashflows.	**Mitigates materially** Demand risk (pre-regulatory intervention) relatively low. Some higher consumption in dry years. Some lower consumption from businesses in recessions. The regulatory framework sets total revenue controls. If companies under or over recover in any given year, there is a true up in the future. For large deviations (+/- 2%) the regulator applies a penalty to incentivise accurate forecasting.	**Systematic** The ability (and willingness) to pay for the use of the services in question is often linked to the economic outlook – in bad states of the world, sales volumes (and prices, in competitive markets) reduce.	For PR24 Ofwat is proposing to remove certain developer services from the price review. This will likely affect the volatility of the revenue recovered by companies that contributes towards the overall revenue controls. This in turn, may affect how companies perform in relation to the revenue forecasting incentives (RFIs) compared to PR19.	PR14 had fewer disaggregated revenue correction mechanisms – it was set at a wholesale water / wastewater level. Greater aggregation meant that there was more scope for offsetting / netting off within the overall wholesale revenue forecasting incentive mechanism than at PR19 and at PR24.
Cost risk	Totex performance	This risk relates to the cash flow mismatch arising from the differences between expected and outturn total expenditure. It is impacted by the scale of the capital programme as well as the complexity and uncertainty of the investment programme, and operational risks (such as weather events and power price increases). Cost distribution generally is not symmetric for Totex. This is because there is a limit to how much costs can be constrained to generate outperformance relative to expectation, whereas there are many foreseeable as well as unforeseeable ways in which costs could increase, leading to cost overruns.	**Exacerbates materially** Cost risk (pre-regulatory intervention) is medium. Risk is exacerbated by a regulatory framework that only allows a proportion of overspend to be passed onto customers. The sector is capital intensive, infrastructure projects sometimes overspend[52]. Further, the sector is somewhat sensitive to weather events causing asset failures.	**Asymmetric** An efficiency challenge that goes beyond upper quartile is likely to result in an asymmetric risk exposure. The sharing rates can be designed to be either symmetric or asymmetric. For PR24, Ofwat is proposing to make cost sharing rates more symmetric, with rates sitting in the range of 40%:60%, to 50%:50%.	For PR24 Ofwat is proposing an efficiency challenge that goes beyond upper quartile. All things being equal, this should lead to a more stretching efficiency challenge, and greater scope for underperformance. At PR19 the CMA applied an upper quartile efficiency challenge[53]. PR19 framework applied asymmetric cost sharing rates (out/underperformance is shared with customers). This rate varies by company. This rate varies by company. Best case: 60%:50% (company retains 60% of any Totex outperformance and bears 50% of any underperformance) to 32%:75%[54]. This compares to the CMA's calibration of 45:55%[55].	At PR14, the efficiency challenge used was upper quartile[56]. There was a complex menu arrangement for cost sharing that was not well understood[57], however, the range of available sharing rates is broadly comparable between PR24 and PR14. Ofwat's proposal for PR24 should lead to a more stretching efficiency challenge, and greater scope for underperformance.
Performance risk	Outcome Delivery Incentives	This risk relates to the incentives to meet defined levels of performance. PR24 will feature a number of performance commitments. Failure to meet the PC level requirements or underperform incentive targets can have a sizeable impact on the company.	**Exacerbates** Based on Ofwat's draft methodology, it is expected that nearly all water companies will have outcome delivery incentives with more downside than upside due to the calibration of the incentives.	**Asymmetric** Some incentives are downside-only or have downside risk that does not have a commensurate upside. Ofwat is proposing to remove penalty caps, and deadbands on penalty-only measures.	For PR24, Ofwat is proposing fewer but stronger incentives (less scope for a portfolio effect), the removal of deadbands including for penalty-only measures, removal of penalty caps, and removal of exclusions for exogenous factors (such as severe weather). It is also proposing to make measures	At PR14 there were few common measures across the sector with companies more able to control which areas were had financial incentives. At PR24 the scope for use of bespoke measures is much reduced.

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[52] See for example, National Audit Office, 2019, Completing Crossrail

[53] CMA PR19 FD, para. 36

[54] PR19-final-determinations-Securing-cost-efficiency-technical-appendix.pdf (ofwat.gov.uk)

[55] CMA PR19 FD, para. 6.107

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

[57] Companies could make menu choices in relation to Totex that would determine their allowed revenue and Totex cost sharing rate and provide wider incentives for accurate and realistic forecasting. The available rates ranged between 45-59% across enhanced and non-enhanced companies. det_pr20141212wholesale.pdf (ofwat.gov.uk)

Risk category	Risk	Description	Impact of regulation	Classification	PR24 vs PR19 CMA	PR24 vs PR14
		The strength of those incentives and PC targets and the plausible outcomes will impact the risk faced by the water companies.		Performance risk is likely to be predominantly idiosyncratic, either at a company level or a sector level.	common across the sector and reduce the use of bespoke measures.	
Financing risk	Uncertain market interest rates	The interest rate environment is a significant source of exposure to the wider economy.	**Mitigates partially** Financing risk (pre-regulatory intervention) medium. Water companies are capital intensive, so are heavily exposed to changes in interest rates. However, all incumbent companies hold investment grade credit ratings. The regulatory framework includes indexation for the cost of new debt, and this is expected to be set with reference to iBoxx indices. Risk-free rate is expected to be based on the current yield, without a forward uplift.	**Systematic** As noted in the UKRN cost of capital study, the disconnect between a gradualism-based cost of debt and a spot-based cost of equity could distort investment decisions. It is unclear whether those distortions could include systematic risk factors.	Ofwat is proposing to index the cost of new debt (as per PR19). Use of the sector average as the primary methodology for estimation of the cost of debt allowance may create additional exposure to financing strategies adopted by other companies.	Ofwat applies an indexation approach for the cost of new debt at PR24 which reduces risk. On the other hand, the use of sector average for setting embedded debt costs at PR24 may increase risk. At PR14 both cost of debt and cost of equity reflected historical yields as the risk-free rate was set assuming some reversion to the long-term mean. On balance, the exposure is likely to be broadly comparable between PR14 and PR24.
Performance risk sharing	Outcome delivery incentives	This captures the risk to the overall returns (in additional to the inherent risks set out above in this table) arising from the application of regulatory finance mechanisms.	**Uncertain** There is sharing of ODI rewards and penalties beyond 3% of RoRE. Rewards and penalties are further reduced beyond +/-5%.	**Idiosyncratic – Asymmetric** The incentive by itself may be skewed to the upside but likely neutral when combined with the rest of the incentive package as it is not clear that performance beyond the cap is plausible..	At PR19 there was an overall reward cap. For PR24 Ofwat proposes to remove the overall reward cap. This increases the scope for potential upside, should companies earn >3% RoRE. However, on a mean-expected basis this change is likely to be neutral for risk exposure as the impact of the removal of the cap is likely to be limited in practice and it is not clear that performance beyond the cap is a plausible outcome.	At PR14, Ofwat had an overall five-year aggregate cap of +/- 2% RoRE[58] – i.e., the new proposals increase risk (upside and downside) outside of the previous range.
Regulatory risk	Regulatory risk	The prospects for returns for regulated companies beyond a current price control period are highly dependent on the regulatory environment, the factors that influence and inform decisions by regulators and legislators. It is appropriate for regulators to be informed by societal concerns. The longer-term sustainability of regulation itself may depend on the regulator maintaining society's confidence in its processes. The transmission mechanisms for systematic risk will be principally through the exercise of discretion in the design and implementation of policy. It will be largely conveyed through periodic price control decisions, but also through broader legislative initiatives and wherever discretion is exercised in-period.	**Exacerbates** Risk exists for regulators / government to intervene outside of the price review process, particularly in areas of high political interest (for example, there are ongoing discussions regarding a windfall tax in the energy sector).	**Asymmetric** Intervention risk is skewed to the downside.	Greater media focus on water companies following coverage on storm overflows, FFT investigations, and drought restrictions. Significant exercise of regulatory discretion reflected in draft methodology, including material departures from the CMA's methodology at PR19 for setting allowed returns.	Greater media focus on water companies following coverage on storm overflows, FFT investigations, and drought restrictions.

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[58] Setting price controls for 2015-20 Final price control determination notice: policy chapter A2 – outcomes, p. 94

5.4 Key conclusions

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

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

5.4.3 There are some changes that Ofwat proposes at PR24 which are likely to decrease risk compared to previous price review regimes, but they are mostly limited in scope and not material. The most material of these is the narrowing of cost sharing rates from those applied at PR19. However, the sharing rates could remain symmetrical at best and for many companies are likely to be asymmetric, with companies bearing a larger proportion of cost risk than customers.

5.4.4 The change in risk arising from changes in performance targets is not possible to assess at this stage, as the levels are not discussed within the draft methodology. However, Ofwat expects companies to meet their 2024-25 targets set at PR19 unless there are clear external factors that were unknown at the time of the PR19 final determinations. This is the starting assumption for the levels that companies will be expected to improve from through the 2025-30 period. Performance in the first two years of AMP7 reveals more companies are failing to meet their performance targets than are meeting them.

5.4.5 At the same time, the changes to the application of incentives proposed at PR24 are highly likely to increase risks. Restricting bespoke performance commitments, and removing exclusions, deadbands, caps and collars leaves companies exposed to more performance risk, particularly in case of penalty-only compliance measures. Although Ofwat proposes to mitigate the risk to some degree by introducing an ODI sharing mechanism which will apply once aggregate ODI payments reach 3% of RoRE, the proposed changes make it more likely that the ODI-sharing will be triggered due to underperformance than outperformance and companies will be exposed to higher downside risk. The value of the deadbands in AMP6 for two compliance measures, water compliance risk index and wastewater treatment works compliance, are at sector

level c.-2% of RoR[59]E, a greater level of negative asymmetry than the CMA modelled at PR19.

5.4.6   Analysis of relative risk across recent price controls indicates that – based on underlying dynamics of risk allocation implied by the regulatory framework – risk is at least as high as at PR19 and is likely to be *higher* at PR24. This finding is consistent with Ofwat's position that based on its current policy its "*overall package at PR24 is likely to put at least as much return at risk as at PR19*"[60].

5.4.7   All else equal beta as a measure of systematic risk would be expected to be flat or increasing, assuming that the increasing risks have a systematic component. As the holistic assessment of risk factors which drive systematic risk for water companies indicates that risk exposure is *increasing*, all else equal, it would be expected that the beta estimate for PR24 would reflect this increase in risk.

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

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

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[59] KPMG analysis of the 2020/21 Service Delivery Report
[60] Draft-methodology-main-document-3.pdf (ofwat.gov.uk), page 88

6 Estimation of beta at PR24 – methodological considerations

6.1 Introduction

6.1.1 This section evaluates the technical approach to beta estimation proposed by Ofwat for PR24 against finance theory and regulatory precedent. This assessment considers a number of the key methodological decisions required to estimate beta in turn:

— Listed comparator set

— Frequency of data

— Treatment of significant events affecting returns or volatility

— Estimation windows

— Averaging windows

6.2 Listed comparator set

6.2.1 An equity beta which is sufficiently representative of the business and financial risk of the notional firm represents a key input into the determination of the allowed return. The financial risk of the notional firm stems from the gearing assumption determined by the regulator, whereas the assessment of business or asset risk is inferred from the asset betas of chosen listed comparators.

6.2.2 As the regulatory allowed return is determined for the regulated element of the water company business, the notional water company is assumed to be a pure play operator. In other words, the notional company is not assumed to have any non-regulated business whose asset risk may be materially different from that of a pure play regulated company.

6.2.3 In practice, water companies can and do also undertake non-regulated activities although the scale and nature vary from company to company. Given the availability of listed water companies to inform the determination of asset beta by the regulator, the exam question is how to best proxy the business risk of the pure play operator, whilst also ensuring that all relevant and useful data is taken into account such that the calculation is representative of business risk and robust.

6.2.4 Regulated activities have comprised the majority of Severn Trent (SVT) and United Utilities' (UUW) businesses[61] since c. 2007-2008 following the sale of UUW's telecoms

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[61] Regulated activities comprised c. 93% of 2021/22 revenues for SVT and c. 96% for UUW according to annual reports.

business[62] and the demerger of SVT's waste management business[63]. In contrast, PNN has in the past had a material unregulated business (related to recycling, energy recovery and waste management services) until its sale of Viridor in 2020[64]. The timing of the sale means that previous ownership of the waste management business is likely to constrain the extent to which weight can be placed on its data at PR24.

6.2.5 Ofwat has proposed to review whether to include PNN data in beta estimation in the final methodology and has noted that reflecting this data would not be straightforward due to difficulties in accounting for cash holdings from the disposal of Viridor with gearing.

6.2.6 Given the limited number of listed companies in the sector (3 out of 17), the inclusion of additional data from the period since the sale of the Viridor business would be helpful to increase the statistical robustness and representativeness of the beta estimate used to set allowed returns for the notional company. The following considerations would inform the treatment of PNN data in the derivation of the PR24 asset beta.

— **Availability of sufficient pure play data for different beta estimators:** As the sale of Viridor was announced in March 2020[65], currently only the spot 2-year estimates could be assumed to reflect the pure play PNN. Assuming that PR24 beta is estimated in September 2024, a similar cut-off date to PR19, an additional two years of data would enable the calculation of pure play 2-year betas using spot, 1-year, and 2-year averaging windows whereas 5-year spot betas would include a non-negligible proportion of data incorporating the risk of the non-regulated business.

— **The cut-off date used for beta estimation:** For example, the CMA used two cut off dates in its analysis of the PR19 beta and none of the estimators as at February 2020 would have included pure play information for PNN. The selection of cut-off date(s) for beta estimation in this Report will reflect the results of the structural break analysis and the requirement to set a beta reflective of the systematic risk for a notional water company over a long-term investment horizon. The extent to which PNN data will warrant inclusion based on the selected cut-off date will be considered separately.

— **The impact of the sale on gearing:** The impact of the sale of Viridor on cash balances, and consequently on gearing and asset beta, was constrained to a single financial year and could be normalised with reference to net debt balances held

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[62] United Utilities (companieshistory.com)
[63] Biffa looking forward after 100 years
[64] Disposal of the Viridor Business | Pennon Group PLC (pennon-group.co.uk)
[65] Ibid.

during recent periods before and after the sale.

6.2.7   The chart below contrasts the 2Y unlevered beta of PNN (normalised for the impact of the sale of Viridor[66]) to that of a value-weighted portfolio of SVT/UUW and shows that unlevered beta of PNN has continued to materially exceed the beta of the SVT/UUW portfolio even after the sale of Viridor.

Figure 2 Comparison of 2Y daily rolling asset betas (unlevered) for PNN and SVT/UUW value-weighted portfolio
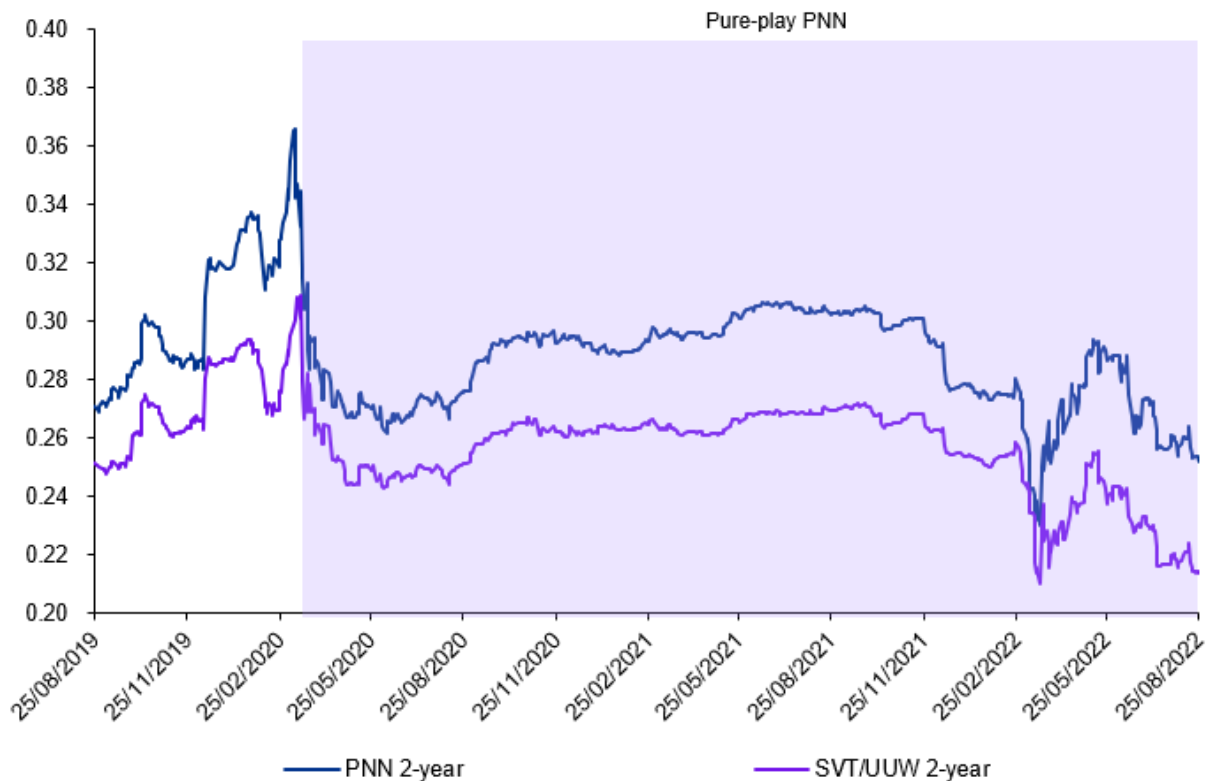
Source: KPMG analysis of Thomson Reuters Eikon data as of 25 August 2022.

