A Note for Ofwat on what the cost of debt means for the cost of equity

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1. Background and summary

1.1. We have been asked by Ofwat to look into two questions:

1.1.1. Are companies measuring the gap between the allowed CoE and cost of new debt accurately?
1.1.2. Are companies' arguments in favour of a minimum buffer between allowed CoE and new debt benchmarks based on sound analysis and do they represent a correct interpretation of financial theory?

1.2. These questions arise out of two Reports:

- *Inference analysis as a cross-check on allowed returns at PR24*, September 2023, prepared by KPMG. The core of this report uses an empirical implementation of Merton's (1974)[1] model to estimated expected excess returns on equity.
- *Cost of capital for PR24: Final report for South West Water*, 25 August 2023, prepared by Oxera. The main argument in this report involves the Asset Risk Premium to Debt Risk Premium (ARP-DRP) framework.

1.3. While the Reports differ in their approach, they have the common theme of using estimates of the cost of new debt to make inferences about the cost of equity. In principle, this is a reasonable thing to do.[2] The issue is how, in practice, the inference is made (although there are some in-principle points that we also consider).

1.4. As we will argue, we do not think that either approach deals sufficiently with some serious empirical questions. The KMPG approach suggests the highly novel

[1] Merton, R. C. (1974). "On the pricing of corporate debt: The risk structure of interest rates." *The Journal of Finance*, 29(2), 449-470. https://doi.org/10.2307/2978814.

[2] As the CMA noted, "this type of comparison is intuitively appealing and may provide a useful cross-check": §6.259 of the CMA's H7 Heathrow Airport Licence modification appeals, Final Determination, available at https://assets.publishing.service.gov.uk/media/652fe1e4d06662000d1b7cc0/3_H7_Appeal_Final_Determinations_Non-Sensitive.pdf.

approach of stepping away from standard asset pricing models, and using estimates of the equity-debt elasticity and the cost of debt, to price equity. While KPMG claims that this follows the approach developed in the academic literature, it is in fact quite different from it (as we will show). Furthermore, the estimates involved in KPMG's analysis have very low statistical significance. In the round, therefore, we find that little weight, if any, can be placed on their resulting calculations of the cost of equity.

1.5. Oxera's ARP-DRP framework has the advantage of simplicity, but it is critically reliant on being able to estimate a small number of data points to support an extrapolation well away from observed data (to estimate the cost of debt for a firm with 100% gearing). We will show that there is considerable uncertainty about those data points, and therefore a wide range of possible end points to the extrapolation. We also provide a more in-principle objection to the framework: it relies on a convexity assumption that does not hold in general.

1.6. Two other points will feature throughout our assessment of these two Reports. First, both the KPMG and Oxera approaches rely on the notion that there is a stable relationship between the cost of debt and the cost of equity.[3] As we will note in the next Section, there is little empirical evidence that this is the case. Secondly, both approaches rely on the implicit assumption that the part of the credit spread that is not explained by observable default risk *must* be due to a large debt premium. There are equally valid arguments, however—consistent with the logic of past submissions by the regulated companies—that the debt premium is, in fact, small.

2. Context

The relationship between equity and debt

2.1. The KPMG and Oxera Reports, while having the common theme of making inferences about the cost of equity from the cost of debt, differ in their approach. KPMG use the cost of debt (and an estimated elasticity) to estimate the cost of equity directly; Oxera estimate a lower bound on the cost of equity, using the cost of debt and other estimated parameters.

2.2. The rationale for the KPMG approach is novel, and with the (as it turns out, we argue, superficial) attraction of simplicity. It bypasses asset pricing models entirely, by assuming that the estimated equity premium is simply a scaling of the debt premium.

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[3] For example, Oxera state on p. 38 of their Report, "… it is visible that for both our scenarios and the Ofwat PR24 ones the ARP-DRP differential is significantly lower compared to the level in the PR19 decisions. This represent [sic] a significant narrowing in the risk premium on equity relative to the risk premium on debt."

2.3. The rationale for the Oxera approach is as follows. Structural models following Merton (1974) imply that the market price of risk must be the same for all contingent claims written on a firm's assets, and so equity and debt risk premia should be related. In terms of a lower bound (Oxera's argument): the cost of equity must be greater than the cost of debt, given the seniority of debt in the hierarchy of claims on a firm's assets—hence it is reasonable to argue that the cost of debt, if it can be correctly measured, can give a lower bound to the cost of equity.

2.4. Clearly both approaches rely on being able to measure accurately the expected return on debt. This is less straightforward than either report implies. It is well-known that the observed cost of debt is not equal to the expected return on debt. At the very least, there has to be an adjustment for the expected loss in the event of default—something which, in fairness to both the KPMG and Oxera Reports, they do. The pricing of the risk of default is, however, a long-standing empirical puzzle in finance, since observed credit spreads appear hard to explain in terms of any combination of observed frequency of default and plausible risk premia. In short, spreads are typically too high.[4]

2.5. Two empirical questions arise immediately from these observations. The first is: how good (tight) a lower bound can reasonably be inferred from the observed cost of debt? This is, of course, critically important when trying to estimate a lower bound, especially given strong incentives the companies have to make the lower bound as high as possible. (We return to this question when evaluating Oxera's argument.) The second question is: quantitatively, how close and stable is the link between equity and debt risk premia?

2.6. At the aggregate level, Damodaran (2023)[5] looks at the historical (longitudinal) relationship between the equity risk premium—estimated using his "implied" approach, a variant of a dividend discount model—and the corporate default spread. He uses US data: the implied ERP is based on the S&P 500 Index; and the default spread is the difference between the interest rate on Baa-rated US corporate bonds and the 10-year US treasury bond rate. (Note that this spread does not adjust for expected default loss, and so it is an estimate of the debt risk premium rather than the expected return on debt.)

[4] See, for example, Huang, Jing-Zhi and Ming Huang (2012). "How Much of the Corporate-Treasury Yield Spread Is Due to Credit Risk?". *The Review of Asset Pricing Studies*, 2(2), pp. 153–202 https://doi.org/10.1093/rapstu/ras011; and Huang, J. Z. and Z. Shi (2021). "What do we know about corporate bond returns?" *Annual Review of Financial Economics*, 13, 363-399, https://doi.org/10.1146/annurev-financial-110118-123129.

[5] Damodaran, Aswath, (March 23, 2023). "Equity Risk Premiums (ERP): Determinants, Estimation and Implications - The 2023 Edition". Available at SSRN: https://ssrn.com/abstract=4398884 or http://dx.doi.org/10.2139/ssrn.4398884.

2.7. The next two Figures show the data (derived from Figure 16 in Damadoran, 2023). Figure 2 shows the levels of the ERP and default spread; Figure 3 shows the ratio of the two (the red line shows the average ratio of 2.26 over the period); both for the period 1960-2022.

Figure 2: the estimated equity risk premium and the default spread, taken from Damadoran (2023)

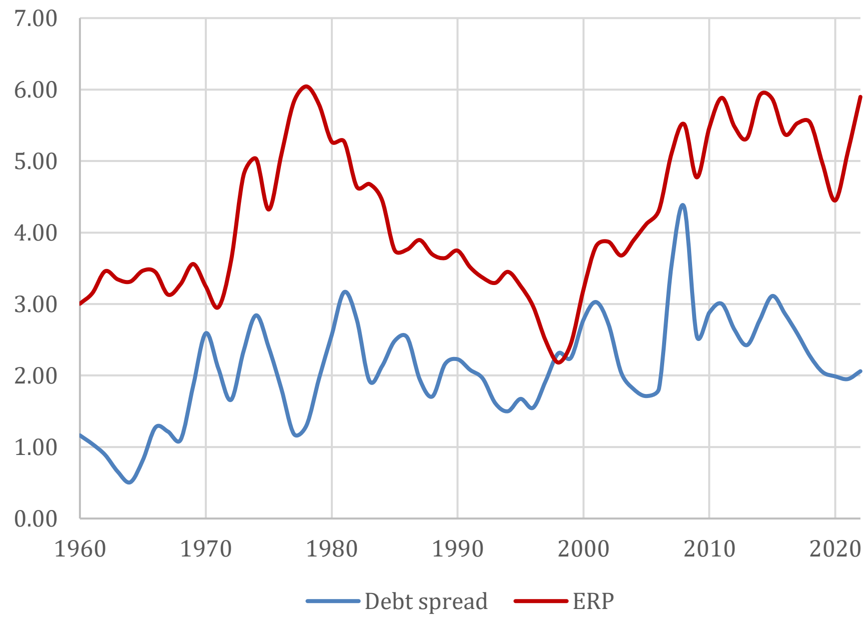
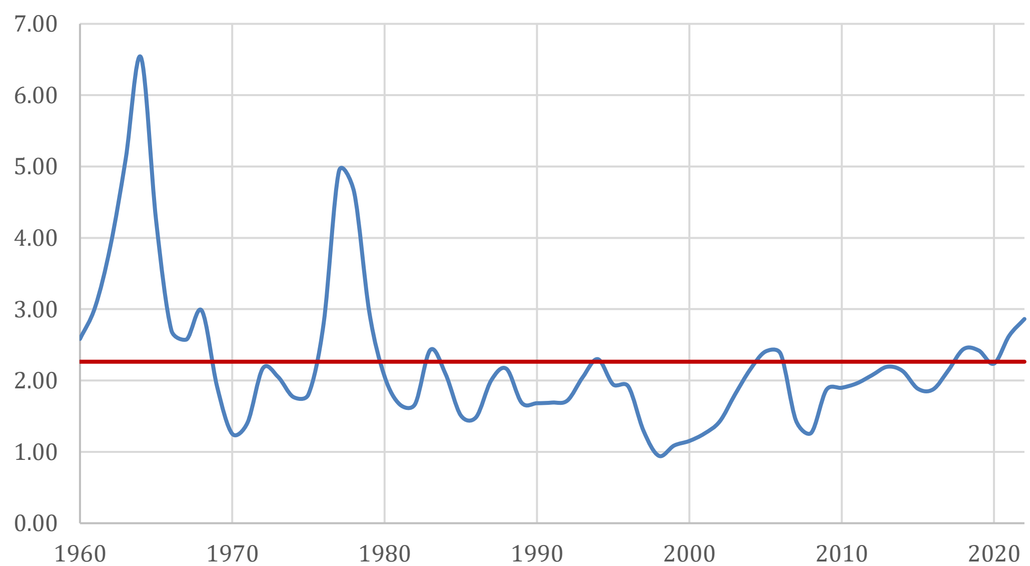


