Affinity Water

AFW110 Economic Insight - Impact of asset growth on systematic risk

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Economic Insight

IMPACT OF CAPITAL INVESTMENT ON SYSTEMATIC RISK

REPORT FOR AFFINITY WATER AND WESSEX WATER

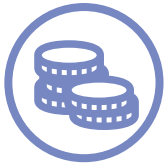
CONTENTS

EXECUTIVE SUMMARY

THE LEVEL OF SYSTEMATIC RISK AT PR24 WILL BE HIGHER THAN IN THE PAST, DUE TO A MATERIAL INCREASE IN CAPITAL INVESTMENT (RELATIVE TO HISOTIRCAL LEVELS). THE RETURN FOR INVESTORS IS, HOWEVER, CALCULATED USING BACKWARDS-LOOKING DATA.

The need for a fair rate of return for investors

- Providing equity investors with a fair rate of return, commensurate with the level of systematic risk in the sector, is a cornerstone of Ofwat's financeability duty (and is also critical to the consumer duty).
- Without a fair rate of return, the sector will not attract the significant new equity investment required at PR24.



The changing nature of companies' activities

- Companies are materially increasing capital investment at PR24. This is to: respond to statutory requirements; meet customer needs; and address historical underfunding.
- The increase in investment is associated with a change in the mix of activities undertaken by companies (including increased asset construction). This results in an increase in systematic risk exposure.

The backwards-looking nature of beta analysis

- Equity investors are compensated for the level of systematic risk they face through the beta parameter in the capital asset pricing model (CAPM).
- The methodology for estimating beta focuses on backwards-looking analysis of historical data on share price volatility.

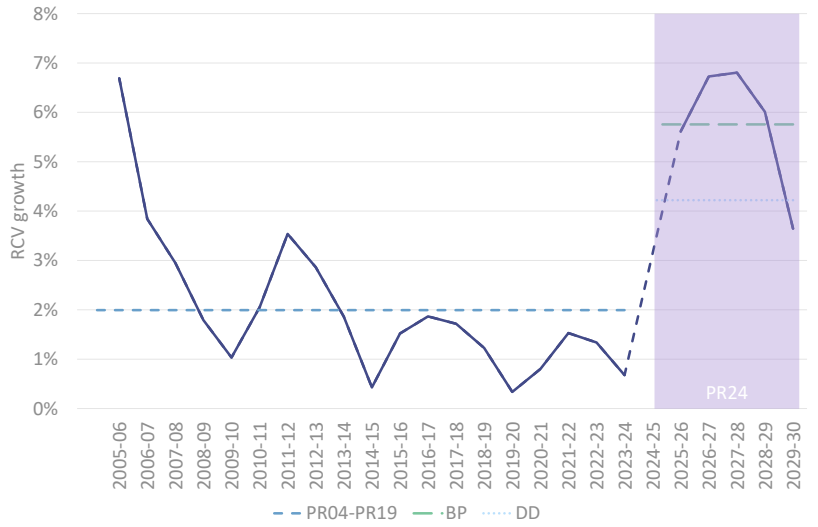
There is a need to ensure the view of systematic risk at PR24 is forward-looking.

PR24 WILL SEE ASSET GROWTH AT A HIGHER RATE THAN IN THE RECENT PAST.

- At PR24, water companies propose capital programmes that are materially different from the past. Both the type and the scale of capital investment will change significantly, as companies aim to improve their environmental performance.
- While *both* the type and scale of capital investment may affect the level of systematic risk companies face, this report is concerned with the effect of scale alone.
- The adjacent figure shows RCV growth since 2005-06. This is calculated as the percentage movement in RCV in each year, from opening RCV (including indexation) to closing RCV.
- Water companies' proposed RCV growth at PR24 represents a step change that is unprecedented in recent history.
  - From PR04 to PR19, RCV growth across the industry was on average 2.0% (and lower in PR14 and PR19).
  - Industry RCV growth in company business plans is on average 5.8% across PR24 (shown as BP in the adjacent graph) and is 4.2% in draft determinations, (DD in the adjacent graph).

Estimating beta solely using backwards-looking historical data *may* have been appropriate in previous price controls, but it is not sufficient to rely on at PR24.

Figure 1: Industry RCV growth since PR04 vs PR24 business plans



Source: Economic Insight analysis of Ofwat data and PR24 business plan data tables

WE DEVELOP A FORWARD-LOOKING VIEW BY ISOLATING THE EFFECT OF CAPITAL INVESTMENT (ASSET GROWTH) ON SYSTEMATIC RISK.

Econometric beta analysis

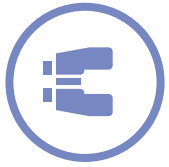
- **Fundamental beta analysis** isolates the effects of different sources of risk on companies' overall systematic risk, as measured by beta.
- In particular, it can measure the relationship between asset growth and the level of systematic risk.
- This estimation approach therefore addresses Ofwat's concerns regarding comparator methods for quantifying a beta adjustment.

Asset growth increases systematic risk

- We find **a significant positive relationship between asset growth rates and beta** in FTSE 100/350 companies.
- Our results suggest that an increase in asset growth of 1 percentage point is associated with an increase in beta of close to 0.01.

A forward-looking view of beta

- This estimate of the relationship between asset growth rates and beta allows us to quantify the expected increase in systematic risk at PR24, based on companies' planned RCV growth.
- **This analysis implies an increase in asset beta of 0.019–0.033** above the level implied by historical data.



BACKGROUND AND CONTEXT

OFWAT'S FINANCEABILITY DUTY REQUIRES IT TO ENSURE THAT EFFICIENT COMPANIES CAN SECURE REASONABLE RETURNS ON THEIR CAPITAL, WHICH INCLUDES SETTING AN APPROPRIATE COST OF EQUITY AND, RELATEDLY, BETA.

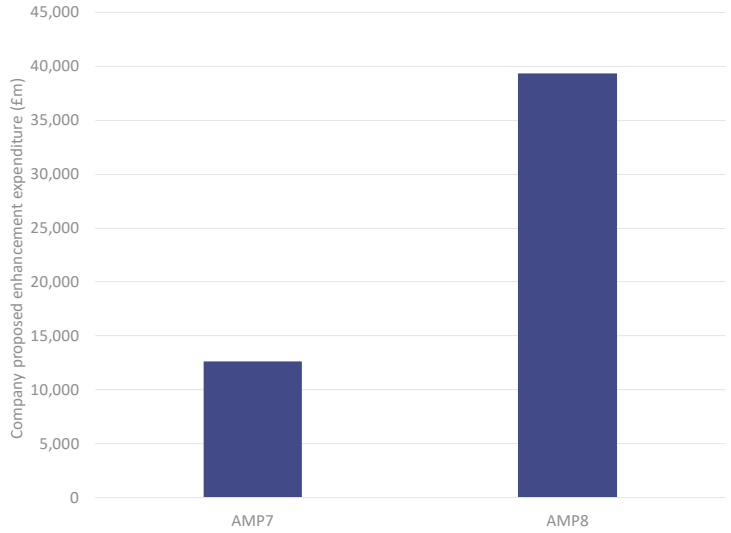
- Financeability duties require regulators to ensure that efficient regulated companies can attract and retain the investment required to run capital-intensive businesses. Under the Water Industry Act 1991, Ofwat has a statutory duty to *"secure that [water companies] are able (in particular, by securing reasonable returns on their capital) to finance the proper carrying out of [their statutory] functions"*.*
- Relatedly, Ofwat has a statutory duty to protect the interests of consumers. To meet consumer needs in the long run, sufficient investment in water infrastructure is critical, which in turn requires efficient companies to be able to attract and retain equity.
- The ability of companies to secure a reasonable return on capital is crucial to their ability to attract and retain equity investment, as well as their ability to service their debt. Furthermore, the allowed cost of equity is an important input to determining companies' revenue allowances.
- The role of equity in companies' capital structure is to bear the brunt of the risk that companies face. This includes both: (i) idiosyncratic risk, which is company-specific and which investors can mitigate by holding a balanced portfolio; alongside (ii) systematic risk, which is non-diversifiable because it is correlated with other risks across the economy.
- For companies to be able to attract and retain equity, equity investors must be able to earn a return that is commensurate with the level of systematic risk. In setting the allowed cost of equity, systematic risk is accounted for in the parameter beta, with a higher beta indicating higher systematic risk - and therefore, a higher allowance for equity costs.
- It follows that determining an appropriate level for beta is itself a critical step in ensuring the financeability and consumer duties are met.