6.2.8   Table 5 illustrates that the inclusion of PNN in the value-weighted water portfolio results in a small increase in the 2Y spot unlevered beta. All else equal, this suggests that a beta based solely on SVT and UUW data may under-remunerate the systematic risk exposure for the notional water company.

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[66] In Thomson Reuters Eikon, the sale of Viridor affects the EV gearing of PNN from 25/11/2020 to 30/11/2021 (the dates at which the Net Debt values from Half Year results of respective years were reflected in the Eikon database). EV gearing has been normalised by effectively replacing values between 25/11/2020 – 30/11/2021 with the average observed gearing during (1) the one-year window before gearing went negative and (2) the period between 01/12/2021 – 25/08/2022.

Table 5 The impact on 2Y spot beta of the inclusion of PNN in the value-weighted portfolio of water stocks

	2Y spot unlevered beta as at 25 Aug 2022
SVT/UUW	0.2540
PNN/SVT/UUW	0.2586
Difference	0.0046

Source: KPMG analysis of Thomson Reuters Eikon data as of 25 August 2022.

6.2.9   This Report does not include PNN in beta estimates as there is insufficient pure play data as at the two cut off dates used in the Report. (28 February 2020 and 23 February 2022 as per section 8.1.4). However, should the inclusion of PNN continue to result in higher betas as more pure play data becomes available for PNN, this may indicate that estimates based on SVT and UUW alone *understate* beta for the water sector. Ofwat should carefully consider how the evidence from PPN should be taken into account, particularly in the context of having a very limited number of listed comparators available for the sector.

6.3   Frequency of data

6.3.1   Typical frequencies used in the estimation of betas include daily, weekly, and monthly. In practice, there is a trade-off between observation frequency and statistical accuracy, insofar as higher frequency of data increases the precision of estimates through lowering of the standard errors, but may bias estimates in the presence of asynchronous trading (a situation where the stock in question does not trade with the same frequency as the overall market portfolio As a result there is a mismatch between the time when new signals are assimilated in the stock vs the market price), or where stocks are subject to any of "opacity", liquidity and size considerations.[67]

6.3.2   For liquid stocks that are unlikely to suffer from asynchronous trading, we consider daily frequency to be an appropriate starting position for development of point estimates. This is consistent with the approach proposed by Ofwat in the draft methodology.

6.3.3   During the PR19 re-determination the CMA placed weight on different frequencies of data to form their range of estimates. This approach is similar to CMA's analysis in the Bristol PR14[68] and NATS/CAA Determinations[69]. However, as shown by the CMA's PR19 FDs, the estimates based on weekly frequency of data are not materially different

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[67] See Gilbert et al (2014) and Gregory et al (2018):

Gilbert, T., Hrdlicka, C., Kalodimos, J. and Siegel, S. (2014). Daily data is bad for beta: Opacity and frequency-dependent betas. *The Review of Asset Pricing Studies*, 4(1), pp.78-117, and

Gregory, A., Hua, S. and Tharyan, R. (2018), In search of beta, *The British Accounting Review*, 50(4), pp.425-441

[68] Bristol FD, p.325

[69] CMA NATS, p.151

from those based on daily data (in the case of UK water stocks) whereas monthly estimates are more volatile and sensitive to outliers.[70]

6.3.4   Given that all the comparators considered in this Report are liquid, the Report considers that daily frequency represents a good starting point for assessing betas in a UK regulatory context, consistent with Ofwat's proposed approach.

6.4   Treatment of significant events impacting on returns or volatility

I.   Framework for determining the appropriate treatment of significant events affecting returns or volatility

6.4.1   The appropriate treatment of significant events affecting returns or volatility should be informed by the investment horizon implied in the regulatory WACC and the specification of the CAPM used to estimate cost of equity.

The relevant investment horizon

6.4.2   The cost of capital varies with the assumed investment horizon. This is predominantly because the risk-free rate observed using various market instruments and short-term betas change over time.[71] The specified investment horizon can represent a key determinant of the calculated cost of equity estimate.

6.4.3   It is appropriate for the investment horizon for estimating the forward-looking cost of equity in regulatory price controls to be long run. This is because both debt and equity investors in regulated utilities make long-term financing decisions, including debt financing of up to 30 years' maturity[72], reflecting the asset lives of the underlying infrastructure. In order to attract investment, a forward-looking cost of equity over that same long-run horizon is required. The view that a long-run investment horizon should be used when estimating the allowed cost of equity, does not appear to be controversial. For example:

—   The UKRN Cost of Equity Study (2018)[73] recommended the use of a long-run investment horizon because regulatory assets tend to be long-lived.

—   At PR19 the CMA noted that "*the **very long-life assets and long-horizon investment decisions** that are likely to be based on our cost of capital estimates. As a result, we suggest that **a 20-year investment horizon would closely match the reality of decision-making** within the sector and so use gilt and other market*

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[70] CMA PR19 FD, Tables 9-8 and 9-11

[71] In theory, the short-term total market return will also vary with time.

[72] CMA PR14 FD (Bristol), para. 10.6

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

data at or close to 20-year maturities. We note this horizon is longer than the 15 years used by Ofwat.[74]"

— In the draft methodology consultation for PR24 Ofwat noted that "*the CAPM is a model for estimating the market required return on an equity investment over a single period, or investment horizon. We consider this should be long-term, or around 10-20 years*"[75]. Ofwat also refers to 15Y Gilts in the context of the risk-free rate, which all else equal, suggests an investment horizon of at least 15 years[76]. Ofwat also considers a 25Y for investment planning through its new Long Term Delivery Strategy framework[77].

6.4.4 The investment horizon should be specified clearly and estimation of each parameter in the cost of equity should be developed through the lens of this investment horizon, as far as possible, as otherwise the cost of equity estimate would not represent a true expected return over the long run investment horizon. This is consistent with the position adopted by the CMA[78] and each of the authors[79] of the Wright et al (2018) paper, where the authors stated:

6.4.5 "*However, we are in agreement on a key caveat: that, **whichever horizon is chosen, the components of the cost of capital should, as far as practically possible, be estimated in a way that is consistent with the chosen horizon,** since without this consistency we cannot view our CAPM-WACC estimate as a true expected return. We shall argue that this has not always been the case for the choices made by UK regulators.*"[80]

6.4.6 Nevertheless, for horizons which are appropriate for regulatory price control purposes, e.g. 15 or 20 years, isolating the impact on the allowed cost of equity of moving from (say) 15 to 20 years is difficult. The purpose of the requirement to adopt a consistent investment horizon is primarily to ensure that a long-run cost of equity is estimated. Retaining a long-run approach to estimating the parameters and applying this consistently ensures short-term market movements or volatility are not introduced into the long-run cost of equity estimate.[81] All else equal attaching weight to short term volatility is likely to introduce distortions in the long-run cost of capital.

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[74] CMA PR19 FD, para. 9.128

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

[76] Ibid, p. 5

[77] PR24-and-beyond-Final-guidance-on-long-term-delivery-strategies_Pr24.pdf (ofwat.gov.uk)

[78] See, for example, CMA PR19 FD, paras. 9.330 and 9.551

[79] The phrase 'each of the authors' is used as they do not agree on all of their recommendations.

[80] Estimating the cost of capital for implementation of price controls by UK Regulators, p.29

[81] It should be noted that fundamentally, the parameters using in the cost of equity estimates are expectations of forward-looking outcomes over a long-run investment horizon, for which it may be appropriate to rely wholly or partially on historical data.

6.4.7   The above implies that the objective is to estimate a beta that will apply over a horizon consistent with that used in the estimation of the other CAPM parameters, i.e. at least 15 years. This Report assumes an investment horizon of *at least* 15Y. This is a key assumption as reflecting short term variation in betas – such as variation observed in relation to Covid19 and the war – may not be reflective of risks and return requirements over the selected long-run investment horizon, would not be consistent with the basis for estimation of other parameters such as the risk-free rate and in turn might not attract long-run capital to the sector.

Specification of CAPM used to set allowed cost of equity

6.4.8   As noted by Ofwat in the draft methodology consultation, the standard version of CAPM used by regulators estimates the required return on an equity investment over a single period or investment horizon[82].

6.4.9   This *unconditional* version of CAPM is the standard model and does not distinguish between different potential future states of the world under different scenarios. The unconditional model assumes any variation in the stock beta and the market risk premium is effectively 'noise' which could distort long-run estimates of beta.

6.4.10   This CAPM is effectively *unconditional* and is not contingent on time-variation in the market risk premium and beta. For example, the assumption underpinning the CAPM used to set allowed returns for a 15-year investment horizon is that beta would not vary across time and business cycles during this 15-year forward-looking period.

6.4.11   This contrasts with an alternative, *conditional* CAPM which assumes betas and the market risk premium vary over time. In consequence a conditional beta would capture potentially transient shifts in the relationships between daily returns or differences in betas in different economic climates. These transient shifts are not reflected in the long-run beta which abstracts from variance between different potential economic states of the world.

6.4.12   Overall, as the CAPM used in the regulatory process is an unconditional CAPM, an estimate of the unconditional beta is the relevant and appropriate input into the calculation of allowed cost of equity. The unconditional beta reflects the fundamental systematic risk of a company, in other words, some sort of "normal" beta to which one might expect a water company's beta to revert to despite short-term fluctuations.

6.4.13   Absent adoption of a conditional CAPM – which would represent a significant departure from use of the unconditional CAPM as the primary methodology for setting returns – a

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

key question becomes how to estimate a long-run, unconditional beta which takes into account underlying business risk over the assumed investment horizon.

6.4.14 UKRN's cost of equity study noted that:

⸺ *if we are concerned to assess the nature of systematic risk at long horizons, we should ensure that our estimation techniques are consistent with that horizon.*

⸺ *But **for regulators, who deliberately pick long horizons**, it appears at first sight to be **distinctly counterintuitive to use such a short samples of high frequency data** to assess the systematic component of equity returns over long horizons.*

⸺ *We would ideally like to **estimate the unconditional (or "long-run") beta**, which is the ratio of the unconditional covariance to the unconditional variance of the market return. It is **long-run beta that will determine the impact of systematic risk over the horizons relevant to regulators**.[83]*

6.4.15 All else equal the adoption of a beta which is materially influenced by a specific, short-term economic cycle is not likely to reflect an unconditional, long-run beta as significant weight would be attached to a period which might be transient and 'noisy'.

6.4.16 This is consistent with the position adopted by the CMA in its PR19 re-determination, which noted that its estimates should be calibrated such that limited weight is attached to specific economic cycles[84].

Treatment of structural breaks

6.4.17 Beta captures the expected change in return associated with a systematic risk event, be that positive or negative, *but the beta itself does not change.* During the PR19 appeal Professor Alan Gregory et al (2020, 2021)[85] submitted that in case of systematic risk events, the returns on water companies should move in line with market returns, proportionate to their betas, and that the unconditional CAPM specifically predicts the degree of the relative movement.

6.4.18 One would not expect the unconditional beta itself to change in case of such an event, because if it does, then this implies a break in the econometric relationship between the

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[83] [Estimating the cost of capital for implementation of price controls by UK Regulators](#), p. 147

[84] CMA PR19 FD, para. 9.477

[85] Gregory, A., Harris, R., and Tharyan, R. (2021), The Evolution of Beta Through the Covid Crisis, (referred to as 'Prof Alan Gregory et al (January 2021)');

Gregory, A., Harris, R., and Tharyan, R. (2020). A response to the CMA's Provisional Findings on Water and the Estimation of Beta, (referred to as 'Prof Alan Gregory et al (October 2020)');

Gregory, A., Harris, R., and Tharyan, R. (2020), A Response to "Further Comments Regarding Beta" by Europe Economics, (referred to as 'Prof Alan Gregory et al (June 2020)');

Gregory, A., Harris, R., and Tharyan, R. (2020). A Report on the Estimation of Beta for Regulatory Charge Control Purposes, (referred to as 'Prof Alan Gregory et al (April 2020)')

water industry and the wider market. Should such an event occur, Gregory et al posit that the obvious question is whether this is an example of a permanent state of affairs, or a temporary hiatus in the relationship. The exam question then becomes whether this structural break is representative of a "new normal" in which case the affected should be legitimately included in the calculation of beta. If, however, the effect is transitory, it should be excluded.

6.4.19   In this context Ofwat recognises the relevance of structural breaks for beta estimation, noting for example that "***regulatory reforms can change a sector's systematic risk. For example, before 2015, our determinations were set as controls on tariffs, but since PR14 we have set total revenue controls for wholesale activities, with an accompanying reduction in revenue risk.***"[86]

6.4.20   At the same time Ofwat also notes that "*we propose not to use structural break analysis to inform the estimation period[87]*". It is not clear that these two positions are consistent as Ofwat's approach recognises that there are factors which can impact on systematic risk which might not be relevant to setting a long-run, unconditional beta. Ofwat's position that PR14 represents a structural break is consistent with the position adopted in this report and the evidence developed by Gregory et al that PR14 represents a clear structural break event[88]. Importantly, changes to regulation can have a material impact on the systematic risk for regulated companies and it is reasonable to estimate beta based on data which captures the most relevant dynamics of regulation and so best proxies the framework under which companies will be operating across the forward-looking investment horizon.

6.4.21   There are equally structural breaks in the data related to economic periods which are transitory in nature, do not reflect an enduring change to underlying business risk and hence do not represent a robust proxy for estimation of long-run beta. In this context Ofwat's intention to avoid setting a beta which is dominated by data from the Covid19 pandemic and the recognition that this could distort beta are welcome. However, the approach proposed by Ofwat is likely to attach weight to beta which is disproportionate to the likelihood of a pandemic recurring within the investment horizon.

6.4.22   In order to evaluate this issue both a statistical and economic investigation of structural breaks should be undertaken. This is consistent with recommendations from Gregory et al during the PR19 CMA appeals as well as from the authors of the Indepen report, commissioned by Ofgem, who noted that "*in an ideal world the estimation of equity β would be based upon all available information back to the date of listing. However, **given the likelihood of structural breaks due to company specific, regulatory or***

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[86] Appendix-11-Allowed-return-on-capital-appendix.pdf (ofwat.gov.uk), p. 15

[87] Ibid.

[88] As reflected in the papers set out in footnote 85.

*market wide factors, the data used for estimation may be restricted. If structural breaks affect relative risk, it will be important to know whether an event had a significant effect or not and **whether the effect is permanent or transitory.**" [89]*

6.4.23 In case of permanent structural breaks, the relevant input into the calculation of regulatory cost of equity is the data since the most recent break as this would accurately reflect the systematic risk going forwards. In case of temporary breaks, caution is required as reflecting the affected data in forward-looking beta estimates over the chosen investment horizon may over-weight the impact of such events in beta estimates.

6.4.24 In this context, Gregory et al note that "*our view on how these breaks should be treated depends upon the nature of the break. In common with Indepen (p.6-7), we would agree that **if the break induces a permanent change** (as PR14/RIIO would appear to have done)[90], then the **appropriate approach is to use the full data period since the break**, but that if the break is of a temporary disruptive nature (as may be the case with the financial crisis and Covid-19) then one would want to estimate beta using data before and after the break point, but not during the period of disruption*".[91]

6.4.25 The following overarching principles emerge based on the above:

— The estimation of allowed cost of equity requires an estimate of an unconditional beta that will apply over the long-term investment horizon implied in the regulatory WACC.

— Changes in the unconditional beta imply a break in the econometric relationship between the stock and the market and would need to be carefully evaluated to determine whether they are temporary or permanent. This will inform how the break event should be treated in forward-looking beta estimates. All else equal it would not be expected that material weight would be attached to transitory effects in estimation of unconditional beta over a long-run horizon.

II. Analysis of significant events affecting returns or volatility ahead of PR24

6.4.26 Two significant events have a significant impact on the global and UK economies, namely: Covid19 and the Russia-Ukraine war[92].

6.4.27 Covid19 resulted in a sudden and severe global recession as a result of lockdowns and major disruptions to everyday life that is unique across multiple dimensions.

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[89] Indepen (2019), 'Beta Study–RIIO-2, Main Report', p.7

[90] The analysis undertaken by Gregory et al during the PR19 appeals found a structural break for the UK water sector around the PR14 period. This is discussed in greater detail in section 8.5.

[91] Prof Alan Gregory et al (June 2020)

[92] UK Economic Outlook, KPMG (2020-2021 editions)

— The pandemic was an exogenous crisis that did not have an economic origin.

— It created significant uncertainty for businesses, individuals and governments as its scale and duration were dependent on unpredictable non-economic factors, such as the speed at which vaccines could be developed and rolled out.

— Its impact was global in the sense that it affected all countries and all sectors, although the impact varied significantly.

6.4.28   The Covid19 pandemic represented both a shock to demand, as people adjusted their behaviour to reduce the risk of exposure to the virus and conform with mandated lockdowns (a highly atypical feature of this event); and a shock to supply, as the effect of factory closures reduced the productive capacity of the world economy.