Figure 3: the ratio of the estimated equity risk premium to the default spread, taken from Damadoran (2023)



2.8. A few things are striking from these Figures. First, there is considerable variability: the ratio of Damodaran's ERP to the default spread ranges from just under 1 (in 1998, during the Asian financial crisis) to over 6 (in 1964: and in general, the ratio is high throughout most of the 1960s). Secondly, the ratio has been below the 60-year average for most of the last four decades, but more recently has increased above the long-run average. Thirdly, the default spread has greater variation than the equity risk premium during the two decades at the start and the end of the period—a fact consistent with the results in Jordà et al. (2019)[6]—and hence plays the greater role in the variation of the ratio.

2.9. At the level of individual firms, the evidence is predominantly cross-sectional, rather than longitudinal. Schaefer and Strebulaev (2008)[7] find a positive relationship between the excess returns on a firm's corporate bonds and the excess return on its equity. In particular, they find that the elasticity of the value of debt to equity (the hedge ratio in the Merton model, and related to the elasticity estimated in the KPMG report) is helpful in explaining co-movements between equity and bond returns. They also find, however, that the effect is weakest, in terms of both magnitude and statistical significance, for the highest-rated (AAA) bonds, becoming stronger for lower-grade (i.e., more equity-like) bonds. Friewald, Wagner and Zechner (2014)[8] look at the cross-sectional relation between firms' stock returns and credit market-implied risk premia, for a total of 491 US firms over the period from January 2001 to April 2010. They find a strong and positive relationship, with firms' stock returns increasing with credit risk premia. They find that various firm-specific characteristics matter for the strength of the relationship.

2.10. In contrast, van Zundert and Driessen (2022)[9] compare bond-implied expected equity returns to realized equity returns. They construct bond-implied expected equity returns in much the same way as we will review shortly when assessing KPMG's Report i.e., using estimates of equity-bond elasticities. They find a strong *negative* relation between them: firms with high bond-implied expected equity returns[10] have low average equity returns, and vice versa. The same sort of

[6] Jordà, Òscar, Katharina Knoll, Dmitry Kuvshinov, Moritz Schularick and Alan M Taylor (2019). "The Rate of Return on Everything, 1870–2015." *The Quarterly Journal of Economics*, 134(3), 1225–1298, https://doi.org/10.1093/qje/qjz012.

[7] Schaefer, Stephen M. and Ilya A. Strebulaev (2018). "Structural models of credit risk are useful: Evidence from hedge ratios on corporate bonds." *Journal of Financial Economics,* 90(1), 1-19, https://doi.org/10.1016/j.jfineco.2007.10.006.

[8] Friewald, Nils, Christian Wagner, and Josef Zechner (2014). "The cross-section of credit risk premia and equity returns." *The Journal of Finance,* 69(6), 2419-2469.

[9] van Zundert, Jeroen and Joost Driessen, (2022). "Stocks versus corporate bonds: A cross-sectional puzzle." *Journal of Banking & Finance,* April, 137, 106447. https://doi.org/10.1016/j.jbankfin.2022.106447.

[10] I.e., those with a high bond return and/or a high elasticity equity-bond elasticity.

result arises, in the opposite direction, in Chen, Chen and Li (2023)[11]. They find a negative relationship between equity-implied credit spreads that they estimate, and actual credit spreads.

2.11. This rather mixed picture points to the complex empirical relationship between equity and debt (excess) returns. Most, but not all, of the evidence points to a positive relationship, consistent with theory; but most of the evidence also points to the relationship being variable across time and between firms (and much more variable than e.g., Merton would imply).

The regulatory contract

2.12. Before we get into the details of the two Reports, it is also worth stepping back and reflecting on the broad context of how utilities regulation has worked over the last 20 years or more. As the CMA has noted[12], and as commented on by Hoon and Earwaker[13], it is not especially surprising that the gap between the assumed costs of equity and debt is smaller when an extended period of low interest rates is followed by a period in which interest rates rise sharply.

2.13. This obviously follows from the mechanics of UK regulatory determinations over the last 20 years or so: the cost of equity is derived from the CAPM where the total market return is estimated from a very long-run of data; and the cost of new debt taken from market observations. The mechanics naturally smooth out variations in the cost of equity, on the presumption that the allowed return on equity will over the long run be very close to the actual cost of equity.

2.14. Within this process, there is a clear danger in an asymmetric argument that seeks to increase the allowed return on equity when the perceived gap between the costs of equity and debt is small; but does not seek to *decrease* the allowed return on equity when that gap is large.

[11] Chen, Hui and Chen, Zhiyao and Li, Jun, (2023). "The Debt-Equity Spread". Available at SSRN: https://ssrn.com/abstract=3944082 or http://dx.doi.org/10.2139/ssrn.3944082.

[12] See §6.272 of the CMA's H7 Heathrow Airport Licence modification appeals, Final Determination, op. cit..

[13] See https://www.linkedin.com/posts/john-earwaker-6a457a30_the-h7-price-control-appeal-activity-7131184649615151104-u7pL, last accessed on 10 January 2024.

3. The KPMG report on Inference analysis

3.1. KPMG base their approach on the paper by Campello, Chen and Zhang (2008; CCZ)[14]. KPMG's approach involves deriving an "inferred" CoE in four broad steps.

3.1.1. Estimate excess returns on debt.
3.1.2. Regress observed elasticities (of firms' equity values with respect to their bond values) against independent variables for non-financial and non-AIM listed companies on the London Stock Exchange.
3.1.3. Apply the regression equation to data from Severn Trent and United Utilities to predict elasticities for these two water firms.
3.1.4. From the product of the first two steps, estimate the nominal cost of equity (by adding yields on the 20-year nominal gilt); and then the real cost of equity (by deflating via a 20-year CPI swap rate). Implicitly this last stage of their approach takes the predicted elasticity as a known constant.

3.2. It is not always straightforward to assess each step separately, since in places, too few details are given. This is a real deficiency of the work as it is presented: for this to be a valid cross-check on the cost of equity, there has to be transparency and replicability, in order for regulatory decisions to be defensible (to use the term that we employed in the UKRN 2018 report).

3.3. To illustrate the difficulties, consider the key results shown in their Table 6, replicated below:

	Cut-off date	Inferred CoE	CAPM-derived CoE	Differential between inferred CoE and current debt pricing	Differential between CAPM-derived CoE and current debt pricing
PR19 CMA FD	31/12/2020	2.62-4.50	4.15[15]	2.91-4.59	3.96
PR24 FM	30/09/2022	5.35-6.91	4.14	3.31-3.64	0.86
PR24 FM (updated for -June 2023)	30/06/2023	5.71-5.78	4.36	2.09-2.49	0.54

[14] Campello, M., L. Chen, and L. Zhang (2008). "Expected returns, yield spreads, and asset pricing tests." *The Review of Financial Studies*, 21(3), 1297-1338. https://doi.org/10.1093/rfs/hhn011.

[15] This figure does not appear in the accompanying spreadsheet showing KPMG's analysis: it should be either 4.48% (without aiming up) or 4.73% (with aiming up).