*'Water Industry Act.' (1991); Section 2.

A STRIKING FEATURE OF COMPANY PLANS AT PR24 IS THE LARGE INCREASE IN PROPOSED EXPENDITURE AND, WITHIN THAT, CAPITAL INVESTMENT.

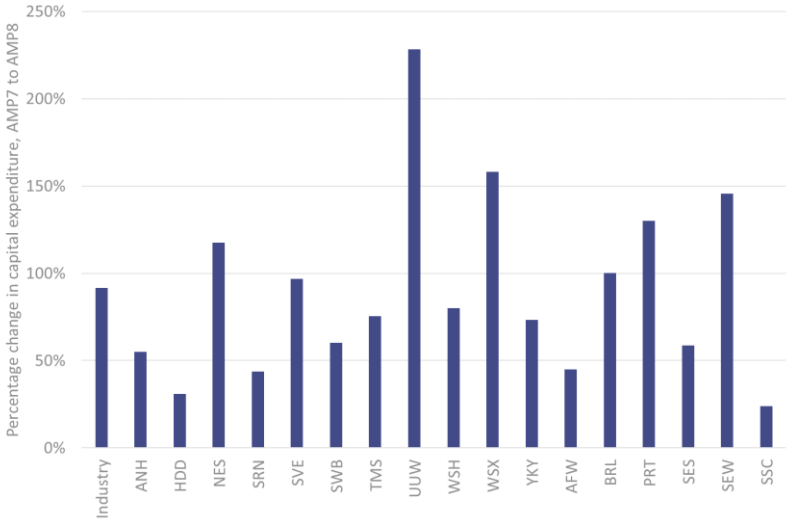
Companies' business plans include material increases in totex at PR24, relative to AMP7. While higher maintenance expenditure accounts for a material amount, the most significant portion comprises higher enhancement expenditure, with most companies proposing large increases compared to PR19. **As a consequence, the sector will see significant asset growth over the period, with potentially important implications for the level of systematic risk that companies in the sector face.**

Figure 2: Business plan enhancement expenditure in AMP8 vs AMP7 (whole industry)



Source: Economic Insight analysis of PR24 business plans

Figure 3: Percentage change in capital expenditure in AMP8 vs AMP7

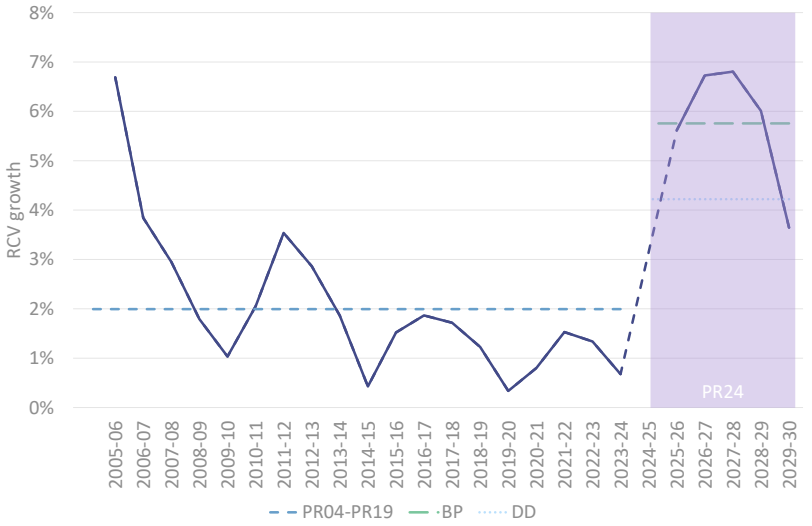


Source: Economic Insight analysis of PR24 business plans
Note: Figures to 2023/24 are actual expenditure; figures from 2024/25 to 2029/30 are forecast efficient expenditure

THE LARGE INCREASE IN CAPITAL EXPENDITURE IS REFLECTED IN SIGNIFICANT ASSET GROWTH, WITH RCV's PROJECTED TO RISE SIGNIFICANTLY RELATIVE TO HISTORICAL PATTERNS.

- The adjacent figure shows industry percentage RCV growth (real) from 2005–06 to 2022–23, and *projected* RCV growth (as per companies' business plans) over 2025–26 to 2029–30.
- Real RCV growth is calculated as the percentage change in RCV in each year, from opening RCV (including indexation) to closing RCV. It therefore reflects the net impact of RCV additions and depreciation / RCV run off in each year.
- RCV growth planned at PR24, at 5.8% in company business plans (and 4.2% in draft determinations), is substantially higher than at any point in PR14 or PR09. From PR04 to PR19, RCV growth across the industry was, on average, 2.0% (and lower in PR14 and PR19). Indeed, it has only been at a comparable level to PR24 business plan levels during a single year of PR04 (2005-06).

Figure 4: Industry RCV growth since PR04 vs PR24 business plans (real)



Source: Economic Insight analysis of Ofwat data and PR24 business plan data tables

THEORY AND PREVIOUS EMPIRICAL STUDIES SUGGEST THAT LARGE INCREASES IN CAPITAL INVESTMENT (ASSET GROWTH) MAY BE ASSOCIATED WITH HIGHER SYSTEMATIC RISK.

- The primary purpose of this report is to provide a *quantitative assessment* of the relationship between increases in capital investment and beta. As such, we do not consider the theoretical basis for a relationship between capital investment and systematic risk in detail here.
- Nonetheless, briefly, we note that theory and prior empirical studies identify two main reasons why systematic risk may increase with greater capex.
  - First, because the increase in investment is likely to be associated with **a change in the mix of activities being undertaken.** Some activities are exposed to higher systematic risk than others. If the mix that a firm undertakes varies to include a greater proportion of such activities, then the firms' overall systematic risk exposure rises. In practice, the main relevant change in mix at PR24 is likely to be a material increase in higher-risk asset construction and asset maintenance activities, relative to historical levels.
  - Second, being a fixed cost, an increase in capital investment tends **to increase a firms' operating leverage** (the ratio of fixed to variable costs) if it is not matched by a similar increase in variable costs. A higher proportion of fixed costs makes a company's returns more volatile, because its profit will vary more with volumes than they otherwise would (even if all other drivers of systematic risk are identical). For example, holding all else equal in response to a decrease in volume (and, in turn, revenue), a company with a high proportion of fixed costs will not be able to reduce its costs as much as a company for which fixed costs are less significant.