6.4.29   The speed, scale, and scope of the policy response was also unique, resulting in substantive monetary and fiscal policies with support schemes for businesses and individuals. The KPMG Economic Outlook paper in June 2020 highlighted that "*the UK economy is in the midst of the most severe economic downturn in modern times. The nature of lockdown and social distancing restrictions has curtailed the ability of businesses to operate*…

6.4.30   *Over the past three months, COVID-19 has become one of the most significant global pandemics in history. By early June, the pandemic had spread to 213 countries and territories…The latest data points to one of the deepest economic recessions on record, with a record fall in GDP in the second quarter of 2020".*[93]

6.4.31   More recently the global economy has been recovering from the Covid19 pandemic, although the bounce-back has been uneven across countries. Overall, GDP across the OECD countries is now 2.4% above its pre-pandemic level, with the US economy 2.8%, the Eurozone 0.8%, and the UK 0.7% higher than in the fourth quarter of 2019. However, a number of countries are yet to reach that threshold, including Spain, Germany, and Japan.

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[93] UK Economic Outlook June 2020 - Hard Times (assets.kpmg)

Figure 3 Uneven recovery from Covid19 across countries[94]

Changes in GDP relative to 2019 Q4, %

◆ Pre-COVID to current ◆ COVID trough
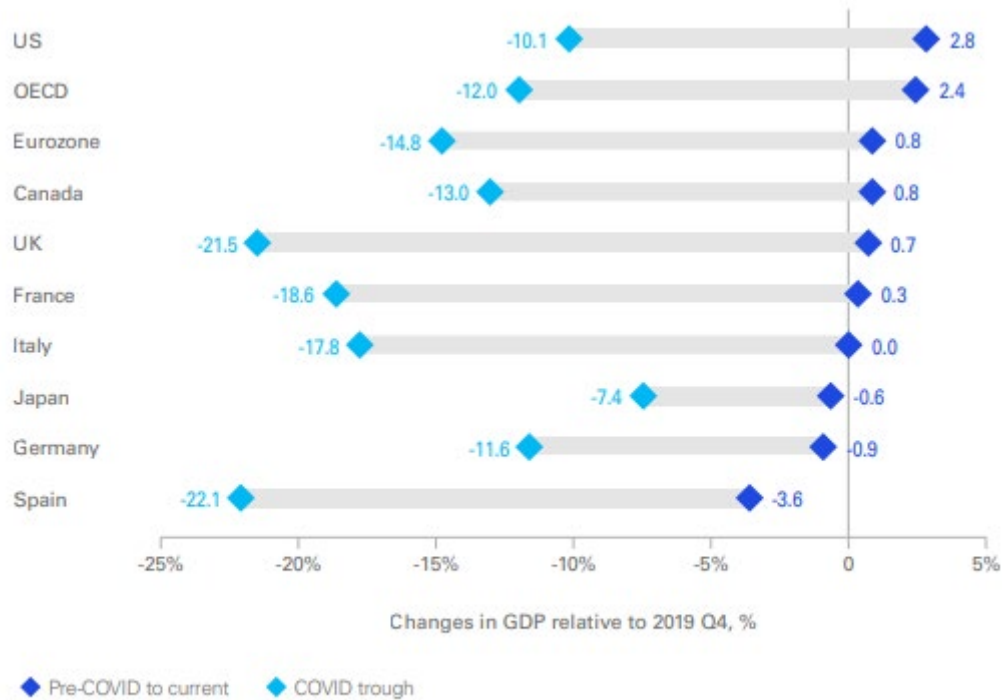
Source: OECD, Eurostat, ONS, Refinitiv Datastream, KPMG analysis.

6.4.32   As the global economy was re-opening in early 2022, with many parts of the world lifting restrictions, and a number of economies returning to their pre-Covid19 size, a second, very rare, shock with a significant impact on global and in particular European economies materialised. Whilst localised, the conflict between Russia and Ukraine has had broad implications for economies around the world as these countries account for a large share of global energy exports, as well as exports of a range of metals, food staples and agricultural inputs.

6.4.33   The risk of the Russia-Ukraine conflict escalating further appears to have diminished, but the war has left tangible side-effects on the global commodity markets. For example, global gas prices are now around six times higher than their pre-pandemic average, while oil prices are twice their average levels (as set out in the figure below).

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[94] UK Economic Outlook - June 2022 (assets.kpmg)

Figure 4 The rise in global commodity prices post Covid19 and Russia-Ukraine war
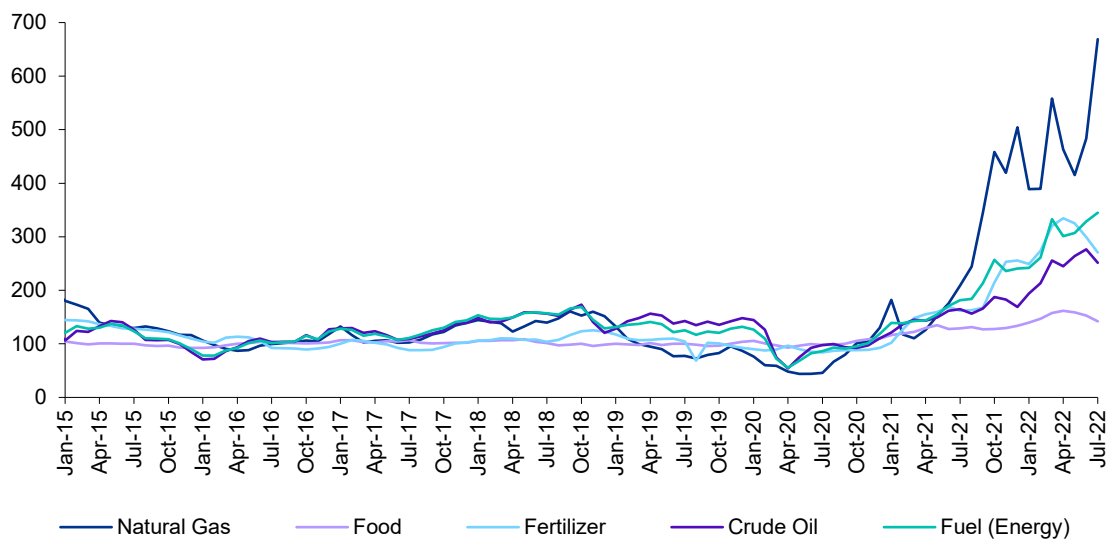
Source: KPMG analysis of IMF Primary Commodity Prices

6.4.34   The prices of many of the commodities exported by Russian and Ukraine were already high, and stocks low, as the Covid19 pandemic had caused production to slow, and demand accelerated quickly when economies reopened. The escalation of the conflict, which resulted in a number of sanctions on Russia and paused most production in Ukraine caused prices to rise further and exacerbated supply chain pressures for a number of industries.

6.4.35   The significant impact that Covid19 *and* the war have had on the global and UK economies suggests that a statistical investigation is warranted to assess their impact on water company betas. Gregory et al undertook several iterations of structural break analyses during the PR19 appeal – albeit with less than 12 months of affected data[95] – and found that Covid19 had a significant negative impact on water betas.

6.4.36   The Report carries out additional structural break analysis. Dummy variables corresponding to potential structural break dates are incorporated into the regression of daily returns for the water portfolio (SVT, UUW) against the returns of the benchmark index. The analysis covers the period from 1 October 2014[96] through to 25 August 2022. Where the change in beta associated with a given dummy variable is material and statistically significant, this is indicative of a structural break.

Covid19

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[95] The latest version of the analysis included data up to 31 December 2020

[96] Gregory et al identified a structural break for the water sector coinciding with the PR14 price control.

6.4.37   In this context 28 February 2020 is selected as the structural break date for Covid19 as (1) the CMA used this date as the cut off for estimating betas not affected by the pandemic, (2) by mid-March UK was starting to gear up to impose restrictions[97], and (3) it is clear from the chart below that there is evidence of material stock market movements in March.

6.4.38   The assumed end date for the pandemic corresponds with the removal of the remaining Covid19 international travel restrictions for all passengers on 18 March 2022[98] (all restrictions amending UK residents and domestic travel had been removed some months prior to this date).

Russia-Ukraine war

6.4.39   24 February 2022 is selected as the structural break for the Russia-Ukraine war as the date at which Russia invaded Ukraine. The impact of the war is assumed to apply to all subsequent data, i.e. up to the cut-off of 25 August 2022.

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[97] Timeline of UK government coronavirus lockdowns and restrictions | The Institute for Government
[98] All COVID-19 travel restrictions removed in the UK - GOV.UK (www.gov.uk)

Figure 5 2Y daily rolling asset betas (unlevered) for water companies
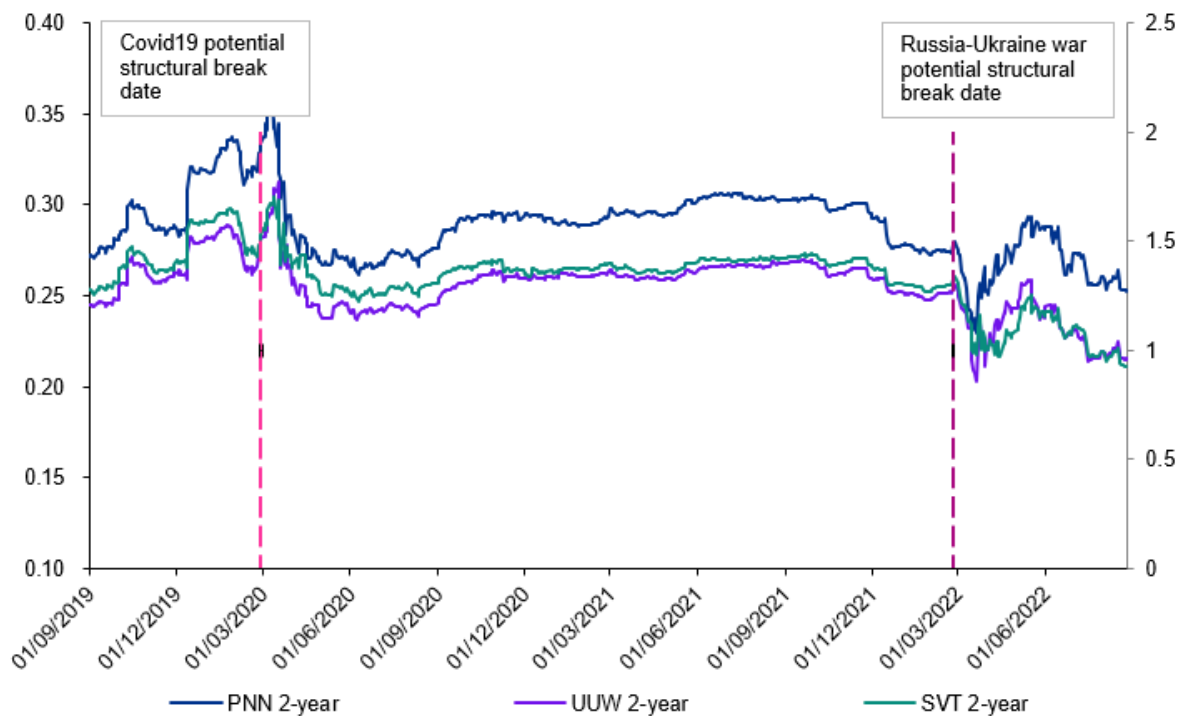
Source: KPMG analysis of Thomson Reuters Eikon data as of 25 August 2022[99].

6.4.40   The table below indicates that both Covid19 and the war have had significant negative impacts on water company equity betas. Table 6 indicates that the Covid19 has resulted in a statistically significant reduction in the equity beta for the pure play water portfolio of c.0.14, whereas the impact of the war has so far been equivalent to a reduction of c.0.27.

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[99] Please refer to footnote 66 for an explanation of the methodology for normalising PNN EV gearing for the impact of the sale of Viridor.

Table 6 Results of the structural break analysis

	Coefficients	Standard Error	t Stat	P-value
Intercept	0.0002	0.0003	0.7477	0.4547
Base beta (SVT/UUW, equity)[100]	0.6795	0.0375	18.1114	0.0000***
Change in equity beta associated with the Covid	**-0.1446**	0.0523	-2.7657	0.0057***
Covid dummy variable[101]	0.0001	0.0006	0.1984	0.8427
Change in equity beta associated with the war	**-0.2669**	0.0951	-2.8068	0.0051***
Russia-Ukraine war dummy variable[102]	0.0003	0.0011	0.2531	0.8002

Source: KPMG analysis of Thomson Reuters Eikon data as of 25 August 2022.
Note: * is significant at the 10% level, ** at the 5% level and *** at the 1% level.

6.4.41   To assess the weight that should be given to the data affected by Covid19 and the war in the context of setting long-run unconditional betas for PR24, this Report considers:

— How likely is it that pandemics with similar impact to Covid19 will occur over the (at least) 15Y investment horizon likely to be assumed by Ofwat?

— Is the impact of the Russia-Ukraine war temporary or protracted, relative to the investment horizon in the PR24 WACC?

How likely is it that pandemics with similar impact to Covid19 will occur over the investment horizon?

6.4.42   In relation to this question, it is important to consider the frequency of comparable pandemics in future (will a pandemic of similar magnitude happen every 20Y, 50Y or 100Y?)

6.4.43   Forecasting each of these variables is inherently highly uncertain. The last comparable pandemic was approximately 100Y ago in a significantly different environment in terms of geographical integration (i.e. the ease of travel), medical and technological advancement and the tools available to deal with economic crises.

6.4.44   There have been several studies which have sought to estimate the likely frequency of pandemics which are comparable to Covid19. Ofwat's draft methodology is predicated on a paper which considers the potential frequency of pandemics which are comparable to Covid19 in terms of severity and duration.

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[100] Value-weighted
[101] The dummy variable is 1 between 01/03/2020 – 18/03/2022
[102] The dummy variable is 1 24/02/2022 onwards

6.4.45 "*Using the number of epidemic occurrences observed in the past 20 y (i.e., 2000 to 2019) in the MEVD model, this intensity corresponds to an average recurrence time of 59 y (95% CI 55 to 64 y). This value is much lower than intuitively expected. However, in many countries, drastic nonpharmaceutical interventions, contact tracing, and quarantine have significantly reduced the number of deaths that could have otherwise occurred. Detailed modelling work suggests that unconstrained epidemic spread would have led to as much as eight times the number of deaths that actually occurred in some countries (20). Assuming this amplification factor, one obtains an intensity of 2.63 ‰/year, which corresponds to an average recurrence time of 209 y.*"[103]

6.4.46 The paper estimates the base probability of experiencing a comparable pandemic as 0.38 to 0.76 in 100Y.

6.4.47 This suggests that the likelihood that another pandemic event occurs in the estimation window is low. All else equal this would not justify the weight that is implied by a 2Y or 5Y beta including the Covid19 period. Implicitly the latter assumes a similar event is a near certainty in the PR24 period.

6.4.48 This contrasts with the position set out by Ofwat in its PR24 draft methodology, which considers that irrespective of the proximity of Covid19 to the PR24 decision date that it is not necessary to estimate an unconditional beta which is not disproportionately affected by structural changes in beta arising from the pandemic:

6.4.49 "*Our current preference to address this issue is through relying on evidence from a **range of estimation periods (of 2, 5, and 10 years),** ensuring that our approach encompasses data from unaffected periods and a reasonable span of years. **We do not propose to apply bespoke weights to the Covid-affected data**, as we note that a selective treatment of just one of many sources of systematic risk might miscalibrate weightings for alternative sources of risk that are more relevant to the 2025-30 period*"[104].

6.4.50 This approach does not appear to consider whether observed effects on beta are likely to be transitory and hence could distort estimates of the long-run, unconditional beta. An approach which reflects transitory impacts on beta effectively reduces the approach to a conditional beta methodology which (1) is not consistent with the unconditional CAPM model used by the regulators, (2) is not consistent with the investment horizon and calibration of other parameters which are estimated over the long run and (3) is likely to attach weight to data from a period which is not reflective of underlying risk exposure, which is expected to increase at PR24. Importantly, there is not robust evidence to indicate that a conditional model would substantively improve as a basis for estimation

[103] Intensity and frequency of extreme novel epidemics | PNAS
[104] Appendix-11-Allowed-return-on-capital-appendix.pdf (ofwat.gov.uk)

of returns implied by an unconditional, long run model – however a conditional model would add significant volatility into estimation of returns and reduce stability of estimates of required returns in the sector.

6.4.51   In contrast, the CMA recognised that this type of economic crisis is relatively rare and was likely to be over-weighted in the CMA's beta estimates, which covered the last 2-, 5- and 10-year periods[105]. Overall, at PR19 the CMA placed very limited weight on the evidence on beta estimates from December 2020 (that include the Covid19 period) than on observations pre-February 2020 (i.e. before the Covid19 period). The CMA's final range of asset beta estimates of 0.28-0.30 (zero debt beta basis) was fully encompassed within the range of evidence that results from estimates being calculated with pre-Covid cut-off[106]. As a result, the CMA's range for beta is relatively unaffected by Covid19 estimates.

6.4.52   The chart below illustrates the relative weight placed by the CMA on the data from the period affected by the pandemic for each estimation window based on its approach to (1) use cut off dates from both February and December 2020, (2) test and exclude outliers and (3) place less weight on estimates from December 2020.

6.4.53   It is unclear exactly what weight the CMA placed on outlier-adjusted estimates from December 2020, therefore the figures in the chart have been derived as an average of the following upper and lower bounds for the proportion of Covid-affected data reflected in the estimates.