3.4. There should be consistency between the final two columns, presenting differentials between current debt pricing and either the inferred CoE, or the CAPM-derived CoE. But there is not. To illustrate, consider the final row: PR24 FM (updated for June 2023). Since the CAPM-derived CoE is 4.36%, and the differential is 0.54%, the implied current debt price is 4.36-0.54 = 3.82%. With this current debt price, and the range given for the inferred CoE, however, the differential between the inferred CoE and the debt price would be 1.89-1.96%: not the range 2.09-2.49% that is stated. This problem runs throughout this Table, as well as the more detailed Table 7 in Appendix 2 of the Report.

3.5. The discrepancies could well be explained by how inflation is treated in the estimations/calculations (see e.g., discussion on p. 28 of the Report). Without further detail, however, it is impossible to tell. In short, KPMG's Report is still opaque at important points, even with the accompanying spreadsheet. This makes it quite unsuitable for regulatory purposes.

3.6. Despite these limitations, we will attempt to analyse the separate steps. Before we do, it is worth stepping back and reflecting on what the original CCZ—KPMG's starting point—was intended to do.

The overall approach

3.7. CCZ's stated purpose is to move away from using *ex post* equity returns as a proxy for *ex ante* expected equity returns in asset pricing models. Specifically, they run Fama and French multi-factor models on data where expected equity returns are estimated using their elasticity approach. (The approach is described further below.) For example, on p. 1298 of their paper, they state "Because most results in the empirical asset pricing literature have been established using averaged realized returns, it is natural to ask whether extant inferences about risk-return trade-offs hold under alternative measures of expected returns". (They go on to find e.g., that "the market beta plays a much more important role in the cross section of expected returns than previously reported": see p. 1331.)

3.8. Why do CCZ not use their approach directly as an asset pricing model? Although they do not report the R^2 of their elasticity regression (see p. 1313),[16] they do state: "From the f-statistics, the slopes [i.e., the regression coefficients] are estimated reasonably precisely. Given the low R^2, however, our expected-return measure allows for quite a bit of noise." They go on to say "the use of our measure in standard asset pricing tests dramatically increases cross-sectional R^2s compared to the traditional practice of using realized returns." It is reasonable to infer from this that, despite good statistical significance of the explanatory variables, a more standard factor-based asset pricing model does a better job of explaining variation in equity excess returns. This is, presumably,

[16] We have searched the working papers leading up to the published paper; they do not report the R^2 either.

why CCZ then go on to estimate Fama-French and Fama-MacBeth asset pricing models (in Section 4 of their paper).

3.9. This is not what KMPG do. They use CCZ's method *to replace an asset pricing model*. Specifically, they estimate an average elasticity; and apply this to an average cost of debt (actually, an average bond excess return) to calculate an average cost of equity (an average equity excess return). This is in contrast to the rest of the academic literature, including CCZ, which treats elasticities as an intermediate step to be used subsequently in an asset pricing model. As van Zundert and Driessen (2022), who also use the CCZ approach, state: "We do not aim to explain the level of bond-implied expected returns, nor the level of realized average equity returns. For such an analysis, one would need to assume an asset pricing model and see if observed risk premiums are in line with the model predictions." KPMG depart from the standard approach in using elasticities estimation directly to estimate the cost of equity.

3.10. As will be seen below, this non-standard approach is further undermined by the poor statistical performance of KPMG's regressions, which in turn appear to follow from the distinctly odd statistical properties of their estimated elasticity. These problems are clearly anticipated in CCZ's original work. We address some of these concerns in an appendix.

Step 1: estimation of excess returns on debt

3.11. What is needed for this first step is the excess return on debt for each firm. As we note above, this is a common element in both KPMG's and Oxera's approaches; hence some of our concerns expressed here are relevant to both.

3.12. KPMG's approach is to (i) take the nominal yield on the benchmark index, and (ii) adjust this (downwards) by subtracting an expected default loss rate. The latter is taken as the product of a 0.24% annualised default rate (an average for A/BBB corporate issuers) and a non-recovery rate for senior unsecured bonds of 62.3%, taken from a Moody 2023 default study. KPMG therefore calculate the debt loss rate to be $0.24 \times 0.623 = 0.15$. (This is in line with e.g., estimates in UKRN 2018.)

3.13. The debt risk premium derived by this method is necessarily a generic one for investment-grade companies. In particular, the debt risk premia for the two specific firms of Severn Trent (SVE) and United Utilities (UUW) are derived from the generic (iBoxx A/BBB) index. In contrast, CCZ derive firm-specific bond excess returns (while using generic data for some of the components) by using the much richer Lehman Brothers Fixed Income dataset, which provides detailed monthly information on corporate bonds including price, yield, coupon, maturity, modified duration, and convexity. This dataset covers the period January 1973 to March 1998, and 1205 non-financial firms. The firm-specific approach is simply not available to KPMG, because of data limitations: in that sense, this is not a criticism. But data limitations lead to analytical limitations.

3.14. How large are these limitations? We note from Ofwat's latest financial resilience report[17] that the indicative weighted average interest rates of Severn Trent (SVE) and United Utilities (UUW), as at 31 March 2023, are quite different: less than 7%, and more than 8% respectively. This is with broadly similar maturities, but with UUW have somewhat higher regulatory gearing. It is worth noting that the previous year's figures were more similar: 5.3% for SVE, and 5.9% for UUW. Inflation appears to be having an effect, given the use of index-linked debt by these two firms. Our point here, however, is that there appears to be a non-trivial difference in the cost of debt for SVE and UUW; this fact should not be affected by the common inflation rate.

3.15. Hence there is evidence that there are significant differences in firm-specific bond credit spreads. It is not straightforward to assess what effect this has on KPMG's analysis. Indeed, there is an argument that it leads to estimates of elasticities that are lower than would be the case without this mismeasurement of bond excess returns. Our main point at this stage is that this issue should have been identified and discussed in the KPMG analysis, in the spirit of being clear about limitations.

3.16. But we should also bear in mind the broader concerns expressed earlier, that a longstanding literature has failed to explain the size of the credit spread. While the large inexplicable component *could* be due to an equivalent large difference in expected returns, a range of other explanations have been offered in the literature—most notably the distinctly thin market for many corporate bonds, resulting in credit spreads that my reflect an illiquidity premium and/or large bid-ask spreads. It is indeed striking that one of the limitations in the estimation of elasticities (Stage 2, below) is the absence of regular quoted prices for the two companies studied, in stark contrast to their stock prices. We note in our concluding remarks that if these factors are driving credit spreads, rather than expected returns, then very much lower estimates of the debt premium are not implausible.

Step 2: estimation of elasticities

3.17. There are two parts to this step. The first is to regress "out-turn" elasticities against a set of independent variables for a broad set of firms listed on the London Stock Exchange. In this first part, "out-turn" elasticities are calculated as the percentage change in the market value of equity divided by the percentage change in the market value of debt.[18] (The latter is calculated by scaling the book

[17] Available at https://www.ofwat.gov.uk/wp-content/uploads/2023/10/The-Monitoring-Financial-Resilience-Report-2022-23.pdf.

[18] We discuss the distinctly odd statistical features of these elasticities in an appendix.

value of debt using the weighted average bond market price.[19]) The regression equation is

$$\eta_{it} = \alpha_i + \beta_{lev} Leverage_{it} + \beta_{vol} Volatility_{it} + \beta_{rf} r_{f_t} + \epsilon_{it},$$

where (a) η_{it} is the elasticity for firm *i* at time *t*; (b) leverage is measured as the ratio of market value of debt to market value of equity, where market value of debt is obtained by scaling the book value of debt by the weighted-average bond market price;[20] (c) volatility is based on the 180-day daily stock return volatility. The daily stock return is calculated as the daily percentage change in the Total Return Index (TRI); (d) the risk-free rate is measured based on the yields on the 20-year nominal gilt; and (e) α_i is a firm-level fixed effect. The βs are regression coefficients on the independent variables in equation.

