The Risk-free Rate
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1. Introduction

Ofwat's draft PR24 methodology consultation document states that Ofwat intends to use index-linked gilt yields as its proxy for the CAPM risk-free rate. Ofwat also notes that converting from an observed RPI real yield to a CPIH-stripped rate of return will be more challenging in PR24 compared to previous price reviews.

This short note discusses the issues that Ofwat will need to confront:

- section 2 focuses directly on the possible ways of calculating the risk-free rate; and
- section 3 looks more generally at the knock-on effects that the risk-free rate selection has on other aspects of the cost of capital calculation.

Drawing on both of these lenses, we question whether it is appropriate for Ofwat to place sole weight on index-linked gilts to the exclusion of other possible proxies for a riskless asset.

2. Calculating the Risk-free Rate

2.1 The issue

Ofwat sets price controls that index in line with CPIH inflation. Companies' RCVs also index with CPIH (with Ofwat transitioning to full CPIH indexation from 1 April 2025). Index-linked gilts, on the other hand, index with RPI inflation. This means that Ofwat has to make an inflation conversion in order to make use of published yield data in its cost of capital computation.

When converting yields on RPI-indexed gilts to a CPIH-stripped risk-free rate, it is important that Ofwat makes accurate allowance for current RPI inflation expectations. Any under- or over-statement of expectations will introduce error into Ofwat's calculation, i.e.:

- if Ofwat understates current RPI expectations, it will under-estimate the all-in, inflation-inclusive return that investors expect to make from index-linked gilts and, hence, also go on to under-estimate the current CPIH-stripped equivalent risk-free rate; but
- if Ofwat overstates current RPI expectations, it will over-estimate the all-in, inflation-inclusive return that investors expect to make from index-linked gilts and, hence, also over-estimate the current CPIH-stripped equivalent risk-free rate.

Importantly, the expectations that matter here are not Ofwat's expectations, companies' expectations or the expectations of any individual forecaster (e.g. the OBR). Rather, if Ofwat is to be able to obtain a genuine market-based estimate of the return that investors are willing to accept on a riskless asset, the conversion out of RPI real yield has to capture the expectations that buyers of index-linked gilts have as they make their purchases.

This has become more complicated in recent years as the RPI measure of inflation has started to become obsolete. An investor that is pricing an index-linked gilt in today's market will be aware, in particular, of the announcement made by the UK Statistics Authority (UKSA) and HM Treasury in November 2020 which stated that the Authority intends that the methodology for calculating RPI will be brought into line with the methodology for calculating CPIH from February