THE BACKWARDS-LOOKING NATURE OF BETA ESTIMATION RISKS OMITTING THE IMPACT OF INCREASED CAPEX AND OFWAT IS NOT CURRENTLY MINDED TO MAKE AN ADJUSTMENT TO ITS APPROACH.

- When estimating betas for regulatory price setting purposes, it is standard practice to estimate them over historical time periods on a backwards-looking basis.
- This is for good reasons, including that:
  - it is conducive to regulatory stability and predictability;
  - it is transparent and, being based on observable data, removes a degree of subjectivity that arises if one departs from a historical estimation method; and
  - one would expect historical betas, to some degree, to reflect investors' expectation of forward-looking risk (the extent to which this holds may depend in part on the beta estimation window).
- The drawback of a strictly historical approach to beta estimation, however, is that it is unlikely to fully reflect any material change in systematic risk that will arise on a forward-looking basis.
- In its PR24 DDs, Ofwat recognised the principle that the large-scale increase in capital investment (and related change in mix of activities) may increase systematic risk, stating: *"a mix of more complex and uncertain activities for PR24 could potentially increase systematic risk".**
- However, at this time Ofwat is minded to retain its historical approach to beta estimation and not to make an adjustment for forward-looking risk. This is for three main reasons:
  - Firstly, whilst accepting the 'in principle' point that higher capex may increase systematic risk, Ofwat was **not convinced that the relevant theory applies in the case of the water sector** (effectively because the regulatory framework itself shields companies from the identified risks).
  - Secondly, because Ofwat was **not satisfied that any of the evidence presented by companies to quantify the impact on beta was sufficiently robust** to warrant an adjustment.
  - Thirdly, Ofwat was concerned that an adjustment would **set a precedent,** whereby it would also be required to consider downwards adjustments to beta if capital intensity or complexity are lower in future price controls.

'PR24 draft determinations. Aligning risk and return – Allowed return appendix.' Ofwat (July 2024); page 41.

WE CONSIDER OFWAT'S REASONING VALID, AND SO IN THIS REPORT, FOCUS ON DEVELOPING ALTERNATIVE EMPIRICAL ANALYSIS OF THE IMPACT OF INCREASED INVESETMENT ON BETA.

- In our view, there is some validity to all three of Ofwat's reasons for not making a forward-looking adjustment to beta in its DDs. In practice, we think a more nuanced consideration of the theory and evidence would be beneficial for the final determinations.
- On Ofwat's first point (applicability of theory), we agree it is important to consider what systematic risks water companies are likely exposed to in reality, given how the regulatory model functions. However, whilst we consider the regulatory model *mitigates* some of the relevant sources of systematic risk arising from an increase in investment, *they do not remove it* (and in some instances, any mitigation effect is likely modest). Thus, in our view, water companies *are* exposed to higher systematic risk arising from both: (i) greater and more varied construction activity; and (ii) higher operational leverage. Relatedly, we therefore think it an overstatement to suggest that there is either:
  - on one hand, no (or a very limited) increase in systematic risk arising from these factors at PR24; or
  - on the other hand, that water companies are fully exposed to these risks.
- In the Annex to this report, we expand on our reasoning and evidence as to how (and to what extent) the regulatory regime impacts systematic risk exposure in practice.
- On Ofwat's second point, we also agree that there are limitations with the empirical evidence and analysis presented by companies to date. Indeed, the primary purpose of this paper is to address this concern by developing an alternative empirical method that is CAPM-consistent. That said, we note that no method is perfect and (as with beta estimation itself) all are subject to measurement error. Thus, the weight one attaches to this concern should be considered in the context of the consequences of failing to address the 'in principle' point and the impact of that on customers. In the subsequent slides, we expand on Ofwat's concerns regarding the existing empirical methods and share our own observations on them.
- Finally, on Ofwat's third point, we also agree that applying a forward-looking adjustment may raise the prospect of having to consider the issue at future price controls (i.e. making downward adjustments when capital intensity falls). However, in practice, we think this depends on the extent to which the increase in investment at PR24 reflects: (i) reoccurring factors that cause investment to fluctuate across price controls; and / or (ii) a one-off adjustment to correct for historical underinvestment / meet new requirements. In our view, the key point is to carefully consider this distinction, so as to avoid: (a) overstating any uplift to beta; or (b) setting a precedent that (rightly) concerns Ofwat. We discuss this issue further when presenting our results.

EMPIRICAL ANALYSIS PROVIDED BY COMPANIES TO DATE HAS (MAINLY) FOCUSED ON HOW COMPARATOR COMPANIES MIGHT INFORM AN ADJUSTMENT TO BETA AT PR24.

- Companies, and their advisors, provided a range of empirical analyses to Ofwat as part of their PR24 Business Plan submissions, seeking to quantify the impact of increased capital investment on systematic risk (including quantifying a beta adjustment). Most of these methods (but not all) were a form of 'comparator' analysis, whereby companies sought to: (a) identify comparators that undertook a 'higher mix' of investment / construction; and then (b) draw inferences as to the beta uplift from those. The main evidence provided to Ofwat was as follows:
- KPMG identified National Grid's regulated gas and electricity business as a potential comparator. KPMG made the point that National Grid (NG) had seen RAV growth in the past (2014-21) that was more reflective of water companies' plans for AMP8. KPMG estimated an unlevered beta of 0.36 for NG, which is higher than KPMG's backwards-looking estimate for listed water companies (0.32) over the same period. KPMG therefore advocated placing 'some' weight on the NG beta, recommending: *"a beta based on a weighted portfolio of water companies and NG may be the minimum required to appropriately price this forward-looking systematic risk exposure given that the scale of investment."**
- KPMG also provided evidence on betas from the construction sector, commenting that: *"The requirements and challenges of these firms in delivering infrastructure projects could closely align with those faced by water companies."*
  - Focusing on construction firms specialising in infrastructure investment, for 2010-2020, KPMG estimated an unlevered beta of 0.62.
  - KPMG then calculated a weighted average of a 'pure play' business as usual water beta, and the (higher) construction beta (with the weight for construction based on net RCV arising from enhancement spend). This gave a beta of 0.33. KPMG suggests this analysis is best used as a 'cross check'.**

*'Estimating the Cost of Equity for PR24.' KPMG (2023); pages 94–95.
**'Estimating the Cost of Equity for PR24.' KPMG (2023); pages. 96–97.

WHILE EVIDENCE FROM WIDER COMPARATORS MAY HELP INFORM FORWARD-LOOKING RISK, WE AGREE WITH OFWAT THAT IT ALSO HAS LIMITATIONS.