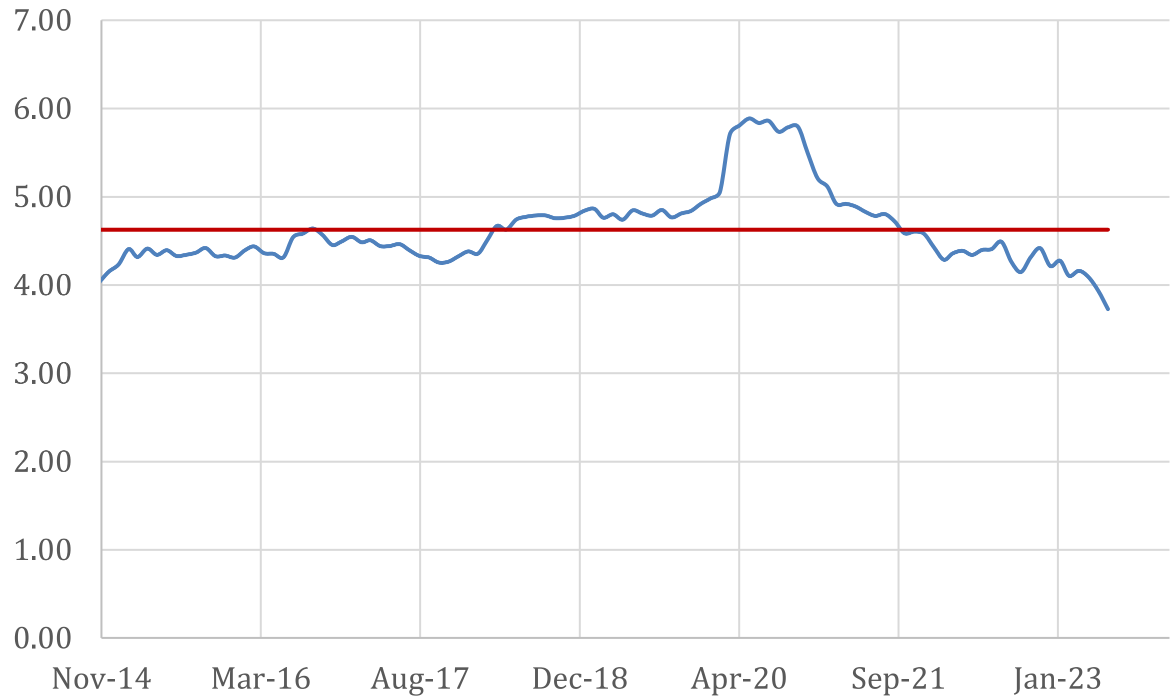
3.18. In the second part, the regression coefficients from this exercise are used to give point predictions for the elasticities of SVE and UUW. The resulting predicted elasticities, averaged across SVE and UUW, are shown in Figure 13 of the KPMG report, reproduced as Figure 4 below. The average value across the period, shown in red, is 4.63. The Report states "apart from a temporary spike during the height of the Covid19 pandemic in 2020, elasticity remained broadly stable until 2022 where it experienced a modest decrease" (p. 30).

3.19. This claim is subject to a major caveat. The stability to which KPMG refer is the stability of the *predicted* elasticity, not the actual elasticity. In the limiting case of a regression with absolutely no predictive power, the predicted value of the dependent variable will simply be its sample mean, which is indeed constant. But this does not provide much reassurance. And it turns out that this is indeed very close to being the case for KPMG's regressions.

[19] Note that, since the bond price is an index, this measure of market value cannot be directly compared with book values. However, given the availability of yield data both for company bonds and the index, a direct measure of market value could have been constructed, which would have been a useful cross-check, but KPMG do not attempt to do so.

[20] This approach leads to some oddities. For example, leverage for both UUW and SVE is greater than 100% under this measure.

Figure 4: Expected elasticity for SVE/UUW (average), taken from KPMG Figure 13



3.20. Further interrogation of these results hits the problem that so little detail is given in the KPMG Report. Instead, it is necessary to re-run the accompanying Stata files, from which the following output can be obtained:

Table 1: Detailed regression results for the KPMG analysis, using KPMG data and Stata files

	Coefficient	Std. err.	t	P > |t|	95% conf. interval	
market_leverage	0.0955	0.5408	0.18	0.860	-0.9646	1.1556
volatilities	91.3922	48.0595	1.90	0.057	-2.8142	185.5986
rfr	-0.2990	0.3819	-0.78	0.434	-1.0476	0.4496

R-squared: Within = 0.0007; Between = 0.0514; Overall = 0.0015.
F test that all u_i=0: F(189, 9870) = 1.42; Prob > F = 0.0002.

3.21. As the KPMG Report states, the three independent variables are jointly statistically significant to a high degree of confidence. Individual statistical significance is less impressive, however; market leverage and the risk-free rate have particularly high standard errors, with the constant term being the only variable individually passing standard thresholds for significance (of absolute t-values greater than 1.96, or P values less than 0.05, for 95% statistical significance). The R-squared of the whole equation is very low. Given the poor statistical performance of the equation, we have not calculated confidence intervals for the predicted values of the elasticities of SVE and UUW. But it is clear that they will be very wide indeed.

3.22. The claim of stability encounters a second issue. Unlike CCZ, the KPMG report includes firm-level fixed effects in the elasticity regression; CCZ use a pooled regression. The fixed effects, while statistically significant, make a material difference to elasticity estimates. There are two aspects to this. First, as Figures 5 and 6 below show, the fixed-effect coefficients are dominant in determining estimated elasticities. Both Figures show the composition of the estimated elasticities for June 2023. (The same pattern holds throughout the sample period.) For example, for SVE, market leverage contributes 0.09; volatility 1.09; the risk-free rate -1.35; and the constant fixed effect 4.25. Adding these components together gives SVE's overall elasticity estimate for June 2023 of 4.09. The same holds for UUW. The claim of stability, therefore, relies very heavily on the estimates of fixed effects. Indeed, to a quite close approximation: since the impact of the regressors roughly cancel out, the estimates *are* the fixed effects.

Figure 5: The components of KPMG's estimate of SVE's elasticity in June 2023

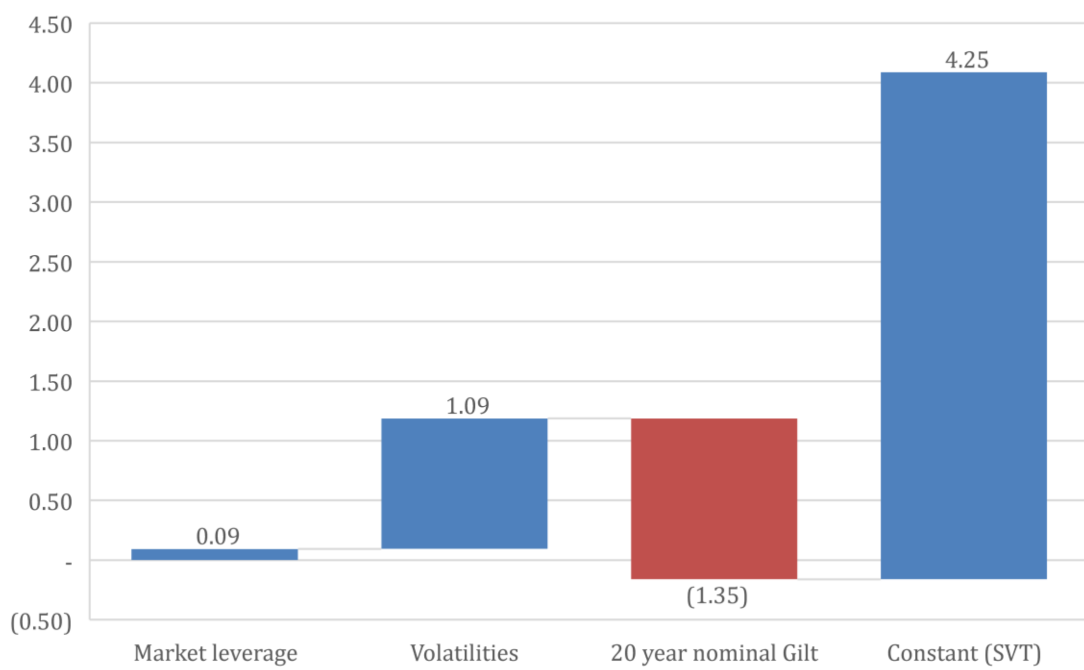
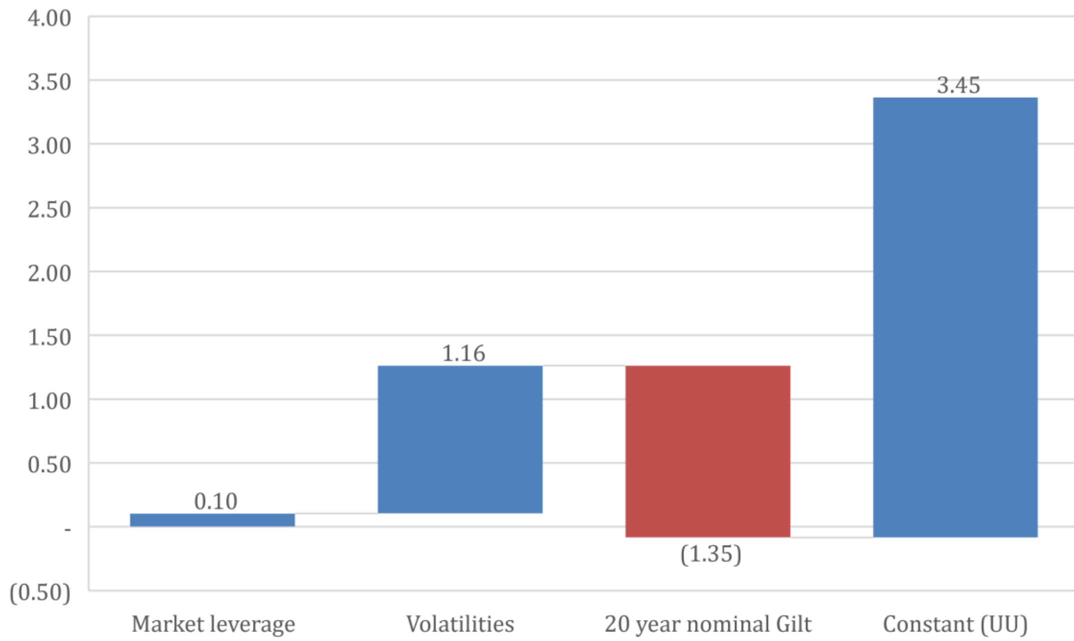