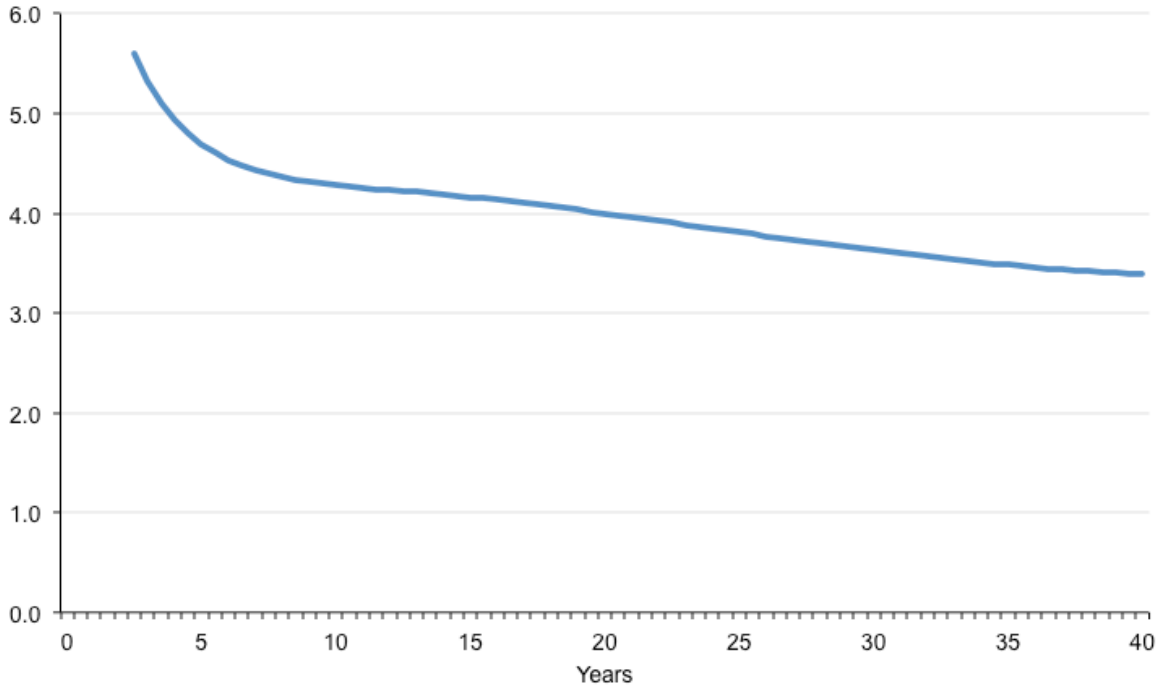
2030.[1] The investor will also be aware that the decision is the subject of an ongoing judicial review and that there has been discontent from pension funds and other investors in response to the government's refusal to compensate holders of RPI-denominated financial instruments.

Given this backdrop, an investor in the index-linked gilt market will have to form expectations not just about the future level of inflation, and the likely readings that the now statistically imprecise RPI will give, but also around the likelihood that the transition to CPIH will actually take place as intended on the timetable that the UKSA has signalled. The prices of index-linked gilts will then incorporate the marginal investor's probability-weighted assumptions about the likely worth of inflation indexation from 2030 onwards.

Ofwat does not have the ability to access prevailing market expectations directly. However, a priori, one would expect buyers and sellers to eliminate arbitrage opportunities so that the yields on nominal gilts equal the yields on index-linked gilts plus expected RPI inflation plus an inflation-risk premium. In principle, therefore, it ought to be possible to gain a good level of insight into investors' assumptions by examining the pricing of index-linked gilts versus the pricing of nominal gilts.

Figure 1 plots the so-called break-even inflation[2] curve as at 1 April 2022.[3]

Figure 1: Difference between the yield on nominal and index-linked gilts (%), 1 April 2022