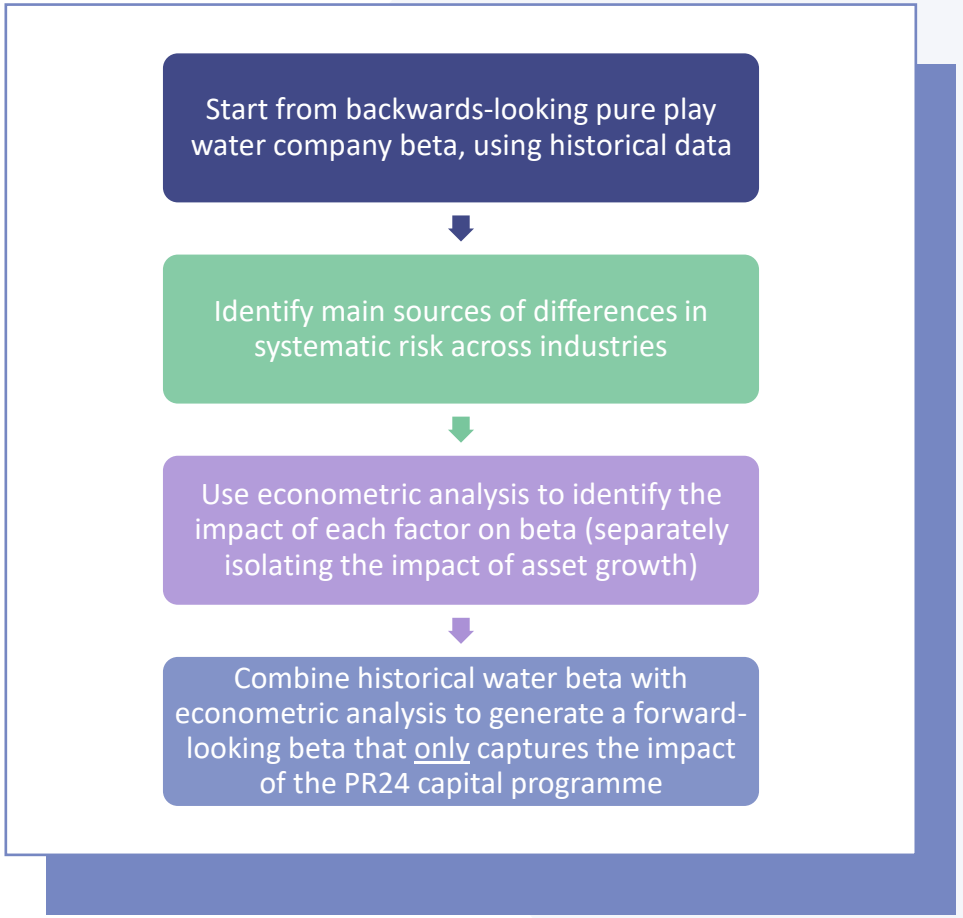
- Evidence from wider (non-pure-play water) comparators *may* be a helpful way to inform us as to how forward-looking risk may differ from the past. It might, therefore, be a useful method for considering the potential need for, and extent of, a beta adjustment at PR24 to reflect the large increase in capital programmes. However, we agree with Ofwat that this evidence has some limitations.
- In its DD's, Ofwat's main reason for not relying on this evidence was that: *"placing weight on non pure-play water stocks is… liable to introduce beta risk from completely unrelated sources (e.g. differences in regulatory framework)".** Similarly, Ofwat also states: *"differences in risk are not limited to capex intensity, so placing weight on these betas could result in investors being compensated for risks (such as demand risk for construction companies) which are almost non-existent in the water sector". ***
- Specifically in relation to NG, Ofwat notes the company: *"is governed by a different regulatory framework, has non-network (e.g. generation) activities within its portfolio, and has material US operations".**** In relation to construction companies, Ofwat does not think this is a *"reliable way of capturing any potential risk from the PR24 capex programme".*****
- We agree with the central thrust of Ofwat's concern. Namely, when one draws on comparators to inform in impact of an increase in capex-related systematic risk, one cannot know to what extent differences in beta across said comparators arise due to capital intensity or other factors, which are not relevant to the primary issue (capital programmes) of concern at PR24.
- With the above issue in mind, the primary aim of this report is to provide additional empirical evidence, using a method that: (a) isolates the impact of investment on systematic risk, so as to address the 'pollutant' limitation of comparator methods; and (b) is consistent with retaining the CAPM.

*'PR24 draft determinations. Aligning risk and return – Allowed return appendix.' Ofwat (July 2024); page 40.
**'PR24 draft determinations. Aligning risk and return – Allowed return appendix.' Ofwat (July 2024); page 47.
***'PR24 draft determinations. Aligning risk and return – Allowed return appendix.' Ofwat (July 2024); page 50.
****'PR24 draft determinations. Aligning risk and return – Allowed return appendix.' Ofwat (July 2024); page 50.

AN EMPIRICAL METHOD TO ISOLATE THE IMPACT OF CAPEX ON SYSTEMATIC RISK

TO ADDRESS THE LIMITATIONS OF COMPARATOR APPROACHES, WE HAVE DEVELOPED AN ALTERNATIVE METHOD, WHICH USES ECONOMETRICS TO ISOLATE THE IMPACT OF AN INCREASE IN CAPEX ON BETA.

- We have developed a methodology for adjusting backwards-looking historical (water company) beta estimates, using an econometric method that addresses the limitations of comparator approaches.
- Our method takes as its starting point pure-play water company betas, using historical data (thus, going with the grain of existing regulatory methods).
- We then undertake an econometric analysis, whereby for a cross section of FTSE 100/350 companies, we regress their betas against variables relating to alternative sources of systematic risk. These include a variable to reflect differences in capex (in practice, we use asset growth), but also a range of controls, intended to 'strip out' other factors affecting differences in systematic risk across firms (thus, addressing the 'pollutant' concern that arises when using comparator methods).
- We then take our pure-play historical water beta and adjust it to reflect the estimated beta impact of increased asset growth, as established in our econometrics.



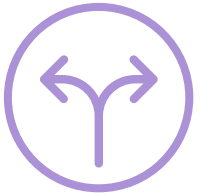
ECONOMETRIC ANALYSIS OF THE SOURCES OF RISK CAN OVERCOME SOME OF THE LIMITATIONS OF COMPARATOR APPROACHES.

In our view, our econometric methodology has three main advantages, relative to the comparator approach.

- **The method can disentangle the effects of (i) the underlying driver of risk that is expected to change – asset growth – and (ii) other sources of risk that may differ between water companies and wider comparators.** This ensures that the adjustment applied to historical pure-play water company betas is a fair reflection of the expected change in systematic risk in the water industry (due to the capital programme) and is not distorted by potentially unobserved (and irrelevant) differences in the characteristics or activities of the comparators.

- **The method can be applied even where good comparators are difficult to find.** As outlined in the previous point, the method strips out the effect of differences in companies' activities other than the source of risk in question. Consequently, it does not rely on finding a comparator with a risk profile that is similar to the water industry's in every other respect. Instead, the method offers a way to take into account valuable evidence from the wider economy that would be overlooked by a comparator approach.

- **The method is consistent with using the CAPM to set the allowed cost of equity.** Limitations of the CAPM in setting the allowed return on equity are increasingly recognised. Consequently, there has been some debate as to whether alternative methods (including using multi-factor models) might be preferable. In some cases, such alternative methods may themselves address some of the issues discussed in this report (e.g. multi-factor models can, by definition, 'factor in' multiple drivers of risk). However, the method we propose here allows one to set aside the wider debate as to the relative merits (or otherwise) of the CAPM. Put simply, it allows Ofwat to retain the existing CAPM approach, whilst also addressing the important consideration of whether, and to what extent, the capital programme may affect systematic risk over PR24.



ECONOMETRIC ANALYSIS OF THE RELATIONSHIP BETWEEN BETA AND FUNDAMENTAL SOURCES OF RISK.