Figure 6: The components of KPMG's estimate of UUW's elasticity in June 2023



3.23. Again, KPMG give little detail on the estimates of the fixed effects for SVE and UUW within their Report. Re-running Stata programs, and examining carefully the output, shows the following:

Table 2: Regression results for the fixed-effect constants for SVE and UUW, using KPMG data and Stata files

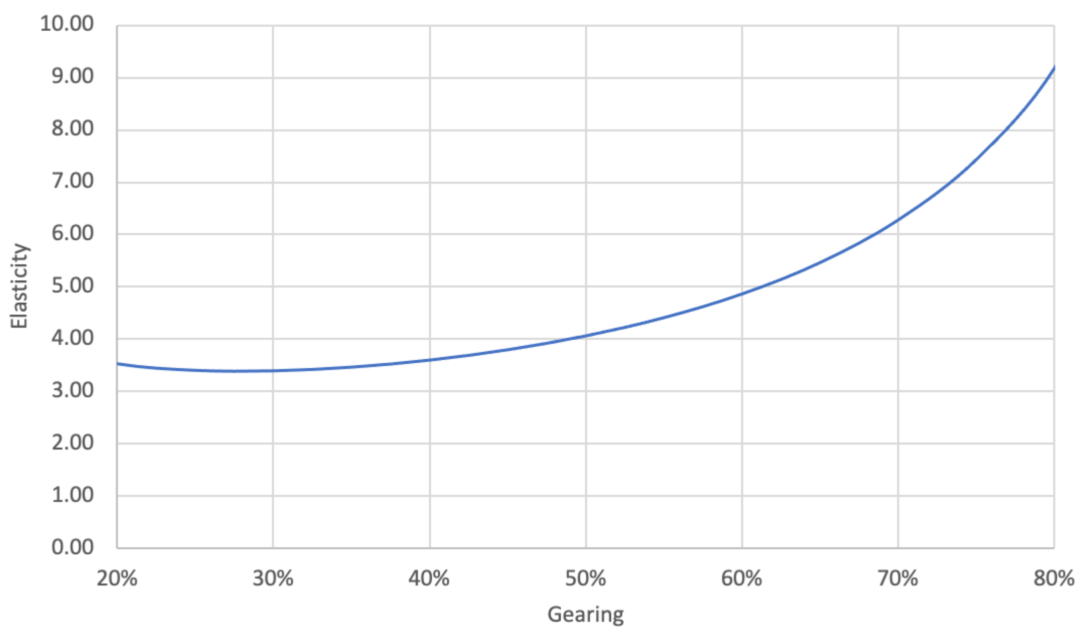
	Coefficient	Std.err.	t	P>|t|	95% conf. interval	
SVE	-13.8752	11.0957	-1.25	0.211	-35.6251	7.8747
UUW	-14.6763	11.1050	-1.32	0.186	-36.4443	7.0917
Constant	18.1252	10.6010	1.71	0.087	-2.655	38.9054

(To obtain the actual fixed effect constant, these coefficient estimates have to be added to the constant e.g., for SVE, it is 18.1252-13.8752 = 4.52.) As is clear from Table 2, the fixed-effect coefficients for SVE and UUW and the general constant all have very low statistical significance and hence very wide confidence intervals. A "broadly stable" elasticity estimate sits within a 95% confidence interval which includes highly negative values of the elasticity.

3.24. Even taking the points estimates of 4.25 and 3.45: these elasticity estimates differ by 0.8, or 17% of the average value. Some variation is to be expected, of course; but this is quite a difference, and is in contrast to e.g., their equity betas, which are typically very close in value. Given the significant difference between SVE and UUW, and indeed in KPMG's wider sample, we would expect some test of e.g., in-sample prediction, in order to assess the statistical soundness of using results for SVE and UUW.

3.25. The final issue for assessing stability is the sensitivity of elasticities to gearing. This is apparent in the regression equation, where the coefficient on leverage is positive (albeit not statistically significant); and although the contribution of leverage to the elasticity estimate is small (see Figures 5 and 6), it is still worth considering. The Report notes that "It is difficult to translate elasticity from market to notional leverage" (footnote 71); in that footnote, it discusses a method assuming that the call option Δ is the same at both market leverage and notional gearing. There is no need to make this assumption. Figure 7 shows the dependence of the elasticity coming from the Merton model, with model parameters chosen to match market data (the risk-free rate) and calibrate roughly to the average elasticity (4.65) at the average leverage from KPMG's Figure 12 (56.21%).[21] Over the range of observed gearing (which was 48.5-62.1% over the period in KPMG's Figure 12), the estimated elasticity would vary from 3.98 to 5.10: a significant difference. In short, while the elasticity may appear to have been stable, it is sensitive to (re)gearing.

Figure 7: Merton-based elasticity v. gearing



3.26. In conclusion: while there is a serious deficit of information in the KPMG report, analysis through the accompanying Stata files raise serious doubts about the claim that the estimated elasticity has been broadly stable.

[21] In this Figure 4, the (nominal) risk-free rate is set at 4%; the maturity of debt at 10 years; and the asset volatility parameter at 14%.

Step 3: nominal cost of equity; real cost of equity

3.27. As noted in the previous sections, there are major problems with the approach adopted by KPMG in deriving their elasticity estimates. We should note, however, that even if it were possible to have confidence in KPMG's elasticity estimates, there is a further, potentially quite major, statistical flaw in their approach. They project the equity premium, hence the expected excess return, by effectively treating the elasticity as a known constant. But it is clearly very far from known. There is thus a clear component both of measurement error, with associated (very wide, we suspect) standard errors to their point estimate. Additionally, there may potentially be bias in their point estimate itself, to the extent that estimates of the debt premium and the elasticity are correlated. KPMG fail to address either issue.

3.28. As a final note, consider Table 6 in KPMG's Report, reproduced below. The Table contains figures for PR24, but also for PR19, based on the CMA's Final Determination. KPMG calculate the range of the inferred cost of equity to be 2.62%-4.50%, with a mid-point of 3.56%. This is contrasted with the CMA's (CAPM-derived) cost of equity of 4.15%. This would seem to indicate that the allowed return of equity in PR19 was in fact too high, according to KPMG's approach. This is an example of the sort of asymmetry that we noted in Section 2: arguments that only argue for *higher* allowed returns, leaving out arguments for lower allowed returns.

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

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

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

Conclusion

3.29. The KPMG Report's objective is, in principle, sound: to use information on the cost of debt to make inferences about the cost of equity. The exercise is severely limited, however, by the statistical robustness of the results; doubt about the stability of the estimates; how significant differences between SVE and UUW are treated; and the sensitivity of estimates to (re)gearing. Combined, these issues mean that, in our view, the KPMG analysis does not offer a useful or usable cross-check on the CAPM-based cost of equity estimate.

3.30. As a related comment, we found it surprising how little detail was given in KPMG's main Report. True, with some effort, results can be reconstructed by e.g., re-running Stata programs. Nevertheless, it is standard to report far more extensively about the statistical significance of regression analysis—especially when the statistical significance is so low, and hence when results have to be interpreted with extreme care. We find that lack of transparency to be unfortunate.

4. The Oxera report on the Asset Risk Premium to Debt Risk Premium (ARP-DRP) framework

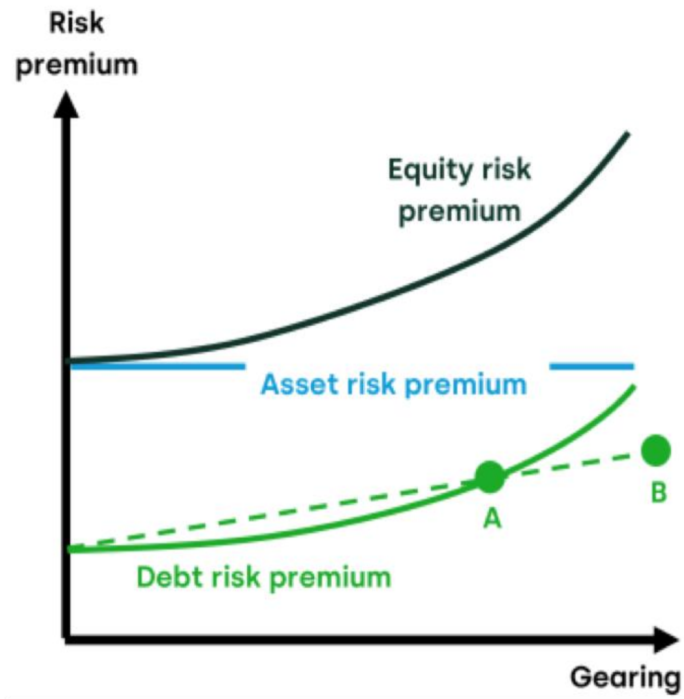
4.1. Oxera's approach is distinct from KPMG. They aim to derive a lower bound for the cost of equity.