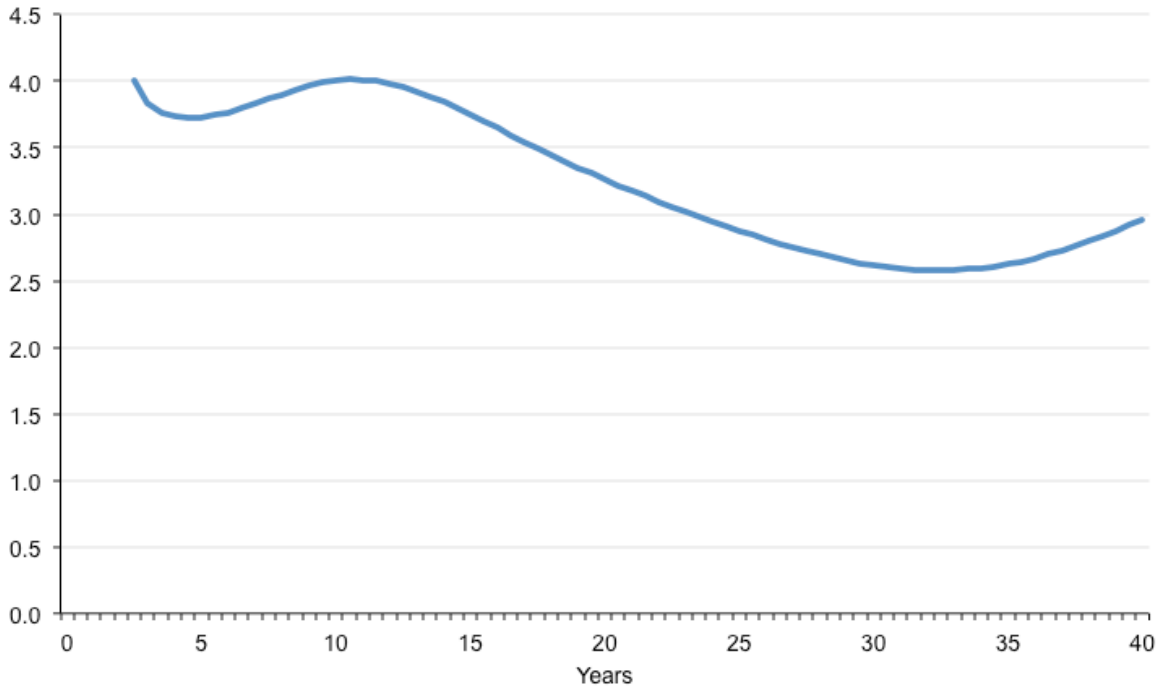


Source: Bank of England website.

[1] UKSA and HM Treasury (2020), A response to the consultation on the reform to Retail Prices Index (RPI) methodology.
[2] Break-even inflation is the average RPI inflation rate that would have to occur over the life of a bond in order for an index-linked gilt to generate the same return to maturity as a conventional gilt with the same tenor.
[3] We choose the date 1 April 2022 to ensure that there is alignment throughout the paper with the timing of the OBR's most recent inflation forecasts which were published at the end of March 2022.

The chart shows a difference of around 4.2 percentage points between 10-year nominal gilt yields and 10-year index-linked gilt yields and a similar 4.0 percentage points difference between 20-year nominal gilt yields and 20-year index-linked gilt yields. In and of themselves, these numbers are hard to interpret at a time of higher-than-usual inflation across the economy. Figure 2 therefore further develops the picture by unpacking the data in figure 1 into an instantaneous forward curve (i.e. a set of estimates of the prevailing rate of inflation at each moment in time over a 40-year horizon).

Figure 2: Instantaneous forward inflation curve (%), 1 April 2022



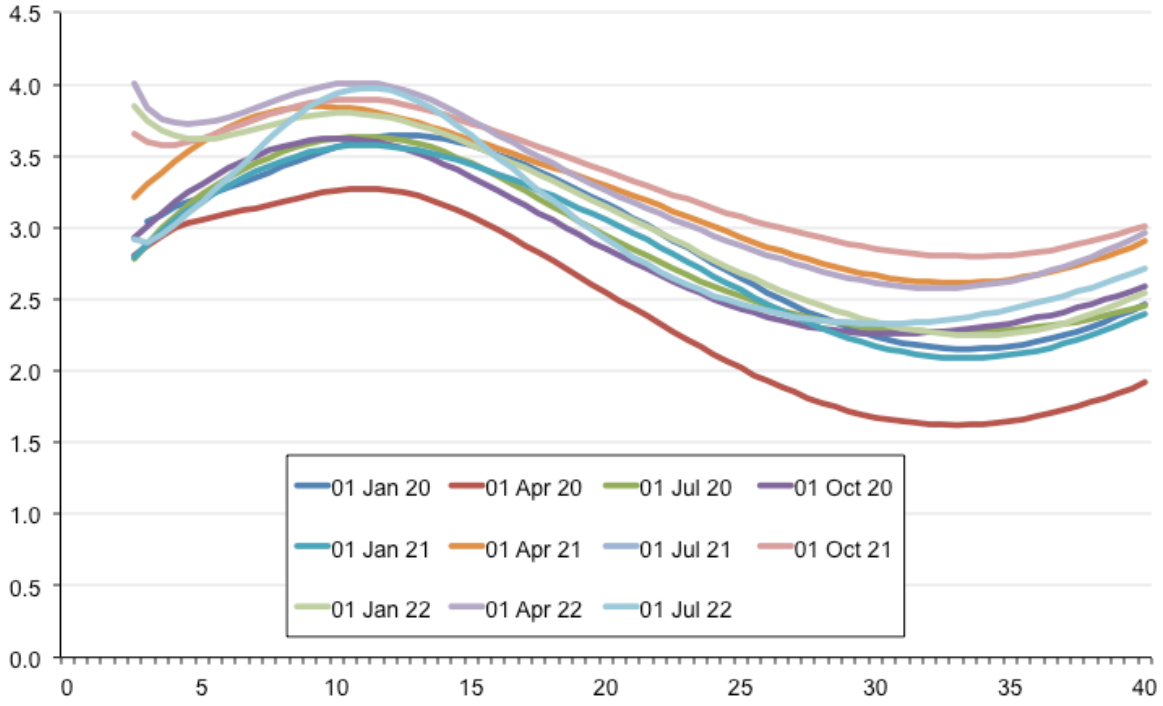
Source: Bank of England website.