- The type of analysis we have undertaken is referred to as **'fundamental beta analysis',** as it relates beta to underlying economic fundamentals. That is, the analysis isolates the effects of fundamental sources of risk – such as asset growth – on companies' overall systematic risk (as measured by beta).
- Our starting point is a model with the following form, where i is an individual company and t denotes a time period covering five years:

$$\beta_{i,t} = \alpha_i + \gamma \times \text{asset growth}_{i,t} + \delta \times \text{controls}_{i,t} + \varepsilon_{i,t}.$$

- There is significant variation in companies' systematic risk levels, and the underlying drivers thereof are difficult to measure. The control variables included in the model are therefore unlikely to account for all of the differences in beta across companies that are not attributable to asset growth. To remove the confounding effect of any remaining unobserved heterogeneity that is not captured by the control variables, we use a first-difference approach.
- Taking first differences yields:

$$\Delta\, \beta_{i,t} = \gamma \times \Delta\, \text{asset growth}_{i,t} + \delta \times \Delta\, \text{controls}_{i,t} + \epsilon_{i,t},$$

where $\Delta\, x_{i,t} = \left(x_{i,t} - x_{i,t-1}\right)$ and $\epsilon_{i,t} = \left(\varepsilon_{i,t} - \varepsilon_{i,t-1}\right)$.

- To measure the dependent variable in this model, we first estimate equity betas by regressing a company's daily total returns on the market index's daily total returns over the relevant five-year period. We then de-lever this estimate, using enterprise value (EV) gearing to arrive at unlevered betas:

$$\text{unlevered } \beta_{i,t} = \left(1 - \text{EV gearing}_{i,t}\right) \times \text{equity } \beta_{i,t}.$$

- Asset growth is measured as the geometric mean of the company's nominal annual asset growth rate over the relevant five-year period.
- We estimate this first-difference model using OLS with robust standard errors clustered on companies.

WE INCLUDE A RANGE OF CONTROLS BASED ON ACCOUNTING METRICS IDENTIFIED IN THE ECONOMICS LITERATURE AS BEING RELEVANT DRIVERS (OR PROXIES FOR DRIVERS) OF SYSTEMATIC RISK.

- Our approach to selecting appropriate control variables is informed by the academic literature. We include measures of dividend payout, liquidity, asset size and earnings variability, in line with those proposed by Beaver, Kettler & Scholes (1970).
- We do not add leverage as a separate control variable, as we instead account for its effect on systematic risk by using unlevered beta as the dependent variable.

Table 1: Risk measures proposed in the academic literature

VARIABLE	RATIONALE
Dividend payout	Firms with greater volatility of earnings will tend to pay out a lower percentage of expected earnings.
Growth	Incremental earnings over and above a firm's usual level may be riskier than 'normal' earnings.
Leverage	In line with Modigliani-Miller, equity holders' earnings become more volatile as the use of debt financing increases.
Liquidity	Liquid current assets can be viewed as facing only inflation risk and so have a less volatile return than non-current assets. On the other hand, riskier companies may choose to hold more liquid assets.
Size	If individual asset returns are less than perfectly correlated, the rate of return for larger firms will have a lower variance than the rate of return for smaller firms.
Earnings variability	A measure of overall variability in earnings, including both systematic and non-systematic variation.
Earnings covariability	A measure of systematic earnings variability defined in a similar manner to equity beta, sometimes referred to as 'accounting beta'.

Source: Beaver, Kettler & Scholes (1970) "The Association between Market Determined and Accounting Determined Risk Measures", The Accounting Review 45(4), pp. 654–682

APPLYING A FORWARD-LOOKING ADJUSTMENT TO HISTORICAL BETA ESTIMATES

WE ESTIMATE THE MODEL USING LSEG EIKON DATA ON NON-FINANCIAL FTSE 100 COMPANIES.

- We use data from LSEG (formerly Refinitiv) Eikon, a financial database. For the estimation of beta, the 'Total Return' on companies' shares – a measure accounting for both movements in the share price and dividends paid – is regressed on the return on the FTSE 100 Total Return Index. Other variables used in the model are calculated using Eikon data, as set out in the adjacent table.
- For consistency, all variables are calculated over the same time period used to estimate beta. In each instance, this is a period covering five of the respective company's financial years. Based on data availability, we include two five-year periods covering FY2013–FY2017 and FY2018–FY2022.
- We include companies that are current constituents of the FTSE 100. We exclude financial institutions (20 companies), as the nature of asset growth for these companies is likely to be different to non-financials, and their underlying sources of risk (and the relationship with beta) are unlikely to be sufficiently comparable to those of other companies in the sample.
- For a further 33 companies, there is insufficient data available to calculate all required variables in both periods. This yields a sample of 47 companies.

Table 2: Definition of variables in terms of Eikon data

VARIABLE	DEFINITION	EIKON DATA ITEMS USED
Asset growth	$\left(\frac{\text{total assets}_{T-5}}{\text{total assets}_{T}}\right)^{1/5} - 1$	• 'Total Assets, Reported'
Dividend payout	$\frac{\sum_{\tau=T-4}^{T} \text{dividends paid}_{\tau}}{\sum_{\tau=T-4}^{T} \text{income to common}_{\tau}}$	• 'Cash Dividend Paid, Common, Discrete' • 'Income Avail to Cmn Shareholders Incl Extra'
Liquidity	$\frac{1}{5}\sum_{\tau=T-4}^{T} \frac{\text{current assets}_{\tau}}{\text{current liabilities}_{\tau}}$	• 'Total Current Assets' • 'Total Current Liabilities'
Size	$\log\left(\frac{1}{5}\sum_{\tau=T-4}^{T} \text{total assets}_{\tau}\right)$	• 'Total Assets, Reported', in £m
Earnings variability	$\sqrt{\frac{1}{5}\sum_{\tau=T-4}^{T}\left(\frac{E}{P_{\tau}} - \frac{\bar{E}}{P}\right)^2}$, where: $\frac{E}{P_{\tau}} = \frac{\text{income to common}_{\tau}}{\text{share price}_{\tau-1} \times \text{shares}_{\tau-1}}$	• 'Income Avail to Cmn Shareholders Incl Extra' • 'Hist Fscl Period Price Close (fin cur)' • 'Total Common Shares Outstanding'
EV gearing	$\frac{1}{5}\sum_{\tau=T-4}^{T} \text{net debt/EV}_{\tau}$	• 'Historic Net Debt/EV'

Note: τ denotes financial years, with T being the last FY included in a time period. Variable definitions for asset growth, dividend payout, liquidity, asset size and earnings variability follow Beaver, Kettler & Scholes (1970) "The Association between Market Determined and Accounting Determined Risk Measures", The Accounting Review 45(4), pp. 654–682.

THE SIGNIFICANT POSITIVE RELATIONSHIP BETWEEN ASSET GROWTH AND SYSTEMATIC RISK INDICATES A NEED TO ADJUST HISTORICAL BETA ESTIMATES UPWARDS, WHERE ASSET GROWTH IS EXPECTED TO INCREASE MATERIALLY.

- **We find that there is a statistically significant and positive relationship between asset growth and beta.** The coefficient on asset growth is statistically significant at 1%. Other things equal, an increase in a company's nominal asset growth rate of 1 percentage points is associated with a 0.0087 increase in its unlevered beta.
- The model explains a material proportion of variation in the dependent variable, with its R^2 being 32%.
- In relation to the other model coefficients:
  - The coefficient on asset growth is statistically significant and has the expected positive sign, meaning that higher asset growth is associated with higher systematic risk.
  - The coefficient on dividend payout is statistically significant and has the expected negative sign.
  - The coefficient on liquidity is statistically significant and has a positive sign. As set out above, higher risk companies may choose to hold more liquid assets.
  - The coefficient on size is positive, but is not statistically significant.