4.2. Their argument is relatively simple (illustrated in Figure 8 below):

1. As a senior claim on the assets, the debt risk premium (DRP) should be (weakly) lower than the risk premium on unlevered equity at any level of gearing.
2. At 100% market gearing, the DRP must equal the asset risk premium (ARP). At 0% gearing, the DRP is zero i.e., debt is riskless.
3. The DRP increases with gearing, and does so at an increasing rate: that is, the DRP is a convex function of gearing.
4. From 3, the DRP at 100% must be greater than the value given by a straight line drawn between the origin (zero gearing, zero DRP) and the observed DRP at the observed level of gearing).
5. From 2, this value is therefore less than the ARP.
6. And from 1, this value is therefore less than the equity risk premium.

4.3. In Figure 8, taken from Figure 4.2 of the Oxera Report, the lower bound, indicated by point B, is calculated as the observed debt risk premium at some level of gearing, divided by that level of gearing.

Figure 8: Oxera's relationship between risk premia and gearing



Source: Oxera.

4.4. As we have previously stated, claim 1 is (surely) correct. Claim 4 follows from claim 3, although there is the empirical question of whether observed gearing and the observed DRP are measured correctly. Claims 5 and 6 are consequences of earlier claims. The nub of the argument therefore boils down to:

4.4.1. Claim 2: is the DRP zero at 0% gearing?
4.4.2. Claim 3: is DRP convex in gearing?
4.4.3. Measurement in Claim 4: does Oxera measure observed gearing and the DRP correctly?

We deal with these questions (although not in order) below.

Measurement

4.5. To repeat: Oxera's lower bound is the ratio of the observed DRP to the observed gearing: DRP/g. Naturally, measurement of both variables affects the calculation of Oxera's bound; since gearing appears in the denominator, it has the greater effect. The CMA's responses to Oxera's argument—in the 2023 H7 Heathrow Appeal and the 2021 Energy licence modification appeals—focus on measurement.

4.6. First, consider the DRP. We have already addressed a number of general issues relating to the DRP in our discussion of KPMG, which are equally applicable here. Thus we focus purely on issues specific to Oxera.

4.7. It is a little difficult to follow Oxera's argument here. In Table 3.1, they give the cost of new debt in CPIH-real terms as 3.84%; this figures comes from (a) using nominal yields from iBoxx £ non-financials A/BBB 10+ indices; (b) deflated using 2% as the estimate of long-term CPIH inflation; (c) adjusted upwards by a forward premium of 0.11%. Later, they say that the DRP is the cost of new debt, minus the risk-free rate, and minus the expected default loss: see p. 37. From their Table 4.1, the CPIH-real risk-free rate is 1.74%; and the default loss is 0.30%. (Note that the default loss is an annualised default rate times one minus the recovery rate. Nothing in this calculation is affected by inflation, and so the default loss should be the same in nominal and real terms.) This gives the DRP as 1.8%: a very high figure. (We include here Oxera's Tables 3.1 and 4.1 for ease of reference.)

Table 3.1 Cost of new debt estimates

	Formula	Spot
iBoxx A/BBB 10+, nominal	[A]	5.81%
CPIH inflation[1]	[B]	2.00%
iBoxx A/BBB 10+, CPIH real	[C]=(1+[A])/(1+[B])	3.74%
Forward premium (5Y)	[D]	0.11%
Cost of new debt, CPIH real	[E]=[C]+[D]	3.84%

Table 4.1 ARP-DRP results comparison

	Oxera low[1]	Oxera high[1]	Ofwat PR24 FM[2]	Updated Ofwat PR24[3]	Ofwat PR19[4]	CMA PR19[5]	Ofwat PR09[6]
RfR, CPIH real	1.74%	1.74%	0.47%	1.54%	-1.39%	-1.34%	2.00%
TMR, CPIH real	6.70%	7.70%	6.46%	6.46%	6.50%	6.81%	7.40%
Asset beta	0.30	0.35	0.33	0.33	0.36	0.33	0.40
ARP	**1.49%**	**2.09%**	**1.98%**	**1.64%**	**2.84%**	**2.78%**	**2.16%**
CoND, nominal	5.92%	5.92%	5.34%	5.82%	2.54%	2.19%	5.70%
RfR, nominal	4.75%	4.75%	3.71%	4.55%	1.10%	0.86%	4.19%
Expected loss	0.30%	0.30%	0.30%	0.30%	0.30%	0.30%	0.30%
DRP	**0.87%**	**0.87%**	**1.33%**	**0.97%**	**1.14%**	**1.04%**	**1.21%**
ARP-DRP	**0.62%**	**1.23%**	**0.65%**	**0.67%**	**1.70%**	**1.75%**	**0.95%**

4.8. Rather than using nominal figures and deflating, Oxera instead work just in nominal figures. In their Table 4.1, they take the nominal cost of new debt to be 5.92% (i.e., the real cost of new debt with 2% inflation); subtract the nominal risk-free rate of 4.75% (some 3% higher than their CPIH-real risk-free rate in the same table); and subtract 0.30% for default, to arrive at a DRP of 5.92-4.75-0.30 = 0.87%.

4.9. So this is the first issue: why is there such a large discrepancy in Oxera's DRPs when derived using real rather than nominal variables? The paragraph explaining why they take their approach on p. 37[22] does not shed much light. Indeed, the rest of Table 4.1 shows a range of values of the DRP, although admittedly all above Oxera's estimate. It is possible this comes about because of inconsistent inflation measures; but without further detail than is given, it is not possible to be certain.

4.10. Setting aside these questions of real v. nominal calculations, and taking Oxera's nominal approach (Table 4.1), we note that the figure of 5.92% for the cost of new debt includes a forward premium (see note 1 in the Table). Stripping this out to be consistent with Ofwat's final methodology, gives a DRP of 0.76%; using Oxera's calculation, this gives a bound of 0.76/0.55 = 1.38% (see below), which is below Oxera's lowest estimate of the ARP (1.49%).

4.11. Finally, and again a point noted by the CMA in the H7 appeal, Oxera's calculation relies on the DRP being zero at zero gearing: Claim 2 above.[23] If instead the DRP is non-zero even for very low levels of gearing—if the first tranche of debt is not priced at or near the risk-free rate—then the line flattens. The numerator should be not the DRP at 55% (or whatever gearing level is appropriate—see below), but the DRP at 55% *minus* the DRP at 0% gearing.

4.12. In short, for what ought to be a straightforward calculation, there is considerable doubt about and sensitivity to the determination of the DRP. Even taking Oxera's approach, but stripping out the forward premium, brings the DRP, and hence Oxera's calculated bound, down significantly. Clearly if the DRP is overstated in other ways (relating to the more general concerns raised earlier) this effect would be even stronger.

4.13. Turning now to the gearing figure: Oxera adopts Ofwat's notional gearing level of 55% for the calculation of its bound; so, using Oxera's figures, their bound is the DRP of 0.87% divided by 0.55, i.e., 1.58% (see Table 4.2). But as the CMA notes in the H7 Appeal (see §6.279), the gearing figure in the denominator needs to match the DRP figure in the numerator. The appropriate gearing figure for an iBoxx index comprised of many different firms is far from straightforward. If the appropriate gearing level is 60%, say, rather than 55%, then Oxera's bound shifts from 1.58% to 1.45%: again, below Oxera's lowest estimate of the ARP (1.49%). Stripping out the forward premium, and taking gearing to be 60%, the bound becomes 1.27%.