The standout feature of this chart is the absence of any sign of a switch in RPI expectations at the point when the UKSA has said it will change its methodology (i.e. roughly year 8 in the chart). The profile of the line is also remarkable as regards both:

- the *level* of break-even inflation during the 2030s – i.e. up to 4% per annum versus the government's CPI inflation target of 2% per annum; and
- the *shape* of the forward curve – i.e. with expectations for inflation apparently increasing up to 2035 then decreasing up to 2050 then increasing again up to the 2060s.

These features of the data are not a new or transitory phenomenon. Figure 3 adds additional lines showing the forward inflation curve at the start of each quarter since the beginning of 2020. In each case, the level and shape of the curves are not dissimilar to figure 2.

Figure 3: Instantaneous forward inflation curve (%), earlier dates



Source: Bank of England website.

By any assessment, therefore, the story that the preceding charts tell is a challenging one. While we are admittedly not able to isolate precise RPI expectations from the above data, at least not without expending a great deal of effort to pin down the value of the (potentially time-varying) inflation-risk premium, it seems abundantly clear that the pricing of the different types of government bonds contains information that Ofwat needs to take account of in its PR24 work.

2.2 Ofwat's proposed approach

Ofwat examined the possible ways of dealing with uncertainty around inflation expectations in its July 2022 PR24 draft methodology consultation. The document states that Ofwat's preferred approach is to use 'Official forecasts' to convert RPI real yields to a CPIH-stripped equivalent. In practical terms, we interpret this to mean that Ofwat intends to:

- convert from RPI real to nominal in accordance with the OBR's RPI forecasts for a period of five years, a 3.0% RPI inflation assumption for the remaining years up to 2029/30, and 2.0% CPIH inflation thereafter; then
- convert from nominal to CPIH real by stripping out the OBR's CPI forecasts for five years and a 2.0% CPIH inflation assumption thereafter.

Table 1 illustrates the application of this approach by calculating the average annual RPI inflation rate that Ofwat's 'Official forecasts' would produce for a 15- and a 20-year period[4] starting 1 April 2022.

[4] This aligns with Ofwat's and the CMA's chosen horizons in PR19.