— The lower bound assumes that the CMA placed no weight on Covid19-affected estimates given that its final range was fully encompassed within the range of evidence that results from estimates being calculated with pre-Covid cut-off[107]. The result is 0% weight attached to Covid19-affected data at the lower end of the range.

— The upper bound calculates the overall weight attached to the data from the period affected by the pandemic for each estimation window as an average across the two cut off dates. It indicates that c. 7.4% of the data reflected in the estimates could be Covid-affected. This analysis takes into account the exclusion of certain estimates from December 2020 by the CMA as outliers but does not reflect the CMA's additional decision to place less weight on outlier-adjusted December 2020 estimates[108]. As a result, it somewhat overstates the potential upper end of the range for proportion of Covid-affected data reflected in the estimates.
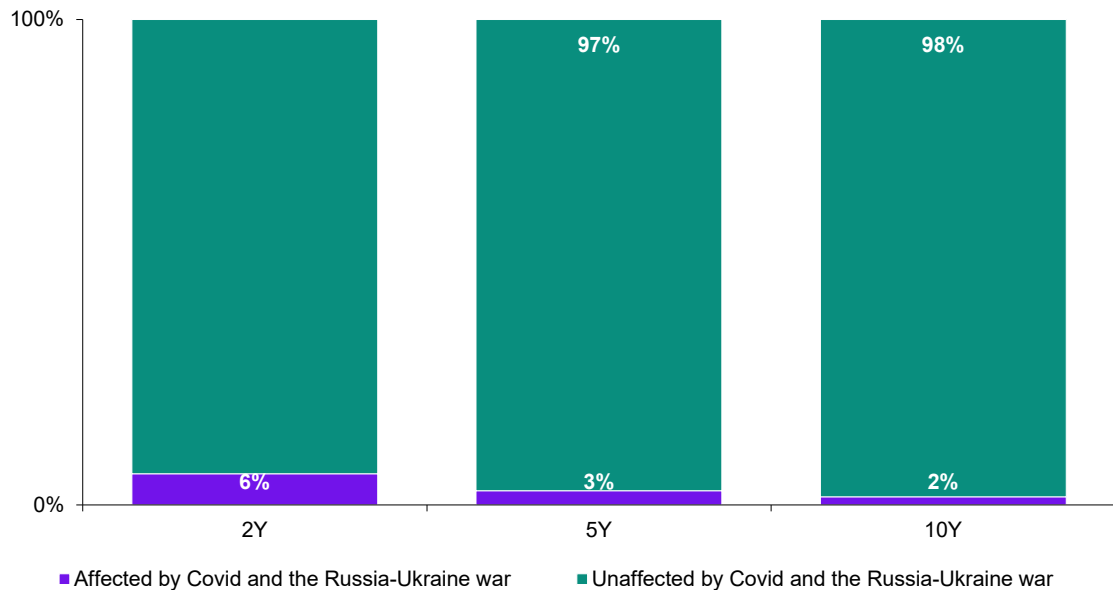
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[105] Ibid., para. 9.493
[106] CMA PR19 FD, Table 9-16
[107] CMA PR19 FD, Table 9-16
[108] CMA PR19 FD, para 9.493: "*Therefore, we have placed less weight on the lower estimates from the dataset to December 2020*".

Figure 6 Weight attached by the CMA to the data affected by Covid19

Source: KPMG analysis.

6.4.54　This analysis suggests that c. 3.7% (midpoint of the 0 – 7.4% range) of data used to derive PR19 beta estimates could have been Covid-affected. In the context of a 20-year investment horizon employed by the CMA, this corresponds to an assumption that a pandemic of a similar scale as experienced during the first ten months of Covid19 would occur during c 0.74 years out of 20.

6.4.55　Relatedly, the Civil Aviation Authority ('CAA') in the Final Proposals for the H7 price control for Heathrow set a beta assuming that a pandemic-like event would occur once in every 20 or 50 years and last 17 or 30 months[109].

Is the impact of the Russia-Ukraine war likely to be temporary or protracted, relative to the investment horizon implied by the PR24 WACC?

6.4.56　The Russia-Ukraine war has also had a significant and continued (as evident from Figure 5) impact on water company betas. The extent to which this impact should be taken into account in the setting of allowed returns for PR24 depends on whether it is temporary or protracted, relative to the investment horizon in the PR24 WACC.

6.4.57　The conflict is still ongoing as of August 2022 and it is not possible to arrive at a robust and well-justified conclusion regarding the potential end date. However, the length of the economic impact of the war on Europe and the UK is unlikely to be perfectly correlated

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

with the duration of the war itself and is likely to vary between short-, medium- and long-term windows.

6.4.58   In the short-term the global supply of both energy and non-energy commodities will be disrupted, translating into price and inflationary pressures and challenges for businesses to manage shortages and bottlenecks in their supply chains. In the medium to longer term businesses and governments can find ways to limit disruption by, for example, diversifying suppliers of commodities, building flexibility into the procurement processes to accommodate longer lead times, etc.

6.4.59   Europe has already started developing plans to increase energy autonomy and thereby reduce the exposure to market disruptions such as those caused by the war. On May 18 the European Commission presented the REPowerEU Plan, its response to the hardships and global energy market disruption caused by Russia's invasion of Ukraine. The plan addresses energy savings, diversification of energy supplies, and accelerated roll-out of renewable energy to replace fossil fuels in homes, industry, and power generation. The Commission proposes to increase the headline 2030 target for renewables from 40% to 45%[110].

6.4.60   According to McKinsey[111] this includes plans to almost *double* European biomethane production and *triple* capacity of green hydrogen via production increases and imports by 2030, a massive deployment of 510 gigawatts of installed wind and 600 gigawatts of installed solar photovoltaic power by 2030 (and doubling of existing capacity by 2025[112]), the installation of around 30 million heat pumps, the enhancement of domestic manufacturing capability, and a substantial simplification of approval and permitting processes for renewable generation and infrastructure development projects, all over the next eight years. All else equal, these increases in the self-generated supply of renewable energy and the decrease in the reliance on Russian exports can reasonably be expected to mitigate the price pressures arising from the war.

6.4.61   Quantitative evaluation of the potential speed of reversion to the 'normal' economic conditions extant prior to the war and Covid19 requires a leading proxy measure that can capture and reflect the main channels via which the war is affecting the economy. This Reports adopts forecast UK CPI inflation as a proxy based on the view from Bank of England ('BoE') that "*the main channel through which the Russian invasion of Ukraine affects the UK economy is through higher energy and non-energy commodity prices, which push up UK inflation materially in 2022 and 2023*".[113]

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[110] REPowerEU (europa.eu)
[111] The net-zero transition in the wake of the war in Ukraine: A detour, a derailment, or a different path? | McKinsey
[112] REPowerEU (europa.eu)
[113] Bank of England Monetary Policy Report May 2022

6.4.62 According to the BoE, the bulk of the high short-term inflation stems from the direct impact of high energy and tradable goods prices as well as their indirect impact via higher transport, production and utility costs for firms supplying non-energy goods and services. BoE notes that "*the rise in energy prices has been significantly exacerbated by the build-up to and Russia's subsequent invasion of Ukraine. Higher global goods prices reflect various factors including: the economic recovery from the worst of the pandemic; the rotation of consumer spending towards goods and away from services, most notably in the United States; and supply constraints in certain sectors*"[114]. The Bank notes, however, that domestic factors have also contributed to high inflation, notably the strength in pay growth due to the tight labour market

Figure 7 Bank of England analysis of contributors to CPI inflation
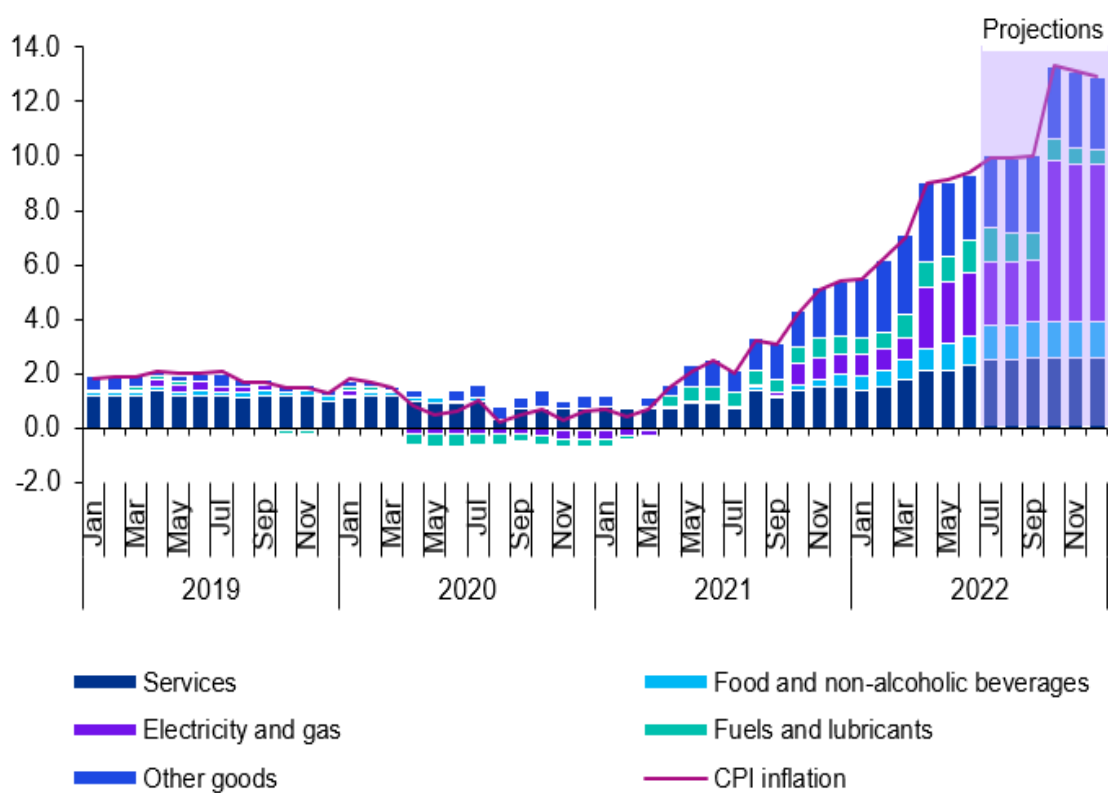
Source: Monetary Policy Report - August 2022 | Bank of England

6.4.63 The implication from the above is that the level of inflation forecasts is largely, but not entirely, driven by the impact of the war and that the reversion of inflation to the long-term target can be indicative of a broader normalisation of the economic environment.

6.4.64 As evidenced from the chart below, inflation is expected to normalise ahead of the start of the PR24 price control which would suggest that the impact of the war could reverse in the next couple of years. In combination with the actions being undertaken to mitigate

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[114] Monetary Policy Report - August 2022 | Bank of England

the economic impact of the war on Europe, this evidence implies that the beta estimates from the war-affected period are not likely to be relevant for setting a long run, unconditional beta for PR24.

Figure 8 Forecast inflation for 2024 (sorted by timing of the projection, from earliest to most recent projections)
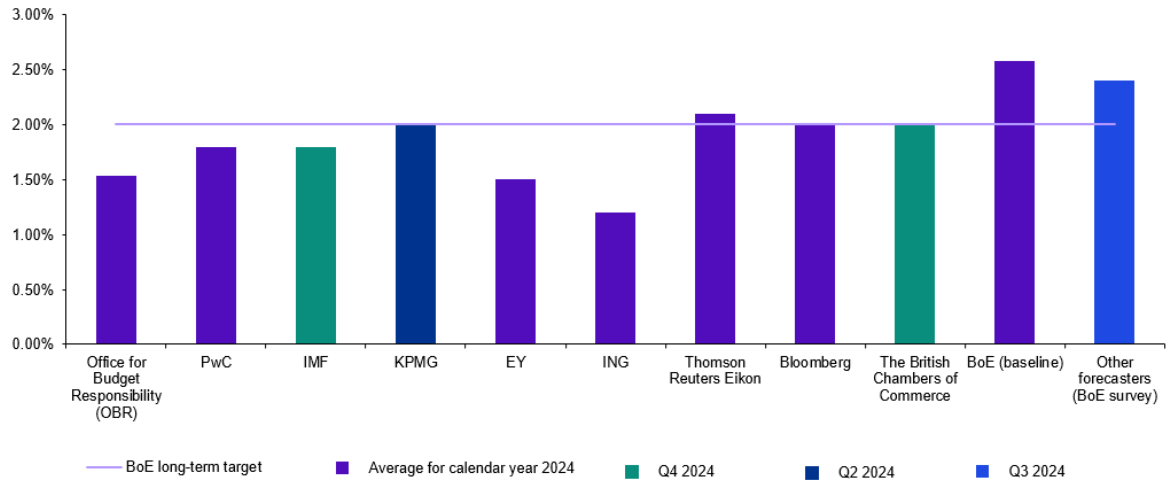
Source: Inflation - Office for Budget Responsibility (obr.uk), UK Economic Outlook April 2022 (pwc.co.uk), United Kingdom and the IMF, UK Economic Outlook - June 2022 (assets.kpmg), ey-item-club-summer-forecast.pdf, Forecasts | ING Think, Britishchambers.org.uk, Monetary Policy Report - August 2022 | Bank of England, Charts and data for the Monetary Policy Report- August 2022

How much weight should be given to the data affected by Covid19 and the war, for the purposes of estimating a long-run, unconditional beta?

6.4.65   The nature and scale of Covid19 impacts on the economy distorted normal cyclical patterns because of mandated shutdowns of entire industries. Mandated shutdowns amplify the betas of those industries that are directly affected, and industries that supply these industries.

6.4.66   Overall, the Covid19 lockdowns have had a significant impact on estimates of beta. The most likely explanation for the reductions implied in the water company betas are the short-term changes in the market portfolio. In other words, that the behaviour of the market portfolio has changed during the lockdowns, such that the covariance of water company stocks with the market changed.

6.4.67   In consequence attaching significant weight to data affected by the Covid19 would suggest that the resulting beta estimate would not be reflective of the long-run beta of water companies. For example, if the beta estimates are based on 2Y, 5Y and 10Y spot estimation windows as set out in the draft methodology, this would effectively be assuming that 100% (2Y/2Y) or 40% (2Y/5Y) weight should be attached to the Covid19 period.

6.4.68   Similarly, attaching material weight to the data affected by the war would be tantamount to assuming that its impact will continue during the PR24 period and beyond. Whilst there is uncertainty around the timing of reversion to pre-war economic conditions, the evidence considered in this Report implies that the beta estimates from the war-affected period are not likely to be relevant for setting a long run, unconditional beta for PR24.

6.4.69   The change in short-term water company betas following these events appears to be a function of the 'flight to safety'[115] phenomenon whereby in times of market turbulence investors respond by switching their holdings away from higher risk investments into investments which are perceived to be low risk. In March 2020, the flight to safety in financial markets even became an abrupt and extreme 'dash for cash' in which investors sold off even safe assets such as long-term government bonds in order to obtain short-term highly liquid assets.[116] The effect of the flight to safety behaviour is to simultaneously (1) raise the price and reduce the return of lower risk assets and (2) lower the price and increase the expected return on higher risk assets.

6.4.70   These behavioural factors such as flight to safety or dash for cash are temporary *by nature*[117] and are a feature of a specific set of economic conditions. All else equal this indicates that attaching material weight to economic conditions in a period of market distress would likely distort the unconditional beta.

6.4.71   There is nonetheless some inherent uncertainty in relation to whether the impact of a major shock is temporary and betas will mean revert, or whether it reveals new information about business risk which is priced in by the market. The relative risk analysis carried out in this Report indicates that there is no change to fundamentals which could, on balance, drive reductions in business risk. As there are no clear reductions to risk factors which affect systematic risk for water companies, data affected by Covid19 and the Russia-Ukraine war can be seen as specific to prevailing economic conditions which, all else equal, should not be reflected in an unconditional, long run beta estimate.

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

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

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

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

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

6.4.72 This Report focuses on (1) estimates which exclude all data from 1 March 2020 onwards, and (2) estimates which attach low weight to Covid19 data based on the assumed frequency of a future pandemic with a similar impact and duration in order to avoid introducing a transitory and downward bias in the beta estimates which are intended to reflect expected returns over long-run holding periods (10 – 20 years), consistent with the remaining parameters in the CAPM.

6.5 Estimation windows

6.5.1 Consistent with the UKRN (2018) recommendations[118], and with the submissions by Prof Alan Gregory et al (April 2020, October 2020, January 2021)[119], for the purpose of setting the regulatory cost of equity allowance, what is needed is an estimate of the long-run beta, which should be estimated based on the longest available period of data *absent structural breaks.* This balances the need to use the longest possible information set to achieve statistical robustness of the estimates, with the need to include the most relevant set of data that reflects the current underlying asset risk.

6.5.2 As submitted by Prof Alan Gregory et al (2020, 2021)[120] on behalf of the water companies in the PR19 appeals, evidence from the UK water sector suggests the existence of a structural break for the UK water sector around the PR14 period, which suggests that data from 2014 onwards is most relevant to set cost of equity for PR24. This is consistent with the findings of the Indepen report which notes that *"significant changes in regulatory regime, like the shift from RPI-X to RIIO in the energy sector or the implementation of the Future Price Limits changes at PR14 in the water sector, suggest that the assumption of a constant equity β is likely to be untenable."*[121]

6.5.3 Notably, using this cut-off in combination with spot estimates of beta (discussed in the next section), would also exclude the period where SVT and UUW has material non-regulated business and the Global Financial Crisis.