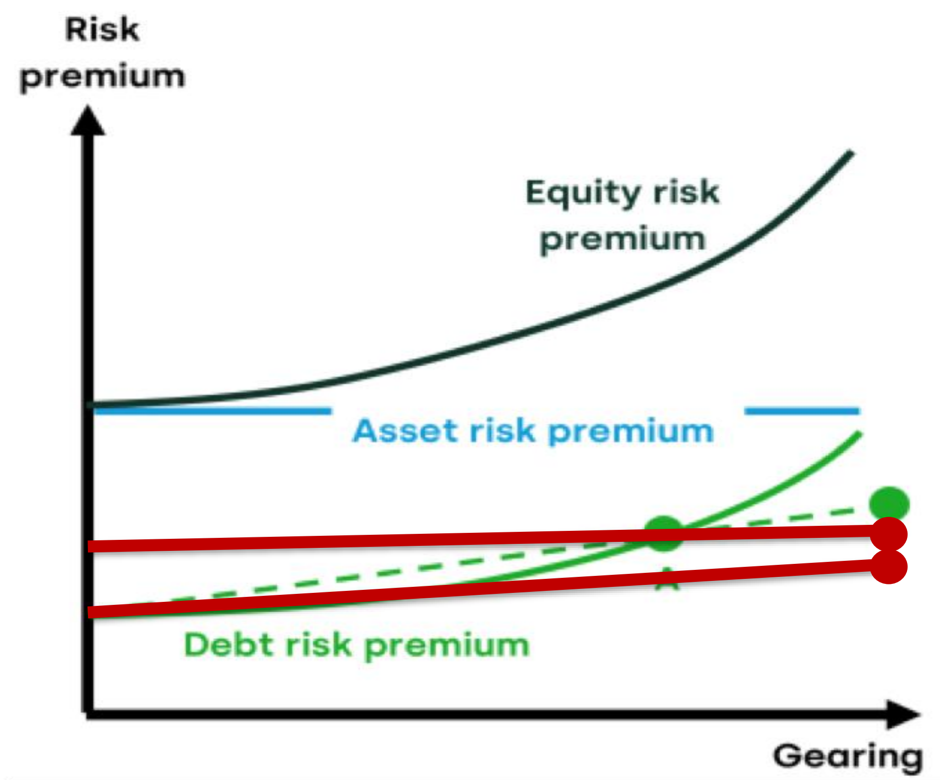
[22] "Aligned with the above principle that the ARP-DRP framework provides a method for the evaluation of financeability in a way that is neutral to the treatment of inflation we have estimated the ARP starting from CPIH-real numbers and the DRP starting from nominal rates. This allows us to treat inflation consistently within the ARP calculation and within the DRP calculation."

[23] It is worth noting that in Oxera's calculations, the risk-free rate used to determine the DRP includes both a convenience premium and a forward premium.

4.14. It is, of course, possible that the underlying gearing in the iBoxx index is lower than 55% (which would have the effect of increasing Oxera's bound). The point here is simply that we do not know; and we cannot know without a further data-gathering exercise.

4.15. Taken together, we conclude that Oxera's seemingly simple calculation to arrive at a bound—divide an observed debt price by a notional gearing—conceals a number of significant measurement problems, making the resulting bound subject to considerable uncertainty. The point is illustrated in Figure 9, in which the higher red line shows the potential effect of a non-zero DRP at zero gearing; and the lower red line shows the potential effect of mismeasurement of gearing.

Figure 9: Uncertainty in Oxera's relationship between risk premia and gearing

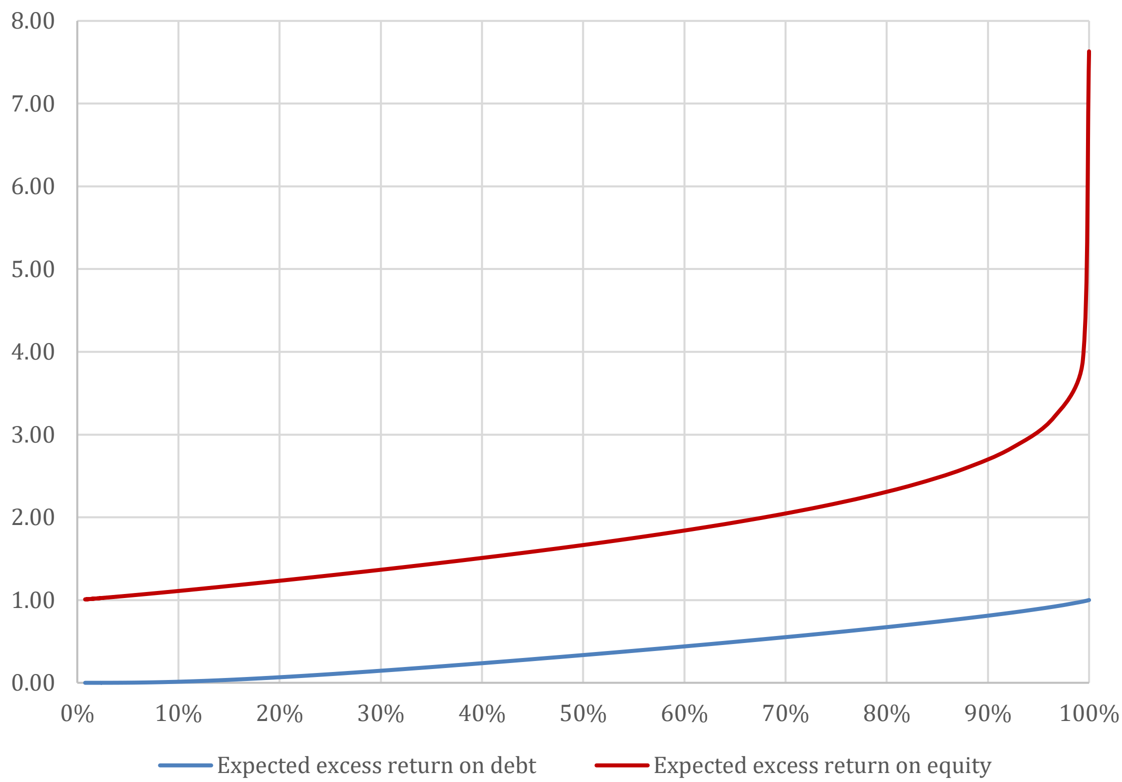


Source: Oxera.

Is the DRP convex in gearing?

4.16. Oxera's argument appeals to a diagram in the well-known textbook by Berk and DeMarzo.[24] They could instead have appealed directly to results from the Merton (1974) model: this is what we show in Figure 10 below.[25]

Figure 10: expected excess returns[26] from the Merton model against gearing



4.17. Note that the Merton (1974) model has a fixed capital structure; in particular, there are only two classes of claims: (i) a single, homogenous class of debt and (ii) the residual claim, equity. In addition, it assumes a particular process for the value of the firm: a geometric Brownian motion. This assumption has a few implications. First, the firm's asset value is lognormally distributed. Secondly, past changes do not influence future changes (strictly speaking, changes in the process over non-overlapping time intervals are statistically independent).

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[24] Berk, J. and DeMarzo, P. (2019), *Corporate Finance, Fifth edition*, 11 June, p. 536.

[25] For completeness, the other parameters are: risk-free rate, 4%; maturity, 20 years; volatility of the firm's assets, 20%; asset beta, 0.2.

[26] As a reference point, the numerical assumptions underlying the chart imply that the market risk premium is 5 percentage points.

Finally, and mostly importantly for this discussion, the process for the asset value is strictly continuous.

4.18. Now consider instead the Merton (1976) model,[27] which is in many respects the same as Merton (1974), but allows for jumps in the process for the firm's asset value. Like Merton (1976), assume that the CAPM applies to both equity and debt. This assumption allows Merton (1976) to price options on the firm's assets. It also means that it is enough to look at CAPM betas when assessing convexity.

4.19. Figure 11 plots the equity and debt betas for a particular parameterization of the jump process that Merton (1976) uses.[28] As the figure shows, the debt beta—and hence the cost of debt—is no longer a convex function of gearing, and indeed concave over most of the range.

4.20. To be clear: we are not arguing that this the Merton (1976) jump process is the correct one; or that the parameters that we have chosen are empirically the most plausible. Our point is the property of convexity of the cost of debt with respect to gearing cannot be taken as given, as Oxera assumes.