Table 1: Ofwat's proposed 15-year and 20-year RPI inflation forecasts as at 1 April 2022

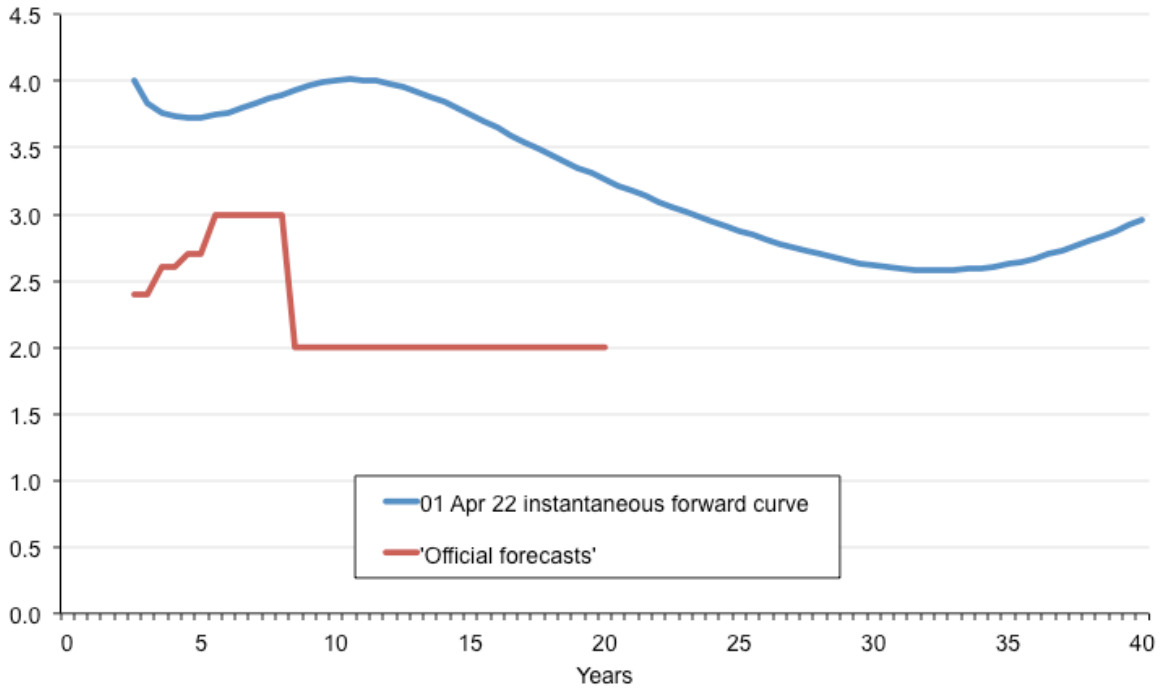
Year	'Official forecast'
2022/23	10.3%
2023/24	3.6%
2024/25	2.4%
2025/26	2.6%
2026/27	2.7%
2027/28 to 2029/30	3.0%
2030/31 onwards	2.0%
15-year average	**2.9%**
20-year average	**2.7%**

Source: OBR, Ofwat and First Economics' calculations.

It is immediately apparent that the inflation projections in the final row of the table fall short of the numbers seen in figure 1. Moreover, the scale of the difference is much larger than can be explained by any economic factor – e.g. the aforementioned inflation-risk premium.

Figure 4 further emphasises this point by superimposing the 'Official forecasts' from table 1 onto the instantaneous forward inflation curve. Again, there is a sizeable, unexplained gap between the two lines throughout the forecast period.

Figure 4: 'Official forecasts' vs instantaneous forward inflation curve (%)



Source: Bank of England website, OBR, Ofwat.

What we interpret figure 4 to be showing is that Ofwat, in effect, is in danger of introducing a significant mismatch between market pricing and regulatory assumptions. In extremis, the risk is that Ofwat will end up imposing its own regulator-created calculation of the all-in inflation

inclusive risk-free rate of return, and hence also the CPIH-stripped equivalent risk-free rate, rather than pick up a properly market-based measure of the prevailing riskless rate of return.

2.3 Conclusions

In our assessment, the picture that figure 4 presents gives Ofwat a serious problem to work through during PR24. We can understand why Ofwat would wish to approach the conversion of yields on index-linked gilts by assessing what expectations a rational investor ought to form about the future worth of RPI inflation indexation upon reviewing official forecasts and official policy statements. However, the evidence set out above indicates clearly that something is happening in the gilt market that is pushing the prices of index-linked and nominal gilts away from what Ofwat would regard as normal economic fundamentals.