6.6 Averaging windows

6.6.1 When interpreting beta evidence from different estimation windows there is a choice around the relative weight placed on spot estimates and averages of 'rolling betas'. For a given estimation window, spot estimates reflect solely the market data from each window, whereas rolling averages incorporate market data from periods before the start of the estimation window. This is because rolling averages require beta estimates that

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[118] Wright et al (2018), p. 52-53, *"there is therefore a quite strong prima facie case to use all available data to estimate beta, not just a relatively short recent sample".*

[119] Prof Alan Gregory et al (January 2021), Prof Alan Gregory et al (October 2020), Prof Alan Gregory et al (April 2020).

[120] Ibid.

[121] Indepen (2019), 'Beta Study–RIIO-2, Main Report', p.7

reflect the chosen estimation window at each date of the averaging horizon. For example:

— a spot estimate of a daily 2-year beta as at 30 September 2023[122] would reflect the relationship between water stocks and the market based on returns data for each working day during the 2-year estimation window i.e. from 30 September 2021 to 30 September 2023

— a 1-year rolling average of the daily 2-year beta as at 30 September 2023 would require beta estimates for each working day during the averaging window between 30 September 2022 and the cut-off date of 30 September 2023. The 2-year daily beta as at 30 September 2022 would reflect the relationship between water stocks and the market based on returns during the 2 years between 30 September 2020 and 30 September 2022. In total, this approach would cover 3-years' worth of data.

6.6.2 Ofwat has not signalled the weight it would assign to spot and rolling estimates of beta, however, use of rolling betas has several flaws:

6.6.3 First, when the rolling betas are 'averaged' across the years, the weight placed on the different data observations differs relative to the weight given to market observations under a simple 'spot' OLS regression using the same period of data. In a simple OLS regression, each data point (i.e. market and asset return pair) receives equal weighting. However, in the case of rolling regressions which are averaged, the first day's data gets used once, the second twice, and so on, such that more recent data (within the middle of the estimation window) receives greater weight than data on both ends of the sample.

6.6.4 This issue was recognised at the PR19 appeal by the CMA who noted that "*rolling averages place different weight on the various underlying data points and that this can give rise to potential distortions in the figures*"[123].

6.6.5 The UKRN Cost of Equity Study (2018) further noted that *"the econometric basis for this approach is actually fairly shaky: in particular all parameter standard errors are invalidated by this methodology"*[124].

6.6.6 Second, in the presence of structural breaks, rolling window estimates will place some weight on the evidence prior to the break, which introduces bias in the data to the extent that earlier data no longer reflects current pricing of risk. This has been recognised by several parties during the PR19 re-determination:

— The CMA noted that using a 5-year averaging window in combination with a 10-

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[122] 30 September was the cut off used in the PR19 FD.

[123] CMA PR19 FD, para. 9.473

[124] Wright et al (2018). Estimating the cost of capital for implementation of price controls by UK Regulators, p.50 footnote 67

year estimation window would assign some weight to the data from early 2006 when SVT and UUW had material non-regulated business (which has been recognised by the CMA to be a structural break)[125].

— A similar position was adopted by Ofwat, who did not agree with the use of rolling averages noting that its consideration of the issues around final determinations led it not to favour a 'rolling average' approach to estimating betas as such an approach would result in assigning weight to data as far back as 2009, which Ofwat did not consider to be especially relevant to informing investor expectations[126].

— On behalf of the water companies Gregory et al (2020)[127] outlined several flaws in the rolling average approach and submitted evidence of a structural break for the UK water sector around the PR14 period[128] (c. October 2014), which suggests that data from 2014 onwards is most relevant for estimating a forward-looking beta for the sector. Beta estimates that reflect data from the previous 9 years or more (via the combination of estimation and averaging windows)[129] as at 30 September 2024 will incorporate information before the structural break and will not be representative of the systematic risk going forward.

6.6.7   Third, rolling beta estimates based on the same estimation window might considerably vary, rendering the 'average' difficult to interpret.

6.6.8   Professors Wright and Mason – Ofwat's advisers during the PR19 appeal – consider that rolling beta estimates are a legitimate diagnostic tool for addressing the issue of whether the true (and unobservable) beta is stable over time, however, if the true beta is assumed not to be stable over time, rolling betas have a number of problems as estimators of this time-varying value at any point in time – and most notably standard errors (whether OLS or heteroscedastic-consistent) are spurious[130].

6.6.9   For these reasons, while this Report considers that rolling beta estimates might be useful for visual inspection of the data, and to indicate possible changes in risk and structural breaks in the data, 'averaging' across the estimates is not an appropriate interpretation of the data. This is because conceptually the average rolling beta estimate does not result in any more 'relevant' estimate of the current pricing of risk than a spot

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[125] CMA PR19 FD, para. 9.461

[126] Reference-to-the-PR19-final-determinations-Risk-and-return---response-to-common-issues.pdf (ofwat.gov.uk), para. 3.58

[127] Prof Alan Gregory et al (October 2020)

[128] Prof Alan Gregory et al (January 2021), Prof Alan Gregory et al (October 2020), Prof Alan Gregory et al (April 2020).

[129] For example, 10-year betas or 5-year averages of 5-year betas

[130] Comments prepared for Ofwat on the CMA's Provisional Findings Anglian Water Services Limited, Bristol Water plc, Northumbrian Water Limited and Yorkshire Water Services Limited price determinations: Cost of capital considerations, para. 5.6

estimate, whilst introducing arbitrary weighting of the underlying pricing signals within the sample under consideration.

6.6.10   Notably, the CMA relied on rolling averages estimates, along with spot estimates, to set the beta during the PR19 appeal. The CMA noted that "*the additional information provided by the rolling averages, in terms of highlighting trends in betas is useful in coming to an in the round assessment of the appropriate beta value, particularly in light of the material changes in the 2-year and 5-year beta estimates over the period*"[131].

6.6.11   The material changes highlighted by the CMA are to a large extent driven by the impact of Covid19 on beta estimates[132]. The table below sets out the summary data considered by the CMA in making its decision. It is clear that for beta estimates from the Covid-affected period (i.e. December 2020 cut off) the choice of averaging window has a material impact. Spot and shorter-term averages yield low estimates relative to the longer-term averages. In contrast, for the period not affected by Covid19 (i.e. February 2020 cut off) the values across all averaging windows are broadly consistent.

Table 7 Summary of CMA analysis of Severn Trent and United Utilities unlevered equity betas by timeframe per the PR19 CMA FD

Average by timeframe	Spot	1-year average	2-year average	5-year average
February 2005 to February 2020	0.29	0.28	0.29	0.30
January 2006 to December 2020	0.26	0.26	0.27	0.30

Source: CMA PR19 FD, Table 9-16

6.6.12   Intuitively this dynamic is in line with expectations – because the longer-term rolling averages incorporate more of the historical data not affected by Covid19, the impact of the pandemic is 'averaged out' and normalised to an extent. Relatedly, because the period between February 2005 and February 2020 does not reflect one-off events which affect beta in the same way as Covid19, different averaging windows yield similar results. In combination with placing less (but not zero) weight on beta estimates from December 2020 and excluding outliers[133] from this period, by using rolling averages the CMA[134] further reduced the impact of the pandemic on PR19 beta estimates.

6.6.13   The charts below illustrate the difference in the weight attached to the period affected by Covid19 and the Russia-Ukraine war in each estimation window where the existence of temporary structural breaks is not explicitly factored into the analysis and (1) only
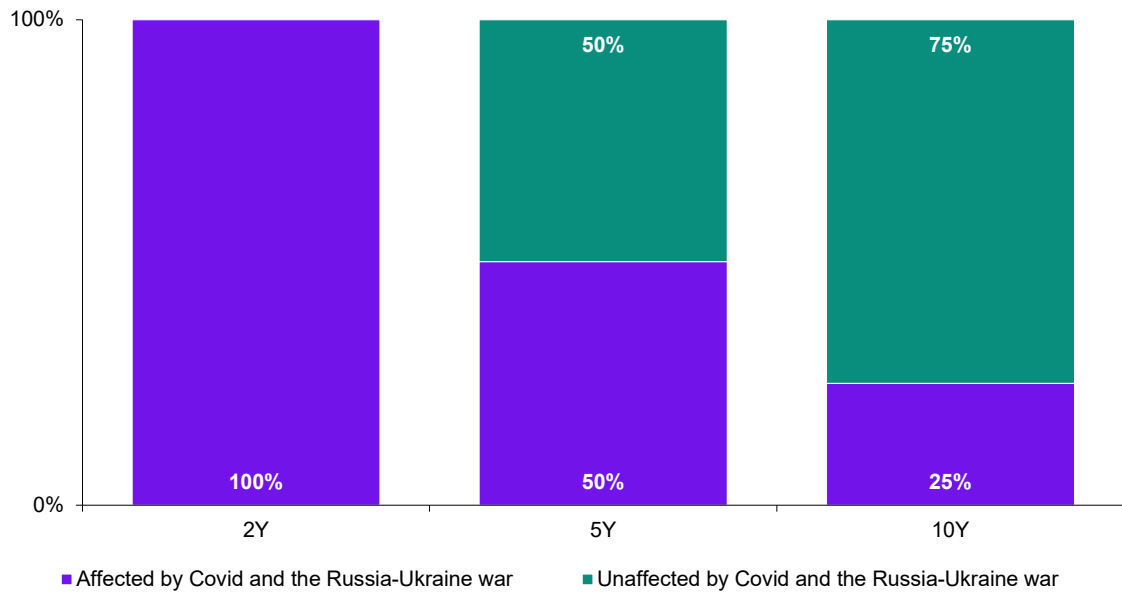
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[131] CMA PR19 FD, para. 9.473
[132] Ibid. para. 9.493
[133] Ibid. para. 9.482
[134] Ibid. para. 9.493

equally weighted spot estimates are used to estimate beta or (2) equally weighted spot and rolling averages are used to estimate beta.

Figure 9 Weight attached to the data affected by Covid19 and the Russia-Ukraine war when using spot estimates only
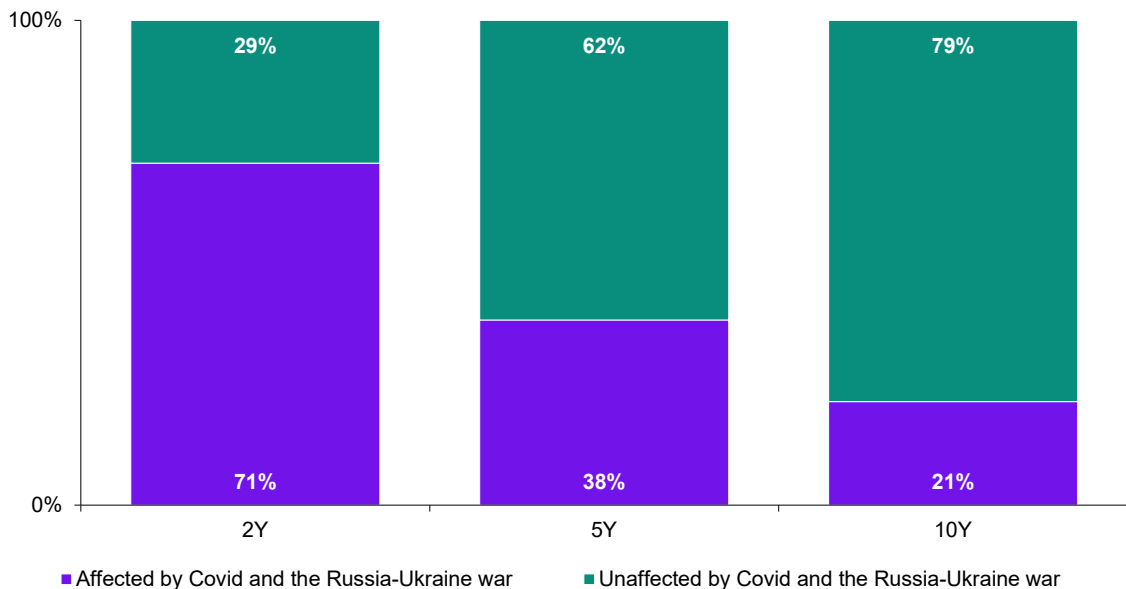

Note: As at 31 August 2022.

6.6.14   Where equal weight is placed on each averaging window to derive the point estimate, the proportion of the underlying data affected by Covid19 and the war is.c.58%[135].

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[135] 1/3x100%+1/3x50%+1/3x25%=58%

Figure 10 Weight attached to the data affected by Covid19 and the Russia-Ukraine war when using both spot and rolling average estimates

Note: As at 31 August 2022.

6.6.15 The inclusion of rolling averages alongside spot estimates, all else equal, reduces the proportion of the underlying data affected by Covid19 and the war to. 43%[136].

6.6.16 The above implies that where the data affected by the temporary structural breaks – whose inclusion in the beta estimates would overweight the impact of one-off events on PR24 beta estimates – is not explicitly excluded from estimation, the use of rolling averages can partially mitigate the risk of misstating beta, particularly if used in combination with bespoke weights for the affected period.

6.7 Key conclusions

6.7.1 The Report considers SVT and UU as primary comparators on the basis that long-run beta data is available for both companies as pure play water companies. Given that all of the comparators considered in this Report are liquid, daily frequency represents a good starting point for assessing betas in a UK regulatory context, consistent with Ofwat's proposed approach. Spot estimates of daily betas are found to be the most robust input into setting the allowed return.

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

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[136] 1/3x71%+1/3x38%+1/3x21%=43%

6.7.3   To explore this the Report considers key inputs to this question including:

The relevant investment horizon for beta estimation

6.7.4   A long-run investment horizon of 15Y is adopted in this Report. The use of a long-term investment horizon for the water sector is consistent with the long useful lives of underlying assets, the long-term financing decisions made the investors in the sector, the recommendations of Wright et al (2018), the approach followed by the CMA and the 15Y investment horizon implied in Ofwat's draft methodology.

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

Setting returns based on an *unconditional* CAPM

6.7.6   As noted by Ofwat in the Draft Methodology consultation, the version of CAPM used by regulators estimates the required return on an equity investment over a single period or investment horizon[137].

6.7.7   This *unconditional* version of CAPM does not distinguish between different potential future states of the world and does not consider that beta will vary over time. For example, the assumption underpinning the CAPM based on a 15Y investment horizon is that beta would not vary on average across this period. In other words short term fluctuations in beta for example due to Covid are 'noise' which the unconditional CAPM 'looks through' to estimate beta over the long term.

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

6.7.9   This Report focusses on estimating an *unconditional* beta for the selected investment horizon. For this a measure of a constant, long run beta is required. As a result the Report considers whether and how recent structural breaks arising from Covid19 and the war should be taken into account in estimation of beta on an *unconditional* basis

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

which is not sensitive to different economic scenarios. This is particularly challenging for very rare events such as global pandemics which shut down large parts of the economy as the timeline used to estimate betas may be too short to include all relevant variations.

Interpretation of Covid19 and Russia-Ukraine war structural breaks

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

— *How likely is it that pandemics with similar impact to Covid19 will occur over the (at least) 15Y investment horizon assumed by Ofwat?*

— *Is the impact of the Russia-Ukraine war likely to be temporary or protracted, relative to the investment horizon implied by the PR24 WACC?*

6.7.11   To answer the first question, the Report considers evidence from the paper which considers the potential frequency of pandemics which are comparable to Covid19 in terms of severity and duration and the approaches adopted by the CMA at PR19 and the CAA in its recent final proposals for Heathrow. The Report finds that the likelihood that another pandemic event occurs in the estimation window is low. For example, the analysis of the CMA's approach suggests that c. 3.7% of data used to derive PR19 beta estimates could have been Covid-affected, which corresponds to c 0.74 years out of 20-year horizon being affected. As a result, attaching material weight to the data from the Covid19 period (c. 2 years) within the evidence used to set beta estimates for PR24 risks assuming that a pandemic of a similar scale occurs more frequently or lasts longer than justified by the available evidence.

6.7.12   To answer the second question, the Report – supported by the view from BoE[138] – chooses forecast inflation as a proxy to quantitatively evaluate the timing of reversion to 'normal' economic conditions following the war. It finds that forecast inflation is expected to revert to long-term target levels ahead of the start of the PR24 price control. In combination with the actions being undertaken to mitigate the economic impact of the war on Europe (for example via increasing self-supply of energy)[139], this evidence implies that the impact of the war could reverse in the next couple of year and is not likely to be relevant for setting the allowed returns for PR24.

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[138] According to the BoE, the bulk of the high short-term inflation stems from the direct impact of high energy and tradable goods prices as well as their indirect impact via higher transport, production and utility costs for firms supplying non-energy goods and services.

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

6.7.13   The change in short-term water company betas following these events appears to be a function of the 'flight to safety' which is temporary *by nature* and is a feature of a specific set of economic conditions rather than driven by fundamentals. All else equal this indicates that attaching material weight to economic conditions in a period of market distress would likely distort a beta estimated on an unconditional basis for a long-run investment horizon.

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

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

7 The methodology to estimate beta for PR24 – de and re-levering betas

7.1 Introduction

7.1.1 This section considers treatment of de- and re-levering betas at PR24 based on the options set out in Ofwat's draft methodology.