Table 3: Regression results

Model	FTSE 100 non-financials
Asset growth	0.866*** (0.278)
Dividend payout	−0.006*** (0.001)
Liquidity	0.207*** (0.073)
Size	0.041 (0.048)
Earnings variability	0.457** (0.196)
Observations	47
R^2	0.316

*Standard errors in parentheses; * p < 0.1, ** p < 0.05, *** p < 0.01*

DIFFERENT MODEL SPECIFICATIONS ALSO SHOW A SIGNIFICANT POSITIVE RELATIONSHIP BETWEEN ASSET GROWTH AND SYSTEMATIC RISK

- As a robustness check, we estimate the relationship between asset growth and beta in three alternative model specifications:
  i. dropping the control variables from the model;
  ii. including a broader sample of FTSE 350 companies; and
  iii. using an arithmetic, rather than geometric, average to measure of asset growth.
- Our finding of a statistically significant and positive relationship between asset growth and beta is robust to these changes in model specification.

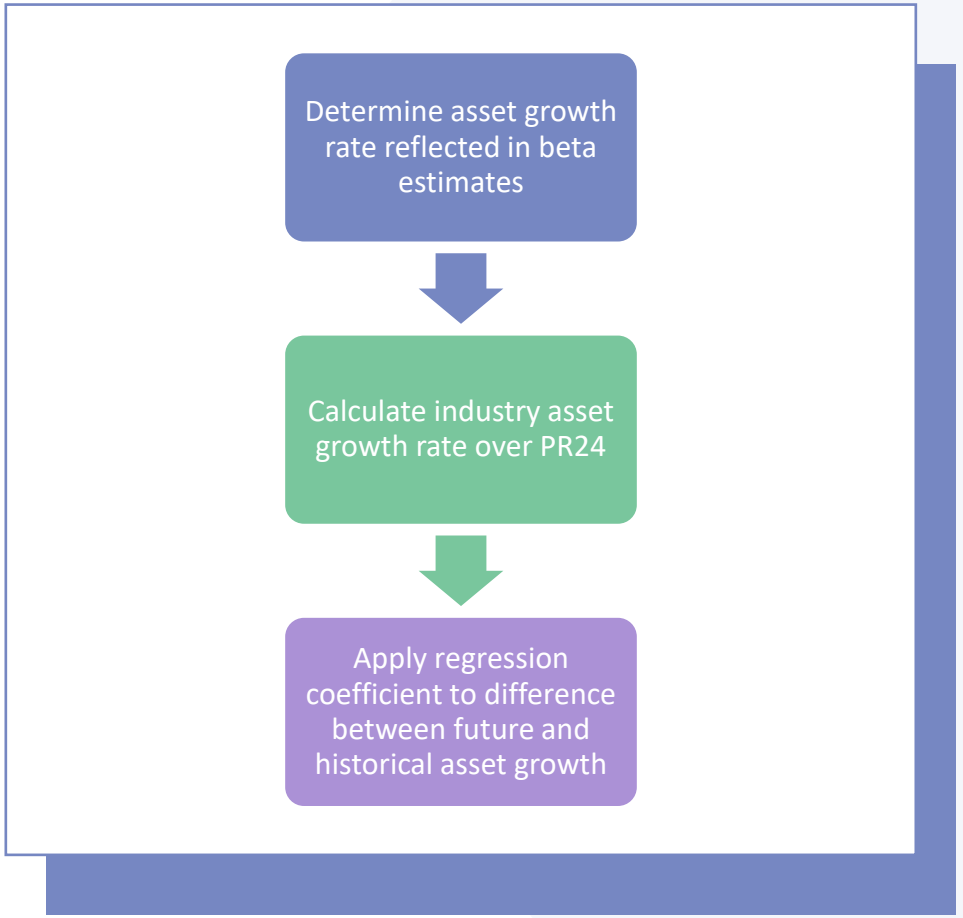
Table 4: Regression results – robustness checks

Model	FTSE 100 non-financials	FTSE 350 non-financials	FTSE 100 non-financials (arithmetic average asset growth measure)
Asset growth	0.851*** (0.229)	0.616*** (0.189)	0.579** (0.218)
Dividend payout	—	−0.007* (0.004)	−0.006*** (0.002)
Liquidity	—	0.008 (0.018)	0.190*** (0.070)
Asset size	—	0.068 (0.045)	0.042 (0.050)
Earnings variability	—	0.870*** (0.262)	0.399* (0.212)
Observations	52	76	47
R^2	0.177	0.259	0.292

*Standard errors in parentheses; * p < 0.1, ** p < 0.05, *** p < 0.01*

TO TRANSLATE THE RESULTS OF OUR ECONOMETRIC MODEL INTO AN IMPACT ON BETA AT PR24, WE EXAMINE EVIDENCE ON THE LEVEL OF ASSET GROWTH AND PR24 VERSUS HISTORICAL LEVELS OF ASSET GROWTH.

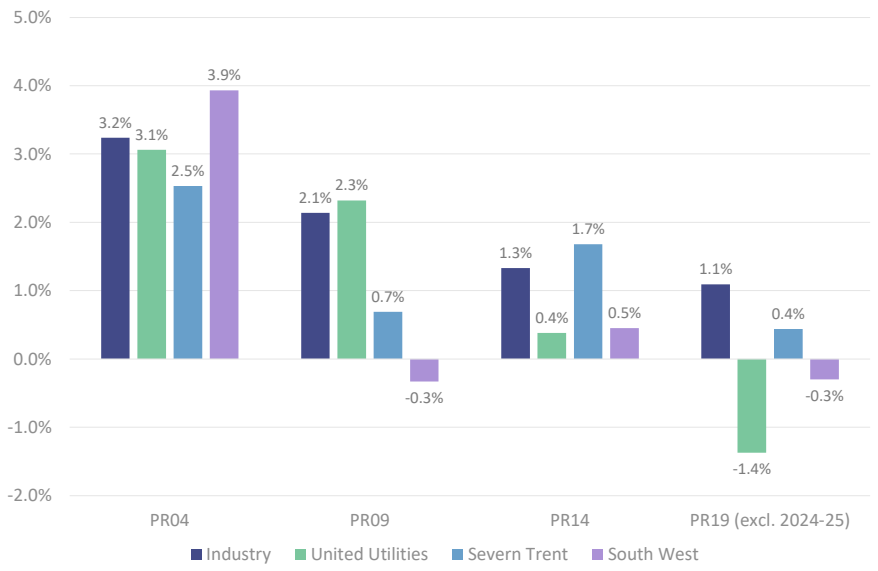
- To determine the implication of our findings for PR24, we first calculate the historical asset growth rate, reflecting a business-as-usual scenario. To do so, as we explain in the subsequent slide, we focus on industry data over a 19-year period from PR04 to the most recent financial year.
- We then calculate asset growth rates for the industry over PR24. This is based on an analysis of companies' business plans and Ofwat's draft determinations.
- Finally, we determine the impact of asset growth on beta at PR24 by applying the coefficient from our econometric model to the difference between future and historical asset growth.



TO ISOLATE THE STEP CHANGE IN INVESTMENT AT PR24, WE HAVE ANALYSED HISTORICAL RCV GROWTH OVER A LONG TIMEFRAME.