The scale of the risks here are not trivial. In table 2 we calculate the value of the risk-free rate using two alternative RPI inflation assumptions, i.e.:

- break-even inflation averaging 3.75% per annum inflation, in line with the numbers in figure 1 less a modest inflation-risk premium; and
- the 'Official forecasts' from table 1.

The calculations show a margin of uncertainty around the risk-free rate computation worth up to 1 percentage point.

Table 2: Possible risk-free rate calculations, 1 April 2022

	Approach 1 **'Official forecasts'**	**Approach 2** **Adjusted break-even inflation**
20-year index-linked gilt yields	-2.15%	-2.15%
RPI inflation adjustment	2.7%	3.75%
CPIH inflation	(2.3%)	(2.3%)
CPIH-stripped real risk-free rate	-1.8%	-0.8%

In these circumstances, we think that it would be prudent for a regulator to look beyond just index-linked gilts to a wider basket of proxies for the riskless assets. We note that this this is not a novel idea – the possible other ways that there are of obtaining estimates of the risk-free rate have been discussed at length over a period of many years due to long-standing concerns about the "specialness" of index-linked gilts compared to other assets.

The most recent, substantive contribution in this area came from the Competition & Markets Authority (CMA) in its PR19 determinations. In its report the CMA identified both a theoretical and a practical rationale for estimating the risk-free rate using basket of assets comprising index-linked gilts and AAA rated non-government bonds. We are aware that Ofwat disagreed/disagrees with some aspects of the CMA's reasoning, but we would suggest that the margin of error in an index-linked gilts only methodology is now far greater than the margin of error that arises from using additional proxies, for the reasons set out in the preceding charts and tables.

3. The Risk-free Rate, Debt Premium, Debt Beta and the Effect of Gearing

We note that a change in Ofwat's proposed approach would also help Ofwat resolve the concerns it identified in its PR24 consultation document about a seemingly counter-intuitive relationship between gearing and the cost of capital.

3.1 The issue

A priori, one would expect to see that the framework that Ofwat uses when calculating the cost of capital ensures that required returns remain broadly constant, at the margin, in the face of fairly modest changes in gearing. Ofwat's draft methodology document highlights that this is not a quality that Ofwat's PR19 calculations exhibit. In table 3 we reproduce Ofwat's analysis of the consequences of varying gearing from 60% down to 54.2%.[5] The final line of the table shows that Ofwat's estimate of the forward-looking WACC (i.e. comprising the cost of equity and the expected cost of new debt only) would have been a counter-intuitive 4 basis points lower at the lower level of gearing.

Table 3: Ofwat's depiction of the PR19 relationship between gearing and the marginal cost of capital

	PR19 final determination	Alternative gearing
Gearing	0.6	0.542
Risk-free rate	-1.39%	-1.39%
Expected market return	6.5%	6.5%
Unlevered beta	0.29	0.29
Debt beta	0.125	0.125
Equity beta	0.71	0.63
Cost of equity	4.19%	3.60%
Expected cost of new debt	0.31%	0.31%
Marginal cost of capital	1.86%	1.82%

Source: Ofwat.

The root cause of the above result is the size of the debt premium (i.e. the premium in the cost of debt vs the risk-free rate) relative to the size of the debt beta. In very simple terms, Ofwat's PR19 calculation of the cost of debt included an element of unexplained cost that does not fit within the standard CAPM framework. If a company were assumed to borrow more, Ofwat implicitly assumes that the company would have more of this additional cost, thus increasing the overall cost of capital. And if a company were assumed to borrow less, the implicit assumption would be that the company would face less of this cost, reducing the cost of capital.