7.1.2 The current regulatory approach to gearing, as determined in PR19, involves Ofwat setting a notional level of gearing based on a number of principles and estimating what a company's weighted average cost of capital ("WACC") would be at this notional gearing level. This is to avoid attaching undue weight to a particular capital structure adopted by an actual company and the associated WACC that this implies. In particular, this approach prevents a company from benefiting from choosing a suboptimal capital structure that could lead to an unnecessarily high WACC.

7.1.3 A key in estimating the WACC at the notional gearing level is to estimate the notional equity beta at this gearing level. To do so, regulators first un-lever the raw equity beta from listed comparators, to strip out the component of the beta that comes from the company's actual gearing, and then re-lever the asset beta by applying the notional gearing level and assumed debt beta.

7.1.4 Mason and Wright (MW) argue in their paper on financial resilience and gearing[140] that this approach leads to a WACC that is increasing with gearing, which they consider is contrary to Modigliani and Miller (1958[141], "MM"). MW propose a number of remedies to this apparent problem. Ofwat also appears to consider that this dynamic is a problem, proposes to "*set debt beta at the level which would make the CAPM-WACC calculation fully invariant to gearing.*"[142]

7.1.5 In order to address this question, the rest of this section proceeds as follows:

— First, it provides an overview of Modigliani-Miller theory

— Second, it evaluates key arguments and evidence which underpin MW and Ofwat specification of a problem with the current approach to de- and re-levering

— Third, it sets out high level estimates for debt beta, drawing on CMA PR19 and academic research

— Fourth, it evaluates the options identified by Ofwat to de- and re-lever betas at

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

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

[142] Appendix-11-Allowed-return-on-capital-appendix.pdf (ofwat.gov.uk), p20

PR24.

7.2 Modigliani-Miller theorem – theory and practical application in a regulatory context

I. The theory behind the MM theorem

7.2.1 This section starts with a brief overview of the theory behind the MM theorem. MM showed that, in a perfect capital market, the WACC of a company is independent of gearing. This is known as *MM's Proposition I*.

7.2.2 To understand the significance of this result, it is useful to first understand the context. The WACC of a company is given by the following formula:

$$r^* = D/V * rD + E/V * rE \ (1)$$

where r^* is the WACC, rD is the cost of debt, rE is the cost of equity, D is the market value of debt, E is the market value of equity, and V = D + E is aggregate value.

7.2.3 Since rD < rE, conventional wisdom at the time was that companies could reduce their WACC by increasing their gearing. In equation (1), if D rises and E falls, and all other variables are held constant, then r^* falls because the company is placing more weight on the cheaper source of financing.

7.2.4 MM's key insight is that rD and rE are *endogenous* variables, not *exogenous* parameters – they cannot be held constant when changing gearing. In particular, the cost of equity rE depends on two factors:

— The first is *business risk*, which is the risk of the company's assets and stems from how cyclical they are – a luxury goods firm has more business risk than a consumer goods firm. Since business risk depends on a firm's assets, and the assets a firm has are independent of gearing, business risk is independent of gearing. Business risk is denoted rA, and is the cost of capital for an unlevered firm – the cost of capital that the firm would have if it were all-equity-financed. It is also known as the company cost of capital.

— The second is *financial risk*. Since equity holders are junior to debtholders, they bear a disproportionate share of the firm's business risk. Thus, even though gearing does not change business risk, it increases financial risk because it makes equity holders even more junior.

7.2.5 MM's Proposition II shows mathematically how the cost of equity changes with gearing:

$$rE = rA + D/E * (rA - rD) \ (2)$$

where rA, the unlevered cost of capital, represents business risk, while the second term on the right-hand side, D/E * (rA – rD), represents financial risk. When gearing increases, D rises and E falls, thus augmenting financial risk.

7.2.6   Since rE is increasing with gearing, it is no longer the case that firms can reduce their WACC by increasing their gearing. In equation (1), while increasing D and reducing E places more weight on the cheaper source of financing, it is exactly offset by the fact that the cost of equity rises. Thus, the WACC is constant.

7.2.7   It is important to note two points:

MM do not assume a constant cost of debt

7.2.8   The MM results, that WACC is independent of gearing (*MM Proposition 1*), and that the cost of equity is increasing with gearing (*MM Proposition 2*) hold regardless of whether a constant cost of debt is assumed or not.

7.2.9   MM first derive their result assuming a constant cost of debt for simplicity. Then, they consider the case in which the cost of debt is increasing with gearing and show that the result still holds. MM write:

"*Economic theory and market experience both suggest that the yield demanded by lenders tend to increase with the debt-equity ratio of the borrowing firm…*

Proposition I is actually unaffected in form and interpretation by the fact that the rate of interest may rise with gearing; while the average cost of borrowed funds will tend to increase as debt rises, the average cost of funds from all sources will still be independent of gearing…

Although Proposition I remains unaffected … the relation between common stock yields and gearing will no longer be the strictly linear one given by the original Proposition II. If rD increases with gearing, the yield rE will still tend to rise as D/E increases, but at a decreasing rather than constant rate."[143]

7.2.10   Equation (2) above continues to apply, but if rD rises with gearing, then rE = rA + D/E * (rA – rD) is lower than it would otherwise be if rD were constant. However, it remains the case that rE is increasing with gearing.

7.2.11   Thus, the assumption of whether the cost of debt increases with gearing or is independent of gearing does not matter; the WACC is independent of gearing regardless. Indeed, the irrelevance of the constant debt assumption is very well understood. See, for example, the classic textbook "Principles of Corporate Finance"[144]

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[143] The only changes made are to harmonise notation
[144] Brealey, Myers, Allen, and Edmans, 2022

which cover both cases and shows that, in both, the rA line is horizontal and independent of gearing:

"*Suppose the firm changes its capital structure by issuing more debt and using the proceeds to repurchase stock. The implications of MM's Proposition 2 are shown in Figure 16.2. The required return on equity increases with the debt-equity ratio (D/E). Yet, no matter how much the firm borrows, the required return on the package of debt and equity, rA, remains constant at 12.75%. How is it possible for the required return on the package to stay constant when the required return on the individual securities is changing? Answer: Because the proportions of debt and equity in the package are also changing. More debt means that the cost of equity increases but at the same time the proportion of equity declines...*"[145]

Figure 11 MM's proposition 2 under constant rD
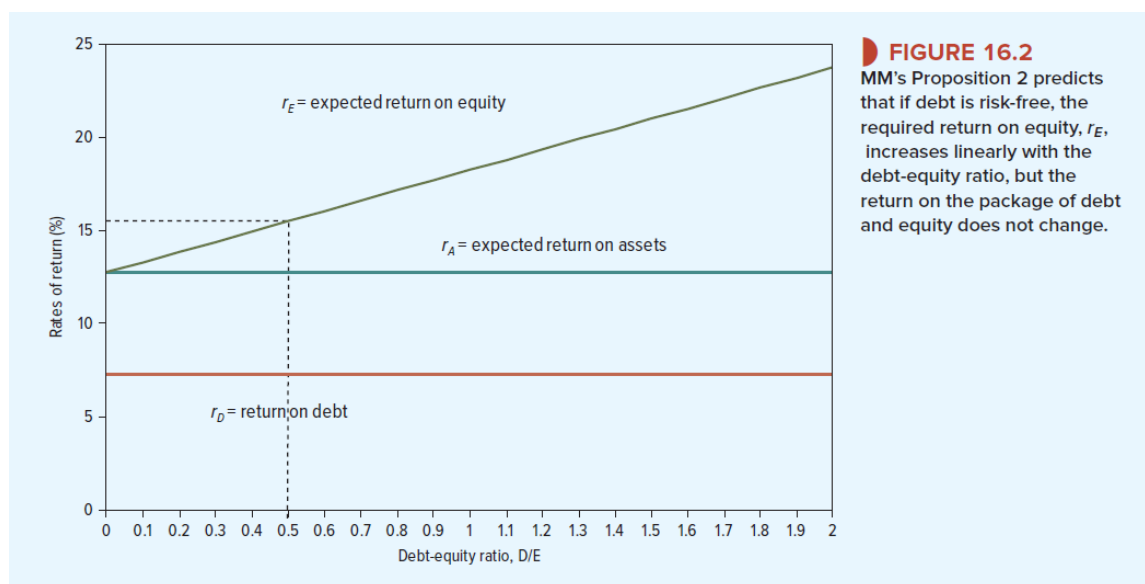
"*In Figure 16.2, we have drawn the rate of interest on the debt as constant no matter how much the firm borrows. This is not wholly realistic. It is true that most large, conservative companies could borrow a little more or less without noticeably affecting the interest rate that they pay. But at higher debt levels, lenders become concerned that they may not get their money back, and they demand higher rates of interest to compensate. Figure 16.3 modifies Figure 16.2 to account for this. You can see that as the firm borrows more, the risk of the debt slowly increases. Proposition 2 continues to predict that the expected return on the package of debt and equity does not change. However, the slope of the rE line now tapers off as D/E increases. Why? Essentially*

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[145] Ibid.

because holders of risky debt begin to bear part of the firm's operating risk. As the firm borrows more, more of that risk is transferred from stockholders to bondholders."[146]

Figure 12 MM's proposition 2 under increasing rD
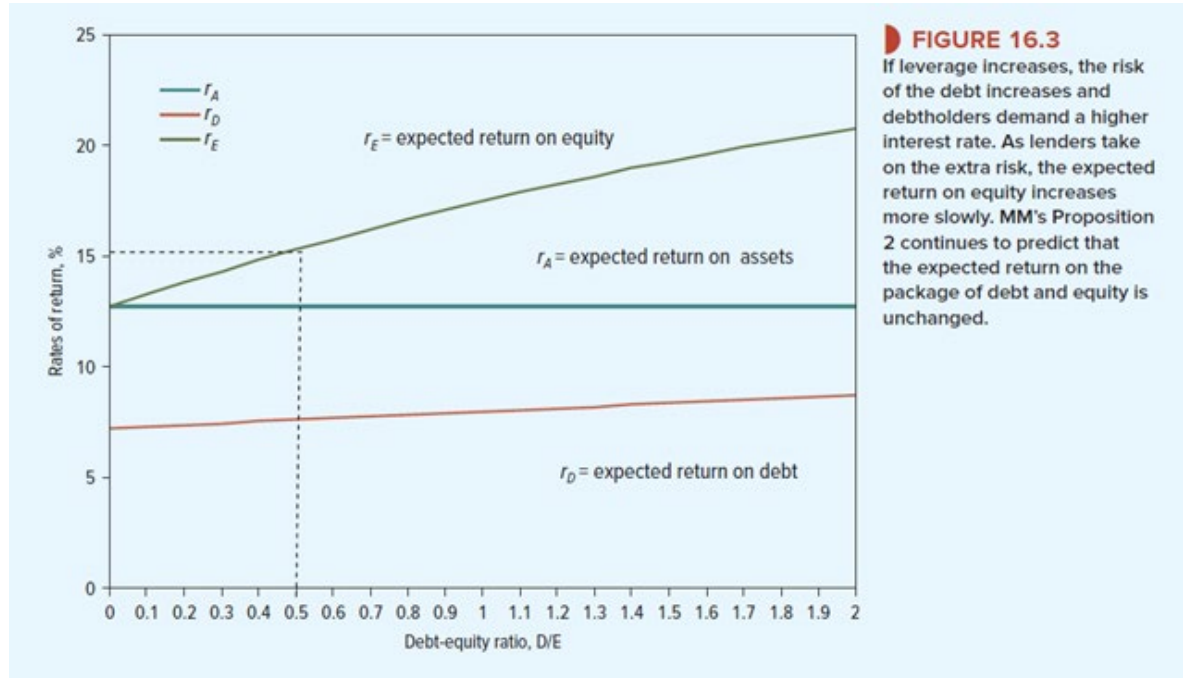
7.2.12   In summary, the MM results apply regardless of whether rD is constant or increasing with gearing. However, what is required is for the application to be internally consistent. If rD is constant in the real world (e.g. because low levels of leverage make the debt close to risk-free), then the rD's that included in the formulas should be constant. If rD is increasing with gearing in the real world, then the rD's included the formulas should be increasing with gearing.

MM Proposition I only holds in a perfect capital market

7.2.13   MM stressed that Proposition I holds in a perfect capital market. This is one in which there are no market frictions such as taxes, transaction costs, or inefficiencies, nor regulatory distortions. They explicitly show that, in the presence of taxes, WACC will be unambiguously decreasing with gearing, since debt benefits from interest tax shields. MM also state that, if "*there are lags and frictions in the equilibrating process – a feeling we certainly share*"[147], then Proposition I will not hold, as long as the frictions are not short-lived.

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[146] Ibid.

[147] Modigliani and Miller, Corporate Finance and the Theory of Investment, The Americal Economic Review, Vol.48, p. 281

7.2.14 However, it always remains the case that rE is increasing with gearing. Regardless of whether there are taxes, transactions costs, market inefficiencies, or regulatory intervention, it will always be true that increasing debt makes equity even more junior, and thus increases financial risk. The formula used to calculate how rE increases with gearing might change if there are taxes, but the if company always rebalances its debt so that D/V is a constant ratio ("debt rebalanced"), then equation (2) still applies. If there are taxes, and the company keeps the amount of debt D fixed in absolute terms ("debt fixed"), then the formula becomes:

$$rE = rA + D/E * (rA - rD) * (1 - tc) \; (3)$$

where tC is the corporate tax rate.

7.2.15 However, even though the precise formula changes, the key insight that rE is increasing with gearing still holds.

7.2.16 This Report considers the case of either no taxes, or taxes plus debt rebalanced so that equation (2) holds. This avoids setting out two sets of formulas, one using equation (2) and another using equation (3).

II.   **Practical application of the theorem**

7.2.17 The most important implication of MM for real-world finance is that the cost of equity must always take gearing into account. *Any approach to estimating the cost of capital that assumes a constant cost of equity is "textbook wrong"*, such as using the raw equity beta (Option III in MW).

7.2.18 This implication is widely recognised in corporate finance. For example, when estimating the cost of equity based on comparable companies, it is not correct to simply take the cost of equity of a peer firm, even if that peer firm has exactly the same business risk. Identical business risk only means an identical rA, but equation (2) shows that rE depends not only on rA but financial risk, and the peer firm may have different gearing. Thus, de-levering and re-levering are fundamental principles of corporate finance.

7.2.19 The following example illustrates this point. Company A has a cost of equity of 7.8%, a cost of debt at 5%, and has a gearing ratio (D/V) of 40%. Company B has a gearing ratio of 60% and a cost of debt of 5.5%. To use Company A's cost of equity to estimate Company B's, it is necessary to:

— De-lever A's rE, i.e. strip out its 40% gearing to move from its rE to rA. Using the formula rA = D/V * rD + E/V * rE (which is simply a rearrangement of (2)), this gives: rA = 0.4 * 5% + 0.6 * 7.8% = 6.68%. This rA is also B's rA, since they have the same business risk.

— Re-lever B's rA, i.e. add in its 60% gearing to move from rA to rE. The same

formula gives: 6.68% = 0.6 * 5.5% + 0.4 * rE, which yields rE = 8.45%.

7.2.20   One practical challenge of using equation (2), or its rearrangement, is that it requires estimation of how rD changes as leverage changes. Company A's rD of 5% does not automatically apply to Company B, and – unlike for rE – there is no formula that can be used to calculate how rD changes with leverage. In the above example, it was assumed that Company B's cost of debt could be observed and that it was 5.5%. However, it may be that the historical cost of debt is not the same as the current cost of debt. Alternatively, it may be that Company B is considering a change with gearing from its current 60% level. In both cases, an estimation of the cost of debt is required in order to re-lever the cost of equity.

7.2.21   What this means is that *practitioners almost never assume a constant cost of debt when applying the MM formulas.* "Almost never" is used because, in some cases, practitioners might assume a constant cost of debt for simplicity – for example, if the gearing change being considered is not large. However, practitioners are aware that this is a simplifying assumption, rather than one that is correct, since the cost of debt increases with gearing in practice.

III.   Decomposition of the underlying drivers of observed variance of WACC to gearing

7.2.22   WACC will vary with gearing for a number of reasons, all linked to capital market imperfections. These effects cause the WACC to be U-shaped with gearing. All academics and practitioners agree that WACC is U-shaped with gearing where markets are imperfect. As a result, it is widely recognised that the WACC should not be independent of gearing. There are several other reasons why the WACC may not be independent of gearing, all related to market imperfections. For example:

—   If illiquidity leads to a debt premium and thus a cost of debt that is "too high", then WACC will be increasing with gearing.

—   If debt is cheap relative to equity, e.g. due to a frothy debt market, then the WACC will be decreasing with gearing (all else equal) and *vice versa*.

7.2.23   In summary, WACC should not be expected to be independent of gearing, due to capital market imperfections.

7.3   Evaluation of the arguments and evidence for specification of a problem

7.3.1   MW's paper on financial resilience and gearing (Section 5) argues that the current regulatory approach to adjusting equity beta for gearing is flawed as it leads to a WACC that is increasing with gearing, whereas MM show that WACC should be independent of gearing.