- We considered whether to calculate asset growth over the same timeframe as used when estimating beta. There is a risk, however, that doing so would overstate the impact of asset growth on beta. This is because the period since PR14 may represent the bottom of the asset renewal cycle. As we show in the adjacent figure, historical RCV growth was materially higher in PR04 and PR09 than in PR14 and PR19.
- We therefore focus on the 19-year period from PR04 to the most recent financial year. Taking a long-term average avoids measuring changes in reoccurring factors that cause asset growth to fluctuate across price controls, and which would be anticipated by equity investors and therefore be reflected in the historical pricing data used to estimate beta.
- The timeframe is also broadly similar to assumed asset lives in the sector and should therefore capture peaks and troughs over the investment cycle.
- This means that comparing planned asset growth over PR24 with the historical average over a long timeframe will capture asset growth in excess of the 'business-as-usual' asset growth rate. Put another way, this addresses Ofwat's (valid) concern regarding the potential precedent set by any adjustment at this time.

Figure 5: Historical RCV growth since PR04

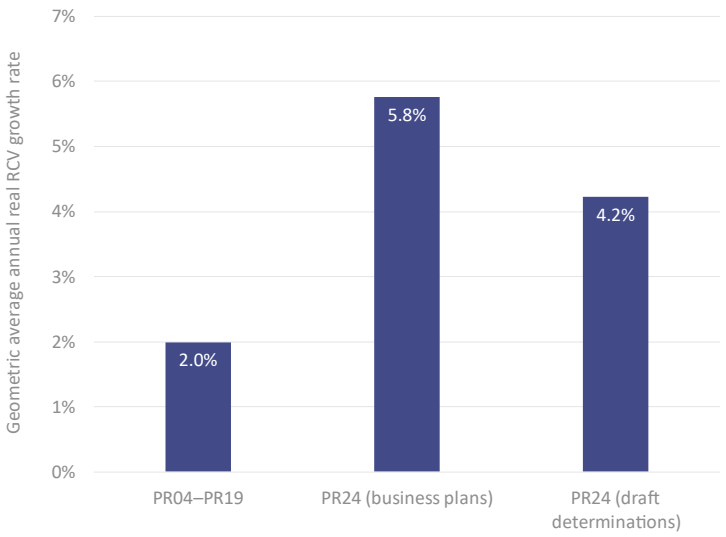


Source: Economic Insight analysis of industry RCV data

OUR ANALYSIS IMPLIES THAT HISTORICAL BETA ESTIMATES SHOULD BE UPLIFTED BY 0.019–0.033 TO REFLECT HIGHER SYSTEMATIC RISK AT PR24.

- From 2005–06 to 2023–24, the industry had an average annual rate of real asset growth of 2.0%. Annual real asset growth set out in business plans is 5.8% across PR24; the draft determinations imply a rate of 4.2%.
- This means that planned annual asset growth will be 2.2%–3.8% higher than in the 'business-as-usual' scenario, based on the historical long-term average.
- Our econometric model implies an increase in beta of 0.0087 for every 1% increase in annual asset growth. This indicates an uplift of 0.019–0.033 across the industry for forward-looking risk.
- KPMG estimated a backwards-looking unlevered beta range of 0.29–0.33 for PR24; Ofwat's draft determinations use a range of 0.26–0.29. Together with the forward-looking uplift calculated above, **this implies an unlevered beta in the range of 0.28–0.35.**

Figure 6: Historical RCV growth (2005–06 to 2023–24) and planned RCV growth at PR24



Source: Economic Insight analysis of industry RCV data

ANNEX A: OVERVIEW OF RELEVANT THEORY

A NUANCED UNDERSTANDING OF SOURCES OF SYSTEMATIC RISK IS REQUIRED IN ORDER TO PROPERLY ADDRESS OFWAT'S CONCERNS REGARDING THEORY.

- As noted in the main body of this report, one of the three reasons identified by Ofwat in its DDs for not making an upwards beta adjustment was due to the regulator not being convinced the relevant theory (as to why beta may be higher at PR24) applies to regulated water companies.
- The scope of this report is focused on the empirical estimation of the relationship between beta and investment, rather than the theory that may explain *why* there is one. Nonetheless, in this annex we briefly expand on why we consider that it would be an overstatement to suggest that there is no theoretical basis to suppose this relationship exists for water companies.
- Focusing on the *'change in mix of activities'* theory, water companies will undertake materially more construction at PR24, relative to the past. This gives rise to two main potential types of risk:
  - (a) delay and delivery risks (which have cost impacts, due to for example, materials storage costs, incurring labour costs for longer etc.); and
  - (b) cost risks (the risk that construction costs vary over time, resulting in variation in company cash flows).
- To determine the extent of systematic risk that arises for water companies under either channel (a) or (b) above, it is necessary to
  - firstly, identify and consider the individual sources of systematic risk at a granular level; and then
  - secondly, assess its relevance to water companies, including by taking into account any mitigating (or accentuating) impacts of the regulatory framework.

THERE EXISTS A BODY OF HIGH-QUALITY STUDIES THAT ALLOW PRECISELY THIS DETAILED UNDERSTNDING OF RISK SOURCES TO BE DEVELOPED.

- It is beyond the scope of this report to address the preceding in detail. However, to indicate what could be done, we note there is a considerable existing theoretical and empirical literature that surveys the main sources of construction delay and cost risk. For example, Xie et al. (2022) identifies 65 common sources of construction cost risk, categorised by: 'project macro' risks; 'project management' risks; and 'stakeholder' risks.*
- Examples of individual risk sources identified by Xie within the above categories include sources that are both idiosyncratic (for example, inadequate cost management and relationship with the labour force) and sources that are systematic (exchange rate movements; input cost variation; interest rates etc.). It is therefore feasible, by drawing on this type of literature, to build up quite a detailed understanding of the specific sources of systematic risk that arise, and which (in principle) apply to water companies. Our preliminary review suggests that a material proportion of delay / delivery and cost related risk sources for construction are systematic in nature and do apply to water companies.
- Following from the above, one then needs to consider the key elements of the regulatory framework that may affect the exposure of regulated companies to the identified risk sources. For example: cost sharing rates; the aggregate sharing mechanism; real price effects; DPC; and PCDs etc. Our preliminary review suggests some elements of regulation do mitigate certain risk sources for water companies (e.g. new real price effects mechanisms for energy and 'materials plant and equipment costs' will somewhat mitigate construction systematic cost risk arising from input cost variation). Other mechanisms will increase systematic risk exposure (e.g. PCDs). However, we have not considered this in detail and here are just illustrating the steps required to thoroughly understand this issue.
- We should further emphasise that the key issue regarding any mitigating / accentuating effects of regulation is changes in the regulatory framework at PR24 relative to the past (because the existing regulatory framework impacts are already captured in the historical beta). Our preliminary review suggests that the overall impact of changes to regulation at PR24 is unlikely to have any large net mitigating effect on exposure to the risk sources identified, and PCDs may result in a net increase in exposure (but this requires more analysis).

'Critical Factors Influencing Cost Overrun in Construction Projects: A Fuzzy Synthetic Evaluation.' Wenwen Xie, Binchao Deng, Yilin Yin Xindong Lv and Zhenhua Deng. Buildings (2022).

ANNEX B: CIRCUMSTANCES IN WHICH BACKWARDS-LOOKING BETA ESTIMATES CAN BE INACCURATE

DESPITE THE EVIDENT NEED FOR A FORWARD-LOOKING VIEW OF RISK, THERE ARE SEVERAL IMPEDIMENTS TO ACHIEVING SUCH A VIEW IN PRACTICE.