Because Ofwat did not compute a debt premium directly in its PR24 work,[6] we cannot say what the 'additional cost' represents or what it was meant to pay for. One possibility that exists, therefore, is that there was simply an error somewhere within Ofwat's arithmetic and that the resulting scale of the debt premium was an unintentional accident.

[5] 54.2% is the actual historical gearing level of the listed companies that Ofwat used when estimating the PR19 beta.

[6] Ofwat made completely separate calculations of the risk-free rate and the allowed cost of debt without at any point cross-referencing between the different pieces of work.

The analysis that we provided in section 2 of this paper makes this a possibility that is worth taking seriously. If it were the case that Ofwat under-estimated the value of the CPIH-stripped risk-free rate, for the reasons set out in the preceding discussion, we would expect to observe exactly the same kind of out-sized debt premium and consequent counter-intuitive relationship between gearing and the cost of capital that we see in table 3. Table 4 illustrates this point by showing what happens if we increase – or 'correct' – the value of the PR19 risk-free rate by ~70 basis points. The final line of the table shows that the effect of varying gearing from 60% down to 54.2% disappears in this scenario.

Table 4: Alternative estimate of the relationship between gearing and the marginal cost of capital

	PR19 gearing	Alternative gearing
Gearing	0.6	0.542
Risk-free rate	-0.7%	-0.7%
Expected market return	6.5%	6.5%
Unlevered beta	0.29	0.29
Debt beta	0.125	0.125
Equity beta	0.71	0.63
Cost of equity	4.39%	3.86%
Expected cost of new debt	0.31%	0.31%
Forward-looking WACC	1.94%	1.94%

Source: First Economics' calculations.

Further credence for the suspicion that the problem here may lie in the selection of the risk-free rate can be found if we wind the clock forward two and a half years and look at the numbers as at 1 April 2022. Table 5 shows that the difference between the cost of new debt, calculated using Ofwat's PR19 methodology, and Ofwat's preferred estimate of the risk-free rate, calculated using Ofwat's proposed PR24 methodology has widened from 190 basis points to 270 basis points.

Table 5: Debt premium calculation, PR19 vs 1 April 2022

	PR19 final determination	Ofwat 'Official forecasts' approach, 1 April 2022
iBoxx A/BBB 10+ year benchmark (CPIH-stripped)	0.53%	0.9%
Risk-free rate (CPIH-stripped)	-1.39%	-1.8%
Debt premium	1.92%	2.7%

Source: Ofwat, IHS Markit iBoxx website and First Economics' calculations.

If we insert the updated numbers from the final column of table 5 into the PR19 cost of capital calculation, holding all other inputs the same,[7] we find that the effect of varying gearing from 60% to 54.2% has increased to an even more counter-intuitive 9 basis points.

[7] The 'expected cost of new debt' line in table 6 is calculated using Ofwat's formula in which the expected cost of new debt = (1 – probability of default) x iBoxx benchmark cost of debt – probability of default x loss-given default.

Table 6: Up-to-date depiction of the PR19 relationship between gearing and the marginal cost of capital

	PR19 gearing	Alternative gearing
Gearing	0.6	0.542
Risk-free rate	-1.8%	-1.8%
Expected market return	6.5%	6.5%
Unlevered beta	0.29	0.29
Debt beta	0.125	0.125
Equity beta	0.71	0.63
Cost of equity	4.07%	3.46%
Expected cost of new debt	0.7%	0.7%
Forward-looking WACC	2.05%	1.96%

Source: First Economics' calculations.

3.2 Ofwat's proposed approach

Ofwat's reaction to the issues set out above has so far focused on the calculation of the debt beta. Specifically, Ofwat's thesis appears to be that the counter-intuitive relationship shown in table 3 is a consequence of Ofwat under-estimating the debt beta, thus leaving an inexplicably large component of the debt premium as unexplained cost outwith the normal CAPM framework.