7.3.2 This section explores two potential specifications of the problem based on MW's paper:

— the cost of debt is independent of gearing; and

— the estimated cost of debt is too high

I. Potential MW specification of the problem: cost of debt is independent of gearing

7.3.3 A material concern set out in MW's paper appears to be that the current method for de-levering and re-levering beta assumes a constant cost of debt, i.e. one that is not increasing with gearing. For example, in paragraph 5.3, MW argue that there is an inconsistency due to the "*partial application of the CAPM*" – the CAPM is used to estimate the cost of equity, which is increasing with gearing, but the cost of debt is taken from market data which MW argue is independent of gearing. Indeed, MW comment that $WACC(g) = grD + (1-g)rE(g)$, where the contrast between rD and rE(g) highlights how, according to MW, the approach assumes that rD is independent of g but rE depends on g.

7.3.4 Two interpretations of the MW argument are considered below.

MM assume a cost of debt that is independent of gearing

7.3.5 The first interpretation is that MW are arguing that it is MM who assume a constant cost of debt. However, in reality, practitioners need to estimate the cost of debt from market data. The market cost of debt is not invariant of leverage – the market charges a higher cost of debt to more levered firms. MM derive their result, that the WACC is independent of leverage, because they assume the cost of debt is independent of leverage. But if, in reality, the cost of debt is increasing in leverage, then WACC will now be increasing in leverage.

7.3.6 This argument does not appear to be correct, since MM explicitly allow the cost of debt to be non-constant, as explained above.

Practitioners assume a cost of debt that is independent of gearing

7.3.7 The second interpretation is that MW are arguing that it is practitioners who assume a constant cost of debt when applying MM: for example, MW comment that "*βD … is typically assumed to be a constant and small (an assumption that the regulated companies have the incentive to support)*".

7.3.8 However, practitioners do not assume that rD is constant; it is higher in more geared firms. MW emphasise that practitioners use the market cost of debt (since it is difficult to apply the CAPM to debt) – however the market cost of debt is automatically increasing with leverage, as the market charges a higher cost of debt to more highly-geared

companies. Thus, a market-based approach to estimating D is likely to mean that rD will depend on g. All else equal this is inconsistent with MW's assumption that rD is independent of g, which they require to obtain their result that WACC'(g) = rD – (RF + βDERP).

II. <u>Potential MW specification of the problem: the estimated cost of debt is too high</u>

7.3.9 MW also set out concerns with the *level* of rD rather than whether it varies or does not vary with g. Specifically, they are concerned that, in practice, the level of rD estimated is too high. Indeed, the MW equation WACC'(g) = rD – (Rf + βDERP) argues that WACC is increasing with gearing if the estimated level of rD is greater than the Rf + βDERP that would be implied by the CAPM. MW argue that the estimated level of rD is too high in practice because the market-based cost of debt includes a debt premium, and because regulators give an allowance for embedded debt (currently higher than the market cost of debt).

7.3.10 However, MM does not apply in the presence of market frictions or regulatory distortions. Ofwat highlighted a number of these frictions in the recent PR19 CMA appeal.[148] As a result, there is no contradiction that the MM prediction of gearing-independent WACC might not hold, since MM should not apply in the first place. Examples follow below:

— **Market frictions leading to constant cost of debt.** As explained above, if the cost of debt should be increasing with gearing in the real world, but practitioners assume a constant cost of debt (i.e. they do not take into account the fact that debt becomes riskier as gearing rises, so debt is incorrectly priced), then this is a market friction and so MM would not be expected to hold.

— **Market frictions leading to high cost of debt.** The cost of debt may be higher than in an MM world due to market frictions assumed away by MM, such as illiquidity (leading to the market cost of debt containing a debt premium). Indeed, if illiquidity costs mean that the cost of debt is high, then more highly geared firms are particularly penalised by this premium, and so a WACC that is increasing with gearing is exactly what would be expected.

— **Regulatory distortions.** If there is a regulator and regulatory policy depends on gearing, then firm value will depend on gearing; thus, the cost of capital must also depend on gearing as it is inversely related to firm value. For example, if the regulatory allowance for embedded debt exceeds the cost of new debt, then regulatory policy is non-neutral to gearing, and so the cost of capital will also be

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[148] CMA PR19 FD, para. 9.1166

non-neutral to gearing.

7.3.11 One might argue that the cost of debt is "too high" relative to an MM world. However, if so, the issue is exactly that – that the cost of debt is high, rather than this leading to a WACC that is increasing with gearing. The latter is not the issue, but a symptom of the issue, and not a symptom that should necessarily cause concern as the symptom is not observed in an MM world.

7.3.12 Moreover, there is no reason to believe that the cost of debt is too high. A high cost of debt (relative to MM) may arise from two sources.

— The first is **market frictions**. However, market frictions lead to the cost of debt being justifiably high, not excessively high. The real world involves liquidity concerns, and so debtholders rationally demand a debt premium to compensate for liquidity. Thus, market frictions do not warrant regulatory intervention.

— The second is **regulatory distortions**, such as giving an allowance for embedded debt that is different from the market cost of debt. However, there is no evidence that this allowance is too high; instead the cost of debt is set based on prevailing regulatory policy which is currently based on either an estimate of sector average costs or benchmark indices in line with for example the CMA's approach at PR19. Indeed, embedded debt is justifiably high due to long-dated financing raised before the financial crisis when interest rates were relatively high. In other macroeconomic environments, the regulatory allowance for embedded debt could turn out to be too low, e.g. if embedded debt were raised in a low interest rate environment.

7.3.13 While assuming the MM principle – that WACC should be invariant to gearing – is reasonable as a starting point for estimating cost of capital in a regulatory context, importantly the allowed return is not set in the frictionless capital markets assumed by MM. Absent clear isolation of the particular specific market frictions or regulatory interventions which are solely driving the dynamic of WACC increasing with gearing *and* warrant regulatory intervention, caution is required before intervening to 'force' invariance to gearing avoid introducing *additional* distortions into the estimation of WACC for regulatory price setting. Where specific frictions are identified, whether an adjustment is required for regulatory price setting should be assessed on merit.

7.4   Debt beta

7.4.1 Debt beta measures the covariance of returns to debt investors with the market and captures the systematic risk of debt, following the same theory as for equity betas. The debt beta influences the overall equity beta because it impacts the size of the gearing adjustment from the asset beta to the equity beta.

7.4.2   There are several empirical approaches that could be used to estimate debt beta but as noted by the CMA there is no one approach to estimating debt betas that dominates all others. This is borne out by the different methods used in studies and the different weights regulators have given to different evidence sources[149].

7.4.3   The CMA's overall view is that debt beta is difficult to measure and has a relatively small effect on the overall WACC so should be set at a level which is consistent as far as possible with the overall framework for the WACC, without acting contrary to financial market evidence[150].

7.4.4   Ofwat has not proposed to empirically estimate debt beta, instead it would set debt beta such that forward-looking WACC does not vary with gearing. Based on the PR19 FD WACC assumptions this would yield a debt beta of 0.216 is the holding assumption.

7.4.5   The resulting debt beta significantly exceeds PR19 debt beta estimates from both Ofwat (0.12) and the CMA (0.075 point estimate and the 0.10 upper bound applied by the CMA) as well as estimates that from academic literature or in use among practitioners for a company with investment grade credit rating. For example, under Schwert and Strebulaev's methodology debt betas of 0.21 and above correspond to BB-CCC credit rating[151]. This is inconsistent with the credit rating assumed in the cost of debt allowance and actual water company financing.

7.4.6   At PR19 the CMA also cross-checked its debt beta estimate by recalculating the appointee WACC using the observed 54.2% gearing used within beta calculations as the notional level of gearing – thus removing the need to consider a debt beta.[152] The CMA noted that this analysis implied some variance of WACC with gearing but that this was not material at 4bps and did not adjust its approach or assumptions.

7.4.7   The debt beta estimate from the PR19 re-determination (0.075) was a result of a detailed consideration and challenge of empirical evidence from different potential estimation approaches. At this stage there is no robust and compelling evidence to depart from the CMA's findings.

7.5   Evaluation of the options proposed by Ofwat

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[149] CMA PR19 FD, para. 9.518

[150] Ibid. para. 9.517

[151] Available at: Capital Structure and Systematic Risk by Michael Schwert, Ilya A. Strebulaev :: SSRN, short summary

Rating	AAA	AA	A	BBB	BB	B	CCC
L_M	0.10	0.21	0.32	0.37	0.50	0.66	0.74
β_D	0.04	0.05	0.05	0.10	0.24	0.31	0.43
σ_D	0.07	0.05	0.06	0.10	0.14	0.21	0.31
ρ_{ED}	-0.03	-0.02	0.06	0.16	0.28	0.36	0.37

of findings:

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

7.5.1   This section evaluates the alternative approaches proposed by Ofwat – notwithstanding conclusions from previous sections that it is not clear that there is a problem since the MM assumptions do not hold in the real world due to market frictions.

7.5.2   It is important that the search for theoretically correct relationships in all WACC parameters does not override consideration of the validity of inputs and outputs. There is little value in estimating the cost of capital parameters that meet one theoretical criterion precisely but are ultimately in themselves implausible. In other words it is important to be careful that in trying to make the theoretical equation work perfectly as to achieve this can result in implausible specification of CAPM parameters. It is critical to strike the right balance between meeting theoretical requirements and estimating of plausible parameters.

7.5.3   As a result this section considers whether parameters implied by MW options meet market tests and market evidence, and hence are plausible and make economic sense.

7.5.4   Ofwat propose three approaches, as follows: (1) maintaining the PR19 approach, (2) setting the debt beta at a level which would make the CAPM-WACC calculation invariant to gearing and (3) changing the notional gearing to align with the EV gearing of listed companies.

7.5.5   The preferred approach based on the analysis in this Report is (1), since there is not a clear problem that requires a solution.

7.5.6   Option 2 seeks to "*hard-wire*" the debt beta to give a CAPM-implied cost of debt which equals the actual expected cost of new debt. In other words, it backs out the debt beta from the observed cost of debt using the formula $rD = RF + \beta D * (rM – rF)$. This approach might be reasonable in theory; however, the justification for adoption of this approach would typically not be to make the WACC invariant to gearing, but because the CAPM is a poor model for debt returns.

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

— difficult to apply objectively, including which parameter should be adjusted and by how much. An approach which forces invariance to gearing is trying to arrive at a combination of parameters that is ultimately not known i.e. the resulting WACC is no longer a combination of parameters that were ex-ante determined to represent an appropriate input into the estimation of allowed returns.

— can introduce new distortions (because it is not clear which level of WACC it might be correct to hold constant at different levels of gearing). Variance with gearing could be driven by a methodology for a different parameter which has been set too

low. This does not appear to have been considered in the draft methodology at this stage. In this case hard-wiring debt beta – which all else would result in lower returns – could *compound* an existing issue which is already resulting in under-estimation of required returns.

— does not recognise that there might be various other factors affecting the cost of capital that might cause departures from MM.

7.5.8   Option 2 assumes that hard-wiring debt beta will address an underlying problem (invariance of WACC to gearing) which in Ofwat's view is driven by the cost of equity being set too high under current levels of notional gearing. However equally the market friction or distortion which underpins invariance could be driven by a methodology for a different parameter which has been set too low. To avoid compounding or introducing additional distortions into the WACC, focus should be on the calibration of each parameter which all have margin of error which could be significantly larger than the variance to gearing highlighted in the draft methodology. This is consistent with the methodology applied by the CMA at PR19, which noted *small* increases in WACC with gearing[153] – which is in line with expectations that WACC at different gearing levels would be *broadly* unchanged.

7.5.9   In this context whilst an approach based on hard-wiring debt beta is reasonable in theory, in practice it is very difficult to implement. In particular, the formula $r_D = RF + \beta_D * (r_M - RF)$ requires us to estimate two parameters: the risk-free rate (RF) and the equity risk premium ($r_M - RF$). If the regulator uses a risk-free rate that is too low for example, then the implied debt beta would much higher than what would be achieved through direct estimation (e.g. regressing historic debt prices on historic market returns).

7.5.10   First Economics[154] show that, if the regulator uses a too-low risk-free rate, this leads to a WACC that is increasing in leverage. If the risk-free rate is calculated correctly, then the WACC is no longer increasing in leverage. Thus, to the extent that the regulator considers that it is a problem that WACC is increasing slightly in leverage, a superior solution is to ensure the risk-free rate is calculated correctly. In short, WACC'(g) > 0 may arise from RFR being too low; it is not necessarily correct to reach the conclusion that it must be caused by an inconsistency between the r_D and β_D parameters.

7.5.11   The equity risk premium (which is a function of r_M (the Total Market Return) and the risk-free rate) is also difficult to estimate. The approach in regulatory charge controls is predicated on the Total Market Return (rather than direct estimation of the equity risk premium, which is also difficult to estimate, with a number of available approaches for estimation (such as historical ex post returns, historical ex ante returns), for deflation

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[153] CMA PR19 FD, paras. 9.529 – 9.530
[154] First Economics Risk Free Rate

and for averaging historical returns. As a result, any implied debt beta will be highly contingent upon the assumptions for the risk-free rate and the equity risk premium.

7.5.12 In addition to two key parameters in the CAPM being very difficult to estimate, the CAPM itself may not hold. It is very well-known that the CAPM does not hold for equity returns – for example, the effect of beta on equity returns is significantly lower than what CAPM implies. This may be due to market frictions that CAPM assumes away, such as illiquidity.

7.5.13 In addition, assuming invariance of cost of capital:

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

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

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

7.5.14 The specification of Option 3 appears to undermine the rationale for setting notional gearing. The reason for the concept of notional gearing is so that companies do not benefit from inflating their actual gearing. Otherwise, companies could choose an actual gearing that led to a high WACC, and thus be set a high allowed return. To set notional

gearing to a company's actual gearing is effectively to depart from the concept of notional gearing, and to base the allowed WACC on actual gearing. Furthermore, the enterprise value gearing is not the relevant and appropriate measure of the gearing for the sector in the first place. Frontier Economics has recently considered on what basis notional gearing could be set in the context of PR24.[155]

7.6   Key conclusions

7.6.1   Overall, this Report finds that there is not a clear problem with a WACC that is increasing with gearing. For example the MW analysis considers that a primary driver of this dynamic might be that the cost of debt is set too high, but it is not clear that this is the case as there are multiple sources of market friction which could impact on debt costs, such as illiquidity, as well as distortions driven by regulatory intervention. There is no expectation that MM should hold *precisely* due to market frictions and distortions. As a result, whether WACC is increasing with gearing or not should not represent the sole criterion used to assess whether a given regulatory approach to estimation of required returns is correct.

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

7.6.3   Relatedly it is important that the search for theoretically correct relationships in all WACC parameters does not override consideration of the validity of inputs and outputs. There is little value in estimating the cost of capital parameters that meet one theoretical criterion precisely but are ultimately in themselves implausible. In other words, trying to make the theoretical equation work according to theory can result in implausible specification of other CAPM parameters. It is critical to strike the right balance between meeting theoretical requirements and estimating plausible parameters.

7.6.4   To avoid compounding or introducing additional distortions into the WACC, focus should be on the calibration of each parameter which all have margin of error which could be significantly larger than the variance to gearing highlighted in the draft methodology. This is consistent with the methodology applied by the CMA at PR19, which noted *small* increases in WACC with gearing[156] – which is in line with expectations that WACC at different gearing levels would be *broadly* unchanged.

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[155] Frontier Economics Setting Notional Gearing
[156] CMA PR19 FD, paras. 9.529 – 9.530

7.6.5   First Economics[157] show that, if the regulator uses a too-low risk-free rate, this leads to a WACC that is increasing in leverage. If the risk-free rate is calculated correctly, then the WACC is no longer increasing in leverage. Thus, to the extent that the regulator considers that it is a problem that WACC is increasing slightly in leverage, a superior solution is to ensure the risk-free rate is calculated correctly. In short, a WACC that increases with gearing may arise from risk-free rate being too low; it is not necessarily correct to reach the conclusion that it must be caused by an inconsistency between the cost of debt and debt beta parameters.

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[157] First Economics Risk Free Rate

8 Estimation of beta for PR24

8.1 Introduction

8.1.1 This section considers the implications of the qualitative and quantitative analysis presented in this Report for the beta estimate for PR24.

8.1.2 A key methodological decision in specifying the beta range for PR24 is the appropriate treatment of the data affected by Covid19 and Russia-Ukraine war in the context of the (at least) 15Y investment horizon expected to be assumed in the PR24 WACC. The following principles and evidence developed in this Report will be used to inform this decision:

— The estimation of allowed cost of equity requires an estimate of an *unconditional* beta that will apply over the long-term investment horizon implied in the regulatory WACC.

— Changes in the unconditional beta imply a break in the econometric relationship between the stock and the market and would need to be carefully evaluated for whether they are temporary or permanent to assess how the break event should be treated in forward-looking beta estimates.

8.1.3 Both Covid19 and the war have had significant negative impacts on water company betas. Covid19 has resulted in a statistically significant reduction in the equity beta for the pure play water portfolio of c.0.14, whereas the impact of the war has so far been a reduction equivalent to 0.27.

— There is inherent uncertainty in assessing the nature of the events but the impact of both is assumed to be predominantly transitory as outlined in section 6.4 and arising from current economic conditions, rather than representative of unconditional, long-run beta.

— According to the study on pandemics cited by Ofwat, the likelihood that another pandemic event occurs in the estimation window is very low, therefore an approach which attaches material weight to data from the Covid19 window is likely to result in distortions.