Lack of agreed method for incorporating forward-looking risk

- The use of backwards-looking historical share price data is 'bedded in', and its use makes a great deal of sense when the overall level of risk is stable.
- The sector lacks an agreed method for adjusting for different levels of future systematic risk.

Difficulty disentangling backwards- and forward-looking views of risk

- Historical share price data may capture some, but not all, of the anticipated future risk in the sector.
- More recent historical price data may partly reflect the impact of new information about the changing nature of activities in the sector.

Historical data catches up with changes in risk (eventually)

- Historical data may eventually capture the effects of changes in risk, albeit with a lag, assuming the approach to estimating beta is fully consistent across price controls.
- Use of long-run data could also mitigate the impact of cyclical changes in risk profiles.

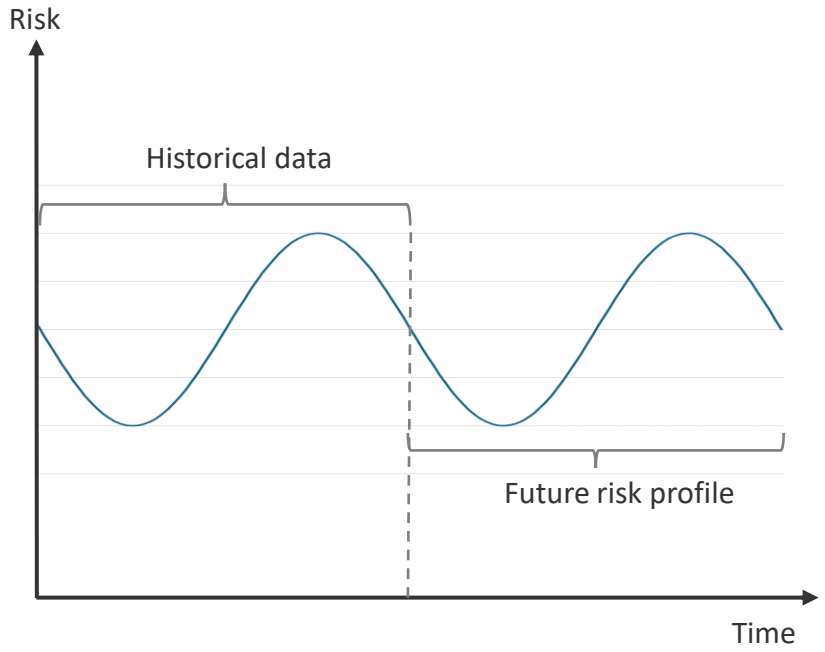
Difficulties with the comparability of other sectors

- Data on beta in other sectors may provide a useful indicator of the impact of higher risk – e.g. construction firm betas may be informative about construction risk.
- However, it is very difficult to ensure betas from other sectors are comparable with the sector of interest.

USE OF BACKWARDS-LOOKING HISTORICAL DATA TO ESTIMATE BETA WILL BE RELIABLE IF MARKET PRICING DURING THE ESTIMATION PERIOD REFLECTED FUTURE RISK.

- The level of systematic risk that companies face varies over time. In addition to external factors such as input costs and regulation, risk varies as companies engage in cycles of asset renewal and enhancement.
- Market pricing at any point in time reflects expectations of future risk. As such, the use of historical data can be accurate when, as in the adjacent figure, these cycles of asset renewal and enhancement are expected to be broadly similar to historical levels.
- The use of backwards-looking historical data is, however, problematic when future risk levels lie outside the historical range of variation. As we show in the next slide, this is the case for PR24.

Figure 7: Stylised example of variation in risk over time

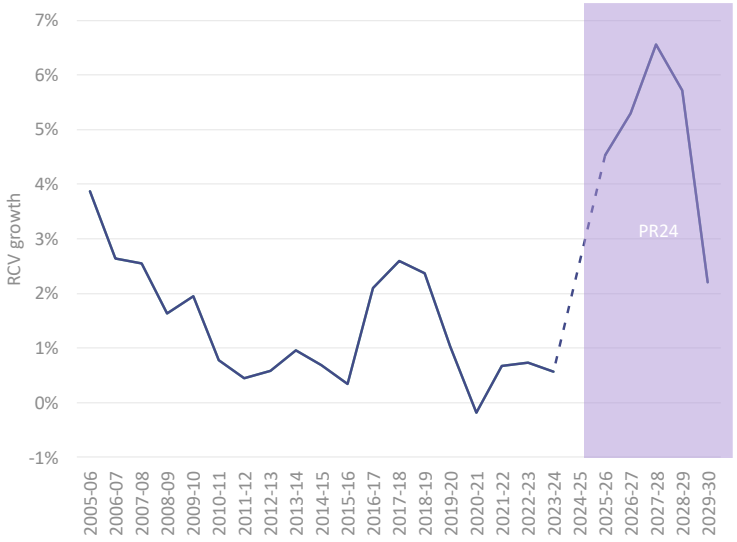


Source: Economic Insight

LISTED WATER COMPANIES SHOW A SIMILAR PATTERN TO THE INDUSTRY AS A WHOLE, WITH RCV GROWTH AT PR24 SIGNIFICANTLY HIGHER THAN HISTORICAL LEVELS.

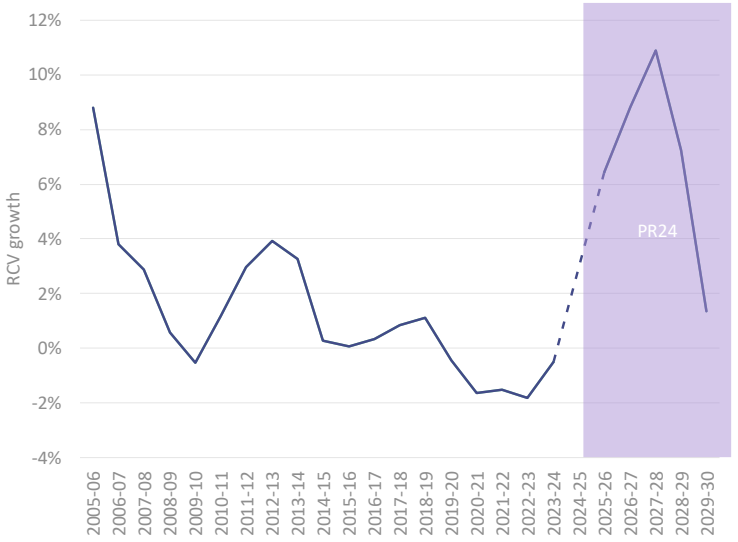
- Listed water companies (Severn Trent and United Utilities) are the main source of evidence on historical beta. As the two figures below show, the same pattern of asset growth observed for the whole industry also applies to Severn Trent and United Utilities. Consequently, backwards-looking estimates based on these two companies are unlikely to provide an accurate reflection of companies' full risk profiles.

Figure 8: SVT RCV growth since PR04 vs PR24 business plans



Source: Economic Insight analysis of Ofwat data and PR24 business plan data tables

Figure 9: UUW RCV growth since PR04 vs PR24 business plans



Source: Economic Insight analysis of Ofwat data and PR24 business plan data tables

Although a backwards-looking approach to beta was adequate for PR19 and PR14, it is unlikely to be sufficient for PR24.

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