Ofwat's proposed fix for PR24, following this diagnosis, is the selection of a higher debt beta. The maths shown in table 7 below, taken from the PR24 methodology document, shows that an increase in the PR19 debt beta from 0.125 to 0.216 restores the expected relationship between gearing and the cost of the capital.

Table 7: Ofwat's proposed solution

	PR19 gearing	Alternative gearing
Gearing	0.6	0.542
Risk-free rate	-1.39%	-1.39%
Expected market return	6.5%	6.5%
Unlevered beta	0.29	0.29
Debt beta	0.216	0.216
Equity beta	0.69	0.63
Cost of equity	4.08%	3.61%
Expected cost of new debt	0.31%	0.31%
Forward-looking WACC	1.82%	1.82%

Source: Ofwat.

What Ofwat does not explicitly say in the draft methodology document is that the subsequent increase that there has been in the differential between Ofwat's preferred estimates of the risk-free rate and the cost of debt since PR19 would require Ofwat to use an even higher debt beta if it were to rerun the same calculation using today's market data. In table 8 we show that the required debt beta as at 1 April 2022 would be 0.30 – i.e. more than double the actual PR19 debt beta.

Table 8: Ofwat's implied solution, 1 April 2022

	PR19 gearing	Alternative gearing
Gearing	0.6	0.542
Risk-free rate	-1.8%	-1.8%
Expected market return	6.5%	6.5%
Unlevered beta	0.29	0.29
Debt beta	0.30	0.30
Equity beta	0.68	0.63
Cost of equity	3.85%	3.46%
Expected cost of new debt	0.7%	0.7%
Forward-looking WACC	1.96%	1.96%

Source: First Economics' calculations.

3.3 Conclusions

A debt beta of 0.216 pushes at the boundaries of plausibility. A debt beta of 0.30 goes well beyond the estimates that one can find in academic literature or in use among practitioners for a modestly geared company with investment-grade debt.

The conclusion that we draw from the preceding analysis is that the problem that Ofwat has identified is not, in fact, likely to be the product of a faulty debt beta selection, but rather it is much more likely to be bound up in the issues that we presented in section 2.

We set out in table 9 two alternative ways of updating the PR19 cost of capital calculation to incorporate data as at 1 April 2022. Both approaches give broadly equivalent estimates of the cost of capital at 60% and 54.2% gearing respectively. But our strong view is that the second set of parameters is a much more coherent representation of the prevailing debt premium paid by companies and the prevailing debt beta, each of which is in turn anchored by a much more realistic characterisation of the prevailing risk-free rate of return.

Table 9: Alternative updates to the PR19 cost of capital calculation

	Ofwat – high debt beta		Alternative risk-free rate	
Gearing	0.6	0.542	0.6	0.542
Risk-free rate	-1.8%	-1.8%	-0.8%	-0.8%
Expected market return	6.5%	6.5%	6.5%	6.5%
Unlevered beta	0.29	0.29	0.29	0.29
Debt beta	0.30	0.30	0.125	0.125
Equity beta	0.68	0.63	0.71	0.63
Cost of equity	3.85%	3.46%	4.36%	3.82%
Expected cost of new debt	0.7%	0.7%	0.7%	0.7%
Forward-looking WACC	1.96%	1.96%	2.16%	2.13%

Source: Ofwat, First Economics' calculations.

Our recommendation to Ofwat is that it can give greater weight to this alternative perspective when calculating the PR24 cost of capital.

Information sources

Bank of England yield curve data:

https://www.bankofengland.co.uk/statistics/yield-curves

OBR economic forecasts:

https://obr.uk/efo/economic-and-fiscal-outlook-march-2022/

IHS Markit iBoxx bond yield indices:

https://ihsmarkit.com/products/iboxx.html

Ofwat PR19 draft methodology consultation:

https://www.ofwat.gov.uk/wp-content/uploads/2022/06/Appendix-11-Allowed-return-on-capital-appendix.pdf