— An analysis of the CMA's approach suggests that only c. 3.7% of data used to derive PR19 beta estimates could have been Covid-affected. In the context of the 20-year investment horizon employed by the CMA, this corresponds to an assumption that a pandemic of a similar scale as experienced during the first ten months of Covid19 would occur during c 0.74 years out of 20. As a result, the CMA's range for beta is relatively unaffected by Covid19 estimates.

— Relatedly, the Civil Aviation Authority ('CAA') in the Final Proposals for the H7 price

control for Heathrow set a beta assuming that a pandemic-like event would occur once in every 20 or 50 years and last 17 or 30 months[158].

— All else equal this suggest attaching low weight to Covid19 data for estimation of beta over a long run, 15Y investment horizon. This Report considers (1) excluding all data from the Covid19 period (2) attaching low weight to Covid data based on the the assumed frequency of a future pandemic with a similar impact and duration.

— Forecast inflation – the chosen proxy to quantitatively evaluate the timing of reversion to 'normal' economic conditions following the war – is expected to revert to long-term target levels ahead of the start of the PR24 price control which would suggest that the impact of the war could reverse in the next couple of years. In combination with the actions being undertaken to mitigate the economic impact of the war on Europe (for example via increasing self-supply of energy), this evidence implies that the beta estimates from the war-affected period are not likely to be relevant for setting the allowed returns for PR24.

8.1.4 The above suggests that beta values as two cut off dates are the relevant input into the consideration of the appropriate beta range for PR24:

— **28 February 2020**: consistent with the CMA's approach at PR19 and the finding of a statistically significant structural break after 28 February 2020 due to Covid.

— **23 February 2022**: consistent with the finding of a statistically significant structural break after 24 February 2022. Using this cut-off date would assign weight to Covid-affected data based on the assumed frequency of a future pandemic with a similar impact and duration but would not assume that the impact of the war would continue at a similar scale or reoccur during the assumed investment horizon.

8.1.5 The remainder of this section first presents beta estimates for proxy companies under different estimation and averaging windows and cut off dates and then derives the asset beta range for PR24 based on a holistic consideration of the evidence presented in this report.

8.2 Analysis of beta estimators from proxy companies (to February 2020 and February 2022)

8.2.1 Beta estimates for the proxy companies presented in this section have been derived using an approach broadly comparable to that employed by the CMA at PR19. The focus on beta estimates derived using daily returns information – consistent with the

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

approach proposed by Ofwat – is the primary divergence from the CMA's approach (which is based on daily, weekly, and monthly frequencies).

8.2.2 Consistent with the CMA's PR19 re-determination, estimates are presented for value-weighted pure play water portfolio under spot, 1-, 2- and 5-year averaging windows. The pure play portfolio is assumed to include SVT and UUW only. Given the amount of time that has passed between the announcement of the sale of Viridor and the February 2022 cut-off date, there is insufficient pure play return data for PNN. As noted in section 6.2, the inclusion of PNN data in the value-weighted water sector portfolio results in a small increase in the 2Y spot beta. If this dynamic persists as more pure play data becomes available for PNN, it may indicate that estimates based on SVT and UUW alone *understate* beta for the water sector and would suggest that Ofwat should carefully consider how the evidence from PPN should be taken into account, particularly in the context of having a very limited number of listed comparators available for the sector.

8.2.3 The CMA's analysis of the asset beta for PR19 included a step to identify and exclude outliers using a statistical rule based on the interquartile range (IQR).[159] The IQR is the difference between the 75th percentile (or third quartile) and the 25th (or first quartile) percentile in a dataset. It measures the spread of the middle 50% of values. An observation is considered an outlier where it is either 1.5 times the interquartile range (IQR) greater than the third quartile or 1.5 times the IQR less than the first quartile.

8.2.4 The CMA appears to have undertaken outlier by applying the interquartile range rule to (1) underlying beta estimates (e.g. individual data points from the weekly beta dataset) and (2) headline beta estimates across different frequencies and averaging and estimation windows (e.g. 10-year monthly, 5-year monthly). Outlier identification and exclusion appears to have been performed at the equity beta level separately for each cut-off date used by the CMA (28 February 2020, 31 December 2020).

8.2.5 The CMA did not identify any outliers for the beta estimates as at 28 February 2020 (i.e. pre-Covid) but excluded both individual data points and headline estimates from the 31 December 2020 estimates as outliers.

8.2.6 Beta estimates from February 2022 set out below have been tested for outliers following a similar approach to that employed by the CMA. Several outliers were identified in individual data points and are excluded from the betas presented below. The headline beta values for the 2Y spot and 5Y5Y estimators were also identified as outliers relative to the other estimators from 23 February 2022. Beta estimates from February 2020 have not been tested for outliers given the CMA's findings that there were none in this data.

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[159] CMA PR19 FD, para. 9.474

Table 8 Beta evidence from the water portfolio (to February 2020 and February 2022)

Estimation window	Averaging window	Raw equity beta (28 Feb 2020)	Unlevered beta (28 Feb 2020)	Raw equity beta (23 Feb 2022)	Unlevered beta (23 Feb 2022)
2-year	Spot	0.65	0.28	0.54	0.25
2-year	1-year	0.61	0.27	0.58	0.27
2-year	2-year	0.62	0.28	0.57	0.26
2-year	5-year	0.67	0.33	0.60	0.28
5-year	Spot	0.69	0.33	0.56	0.26
5-year	1-year	0.67	0.32	0.58	0.26
5-year	2-year	0.68	0.33	0.59	0.27
5-year	5-year	0.64	0.31	0.64	0.31
10-year	Spot	0.59	0.28	0.60	0.28
10-year	1-year	0.56	0.26	0.59	0.28
10-year	2-year	0.57	0.27	0.59	0.28
10-year	5-year	0.59	0.29	0.59	0.28

Source: KPMG analysis of Thomson Reuters Eikon data as of 25 August 2022.
Purple highlights indicate that the headline estimate is an outlier relative to the other equity beta values in the table.

8.2.7 The comparison of beta values estimated using data up to 23 February 2022 to those estimated using the data unaffected by Covid19 and reveals a significant reduction in 2- and 5-year betas across all averaging windows. In contrast, 10-year betas have remained broadly stable. A similar dynamic can be observed from the comparison of February and December 2020 daily betas in the CMA PR19 FD[160].

— As at 28 February 2020, the 5-year betas materially exceed 10-year betas, reflecting the presence of a structural break in 2014 which signalled an increase in systematic risk exposure for water stocks. 10-year betas in 2020 take into account the betas before this structural break and so are lower than the 5-year betas.

— As at 23 February 2022, 10-year betas exceed 5-year betas because they are less affected by the pandemic – given the reliance on materially greater quantum of unaffected data – and incorporate less of the data from before the PR14 structural break than 2020 estimates. Notably, the CMA did not take into account the presence of the structural break at PR14 when deriving its beta range for PR19.

8.2.8 The **equally weighted average for the spot betas as at 28 February 2020 is 0.296** per Table 8, whereas the **outlier-adjusted average as at 23 February 2022 is 0.271.**

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[160] CMA PR19 FD, tables 9-8, 9-11

8.2.9   As discussed in section 6.6, a rolling average approach has some statistical shortcomings and does not result in any more 'relevant' estimate of the current pricing of risk than a spot estimate, whilst introducing arbitrary weighting of the underlying pricing signals within the sample under consideration. As a result, this Report focuses on deriving an asset beta range using spot values which appropriately take into account structural breaks.

8.3   Assessment of the weighting assumed for Covid-affected data

8.3.1   In order to derive an asset beta for PR24, this Report first considers an approach that attaches some weight to data from the Covid period consistent with assumptions around likely recurrence of a comparable pandemic event. This is consistent with the approach adopted by the CMA at PR19 which appears to have assigned some weight to the Covid-affected data as discussed in 6.4.

8.3.2   The comparable event is assumed to last approximately 2 years in line with the Covid19 duration implied by structural break analysis to (1) allow for the delineation between the impacts of the pandemic and the war and (2) avoid judgement regarding the length of potential future pandemics.

8.3.3   Two options are considered in terms of the frequency of pandemic events of a comparable scale and duration as Covid19.

⸺   1 in 15-year frequency – for consistency with tenor of 15Y Gilts referred to by Ofwat in the draft methodology. All else equal this is likely to *overstate* the frequency of future pandemics.

⸺   1 in 100-year frequency – consistent with (1) the gap between Covid19 and the last pandemic of a comparable scale, (2) the recognition that Covid19 is once-in-a-century event[161] and (3) the more conservative estimate from the study cited by Ofwat which suggests a range of c.70Y to 210Y for recurrence of a pandemic of comparable magnitude to Covid-19.

8.3.4   Assuming that a pandemic lasting c. 1.98 years occurs once in 15 years implies that c. 13.2% of the investment horizon would be affected, whereas for a once in 100-year occurrence, only 2% of the data would be affected. This information is combined with the following assumptions to estimate the relative weight that should be assigned to beta estimates from February 2020 and 2022 to arrive at values that incorporate the same amount of Covid-affected data:

⸺   Only spot beta estimates are used in the analysis;

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[161] For example, the chief of the World Health Organization (WHO) said that the Covid-19 pandemic. is "a once-in-a-century health crisis."

— 2-year spot value as at February 2022 are not included at this data is identified as an outlier; and

— Beta estimates under 2-, 5- and 10-year estimation are assigned equal weight relative to one another.

Table 9 Assumed Covid19 weightings to simulate a 1 in 15-year frequency

	Estimation window			Overall
	2-year average	**5-year average**	**10-year average**	
Proportion of the data affected by Covid as at 23 February 2022	0%	40%*	20%	
Proportion of the data affected by Covid as at 28 February 2020	0%	0%	0%	
Proportion of Covid-affected data	0%	26%	13%	13.2%**

Source: KPMG analysis.

* For example, the 40% proportion of the data affected by Covid has been calculated as the proportion of the 01/03/2020 – 23/02/2022 Covid-affected period relative to the full 23/03/2017 – 23/02/2022 covered by the 5-year averaging window.

** The relative weight assigned to the Feb 2020 and Feb 2022 cut-offs has been calculated such that the overall proportion of Covid-affected data is 13.2 (1/3x0%+1/3x26%+1/3x13%)

Table 10 Assumed Covid19 weightings to simulate a 1 in 100-year frequency

	Estimation window			Overall
	2-year average	**5-year average**	**10-year average**	
Proportion of the data affected by Covid as at 23 February 2022	0%	40%	20%	
Proportion of the data affected by Covid as at 28 February 2020	0%	0%	0%	
Proportion of Covid-affected data	0%	4%	2%	2.0%*

Source: KPMG analysis.

* The relative weight assigned to the Feb 2020 and Feb 2022 cut-offs has been calculated such that the overall proportion of Covid-affected data is 2%.

8.3.5 Applying these weights to the equally weighted average for the spot betas as at 28 February 2020 (0.296) and the outlier-adjusted average as at 23 February 2022 (0.272) yields an unlevered beta estimate of **0.280 for 1 in 15-year** and **0.293 for 1 in 100-year frequencies.**

8.4 Deriving the beta range for PR24

8.4.1 The following evidence set out in this Report is considered in coming to a view on the asset beta range for PR24:

— The increased systematic risk exposure faced by the water companies at PR24

relative to PR19, predominantly driven by proposed changes to incentives and performance commitments, costs, changing environmental requirements and heightened pressure on the sector 'in the headlines' which, *inter alia,* increases regulatory risk. The relative risk analysis indicates *prima facie* that beta would be expected to increase somewhat relative to PR19 values due to changes in the systematic risk exposure faced.

— The analysis of structural breaks, which implies that water proxies react materially to Covid and Russia-Ukraine war but that these impacts are transitory. Betas affected by the pandemic are expected to mean-revert as Covid19 does not indicate a change in business fundamentals (the pandemic has not revealed new information or changed risk for the sector). The impact of the war could reverse in the next couple of years ahead of the PR24 price control, supported by *inter alia* plans to increase Europe's self-sufficiency from an energy supply perspective.

— The evidence submitted by Gregory et al on behalf of the water companies in the PR19 appeals on the existence of a structural break for the UK water sector around the PR14 period, which suggests that data from 2014 onwards is most relevant to set cost of equity for PR24. This is consistent with the findings of the Indepen report which notes that "*significant changes in regulatory regime, like the shift from RPI-X to RIIO in the energy sector or the implementation of the Future Price Limits changes at PR14 in the water sector, suggest that the assumption of a constant equity β is likely to be untenable.*"

— The inference that the CMA potentially placed no weight on Covid affected estimates given that its final range was fully encompassed within the range of evidence that results from estimates being calculated with pre-Covid.

— The upper bound of the range takes into account (1) the evidence of the structural break around PR14 and (2) the inference that the CMA potentially placed no weight on Covid affected estimates. It is based on the equally weighted average of spot estimates of 2- and 5-year betas as at 28 February 2020 **(0.304).**

— The lower bound of the unlevered beta range is informed by the Covid-adjusted estimate which assumes that a c. 2-year pandemic of a similar scale as Covid occurs once in 15 years **(0.280).**

8.4.2 Figure 13 sets out a comparison between the unlevered beta range proposed in this Report and estimates implied by the different approaches considered in the Report and by the CMA at PR19.

Figure 13 Summary of unlevered beta estimates
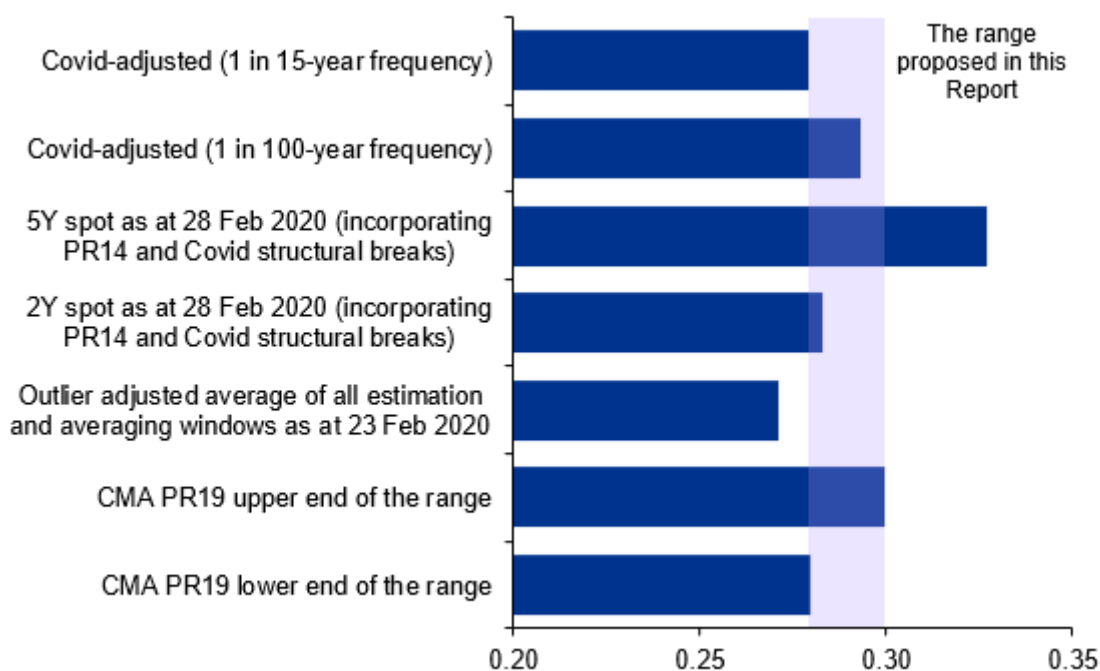
Source: KPMG analysis.

8.4.3 The qualitative and quantitative evidence set out in this Report indicates that this range is best supported by the evidence provided by relevant financial literature and regulatory principles.

8.4.4 Table 11 combines the unlevered beta estimates with a debt beta of 0.075 and notional gearing of 60% using the standard approach to de- and re-levering in order to derive the notional equity beta range for PR24.

Table 11 Notional equity beta range for PR24

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

Source: KPMG analysis.

8.4.5 The proposed equity beta range is consistent with the range of 0.69 – 0.74 determined by the CMA for PR19.[162]

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[162] CMA PR19 FD, Table 9-19

9   Appendix 1: Scope of work

9.1.1   Water UK has asked KPMG to develop a report on Relative Risk Analysis and Beta Estimation, to assist Water UK in its considerations regarding the PR24 draft methodology and, in particular, asset beta that is reflective of the systematic risk exposure faced by water companies and is best supported by the evidence provided by relevant financial literature, regulatory principles, and market evidence. The final report will be shared with Ofwat alongside Water UK's response to the draft methodology.

9.1.2   In order to develop a view on a beta that is reflective of the systematic risk exposure faced by water companies, the report will consider the risk exposure and the beta estimate for water companies in four steps:

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

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

— Third, it sets out a number of methodologies for quantifying the relative risk differential given that risk drivers identified in the previous steps. In particular, this Report considers evidence from observed data, analysis of structural breaks and implied volatility.

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

9.1.3   In addition the report considers the treatment of de and re-levering:

— First it considers the Modigliani-Miller theorem and practical application in a regulatory context

— Second it considers practical application of Modigliani-Miller theorem

— Third it decomposes the underlying drivers of the observed variance of WACC to gearing

— Fourth it evaluates the arguments and evidence put forward by Mason and Wright in relation to de- and -re-levering, based on the options set out in Ofwat's draft methodology.

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