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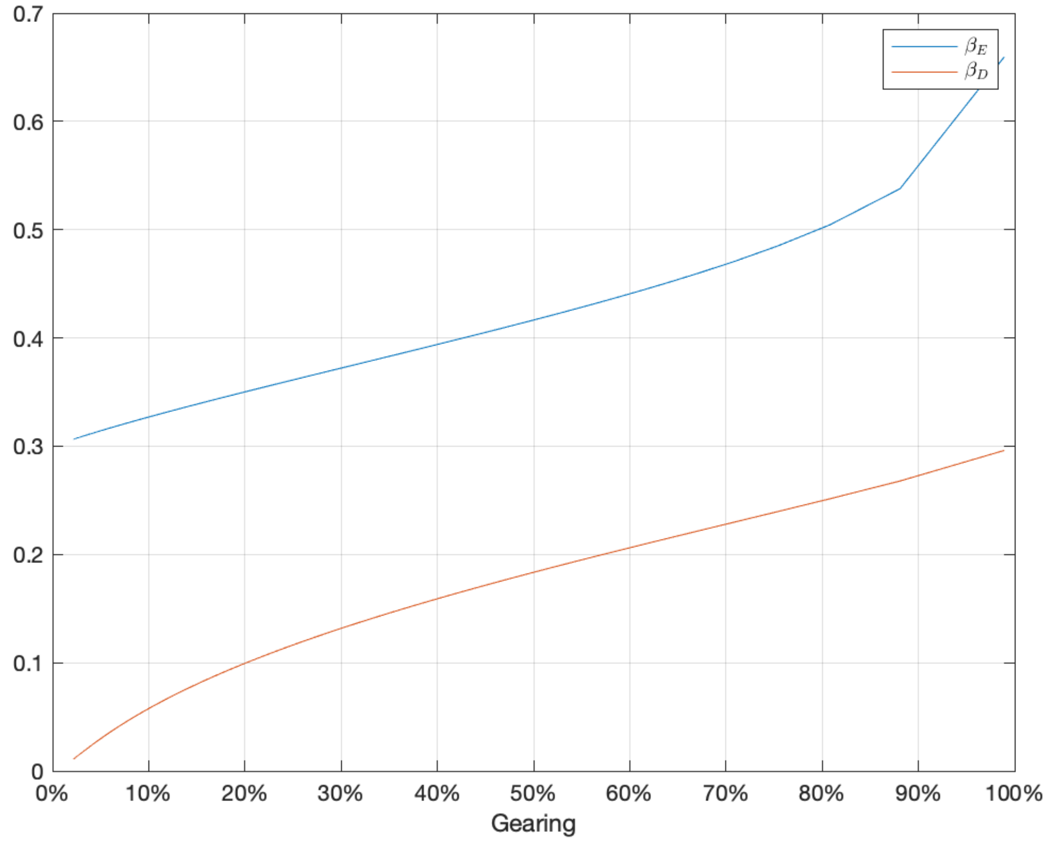
[27] Merton, R. C. (1976). "Option pricing when underlying stock returns are discontinuous." *Journal of Financial Economics*, *3*(1-2), 125-144. https://doi.org/10.1016/0304-405X(76)90022-2.

[28] The maturity of debt is 20 years; the risk-free rate is 4%; the asset volatility is 20%; the exercise price of debt is 500; the asset beta is 0.3; the jump process parameter l is 0.5; the standard deviation of the log-normal distribution for Merton's jump process is 0.1; and the parameter *k* which also controls the size of a jump is 0.5.

Figure 11: betas against gearing in a Merton (1976) model with a jump process



Conclusion

4.21. The Oxera ARP-DRP framework has the appeal of bringing a simple argument, seemingly from first principles, to bear on a complex question. If it worked, it would provide a lower bound to guide the estimation of the cost of equity. But it does not work: it fails on practical (issues of measuring the appropriate debt risk premium and level of gearing) and theoretical (the assumed convexity of the cost of debt with respect to gearing) grounds.

5. Conclusions

5.1. We started this note by expressing support for the notion, in theory, that inferences can be drawn about the cost of equity from the cost of debt. We maintain that view. There are some theoretical/in-principle points that have to be considered in the inference exercise. But the insights from the academic literature over the last 50 years is that debt and equity are claims on the same underlying asset, and so their expected returns should be related. The issue then becomes: how is the relationship to be measured?

5.2. Here, we find that both KPMG and Oxera fall short. Although KPMG do not report the fact in their main Report, it is clear that there are serious issues with their approach. We have noted the low statistical significance of their results. More profoundly, their use of elasticity estimation to replace an asset pricing model is at odds with the academic literature. (We would also suggest a greater degree of transparency about statistical performance: it should not be necessary to re-run Stata files to find out about standard errors.) Overall, therefore, we find that little weight, if any, can be placed on their resulting calculations of the cost of equity.

5.3. Oxera's approach has the benefit of a degree of simplicity. This simplicity is, however, misleading, since it masks a number of critical measurement issues. Most of these issues have been pointed out e.g., in previous CMA Determinations. The fact that they have not been addressed gives weight to a suspicion that they cannot be addressed. (For example, we do not see an easy way in which he average gearing of an iBoxx index can be measured.)

5.4. To end, we return to two broad issues that we raised at the start of this note.

5.5. First, both approaches rely on the implicit assumption that the part of the credit spread that is not explained by observable default risk *must* be due to a (substantial, and inexplicable) debt premium. We think it is worth bearing in mind an alternative, albeit indirect, approach to estimating the debt premium, that can indeed be derived from the logic of past company submissions. Many of these have argued, in the context of re-gearing of equity beta estimates, for very low values of the debt beta; figures of the order of 0.05 are not uncommon. Applying the CAPM directly would imply a debt risk premium of the order of only around 25 basis points, at most (assuming a market premium of around 5 percentage points, as a convenient round number). We cannot, of course, say that such a low estimate is correct. If it *were* correct, then the remainder of the observed credit spread would be need to attributable to some combination of default risk, liquidity premia and bid-ask spreads. But we are not aware of any past work or statistical analysis that would definitively conclude that such a low estimate is *not* correct. And if it were, even setting aside our other serious concerns, this would significantly undermine both sets of results.

5.6. Second, both the KPMG and Oxera approaches rely on the notion that there is a stable relationship between the cost of debt and the cost of equity. There is little empirical evidence that this is the case: seem for example, Section 2 of this Note. In our view, it is inevitable that the gap between the costs of equity and debt (or more precisely, the expected excess returns on equity and debt) will vary over time. Given the regulatory assumption that the expected market return is constant, this must inevitably lead to a smaller gap between the allowed return on equity and the allowed return on debt. Having enjoyed a period where the gap has been large, the regulated firms are experiencing a period where it is smaller. This is entirely consistent with the regulatory context as it has operated for the last two decades (even if firms would prefer to be permanently in the first scenario).

Appendix: Statistical properties of KPMG's elasticities.

If the CAPM holds, then, for any given company,

$$RP_D = \beta_D RP_M = \beta_D E\left(XR_{D,t}\right) \Leftrightarrow XR_{D,t} = \beta_D XR_{M,t} + \varepsilon_{D,t}$$
$$RP_E = \beta_E RP_M = \beta_E E\left(XR_{E,t}\right) \Leftrightarrow XR_{E,t} = \beta_E XR_{M,t} + \varepsilon_{E,t}$$

where the *XR* are excess returns, and the error terms are uncorrelated with the market excess return.

Note that the excess return on debt is the *holding* return on debt, not the yield on debt, thus is made up, as is the equity excess return, of an income and a capital appreciation component.

Even if the CAPM does *not* hold, this relationship will still hold in purely statistical terms, but with the possibility that there may be intercepts (alphas) in the statistical relationships, which may in principle be attributable to other risk factors. But for the current purposes it does not seem likely that such complications would make much difference to what follows.

The "out-turn elasticity", η_t is calculated as the ratio of percentage change in the of the market value of equity to the percentage change in the market value of debt. In the absence of new bond or equity issues, and, for simplicity, assuming zero coupon bonds and no dividend payments, then these percentage changes will in turn be given by the *returns* on debt and equity respectively. Thus

$$\eta_t = \frac{R_{F,t} + XR_{E,t}}{R_{F,t} + XR_{d,t}} \approx \frac{XR_{E,t}}{XR_{d,t}}$$

since there will be very limited short-term variation in the risk-free rate. Hence

$$\eta_t \approx \frac{\beta_E XR_{M,t} + \varepsilon_{E,t}}{\beta_D XR_{M,t} + \varepsilon_{D,t}} = \frac{\beta_E + s_{E,t}}{\beta_D + s_{D,t}}$$
$$\text{where } s_{E,t} = \frac{\varepsilon_{E,t}}{XR_{M,t}}; s_{D,t} = \frac{\varepsilon_{D,t}}{XR_{M,t}}$$

In the absence of any idiosyncratic shocks, then η_t would simply be equal to ratio of the equity beta to the debt beta. But in the data we see significant idiosyncratic shocks, which, even if the betas are unchanged, is likely to result in significant short-term variation in η_t. To complicate matters further, the properties of $s_{E,t}$ and $s_{D,t}$ and hence of η_t, are quite unusual in statistical terms. For example, while we can safely assume that $\varepsilon_{E,t}$ and $\varepsilon_{D,t}$ are zero mean, this does not mean that the same applies to $s_{E,t}$ and $s_{D,t}$. Furthermore, if we assume that $\varepsilon_{E,t}$ and $\varepsilon_{D,t}$ and excess returns are normally distributed then $s_{E,t}$ and $s_{D,t}$ follow Cauchy distributions, with distinctly odd properties (the variance is undefined) and fat tails.

If, and only if, we are prepared to assume that $s_{E,t}$ and $s_{D,t}$ have zero means, and that (plausibly) they are positively correlated) then

$$E\left(\eta_t\right)=\frac{\beta_E}{\beta_D}+\operatorname{cov}\left(s_{E,t},\frac{1}{s_{D,t}}\right)<\frac{\beta_E}{\beta_D}$$

But even in this case deviations from this mean are likely to have highly complex properties, and exhibit wide variation. We suspect that these oddities underlie KPMG's regression results, which point to a very wide degree of uncertainty about the true mean of η_t.